Interferometric processing of PALSAR Wide-Beam SCANSAR Data with GAMMA Software

17-Aug-2011

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1 Introduction

The advantage of SCANSAR is the ability to achieve wide-swath coverage required for short repeat intervals with moderate increase of radar system complexity. Interferometry based applications are facilitated by wide swath widths that permit` short revisit intervals and the potential for frequent acquisitions to reduce interferometric measurement errors due to atmospheric and ionospheric phase variability.

The Japanese ALOS satellite includes the PALSAR radar operating at 1.27 GHz [1]. ALOS has acquired extensive SCANSAR data on a global basis over the last 5 years. We have developed an end-to-end phase-preserving interferometric processing system for SCANSAR-SCANSAR and SCANSAR-STRIPMAP data acquired by ALOS. SCANSAR-SCANSAR interferometry with PALSAR was first reported by Shimada using a SPECAN processor and other groups have described STRIPMAP based approaches for ALOS SCANSAR processing [2-4]. This document describes the end-to-end interferometric processing of PALSAR SCANSAR data using the Gamma Software.

SCANSAR successively illuminates parallel overlapping range swaths with bursts of radar pulses. The PALSAR instrument operates primarily in 5 data acquisition modes including the WB-1 SCANSAR mode with the following characteristics PALSAR Acquisition Mode: ScanSAR (WB1)

Central Frequency	1270 MHz
PRF	1500 - 2500 Hz (discrete stepping)
range Sampling Frequency	16 MHz
Chirp bandwidth	14 MHz
Polarisation	HH
Off-nadir angle [deg]	20.1-36.5

Incidence angle [deg] 18.0-43.3
Swath Width [Km] 350
Bit quantization [bits] 5
Number of Swaths: 5
Number of Pulses/Burst 247, 356, 274, 355, 327
Nominal Pulse Reptition Frequency (PRF): 1669.4, 2314.8, 1692.0, 2132.2, 1890.4
Starting slant range (m): 744337, 784210, 821384, 864104, 894533
Data rate [Mbps] 120

Data acquired during descending passes of ALOS are in SCANSAR WB mode. The PRF and starting slant range change in discrete steps during the acquisition. This requires that the data be resampled using a constant PRF along track for processing to avoid gaps. In the case of SCANSAR data rather than resampling each track to the nominal PRF value, our processor resamples the data in all 5 beams to a constant PRF value of 2150.5 Hz. This PRF is chosen because it is the nominal PRF of the continuous strip-map data acquired by ALOS PALSAR with beam 4. The data are synchronized to a common time reference such that the images from the beams fall onto a common grid in azimuth and slant-range.

The most critical factor in processing SCANSAR data for repeat-track interferometry is synchronization of the bursts as described by Bamler and Eineder [5]. A requirement for interferometric coherence is that the scene is viewed from the same azimuth aspect angle by corresponding pulses. Therefore, coherence is improved by nulling out echoes in the two passes that do not overlap with respect to the aspect angle. The center-swath look-vector at the start and end of each burst in the reference track is calculated. Then the position and time on the track of the second acquisition is determined for these points. The burst overlap is then determined using the ideal start and stop times of the burst in the second track and the actual burst times.

A phase-preserving strip-map SAR processor is used for image formation in our system. In this approach the time between bursts is filled with zeros and the data is processed as if it were continuous strip-mode data. One of the significant advantages of this approach is that no data are discarded at the start and end of the burst images as is the case with the SPECAN based SCANSAR processing. Another advantage is the possibility of generating interferograms of SCANSAR-STRIPMAP image pairs. The SLC image produced from the SCANSAR data after zero filling is identical in format to the STRIPMAP images. What is different is that the azimuth resolution has been significantly reduced due to the fact that each beam is illuminated only approximately 20% of the time in order to obtain a wider image swath.

The SLC images are produced at the pixel spacing of 9.4 meters in range and 3.1 meters in azimuth. The actual azimuth resolution is reduced by a factor of approximately 5 to ~60 meters. The SLC data are detected and multi-looked using 3 range looks and 16 azimuth looks to produce MLI (multi-look intensity images) of each beam to give a pixel spacing of 29 meters in slant range and 51 meters in azimuth. These image strips are mosaicked without interpolation due to the common processing geometry to form the full 5-beam mosaic. Intensity offsets between the beams is corrected by matching the average intensity in the overlap region. The accuracy of the matching in the overlap depends on accurate knowledge of the range antenna patterns and low azimuth ambiguities. The full mosaic of the MLI images is then terrain geocoded using the SRTM DEM. For the purposes of terrain geocoding of the SAR image, the image can be processed without azimuth burst synchronization to maintain full resolution.

One of the products of the terrain geocoding is the SRTM DEM resampled to the slant range coordinates of the MLI mosaic. Performing the geocoding refinement on the full mosaic avoids DEM offsets between the individual beams. The full DEM in radar coordinates (slant range) is sliced into the individual beams and used for SLC coregistration and resampling. The coregistration algorithm in our processing chain takes into account the local terrain to avoid loss of correlation and phase errors due to misregistration. Each SCANSAR beam is individually resampled to the matching beam in the second acquisition.

We form the differential interferogram directly for each beam using the co-registered SLC produced using burst synchronization and the simulated interferogram produced using the timing and track data for each SLC and the DEM in radar coordinates. These 5 differential interferograms are mosaicked without requiring interpolation since the SLC data have a common geometrical reference. No further phase adjustment is required between the differential interferograms in the full differential interferogram mosaic.

We have processed SCANSAR-SCANSAR data covering the New Zealand earthquake that occurred near Christchurch on 20100903 (UTC), and both SCANSAR-SCANSAR and SCANSAR-STRIPMAP data over Los Angeles in our initial tests. The Los Angeles SCANSAR-SCANSAR data are from 20061231and 20070402 and the SCANSAR-STRIPMAP are from 20061231-20070703. Beam 4 of the SCANSAR data on 20061231corresponds to the FBS mode data collected on 20070703. The SCANSAR acquisitions over Los Angeles were acquired with different PRFs with the result that the burst

synchronization varies along-track. and is an excellent test of the burst-synchronization algorithm. The New Zealand data are from 20071020 and 20101028 and show reasonable correlation despite a 3 year time interval and ~1490 meter perpendicular baseline.

References

[1] Rosenqvist, A, Shimada, M, Watanabe, M, "ALOS PALSAR: A Pathfinder Mission for Global-Scale Monitoring of the Environment", *IEEE Transactions on Geoscience and Remote Sensing*, vol. 45, no. 11, Nov. 2007, pp. 3007-3316 doi: 10.1109/TGRS.2007.901027.

[2] Shimada, M. (2008). "PALSAR ScanSAR ScanSAR Interferometry",. in *Proceedings IGARSS 2008 Conference*, pp IV-93–IV-96.

[3] Liang,C, et al. Alos PALSAR "ScanSAR Interferometry and its Application in Wenchan Earthquake", ESA Fringe Workshop 2009.

[4] Sandwell, D., R. Mellors, and X. Tong, "ScanSAR Interferometry with PALSAR", 3rd ALOS Joint PI Symposium, Kona, Hawaii, Nov. 9-13, 2009.

[5] Bamler, R and Eineder, M, "ScanSAR processing using standard high precision SAR algorithms", *IEEE Transactions on Geoscience and Remote Sensing*, January 1996 vol. 34 pp. 212-218, doi: 10.1109/36.481905.

2 PALSAR SCANSAR-SCANSAR Differential Interferometric Processing Example

This is an example of processing WB SCANSAR data to generate terrain geocoded interferometric products. In this example we us data were acquired by the ALOS PALSAR instrument on 20071020 and 20101028 using SCANSAR WB-1 mode. A single terrain-geocoded differential interferogram is produced. Processing requires careful attention to accuracy in coregistration and baseline geometry. It is usually necessary to take into account the terrain height when resampling PALSAR data due to the relatively large baselines between passes. Therefore the processing requires terrain geocoding and generation of a DEM in radar coordinates. Input DEM data are usually from the global SRTM data set (http://www.cgiar-csi.org/data/elevation/item/45-srtm-90m-digital-elevation-database-v41)

In this example Gamma software programs are combined with scripts that simplify the repetitive aspect of processing each of the SCANSAR beams in sequence. The MSP, ISP, and DIFF-GEO Gamma packages are used for the processing starting with raw data and ending with differential interferograms in map coordinates. The following annotated listing of the processing sequence should be a sufficient guide through the processing sequence. Additional HTML documentation is available for the specific MSP and ISP programs developed for PALSAR SCANSAR processing:

PALSAR_pre_proc_WB	Program to extract a single beam of raw data from a PALSAR raw data set and resample to a specified PRF
PALSAR_proc_WB	process each of the PASLAR WB beams to SLC using common autofocus parameters
mosaic_WB	Mosaic multiple beams of SCANSAR data using overlap region for radiometric scaling
split_WB	Split a mosaicked DEM into separate beams for production of differential interferograms

The scripts used to automate the processing include:

mk_tab	Generate 2 column lists of data and data parameter files
PALSAR_pre_proc_WB	Extract the PALSAR data for each beam for multiple scenes
PALSAR_proc_all_WB	Process the 5 SCANSAR beams of multiple scenes
SLC_copy_WB	Extract overlapping synchronized sections of SLC images ready for mosaic
mk_mli_all	Calculate MLI images from the SLC images of each beam
mk_geo	Terrain geocode MLI image mosaic produced by mosaic_WB, resample DEM into slant-range geometry
SLC_resamp_lt_all	Co-register and resample SLC image data from each beam taking from multiple scenes to a common reference scene taking into account topography in the offset calculation
mk_diff_orb	Generate multiple differential interferograms using DEM in range-doppler and orbit information

HTML documentation can be found in the /DIFF/html directory for `mk_tab, SLC_resamp_lt_all, mk_mli_all,` and `mk_geo` scripts.

Throughout this document text written in magenta are user inputs on the command line,blue denotes screen output or the names of files and directories, and green is used for command usage statements for scripts and programs.

2.1 Preprocessing of the PALSAR WB Data

The ALOS PALSAR data are delivered in CEOS format consisting of a CEOS leader file (LED...) and raw image data (IMG-HH....W1.0__D). Note that the WB data has the W1 string in the IMG file name. In the following example we start with 2 directories for the raw data. The first director 20071920 contains the raw data acquired on 20071020 (YYYYMMDD, YearMonthDay) and the second directory acquisition date is 20101028. Using the ls command to look at the directory contents:

```
ls 2010* 2007*
20071020:
IMG-HH-ALPSRS092604500-W1.0__D  LED-ALPSRS092604500-W1.0__D  summary.txt  TRL-ALPSRS092604500-W1.0__D
VOL-ALPSRS092604500-W1.0__D

20101028:
```

```
IMG-HH-ALPSRS253644500-W1.0__D  LED-ALPSRS253644500-W1.0__D  summary.txt  TRL-ALPSRS253644500-W1.0__D
VOL-ALPSRS253644500-W1.0__D
```

The first step in processing the data is to create an input file to the script PALSAR_pre_proc_WB. Make sure that the MSP/scripts directory is in the execution path for running programs, or that you copy the scripts PALSAR_pre_proc_WB and PALSAR_proc_WB_all from the MSP/scripts directory to the current directory. Make sure that the current directory, designated by . is in the PATH environment variable. Typing the PALSAR_pre_proc_WB script without arguments prints out a usage description:

```
$ PALSAR_pre_proc_WB
*** ./PALSAR_pre_proc_WB
*** Copyright 2011, Gamma Remote Sensing, v1.1 18-Mar-2011 clw ***
*** ALOS PALSAR WB ScanSAR raw data pre-processing and parameter setup ***

usage: ./PALSAR_pre_proc_WB <CEOS_list> <PALSAR_ANT> <out_dir> <log> <proc_list> <mode> [PRF] [keyword]
[value]
    CEOS_list  (input) parameter file with 4 entries/line
                 1. PALSAR CEOS leader file (included path as necessary)
                 2. PALSAR CEOS raw SAR data file (included path as necessary)
                 3. unique scene identifier (date format: 20060610)
    PALSAR_ANT  PALSAR antenna pattern file provided by JAXA (e.g. palsar_ant_20061024.dat)
    out_dir     directory for output raw data files, MSP processing parameter and sensor parameter
files.
    log         (output) processing log file
    proc_list   (output) (processing list for use by PALSAR_proc_all)
    mode        processing mode:
                 1: create MSP processing parameter files and reformat raw data
                 2: estimate Doppler centroid (optional)
                 3: set value in the processing parameter files for a keyword:value pair
                 4: generate processing list for use by PALSAR_proc_all
    PRF         pulse repetition frequency for output data (enter - for default PRF from Beam 4)
    keyword    keyword in the MSP processing parameter file (example: doppler_polynomial)
    value   new value delimited by double quotes (example: "317.0 0. 0. 0.")
```

The first argument is the CEOS_list text file with 3 columns. The first column is the CEOS leader file, the second is the raw data file (IMG...) and the third column is a scene identifier consisting of the the date in YYYYMMDD format:

```
cat CEOS_list_WB
20071020/LED-ALPSRS092604500-W1.0__D  20071020/IMG-HH-ALPSRS092604500-W1.0__D 20071020
20101028/LED-ALPSRS253644500-W1.0__D  20101028/IMG-HH-ALPSRS253644500-W1.0__D 20101028
```

The next step is to run the script PALSAR_pre_proc_WB in modes 1 and 4. Mode 1 will create the MSP processing parameter files and extract the raw data for each of the 5 beams by calling the MSP program PALSAR_pre_proc. The data from each of the 5 beams are resampled to a constant PRF and zero-filled between bursts. The value of the common PRF is chosen to be 2150.537634 because this is the nominal PRF of PALSAR beam 4 used for STRIPMAP images. In the case of SCANSAR-STRIPMAP interferometry the displacements between the SLCs are minimized by using the 2150.53 7634 value for the PRF. This relatively high PRF value ensures that all the data are resampled without an increase in azimuth image ambiguities.

The program PALSAR_antpat is called to extract the correct antenna pattern for each beam from the PALSAR antenna data file palsar_ant_20061024.dat located in the MSP/sensors directory. The screen output for processing data from beams 1-3 from 20071020 in the example data set is shown in

Appendix 1: Commands and screen output for PALSAR_pre_proc_WB.

The commands with PALSAR_pre_proc are:

```
#mode 1: generate MSP parameter files, extract and resample raw data, extract antenna pattern
#for each beam in each scene listed in the CEOS_list_WB
PALSAR_pre_proc_WB CEOS_list_WB palsar_ant_20061024.dat raw_WB PALSAR_pre_proc_WB_1.log proc_list_WB 1
2150.537634

#mode 4: generate proc_list parameter file for processing data with scripts PALSAR_proc_all_WB
PALSAR_pre_proc_WB CEOS_list_WB palsar_ant_20061024.dat raw_WB PALSAR_pre_proc_WB_4.log proc_list_WB 4
2150.537634

#list output of proc_list_WB file
cat proc_list_WB

20071020 - - - -      0.0   0.0000e+00 0.8
20101028 - - - -      0.0   0.0000e+00 0.8
```

2.2 SCANSAR Raw Data Burst Synchronization

The next step in processing of an interferometric pair is to determine if there is azimuth overlap of the bursts as is required for interferometric coherence. If there is overlap then the raw data are filtered to retain the overlapping segments of each burst in the two raw data files. The MSP program PALSAR_burst_sync performs this function with usage statement given here:

```
$ PALSAR_burst_sync
*** PALSAR ScanSAR azimuth burst synchronization ***
*** Copyright 2011, Gamma Remote Sensing, v1.1 7-Apr-2011 clw/uw ***

usage: PALSAR_burst_sync <SAR_par1> <PROC_par1> <raw1> <SAR_par2> <PROC_par2> <raw2> <PROC_par1_out>
<raw1_out> <PROC_par2_out> <raw2_out>

input parameters:
  SAR_par1      (input) MSP sensor parameter file for track-1 (reference)
  PROC_par1     (input) MSP processing parameter file for track-1 (reference)
  raw1          (input) WB ScanSAR data track-1
  SAR_par2      (input) MSP sensor parameter file for track-2
  PROC_par2     (input) MSP processing parameter file for track-2
  raw2          (input) WB ScanSAR or FBS raw data track-2
  PROC_par1_out (output) MSP processing parameter file for burst sync. track-1
  raw1_out      (output) WB ScanSAR data for burst sync. track-1
  PROC_par2_out (output) MSP processing parameter file for burst sync. track-2
  raw2_out      (output) WB ScanSAR data for burst sync. track-2
```

This script takes as input 2 raw data files and outputs 2 raw files that have been been filtered in azimuth to retain only the overlapping sections of common SCANSAR bursts. The fraction of burst overlap in azimuth is calculated for each burst in the two raw data sets. Note it is possible that the 2 input raw data sets have a significant relative azimuth offset equivalent to > 10 bursts with the duration of each burst on the order of 0.2 sec.

When processing the data using PALSAR_burst_sync first create a new directory to contain the output synchronized raw data files and the associated parameter files. This prevents having to create entirely new names for the output files to avoid overwriting the input.

#create new raw data directory for burst-synchronized data and parameter files:

```
mkdir raw_WBs
```

#run PALSAR_burst_sync for each of the 5 raw data beams of the interferometric image pair

```
PALSAR_burst_sync raw_WB/20071020_1.sar_par raw_WB/p20071020_1.slc.par raw_WB/20071020_1.raw
raw_WB/20101028_1.sar_par raw_WB/p20101028_1.slc.par raw_WB/20101028_1.raw raw_WBs/p20071020_1.slc.par
raw_WBs/20071020_1.raw raw_WBs/p20101028_1.slc.par raw_WBs/20101028_1.raw

PALSAR_burst_sync raw_WB/20071020_2.sar_par raw_WB/p20071020_2.slc.par raw_WB/20071020_2.raw
raw_WB/20101028_2.sar_par raw_WB/p20101028_2.slc.par raw_WB/20101028_2.raw raw_WBs/p20071020_2.slc.par
raw_WBs/20071020_2.raw raw_WBs/p20101028_2.slc.par raw_WBs/20101028_2.raw

PALSAR_burst_sync raw_WB/20071020_3.sar_par raw_WB/p20071020_3.slc.par raw_WB/20071020_3.raw
raw_WB/20101028_3.sar_par raw_WB/p20101028_3.slc.par raw_WB/20101028_3.raw raw_WBs/p20071020_3.slc.par
raw_WBs/20071020_3.raw raw_WBs/p20101028_3.slc.par raw_WBs/20101028_3.raw

PALSAR_burst_sync raw_WB/20071020_4.sar_par raw_WB/p20071020_4.slc.par raw_WB/20071020_4.raw
raw_WB/20101028_4.sar_par raw_WB/p20101028_4.slc.par raw_WB/20101028_4.raw raw_WBs/p20071020_4.slc.par
raw_WBs/20071020_4.raw raw_WBs/p20101028_4.slc.par raw_WBs/20101028_4.raw

PALSAR_burst_sync raw_WB/20071020_5.sar_par raw_WB/p20071020_5.slc.par raw_WB/20071020_5.raw
raw_WB/20101028_5.sar_par raw_WB/p20101028_5.slc.par raw_WB/20101028_5.raw raw_WBs/p20071020_5.slc.par
raw_WBs/20071020_5.raw raw_WBs/p20101028_5.slc.par raw_WBs/20101028_5.raw
```

It is necessary to copy the MSP sensor parameter files from the original raw data input directory raw_WB to the burst-synchronized raw data directory for the output raw_WBs:

```
#copy sensor parameter files *.sar_par from raw_WB directory to raw_WBs
$ cp raw_WB/*.sar_par raw_WBs
```

2.3 SCANSAR Image Formation with the MSP

The script PALSAR_proc_all_WB located in MSP/scripts is then used to process all beams of the files listed in the proc_list_WB file. This script uses beam 4 to determine the focus velocity parameter and then applies this to the other beams. It is essential that all beams use the same focus parameters to avoid interferometric phase discontinuities. The usage statement for PALSAR_proc_all_WB is listed below:

```
$ PALSAR_proc_all_WB
*** ./PALSAR_proc_all_WB
*** Copyright 2011, Gamma Remote Sensing, v1.1 18-Mar-2011 clw ***
*** ALOS PALSAR SLC generation from raw WB ScanSAR data  ***

usage: ./PALSAR_proc_all_WB <proc_list> <raw_dir> <rc_dir> <SLC_dir> <MLI_dir> <rlks> <azlks>
<SLC_format> [az_patch] [autof_snr]
    proc_list  (input) processing list (6 columns):
                 1. scene identifier
                 2. offset in echoes to start of processed data (enter - for default)
                 3. number of echoes to process (enter - for default)
                 4. range offset in samples (enter - for default)
                 5. number of range samples to process (enter - for default)
                 6. Doppler centroid for scene at center swath (Hz)
                 7. Doppler slope for scene at center swath (Hz/m)
                 8. azimuth processing bandwidth fraction (.1 --> 1.0)
    raw_dir directory containing raw data files
    rc_dir  directory to contain range compressed data (rc data is deleted)
    SLC_dir directory to contain SLC data
    MLI_dir directory to contain multilook intensity (MLI) files derived from SLC data
    rlks          range looks for MLI image
    azlks         azimuth looks for MLI image
    SLC_format output SLC image format:
                 0: FCOMPLEX
                 1: SCOMPLEX
    az_patch    azimuth compression processing patch size (default: 16384)
    autof_snr   minimum SNR threshold for autofocus, 0.0 to turn off autofocus (nominal: 10)
```

Most of the parameters in the proc_list_WB generated by PALSAR_pre_proc_WB are set to – , since we intend to process the full scene. The Doppler centroid of each beam is set to 0.0 such that all beams are co-aligned in azimuth. This is an important point, since without this, azimuth offsets will be fractional pixels between beams and they cannot be mosaicked without higher-order interpolation.

The remaining command line parameters of PALSAR_proc_all_WB are described here:

raw_dir	raw data directory containing the raw data. In the case of interferometry, these are the burst-synchronized raw data file in raw_WBs
rc_dir	directory for range-compression output. This should ideally be located in a directory located on another disk to improve I/O speed. The range compressed data files can be deleted after azimuth compression
SLC_dir	directory for output SLC image data
MLI_dir	directory for multi-look intensity (MLI) images produced from the SLC image data
rlks	number of range looks in the detected MLI images
azlks	number of azimuth looks in the detected MLI images
SLC_format	format of SLC images, recommended to be FCOMPLEX to maintain full dynamic range and phase accuracy
az_patch	azimuth compression patch size, nominal value:16384
autof_snr	auto-focus SNR parameter, byt default 10, set to 0.0 to turn off auto-focus

The auto-focus program af in the MSP is used to determine a estimate of the along-track satellite velocity using the map-drift algorithm over multiple patches in the scene. Running PALSAR_proc_all_WB is done with the following command:

```
PALSAR_proc_all_WB proc_list_WB raw_WBs /media/d1 slc_WBs mli_WBs 3 16 0
```

In this example 3 range looks and 16 azimuth looks have been selected to get approximately 50 meter pixels. This is consistent with the azimuth resolution possible with SCANSAR. Screen output from PALSAR_proc_all_WB for 1 of the 5 beams (beam 4) is given in

Appendix 2: PALSAR_proc_all_WB commands and output

After the SLC and MLI images have been produced the MLI images can be displayed in the MLI directory:

```
eog mli_WBs/*.ras&
```

2.4 Copy SLC to a Common Multi-look Mosaic Geometry

The next step in processing the SCANSAR data to generate a mosaic of the single beam images is to extract a section of each SLC the lies on a common grid of the multi-look image pixels. The starting range and azimuth time of the multi-look (MLI) images produced from the SLCs must be on this grid to avoid the need to perform resampling the data using spline or SINC interpolation. A ISP script SLC_copy_WB determines the offset parameters required to call the ISP program SLC_copy that extracts the section of the SLC for each beam that falls on this common muli-look pixel grid. The command line parameters for the SLC_copy_WB script are:

```
$ SLC_copy_WB
*** ./SLC_copy_WB
*** Copyright 2011, Gamma Remote Sensing, v1.1 9-Apr-2011 clw ***
*** Create a new set of SLCs for all beams in a PALSAR WB ScanSAR image ***

usage: ./SLC_copy_WB <SLC_tab> <SLC2_dir>
    SLC_tab    (input) two column list of input SLC files and SLC ISP image parameter files (including
               paths) (text)
    SLC2_dir   directory to contain copied segments of the input SLC data and the associated parameter
               files

    NOTE: current directory is denoted using .
```

Required input to SLC_copy_WB is a 2 column list of the SLC images and parameter files produced generated using the mk_tab script located in the DIFF/scripts directory. mk_tab uses as input the directory containing the image and parameter files, and the extensions of the files, in this case slc and slc.par

```
$ mk_tab
*** Copyright 2011, Gamma Remote Sensing, v1.2 29-Apr-2011 clw ***
*** Generate SLC_tab, MLI_tab, or RAW_list for processing  ***

usage: /home/cw/GPRI2/trunk/software/mk_tab <dir> <ext-1> <ext-2> <tab>
    dir   (input) directory including paths that contain the data files
    ext-1 (input) pattern to select data files (examples: slc, raw...)
    ext-2 (input) pattern to select parameter files that match the data (enter -  for none, examples:
           slc.par, raw_par, raw.par)
    tab   (output) list of data filenames and associated parameter files (including paths) (text)

    NOTE: The current directory is denoted using .
```

Now use mk_tab to generate the SLC_tab files required by SLC_copy_WB we make use of the globbing character ? You can also use the other globbing constructs such as (see http://en.wikipedia.org/wiki/Glob_(programming) for details):

```
"*"     match any number of unknown characters
"?"     match one unknown character
[ab]    match any of a set of characters in the bracket (match a, or b in this example]
[3-5]    match 3,4 or 5
```

To generate the associated SLC_tab files for each set of single-beam SLC images:

```
mk_tab slc_WBs 20071020_?.slc slc_WBs 20071020_?.slc.par SLC_WBs_20071020_tab
SLC_WBs_20071020_tab:
slc_WBs/20071020_1.slc        slc_WBs/20071020_1.slc.par
slc_WBs/20071020_2.slc        slc_WBs/20071020_2.slc.par
slc_WBs/20071020_3.slc        slc_WBs/20071020_3.slc.par
slc_WBs/20071020_4.slc        slc_WBs/20071020_4.slc.par
slc_WBs/20071020_5.slc        slc_WBs/20071020_5.slc.par

mk_tab slc_WBs 20101028_?.slc slc_WBs 20101028_?.slc.par SLC_WBs_20101028_tab
SLC_WBs_20101028_tab:
slc_WBs/20101028_1.slc        slc_WBs/20101028_1.slc.par
slc_WBs/20101028_2.slc        slc_WBs/20101028_2.slc.par
slc_WBs/20101028_3.slc        slc_WBs/20101028_3.slc.par
slc_WBs/20101028_4.slc        slc_WBs/20101028_4.slc.par
slc_WBs/20101028_5.slc        slc_WBs/20101028_5.slc.par

#extract sections of each beam so that mosaic is possible with integer offsets
SLC_copy_WB SLC_WBs_20071020_tab slc_WBs2

SLC_tab table of SLC images and parameter files: SLC_WBs_20071020_tab
output resampled SLC directory: slc_WBs2
processing start: Sat Apr  9 20:59:37 2011

SLC: 1  slc_WBs/20071020_1.slc slc_WBs/20071020_1.slc.par
SLC start_time (s): 79428.200226  r0 (m): 743400.155  r2 (m): 789483.875  nr: 4920   naz: 114526
SLC range pixel spacing (m): 9.368514  azimuth line time (s): 4.650000e-04
```

```
SLC: 2  slc_WBs/20071020_2.slc slc_WBs/20071020_2.slc.par
SLC start_time (s): 79428.418776  r0 (m): 783273.151  r2 (m): 826958.532  nr: 4664   naz: 114231
SLC range pixel spacing (m): 9.368514  azimuth line time (s): 4.650000e-04

SLC: 3  slc_WBs/20071020_3.slc slc_WBs/20071020_3.slc.par
SLC start_time (s): 79428.659181  r0 (m): 820447.116  r2 (m): 870428.139  nr: 5336   naz: 113879
SLC range pixel spacing (m): 9.368514  azimuth line time (s): 4.650000e-04

SLC: 4  slc_WBs/20071020_4.slc slc_WBs/20071020_4.slc.par
SLC start_time (s): 79428.082581  r0 (m): 863167.092  r2 (m): 904454.133  nr: 4408   naz: 113609
SLC range pixel spacing (m): 9.368514  azimuth line time (s): 4.650000e-04

SLC: 5  slc_WBs/20071020_5.slc slc_WBs/20071020_5.slc.par
SLC start_time (s): 79428.313686  r0 (m): 893596.176  r2 (m): 937281.557  nr: 4664   naz: 113346
SLC range pixel spacing (m): 9.368514  azimuth line time (s): 4.650000e-04

maximum start time: 79428.659181  SLC: 3
beam: 1  time offset: 1.13460e-01  line offset: 987
near slant range (m): 743400.155  difference to near range beam (m): 0.000  range samples:     0
range offset (samples) to start of output SLC: 0

beam: 2  time offset: 1.13460e-01  line offset: 517
near slant range (m): 783273.151  difference to near range beam (m): 39872.997  range samples:  4256
range offset (samples) to start of output SLC: 4

beam: 3  time offset: 1.13460e-01  line offset: 0
near slant range (m): 820447.116  difference to near range beam (m): 77046.961  range samples:  8224
range offset (samples) to start of output SLC: 8

beam: 4  time offset: 1.13460e-01  line offset: 1240
near slant range (m): 863167.092  difference to near range beam (m): 119766.937  range samples: 12783
range offset (samples) to start of output SLC: 8

beam: 5  time offset: 1.13460e-01  line offset: 743
near slant range (m): 893596.176  difference to near range beam (m): 150196.022  range samples: 16032
range offset (samples) to start of output SLC: 12

SLC slant range overlap beams 1 <--> 2:    6173.250   range pixels: 658
SLC slant range overlap beams 2 <--> 3:    6436.468   range pixels: 687
SLC slant range overlap beams 3 <--> 4:    7186.098   range pixels: 767
SLC slant range overlap beams 4 <--> 5:   10745.535   range pixels: 1146

SLC_copy slc_WBs/20071020_1.slc slc_WBs/20071020_1.slc.par slc_WBs2/20071020_1.slc
slc_WBs2/20071020_1.slc.par 1 - 0 - 987 113346

SLC_copy slc_WBs/20071020_2.slc slc_WBs/20071020_2.slc.par slc_WBs2/20071020_2.slc
slc_WBs2/20071020_2.slc.par 1 - 4 - 517 113346

SLC_copy slc_WBs/20071020_3.slc slc_WBs/20071020_3.slc.par slc_WBs2/20071020_3.slc
slc_WBs2/20071020_3.slc.par 1 - 8 - 0 113346

SLC_copy slc_WBs/20071020_4.slc slc_WBs/20071020_4.slc.par slc_WBs2/20071020_4.slc
slc_WBs2/20071020_4.slc.par 1 - 8 - 1240 113346

SLC_copy slc_WBs/20071020_5.slc slc_WBs/20071020_5.slc.par slc_WBs2/20071020_5.slc
slc_WBs2/20071020_5.slc.par 1 - 12 - 743 113346

*** ./SLC_copy_WB processing end: Sat Apr  9 21:12:54 2011 ***
######################################################################

#now process the scene from 20101028
cw@gamma01 /media/d2/PALSAR_ScanSAR_NZ
SLC_copy_WB SLC_WBs_20101028_tab slc_WBs2

SLC_tab table of SLC images and parameter files: SLC_WBs_20101028_tab
output resampled SLC directory: slc_WBs2
processing start: Sat Apr  9 21:39:08 2011

SLC: 1  slc_WBs/20101028_1.slc slc_WBs/20101028_1.slc.par
SLC start_time (s): 79381.189200  r0 (m): 743251.158  r2 (m): 789334.878  nr: 4920   naz: 114436
SLC range pixel spacing (m): 9.368514  azimuth line time (s): 4.650000e-04

SLC: 2  slc_WBs/20101028_2.slc slc_WBs/20101028_2.slc.par
SLC start_time (s): 79381.404495  r0 (m): 783123.105  r2 (m): 826808.486  nr: 4664   naz: 114148
SLC range pixel spacing (m): 9.368514  azimuth line time (s): 4.650000e-04
```

```
SLC: 3  slc_WBs/20101028_3.slc slc_WBs/20101028_3.slc.par
SLC start_time (s): 79381.642110  r0 (m): 820297.220  r2 (m): 870278.242  nr: 5336   naz: 113801
SLC range pixel spacing (m): 9.368514  azimuth line time (s): 4.650000e-04

SLC: 4  slc_WBs/20101028_4.slc slc_WBs/20101028_4.slc.par
SLC start_time (s): 79381.063650  r0 (m): 863018.095  r2 (m): 904305.136  nr: 4408   naz: 113525
SLC range pixel spacing (m): 9.368514  azimuth line time (s): 4.650000e-04

SLC: 5  slc_WBs/20101028_5.slc slc_WBs/20101028_5.slc.par
SLC start_time (s): 79381.292430  r0 (m): 893447.179  r2 (m): 937132.560  nr: 4664   naz: 113262
SLC range pixel spacing (m): 9.368514  azimuth line time (s): 4.650000e-04

maximum start time: 79381.642110  SLC: 3
beam: 1  time offset: 1.03230e-01  line offset: 974
near slant range (m): 743251.158  difference to near range beam (m): 0.000  range samples:     0
range offset (samples) to start of output SLC: 0

beam: 2  time offset: 1.03230e-01  line offset: 511
near slant range (m): 783123.105  difference to near range beam (m): 39871.947  range samples:  4255
range offset (samples) to start of output SLC: 4

beam: 3  time offset: 1.03230e-01  line offset: 0
near slant range (m): 820297.220  difference to near range beam (m): 77046.062  range samples:  8223
range offset (samples) to start of output SLC: 8

beam: 4  time offset: 1.03230e-01  line offset: 1244
near slant range (m): 863018.095  difference to near range beam (m): 119766.937  range samples: 12783
range offset (samples) to start of output SLC: 8

beam: 5  time offset: 1.03230e-01  line offset: 752
near slant range (m): 893447.179  difference to near range beam (m): 150196.021  range samples: 16032
range offset (samples) to start of output SLC: 12

SLC slant range overlap beams 1 <--> 2:    6174.299   range pixels: 659
SLC slant range overlap beams 2 <--> 3:    6436.318   range pixels: 687
SLC slant range overlap beams 3 <--> 4:    7185.199   range pixels: 766
SLC slant range overlap beams 4 <--> 5:   10745.535   range pixels: 1146

SLC_copy slc_WBs/20101028_1.slc slc_WBs/20101028_1.slc.par slc_WBs2/20101028_1.slc
slc_WBs2/20101028_1.slc.par 1 - 0 - 974 113262

SLC_copy slc_WBs/20101028_2.slc slc_WBs/20101028_2.slc.par slc_WBs2/20101028_2.slc
slc_WBs2/20101028_2.slc.par 1 - 4 - 511 113262

SLC_copy slc_WBs/20101028_3.slc slc_WBs/20101028_3.slc.par slc_WBs2/20101028_3.slc
slc_WBs2/20101028_3.slc.par 1 - 8 - 0 113262

SLC_copy slc_WBs/20101028_4.slc slc_WBs/20101028_4.slc.par slc_WBs2/20101028_4.slc
slc_WBs2/20101028_4.slc.par 1 - 8 - 1244 113262

SLC_copy slc_WBs/20101028_5.slc slc_WBs/20101028_5.slc.par slc_WBs2/20101028_5.slc
slc_WBs2/20101028_5.slc.par 1 - 12 - 752 113262

*** ./SLC_copy_WB processing end: Sat Apr  9 21:52:50 2011 ***
```

2.5 Generate Mosaic of MLI images in Range-Doppler Coordinates

Mosaicking of the MLI image files is performed using the mosaic_WB program in the ISP. The mosaic of New Zealand consists of beams 3, 4, and 5 since beams 1 and 2 cover open ocean and are not of interest for this application. The mosaic processing relies on using tab files produced with mk_tab containing lists of the different images and parameter files.

The first step is to generate MLI images from the processed SLC images. Note that the ? character is used as a globbing wildcard for a single character.

```
#make SLC tab files of the two scenes
mk_tab slc_WBs2 20071020_?.slc  slc_WBs2 20071020_?.slc.par  SLC_WBs2_20071020_tab
SLC_WBs2_20071020_tab:
slc_WBs2/20071020_1.slc       slc_WBs2/20071020_1.slc.par
slc_WBs2/20071020_2.slc       slc_WBs2/20071020_2.slc.par
slc_WBs2/20071020_3.slc       slc_WBs2/20071020_3.slc.par
slc_WBs2/20071020_4.slc       slc_WBs2/20071020_4.slc.par
slc_WBs2/20071020_5.slc       slc_WBs2/20071020_5.slc.par

mk_tab slc_WBs2 20101028_?.slc  slc_WBs2 20101028_?.slc.par  SLC_WBs2_20101028_tab
SLC_WBs2_20101028_tab:
slc_WBs2/20101028_1.slc       slc_WBs2/20101028_1.slc.par
slc_WBs2/20101028_2.slc       slc_WBs2/20101028_2.slc.par
slc_WBs2/20101028_3.slc       slc_WBs2/20101028_3.slc.par
slc_WBs2/20101028_4.slc       slc_WBs2/20101028_4.slc.par
slc_WBs2/20101028_5.slc       slc_WBs2/20101028_5.slc.par

#generate MLI images, output images are written in the mli_WBs2 directory
mk_mli_all SLC_WBs2_20071020_tab mli_WBs2 3 16 0 .6 .4
mk_mli_all SLC_WBs2_20101028_tab mli_WBs2 3 16 0 .6 .4
```

The ISP program mosaic_WB is used to mosaic the MLI, differential interferograms, or correlation maps in RDC. The program can mosaic both MLI images and complex data. In the case of MLI images the overlap region between beams is used to calculate the radiometric scaling.

```
$ mosaic_WB
*** ISP: Program mosaic_WB.c ***
*** Copyright 2011, Gamma Remote Sensing, v1.2 6-Apr-2011 clw ***
*** Mosiac Wide-Beam ScanSAR data processed by the MSP ***

usage: mosaic_WB <data_tab> <dtype> <data_out> <data_par_out> [sc_flg]}

input parameters:
  data_tab      (input) 2 column list of data  and ISP image parameter files for the beams in the
                   mosaic (text)
  dtype         (input) input data type:
                   0: FLOAT
                   1: FCOMPLEX
  data_out      (output) output image mosaic
  data_par_out  (output) ISP image parameter file for output image mosaic
  sc_flg        intensity scaling flag:
                  0: do not scale different beam data values
                  1: use overlap regions to scale beam intensities (default)


#mosaic beams 3,4,and 5 of 20071020 and 20101028, do not include beams 1 and 2 in the mosiac since
these are water only. Use the [3-5] to select beams 3,4,and 5:

mk_tab mli_WBs2 20071020_[3-5].mli 20071020_[3-5].mli.par MLI_WBs2_20071020_tab
MLI_WBs2_20061231_tab:
mli_WBs2/20071020_3.mli       mli_WBs2/20071020_3.mli.par
mli_WBs2/20071020_4.mli       mli_WBs2/20071020_4.mli.par
mli_WBs2/20071020_5.mli       mli_WBs2/20071020_5.mli.par

mosaic_WB MLI_WBs2_20071020_tab 0 nz_WBs2_20071020.mli nz_WBs2_20071020.mli.par
*** ISP: Program mosaic_WB.c ***
*** Copyright 2011, Gamma Remote Sensing, v1.2 6-Apr-2011 clw ***
*** Mosiac Wide-Beam ScanSAR data processed by the MSP ***
list of data files and image parameter files (text): MLI_WBs2_20071020_tab
number of input image data files: 3
input image   1: mli_WBs2/20071020_3.mli     mli_WBs2/20071020_3.mli.par
input image   2: mli_WBs2/20071020_4.mli     mli_WBs2/20071020_4.mli.par
input image   3: mli_WBs2/20071020_5.mli     mli_WBs2/20071020_5.mli.par
```

```
beam: 1 image data type: FLOAT
r0 (m): 820531.433  r2 (m): 870418.770  nr:  1776  rpix (m): 28.105542  t0 (s): 79428.662668  nlines:
7084  time_per_line (s): 7.440000e-03

beam: 2 image data type: FLOAT
r0 (m): 863251.409  r2 (m): 904426.027  nr:  1466  rpix (m): 28.105542  t0 (s): 79428.662668  nlines:
7084  time_per_line (s): 7.440000e-03

beam: 3 image data type: FLOAT
r0 (m): 893717.967  r2 (m): 937253.452  nr:  1550  rpix (m): 28.105542  t0 (s): 79428.662668  nlines:
7084  time_per_line (s): 7.440000e-03

beam 1<-->2 beam_overlap (m):   7167.361  range pixels:    255.016
max range (m):866877.472  swath width (m): 46346.039  samples:  1649  next beam r0:866877.472  samples
offset:   129

beam 2<-->3 beam_overlap (m):  10708.061  range pixels:    380.995
max range (m):899114.080  swath width (m): 32236.608  samples:  1147  next beam r0:899114.080  samples
offset:   192

beam 3
max range (m):937281.557  swath width (m): 38167.477  samples:  1358
beam: 1  pixels overlap: 256   offset:  68  range sample start: 1588  end: 1708
beam: 2  pixels overlap: 382   offset: 131  range sample start: 1215  end: 1335

overlap: 1  points:  842880  ave_pwr_beam_0: 1.577248e-02  ave_pwr beam_1: 3.311887e-02  ratio:  2.0998
overlap: 2  points:  842880  ave_pwr_beam_0: 2.913778e-02  ave_pwr beam_1: 4.888886e-02  ratio:  1.6779

scale factor for beam 1  1.000000
scale factor for beam 2  0.476239
scale factor for beam 3  0.283838

output line: 0
output line: 2000
output line: 4000
output line: 6000

SLC center track time (s):   79455.0077  Doppler (Hz):      0.000   range(m):  878878.5381
center swath position at 79455.00771  lat. (deg.): -43.40390826  lon.(deg.): 172.33549132
center swath position at 79455.25771  lat. (deg.): -43.40976924  lon.(deg.): 172.33287905
initial heading (deg.): -162.550364    new heading (deg.): -162.058810
incidence angle mid-swath (deg):       38.179

output mosaic file: nz_WBs2_20071020.mli
output image parameter file: nz_WBs2_20071020.mli.par
width: 4154   lines: 7084
slant range pixel spacing (m): 28.10554    azimuth pixel spacing (m): 50.93155

user time (s):         1.800
system time (s):       0.120
elapsed time (s):      2.010

raspwr nz_WBs2_20071020.mli 4154 1 0 1 1 .6 .4
```

The mosaic generates an MLI image as shown in Figure 1 and MLI image parameter file contents are listed:

cat nz_WBs2_20071020.mli.par

```
Gamma Interferometric SAR Processor (ISP) - Image Parameter File

title:     ALPSRS092604500
sensor:    PALSAR
date:      2007   10   20
start_time:             79428.662668   s
center_time:            79455.011429   s
end_time:               79481.360189   s
azimuth_line_time:     7.4400000e-03  s
line_header_size:                  0
range_samples:                  4154
azimuth_lines:                  7084
range_looks:                       3
azimuth_looks:                    16
image_format:               FLOAT
image_geometry:             SLANT_RANGE
range_scale_factor:     1.0000000e+00
azimuth_scale_factor:   1.0000000e+00
center_latitude:         -43.4039083   degrees
```

```
center_longitude:        172.3354913   degrees
heading:                -162.0588097   degrees
range_pixel_spacing:       28.105542   m
azimuth_pixel_spacing:     50.931552   m
near_range_slc:           820531.4329   m
center_range_slc:         878906.6436   m
far_range_slc:            937281.8544   m
first_slant_range_polynomial:        0.00000      0.00000  0.00000e+00  0.00000e+00  0.00000e+00
0.00000e+00  s m 1 m^-1 m^-2 m^-3
center_slant_range_polynomial:       0.00000      0.00000  0.00000e+00  0.00000e+00  0.00000e+00
0.00000e+00  s m 1 m^-1 m^-2 m^-3
last_slant_range_polynomial:         0.00000      0.00000  0.00000e+00  0.00000e+00  0.00000e+00
0.00000e+00  s m 1 m^-1 m^-2 m^-3
incidence_angle:            38.1790   degrees
azimuth_deskew:           ON
azimuth_angle:              90.0000   degrees
radar_frequency:        1.2700000e+09   Hz
adc_sampling_rate:      1.6000000e+07   Hz
chirp_bandwidth:        1.4000000e+07   Hz
prf:                     2150.537634   Hz
azimuth_proc_bandwidth:   1720.43011   Hz
doppler_polynomial:          0.00000  0.00000e+00  0.00000e+00  0.00000e+00  Hz     Hz/m     Hz/m^2
Hz/m^3
doppler_poly_dot:        0.00000e+00  0.00000e+00  0.00000e+00  0.00000e+00  Hz/s   Hz/s/m   Hz/s/m^2
Hz/s/m^3
doppler_poly_ddot:       0.00000e+00  0.00000e+00  0.00000e+00  0.00000e+00  Hz/s^2 Hz/s^2/m Hz/s^2/m^2
Hz/s^2/m^3
receiver_gain:              24.0000   dB
calibration_gain:          -49.0000   dB
sar_to_earth_center:            7079792.2921   m
earth_radius_below_sensor:      6368023.4849   m
earth_semi_major_axis:          6378137.0000   m
earth_semi_minor_axis:          6356752.3141   m
number_of_state_vectors:                  15
time_of_first_state_vector:     79020.000000   s
state_vector_interval:             60.000000   s
state_vector_position_1:  -6686000.3999    -627859.8241   -2235750.4766   m   m   m
state_vector_velocity_1:     2176.65180      1823.94150     -7041.73730   m/s m/s m/s
state_vector_position_2:  -6541540.3551    -517843.5634   -2653431.8596   m   m   m
state_vector_velocity_2:     2637.05950      1841.36120     -6876.27640   m/s m/s m/s
state_vector_position_3:  -6369767.5432    -407124.8000   -3060347.1078   m   m   m
state_vector_velocity_3:     3086.75470      1847.36690     -6682.99250   m/s m/s m/s
state_vector_position_4:  -6171382.2799    -296386.1858   -3454850.6988   m   m   m
state_vector_velocity_4:     3523.82740      1842.04210     -6462.69920   m/s m/s m/s
state_vector_position_5:  -5947197.7987    -186303.4647   -3835349.2112   m   m   m
state_vector_velocity_5:     3946.42500      1825.53340     -6216.31910   m/s m/s m/s
state_vector_position_6:  -5698136.5732     -77541.7445   -4200307.7225   m   m   m
state_vector_velocity_6:     4352.76020      1798.04840     -5944.87880   m/s m/s m/s
state_vector_position_7:  -5425226.1721      29248.1322   -4548255.9147   m   m   m
state_vector_velocity_7:     4741.11820      1759.85470     -5649.50410   m/s m/s m/s
state_vector_position_8:  -5129594.6876     133433.1162   -4877793.8628   m   m   m
state_vector_velocity_8:     5109.86400      1711.27760     -5331.41480   m/s m/s m/s
state_vector_position_9:  -4812465.7711     234401.3611   -5187597.5040   m   m   m
state_vector_velocity_9:     5457.44870      1652.69800     -4991.91900   m/s m/s m/s
state_vector_position_10:  -4475153.2597     331565.4725   -5476423.7651   m   m   m
state_vector_velocity_10:     5782.41590      1584.54970     -4632.40700   m/s m/s m/s
state_vector_position_11:  -4119055.4460     424365.5790   -5743115.2942   m   m   m
state_vector_velocity_11:     6083.40750      1507.31580     -4254.34490   m/s m/s m/s
state_vector_position_12:  -3745649.0501     512272.2315   -5986604.8155   m   m   m
state_vector_velocity_12:     6359.16830      1421.52660     -3859.26810   m/s m/s m/s
state_vector_position_13:  -3356482.8995     594789.1223   -6205919.0837   m   m   m
state_vector_velocity_13:     6608.55040      1327.75620     -3448.77420   m/s m/s m/s
state_vector_position_14:  -2953171.4030     671455.6074   -6400182.4315   m   m   m
state_vector_velocity_14:     6830.51620      1226.61860     -3024.51750   m/s m/s m/s
state_vector_position_15:  -2537387.8337     741849.0170   -6568620.0018   m   m   m
state_vector_velocity_15:     7024.14210      1118.76510     -2588.20310   m/s m/s m/s
```

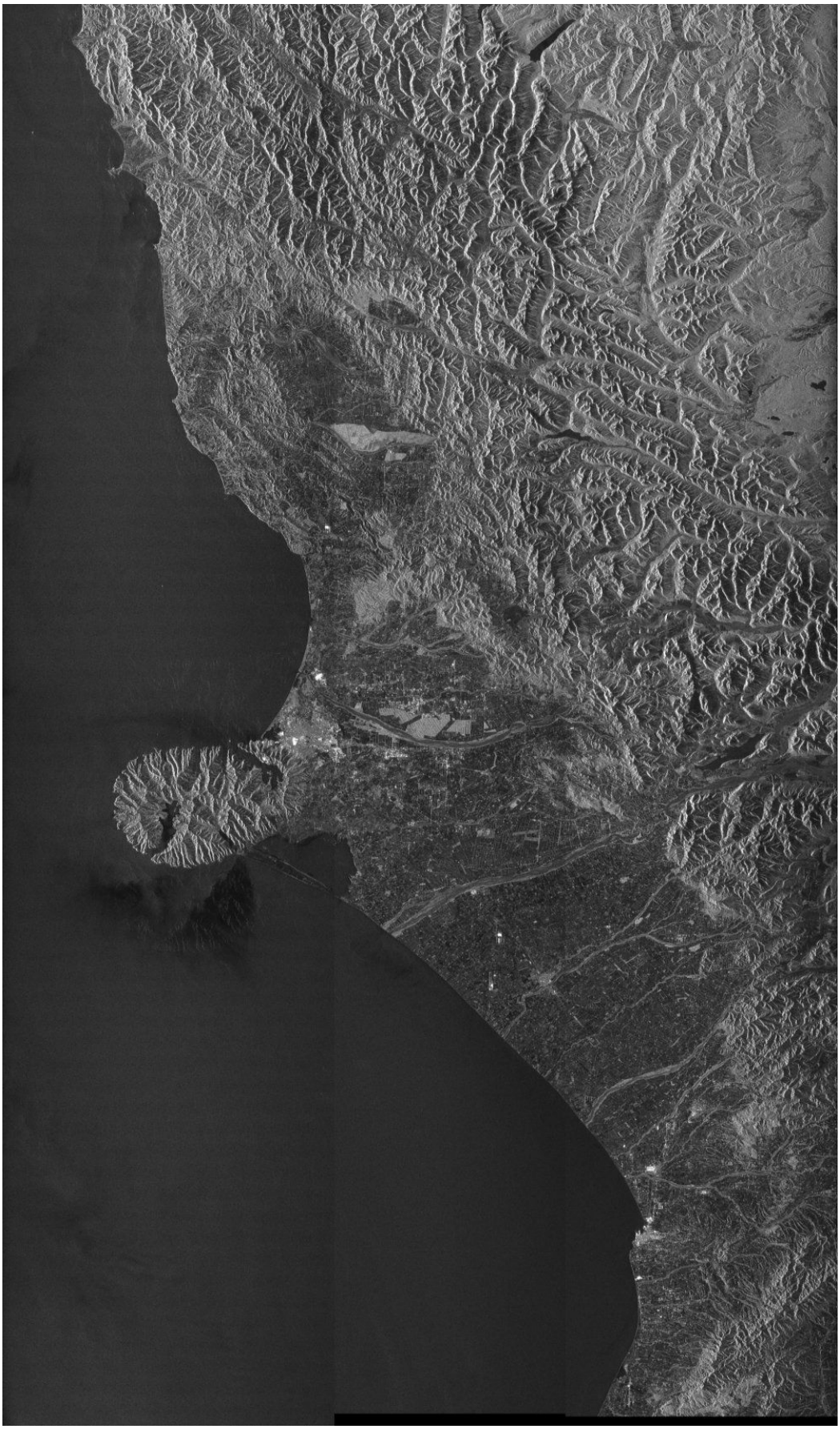

Illustration 1: PALSAR SCANSAR mosaic beams 3,4 and 5 near Christchurch, NZ in slant -range geometry 20071020

2.6 Terrain Geocoding of the SCANSAR Mosaic

Terrain geocoding is automated using the mk_geo script. The processing modes of mk_geo are described in the HTML documentation (DIFF/html/mk_geo.html). A summary of the successive geocoding process steps:

1. Generation of a lookup table relating the SAR image geometry to the map projection and resample a simulated SAR image in map coordinates into SAR Range-Doppler Coordinates (RDC). The simulated SAR image is created using the satellite position derived from the state vectors and the DEM.
2. Measure offsets between the simulated image resampled to RDC and the original SAR image. Calculate an polynomial model for the offsets between the radar coordinates in the lookup table and the actual SAR coordinates.
3. Apply the polynomial correction to the lookup-table values and resample the SAR image into map coordinates. The DEM can be resampled into RDC using the lookup-table.

The summary statement for mk_geo is given by:

```
$ mk_geo
*** ./mk_geo
*** Copyright 2011, Gamma Remote Sensing, v3.3 28-Apr-2011 clw ***
*** Terrain geocoding of SAR images with lookup table refinement and transform DEM --> SAR Range-
Doppler Coordinates (RDC) ***

usage: ./mk_geo <MLI> <MLI_par> <DEM> <DEM_par> <DEM_seg> <DEM_seg_par> <GEO_dir> <scene_id> <post>
<mode> [ls_mode] [r_ovr] [n_ovr] [rad_max] [rlks] [azlks] [thres] [rpos] [azpos] [roff] [azoff]
[r_patch] [az_patch] [nr] [naz]

    MLI           (input) MLI SAR image (including path)
    MLI_par       (input) ISP image parameter file of the MLI image (including path)
    DEM           (input) DEM in desired output projection (including path)
    DEM_par       (input) DEM parameter file (including path)
    DEM_seg       (output) DEM segment for output image products (including path)
    DEM_seg_par   (input/output) DEM parameter file for output image products (including path),
                      regenerated each time
    GEO_dir       directory for output images, lookup tables and DEM products
    scene_id      scene name to identify output files
    post          output image sample spacing in meters or degrees for geographic (EQA) projection
    mode          mk_geo processing mode:
                    0: generate initial lookup table, simulated SAR image, and DEM segment parameters
                    1: generate initial lookup table and simulated SAR image using existing DEM segment
                       to determine image bounds
                    2: measure initial offset between simulated SAR image and actual SAR image
                    3: perform refinement of lookup table by offset measurement with respect to the
                       simulated SAR image
                    4: update lookup table and produce terrain geocoded SAR image and DEM in SAR range-
                       Doppler coordinates (RDC)
                    5: ellipsoid geocoding of the SAR image without a DEM: generate new DEM segment
                       parameters
                    6: ellipsoid geocoding of the the SAR image without a DEM: use existing DEM segment
                       parameters
    ls_mode       algorithm selection in gc_map for regions of layover, shadow, or DEM gaps:
                    0: set to (0.,0.)
                    1: linear interpolation across these regions
                    2: use actual value (default)
                    3: nearest neighbor thinned (nn-thinned)
    r_ovr         range over-sampling parameter for gc_map parameter
                    ls_mode = 3 (nn-thinned) (default: 2)
    n_ovr         interpolation oversampling factor in geocode (default = 2.0)
    rad_max       maximum interpolation search radius in geocode (enter - for default: 4*n_ovr)

    NOTE: n_ovr and rad_max are parameters used by the program geocode for transformation of the
          simulated image and DEM into SAR geometry. The parameters rlks, azlks, thres, rpos, azpos,
          roff, azoff are used for estimation of the initial offset of the SAR image with respected
          to the simulated SAR image.

    rlks          number of range looks for the initial offset estimate (default: 1)
    azlks         number of azimuth looks for the initial offset estimate (default: 1)
    thres         SNR threshold for offset estimates (default: 10)
    rpos          range position for initial offset (enter - for default)
    azpos         azimuth position for initial offset (enter - for default)
    roff          initial range offset estimate (enter - for current value in DIFF_par file)
    azoff         initial azimuth offset estimate (enter - for current value in DIFF_par file)
    r_patch       range patch size for offset estimation (default: 256 samples)
    az_patch      azimuth patch size for offset estimation (default: 256 lines)
    nr            number of range patches for offset estimation (default: 20)
    naz           number of azimuth patches for offset estimation (default: 20)
```

```
    -s scale   (option) set image display scale factor (default: 0.6)
    -e exp     (option) set image display exponent (default: 0.4)
```

The normal processing sequence for terrain geocoding using the script are to use modes 0, 2, 3, and 4. Mode 0 is used for the the case where the scene boundaries are determined from the bounds of the radar image. If there is an already existing DEM parameter file for region of interest, then Mode 1 must be used instead of Mode 0.

In this processing example, we use the SRTM DEM mosaic derived from 5x5 degree tiles from http://srtm.csi.cgiar.org/. These data are given in geographic coordinates with a posting of 3 arc-sec (8.3333333e-4 deg). Creating a larger DEM from multiple tiles if required can be done the mosaic program in the GAMMA LAT package using the GDAL tools. The downloaded DEM data must be conditioned such that NO-DATA values are set to 0. If there are actual heights in the DEM with 0 value, these should offset by 1 meter to identified as valid. In this example a single 5x5 degree tile was used. The mg_geo script post command line parameter is set to produce terrain geocoded image products with 2 arc-sec (5.55555555e-4) posting (about 50 meters).

Output products from running mk_geo are stored in a geocoding data directory specified on the command line. In this example the directory is specified as geo_WBs2. The input DEM covering the entire area is called nz.dem with a DEM parameter file nz.dem_par. The contents of nz.dem_par are listed below:

```
Gamma DIFF&GEO DEM/MAP parameter file
title: srtm_72_22
DEM_projection:     EQA
data_format:        INTEGER*2
DEM_hgt_offset:          0.00000
DEM_scale:               1.00000
width:                6001
nlines:               6001
corner_lat:    -41.0000000  decimal degrees
corner_lon:    170.0000000  decimal degrees
post_lat:   -8.3333333e-04  decimal degrees
post_lon:    8.3333333e-04  decimal degrees

ellipsoid_name: WGS 84
ellipsoid_ra:       6378137.000   m
ellipsoid_reciprocal_flattening:  298.2572236

datum_name: WGS 1984
datum_shift_dx:             0.000   m
datum_shift_dy:             0.000   m
datum_shift_dz:             0.000   m
datum_scale_m:          0.00000e+00
datum_rotation_alpha:  0.00000e+00   arc-sec
datum_rotation_beta:   0.00000e+00   arc-sec
datum_rotation_gamma:  0.00000e+00   arc-sec
datum_country_list Global Definition, WGS84, World
```

The gc_map program (DIFF/GEO package) called by the mk_geo script extracts a section of the DEM that corresponds to the area covered by the scene. In the example this map region is defined by the file geo_WBs2/nz_WBs2.dem_par. The bounding region is determined using the MLI image parameter file specified in the command nz_WBs2_20071020.mli.par.

The DIFF/GEO and DISP package commands called by mk_geo and the screen output from running these commands are logged in files with names mk_geo_0.log, mk_geo_2.log... for each processing step (modes 0,2,3,4), The contents of the log files for geocoding the New Zealand mosaic are stored in **Appendix 3: Geocoding of the MLI mosaic.** The DEM in RDC that is produced from the geocoding in mode 4 is then used for resampling the SAR images. Here are listed the specific commands with mk_geo to geocode the MLI mosaic image:

```
#calculate initial lookup table, generate simulated image, resample simulated image to RDC and display
mk_geo nz_WBs2_20071020.mli nz_WBs2_20071020.mli.par DEM/nz.dem DEM/nz.dem_par geo_WBs2/nz_WBs2.dem
geo_WBs2/nz_WBs2.dem_par geo_WBs2 nz_WBs2 5.555555556e-4 0 2

#measure initial offset between simulated image in RDC and the SAR image
mk_geo nz_WBs2_20071020.mli nz_WBs2_20071020.mli.par DEM/nz.dem DEM/nz.dem_par geo_WBs2/nz_WBs2.dem
geo_WBs2/nz_WBs2.dem_par geo_WBs2 nz_WBs2 5.555555556e-4 2 2

#measure offsets on a grid of 20 x20 patches, each 256x256 samples. Calculated offset polynomial
#correction for the lookup table
mk_geo nz_WBs2_20071020.mli nz_WBs2_20071020.mli.par DEM/nz.dem DEM/nz.dem_par geo_WBs2/nz_WBs2.dem
geo_WBs2/nz_WBs2.dem_par geo_WBs2 nz_WBs2 5.555555556e-4 3 2

#apply correction to the lookup table, resample simulated SAR image to RDC, resample DEM to RDC, and
```

```
#resample the SAR image to map coordinates and display
mk_geo nz_WBs2_20071020.mli nz_WBs2_20071020.mli.par DEM/nz.dem DEM/nz.dem_par geo_WBs2/nz_WBs2.dem
geo_WBs2/nz_WBs2.dem_par geo_WBs2 nz_WBs2 5.555555556e-4 4 2

#split DEM in RDC into a DEM for each individual beam. Create a tab file containing names of the DEMs
in RDC for each of the beams. Copy and edit an existing tab file containing the MLI parameter filenames
cp MLI_WBs2_20071020_tab DEM_RDC_WBs2_20071020_tab

#edit file and assign names for each of the 5 output DEMs in RDC
gedit DEM_RDC_WBs2_20061231_tab
cat DEM_RDC_WBs2_20071020_tab
geo_WBs2/nz_WBs2_dem_3.mli    mli_WBs2/20071020_3.mli.par
geo_WBs2/nz_WBs2_dem_4.mli    mli_WBs2/20071020_4.mli.par
geo_WBs2/nz_WBs2_dem_5.mli    mli_WBs2/20071020_5.mli.par
```

The output from running the mk_geo script are the following files:

```
terrain geocoded SAR image: geo_WBs2/nz_WBs2_map.mli
terrain geocoded SAR image raster file: geo_WBs2/nz_WBs2_map.mli.ras
terrain geocoded SAR image DEM parameter file: geo_WBs2/nz_WBs2.dem_par
DEM in SAR RDC coordinates: geo_WBs2/nz_WBs2_dem.rdc
DEM in SAR RDC coordinates raster image: geo_WBs2/nz_WBs2_dem.rdc.ras
```

The file geo_WBs2/nz_WBs2_dem.rdc is necessary for SLC resampling using a lookup table taking into account the local terrain.

2.7 SLC Coregistration and Resampling using Terrain Elevation

The next step is to extract the DEM data resampled to slant-range geometry for each of the beams. Each of the SLC images is resampled separately since the SLC itself is not mosaicked, but only the MLI, interferometric correlation, and differential phase in the MLI geometry. The program split_WB has the following command line arguments:

```
$ split_WB
*** ISP: Program split_WB.c ***
*** Copyright 2011, Gamma Remote Sensing, v1.2 5-Apr-2011 clw ***
*** Split WB mosaic image into individual beams using ISP parameter files ***

usage: split_WB <data_in> <data_par_in> <data_tab> <dtype>

input parameters:
  data_in      (input) input mosaicked data in slant-range geometry (e.g. DEM data)
  data_par_in  (input) ISP image parameter file for data in the input mosaic
  data_tab     (input) 2 column list of output data filenames and ISP image parameter files for each
                       beam in the mosaic (text)
  dtype        (input) input data type:
                         0: FLOAT
                         1: FCOMPLEX
```

Input to this program is the input mosaic in RDC geometry. The output is written to a set of files listed in the data_tab. In this example the data_tab is called DEM_RDC_WBs2_20071020_tab and contains the following :

```
cat DEM_RDC_WBs2_20071020_tab
geo_WBs2/nz_WBs2_dem_3.rdc    mli_WBs2/20071020_3.mli.par
geo_WBs2/nz_WBs2_dem_4.rdc    mli_WBs2/20071020_4.mli.par
geo_WBs2/nz_WBs2_dem_5.rdc    mli_WBs2/20071020_5.mli.par
```

The first column of the data_tab contains the output file name for each of the DEM segments and the second column contains the MLI parameter file describing the geometry of the segment to be extracted from the DEM mosaic. This processing approach avoids seams in the DEMs for each beam.

```
split_WB geo_WBs2/nz_WBs2_dem.rdc nz_WBs2_20071020.mli.par DEM_RDC_WBs2_20071020_tab
*** ISP: Program split_WB.c ***
*** Copyright 2011, Gamma Remote Sensing, v1.2 5-Apr-2011 clw ***
*** Split WB mosaic image into individual beams using ISP parameter files ***

input mosaic file: geo_WBs2/nz_WBs2_dem.rdc
input image parameter file: nz_WBs2_20071020.mli.par
mosaic width: 4154   lines: 7084
near_range (m): 820531.433  far_range (m): 937281.854  swath_width (m):116750.421  samples:4154
slant range pixel spacing (m): 28.10554    azimuth pixel spacing (m): 50.93155
mosaic image start time: 79428.66267
list of data files and image parameter files (text): geo_WBs2/nz_WBs2_dem.rdc
number of output data files: 3

output file   1: geo_WBs2/nz_WBs2_dem_3.mli  mli_WBs2/20071020_3.mli.par
output file   2: geo_WBs2/nz_WBs2_dem_4.mli  mli_WBs2/20071020_4.mli.par
output file   3: geo_WBs2/nz_WBs2_dem_5.mli  mli_WBs2/20071020_5.mli.par

beam: 1 image data type: FLOAT
r0 (m): 820531.433  r2 (m): 870418.770  nr:  1776  rpix (m): 28.105542  t0 (s): 79428.662668  nlines:
7084

beam: 2 image data type: FLOAT
r0 (m): 863251.409  r2 (m): 904426.027  nr:  1466  rpix (m): 28.105542  t0 (s): 79428.662668  nlines:
7084

beam: 3 image data type: FLOAT
r0 (m): 893717.967  r2 (m): 937253.452  nr:  1550  rpix (m): 28.105542  t0 (s): 79428.662668  nlines:
7084

beam: 1  near_range (m): 820531.433  max_range (m): 870418.770  swath_width (m):  49887.337  samples:
1776  samples offset:     0
beam: 2  near_range (m): 863251.409  max_range (m): 904426.027  swath_width (m):  41174.619  samples:
1466  samples offset:  1520
beam: 3  near_range (m): 893717.967  max_range (m): 937253.452  swath_width (m):  43535.485  samples:
1550  samples offset:  2604

output line: 0
output line: 2000
output line: 4000
output line: 6000
```

```
user time (s):          1.070
system time (s):        0.110
elapsed time (s):       1.190
```

Now we are ready to resample the SLC data. For each beam a SLC_tab containing the list of SLCs to be coregisted must be given. Use mk_tab as follows to create these SLC_tab files for each beam:

```
#resample SLC data, first make SLC tab files for each beam
$ mk_tab slc_WBs2 3.slc  3.slc.par SLC_WBs2_3_tab
SLC_WBs2_3_tab:
slc_WBs2/20071020_3.slc       slc_WBs2/20071020_3.slc.par
slc_WBs2/20101028_3.slc       slc_WBs2/20101028_3.slc.par

cw@gamma01 /media/d2/PALSAR_ScanSAR_NZ
$ mk_tab slc_WBs2 4.slc  4.slc.par SLC_WBs2_4_tab
SLC_WBs2_4_tab:
slc_WBs2/20071020_4.slc       slc_WBs2/20071020_4.slc.par
slc_WBs2/20101028_4.slc       slc_WBs2/20101028_4.slc.par

cw@gamma01 /media/d2/PALSAR_ScanSAR_NZ
$ mk_tab slc_WBs2 5.slc  5.slc.par SLC_WBs2_5_tab
SLC_WBs2_5_tab:
slc_WBs2/20071020_5.slc       slc_WBs2/20071020_5.slc.par
slc_WBs2/20101028_5.slc       slc_WBs2/20101028_5.slc.par
```

The details of using SLC_resamp_lt_all are given in the HTML documentation for this script in the DIFF/html directory (DIFF/html/SLC_resample_lt_all.html). The script receives as input the SLC_tab and the parameters of the reference scene, MLI parameter file and DEM in this geometry. Output is written to a new directory rslc_WBs2 and a RSLC_WBS2_*_tab file for each SLC beam. The SLC_resamp_lt_all script runs in several steps, called modes. Since there are 3 different beams, the script processing sequence through the different modes is repeated 3 times, once for each beam. A log file detailing the processing of each beam is kept in the rslc_WB2 directory. The log file for beam 4 20071020_4_20101028_4_resamp_lt.log is listed in:

Appendix 4: SLC coregistration using a terrain model

The processing steps are as follows:

```
#MODE 0: copy reference scene and generate DIFF parameter files, generate lookup table, and resample
MLI-1 into the geometry of MLI-2

SLC_resamp_lt_all SLC_WBs2_3_tab slc_WBs2/20071020_3.slc slc_WBs2/20071020_3.slc.par
mli_WBs2/20071020_3.mli.par geo_WBs2/nz_WBs2_dem_3.rdc mli_WBs2 rslc_WBs2 RSLC_WBs2_3_tab 0 0

SLC_resamp_lt_all SLC_WBs2_4_tab slc_WBs2/20071020_4.slc slc_WBs2/20071020_4.slc.par
mli_WBs2/20071020_4.mli.par geo_WBs2/nz_WBs2_dem_4.rdc mli_WBs2 rslc_WBs2 RSLC_WBs2_4_tab 0 0

SLC_resamp_lt_all SLC_WBs2_5_tab slc_WBs2/20071020_5.slc slc_WBs2/20071020_5.slc.par
mli_WBs2/20071020_5.mli.par geo_WBs2/nz_WBs2_dem_5.rdc mli_WBs2 rslc_WBs2 RSLC_WBs2_5_tab 0 0

#MODE 1: measure offsets between MLI-1 resampled into MLI-2 geometry using the DIFF tools, generate
#offset polynomials, and update lookup table relating SLC-2 to the reference SLC
SLC_resamp_lt_all SLC_WBs2_3_tab slc_WBs2/20071020_3.slc slc_WBs2/20071020_3.slc.par
mli_WBs2/20071020_3.mli.par geo_WBs2/nz_WBs2_dem_3.rdc mli_WBs2 rslc_WBs2 RSLC_WBs2_3_tab 1 0

SLC_resamp_lt_all SLC_WBs2_4_tab slc_WBs2/20071020_4.slc slc_WBs2/20071020_4.slc.par
mli_WBs2/20071020_4.mli.par geo_WBs2/nz_WBs2_dem_4.rdc mli_WBs2 rslc_WBs2 RSLC_WBs2_4_tab 1 0

SLC_resamp_lt_all SLC_WBs2_5_tab slc_WBs2/20071020_5.slc slc_WBs2/20071020_5.slc.par
mli_WBs2/20071020_5.mli.par geo_WBs2/nz_WBs2_dem_5.rdc mli_WBs2 rslc_WBs2 RSLC_WBs2_5_tab 1 0

#MODE 2: resample SLC-2 into SLC-1 geometry for each of the 3 beams
SLC_resamp_lt_all SLC_WBs2_3_tab slc_WBs2/20071020_3.slc slc_WBs2/20071020_3.slc.par
mli_WBs2/20071020_3.mli.par geo_WBs2/nz_WBs2_dem_3.rdc mli_WBs2 rslc_WBs2 RSLC_WBs2_3_tab 2 0

SLC_resamp_lt_all SLC_WBs2_4_tab slc_WBs2/20071020_4.slc slc_WBs2/20071020_4.slc.par
mli_WBs2/20071020_4.mli.par geo_WBs2/nz_WBs2_dem_4.rdc mli_WBs2 rslc_WBs2 RSLC_WBs2_4_tab 2 0

SLC_resamp_lt_all SLC_WBs2_5_tab slc_WBs2/20071020_5.slc slc_WBs2/20071020_5.slc.par
mli_WBs2/20071020_5.mli.par geo_WBs2/nz_WBs2_dem_5.rdc mli_WBs2 rslc_WBs2 RSLC_WBs2_5_tab 2 0

#MODE 3: measure the residual offsets between the SLCS using the ISP tools,
#calculate SLC offset polynomial
SLC_resamp_lt_all SLC_WBs2_3_tab slc_WBs2/20071020_3.slc slc_WBs2/20071020_3.slc.par
mli_WBs2/20071020_3.mli.par geo_WBs2/nz_WBs2_dem_3.rdc mli_WBs2 rslc_WBs2 RSLC_WBs2_3_tab 3 0
```

```
SLC_resamp_lt_all SLC_WBs2_4_tab slc_WBs2/20071020_4.slc slc_WBs2/20071020_4.slc.par
mli_WBs2/20071020_4.mli.par geo_WBs2/nz_WBs2_dem_4.rdc mli_WBs2 rslc_WBs2 RSLC_WBs2_4_tab 3 0

SLC_resamp_lt_all SLC_WBs2_5_tab slc_WBs2/20071020_5.slc slc_WBs2/20071020_5.slc.par
mli_WBs2/20071020_5.mli.par geo_WBs2/nz_WBs2_dem_5.rdc mli_WBs2 rslc_WBs2 RSLC_WBs2_5_tab 3 0

#MODE 4: resample SLC-2 into SLC-1 geometry using lookup table and SLC offset polynomials, measure
residual offsets
SLC_resamp_lt_all SLC_WBs2_3_tab slc_WBs2/20071020_3.slc slc_WBs2/20071020_3.slc.par
mli_WBs2/20071020_3.mli.par geo_WBs2/nz_WBs2_dem_3.rdc mli_WBs2 rslc_WBs2 RSLC_WBs2_3_tab 4 0

SLC_resamp_lt_all SLC_WBs2_4_tab slc_WBs2/20071020_4.slc slc_WBs2/20071020_4.slc.par
mli_WBs2/20071020_4.mli.par geo_WBs2/nz_WBs2_dem_4.rdc mli_WBs2 rslc_WBs2 RSLC_WBs2_4_tab 4 0

SLC_resamp_lt_all SLC_WBs2_5_tab slc_WBs2/20071020_5.slc slc_WBs2/20071020_5.slc.par
mli_WBs2/20071020_5.mli.par geo_WBs2/nz_WBs2_dem_5.rdc mli_WBs2 rslc_WBs2 RSLC_WBs2_5_tab 4 0
```

2.8 Generation of Differential Interferograms and Correlation Coefficient Maps

The next processing step is generating the interferograms and correlation maps for each of the 3 beams. To do this first generate the SLC_tab files for the resampled SLCs for each beam using the mk_tab script.

```
#Generate RSLC_tab files for beams 3,4, and 5

$ mk_tab rslc_WBs2 3.rslc 3.rslc.par RSLC_WBs2_3_tab
RSLC_WBs2_3_tab:
rslc_WBs2/20071020_3.rslc     rslc_WBs2/20071020_3.rslc.par
rslc_WBs2/20101028_3.rslc     rslc_WBs2/20101028_3.rslc.par

cw@gamma01 /media/d2/PALSAR_ScanSAR_NZ
$ mk_tab rslc_WBs2 4.rslc 4.rslc.par RSLC_WBs2_4_tab
RSLC_WBs2_4_tab:
rslc_WBs2/20071020_4.rslc     rslc_WBs2/20071020_4.rslc.par
rslc_WBs2/20101028_4.rslc     rslc_WBs2/20101028_4.rslc.par

cw@gamma01 /media/d2/PALSAR_ScanSAR_NZ
$ mk_tab rslc_WBs2 5.rslc 5.rslc.par RSLC_WBs2_5_tab
RSLC_WBs2_5_tab:
rslc_WBs2/20071020_5.rslc     rslc_WBs2/20071020_5.rslc.par
rslc_WBs2/20101028_5.rslc     rslc_WBs2/20101028_5.rslc.par
```

Then run mk_mli_all to generate the MLI images of the SLCs using 3 range looks and 16 azimuth looks for each beam. The intensity scale factor is set to a lower than nominal value of 0.6 because of the low backscatter of the ocean leads to saturation of the land. Since the images are coregistered, an average image can be produced for each beam further reducing speckle noise in the multi-look product. Documentation for mk_mli_all is in DIFF/html/mk_mli_all.html.

```
mk_mli_all RSLC_WBs2_3_tab rmli_WBs2 3 16 1 .6 .4 rmli_WBs2_3.ave
mk_mli_all RSLC_WBs2_4_tab rmli_WBs2 3 16 1 .6 .4 rmli_WBs2_4.ave
mk_mli_all RSLC_WBs2_5_tab rmli_WBs2 3 16 1 .6 .4 rmli_WBs2_5.ave

#display results
eog rmli_WBs2/*ave.ras
```

Generating the differential interferograms for each beam requires an ITAB file that defines the entries in the SLC_tab used to calculate the differential interferograms. In this case there are only 2 SLCs in the stack from each beam. Each line of the ITAB corresponds to a single interferogram. The entry in column 1 is the line number of the SLC used as the reference scene. Column 2 is the line number of the SLC in the SLC_tab for the second SLC in the interferometric pair. The 3rd column is line counter and is ignored. The last column of the ITAB file is a entry used by some some programs to determine if the interferogram should be considered in the current processing step. If the value is 1, then it will be considered, and if 0, then it will be ignored.

The same ITAB file can be used for processing all 3 beams of the SCANSAR-SCANSAR data set and looks as follows:

```
#create itab_WB in a text editor, it contains 1 line for the single interferogram
$ cat itab_WB
1 2 1 1
```

A series of scripts have been developed for processing of stacks of differential interferograms. Documentation for these scripts can be found in the DIFF HTML documentation DIFF/html/DIFF_reference_manual.html Each of these scripts generates a log file containing the commands and screen output. In the case of mk_diff_orb_2d, the entries in the ITAB file are used to calculate the interferograms. The DIFF/GEO program phase_sim_orb is used to calculate a simulated interferogram using the state-vector information alone. The DIFF program SLC_diff_intf calculates the differential

interferogram directly from the simulated phase and the coregistered SLC data. The satellite positions are calculated for every point in the interferogram using the DEM, state-vectors and the processing parameters. The commands used for processing the SLCS to form the Differential interferogram as well as the screen output for beam 4 is given in:

Appendix 5 Differential Interferometric Processing

Listed here are the commands with comments:

```
#calculate differential interferograms for beams 3,4 and 5
mk_diff_orb_2d RSLC_WBs2_3_tab itab_WB geo_WBs2/nz_WBs2_dem_3.rdc - rmli_WBs2/rmli_WBs2_3.ave rmli_WBs2
diff0_orb_2d_WBs2 3 16 7 1 0

mk_diff_orb_2d RSLC_WBs2_4_tab itab_WB geo_WBs2/nz_WBs2_dem_4.rdc - rmli_WBs2/rmli_WBs2_4.ave rmli_WBs2
diff0_orb_2d_WBs2 3 16 7 1 0

mk_diff_orb_2d RSLC_WBs2_5_tab itab_WB geo_WBs2/nz_WBs2_dem_5.rdc - rmli_WBs2/rmli_WBs2_5.ave rmli_WBs2
diff0_orb_2d_WBs2 3 16 7 1 0

#generate a a 2 column table of differential interferograms in MLI geometry and the MLI parameter files
#as input for mosiac_WB. Note, since the data are in different directories, the mk_tab script cannot
#be used.
/bin/ls -1 diff0_orb_2d_WBs2/*.diff > q1
/bin/ls -1 rmli_WBs2/20071020_[3-5].rmli.par > q2
paste q1 q2 > DIFF0_ORB_2D_WBs2_tab

#display the tab file for mosaicking the 3 differential interferograms
cat DIFF0_ORB_2D_WBs2_tab
diff0_orb_2d_WBs2/20071020_3_20101028_3.diff rmli_WBs2/20071020_3.rmli.par
diff0_orb_2d_WBs2/20071020_4_20101028_4.diff rmli_WBs2/20071020_4.rmli.par
diff0_orb_2d_WBs2/20071020_5_20101028_5.diff rmli_WBs2/20071020_5.rmli.par

#generate a a 2 column table of correlation maps in MLI geometry and the MLI parameter files
#as input for mosiac_WB. Note, since the data are in different directories, the mk_tab script cannot
#be used.
/bin/ls -1 diff0_orb_2d_WBs2/*.cc > q1
/bin/ls -1 rmli_WBs2/20071020_[3-5].rmli.par > q2
paste q1 q2 > CC_ORB_2D_WBs2_tab

#display the tab file for mosaicking the 3 correlation maps:
$ cat CC_ORB_2D_WBs2_tab
diff0_orb_2d_WBs2/20071020_3_20101028_3.cc   rmli_WBs2/20071020_3.rmli.par
diff0_orb_2d_WBs2/20071020_4_20101028_4.cc   rmli_WBs2/20071020_4.rmli.par
diff0_orb_2d_WBs2/20071020_5_20101028_5.cc   rmli_WBs2/20071020_5.rmli.par
```

2.9 Mosaic Differential Interferograms and Correlation Coefficient Maps

```
#mosaic the differential interferograms and generate the raster image
mosaic_WB DIFF0_ORB_2D_WBs2_tab 1 nz_orb_WBs2.diff nz_20071020.mli.par 0
rasmph_pwr nz_orb_WBs2.diff nz_WBs2_20071020.mli 4154 1 1 0 1 1 .7 .35

#mosaic the correlation coefficient and generate the raster image
mosaic_WB CC_ORB_2D_WBs2_tab 0 nz_orb_WBs2.cc sc_20061231.mli.par 0
rascc nz_orb_WBs2.cc nz_WBs2_20071020.mli 4154 1 1 0 1 1 .1 .8 .7 .35
eog nz_orb_WBs2.cc.ras nz_orb_WBs2.diff.ras

#iteratively filter the mosaicked images using adf with filter windows of 64, 32, and 16 pixels
#this gives a better result that filtering once with a large exponent.
adf nz_orb_WBs2.diff      nz_orb_WBs2.adf1.diff nz_orb_WBs2.adf.cc 4154 .3 64 7 8 0 0 .25
adf nz_orb_WBs2.adf1.diff nz_orb_WBs2.adf2.diff nz_orb_WBs2.adf.cc 4154 .3 32 7 4 0 0 .25
adf nz_orb_WBs2.adf2.diff nz_orb_WBs2.adf3.diff nz_orb_WBs2.adf.cc 4154 .3 16 7 2 0 0 .25

#generate display products in slant-range geometry and display
rasmph_pwr nz_orb_WBs2.adf3.diff nz_WBs2_20071020.mli 4154 1 1 0 1 1 .7 .35

rascc nz_orb_WBs2.adf.cc nz_WBs2_20071020.mli 4154 1 1 0 1 1 .1 .8 .7 .35

#differential interferometric phase
disras nz_orb_WBs2.adf3.diff.ras
eog nz_orb_WBs2.adf3.diff.ras

#correlation map
disras nz_orb_WBs2.cc.ras
eog nz_orb_WBs2.cc.ras
```

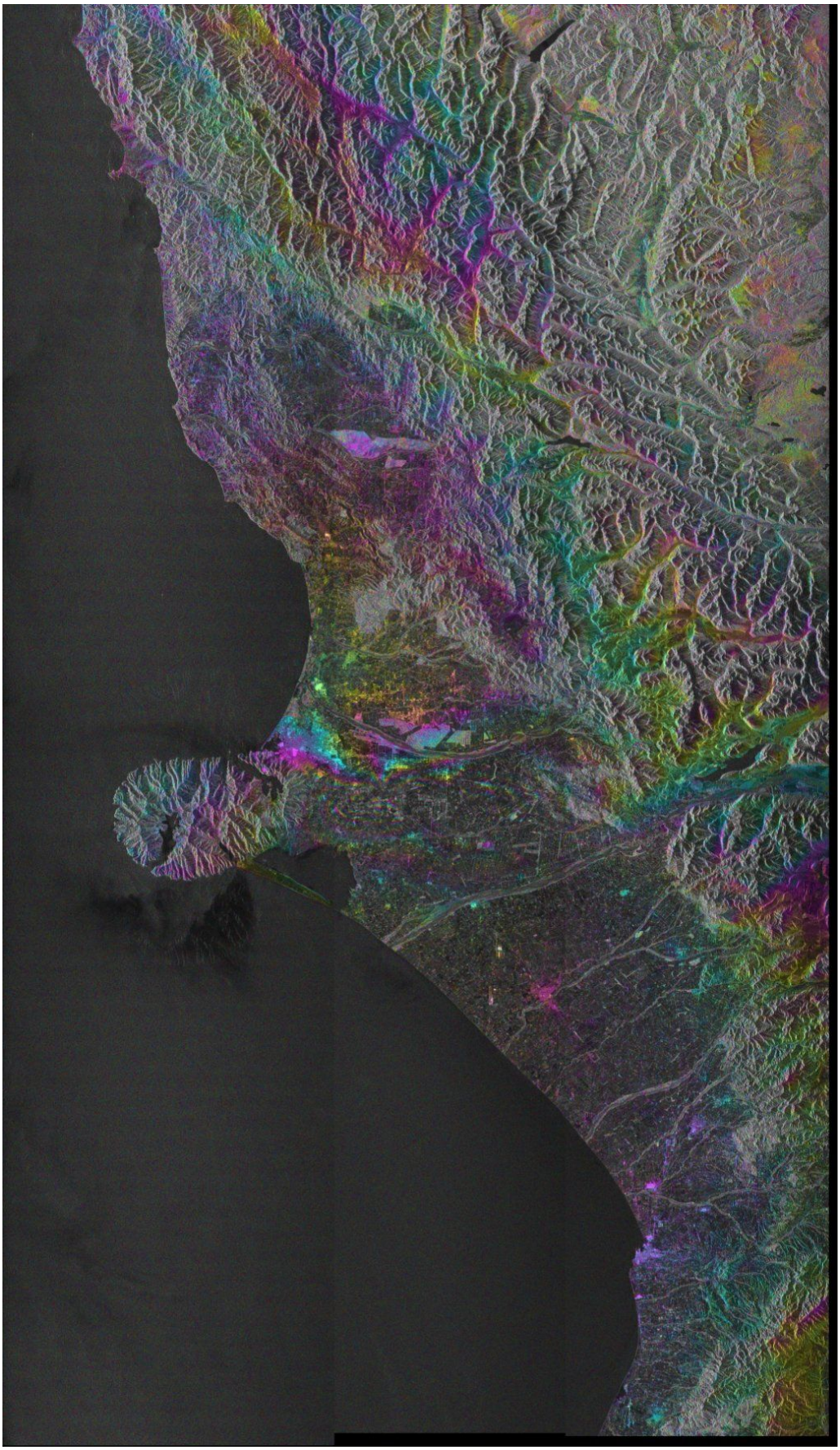

Illustration 2: Multi-beam Differential interferogram mosaic of PALSAR differential interferometric pair 20071020-20101028 in slant-range coordinates One fringe is equivalent to 0.117 meters motion along the LOS.

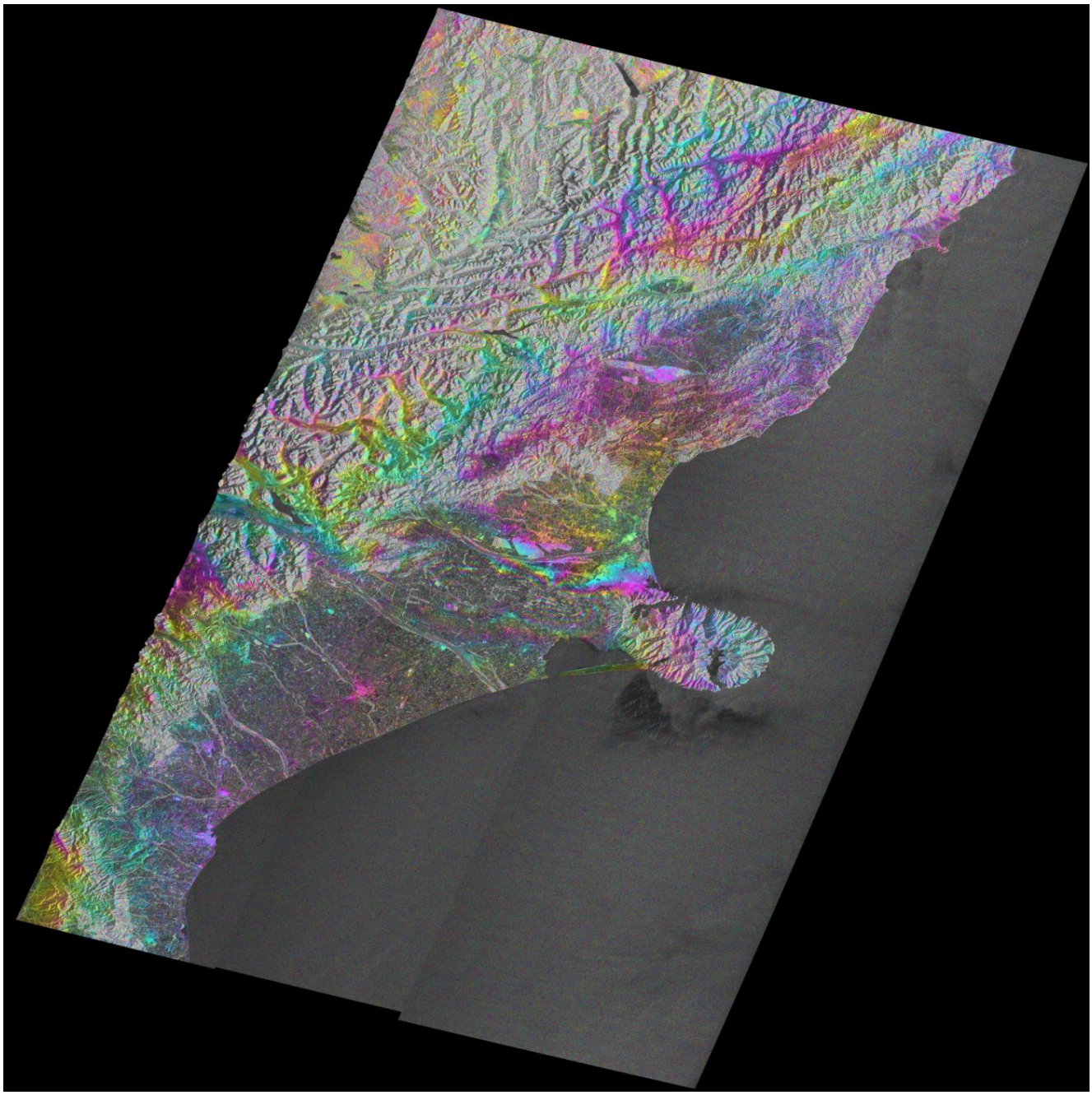

Illustration 3: Multi-beam Differential interferogram mosaic of PALSAR differential interferometric pair 20071020-20101028 in lat/lon geographic coordinates. One fringe is equivalent to 0.117 meters motion along the LOS.

2.10 Terrain Geocoding of Mosaics of Differential Phase and Correlation Coefficient

The differential interferogram and correlation map of the multi-beam mosaic can be terrain geocoded using the lookup table generated when mosaiking the MLI images. The script mk_geo_data (see mk_geo documentation) can be used to resample the mosaicked differential interferogram and correlation map.

```
#terrain geocode differential interferogram mosaic
mk_geo_data nz_WBs2_20071020.mli.par geo_WBs2/nz_WBs2.dem_par geo_WBs2/nz_WBs2_1.map_to_rdc
nz_orb_WBs2.adf3.diff geo_WBs2/nz_orb_WBs2_map.adf.diff 3 1 mk_geo_data_adf.log

rasmph_pwr geo_WBs2/nz_orb_WBs2_map.adf.diff geo_WBs2/nz_WBs2_map.mli  6548 1 1 0 1 1 1.1 .3

disras geo_WBs2/nz_orb_WBs2_map.adf.diff.ras


#terrain geocode correlation coefficient interferogram mosaic
mk_geo_data nz_WBs2_20071020.mli.par geo_WBs2/nz_WBs2.dem_par geo_WBs2/nz_WBs2_1.map_to_rdc
nz_orb_WBs2.adf.cc geo_WBs2/nz_orb_WBs2_map.adf.cc 3 0 mk_geo_data_cc.log

rascc geo_WBs2/nz_orb_WBs2_map.adf.cc geo_WBs2/nz_WBs2_map.mli 6548 1 1 0 1 1 .1 .8 1.1 .3

disras geo_WBs2/nz_orb_WBs2_map.adf.cc.ras

#convert to jpeg format using Imagemagick convert utility
convert geo_WBs2/nz_orb_WBs2_map.adf.diff.ras geo_WBs2/nz_orb_WBs2_map.diff.jpg

mk_kml geo_WBs2/nz_WBs2.dem_par geo_WBs2/nz_orb_WBs2_map.diff.jpg geo_WBs2/nz_orb_WBs2_map.diff.kml
```

3 Appendix 1: PALSAR_pre_proc_WB Commands and Output

Output from running the PALSAR_pre_proc_WB Commands

```
./PALSAR_pre_proc_WB CEOS_list_WB palsar_ant_20061024.dat raw_WB PALSAR_pre_proc_WB_1.log proc_list_WB
1 2150.537634

CEOS leader: 20071020/LED-ALPSRS092604500-W1.0__D   input CEOS raw data file: 20071020/IMG-HH-
ALPSRS092604500-W1.0__D


PALSAR_proc_WB 20101028/LED-ALPSRS253644500-W1.0__D raw_WB/20101028_4.sar_par
raw_WB/p20101028_4.slc.par 20101028/IMG-HH-ALPSRS253644500-W1.0__D 4 raw_WB/20101028_4.raw 2150.537634
*** PALSAR ScanSAR raw data pre-processing and generation of the MSP processing parameters ***
*** Copyright 2011, Gamma Remote Sensing, v1.2 18-Mar-2011 clw ***
PALSAR scene identifier (orbit,frame): ALPSRS253644500
CEOS leader file descriptor record center time: 20101028220327669
Processing Facility: EORC
file header size: 720  line header size: 412
PALSAR center frequency (MHz): 1270.000
PALSAR wavlength (m):  0.2360571
SAR is right looking
ScanSAR beam: 4

total number of input data lines: 110689
input data record length (bytes): 11200
number of bytes of input SAR data per record (including right fill): 10788

line offset: 0  beam number: 4  initial value of the pulse repetition interval (PRI micro-sec): 469
PRF calculated from PRI: 2132.19616205  AUX data value: 2132.19600000
initial value of the slant range to the first sample (m): 863955
number of pulses in the air (double, int):  12.289312  12
initial value of the range delay to the first sample (micro-sec): 144
slant range to first sample from timing (m): 863954.588
number of echoes in the different beams (1-->5): 247  356  274  355  327
pulses per ScanSAR cycle: 1559

new max value for starting slant range at line offset: 48329  range gate: 151  range (m): 865004
new max value for starting slant range at line offset:106012  range gate: 157  range (m): 865903
valid WB ScanSAR data begins at line offset: 0
line offset to the start of beam 1 burst: 682
beam: 1  record:   682  beam:     1  pn_scch: 1  rho (m): 744188.0  PRI (s): 5.9900000e-04  PRF (Hz):
1669.44900
beam: 2  record:   929  beam:     2  pn_scch: 1  rho (m): 784060.0  PRI (s): 4.2700000e-04  PRF (Hz):
2341.92000
beam: 3  record:  1285  beam:     3  pn_scch: 1  rho (m): 821234.0  PRI (s): 5.9100000e-04  PRF (Hz):
1692.04700
beam: 4  record:  1559  beam:     4  pn_scch: 1  rho (m): 863955.0  PRI (s): 4.6900000e-04  PRF (Hz):
2132.19600
beam: 5  record:  1914  beam:     5  pn_scch: 1  rho (m): 894384.0  PRI (s): 5.2900000e-04  PRF (Hz):
1890.35900
output data PRF: 2150.537634
NOTE: change in slant range to first sample of beam 4 observed (m) min.: 863955  max.: 865903

PRF for data in burst 1 for beam 4: 2132.196162
PRF of output resampled raw data: 2150.537634
starting line offset to start of WB SAR mode image data: 0
initial SAR data pixels (samples)/line: 4432
initial right fill zero (samples): 962
number of observation mode data lines: 110689
number of missing lines in the data: 0

chirp bandwidth (Hz):        1.4000e+07
chirp duration (s):          2.7000e-05
ADC sample frequency (Hz):   1.6000e+07
range pixel spacing (m):     9.36851431
slant range delay (microsec)  min.: 863955   max.: 865903
slant range delay (microsec)  first: 144   last: 180
slant range of first sample from line header (m) first: 863955   last: 823033
range gate width (microsec) first: 277   last: 336

duration of data (s): 56.984752
time delay to first sample adjusted for range-gate shifts (s):   5.76369e-03
number of extra range samples due to shifts in the range gate: 208
total number of echo samples in the output data: 4640
output raw data record length (bytes): 9692
maximum number of echoes in a burst: 356
```

```
burst window weighting flag: 0
data start time (millisec) : 79379278
lstr: 0  msod: 79379278  Mpps: 278050  Mpps mod 1000: 50
raw data start time year, month, day: 2010 10 28
raw data start time (s): 79379.278050
raw data center time (s): 79407.769995
raw data start time (hrs,min,sec): 022  0 2  59.278050
time interval between state vectors (s): 60.000000
state vectors stored in parameter file: 15
time of first state vector in the CEOS leader UTC (s):   78660.0000

Rotating Earth-Fixed Reference Frame Position Vectors:
time (UTC s):   78660.0000 rotating position x,y,z (m):  -6978751.647   -1163606.141      50475.667
time (UTC s):   78720.0000 rotating position x,y,z (m):  -6983488.565   -1068441.490    -395234.752
time (UTC s):   78780.0000 rotating position x,y,z (m):  -6959193.395    -969050.707    -839338.665
time (UTC s):   78840.0000 rotating position x,y,z (m):  -6905938.003    -866089.650   -1280031.707
time (UTC s):   78900.0000 rotating position x,y,z (m):  -6823917.841    -760227.295   -1715524.575
time (UTC s):   78960.0000 rotating position x,y,z (m):  -6713451.077    -652141.909   -2144050.426
time (UTC s):   79020.0000 rotating position x,y,z (m):  -6574977.182    -542517.220   -2563872.198
time (UTC s):   79080.0000 rotating position x,y,z (m):  -6409054.960    -432038.562   -2973289.817
time (UTC s):   79140.0000 rotating position x,y,z (m):  -6216359.957    -321389.014   -3370647.195
time (UTC s):   79200.0000 rotating position x,y,z (m):  -5997681.366    -211245.576   -3754338.945
time (UTC s):   79260.0000 rotating position x,y,z (m):  -5753918.444    -102275.426   -4122816.833
time (UTC s):   79320.0000 rotating position x,y,z (m):  -5486076.472       4867.731   -4474595.954
time (UTC s):   79380.0000 rotating position x,y,z (m):  -5195262.260     109547.212   -4808260.586
time (UTC s):   79440.0000 rotating position x,y,z (m):  -4882679.273     211146.788   -5122469.730
time (UTC s):   79500.0000 rotating position x,y,z (m):  -4549622.343     309073.974   -5415962.318
time (UTC s):   79560.0000 rotating position x,y,z (m):  -4197472.003     402763.133   -5687562.025
time (UTC s):   79620.0000 rotating position x,y,z (m):  -3827688.525     491678.412   -5936181.708
time (UTC s):   79680.0000 rotating position x,y,z (m):  -3441805.660     575316.499   -6160827.447
time (UTC s):   79740.0000 rotating position x,y,z (m):  -3041424.144     653209.185   -6360602.175
time (UTC s):   79800.0000 rotating position x,y,z (m):  -2628205.032     724925.723   -6534708.969
time (UTC s):   79860.0000 rotating position x,y,z (m):  -2203862.761     790074.975   -6682454.013
time (UTC s):   79920.0000 rotating position x,y,z (m):  -1770157.994     848307.339   -6803249.077
time (UTC s):   79980.0000 rotating position x,y,z (m):  -1328890.379     899316.464   -6896613.574
time (UTC s):   80040.0000 rotating position x,y,z (m):   -881891.189     942840.718   -6962176.244
time (UTC s):   80100.0000 rotating position x,y,z (m):   -431015.869     978664.415   -6999676.439
time (UTC s):   80160.0000 rotating position x,y,z (m):     21863.444    1006618.812   -7008965.043
time (UTC s):   80220.0000 rotating position x,y,z (m):    474865.481    1026582.853   -6990005.080
time (UTC s):   80280.0000 rotating position x,y,z (m):    926107.530    1038483.679   -6942871.955
index of state vector closest to image center time: 5

interpolated state vectors:
time (UTC s):   78960.0000
position x,y,z (m)  :  -6713451.077    -652141.909   -2144050.426
velocity x,y,z (m/s):     2075.8933      1816.1542     -7074.3413

time (UTC s):   79020.0000
position x,y,z (m)  :  -6574977.182    -542517.220   -2563872.198
velocity x,y,z (m/s):     2538.3503      1836.0973     -6914.9934

time (UTC s):   79080.0000
position x,y,z (m)  :  -6409054.960    -432038.562   -2973289.817
velocity x,y,z (m/s):     2990.5131      1844.6261     -6727.6585

time (UTC s):   79140.0000
position x,y,z (m)  :  -6216359.957    -321389.014   -3370647.195
velocity x,y,z (m/s):     3430.4605      1841.8105     -6513.1263

time (UTC s):   79200.0000
position x,y,z (m)  :  -5997681.366    -211245.576   -3754338.945
velocity x,y,z (m/s):     3856.3268      1827.7831     -6272.2963

time (UTC s):   79260.0000
position x,y,z (m)  :  -5753918.444    -102275.426   -4122816.833
velocity x,y,z (m/s):     4266.3102      1802.7384     -6006.1735

time (UTC s):   79320.0000
position x,y,z (m)  :  -5486076.472       4867.731   -4474595.954
velocity x,y,z (m/s):     4658.6797      1766.9307     -5715.8630

time (UTC s):   79380.0000
position x,y,z (m)  :  -5195262.260     109547.212   -4808260.586
velocity x,y,z (m/s):     5031.7829      1720.6727     -5402.5649

time (UTC s):   79440.0000
```

```
position x,y,z (m)  :  -4882679.273     211146.788   -5122469.730
velocity x,y,z (m/s):     5384.0516      1664.3332     -5067.5689

time (UTC s):   79500.0000
position x,y,z (m)  :  -4549622.343     309073.974   -5415962.318
velocity x,y,z (m/s):     5714.0095      1598.3343     -4712.2485

time (UTC s):   79560.0000
position x,y,z (m)  :  -4197472.003     402763.133   -5687562.025
velocity x,y,z (m/s):     6020.2770      1523.1484     -4338.0541

time (UTC s):   79620.0000
position x,y,z (m)  :  -3827688.525     491678.412   -5936181.708
velocity x,y,z (m/s):     6301.5766      1439.2954     -3946.5068

time (UTC s):   79680.0000
position x,y,z (m)  :  -3441805.660     575316.499   -6160827.447
velocity x,y,z (m/s):     6556.7372      1347.3396     -3539.1917

time (UTC s):   79740.0000
position x,y,z (m)  :  -3041424.144     653209.185   -6360602.175
velocity x,y,z (m/s):     6784.6973      1247.8862     -3117.7513

time (UTC s):   79800.0000
position x,y,z (m)  :  -2628205.032     724925.723   -6534708.969
velocity x,y,z (m/s):     6984.5087      1141.5781     -2683.8805

number of state vectors copied: 15
SAR position at center time x,y,z (m):  -5053218.101    156990.237  -4956183.882
SAR velocity at center time x,y,z (m/s):    5197.5062    1695.8257   -5250.1335
S/C radial distance from earth center (m):   7079789.3881
raw data center latitude, longitude (deg.):   -43.364202    172.229803
geocentric Earth radius at scene center(m):  6368299.588
SAR average altitude above terrain (m):       711489.800
nominal look angle at center swath (deg.):       34.3601

number of echoes in the resampled output burst: 359
burst 1 offset to start of burst (lines): 0   nominal burst length: 355
number of invalid pulses at start of burst: 13

reading burst:   2  output_record:    359  output_time (s):   0.16694  SAR data offset: 1559  prf: 2132.19616
reading burst:   3  output_record:   2082  output_time (s):   0.96813  SAR data offset: 3118  prf: 2132.19616
reading burst:   4  output_record:   3805  output_time (s):   1.76933  SAR data offset: 4677  prf: 2132.19616
reading burst:   5  output_record:   5529  output_time (s):   2.57099  SAR data offset: 6236  prf: 2132.19616
reading burst:   6  output_record:   7252  output_time (s):   3.37218  SAR data offset: 7795  prf: 2132.19616
reading burst:   7  output_record:   8976  output_time (s):   4.17384  SAR data offset: 9354  prf: 2132.19616
reading burst:   8  output_record:  10699  output_time (s):   4.97504  SAR data offset: 10913  prf: 2132.19616
reading burst:   9  output_record:  12422  output_time (s):   5.77623  SAR data offset: 12472  prf: 2132.19616
reading burst:  10  output_record:  14146  output_time (s):   6.57789  SAR data offset: 14031  prf: 2132.19616
reading burst:  11  output_record:  15869  output_time (s):   7.37909  SAR data offset: 15590  prf: 2132.19616
reading burst:  12  output_record:  17592  output_time (s):   8.18028  SAR data offset: 17149  prf: 2132.19616
reading burst:  13  output_record:  19316  output_time (s):   8.98194  SAR data offset: 18708  prf: 2132.19616
reading burst:  14  output_record:  21039  output_time (s):   9.78314  SAR data offset: 20267  prf: 2132.19616
reading burst:  15  output_record:  22763  output_time (s):  10.58480  SAR data offset: 21826  prf: 2132.19616
reading burst:  16  output_record:  24486  output_time (s):  11.38599  SAR data offset: 23385  prf: 2132.19616
reading burst:  17  output_record:  26209  output_time (s):  12.18719  SAR data offset: 24944  prf: 2132.19616
reading burst:  18  output_record:  27933  output_time (s):  12.98885  SAR data offset: 26503  prf: 2132.19616
reading burst:  19  output_record:  29656  output_time (s):  13.79004  SAR data offset: 28062  prf: 2132.19616
reading burst:  20  output_record:  31380  output_time (s):  14.59170  SAR data offset: 29621  prf: 2132.19616
reading burst:  21  output_record:  33103  output_time (s):  15.39290  SAR data offset: 31180  prf: 2132.19616
reading burst:  22  output_record:  34826  output_time (s):  16.19409  SAR data offset: 32739  prf: 2132.19616
reading burst:  23  output_record:  36550  output_time (s):  16.99575  SAR data offset: 34298  prf: 2132.19616
reading burst:  24  output_record:  38273  output_time (s):  17.79695  SAR data offset: 35857  prf: 2132.19616
reading burst:  25  output_record:  39997  output_time (s):  18.59861  SAR data offset: 37416  prf: 2132.19616
reading burst:  26  output_record:  41720  output_time (s):  19.39980  SAR data offset: 38975  prf: 2132.19616
reading burst:  27  output_record:  43443  output_time (s):  20.20100  SAR data offset: 40534  prf: 2132.19616
reading burst:  28  output_record:  45167  output_time (s):  21.00266  SAR data offset: 42093  prf: 2132.19616
reading burst:  29  output_record:  46890  output_time (s):  21.80385  SAR data offset: 43652  prf: 2132.19616
reading burst:  30  output_record:  48614  output_time (s):  22.60551  SAR data offset: 45211  prf: 2132.19616
reading burst:  31  output_record:  50337  output_time (s):  23.40671  SAR data offset: 46770  prf: 2132.19616
reading burst:  32  output_record:  52060  output_time (s):  24.20790  SAR data offset: 48329  prf: 2132.19616
reading burst:  33  output_record:  53788  output_time (s):  25.01142  SAR data offset: 49888  prf: 2132.19616
reading burst:  34  output_record:  55516  output_time (s):  25.81494  SAR data offset: 51447  prf: 2132.19616
reading burst:  35  output_record:  57244  output_time (s):  26.61846  SAR data offset: 53006  prf: 2132.19616
reading burst:  36  output_record:  58972  output_time (s):  27.42198  SAR data offset: 54565  prf: 2132.19616
reading burst:  37  output_record:  60700  output_time (s):  28.22550  SAR data offset: 56124  prf: 2132.19616
reading burst:  38  output_record:  62428  output_time (s):  29.02902  SAR data offset: 57683  prf: 2132.19616
reading burst:  39  output_record:  64156  output_time (s):  29.83254  SAR data offset: 59242  prf: 2132.19616
reading burst:  40  output_record:  65884  output_time (s):  30.63606  SAR data offset: 60801  prf: 2132.19616
reading burst:  41  output_record:  67612  output_time (s):  31.43958  SAR data offset: 62360  prf: 2132.19616
reading burst:  42  output_record:  69340  output_time (s):  32.24310  SAR data offset: 63919  prf: 2132.19616
reading burst:  43  output_record:  71068  output_time (s):  33.04662  SAR data offset: 65478  prf: 2132.19616
reading burst:  44  output_record:  72796  output_time (s):  33.85014  SAR data offset: 67037  prf: 2132.19616
```

```
reading burst:  45  output_record:  74524  output_time (s):  34.65366  SAR data offset: 68596  prf: 2132.19616
reading burst:  46  output_record:  76252  output_time (s):  35.45718  SAR data offset: 70155  prf: 2132.19616
reading burst:  47  output_record:  77980  output_time (s):  36.26070  SAR data offset: 71714  prf: 2132.19616
reading burst:  48  output_record:  79708  output_time (s):  37.06422  SAR data offset: 73273  prf: 2132.19616
reading burst:  49  output_record:  81436  output_time (s):  37.86774  SAR data offset: 74832  prf: 2132.19616
reading burst:  50  output_record:  83164  output_time (s):  38.67126  SAR data offset: 76391  prf: 2132.19616
reading burst:  51  output_record:  84892  output_time (s):  39.47478  SAR data offset: 77950  prf: 2132.19616
reading burst:  52  output_record:  86620  output_time (s):  40.27830  SAR data offset: 79509  prf: 2132.19616
reading burst:  53  output_record:  88348  output_time (s):  41.08182  SAR data offset: 81068  prf: 2132.19616
reading burst:  54  output_record:  90076  output_time (s):  41.88534  SAR data offset: 82627  prf: 2132.19616
reading burst:  55  output_record:  91804  output_time (s):  42.68886  SAR data offset: 84186  prf: 2132.19616
reading burst:  56  output_record:  93532  output_time (s):  43.49238  SAR data offset: 85745  prf: 2132.19616
reading burst:  57  output_record:  95260  output_time (s):  44.29590  SAR data offset: 87304  prf: 2132.19616
reading burst:  58  output_record:  96988  output_time (s):  45.09942  SAR data offset: 88863  prf: 2132.19616
reading burst:  59  output_record:  98716  output_time (s):  45.90294  SAR data offset: 90422  prf: 2132.19616
reading burst:  60  output_record: 100444  output_time (s):  46.70646  SAR data offset: 91981  prf: 2132.19616
reading burst:  61  output_record: 102172  output_time (s):  47.50998  SAR data offset: 93540  prf: 2132.19616
reading burst:  62  output_record: 103900  output_time (s):  48.31350  SAR data offset: 95099  prf: 2132.19616
reading burst:  63  output_record: 105628  output_time (s):  49.11702  SAR data offset: 96658  prf: 2132.19616
reading burst:  64  output_record: 107356  output_time (s):  49.92054  SAR data offset: 98217  prf: 2132.19616
reading burst:  65  output_record: 109084  output_time (s):  50.72406  SAR data offset: 99776  prf: 2132.19616
reading burst:  66  output_record: 110812  output_time (s):  51.52758  SAR data offset: 101335  prf: 2132.19616
reading burst:  67  output_record: 112540  output_time (s):  52.33110  SAR data offset: 102894  prf: 2132.19616
reading burst:  68  output_record: 114268  output_time (s):  53.13462  SAR data offset: 104453  prf: 2132.19616
reading burst:  69  output_record: 115996  output_time (s):  53.93814  SAR data offset: 106012  prf: 2132.19616
reading burst:  70  output_record: 117724  output_time (s):  54.74166  SAR data offset: 107571  prf: 2132.19616
reading burst:  71  output_record: 119452  output_time (s):  55.54518  SAR data offset: 109130  prf: 2132.19616

total output lines: 122547   bytes/line: 9692
duration of raw data (s): 56.983890
number of echoes: 122547
MSP sensor parameter file:     raw_WB/20101028_4.sar_par
MSP processing parameter file: raw_WB/p20101028_4.slc.par
output reformatted raw data file: raw_WB/20101028_4.raw

user time (s):          8.440
system time (s):        1.110
elapsed time (s):      18.100


PALSAR_antpat raw_WB/20101028_4.sar_par raw_WB/p20101028_4.slc.par palsar_ant_20061024.dat
PALSAR_20101028_4.antpat 21
*** Extract specified antenna pattern from a PALSAR JAXA antenna pattern file ***
*** Copyright 2011, Gamma Remote Sensing, v1.1 clw 24-Mar-2011 ***
MSP sensor parameter file: raw_WB/20101028_4.sar_par
MSP processing parameter file: raw_WB/p20101028_4.slc.par
JAXA PALSAR antenna  pattern file: palsar_ant_20061024.dat
MSP format antenna  pattern file: PALSAR_20101028_4.antpat
NOTE: using command line value for Beam_ID: 21
off-nadir look angle (deg): 34.360

PALSAR polarization (T/R): HH  pol. index: 0

Beam_ID   samples   HH (dB)   HV (dB)   VH (dB)   VV (dB)
============================================================
    0       101      33.800    33.760    33.450    33.410
    1        99      34.360    34.870    34.460    34.970
    2        93      34.750    35.410    34.840    35.500
    3        89      34.980    35.510    34.970    35.500
    4        83      35.550    36.140    35.640    36.230
    5        77      35.710    36.270    35.800    36.370
    6        73      35.810    36.300    35.910    36.390
    7        67      36.030    36.340    36.030    36.340
    8        61      36.060    36.440    36.190    36.570
    9        57      36.090    36.450    36.190    36.550
   10        53      36.550    36.810    36.670    36.920
   11        49      36.590    36.850    36.670    36.940
   12        45      36.600    36.870    36.700    36.980
   13        41      36.610    36.880    36.700    36.970
   14        39      36.610    36.890    36.700    36.980
   15        37      36.580    36.860    36.700    36.980
   16        35      36.580    36.850    36.690    36.970
   17        33      36.590    36.870    36.700    36.970
   18        91      33.550    34.360    33.720    34.520
   19        81      35.020    35.550    35.100    35.630
   20        73      35.200    35.760    35.310    35.880
   21        67      35.890    36.310    35.890    36.310
   22        63      36.040    36.270    36.140    36.370

total number of antenna patterns: 23
```

```
Beam_ID  lk_angle (deg.)  peak gain (dB)
========================================
   0          9.700         33.800
   1         14.100         34.360
   2         17.900         34.750
   3         21.200         34.980
   4         25.800         35.550
   5         28.700         35.710
   6         30.800         35.810
   7         34.000         36.030
   8         36.700         36.060
   9         38.500         36.090
  10         41.300         36.550
  11         43.400         36.590
  12         45.100         36.600
  13         46.600         36.610
  14         47.700         36.610
  15         49.000         36.580
  16         50.000         36.580
  17         50.600         36.590
  18         19.900         33.550
  19         25.800         35.020
  20         30.300         35.200
  21         33.600         35.890
  22         36.000         36.040

selected beam: 21  nominal lk_ang (deg.): 34.360  beam center (deg.): 33.600  offset (deg.): 0.760

Gamma MSP SAR sensor parameters
SAR sensor parameter title:                          ALPSRS253644500
sensor (ERS, ASAR, PALSAR...):                       PALSAR
chirp direction flag: (UP_CHIRP, DOWN_CHIRP):        DOWN_CHIRP
receiver A/D mode: (REAL, FMCW, IQ):                 IQ
SAR data sample type (FLOAT, BYTE):                  BYTE
SAR receiver spectrum (NORMAL, INVERT):              NORMAL
carrier frequency (Hz):                               1.270000000e+09
chirp bandwidth (Hz):                                 1.400000e+07
chirp duration (sec.):                                2.700000e-05
range A/D sampling frequency (HZ):                    1.600000e+07
SAR raw data file header size (bytes):                    0
SAR raw data record length (bytes):                    9692
SAR raw data record header size (bytes):                412
number of samples/record (IQ counts as 1 sample):      4640
azimuth antenna 3 dB beamwidth (decimal degrees):          1.3449
range antenna 3 dB beamwidth (decimal degrees):            3.8612
nominal azimuth antenna angle (degrees CW from North ):   90.0000
nominal look-angle, off-nadir (deg.):                     33.6000
nominal platform pitch angle (deg., nose up+):             0.0000
antenna gain pattern filename:                       PALSAR_20101028_4.antpat

updated SAR_par parameter file: raw_WB/20101028_4.sar_par

user time (s):         0.000
system time (s):       0.010
elapsed time (s):      0.380


PALSAR_proc_WB 20101028/LED-ALPSRS253644500-W1.0__D raw_WB/20101028_5.sar_par
raw_WB/p20101028_5.slc.par 20101028/IMG-HH-ALPSRS253644500-W1.0__D 5 raw_WB/20101028_5.raw 2150.537634
*** PALSAR ScanSAR raw data pre-processing and generation of the MSP processing parameters ***
*** Copyright 2011, Gamma Remote Sensing, v1.2 18-Mar-2011 clw ***
PALSAR scene identifier (orbit,frame): ALPSRS253644500
CEOS leader file descriptor record center time: 20101028220327669
Processing Facility: EORC
file header size: 720  line header size: 412
PALSAR center frequency (MHz): 1270.000
PALSAR wavlength (m):  0.2360571
SAR is right looking
ScanSAR beam: 5

total number of input data lines: 110689
input data record length (bytes): 11200
number of bytes of input SAR data per record (including right fill): 10788

line offset: 355  beam number: 5  initial value of the pulse repetition interval (PRI micro-sec): 529
PRF calculated from PRI: 1890.35916824  AUX data value: 1890.35900000
initial value of the slant range to the first sample (m): 894384
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number of pulses in the air (double, int):  11.279183  11
initial value of the range delay to the first sample (micro-sec): 156
slant range to first sample from timing (m): 894383.523
number of echoes in the different beams (1-->5): 247  356  274  355  327
pulses per ScanSAR cycle: 1559

new max value for starting slant range at line offset: 48684  range gate: 163  range (m): 895433
new max value for starting slant range at line offset:106367  range gate: 169  range (m): 896332
valid WB ScanSAR data begins at line offset: 0
line offset to the start of beam 1 burst: 682
beam: 1  record:   682  beam:    1  pn_scch: 1  rho (m): 744188.0  PRI (s): 5.9900000e-04  PRF (Hz): 1669.44900
beam: 2  record:   929  beam:    2  pn_scch: 1  rho (m): 784060.0  PRI (s): 4.2700000e-04  PRF (Hz): 2341.92000
beam: 3  record:  1285  beam:    3  pn_scch: 1  rho (m): 821234.0  PRI (s): 5.9100000e-04  PRF (Hz): 1692.04700
beam: 4  record:  1559  beam:    4  pn_scch: 1  rho (m): 863955.0  PRI (s): 4.6900000e-04  PRF (Hz): 2132.19600
beam: 5  record:  1914  beam:    5  pn_scch: 1  rho (m): 894384.0  PRI (s): 5.2900000e-04  PRF (Hz):
1890.35900
output data PRF: 2150.537634
NOTE: change in slant range to first sample of beam 5 observed (m) min.: 894384  max.: 896332

PRF for data in burst 1 for beam 5: 1890.359168
PRF of output resampled raw data: 2150.537634
starting line offset to start of WB SAR mode image data: 0
initial SAR data pixels (samples)/line: 4432
initial right fill zero (samples): 962
number of observation mode data lines: 110689
number of missing lines in the data: 0

chirp bandwidth (Hz):        1.4000e+07
chirp duration (s):          2.7000e-05
ADC sample frequency (Hz):   1.6000e+07
range pixel spacing (m):     9.36851431
slant range delay (microsec)  min.: 894384   max.: 896332
slant range delay (microsec)  first: 144   last: 180
slant range of first sample from line header (m) first: 863955   last: 823033
range gate width (microsec) first: 277   last: 336

duration of data (s): 56.984752
time delay to first sample adjusted for range-gate shifts (s):   5.96669e-03
number of extra range samples due to shifts in the range gate: 208
total number of echo samples in the output data: 4896
output raw data record length (bytes): 10204
maximum number of echoes in a burst: 356

burst window weighting flag: 0
data start time (millisec) : 79379278
lstr: 0  msod: 79379278  Mpps: 278050  Mpps mod 1000: 50
raw data start time year, month, day: 2010 10 28
raw data start time (s): 79379.278050
raw data center time (s): 79407.769995
raw data start time (hrs,min,sec): 022  0 2  59.278050
time interval between state vectors (s): 60.000000
state vectors stored in parameter file: 15
time of first state vector in the CEOS leader UTC (s):   78660.0000

Rotating Earth-Fixed Reference Frame Position Vectors:
time (UTC s):   78660.0000 rotating position x,y,z (m):  -6978751.647   -1163606.141      50475.667
time (UTC s):   78720.0000 rotating position x,y,z (m):  -6983488.565   -1068441.490    -395234.752
time (UTC s):   78780.0000 rotating position x,y,z (m):  -6959193.395    -969050.707    -839338.665
time (UTC s):   78840.0000 rotating position x,y,z (m):  -6905938.003    -866089.650   -1280031.707
time (UTC s):   78900.0000 rotating position x,y,z (m):  -6823917.841    -760227.295   -1715524.575
time (UTC s):   78960.0000 rotating position x,y,z (m):  -6713451.077    -652141.909   -2144050.426
time (UTC s):   79020.0000 rotating position x,y,z (m):  -6574977.182    -542517.220   -2563872.198
time (UTC s):   79080.0000 rotating position x,y,z (m):  -6409054.960    -432038.562   -2973289.817
time (UTC s):   79140.0000 rotating position x,y,z (m):  -6216359.957    -321389.014   -3370647.195
time (UTC s):   79200.0000 rotating position x,y,z (m):  -5997681.366    -211245.576   -3754338.945
time (UTC s):   79260.0000 rotating position x,y,z (m):  -5753918.444    -102275.426   -4122816.833
time (UTC s):   79320.0000 rotating position x,y,z (m):  -5486076.472       4867.731   -4474595.954
time (UTC s):   79380.0000 rotating position x,y,z (m):  -5195262.260     109547.212   -4808260.586
time (UTC s):   79440.0000 rotating position x,y,z (m):  -4882679.273     211146.788   -5122469.730
time (UTC s):   79500.0000 rotating position x,y,z (m):  -4549622.343     309073.974   -5415962.318
time (UTC s):   79560.0000 rotating position x,y,z (m):  -4197472.003     402763.133   -5687562.025
time (UTC s):   79620.0000 rotating position x,y,z (m):  -3827688.525     491678.412   -5936181.708
time (UTC s):   79680.0000 rotating position x,y,z (m):  -3441805.660     575316.499   -6160827.447
time (UTC s):   79740.0000 rotating position x,y,z (m):  -3041424.144     653209.185   -6360602.175
time (UTC s):   79800.0000 rotating position x,y,z (m):  -2628205.032     724925.723   -6534708.969
time (UTC s):   79860.0000 rotating position x,y,z (m):  -2203862.761     790074.975   -6682454.013
time (UTC s):   79920.0000 rotating position x,y,z (m):  -1770157.994     848307.339   -6803249.077
time (UTC s):   79980.0000 rotating position x,y,z (m):  -1328890.379     899316.464   -6896613.574
time (UTC s):   80040.0000 rotating position x,y,z (m):   -881891.189     942840.718   -6962176.244
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time (UTC s):   80100.0000 rotating position x,y,z (m):   -431015.869     978664.415   -6999676.439
time (UTC s):   80160.0000 rotating position x,y,z (m):     21863.444    1006618.812   -7008965.043
time (UTC s):   80220.0000 rotating position x,y,z (m):    474865.481    1026582.853   -6990005.080
time (UTC s):   80280.0000 rotating position x,y,z (m):    926107.530    1038483.679   -6942871.955
index of state vector closest to image center time: 5

interpolated state vectors:
time (UTC s):   78960.0000
position x,y,z (m)  :  -6713451.077    -652141.909   -2144050.426
velocity x,y,z (m/s):     2075.8933      1816.1542     -7074.3413

time (UTC s):   79020.0000
position x,y,z (m)  :  -6574977.182    -542517.220   -2563872.198
velocity x,y,z (m/s):     2538.3503      1836.0973     -6914.9934

time (UTC s):   79080.0000
position x,y,z (m)  :  -6409054.960    -432038.562   -2973289.817
velocity x,y,z (m/s):     2990.5131      1844.6261     -6727.6585

time (UTC s):   79140.0000
position x,y,z (m)  :  -6216359.957    -321389.014   -3370647.195
velocity x,y,z (m/s):     3430.4605      1841.8105     -6513.1263

time (UTC s):   79200.0000
position x,y,z (m)  :  -5997681.366    -211245.576   -3754338.945
velocity x,y,z (m/s):     3856.3268      1827.7831     -6272.2963

time (UTC s):   79260.0000
position x,y,z (m)  :  -5753918.444    -102275.426   -4122816.833
velocity x,y,z (m/s):     4266.3102      1802.7384     -6006.1735

time (UTC s):   79320.0000
position x,y,z (m)  :  -5486076.472       4867.731   -4474595.954
velocity x,y,z (m/s):     4658.6797      1766.9307     -5715.8630

time (UTC s):   79380.0000
position x,y,z (m)  :  -5195262.260     109547.212   -4808260.586
velocity x,y,z (m/s):     5031.7829      1720.6727     -5402.5649

time (UTC s):   79440.0000
position x,y,z (m)  :  -4882679.273     211146.788   -5122469.730
velocity x,y,z (m/s):     5384.0516      1664.3332     -5067.5689

time (UTC s):   79500.0000
position x,y,z (m)  :  -4549622.343     309073.974   -5415962.318
velocity x,y,z (m/s):     5714.0095      1598.3343     -4712.2485

time (UTC s):   79560.0000
position x,y,z (m)  :  -4197472.003     402763.133   -5687562.025
velocity x,y,z (m/s):     6020.2770      1523.1484     -4338.0541

time (UTC s):   79620.0000
position x,y,z (m)  :  -3827688.525     491678.412   -5936181.708
velocity x,y,z (m/s):     6301.5766      1439.2954     -3946.5068

time (UTC s):   79680.0000
position x,y,z (m)  :  -3441805.660     575316.499   -6160827.447
velocity x,y,z (m/s):     6556.7372      1347.3396     -3539.1917

time (UTC s):   79740.0000
position x,y,z (m)  :  -3041424.144     653209.185   -6360602.175
velocity x,y,z (m/s):     6784.6973      1247.8862     -3117.7513

time (UTC s):   79800.0000
position x,y,z (m)  :  -2628205.032     724925.723   -6534708.969
velocity x,y,z (m/s):     6984.5087      1141.5781     -2683.8805

number of state vectors copied: 15
SAR position at center time x,y,z (m):  -5053218.101    156990.237  -4956183.882
SAR velocity at center time x,y,z (m/s):    5197.5062    1695.8257   -5250.1335
S/C radial distance from earth center (m):   7079789.3881
raw data center latitude, longitude (deg.):   -43.224175    171.657502
geocentric Earth radius at scene center(m):  6368351.731
SAR average altitude above terrain (m):       711437.657
nominal look angle at center swath (deg.):       36.7376

number of echoes in the resampled output burst: 373
burst 1 offset to start of burst (lines): 355   nominal burst length: 327
```

```
number of invalid pulses at start of burst: 13

reading burst:   2  output_record:    731  output_time (s):   0.33992  SAR data offset: 1914  prf: 1890.35917
reading burst:   3  output_record:   2454  output_time (s):   1.14111  SAR data offset: 3473  prf: 1890.35917
reading burst:   4  output_record:   4177  output_time (s):   1.94231  SAR data offset: 5032  prf: 1890.35917
reading burst:   5  output_record:   5901  output_time (s):   2.74397  SAR data offset: 6591  prf: 1890.35917
reading burst:   6  output_record:   7624  output_time (s):   3.54516  SAR data offset: 8150  prf: 1890.35917
reading burst:   7  output_record:   9348  output_time (s):   4.34682  SAR data offset: 9709  prf: 1890.35917
reading burst:   8  output_record:  11071  output_time (s):   5.14802  SAR data offset: 11268  prf: 1890.35917
reading burst:   9  output_record:  12794  output_time (s):   5.94921  SAR data offset: 12827  prf: 1890.35917
reading burst:  10  output_record:  14518  output_time (s):   6.75087  SAR data offset: 14386  prf: 1890.35917
reading burst:  11  output_record:  16241  output_time (s):   7.55207  SAR data offset: 15945  prf: 1890.35917
reading burst:  12  output_record:  17964  output_time (s):   8.35326  SAR data offset: 17504  prf: 1890.35917
reading burst:  13  output_record:  19688  output_time (s):   9.15492  SAR data offset: 19063  prf: 1890.35917
reading burst:  14  output_record:  21411  output_time (s):   9.95612  SAR data offset: 20622  prf: 1890.35917
reading burst:  15  output_record:  23135  output_time (s):  10.75778  SAR data offset: 22181  prf: 1890.35917
reading burst:  16  output_record:  24858  output_time (s):  11.55897  SAR data offset: 23740  prf: 1890.35917
reading burst:  17  output_record:  26581  output_time (s):  12.36017  SAR data offset: 25299  prf: 1890.35917
reading burst:  18  output_record:  28305  output_time (s):  13.16183  SAR data offset: 26858  prf: 1890.35917
reading burst:  19  output_record:  30028  output_time (s):  13.96302  SAR data offset: 28417  prf: 1890.35917
reading burst:  20  output_record:  31752  output_time (s):  14.76468  SAR data offset: 29976  prf: 1890.35917
reading burst:  21  output_record:  33475  output_time (s):  15.56588  SAR data offset: 31535  prf: 1890.35917
reading burst:  22  output_record:  35198  output_time (s):  16.36707  SAR data offset: 33094  prf: 1890.35917
reading burst:  23  output_record:  36922  output_time (s):  17.16873  SAR data offset: 34653  prf: 1890.35917
reading burst:  24  output_record:  38645  output_time (s):  17.96993  SAR data offset: 36212  prf: 1890.35917
reading burst:  25  output_record:  40369  output_time (s):  18.77159  SAR data offset: 37771  prf: 1890.35917
reading burst:  26  output_record:  42092  output_time (s):  19.57278  SAR data offset: 39330  prf: 1890.35917
reading burst:  27  output_record:  43815  output_time (s):  20.37398  SAR data offset: 40889  prf: 1890.35917
reading burst:  28  output_record:  45539  output_time (s):  21.17564  SAR data offset: 42448  prf: 1890.35917
reading burst:  29  output_record:  47262  output_time (s):  21.97683  SAR data offset: 44007  prf: 1890.35917
reading burst:  30  output_record:  48986  output_time (s):  22.77849  SAR data offset: 45566  prf: 1890.35917
reading burst:  31  output_record:  50709  output_time (s):  23.57969  SAR data offset: 47125  prf: 1890.35917
reading burst:  32  output_record:  52432  output_time (s):  24.38088  SAR data offset: 48684  prf: 1890.35917
reading burst:  33  output_record:  54160  output_time (s):  25.18440  SAR data offset: 50243  prf: 1890.35917
reading burst:  34  output_record:  55888  output_time (s):  25.98792  SAR data offset: 51802  prf: 1890.35917
reading burst:  35  output_record:  57616  output_time (s):  26.79144  SAR data offset: 53361  prf: 1890.35917
reading burst:  36  output_record:  59344  output_time (s):  27.59496  SAR data offset: 54920  prf: 1890.35917
reading burst:  37  output_record:  61072  output_time (s):  28.39848  SAR data offset: 56479  prf: 1890.35917
reading burst:  38  output_record:  62800  output_time (s):  29.20200  SAR data offset: 58038  prf: 1890.35917
reading burst:  39  output_record:  64528  output_time (s):  30.00552  SAR data offset: 59597  prf: 1890.35917
reading burst:  40  output_record:  66256  output_time (s):  30.80904  SAR data offset: 61156  prf: 1890.35917
reading burst:  41  output_record:  67984  output_time (s):  31.61256  SAR data offset: 62715  prf: 1890.35917
reading burst:  42  output_record:  69712  output_time (s):  32.41608  SAR data offset: 64274  prf: 1890.35917
reading burst:  43  output_record:  71440  output_time (s):  33.21960  SAR data offset: 65833  prf: 1890.35917
reading burst:  44  output_record:  73168  output_time (s):  34.02312  SAR data offset: 67392  prf: 1890.35917
reading burst:  45  output_record:  74896  output_time (s):  34.82664  SAR data offset: 68951  prf: 1890.35917
reading burst:  46  output_record:  76624  output_time (s):  35.63016  SAR data offset: 70510  prf: 1890.35917
reading burst:  47  output_record:  78352  output_time (s):  36.43368  SAR data offset: 72069  prf: 1890.35917
reading burst:  48  output_record:  80080  output_time (s):  37.23720  SAR data offset: 73628  prf: 1890.35917
reading burst:  49  output_record:  81808  output_time (s):  38.04072  SAR data offset: 75187  prf: 1890.35917
reading burst:  50  output_record:  83536  output_time (s):  38.84424  SAR data offset: 76746  prf: 1890.35917
reading burst:  51  output_record:  85264  output_time (s):  39.64776  SAR data offset: 78305  prf: 1890.35917
reading burst:  52  output_record:  86992  output_time (s):  40.45128  SAR data offset: 79864  prf: 1890.35917
reading burst:  53  output_record:  88720  output_time (s):  41.25480  SAR data offset: 81423  prf: 1890.35917
reading burst:  54  output_record:  90448  output_time (s):  42.05832  SAR data offset: 82982  prf: 1890.35917
reading burst:  55  output_record:  92176  output_time (s):  42.86184  SAR data offset: 84541  prf: 1890.35917
reading burst:  56  output_record:  93904  output_time (s):  43.66536  SAR data offset: 86100  prf: 1890.35917
reading burst:  57  output_record:  95632  output_time (s):  44.46888  SAR data offset: 87659  prf: 1890.35917
reading burst:  58  output_record:  97360  output_time (s):  45.27240  SAR data offset: 89218  prf: 1890.35917
reading burst:  59  output_record:  99088  output_time (s):  46.07592  SAR data offset: 90777  prf: 1890.35917
reading burst:  60  output_record: 100816  output_time (s):  46.87944  SAR data offset: 92336  prf: 1890.35917
reading burst:  61  output_record: 102544  output_time (s):  47.68296  SAR data offset: 93895  prf: 1890.35917
reading burst:  62  output_record: 104272  output_time (s):  48.48648  SAR data offset: 95454  prf: 1890.35917
reading burst:  63  output_record: 106000  output_time (s):  49.29000  SAR data offset: 97013  prf: 1890.35917
reading burst:  64  output_record: 107728  output_time (s):  50.09352  SAR data offset: 98572  prf: 1890.35917
reading burst:  65  output_record: 109456  output_time (s):  50.89704  SAR data offset: 100131  prf: 1890.35917
reading burst:  66  output_record: 111184  output_time (s):  51.70056  SAR data offset: 101690  prf: 1890.35917
reading burst:  67  output_record: 112912  output_time (s):  52.50408  SAR data offset: 103249  prf: 1890.35917
reading burst:  68  output_record: 114640  output_time (s):  53.30760  SAR data offset: 104808  prf: 1890.35917
reading burst:  69  output_record: 116368  output_time (s):  54.11112  SAR data offset: 106367  prf: 1890.35917
reading burst:  70  output_record: 118096  output_time (s):  54.91464  SAR data offset: 107926  prf: 1890.35917
reading burst:  71  output_record: 119824  output_time (s):  55.71816  SAR data offset: 109485  prf: 1890.35917

total output lines: 122547   bytes/line: 10204
duration of raw data (s): 56.983890
number of echoes: 122547
MSP sensor parameter file:     raw_WB/20101028_5.sar_par
MSP processing parameter file: raw_WB/p20101028_5.slc.par
output reformatted raw data file: raw_WB/20101028_5.raw

user time (s):         9.520
system time (s):       1.150
elapsed time (s):     20.650


PALSAR_antpat raw_WB/20101028_5.sar_par raw_WB/p20101028_5.slc.par palsar_ant_20061024.dat
```

```
PALSAR_20101028_5.antpat 22
*** Extract specified antenna pattern from a PALSAR JAXA antenna pattern file ***
*** Copyright 2011, Gamma Remote Sensing, v1.1 clw 24-Mar-2011 ***
MSP sensor parameter file: raw_WB/20101028_5.sar_par
MSP processing parameter file: raw_WB/p20101028_5.slc.par
JAXA PALSAR antenna  pattern file: palsar_ant_20061024.dat
MSP format antenna  pattern file: PALSAR_20101028_5.antpat
NOTE: using command line value for Beam_ID: 22
off-nadir look angle (deg): 36.738

PALSAR polarization (T/R): HH  pol. index: 0
```

Beam_ID	samples	HH (dB)	HV (dB)	VH (dB)	VV (dB)
0	101	33.800	33.760	33.450	33.410
1	99	34.360	34.870	34.460	34.970
2	93	34.750	35.410	34.840	35.500
3	89	34.980	35.510	34.970	35.500
4	83	35.550	36.140	35.640	36.230
5	77	35.710	36.270	35.800	36.370
6	73	35.810	36.300	35.910	36.390
7	67	36.030	36.340	36.030	36.340
8	61	36.060	36.440	36.190	36.570
9	57	36.090	36.450	36.190	36.550
10	53	36.550	36.810	36.670	36.920
11	49	36.590	36.850	36.670	36.940
12	45	36.600	36.870	36.700	36.980
13	41	36.610	36.880	36.700	36.970
14	39	36.610	36.890	36.700	36.980
15	37	36.580	36.860	36.700	36.980
16	35	36.580	36.850	36.690	36.970
17	33	36.590	36.870	36.700	36.970
18	91	33.550	34.360	33.720	34.520
19	81	35.020	35.550	35.100	35.630
20	73	35.200	35.760	35.310	35.880
21	67	35.890	36.310	35.890	36.310
22	63	36.040	36.270	36.140	36.370

```
total number of antenna patterns: 23
```

Beam_ID	lk_angle (deg.)	peak gain (dB)
0	9.700	33.800
1	14.100	34.360
2	17.900	34.750
3	21.200	34.980
4	25.800	35.550
5	28.700	35.710
6	30.800	35.810
7	34.000	36.030
8	36.700	36.060
9	38.500	36.090
10	41.300	36.550
11	43.400	36.590
12	45.100	36.600
13	46.600	36.610
14	47.700	36.610
15	49.000	36.580
16	50.000	36.580
17	50.600	36.590
18	19.900	33.550
19	25.800	35.020
20	30.300	35.200
21	33.600	35.890
22	36.000	36.040

```
selected beam: 22  nominal lk_ang (deg.): 36.738  beam center (deg.): 36.000  offset (deg.): 0.738

Gamma MSP SAR sensor parameters
SAR sensor parameter title:                          ALPSRS253644500
sensor (ERS, ASAR, PALSAR...):                       PALSAR
chirp direction flag: (UP_CHIRP, DOWN_CHIRP):        DOWN_CHIRP
receiver A/D mode: (REAL, FMCW, IQ):                 IQ
SAR data sample type (FLOAT, BYTE):                  BYTE
SAR receiver spectrum (NORMAL, INVERT):              NORMAL
carrier frequency (Hz):                               1.270000000e+09
chirp bandwidth (Hz):                                 1.400000e+07
```

```
chirp duration (sec.):                                2.700000e-05
range A/D sampling frequency (HZ):                    1.600000e+07
SAR raw data file header size (bytes):                       0
SAR raw data record length (bytes):                   10204
SAR raw data record header size (bytes):                412
number of samples/record (IQ counts as 1 sample):       4896
azimuth antenna 3 dB beamwidth (decimal degrees):             1.3449
range antenna 3 dB beamwidth (decimal degrees):               3.8612
nominal azimuth antenna angle (degrees CW from North ):      90.0000
nominal look-angle, off-nadir (deg.):                        36.0000
nominal platform pitch angle (deg., nose up+):                0.0000
antenna gain pattern filename:                       PALSAR_20101028_5.antpat

updated SAR_par parameter file: raw_WB/20101028_5.sar_par

user time (s):          0.010
system time (s):        0.000
elapsed time (s):       0.570


PALSAR_proc_WB 20101028/LED-ALPSRS253644500-W1.0__D raw_WB/20101028_1.sar_par
raw_WB/p20101028_1.slc.par 20101028/IMG-HH-ALPSRS253644500-W1.0__D 1 raw_WB/20101028_1.raw 2150.537634
*** PALSAR ScanSAR raw data pre-processing and generation of the MSP processing parameters ***
*** Copyright 2011, Gamma Remote Sensing, v1.2 18-Mar-2011 clw ***
PALSAR scene identifier (orbit,frame): ALPSRS253644500
CEOS leader file descriptor record center time: 20101028220327669
Processing Facility: EORC
file header size: 720  line header size: 412
PALSAR center frequency (MHz): 1270.000
PALSAR wavlength (m):  0.2360571
SAR is right looking
ScanSAR beam: 1

total number of input data lines: 110689
input data record length (bytes): 11200
number of bytes of input SAR data per record (including right fill): 10788

line offset: 682  beam number: 1  initial value of the pulse repetition interval (PRI micro-sec): 599
PRF calculated from PRI: 1669.44908180  AUX data value: 1669.44900000
initial value of the slant range to the first sample (m): 744188
number of pulses in the air (double, int):   8.288294  8
initial value of the range delay to the first sample (micro-sec): 181
slant range to first sample from timing (m): 744187.501
number of echoes in the different beams (1-->5): 247  356  274  355  327
pulses per ScanSAR cycle: 1559

new max value for starting slant range at line offset: 47452  range gate: 187  range (m): 745087
new max value for starting slant range at line offset:105135  range gate: 192  range (m): 745836
valid WB ScanSAR data begins at line offset: 0
line offset to the start of beam 1 burst: 682
beam: 1  record:   682  beam:     1  pn_scch: 1  rho (m): 744188.0  PRI (s): 5.9900000e-04  PRF (Hz): 1669.44900
beam: 2  record:   929  beam:     2  pn_scch: 1  rho (m): 784060.0  PRI (s): 4.2700000e-04  PRF (Hz): 2341.92000
beam: 3  record:  1285  beam:     3  pn_scch: 1  rho (m): 821234.0  PRI (s): 5.9100000e-04  PRF (Hz): 1692.04700
beam: 4  record:  1559  beam:     4  pn_scch: 1  rho (m): 863955.0  PRI (s): 4.6900000e-04  PRF (Hz): 2132.19600
beam: 5  record:  1914  beam:     5  pn_scch: 1  rho (m): 894384.0  PRI (s): 5.2900000e-04  PRF (Hz): 1890.35900
output data PRF: 2150.537634
NOTE: change in slant range to first sample of beam 1 observed (m) min.: 744188  max.: 745836

PRF for data in burst 1 for beam 1: 1669.449082
PRF of output resampled raw data: 2150.537634
starting line offset to start of WB SAR mode image data: 0
initial SAR data pixels (samples)/line: 4432
initial right fill zero (samples): 962
number of observation mode data lines: 110689
number of missing lines in the data: 0

chirp bandwidth (Hz):         1.4000e+07
chirp duration (s):           2.7000e-05
ADC sample frequency (Hz):    1.6000e+07
range pixel spacing (m):      9.36851431
slant range delay (microsec)  min.: 744188   max.: 745836
slant range delay (microsec)  first: 144   last: 180
slant range of first sample from line header (m) first: 863955   last: 823033
range gate width (microsec) first: 277   last: 336

duration of data (s): 56.984752
time delay to first sample adjusted for range-gate shifts (s):   4.96469e-03
number of extra range samples due to shifts in the range gate: 176
```

```
total number of echo samples in the output data: 5152
output raw data record length (bytes): 10716
maximum number of echoes in a burst: 356

burst window weighting flag: 0
data start time (millisec) : 79379278
lstr: 0  msod: 79379278  Mpps: 278050  Mpps mod 1000: 50
raw data start time year, month, day: 2010 10 28
raw data start time (s): 79379.278050
raw data center time (s): 79407.769995
raw data start time (hrs,min,sec): 022  0 2  59.278050
time interval between state vectors (s): 60.000000
state vectors stored in parameter file: 15
time of first state vector in the CEOS leader UTC (s):   78660.0000

Rotating Earth-Fixed Reference Frame Position Vectors:
time (UTC s):   78660.0000 rotating position x,y,z (m):  -6978751.647   -1163606.141      50475.667
time (UTC s):   78720.0000 rotating position x,y,z (m):  -6983488.565   -1068441.490    -395234.752
time (UTC s):   78780.0000 rotating position x,y,z (m):  -6959193.395    -969050.707    -839338.665
time (UTC s):   78840.0000 rotating position x,y,z (m):  -6905938.003    -866089.650   -1280031.707
time (UTC s):   78900.0000 rotating position x,y,z (m):  -6823917.841    -760227.295   -1715524.575
time (UTC s):   78960.0000 rotating position x,y,z (m):  -6713451.077    -652141.909   -2144050.426
time (UTC s):   79020.0000 rotating position x,y,z (m):  -6574977.182    -542517.220   -2563872.198
time (UTC s):   79080.0000 rotating position x,y,z (m):  -6409054.960    -432038.562   -2973289.817
time (UTC s):   79140.0000 rotating position x,y,z (m):  -6216359.957    -321389.014   -3370647.195
time (UTC s):   79200.0000 rotating position x,y,z (m):  -5997681.366    -211245.576   -3754338.945
time (UTC s):   79260.0000 rotating position x,y,z (m):  -5753918.444    -102275.426   -4122816.833
time (UTC s):   79320.0000 rotating position x,y,z (m):  -5486076.472       4867.731   -4474595.954
time (UTC s):   79380.0000 rotating position x,y,z (m):  -5195262.260     109547.212   -4808260.586
time (UTC s):   79440.0000 rotating position x,y,z (m):  -4882679.273     211146.788   -5122469.730
time (UTC s):   79500.0000 rotating position x,y,z (m):  -4549622.343     309073.974   -5415962.318
time (UTC s):   79560.0000 rotating position x,y,z (m):  -4197472.003     402763.133   -5687562.025
time (UTC s):   79620.0000 rotating position x,y,z (m):  -3827688.525     491678.412   -5936181.708
time (UTC s):   79680.0000 rotating position x,y,z (m):  -3441805.660     575316.499   -6160827.447
time (UTC s):   79740.0000 rotating position x,y,z (m):  -3041424.144     653209.185   -6360602.175
time (UTC s):   79800.0000 rotating position x,y,z (m):  -2628205.032     724925.723   -6534708.969
time (UTC s):   79860.0000 rotating position x,y,z (m):  -2203862.761     790074.975   -6682454.013
time (UTC s):   79920.0000 rotating position x,y,z (m):  -1770157.994     848307.339   -6803249.077
time (UTC s):   79980.0000 rotating position x,y,z (m):  -1328890.379     899316.464   -6896613.574
time (UTC s):   80040.0000 rotating position x,y,z (m):   -881891.189     942840.718   -6962176.244
time (UTC s):   80100.0000 rotating position x,y,z (m):   -431015.869     978664.415   -6999676.439
time (UTC s):   80160.0000 rotating position x,y,z (m):     21863.444    1006618.812   -7008965.043
time (UTC s):   80220.0000 rotating position x,y,z (m):    474865.481    1026582.853   -6990005.080
time (UTC s):   80280.0000 rotating position x,y,z (m):    926107.530    1038483.679   -6942871.955
index of state vector closest to image center time: 5

interpolated state vectors:
time (UTC s):   78960.0000
position x,y,z (m)  :  -6713451.077    -652141.909   -2144050.426
velocity x,y,z (m/s):     2075.8933      1816.1542     -7074.3413

time (UTC s):   79020.0000
position x,y,z (m)  :  -6574977.182    -542517.220   -2563872.198
velocity x,y,z (m/s):     2538.3503      1836.0973     -6914.9934

time (UTC s):   79080.0000
position x,y,z (m)  :  -6409054.960    -432038.562   -2973289.817
velocity x,y,z (m/s):     2990.5131      1844.6261     -6727.6585

time (UTC s):   79140.0000
position x,y,z (m)  :  -6216359.957    -321389.014   -3370647.195
velocity x,y,z (m/s):     3430.4605      1841.8105     -6513.1263

time (UTC s):   79200.0000
position x,y,z (m)  :  -5997681.366    -211245.576   -3754338.945
velocity x,y,z (m/s):     3856.3268      1827.7831     -6272.2963

time (UTC s):   79260.0000
position x,y,z (m)  :  -5753918.444    -102275.426   -4122816.833
velocity x,y,z (m/s):     4266.3102      1802.7384     -6006.1735

time (UTC s):   79320.0000
position x,y,z (m)  :  -5486076.472       4867.731   -4474595.954
velocity x,y,z (m/s):     4658.6797      1766.9307     -5715.8630

time (UTC s):   79380.0000
position x,y,z (m)  :  -5195262.260     109547.212   -4808260.586
```

```
velocity x,y,z (m/s):     5031.7829      1720.6727     -5402.5649

time (UTC s):   79440.0000
position x,y,z (m)   :  -4882679.273     211146.788   -5122469.730
velocity x,y,z (m/s):     5384.0516      1664.3332     -5067.5689

time (UTC s):   79500.0000
position x,y,z (m)   :  -4549622.343     309073.974   -5415962.318
velocity x,y,z (m/s):     5714.0095      1598.3343     -4712.2485

time (UTC s):   79560.0000
position x,y,z (m)   :  -4197472.003     402763.133   -5687562.025
velocity x,y,z (m/s):     6020.2770      1523.1484     -4338.0541

time (UTC s):   79620.0000
position x,y,z (m)   :  -3827688.525     491678.412   -5936181.708
velocity x,y,z (m/s):     6301.5766      1439.2954     -3946.5068

time (UTC s):   79680.0000
position x,y,z (m)   :  -3441805.660     575316.499   -6160827.447
velocity x,y,z (m/s):     6556.7372      1347.3396     -3539.1917

time (UTC s):   79740.0000
position x,y,z (m)   :  -3041424.144     653209.185   -6360602.175
velocity x,y,z (m/s):     6784.6973      1247.8862     -3117.7513

time (UTC s):   79800.0000
position x,y,z (m)   :  -2628205.032     724925.723   -6534708.969
velocity x,y,z (m/s):     6984.5087      1141.5781     -2683.8805

number of state vectors copied: 15
SAR position at center time x,y,z (m):  -5053218.101    156990.237  -4956183.882
SAR velocity at center time x,y,z (m/s):    5197.5062    1695.8257   -5250.1335
S/C radial distance from earth center (m):   7079789.3881
raw data center latitude, longitude (deg.):   -43.972371    174.902007
geocentric Earth radius at scene center(m):  6368072.941
SAR average altitude above terrain (m):       711716.447
nominal look angle at center swath (deg.):       20.9276

number of echoes in the resampled output burst: 319
burst 1 offset to start of burst (lines): 682   nominal burst length: 247
number of invalid pulses at start of burst: 13

reading burst:   2  output_record:   1049  output_time (s):   0.48779  SAR data offset: 2241  prf: 1669.44908
reading burst:   3  output_record:   2772  output_time (s):   1.28898  SAR data offset: 3800  prf: 1669.44908
reading burst:   4  output_record:   4496  output_time (s):   2.09064  SAR data offset: 5359  prf: 1669.44908
reading burst:   5  output_record:   6219  output_time (s):   2.89184  SAR data offset: 6918  prf: 1669.44908
reading burst:   6  output_record:   7942  output_time (s):   3.69303  SAR data offset: 8477  prf: 1669.44908
reading burst:   7  output_record:   9666  output_time (s):   4.49469  SAR data offset: 10036  prf: 1669.44908
reading burst:   8  output_record:  11389  output_time (s):   5.29589  SAR data offset: 11595  prf: 1669.44908
reading burst:   9  output_record:  13112  output_time (s):   6.09708  SAR data offset: 13154  prf: 1669.44908
reading burst:  10  output_record:  14836  output_time (s):   6.89874  SAR data offset: 14713  prf: 1669.44908
reading burst:  11  output_record:  16559  output_time (s):   7.69994  SAR data offset: 16272  prf: 1669.44908
reading burst:  12  output_record:  18283  output_time (s):   8.50160  SAR data offset: 17831  prf: 1669.44908
reading burst:  13  output_record:  20006  output_time (s):   9.30279  SAR data offset: 19390  prf: 1669.44908
reading burst:  14  output_record:  21729  output_time (s):  10.10399  SAR data offset: 20949  prf: 1669.44908
reading burst:  15  output_record:  23453  output_time (s):  10.90565  SAR data offset: 22508  prf: 1669.44908
reading burst:  16  output_record:  25176  output_time (s):  11.70684  SAR data offset: 24067  prf: 1669.44908
reading burst:  17  output_record:  26900  output_time (s):  12.50850  SAR data offset: 25626  prf: 1669.44908
reading burst:  18  output_record:  28623  output_time (s):  13.30970  SAR data offset: 27185  prf: 1669.44908
reading burst:  19  output_record:  30346  output_time (s):  14.11089  SAR data offset: 28744  prf: 1669.44908
reading burst:  20  output_record:  32070  output_time (s):  14.91255  SAR data offset: 30303  prf: 1669.44908
reading burst:  21  output_record:  33793  output_time (s):  15.71375  SAR data offset: 31862  prf: 1669.44908
reading burst:  22  output_record:  35517  output_time (s):  16.51541  SAR data offset: 33421  prf: 1669.44908
reading burst:  23  output_record:  37240  output_time (s):  17.31660  SAR data offset: 34980  prf: 1669.44908
reading burst:  24  output_record:  38963  output_time (s):  18.11780  SAR data offset: 36539  prf: 1669.44908
reading burst:  25  output_record:  40687  output_time (s):  18.91946  SAR data offset: 38098  prf: 1669.44908
reading burst:  26  output_record:  42410  output_time (s):  19.72065  SAR data offset: 39657  prf: 1669.44908
reading burst:  27  output_record:  44134  output_time (s):  20.52231  SAR data offset: 41216  prf: 1669.44908
reading burst:  28  output_record:  45857  output_time (s):  21.32351  SAR data offset: 42775  prf: 1669.44908
reading burst:  29  output_record:  47580  output_time (s):  22.12470  SAR data offset: 44334  prf: 1669.44908
reading burst:  30  output_record:  49304  output_time (s):  22.92636  SAR data offset: 45893  prf: 1669.44908
reading burst:  31  output_record:  51027  output_time (s):  23.72756  SAR data offset: 47452  prf: 1669.44908
reading burst:  32  output_record:  52750  output_time (s):  24.52875  SAR data offset: 49011  prf: 1669.44908
reading burst:  33  output_record:  54478  output_time (s):  25.33227  SAR data offset: 50570  prf: 1669.44908
reading burst:  34  output_record:  56206  output_time (s):  26.13579  SAR data offset: 52129  prf: 1669.44908
reading burst:  35  output_record:  57934  output_time (s):  26.93931  SAR data offset: 53688  prf: 1669.44908
reading burst:  36  output_record:  59662  output_time (s):  27.74283  SAR data offset: 55247  prf: 1669.44908
reading burst:  37  output_record:  61390  output_time (s):  28.54635  SAR data offset: 56806  prf: 1669.44908
reading burst:  38  output_record:  63118  output_time (s):  29.34987  SAR data offset: 58365  prf: 1669.44908
reading burst:  39  output_record:  64846  output_time (s):  30.15339  SAR data offset: 59924  prf: 1669.44908
reading burst:  40  output_record:  66574  output_time (s):  30.95691  SAR data offset: 61483  prf: 1669.44908
```

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reading burst:  41  output_record:  68302  output_time (s):  31.76043  SAR data offset: 63042  prf: 1669.44908
reading burst:  42  output_record:  70030  output_time (s):  32.56395  SAR data offset: 64601  prf: 1669.44908
reading burst:  43  output_record:  71758  output_time (s):  33.36747  SAR data offset: 66160  prf: 1669.44908
reading burst:  44  output_record:  73486  output_time (s):  34.17099  SAR data offset: 67719  prf: 1669.44908
reading burst:  45  output_record:  75214  output_time (s):  34.97451  SAR data offset: 69278  prf: 1669.44908
reading burst:  46  output_record:  76942  output_time (s):  35.77803  SAR data offset: 70837  prf: 1669.44908
reading burst:  47  output_record:  78670  output_time (s):  36.58155  SAR data offset: 72396  prf: 1669.44908
reading burst:  48  output_record:  80398  output_time (s):  37.38507  SAR data offset: 73955  prf: 1669.44908
reading burst:  49  output_record:  82126  output_time (s):  38.18859  SAR data offset: 75514  prf: 1669.44908
reading burst:  50  output_record:  83854  output_time (s):  38.99211  SAR data offset: 77073  prf: 1669.44908
reading burst:  51  output_record:  85582  output_time (s):  39.79563  SAR data offset: 78632  prf: 1669.44908
reading burst:  52  output_record:  87310  output_time (s):  40.59915  SAR data offset: 80191  prf: 1669.44908
reading burst:  53  output_record:  89038  output_time (s):  41.40267  SAR data offset: 81750  prf: 1669.44908
reading burst:  54  output_record:  90766  output_time (s):  42.20619  SAR data offset: 83309  prf: 1669.44908
reading burst:  55  output_record:  92494  output_time (s):  43.00971  SAR data offset: 84868  prf: 1669.44908
reading burst:  56  output_record:  94222  output_time (s):  43.81323  SAR data offset: 86427  prf: 1669.44908
reading burst:  57  output_record:  95950  output_time (s):  44.61675  SAR data offset: 87986  prf: 1669.44908
reading burst:  58  output_record:  97678  output_time (s):  45.42027  SAR data offset: 89545  prf: 1669.44908
reading burst:  59  output_record:  99406  output_time (s):  46.22379  SAR data offset: 91104  prf: 1669.44908
reading burst:  60  output_record: 101134  output_time (s):  47.02731  SAR data offset: 92663  prf: 1669.44908
reading burst:  61  output_record: 102862  output_time (s):  47.83083  SAR data offset: 94222  prf: 1669.44908
reading burst:  62  output_record: 104590  output_time (s):  48.63435  SAR data offset: 95781  prf: 1669.44908
reading burst:  63  output_record: 106318  output_time (s):  49.43787  SAR data offset: 97340  prf: 1669.44908
reading burst:  64  output_record: 108046  output_time (s):  50.24139  SAR data offset: 98899  prf: 1669.44908
reading burst:  65  output_record: 109774  output_time (s):  51.04491  SAR data offset: 100458  prf: 1669.44908
reading burst:  66  output_record: 111502  output_time (s):  51.84843  SAR data offset: 102017  prf: 1669.44908
reading burst:  67  output_record: 113230  output_time (s):  52.65195  SAR data offset: 103576  prf: 1669.44908
reading burst:  68  output_record: 114958  output_time (s):  53.45547  SAR data offset: 105135  prf: 1669.44908
reading burst:  69  output_record: 116686  output_time (s):  54.25899  SAR data offset: 106694  prf: 1669.44908
reading burst:  70  output_record: 118414  output_time (s):  55.06251  SAR data offset: 108253  prf: 1669.44908
reading burst:  71  output_record: 120142  output_time (s):  55.86603  SAR data offset: 109812  prf: 1669.44908

total output lines: 122547   bytes/line: 10716
duration of raw data (s): 56.983890
number of echoes: 122547
MSP sensor parameter file:     raw_WB/20101028_1.sar_par
MSP processing parameter file: raw_WB/p20101028_1.slc.par
output reformatted raw data file: raw_WB/20101028_1.raw

user time (s):         8.300
system time (s):       1.200
elapsed time (s):     20.200


PALSAR_antpat raw_WB/20101028_1.sar_par raw_WB/p20101028_1.slc.par palsar_ant_20061024.dat
PALSAR_20101028_1.antpat 18
*** Extract specified antenna pattern from a PALSAR JAXA antenna pattern file ***
*** Copyright 2011, Gamma Remote Sensing, v1.1 clw 24-Mar-2011 ***
MSP sensor parameter file: raw_WB/20101028_1.sar_par
MSP processing parameter file: raw_WB/p20101028_1.slc.par
JAXA PALSAR antenna  pattern file: palsar_ant_20061024.dat
MSP format antenna  pattern file: PALSAR_20101028_1.antpat
NOTE: using command line value for Beam_ID: 18
off-nadir look angle (deg): 20.928

PALSAR polarization (T/R): HH  pol. index: 0

Beam_ID   samples   HH (dB)   HV (dB)   VH (dB)   VV (dB)
=========================================================
    0       101      33.800    33.760    33.450    33.410
    1        99      34.360    34.870    34.460    34.970
    2        93      34.750    35.410    34.840    35.500
    3        89      34.980    35.510    34.970    35.500
    4        83      35.550    36.140    35.640    36.230
    5        77      35.710    36.270    35.800    36.370
    6        73      35.810    36.300    35.910    36.390
    7        67      36.030    36.340    36.030    36.340
    8        61      36.060    36.440    36.190    36.570
    9        57      36.090    36.450    36.190    36.550
   10        53      36.550    36.810    36.670    36.920
   11        49      36.590    36.850    36.670    36.940
   12        45      36.600    36.870    36.700    36.980
   13        41      36.610    36.880    36.700    36.970
   14        39      36.610    36.890    36.700    36.980
   15        37      36.580    36.860    36.700    36.980
   16        35      36.580    36.850    36.690    36.970
   17        33      36.590    36.870    36.700    36.970
   18        91      33.550    34.360    33.720    34.520
   19        81      35.020    35.550    35.100    35.630
   20        73      35.200    35.760    35.310    35.880
   21        67      35.890    36.310    35.890    36.310
```

```
   22       63      36.040    36.270    36.140    36.370

total number of antenna patterns: 23

Beam_ID  lk_angle (deg.)  peak gain (dB)
========================================
   0          9.700         33.800
   1         14.100         34.360
   2         17.900         34.750
   3         21.200         34.980
   4         25.800         35.550
   5         28.700         35.710
   6         30.800         35.810
   7         34.000         36.030
   8         36.700         36.060
   9         38.500         36.090
  10         41.300         36.550
  11         43.400         36.590
  12         45.100         36.600
  13         46.600         36.610
  14         47.700         36.610
  15         49.000         36.580
  16         50.000         36.580
  17         50.600         36.590
  18         19.900         33.550
  19         25.800         35.020
  20         30.300         35.200
  21         33.600         35.890
  22         36.000         36.040

selected beam: 18  nominal lk_ang (deg.): 20.928  beam center (deg.): 19.900  offset (deg.): 1.028

Gamma MSP SAR sensor parameters
SAR sensor parameter title:                          ALPSRS253644500
sensor (ERS, ASAR, PALSAR...):                       PALSAR
chirp direction flag: (UP_CHIRP, DOWN_CHIRP):        DOWN_CHIRP
receiver A/D mode: (REAL, FMCW, IQ):                 IQ
SAR data sample type (FLOAT, BYTE):                  BYTE
SAR receiver spectrum (NORMAL, INVERT):              NORMAL
carrier frequency (Hz):                               1.270000000e+09
chirp bandwidth (Hz):                                 1.400000e+07
chirp duration (sec.):                                2.700000e-05
range A/D sampling frequency (HZ):                    1.600000e+07
SAR raw data file header size (bytes):                    0
SAR raw data record length (bytes):                   10716
SAR raw data record header size (bytes):                412
number of samples/record (IQ counts as 1 sample):      5152
azimuth antenna 3 dB beamwidth (decimal degrees):          1.3449
range antenna 3 dB beamwidth (decimal degrees):            3.8612
nominal azimuth antenna angle (degrees CW from North ):   90.0000
nominal look-angle, off-nadir (deg.):                     19.9000
nominal platform pitch angle (deg., nose up+):             0.0000
antenna gain pattern filename:                       PALSAR_20101028_1.antpat

updated SAR_par parameter file: raw_WB/20101028_1.sar_par

user time (s):         0.000
system time (s):       0.010
elapsed time (s):      0.340


PALSAR_proc_WB 20101028/LED-ALPSRS253644500-W1.0__D raw_WB/20101028_2.sar_par
raw_WB/p20101028_2.slc.par 20101028/IMG-HH-ALPSRS253644500-W1.0__D 2 raw_WB/20101028_2.raw 2150.537634
*** PALSAR ScanSAR raw data pre-processing and generation of the MSP processing parameters ***
*** Copyright 2011, Gamma Remote Sensing, v1.2 18-Mar-2011 clw ***
PALSAR scene identifier (orbit,frame): ALPSRS253644500
CEOS leader file descriptor record center time: 20101028220327669
Processing Facility: EORC
file header size: 720  line header size: 412
PALSAR center frequency (MHz): 1270.000
PALSAR wavlength (m):  0.2360571
SAR is right looking
ScanSAR beam: 2

total number of input data lines: 110689
input data record length (bytes): 11200
number of bytes of input SAR data per record (including right fill): 10788
```

```
line offset: 929  beam number: 2  initial value of the pulse repetition interval (PRI micro-sec): 427
PRF calculated from PRI: 2341.92037471  AUX data value: 2341.92000000
initial value of the slant range to the first sample (m): 784060
number of pulses in the air (double, int):  12.249848  12
initial value of the range delay to the first sample (micro-sec): 115
slant range to first sample from timing (m): 784059.898
number of echoes in the different beams (1-->5): 247  356  274  355  327
pulses per ScanSAR cycle: 1559

new max value for starting slant range at line offset: 47699  range gate: 49  range (m): 784959
new max value for starting slant range at line offset:105382  range gate: 54  range (m): 785709
valid WB ScanSAR data begins at line offset: 0
line offset to the start of beam 1 burst: 682
beam: 1  record:   682  beam:     1  pn_scch: 1  rho (m): 744188.0  PRI (s): 5.9900000e-04  PRF (Hz): 1669.44900
beam: 2  record:   929  beam:     2  pn_scch: 1  rho (m): 784060.0  PRI (s): 4.2700000e-04  PRF (Hz): 2341.92000
beam: 3  record:  1285  beam:     3  pn_scch: 1  rho (m): 821234.0  PRI (s): 5.9100000e-04  PRF (Hz): 1692.04700
beam: 4  record:  1559  beam:     4  pn_scch: 1  rho (m): 863955.0  PRI (s): 4.6900000e-04  PRF (Hz): 2132.19600
beam: 5  record:  1914  beam:     5  pn_scch: 1  rho (m): 894384.0  PRI (s): 5.2900000e-04  PRF (Hz): 1890.35900
output data PRF: 2150.537634
NOTE: change in slant range to first sample of beam 2 observed (m) min.: 784060  max.: 785709

PRF for data in burst 1 for beam 2: 2341.920375
PRF of output resampled raw data: 2150.537634
starting line offset to start of WB SAR mode image data: 0
initial SAR data pixels (samples)/line: 4432
initial right fill zero (samples): 962
number of observation mode data lines: 110689
number of missing lines in the data: 0

chirp bandwidth (Hz):        1.4000e+07
chirp duration (s):          2.7000e-05
ADC sample frequency (Hz):   1.6000e+07
range pixel spacing (m):     9.36851431
slant range delay (microsec)  min.: 784060   max.: 785709
slant range delay (microsec)  first: 144   last: 180
slant range of first sample from line header (m) first: 863955   last: 823033
range gate width (microsec) first: 277   last: 336

duration of data (s): 56.984752
time delay to first sample adjusted for range-gate shifts (s):   5.23069e-03
number of extra range samples due to shifts in the range gate: 176
total number of echo samples in the output data: 4896
output raw data record length (bytes): 10204
maximum number of echoes in a burst: 356

burst window weighting flag: 0
data start time (millisec) : 79379278
lstr: 0  msod: 79379278  Mpps: 278050  Mpps mod 1000: 50
raw data start time year, month, day: 2010 10 28
raw data start time (s): 79379.278050
raw data center time (s): 79407.769995
raw data start time (hrs,min,sec): 022  0 2  59.278050
time interval between state vectors (s): 60.000000
state vectors stored in parameter file: 15
time of first state vector in the CEOS leader UTC (s):   78660.0000

Rotating Earth-Fixed Reference Frame Position Vectors:
time (UTC s):   78660.0000 rotating position x,y,z (m):  -6978751.647   -1163606.141      50475.667
time (UTC s):   78720.0000 rotating position x,y,z (m):  -6983488.565   -1068441.490    -395234.752
time (UTC s):   78780.0000 rotating position x,y,z (m):  -6959193.395    -969050.707    -839338.665
time (UTC s):   78840.0000 rotating position x,y,z (m):  -6905938.003    -866089.650   -1280031.707
time (UTC s):   78900.0000 rotating position x,y,z (m):  -6823917.841    -760227.295   -1715524.575
time (UTC s):   78960.0000 rotating position x,y,z (m):  -6713451.077    -652141.909   -2144050.426
time (UTC s):   79020.0000 rotating position x,y,z (m):  -6574977.182    -542517.220   -2563872.198
time (UTC s):   79080.0000 rotating position x,y,z (m):  -6409054.960    -432038.562   -2973289.817
time (UTC s):   79140.0000 rotating position x,y,z (m):  -6216359.957    -321389.014   -3370647.195
time (UTC s):   79200.0000 rotating position x,y,z (m):  -5997681.366    -211245.576   -3754338.945
time (UTC s):   79260.0000 rotating position x,y,z (m):  -5753918.444    -102275.426   -4122816.833
time (UTC s):   79320.0000 rotating position x,y,z (m):  -5486076.472       4867.731   -4474595.954
time (UTC s):   79380.0000 rotating position x,y,z (m):  -5195262.260     109547.212   -4808260.586
time (UTC s):   79440.0000 rotating position x,y,z (m):  -4882679.273     211146.788   -5122469.730
time (UTC s):   79500.0000 rotating position x,y,z (m):  -4549622.343     309073.974   -5415962.318
time (UTC s):   79560.0000 rotating position x,y,z (m):  -4197472.003     402763.133   -5687562.025
time (UTC s):   79620.0000 rotating position x,y,z (m):  -3827688.525     491678.412   -5936181.708
time (UTC s):   79680.0000 rotating position x,y,z (m):  -3441805.660     575316.499   -6160827.447
time (UTC s):   79740.0000 rotating position x,y,z (m):  -3041424.144     653209.185   -6360602.175
time (UTC s):   79800.0000 rotating position x,y,z (m):  -2628205.032     724925.723   -6534708.969
```

```
time (UTC s):   79860.0000 rotating position x,y,z (m):  -2203862.761     790074.975   -6682454.013
time (UTC s):   79920.0000 rotating position x,y,z (m):  -1770157.994     848307.339   -6803249.077
time (UTC s):   79980.0000 rotating position x,y,z (m):  -1328890.379     899316.464   -6896613.574
time (UTC s):   80040.0000 rotating position x,y,z (m):   -881891.189     942840.718   -6962176.244
time (UTC s):   80100.0000 rotating position x,y,z (m):   -431015.869     978664.415   -6999676.439
time (UTC s):   80160.0000 rotating position x,y,z (m):     21863.444    1006618.812   -7008965.043
time (UTC s):   80220.0000 rotating position x,y,z (m):    474865.481    1026582.853   -6990005.080
time (UTC s):   80280.0000 rotating position x,y,z (m):    926107.530    1038483.679   -6942871.955
index of state vector closest to image center time: 5

interpolated state vectors:
time (UTC s):   78960.0000
position x,y,z (m)  :  -6713451.077    -652141.909   -2144050.426
velocity x,y,z (m/s):     2075.8933      1816.1542     -7074.3413

time (UTC s):   79020.0000
position x,y,z (m)  :  -6574977.182    -542517.220   -2563872.198
velocity x,y,z (m/s):     2538.3503      1836.0973     -6914.9934

time (UTC s):   79080.0000
position x,y,z (m)  :  -6409054.960    -432038.562   -2973289.817
velocity x,y,z (m/s):     2990.5131      1844.6261     -6727.6585

time (UTC s):   79140.0000
position x,y,z (m)  :  -6216359.957    -321389.014   -3370647.195
velocity x,y,z (m/s):     3430.4605      1841.8105     -6513.1263

time (UTC s):   79200.0000
position x,y,z (m)  :  -5997681.366    -211245.576   -3754338.945
velocity x,y,z (m/s):     3856.3268      1827.7831     -6272.2963

time (UTC s):   79260.0000
position x,y,z (m)  :  -5753918.444    -102275.426   -4122816.833
velocity x,y,z (m/s):     4266.3102      1802.7384     -6006.1735

time (UTC s):   79320.0000
position x,y,z (m)  :  -5486076.472       4867.731   -4474595.954
velocity x,y,z (m/s):     4658.6797      1766.9307     -5715.8630

time (UTC s):   79380.0000
position x,y,z (m)  :  -5195262.260     109547.212   -4808260.586
velocity x,y,z (m/s):     5031.7829      1720.6727     -5402.5649

time (UTC s):   79440.0000
position x,y,z (m)  :  -4882679.273     211146.788   -5122469.730
velocity x,y,z (m/s):     5384.0516      1664.3332     -5067.5689

time (UTC s):   79500.0000
position x,y,z (m)  :  -4549622.343     309073.974   -5415962.318
velocity x,y,z (m/s):     5714.0095      1598.3343     -4712.2485

time (UTC s):   79560.0000
position x,y,z (m)  :  -4197472.003     402763.133   -5687562.025
velocity x,y,z (m/s):     6020.2770      1523.1484     -4338.0541

time (UTC s):   79620.0000
position x,y,z (m)  :  -3827688.525     491678.412   -5936181.708
velocity x,y,z (m/s):     6301.5766      1439.2954     -3946.5068

time (UTC s):   79680.0000
position x,y,z (m)  :  -3441805.660     575316.499   -6160827.447
velocity x,y,z (m/s):     6556.7372      1347.3396     -3539.1917

time (UTC s):   79740.0000
position x,y,z (m)  :  -3041424.144     653209.185   -6360602.175
velocity x,y,z (m/s):     6784.6973      1247.8862     -3117.7513

time (UTC s):   79800.0000
position x,y,z (m)  :  -2628205.032     724925.723   -6534708.969
velocity x,y,z (m/s):     6984.5087      1141.5781     -2683.8805

number of state vectors copied: 15
SAR position at center time x,y,z (m):  -5053218.101    156990.237  -4956183.882
SAR velocity at center time x,y,z (m/s):    5197.5062    1695.8257   -5250.1335
S/C radial distance from earth center (m):   7079789.3881
raw data center latitude, longitude (deg.):   -43.746995    173.873018
geocentric Earth radius at scene center(m):  6368156.962
```

```
SAR average altitude above terrain (m):       711632.426
nominal look angle at center swath (deg.):       26.5545

number of echoes in the resampled output burst: 327
burst 1 offset to start of burst (lines): 929   nominal burst length: 356
number of invalid pulses at start of burst: 13

reading burst:   2  output_record:   1376  output_time (s):   0.63984  SAR data offset: 2488  prf: 2341.92037
reading burst:   3  output_record:   3099  output_time (s):   1.44104  SAR data offset: 4047  prf: 2341.92037
reading burst:   4  output_record:   4822  output_time (s):   2.24223  SAR data offset: 5606  prf: 2341.92037
reading burst:   5  output_record:   6546  output_time (s):   3.04389  SAR data offset: 7165  prf: 2341.92037
reading burst:   6  output_record:   8269  output_time (s):   3.84509  SAR data offset: 8724  prf: 2341.92037
reading burst:   7  output_record:   9993  output_time (s):   4.64675  SAR data offset: 10283  prf: 2341.92037
reading burst:   8  output_record:  11716  output_time (s):   5.44794  SAR data offset: 11842  prf: 2341.92037
reading burst:   9  output_record:  13439  output_time (s):   6.24914  SAR data offset: 13401  prf: 2341.92037
reading burst:  10  output_record:  15163  output_time (s):   7.05080  SAR data offset: 14960  prf: 2341.92037
reading burst:  11  output_record:  16886  output_time (s):   7.85199  SAR data offset: 16519  prf: 2341.92037
reading burst:  12  output_record:  18610  output_time (s):   8.65365  SAR data offset: 18078  prf: 2341.92037
reading burst:  13  output_record:  20333  output_time (s):   9.45485  SAR data offset: 19637  prf: 2341.92037
reading burst:  14  output_record:  22056  output_time (s):  10.25604  SAR data offset: 21196  prf: 2341.92037
reading burst:  15  output_record:  23780  output_time (s):  11.05770  SAR data offset: 22755  prf: 2341.92037
reading burst:  16  output_record:  25503  output_time (s):  11.85890  SAR data offset: 24314  prf: 2341.92037
reading burst:  17  output_record:  27227  output_time (s):  12.66056  SAR data offset: 25873  prf: 2341.92037
reading burst:  18  output_record:  28950  output_time (s):  13.46175  SAR data offset: 27432  prf: 2341.92037
reading burst:  19  output_record:  30673  output_time (s):  14.26295  SAR data offset: 28991  prf: 2341.92037
reading burst:  20  output_record:  32397  output_time (s):  15.06461  SAR data offset: 30550  prf: 2341.92037
reading burst:  21  output_record:  34120  output_time (s):  15.86580  SAR data offset: 32109  prf: 2341.92037
reading burst:  22  output_record:  35843  output_time (s):  16.66700  SAR data offset: 33668  prf: 2341.92037
reading burst:  23  output_record:  37567  output_time (s):  17.46866  SAR data offset: 35227  prf: 2341.92037
reading burst:  24  output_record:  39290  output_time (s):  18.26985  SAR data offset: 36786  prf: 2341.92037
reading burst:  25  output_record:  41014  output_time (s):  19.07151  SAR data offset: 38345  prf: 2341.92037
reading burst:  26  output_record:  42737  output_time (s):  19.87271  SAR data offset: 39904  prf: 2341.92037
reading burst:  27  output_record:  44460  output_time (s):  20.67390  SAR data offset: 41463  prf: 2341.92037
reading burst:  28  output_record:  46184  output_time (s):  21.47556  SAR data offset: 43022  prf: 2341.92037
reading burst:  29  output_record:  47907  output_time (s):  22.27676  SAR data offset: 44581  prf: 2341.92037
reading burst:  30  output_record:  49631  output_time (s):  23.07842  SAR data offset: 46140  prf: 2341.92037
reading burst:  31  output_record:  51354  output_time (s):  23.87961  SAR data offset: 47699  prf: 2309.46882
reading burst:  32  output_record:  53082  output_time (s):  24.68313  SAR data offset: 49258  prf: 2309.46882
reading burst:  33  output_record:  54810  output_time (s):  25.48665  SAR data offset: 50817  prf: 2309.46882
reading burst:  34  output_record:  56538  output_time (s):  26.29017  SAR data offset: 52376  prf: 2309.46882
reading burst:  35  output_record:  58266  output_time (s):  27.09369  SAR data offset: 53935  prf: 2309.46882
reading burst:  36  output_record:  59994  output_time (s):  27.89721  SAR data offset: 55494  prf: 2309.46882
reading burst:  37  output_record:  61722  output_time (s):  28.70073  SAR data offset: 57053  prf: 2309.46882
reading burst:  38  output_record:  63450  output_time (s):  29.50425  SAR data offset: 58612  prf: 2309.46882
reading burst:  39  output_record:  65178  output_time (s):  30.30777  SAR data offset: 60171  prf: 2309.46882
reading burst:  40  output_record:  66906  output_time (s):  31.11129  SAR data offset: 61730  prf: 2309.46882
reading burst:  41  output_record:  68634  output_time (s):  31.91481  SAR data offset: 63289  prf: 2309.46882
reading burst:  42  output_record:  70362  output_time (s):  32.71833  SAR data offset: 64848  prf: 2309.46882
reading burst:  43  output_record:  72090  output_time (s):  33.52185  SAR data offset: 66407  prf: 2309.46882
reading burst:  44  output_record:  73818  output_time (s):  34.32537  SAR data offset: 67966  prf: 2309.46882
reading burst:  45  output_record:  75546  output_time (s):  35.12889  SAR data offset: 69525  prf: 2309.46882
reading burst:  46  output_record:  77274  output_time (s):  35.93241  SAR data offset: 71084  prf: 2309.46882
reading burst:  47  output_record:  79002  output_time (s):  36.73593  SAR data offset: 72643  prf: 2309.46882
reading burst:  48  output_record:  80730  output_time (s):  37.53945  SAR data offset: 74202  prf: 2309.46882
reading burst:  49  output_record:  82458  output_time (s):  38.34297  SAR data offset: 75761  prf: 2309.46882
reading burst:  50  output_record:  84186  output_time (s):  39.14649  SAR data offset: 77320  prf: 2309.46882
reading burst:  51  output_record:  85914  output_time (s):  39.95001  SAR data offset: 78879  prf: 2309.46882
reading burst:  52  output_record:  87642  output_time (s):  40.75353  SAR data offset: 80438  prf: 2309.46882
reading burst:  53  output_record:  89370  output_time (s):  41.55705  SAR data offset: 81997  prf: 2309.46882
reading burst:  54  output_record:  91098  output_time (s):  42.36057  SAR data offset: 83556  prf: 2309.46882
reading burst:  55  output_record:  92826  output_time (s):  43.16409  SAR data offset: 85115  prf: 2309.46882
reading burst:  56  output_record:  94554  output_time (s):  43.96761  SAR data offset: 86674  prf: 2309.46882
reading burst:  57  output_record:  96282  output_time (s):  44.77113  SAR data offset: 88233  prf: 2309.46882
reading burst:  58  output_record:  98010  output_time (s):  45.57465  SAR data offset: 89792  prf: 2309.46882
reading burst:  59  output_record:  99738  output_time (s):  46.37817  SAR data offset: 91351  prf: 2309.46882
reading burst:  60  output_record: 101466  output_time (s):  47.18169  SAR data offset: 92910  prf: 2309.46882
reading burst:  61  output_record: 103194  output_time (s):  47.98521  SAR data offset: 94469  prf: 2309.46882
reading burst:  62  output_record: 104922  output_time (s):  48.78873  SAR data offset: 96028  prf: 2309.46882
reading burst:  63  output_record: 106650  output_time (s):  49.59225  SAR data offset: 97587  prf: 2309.46882
reading burst:  64  output_record: 108377  output_time (s):  50.39531  SAR data offset: 99146  prf: 2309.46882
reading burst:  65  output_record: 110105  output_time (s):  51.19883  SAR data offset: 100705  prf: 2309.46882
reading burst:  66  output_record: 111833  output_time (s):  52.00235  SAR data offset: 102264  prf: 2309.46882
reading burst:  67  output_record: 113561  output_time (s):  52.80587  SAR data offset: 103823  prf: 2309.46882
reading burst:  68  output_record: 115289  output_time (s):  53.60939  SAR data offset: 105382  prf: 2309.46882
reading burst:  69  output_record: 117017  output_time (s):  54.41291  SAR data offset: 106941  prf: 2309.46882
reading burst:  70  output_record: 118745  output_time (s):  55.21643  SAR data offset: 108500  prf: 2309.46882
reading burst:  71  output_record: 120473  output_time (s):  56.01995  SAR data offset: 110059  prf: 2309.46882

total output lines: 122547   bytes/line: 10204
duration of raw data (s): 56.983890
number of echoes: 122547
MSP sensor parameter file:     raw_WB/20101028_2.sar_par
MSP processing parameter file: raw_WB/p20101028_2.slc.par
output reformatted raw data file: raw_WB/20101028_2.raw

user time (s):         8.660
```

```
system time (s):       1.100
elapsed time (s):     18.600


PALSAR_antpat raw_WB/20101028_2.sar_par raw_WB/p20101028_2.slc.par palsar_ant_20061024.dat
PALSAR_20101028_2.antpat 19
*** Extract specified antenna pattern from a PALSAR JAXA antenna pattern file ***
*** Copyright 2011, Gamma Remote Sensing, v1.1 clw 24-Mar-2011 ***
MSP sensor parameter file: raw_WB/20101028_2.sar_par
MSP processing parameter file: raw_WB/p20101028_2.slc.par
JAXA PALSAR antenna  pattern file: palsar_ant_20061024.dat
MSP format antenna  pattern file: PALSAR_20101028_2.antpat
NOTE: using command line value for Beam_ID: 19
off-nadir look angle (deg): 26.555

PALSAR polarization (T/R): HH  pol. index: 0

Beam_ID   samples   HH (dB)   HV (dB)   VH (dB)   VV (dB)
============================================================
    0       101      33.800    33.760    33.450    33.410
    1        99      34.360    34.870    34.460    34.970
    2        93      34.750    35.410    34.840    35.500
    3        89      34.980    35.510    34.970    35.500
    4        83      35.550    36.140    35.640    36.230
    5        77      35.710    36.270    35.800    36.370
    6        73      35.810    36.300    35.910    36.390
    7        67      36.030    36.340    36.030    36.340
    8        61      36.060    36.440    36.190    36.570
    9        57      36.090    36.450    36.190    36.550
   10        53      36.550    36.810    36.670    36.920
   11        49      36.590    36.850    36.670    36.940
   12        45      36.600    36.870    36.700    36.980
   13        41      36.610    36.880    36.700    36.970
   14        39      36.610    36.890    36.700    36.980
   15        37      36.580    36.860    36.700    36.980
   16        35      36.580    36.850    36.690    36.970
   17        33      36.590    36.870    36.700    36.970
   18        91      33.550    34.360    33.720    34.520
   19        81      35.020    35.550    35.100    35.630
   20        73      35.200    35.760    35.310    35.880
   21        67      35.890    36.310    35.890    36.310
   22        63      36.040    36.270    36.140    36.370

total number of antenna patterns: 23

Beam_ID  lk_angle (deg.)  peak gain (dB)
=========================================
   0          9.700          33.800
   1         14.100          34.360
   2         17.900          34.750
   3         21.200          34.980
   4         25.800          35.550
   5         28.700          35.710
   6         30.800          35.810
   7         34.000          36.030
   8         36.700          36.060
   9         38.500          36.090
  10         41.300          36.550
  11         43.400          36.590
  12         45.100          36.600
  13         46.600          36.610
  14         47.700          36.610
  15         49.000          36.580
  16         50.000          36.580
  17         50.600          36.590
  18         19.900          33.550
  19         25.800          35.020
  20         30.300          35.200
  21         33.600          35.890
  22         36.000          36.040

selected beam: 19  nominal lk_ang (deg.): 26.555  beam center (deg.): 25.800  offset (deg.): 0.755

Gamma MSP SAR sensor parameters
SAR sensor parameter title:                          ALPSRS253644500
sensor (ERS, ASAR, PALSAR...):                       PALSAR
chirp direction flag: (UP_CHIRP, DOWN_CHIRP):        DOWN_CHIRP
```

```
receiver A/D mode: (REAL, FMCW, IQ):                IQ
SAR data sample type (FLOAT, BYTE):                 BYTE
SAR receiver spectrum (NORMAL, INVERT):             NORMAL
carrier frequency (Hz):                              1.270000000e+09
chirp bandwidth (Hz):                                1.400000e+07
chirp duration (sec.):                               2.700000e-05
range A/D sampling frequency (HZ):                   1.600000e+07
SAR raw data file header size (bytes):                   0
SAR raw data record length (bytes):                  10204
SAR raw data record header size (bytes):               412
number of samples/record (IQ counts as 1 sample):     4896
azimuth antenna 3 dB beamwidth (decimal degrees):          1.3449
range antenna 3 dB beamwidth (decimal degrees):            3.8612
nominal azimuth antenna angle (degrees CW from North ):   90.0000
nominal look-angle, off-nadir (deg.):                     25.8000
nominal platform pitch angle (deg., nose up+):             0.0000
antenna gain pattern filename:                      PALSAR_20101028_2.antpat

updated SAR_par parameter file: raw_WB/20101028_2.sar_par

user time (s):         0.010
system time (s):       0.000
elapsed time (s):      0.620


PALSAR_proc_WB 20101028/LED-ALPSRS253644500-W1.0__D raw_WB/20101028_3.sar_par
raw_WB/p20101028_3.slc.par 20101028/IMG-HH-ALPSRS253644500-W1.0__D 3 raw_WB/20101028_3.raw 2150.537634
*** PALSAR ScanSAR raw data pre-processing and generation of the MSP processing parameters ***
*** Copyright 2011, Gamma Remote Sensing, v1.2 18-Mar-2011 clw ***
PALSAR scene identifier (orbit,frame): ALPSRS253644500
CEOS leader file descriptor record center time: 20101028220327669
Processing Facility: EORC
file header size: 720  line header size: 412
PALSAR center frequency (MHz): 1270.000
PALSAR wavlength (m):  0.2360571
SAR is right looking
ScanSAR beam: 3

total number of input data lines: 110689
input data record length (bytes): 11200
number of bytes of input SAR data per record (including right fill): 10788

line offset: 1285  beam number: 3  initial value of the pulse repetition interval (PRI micro-sec): 591
PRF calculated from PRI: 1692.04737733  AUX data value: 1692.04700000
initial value of the slant range to the first sample (m): 821234
number of pulses in the air (double, int):   9.270192  9
initial value of the range delay to the first sample (micro-sec): 168
slant range to first sample from timing (m): 821234.163
number of echoes in the different beams (1-->5): 247  356  274  355  327
pulses per ScanSAR cycle: 1559

new max value for starting slant range at line offset: 48055  range gate: 175  range (m): 822283
new max value for starting slant range at line offset:105738  range gate: 180  range (m): 823033
valid WB ScanSAR data begins at line offset: 0
line offset to the start of beam 1 burst: 682
beam: 1  record:   682  beam:     1  pn_scch: 1  rho (m): 744188.0  PRI (s): 5.9900000e-04  PRF (Hz): 1669.44900
beam: 2  record:   929  beam:     2  pn_scch: 1  rho (m): 784060.0  PRI (s): 4.2700000e-04  PRF (Hz): 2341.92000
beam: 3  record:  1285  beam:     3  pn_scch: 1  rho (m): 821234.0  PRI (s): 5.9100000e-04  PRF (Hz): 1692.04700
beam: 4  record:  1559  beam:     4  pn_scch: 1  rho (m): 863955.0  PRI (s): 4.6900000e-04  PRF (Hz): 2132.19600
beam: 5  record:  1914  beam:     5  pn_scch: 1  rho (m): 894384.0  PRI (s): 5.2900000e-04  PRF (Hz): 1890.35900
output data PRF: 2150.537634
NOTE: change in slant range to first sample of beam 3 observed (m) min.: 821234  max.: 823033

PRF for data in burst 1 for beam 3: 1692.047377
PRF of output resampled raw data: 2150.537634
starting line offset to start of WB SAR mode image data: 0
initial SAR data pixels (samples)/line: 4432
initial right fill zero (samples): 962
number of observation mode data lines: 110689
number of missing lines in the data: 0

chirp bandwidth (Hz):        1.4000e+07
chirp duration (s):          2.7000e-05
ADC sample frequency (Hz):   1.6000e+07
range pixel spacing (m):     9.36851431
slant range delay (microsec)  min.: 821234   max.: 823033
slant range delay (microsec)  first: 144   last: 180
slant range of first sample from line header (m) first: 863955   last: 823033
```

```
range gate width (microsec) first: 277   last: 336

duration of data (s): 56.984752
time delay to first sample adjusted for range-gate shifts (s):   5.47868e-03
number of extra range samples due to shifts in the range gate: 192
total number of echo samples in the output data: 5568
output raw data record length (bytes): 11548
maximum number of echoes in a burst: 356

burst window weighting flag: 0
data start time (millisec) : 79379278
lstr: 0  msod: 79379278  Mpps: 278050  Mpps mod 1000: 50
raw data start time year, month, day: 2010 10 28
raw data start time (s): 79379.278050
raw data center time (s): 79407.769995
raw data start time (hrs,min,sec): 022  0 2  59.278050
time interval between state vectors (s): 60.000000
state vectors stored in parameter file: 15
time of first state vector in the CEOS leader UTC (s):   78660.0000

Rotating Earth-Fixed Reference Frame Position Vectors:
time (UTC s):   78660.0000 rotating position x,y,z (m):  -6978751.647   -1163606.141      50475.667
time (UTC s):   78720.0000 rotating position x,y,z (m):  -6983488.565   -1068441.490    -395234.752
time (UTC s):   78780.0000 rotating position x,y,z (m):  -6959193.395    -969050.707    -839338.665
time (UTC s):   78840.0000 rotating position x,y,z (m):  -6905938.003    -866089.650   -1280031.707
time (UTC s):   78900.0000 rotating position x,y,z (m):  -6823917.841    -760227.295   -1715524.575
time (UTC s):   78960.0000 rotating position x,y,z (m):  -6713451.077    -652141.909   -2144050.426
time (UTC s):   79020.0000 rotating position x,y,z (m):  -6574977.182    -542517.220   -2563872.198
time (UTC s):   79080.0000 rotating position x,y,z (m):  -6409054.960    -432038.562   -2973289.817
time (UTC s):   79140.0000 rotating position x,y,z (m):  -6216359.957    -321389.014   -3370647.195
time (UTC s):   79200.0000 rotating position x,y,z (m):  -5997681.366    -211245.576   -3754338.945
time (UTC s):   79260.0000 rotating position x,y,z (m):  -5753918.444    -102275.426   -4122816.833
time (UTC s):   79320.0000 rotating position x,y,z (m):  -5486076.472       4867.731   -4474595.954
time (UTC s):   79380.0000 rotating position x,y,z (m):  -5195262.260     109547.212   -4808260.586
time (UTC s):   79440.0000 rotating position x,y,z (m):  -4882679.273     211146.788   -5122469.730
time (UTC s):   79500.0000 rotating position x,y,z (m):  -4549622.343     309073.974   -5415962.318
time (UTC s):   79560.0000 rotating position x,y,z (m):  -4197472.003     402763.133   -5687562.025
time (UTC s):   79620.0000 rotating position x,y,z (m):  -3827688.525     491678.412   -5936181.708
time (UTC s):   79680.0000 rotating position x,y,z (m):  -3441805.660     575316.499   -6160827.447
time (UTC s):   79740.0000 rotating position x,y,z (m):  -3041424.144     653209.185   -6360602.175
time (UTC s):   79800.0000 rotating position x,y,z (m):  -2628205.032     724925.723   -6534708.969
time (UTC s):   79860.0000 rotating position x,y,z (m):  -2203862.761     790074.975   -6682454.013
time (UTC s):   79920.0000 rotating position x,y,z (m):  -1770157.994     848307.339   -6803249.077
time (UTC s):   79980.0000 rotating position x,y,z (m):  -1328890.379     899316.464   -6896613.574
time (UTC s):   80040.0000 rotating position x,y,z (m):   -881891.189     942840.718   -6962176.244
time (UTC s):   80100.0000 rotating position x,y,z (m):   -431015.869     978664.415   -6999676.439
time (UTC s):   80160.0000 rotating position x,y,z (m):     21863.444    1006618.812   -7008965.043
time (UTC s):   80220.0000 rotating position x,y,z (m):    474865.481    1026582.853   -6990005.080
time (UTC s):   80280.0000 rotating position x,y,z (m):    926107.530    1038483.679   -6942871.955
index of state vector closest to image center time: 5

interpolated state vectors:
time (UTC s):   78960.0000
position x,y,z (m)  :  -6713451.077    -652141.909   -2144050.426
velocity x,y,z (m/s):     2075.8933      1816.1542     -7074.3413

time (UTC s):   79020.0000
position x,y,z (m)  :  -6574977.182    -542517.220   -2563872.198
velocity x,y,z (m/s):     2538.3503      1836.0973     -6914.9934

time (UTC s):   79080.0000
position x,y,z (m)  :  -6409054.960    -432038.562   -2973289.817
velocity x,y,z (m/s):     2990.5131      1844.6261     -6727.6585

time (UTC s):   79140.0000
position x,y,z (m)  :  -6216359.957    -321389.014   -3370647.195
velocity x,y,z (m/s):     3430.4605      1841.8105     -6513.1263

time (UTC s):   79200.0000
position x,y,z (m)  :  -5997681.366    -211245.576   -3754338.945
velocity x,y,z (m/s):     3856.3268      1827.7831     -6272.2963

time (UTC s):   79260.0000
position x,y,z (m)  :  -5753918.444    -102275.426   -4122816.833
velocity x,y,z (m/s):     4266.3102      1802.7384     -6006.1735

time (UTC s):   79320.0000
```

```
position x,y,z (m)   :  -5486076.472       4867.731   -4474595.954
velocity x,y,z (m/s):      4658.6797      1766.9307     -5715.8630

time (UTC s):   79380.0000
position x,y,z (m)   :  -5195262.260     109547.212   -4808260.586
velocity x,y,z (m/s):      5031.7829      1720.6727     -5402.5649

time (UTC s):   79440.0000
position x,y,z (m)   :  -4882679.273     211146.788   -5122469.730
velocity x,y,z (m/s):      5384.0516      1664.3332     -5067.5689

time (UTC s):   79500.0000
position x,y,z (m)   :  -4549622.343     309073.974   -5415962.318
velocity x,y,z (m/s):      5714.0095      1598.3343     -4712.2485

time (UTC s):   79560.0000
position x,y,z (m)   :  -4197472.003     402763.133   -5687562.025
velocity x,y,z (m/s):      6020.2770      1523.1484     -4338.0541

time (UTC s):   79620.0000
position x,y,z (m)   :  -3827688.525     491678.412   -5936181.708
velocity x,y,z (m/s):      6301.5766      1439.2954     -3946.5068

time (UTC s):   79680.0000
position x,y,z (m)   :  -3441805.660     575316.499   -6160827.447
velocity x,y,z (m/s):      6556.7372      1347.3396     -3539.1917

time (UTC s):   79740.0000
position x,y,z (m)   :  -3041424.144     653209.185   -6360602.175
velocity x,y,z (m/s):      6784.6973      1247.8862     -3117.7513

time (UTC s):   79800.0000
position x,y,z (m)   :  -2628205.032     724925.723   -6534708.969
velocity x,y,z (m/s):      6984.5087      1141.5781     -2683.8805

number of state vectors copied: 15
SAR position at center time x,y,z (m):  -5053218.101    156990.237  -4956183.882
SAR velocity at center time x,y,z (m/s):    5197.5062    1695.8257   -5250.1335
S/C radial distance from earth center (m):   7079789.3881
raw data center latitude, longitude (deg.):   -43.542848    172.981551
geocentric Earth radius at scene center(m):  6368233.040
SAR average altitude above terrain (m):       711556.348
nominal look angle at center swath (deg.):       30.9718

number of echoes in the resampled output burst: 349
burst 1 offset to start of burst (lines): 1285   nominal burst length: 274
number of invalid pulses at start of burst: 13

reading burst:   2  output_record:   1724  output_time (s):   0.80166  SAR data offset: 2844  prf: 1692.04738
reading burst:   3  output_record:   3447  output_time (s):   1.60286  SAR data offset: 4403  prf: 1692.04738
reading burst:   4  output_record:   5171  output_time (s):   2.40452  SAR data offset: 5962  prf: 1692.04738
reading burst:   5  output_record:   6894  output_time (s):   3.20571  SAR data offset: 7521  prf: 1692.04738
reading burst:   6  output_record:   8617  output_time (s):   4.00691  SAR data offset: 9080  prf: 1692.04738
reading burst:   7  output_record:  10341  output_time (s):   4.80857  SAR data offset: 10639  prf: 1692.04738
reading burst:   8  output_record:  12064  output_time (s):   5.60976  SAR data offset: 12198  prf: 1692.04738
reading burst:   9  output_record:  13788  output_time (s):   6.41142  SAR data offset: 13757  prf: 1692.04738
reading burst:  10  output_record:  15511  output_time (s):   7.21262  SAR data offset: 15316  prf: 1692.04738
reading burst:  11  output_record:  17234  output_time (s):   8.01381  SAR data offset: 16875  prf: 1692.04738
reading burst:  12  output_record:  18958  output_time (s):   8.81547  SAR data offset: 18434  prf: 1692.04738
reading burst:  13  output_record:  20681  output_time (s):   9.61667  SAR data offset: 19993  prf: 1692.04738
reading burst:  14  output_record:  22405  output_time (s):  10.41833  SAR data offset: 21552  prf: 1692.04738
reading burst:  15  output_record:  24128  output_time (s):  11.21952  SAR data offset: 23111  prf: 1692.04738
reading burst:  16  output_record:  25851  output_time (s):  12.02072  SAR data offset: 24670  prf: 1692.04738
reading burst:  17  output_record:  27575  output_time (s):  12.82238  SAR data offset: 26229  prf: 1692.04738
reading burst:  18  output_record:  29298  output_time (s):  13.62357  SAR data offset: 27788  prf: 1692.04738
reading burst:  19  output_record:  31022  output_time (s):  14.42523  SAR data offset: 29347  prf: 1692.04738
reading burst:  20  output_record:  32745  output_time (s):  15.22643  SAR data offset: 30906  prf: 1692.04738
reading burst:  21  output_record:  34468  output_time (s):  16.02762  SAR data offset: 32465  prf: 1692.04738
reading burst:  22  output_record:  36192  output_time (s):  16.82928  SAR data offset: 34024  prf: 1692.04738
reading burst:  23  output_record:  37915  output_time (s):  17.63048  SAR data offset: 35583  prf: 1692.04738
reading burst:  24  output_record:  39639  output_time (s):  18.43214  SAR data offset: 37142  prf: 1692.04738
reading burst:  25  output_record:  41362  output_time (s):  19.23333  SAR data offset: 38701  prf: 1692.04738
reading burst:  26  output_record:  43085  output_time (s):  20.03453  SAR data offset: 40260  prf: 1692.04738
reading burst:  27  output_record:  44809  output_time (s):  20.83619  SAR data offset: 41819  prf: 1692.04738
reading burst:  28  output_record:  46532  output_time (s):  21.63738  SAR data offset: 43378  prf: 1692.04738
reading burst:  29  output_record:  48255  output_time (s):  22.43858  SAR data offset: 44937  prf: 1692.04738
reading burst:  30  output_record:  49979  output_time (s):  23.24024  SAR data offset: 46496  prf: 1692.04738
reading burst:  31  output_record:  51702  output_time (s):  24.04143  SAR data offset: 48055  prf: 1692.04738
reading burst:  32  output_record:  53430  output_time (s):  24.84495  SAR data offset: 49614  prf: 1692.04738
reading burst:  33  output_record:  55158  output_time (s):  25.64847  SAR data offset: 51173  prf: 1692.04738
reading burst:  34  output_record:  56886  output_time (s):  26.45199  SAR data offset: 52732  prf: 1692.04738
```

```
reading burst:  35  output_record:  58614  output_time (s):  27.25551  SAR data offset: 54291  prf: 1692.04738
reading burst:  36  output_record:  60342  output_time (s):  28.05903  SAR data offset: 55850  prf: 1692.04738
reading burst:  37  output_record:  62070  output_time (s):  28.86255  SAR data offset: 57409  prf: 1692.04738
reading burst:  38  output_record:  63798  output_time (s):  29.66607  SAR data offset: 58968  prf: 1692.04738
reading burst:  39  output_record:  65526  output_time (s):  30.46959  SAR data offset: 60527  prf: 1692.04738
reading burst:  40  output_record:  67254  output_time (s):  31.27311  SAR data offset: 62086  prf: 1692.04738
reading burst:  41  output_record:  68982  output_time (s):  32.07663  SAR data offset: 63645  prf: 1692.04738
reading burst:  42  output_record:  70710  output_time (s):  32.88015  SAR data offset: 65204  prf: 1692.04738
reading burst:  43  output_record:  72438  output_time (s):  33.68367  SAR data offset: 66763  prf: 1692.04738
reading burst:  44  output_record:  74166  output_time (s):  34.48719  SAR data offset: 68322  prf: 1692.04738
reading burst:  45  output_record:  75894  output_time (s):  35.29071  SAR data offset: 69881  prf: 1692.04738
reading burst:  46  output_record:  77622  output_time (s):  36.09423  SAR data offset: 71440  prf: 1692.04738
reading burst:  47  output_record:  79350  output_time (s):  36.89775  SAR data offset: 72999  prf: 1692.04738
reading burst:  48  output_record:  81078  output_time (s):  37.70127  SAR data offset: 74558  prf: 1692.04738
reading burst:  49  output_record:  82806  output_time (s):  38.50479  SAR data offset: 76117  prf: 1692.04738
reading burst:  50  output_record:  84534  output_time (s):  39.30831  SAR data offset: 77676  prf: 1692.04738
reading burst:  51  output_record:  86262  output_time (s):  40.11183  SAR data offset: 79235  prf: 1692.04738
reading burst:  52  output_record:  87990  output_time (s):  40.91535  SAR data offset: 80794  prf: 1692.04738
reading burst:  53  output_record:  89718  output_time (s):  41.71887  SAR data offset: 82353  prf: 1692.04738
reading burst:  54  output_record:  91446  output_time (s):  42.52239  SAR data offset: 83912  prf: 1692.04738
reading burst:  55  output_record:  93174  output_time (s):  43.32591  SAR data offset: 85471  prf: 1692.04738
reading burst:  56  output_record:  94902  output_time (s):  44.12943  SAR data offset: 87030  prf: 1692.04738
reading burst:  57  output_record:  96630  output_time (s):  44.93295  SAR data offset: 88589  prf: 1692.04738
reading burst:  58  output_record:  98358  output_time (s):  45.73647  SAR data offset: 90148  prf: 1692.04738
reading burst:  59  output_record: 100086  output_time (s):  46.53999  SAR data offset: 91707  prf: 1692.04738
reading burst:  60  output_record: 101814  output_time (s):  47.34351  SAR data offset: 93266  prf: 1692.04738
reading burst:  61  output_record: 103542  output_time (s):  48.14703  SAR data offset: 94825  prf: 1692.04738
reading burst:  62  output_record: 105270  output_time (s):  48.95055  SAR data offset: 96384  prf: 1692.04738
reading burst:  63  output_record: 106998  output_time (s):  49.75407  SAR data offset: 97943  prf: 1692.04738
reading burst:  64  output_record: 108726  output_time (s):  50.55759  SAR data offset: 99502  prf: 1692.04738
reading burst:  65  output_record: 110454  output_time (s):  51.36111  SAR data offset: 101061  prf: 1692.04738
reading burst:  66  output_record: 112182  output_time (s):  52.16463  SAR data offset: 102620  prf: 1692.04738
reading burst:  67  output_record: 113910  output_time (s):  52.96815  SAR data offset: 104179  prf: 1692.04738
reading burst:  68  output_record: 115638  output_time (s):  53.77167  SAR data offset: 105738  prf: 1692.04738
reading burst:  69  output_record: 117366  output_time (s):  54.57519  SAR data offset: 107297  prf: 1692.04738
reading burst:  70  output_record: 119094  output_time (s):  55.37871  SAR data offset: 108856  prf: 1692.04738
reading burst:  71  output_record: 120822  output_time (s):  56.18223  SAR data offset: 110415  prf: 1692.04738

total output lines: 122547   bytes/line: 11548
duration of raw data (s): 56.983890
number of echoes: 122547
MSP sensor parameter file:     raw_WB/20101028_3.sar_par
MSP processing parameter file: raw_WB/p20101028_3.slc.par
output reformatted raw data file: raw_WB/20101028_3.raw

user time (s):          9.600
system time (s):        1.550
elapsed time (s):      25.590


PALSAR_antpat raw_WB/20101028_3.sar_par raw_WB/p20101028_3.slc.par palsar_ant_20061024.dat
PALSAR_20101028_3.antpat 20
*** Extract specified antenna pattern from a PALSAR JAXA antenna pattern file ***
*** Copyright 2011, Gamma Remote Sensing, v1.1 clw 24-Mar-2011 ***
MSP sensor parameter file: raw_WB/20101028_3.sar_par
MSP processing parameter file: raw_WB/p20101028_3.slc.par
JAXA PALSAR antenna  pattern file: palsar_ant_20061024.dat
MSP format antenna  pattern file: PALSAR_20101028_3.antpat
NOTE: using command line value for Beam_ID: 20
off-nadir look angle (deg): 30.972

PALSAR polarization (T/R): HH  pol. index: 0

Beam_ID   samples   HH (dB)   HV (dB)   VH (dB)   VV (dB)
============================================================
    0       101      33.800    33.760    33.450    33.410
    1        99      34.360    34.870    34.460    34.970
    2        93      34.750    35.410    34.840    35.500
    3        89      34.980    35.510    34.970    35.500
    4        83      35.550    36.140    35.640    36.230
    5        77      35.710    36.270    35.800    36.370
    6        73      35.810    36.300    35.910    36.390
    7        67      36.030    36.340    36.030    36.340
    8        61      36.060    36.440    36.190    36.570
    9        57      36.090    36.450    36.190    36.550
   10        53      36.550    36.810    36.670    36.920
   11        49      36.590    36.850    36.670    36.940
   12        45      36.600    36.870    36.700    36.980
   13        41      36.610    36.880    36.700    36.970
   14        39      36.610    36.890    36.700    36.980
   15        37      36.580    36.860    36.700    36.980
   16        35      36.580    36.850    36.690    36.970
```

```
   17       33      36.590    36.870    36.700    36.970
   18       91      33.550    34.360    33.720    34.520
   19       81      35.020    35.550    35.100    35.630
   20       73      35.200    35.760    35.310    35.880
   21       67      35.890    36.310    35.890    36.310
   22       63      36.040    36.270    36.140    36.370

total number of antenna patterns: 23

Beam_ID  lk_angle (deg.)  peak gain (dB)
========================================
   0          9.700         33.800
   1         14.100         34.360
   2         17.900         34.750
   3         21.200         34.980
   4         25.800         35.550
   5         28.700         35.710
   6         30.800         35.810
   7         34.000         36.030
   8         36.700         36.060
   9         38.500         36.090
  10         41.300         36.550
  11         43.400         36.590
  12         45.100         36.600
  13         46.600         36.610
  14         47.700         36.610
  15         49.000         36.580
  16         50.000         36.580
  17         50.600         36.590
  18         19.900         33.550
  19         25.800         35.020
  20         30.300         35.200
  21         33.600         35.890
  22         36.000         36.040

selected beam: 20  nominal lk_ang (deg.): 30.972  beam center (deg.): 30.300  offset (deg.): 0.672

Gamma MSP SAR sensor parameters
SAR sensor parameter title:                          ALPSRS253644500
sensor (ERS, ASAR, PALSAR...):                       PALSAR
chirp direction flag: (UP_CHIRP, DOWN_CHIRP):        DOWN_CHIRP
receiver A/D mode: (REAL, FMCW, IQ):                 IQ
SAR data sample type (FLOAT, BYTE):                  BYTE
SAR receiver spectrum (NORMAL, INVERT):              NORMAL
carrier frequency (Hz):                               1.270000000e+09
chirp bandwidth (Hz):                                 1.400000e+07
chirp duration (sec.):                                2.700000e-05
range A/D sampling frequency (HZ):                    1.600000e+07
SAR raw data file header size (bytes):                    0
SAR raw data record length (bytes):                   11548
SAR raw data record header size (bytes):                412
number of samples/record (IQ counts as 1 sample):      5568
azimuth antenna 3 dB beamwidth (decimal degrees):          1.3449
range antenna 3 dB beamwidth (decimal degrees):            3.8612
nominal azimuth antenna angle (degrees CW from North ):   90.0000
nominal look-angle, off-nadir (deg.):                     30.3000
nominal platform pitch angle (deg., nose up+):             0.0000
antenna gain pattern filename:                       PALSAR_20101028_3.antpat

updated SAR_par parameter file: raw_WB/20101028_3.sar_par

user time (s):         0.010
system time (s):       0.000
elapsed time (s):      0.500


PALSAR PRE-PROCESSING mode 1 end: Sat Apr  9 09:11:25 2011
```

```
#############################################################################################
```

Run mode 4 to generate the proc_list_WB file

```
./PALSAR_pre_proc_WB CEOS_list_WB palsar_ant_20061024.dat raw_WB PALSAR_pre_proc_WB_4.log proc_list_WB
4 2150.537634
```

List contents of proc_list_WB

```
cat proc_list_WB

20071020 - - - -      0.0   0.0000e+00 0.8
20101028 - - - -      0.0   0.0000e+00 0.8
```

4 Appendix 2: PALSAR_proc_all_WB Commands and Output

```
./PALSAR_proc_all_WB proc_list_WB raw_WBs /media/d1 slc_WBs mli_WBs 3 16 0

*** scene id: 20071020  processing log file: slc_WBs/20071020_4_MSP.log  start time: Sat Apr  9
09:27:06 2011 ***
MSP processing parameter file: raw_WBs/p20071020_4.slc.par
MSP sensor parameter file: raw_WBs/20071020_4.sar_par
antenna pattern file: PALSAR_20071020_4.antpat
SAR sensor name:   PALSAR   year of acquisition: 2007
calibration factor (dB): -49
minimum autofocus SNR:
azimuth Kaiser beta:      2.12
raw data file:            raw_WBs/20071020_4.raw
range spectrum file:      20071020_4.rspec
azimuth spectrum file:    20071020_4.azsp
SLC output image:         slc_WBs/20071020_4.slc
MSP MLI proc file:
MLI output image:         mli_WBs/20071020_4.mli


set_value raw_WBs/p20071020_4.slc.par raw_WBs/p20071020_4.slc.par doppler_polynomial "     0.000
0.0000e+00    "
*** Update keyword:value in text parameter files ***
*** Copyright 2006, Gamma Remote Sensing, v1.4 20-Nov-2006 clw ***

keyword found: doppler_polynomial
current value: 0.00000e+00  0.00000e+00  0.00000e+00  0.00000e+00   Hz     Hz/m     Hz/m^2     Hz/m^3
new value:       0.000   0.0000e+00

set_value raw_WBs/p20071020_4.slc.par raw_WBs/p20071020_4.slc.par azimuth_bandwidth_fraction 0.8
*** Update keyword:value in text parameter files ***
*** Copyright 2006, Gamma Remote Sensing, v1.4 20-Nov-2006 clw ***

keyword found: azimuth_bandwidth_fraction
current value: 0.8000
new value:  0.8

pre_rc raw_WBs/20071020_4.sar_par raw_WBs/p20071020_4.slc.par raw_WBs/20071020_4.raw
/media/d1/20071020_4.rc - - - - - - 100 100 0 0 1
*** SAR data prefilter and range compression for complex IQ data ***
*** Copyright 2010, Gamma Remote Sensing, v1.5 clw 4-Oct-2010 ***
SAR sensor parameters: raw_WBs/20071020_4.sar_par
MSP processing parameters: raw_WBs/p20071020_4.slc.par
raw data file: raw_WBs/20071020_4.raw
prefiltered/range compressed data file: /media/d1/20071020_4.rc
WARNING rd_vec: insufficient number of values: 4    key: doppler_polynomial
prefilter decimation factor: 1
RFI suppression: ON
RFI range spectra file: range_spectra.dat

raw data file header size: 0
raw data bytes/line: 9692  samples/echo: 4640
file size bytes: 1175145308
number of echoes in the raw data file determined from measured file size: 121249

WARNING: number of raw data samples to process not specified, updating value: 4640
minimum number of points in the range FFT: 5304   ntaps: 432
number of input range samples:  4640
range FFT size:   5376
near range swath extension (samples): 100
far range swath extension  (samples): 100
number of raw data lines to process:  121249
pre-azimuth data extension (echoes):  0
post-azimuth data extension (echoes): 0
single byte values, (2 values/sample in IQ mode), samples/echo:   4640
creating FFTW forward and inverse plans for FFT size: 5376
SAR is right looking

time of first state vector: 79020.0000  number: 15  interval (s): 60.0000
time for focus calculation: 79454.4890
approximate image center latitude:    -43.3510695  longitude:    172.2559913
slant range vector (x,y,z):   452032.230    467804.628    598517.453
estimated azimuth chirp rate (Hz/sec):      -497.521
```

```
SAR geometry from state vectors:
approximate image center coordinates (x,y,z)(m):   -4602901.604     625937.192   -4355944.687
along-track SAR velocity (m/s):     7579.986
effective SAR velocity for image focus (m/s):     7204.081

lines offset to first echo:                  0
lines to prefilter/range compress:       121249
range samples/output line:                 4408
range offset to first sample:                 0 samples
slant range pixel spacing:             9.368514 (m)
approximate slant range resolution:       0.000 (m)
radar wavevector (radians/meter):        26.617
radians/slant range pixel:              498.728
raw SAR data slant range (near,center,far) (m):           864103.943   885834.212   907564.480
prefiltered/rc data, slant range (near,center,far) (m):   863167.092   883810.612   904454.133
Doppler centroid at mid-swath (Hz):          0.0
Doppler centroid (radians/sample):         0.000
azimuth doppler wavevector kx (m^-1):     0.0000
phase aberration without SRC at band edge (radians):        0.000
secondary range migration correction: ON
nominal azimuth chirp rate (Hz/sec/sec):    -4.97521e+02
nominal range chirp rate (Hz/sec/sec):      -5.18519e+11
SRC chirp rate (Hz/sec/sec):                        -inf
SRC modified range chirp rate (Hz/sec/sec): -5.18519e+11
modified range chirp bandwidth (Hz):         1.40000e+07
NOTE: chirp spectrum normal
range chirp length (samples):     433
range chirp rate (Hz/sec/sec):   -5.18519e+11
radiometric scale factor for range chirp length:  4.80569e-02
range chirp Kaiser window parameter:      2.12000
range shift (pixels): 100

number of sample points in DC bias sum:       1381536
I,Q channel DC offsets:                15.5924    15.6475
I,Q channel standard deviations:        5.8783     5.9356
I,Q channel correlation coefficient:   -0.0466

writing updated PROC_par file: raw_WBs/p20071020_4.slc.par
NOTE: chirp spectrum normal
number of frequency bins used by the chirp: 4704
number of lines/input data block: 128
number of input data blocks: 948
RFI smoothing window width: 9
RFI detection threshold: 1.500

number of echoes to process: 121249
range line:      0   rejected fraction:    0.000
range line:    128   rejected fraction:    0.000
range line:    256   rejected fraction:    0.000
range line:    384   rejected fraction:    0.000
range line:    512   rejected fraction:    0.000
range line:    640   rejected fraction:    0.000
range line:    768   rejected fraction:    0.000
range line:    896   rejected fraction:    0.000
range line:   1024   rejected fraction:    0.000
range line:   1152   rejected fraction:    0.000
range line:   1280   rejected fraction:    0.000
range line:   1408   rejected fraction:    0.000
range line:   1536   rejected fraction:    0.000
range line:   1664   rejected fraction:    0.000
range line:   1792   rejected fraction:    0.000
range line:   1920   rejected fraction:    0.000
range line:   2048   rejected fraction:    0.001
range line:   2176   rejected fraction:    0.000

...
range line: 120576   rejected fraction:    0.000
range line: 120704   rejected fraction:    0.000
range line: 120832   rejected fraction:    0.000
range line: 120960   rejected fraction:    0.000
range line: 121088   rejected fraction:    0.000
number echoes to process including pre- and post-azimuth data extension: 121249
total number of output lines: 121249  number of samples/line: 4408

user time (s):        26.950
system time (s):       3.750
elapsed time (s):     36.680
```

```
az_proc raw_WBs/20071020_4.sar_par raw_WBs/p20071020_4.slc.par /media/d1/20071020_4.rc
slc_WBs/20071020_4.slc 16384 0 -49 0 2.12
*** SAR Range-Doppler azimuth compression for range-compressed data ***
*** Copyright 2010, Gamma Remote Sensing, v2.7 30-Dec-2010 clw/uw ***

MSP SAR sensor parameter file: raw_WBs/20071020_4.sar_par
MSP processing parameter file: raw_WBs/p20071020_4.slc.par
range compressed input data:   /media/d1/20071020_4.rc
output SLC image:              slc_WBs/20071020_4.slc

SAR sensor description: ALPSRS092604500
scene description: ALPSRS092604500

azimuth deskew of data: ON
azimuth patch size (lines): 16384
output SLC format: FCOMPLEX (pairs of 4-byte float (re,im))
SAR receiver gain (dB):  24.0000
processor radiometric calibration factor (dB): -49.0000
processor radiometric calibration factor:  1.258925e-05
output SLC type: sigma0 (SQR(re)+SQR(im) => sigma0) (default)

Kaiser window parameter for azimuth reference function:     2.1200
IQ mode raw data, number of compressed range samples: 4408
SAR geometry: right-looking
prefilter decimation factor:      1
points in the azimuth FFT:    16384
range compressed SLC width (samples):   4408
slant range of raw SAR data (near, center, far) (m):          864103.943   885834.211   907564.480
slant range of range compressed data (near,center,far) (m):   863167.092   883810.612   904454.133
approximate center time of image segment (sec.):   79454.4892
pulse repetition frequency (Hz): 2150.53763
Doppler centroid range compressed data (near, center, far)(Hz):0.000  0.000  0.000
Doppler centroid at center swath (radians/sample): 0.00000

SAR GEOMETRY from state vectors:
nominal raw data center latitude, longitude (deg.): -43.351083  172.255985
geoid radius at center of raw data swath (m): 6368104.475
radial distance of SAR from earth center (m): 7079834.538
nominal SAR altitude (m): 711730.063
along-track SAR velocity magnitude (m/s): 7579.9856
approximate azimuth sample spacing along the orbit track (m): 3.52469
angle between sub-radar point and center swath relative to earth center (deg.): 4.474602
slant range:   863167.092  fdd (Hz/s):     -509.366  v_focus:     7203.704
slant range:   883810.612  fdd (Hz/s):     -497.521  v_focus:     7204.081
slant range:   904454.133  fdd (Hz/s):     -486.201  v_focus:     7204.348
effective SAR velocity cross-track rate (m/s)/m:  1.559e-05
NOTE: Using predicted effective velocity for SAR focus (m/s): 7204.0814

lines offset to first echo:            0
radar center frequency (Hz): 1.2700000e+09
radar wavelength (m):            0.2360571
radar wavevector (radians/m):      26.6172
radians/slant range pixel:        498.7278
slant range SLC pixel size:       9.368514
slant range of raw SAR data (near,center,far) (m):            864103.943   885834.211   907564.480
slant range of range compressed data (near,center,far) (m):   863167.092   883810.612   904454.133
angle between vel.+look vec. (center swath)(deg.):     90.00000
Doppler squint angle (degrees):      -0.0000
az. depth of focus (range m, samples):                141.9105      15.1476
range at closest approach (near, far swath)(m):     863167.0919  904454.1331
ranges along the synth. aperture (near swath)(m):   863301.0788  863167.0919  863301.0788
ranges along the synth. aperture (far swath)(m):    904594.5038  904454.1331  904594.5038
RM relative to aperture center min,max: (samples):       0.0000      14.9832
RM min,max (range samples):     0       15

SAR data buffer size (Mbytes):    551.125
allocating patch memory cols: 16384   rows: 4408
creating FFTW plans: 16384

antenna pattern file: PALSAR_20071020_4.antpat
antenna pattern starting angle (deg.):  -3.10000  angular step (deg.):   0.10000  samples: 67

synthetic aperture time (s) (min, max): 3.37759   max: 3.53852
synthetic aperture length samples min: 7263  max: 7609
SLC slant range, zero-Doppler geometry (near range):   863167.092
```

```
SLC slant range, zero-Doppler geometry (center):       883810.612
SLC slant range, zero-Doppler geometry (far range):    904454.133
first non-zero range sample: 6   last non-zero range sample: 4386   number of samples: 4381

patch center slant range:            883810.61250
image center Doppler, azimuth angle:      0.00000     90.00000
image deskew at center swath (pixels):        0.000

processed Doppler bandwidth (Hz):              1720.430
az. chirp rate, near, center, far range (Hz/s):   -509.36588   -497.52054   -486.20093
aperture duration: near, far range (s):         3.37759      3.53852
far range az.ref.length (meters, samples):    25489.373     7609
near range az.ref.length (meters, samples):   24330.308     7263
number of azimuth patches: 14
number of azimuth patches: 14
azimuth offset to center of first SLC image line (s):      1.78374
first, last azimuth line in output buffer:   3836   12547
number of output image lines/patch:          8712
azimuth deskew near, far range (samples): 0  0
SLC image geometry: deskewed (zero-Doppler)
nominal azimuth angle:      90.0000 (right looking)

**** Radiometric Calibration Parameters ****
output SLC image file:   slc_WBs/20071020_4.slc
output SLC format: FCOMPLEX (pairs of 4-byte-float)
output SLC type: sigma0   (SQR(re)+SQR(im) corresponds to sigma0)
SAR receiver gain [dB]:                 24.0000
radiometric calibration factor [dB]:   -49.0000
Kaiser azimuth window parameter:         2.1200
```

pixel number	range [m]	look_ang [deg]	inc_ang [deg]	sin_inc [dB]	cos_inc [dB]	ant_gain2 [dB]	pow_fact [dB]	vel_x [m/s]
0	863167.1	32.450	36.620	1.837	0.955	0.580	-61.512	7203.760
400	866914.5	32.781	37.008	1.877	0.977	0.295	-61.721	7203.818
800	870661.9	33.107	37.390	1.915	0.999	0.117	-61.823	7203.876
1200	874409.3	33.427	37.765	1.952	1.021	0.025	-61.841	7203.935
1600	878156.7	33.741	38.134	1.988	1.043	-0.000	-61.792	7203.993
2000	881904.1	34.050	38.497	2.022	1.064	0.040	-61.681	7204.052
2400	885651.5	34.353	38.854	2.056	1.086	0.137	-61.514	7204.110
2800	889398.9	34.652	39.206	2.089	1.108	0.306	-61.274	7204.168
3200	893146.3	34.945	39.553	2.121	1.129	0.555	-60.957	7204.227
3600	896893.7	35.234	39.894	2.152	1.151	0.897	-60.547	7204.285
4000	900641.1	35.518	40.231	2.183	1.172	1.354	-60.023	7204.344
4400	904388.6	35.798	40.562	2.212	1.194	1.944	-59.367	7204.402

```
PATCH: 1   line offset: 0  center time offset (s): -24.38088
Doppler centroid (center swath) (Hz):      0.000

FORWARD AZIMUTH FFT size: 16384   range bins: 4408

azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3024   closest range (m):  863223.3030
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.3407   aperture (s): 3.37776   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7203.76040
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30238   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 2190   range bin: 2196   range (m): 883740.3481   closest range (m):  883740.3486
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.5599   aperture (s): 3.45773   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.08026
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34808   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 4379   range bin: 4385   range (m): 904248.0253   closest range (m):  904248.0258
```

```
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.3188   aperture (s): 3.53766   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.39997
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02526   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000

PATCH: 2   line offset: 8712  center time offset (s): -20.32980
Doppler centroid (center swath) (Hz):      0.000

FORWARD AZIMUTH FFT size: 16384   range bins: 4408

azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3024   closest range (m):  863223.3030
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.3407   aperture (s): 3.37776   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7203.76040
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30237   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 2190   range bin: 2196   range (m): 883740.3481   closest range (m):  883740.3486
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.5599   aperture (s): 3.45773   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.08026
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34807   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 4379   range bin: 4385   range (m): 904248.0253   closest range (m):  904248.0258
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.3188   aperture (s): 3.53766   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.39997
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02525   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000

PATCH: 3   line offset: 17424  center time offset (s): -16.27872
Doppler centroid (center swath) (Hz):      0.000

FORWARD AZIMUTH FFT size: 16384   range bins: 4408

azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3024   closest range (m):  863223.3030
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.3407   aperture (s): 3.37776   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7203.76040
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30236   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 2190   range bin: 2196   range (m): 883740.3481   closest range (m):  883740.3486
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.5599   aperture (s): 3.45773   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.08026
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
```

```
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34806   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 4379   range bin: 4385   range (m): 904248.0252   closest range (m):  904248.0258
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.3188   aperture (s): 3.53766   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.39997
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02525   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000

PATCH: 4   line offset: 26136  center time offset (s): -12.22764
Doppler centroid (center swath) (Hz):      0.000

FORWARD AZIMUTH FFT size: 16384   range bins: 4408

azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3024   closest range (m):  863223.3030
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.3407   aperture (s): 3.37776   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7203.76040
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30235   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 2190   range bin: 2196   range (m): 883740.3481   closest range (m):  883740.3486
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.5599   aperture (s): 3.45773   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.08026
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34805   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 4379   range bin: 4385   range (m): 904248.0252   closest range (m):  904248.0258
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.3188   aperture (s): 3.53766   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.39997
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02524   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000

PATCH: 5   line offset: 34848  center time offset (s):  -8.17656
Doppler centroid (center swath) (Hz):      0.000

FORWARD AZIMUTH FFT size: 16384   range bins: 4408

azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3023   closest range (m):  863223.3030
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.3407   aperture (s): 3.37776   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7203.76040
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30234   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 2190   range bin: 2196   range (m): 883740.3480   closest range (m):  883740.3486
```

```
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.5599   aperture (s): 3.45773   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.08026
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34805   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 4379   range bin: 4385   range (m): 904248.0252   closest range (m):  904248.0258
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.3188   aperture (s): 3.53766   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.39997
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02523   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000

PATCH: 6   line offset: 43560  center time offset (s):  -4.12548
Doppler centroid (center swath) (Hz):      0.000

FORWARD AZIMUTH FFT size: 16384   range bins: 4408

azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3023   closest range (m):  863223.3030
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.3407   aperture (s): 3.37776   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7203.76040
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30233   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 2190   range bin: 2196   range (m): 883740.3480   closest range (m):  883740.3486
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.5599   aperture (s): 3.45773   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.08026
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34804   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 4379   range bin: 4385   range (m): 904248.0252   closest range (m):  904248.0258
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.3188   aperture (s): 3.53766   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.39997
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02522   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000

PATCH: 7   line offset: 52272  center time offset (s):  -0.07440
Doppler centroid (center swath) (Hz):      0.000

FORWARD AZIMUTH FFT size: 16384   range bins: 4408

azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3023   closest range (m):  863223.3030
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.3407   aperture (s): 3.37776   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7203.76040
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
```

```
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30233   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 2190   range bin: 2196   range (m): 883740.3480   closest range (m):  883740.3486
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.5599   aperture (s): 3.45773   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.08026
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34803   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 4379   range bin: 4385   range (m): 904248.0252   closest range (m):  904248.0258
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.3188   aperture (s): 3.53766   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.39997
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02522   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000

PATCH: 8   line offset: 60984  center time offset (s):   3.97668
Doppler centroid (center swath) (Hz):      0.000

FORWARD AZIMUTH FFT size: 16384   range bins: 4408

azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3023   closest range (m):  863223.3030
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.3407   aperture (s): 3.37776   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7203.76040
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30232   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 2190   range bin: 2196   range (m): 883740.3480   closest range (m):  883740.3486
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.5599   aperture (s): 3.45773   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.08026
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34802   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 4379   range bin: 4385   range (m): 904248.0252   closest range (m):  904248.0258
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.3188   aperture (s): 3.53766   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.39997
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02521   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000

PATCH: 9   line offset: 69696  center time offset (s):   8.02776
Doppler centroid (center swath) (Hz):      0.000

FORWARD AZIMUTH FFT size: 16384   range bins: 4408

azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3023   closest range (m):  863223.3030
```

```
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.3407   aperture (s): 3.37776   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7203.76040
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30231   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 2190   range bin: 2196   range (m): 883740.3480   closest range (m):  883740.3486
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.5599   aperture (s): 3.45773   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.08026
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34801   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 4379   range bin: 4385   range (m): 904248.0252   closest range (m):  904248.0258
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.3188   aperture (s): 3.53766   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.39997
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02520   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000

PATCH: 10   line offset: 78408  center time offset (s):  12.07884
Doppler centroid (center swath) (Hz):      0.000

FORWARD AZIMUTH FFT size: 16384   range bins: 4408

azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3023   closest range (m):  863223.3030
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.3407   aperture (s): 3.37776   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7203.76040
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30230   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 2190   range bin: 2196   range (m): 883740.3480   closest range (m):  883740.3486
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.5599   aperture (s): 3.45773   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.08026
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34801   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 4379   range bin: 4385   range (m): 904248.0252   closest range (m):  904248.0258
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.3188   aperture (s): 3.53766   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.39997
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02519   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000

PATCH: 11   line offset: 87120  center time offset (s):  16.12992
Doppler centroid (center swath) (Hz):      0.000

FORWARD AZIMUTH FFT size: 16384   range bins: 4408

azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
```

```
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3023   closest range (m):  863223.3030
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.3407   aperture (s): 3.37776   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7203.76040
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30229   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 2190   range bin: 2196   range (m): 883740.3480   closest range (m):  883740.3486
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.5599   aperture (s): 3.45773   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.08026
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34800   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 4379   range bin: 4385   range (m): 904248.0252   closest range (m):  904248.0258
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.3188   aperture (s): 3.53766   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.39997
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02519   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000

PATCH: 12   line offset: 95832  center time offset (s):  20.18100
Doppler centroid (center swath) (Hz):      0.000

FORWARD AZIMUTH FFT size: 16384   range bins: 4408

azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3023   closest range (m):  863223.3030
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.3407   aperture (s): 3.37776   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7203.76040
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30228   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 2190   range bin: 2196   range (m): 883740.3480   closest range (m):  883740.3486
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.5599   aperture (s): 3.45773   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.08026
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34799   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 4379   range bin: 4385   range (m): 904248.0252   closest range (m):  904248.0258
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.3188   aperture (s): 3.53766   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.39997
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02518   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000

PATCH: 13   line offset: 104544  center time offset (s):  24.23208
Doppler centroid (center swath) (Hz):      0.000
```

```
FORWARD AZIMUTH FFT size: 16384   range bins: 4408

azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3023   closest range (m):  863223.3030
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.3407   aperture (s): 3.37776   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7203.76040
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30227   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 2190   range bin: 2196   range (m): 883740.3480   closest range (m):  883740.3486
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.5599   aperture (s): 3.45773   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.08026
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34798   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 4379   range bin: 4385   range (m): 904248.0252   closest range (m):  904248.0258
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.3188   aperture (s): 3.53766   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.39997
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02517   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000

PATCH: 14   line offset: 113256  center time offset (s):  28.28316
Doppler centroid (center swath) (Hz):      0.000

WARNING: end of range compressed data, number of lines in last patch: 7993

FORWARD AZIMUTH FFT size: 16384   range bins: 4408

azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3023   closest range (m):  863223.3030
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.3407   aperture (s): 3.37776   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7203.76040
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30227   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 2190   range bin: 2196   range (m): 883740.3480   closest range (m):  883740.3486
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.5599   aperture (s): 3.45773   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.08026
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34797   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 4379   range bin: 4385   range (m): 904248.0252   closest range (m):  904248.0258
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.3188   aperture (s): 3.53766   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.39997
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
```

```
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02516   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000

geolocation track time, Doppler, range 1:     79428.083        0.0000   863167.0919
geolocation track time, Doppler, range 2:     79428.083        0.0000   904463.5016
geolocation track time, Doppler, range 3:     79480.911        0.0000   863167.0919
geolocation track time, Doppler, range 4:     79480.911        0.0000   904463.5016
geolocation track time, Doppler, range 5:     79454.496        0.0000   883815.2968
geoid radius at image center:  6368104.325

***** calculation of sensor velocity vector track angle at scene center ****
SAR position vector (x,y,z) (m):      -5054895.177   158145.197 -4954501.211
SAR velocity vector (vx,vy,vz)(m/s):      5195.839     1698.025    -5251.300
sensor latitude, longitude at image center (decimal deg.):    -44.584374    178.208054
sensor north, east velocities (m/s):  -7348.27654  -1859.66994
sensor track angle (decimal deg.):  -165.798021

***** calculation of swath velocity vector track angle at scene center ****
geolocation track time, Doppler, range:       79454.543        0.0000   883815.2968
delta time along track (s):     0.046500
north swath velocity (m/s):   -6512.1584
east swath velocity (m/s):    -2116.1045
track angle (deg):   -161.998599
along track swath velocity (m/s):   6847.34290
along-track azimuth sample spacing (m):     3.184014

output SLC: slc_WBs/20071020_4.slc
output SLC width: 4408  lines: 113609

user time (s):       366.240
system time (s):       6.690
elapsed time (s):    383.210


af raw_WBs/20071020_4.sar_par raw_WBs/p20071020_4.slc.par slc_WBs/20071020_4.slc - - - - 10 1 0 0
slc_WBs/20071020_4.af_offsets
*** Autofocus estimation of effective velocity for SAR processing ***
*** Copyright 2010, Gamma Remote Sensing, v1.6 13-Sep-2010 clw/uw ***
MSP SAR sensor parameter file:     raw_WBs/20071020_4.sar_par
MSP SAR processing parameter file: raw_WBs/p20071020_4.slc.par
SLC image: slc_WBs/20071020_4.slc
SLC image start time (s): 79428.0826
SLC format: FCOMPLEX (pairs of 4-byte float (re,im))

SLC width: 4408  range starting pixel: 48  range increment between patches: 2048
SLC lines: 113609   starting line: 48  azimuth increment between patches: 16384
SNR threshold for autofocus measurement: 10.0
NOTE: updating velocity polynomial in MSP PROC_par file
output offset and SNR file (text format): slc_WBs/20071020_4.af_offsets
NOTE: automatic correction of Doppler ambiguity errors: ON
SLC oversampling factor: 1
IQ mode raw data, number of compressed range samples:  4408
SAR geometry: right-looking

SLC image size range: 4408  azimuth: 113609
SLC window size range: 1024  azimuth: 4096
range sample increment: 2048
azimuth sample increment: 16384
range and azimuth oversampling factor: 1
number of azimuth looks: 1
oversampled and multilooked offset window size range: 1024   azimuth: 4096
first range:         1180   number range:       2
first azimuth line:  7652   number azimuth:     7
number of offset estimates:     14
correlation SNR threshold:     10.000
starting line: SLC-1: 7652   rwin: 1024  azwin: 4096
sublook relative azimuth frequency bandwidth 0.0 --> 1.0:   0.3500
relative azimuth frequency look separation (0.0 --> 1.0):   0.3825
effective velocity fit parameter flags  a1: 0  b0: 0
range migration/amb.(m): 420.625   over-sampled range pixels: 44.8977

azimuth SLC bandwidth (0-->1.0): 0.8000  oversampling factor: 1
azimuth filter frac. BW:   0.3500  FIR length: 65

bandpass filter center frequency (0-->1.0): 0.2250
```

```
range filter frac. BW:     0.9000  FIR length: 65
bp_filter: bw:  5.6549  wc:  0.0000  nfft: 1024  nps: 65   Kaiser beta:   0.500
bp_filter: bw:  2.1991  wc: -1.4137  nfft: 4096  nps: 65   Kaiser beta:   0.500
bp_filter: bw:  2.1991  wc:  1.4137  nfft: 4096  nps: 65   Kaiser beta:   0.500
average SLC intensity:  3.605e-02  clip1:  1.803e+00

nominal image center effective focus velocity (m/s): 0.0000
SLC image center azimuth chirp rate (Hz/sec**2): -497.521
azimuth chirp aperture time (s): 3.45801
azimuth chirp time-bandwidth product: 5949.261

*** azimuth line: 1  azimuth center line: 7652 ***
az. block: 1  t_focus(s): 79431.6408  near_fd(Hz): 0.0  far_fd(Hz): 0.0  vf0(m/s): 7204.11  vf2 (m/s):
7204.67  vfdot(m/s)/m: 1.280e-05

patch:   1  az_line:   7652  r_pixel: 1180  r_offset (samples):  0.0185  az_offset (samples):  0.8386
SNR:   32.19
  time offset between looks (s):  -3.8996e-04
  PROC_par vel. (m/s): 7204.0814  autofocus scale factor:    8.5807e+07
  delta velocity per azimuth pixel offset (m/s/pixel):    1.0128
  autofocus estimated velocity (m/s):  7204.931  delta_vel.(m/s):  0.8497

patch:   2  az_line:   7652  r_pixel: 3228  r_offset (samples):  0.0099  az_offset (samples):  0.7198
SNR:   16.88
  time offset between looks (s):  -3.3470e-04
  PROC_par vel. (m/s): 7204.0814  autofocus scale factor:    8.5807e+07
  delta velocity per azimuth pixel offset (m/s/pixel):    1.0128
  autofocus estimated velocity (m/s):  7204.811  delta_vel.(m/s):  0.7293

*** azimuth line: 2  azimuth center line: 24036 ***
az. block: 2  t_focus(s): 79439.2593  near_fd(Hz): 0.0  far_fd(Hz): 0.0  vf0(m/s): 7203.98  vf2 (m/s):
7204.57  vfdot(m/s)/m: 1.355e-05

patch:   3  az_line:  24036  r_pixel: 1180  r_offset (samples):  0.0288  az_offset (samples):  1.5891
SNR:   12.83
  time offset between looks (s):  -7.3895e-04
  PROC_par vel. (m/s): 7204.0814  autofocus scale factor:    8.5807e+07
  delta velocity per azimuth pixel offset (m/s/pixel):    1.0128
  autofocus estimated velocity (m/s):  7205.692  delta_vel.(m/s):  1.6104

patch:   4  az_line:  24036  r_pixel: 3228  r_offset (samples):  0.0040  az_offset (samples):  1.1897
SNR:   30.57
  time offset between looks (s):  -5.5319e-04
  PROC_par vel. (m/s): 7204.0814  autofocus scale factor:    8.5807e+07
  delta velocity per azimuth pixel offset (m/s/pixel):    1.0128
  autofocus estimated velocity (m/s):  7205.287  delta_vel.(m/s):  1.2055

*** azimuth line: 3  azimuth center line: 40420 ***
az. block: 3  t_focus(s): 79446.8779  near_fd(Hz): 0.0  far_fd(Hz): 0.0  vf0(m/s): 7203.84  vf2 (m/s):
7204.47  vfdot(m/s)/m: 1.430e-05

patch:   5  az_line:  40420  r_pixel: 1180  r_offset (samples):  0.0211  az_offset (samples):  1.3505
SNR:   14.03
  time offset between looks (s):  -6.2798e-04
  PROC_par vel. (m/s): 7204.0814  autofocus scale factor:    8.5807e+07
  delta velocity per azimuth pixel offset (m/s/pixel):    1.0128
  autofocus estimated velocity (m/s):  7205.450  delta_vel.(m/s):  1.3685

patch:   6  az_line:  40420  r_pixel: 3228  r_offset (samples):  0.0004  az_offset (samples):  1.2673
SNR:   25.32
  time offset between looks (s):  -5.8930e-04
  PROC_par vel. (m/s): 7204.0814  autofocus scale factor:    8.5807e+07
  delta velocity per azimuth pixel offset (m/s/pixel):    1.0128
  autofocus estimated velocity (m/s):  7205.366  delta_vel.(m/s):  1.2842

*** azimuth line: 4  azimuth center line: 56804 ***
az. block: 4  t_focus(s): 79454.4964  near_fd(Hz): 0.0  far_fd(Hz): 0.0  vf0(m/s): 7203.71  vf2 (m/s):
7204.36  vfdot(m/s)/m: 1.504e-05

patch:   7  az_line:  56804  r_pixel: 1180  r_offset (samples):  0.0109  az_offset (samples):  0.1122
SNR:   14.06
  time offset between looks (s):  -5.2173e-05
  PROC_par vel. (m/s): 7204.0814  autofocus scale factor:    8.5807e+07
  delta velocity per azimuth pixel offset (m/s/pixel):    1.0128
  autofocus estimated velocity (m/s):  7204.195  delta_vel.(m/s):  0.1137

patch:   8  az_line:  56804  r_pixel: 3228  r_offset (samples):  0.0137  az_offset (samples):  1.0022
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```
SNR:    6.67

*** azimuth line: 5  azimuth center line: 73188 ***
az. block: 5  t_focus(s): 79462.1150  near_fd(Hz): 0.0  far_fd(Hz): 0.0  vf0(m/s): 7203.58  vf2 (m/s):
7204.26  vfdot(m/s)/m: 1.578e-05

patch:   9  az_line:  73188  r_pixel: 1180  r_offset (samples):  0.0004  az_offset (samples): -0.3392
SNR:   16.47
  time offset between looks (s):   1.5771e-04
  PROC_par vel. (m/s): 7204.0814  autofocus scale factor:    8.5807e+07
  delta velocity per azimuth pixel offset (m/s/pixel):    1.0128
  autofocus estimated velocity (m/s):  7203.738  delta_vel.(m/s): -0.3436

patch:  10  az_line:  73188  r_pixel: 3228  r_offset (samples):  0.0074  az_offset (samples):  0.1574
SNR:   13.88
  time offset between looks (s):  -7.3178e-05
  PROC_par vel. (m/s): 7204.0814  autofocus scale factor:    8.5807e+07
  delta velocity per azimuth pixel offset (m/s/pixel):    1.0128
  autofocus estimated velocity (m/s):  7204.241  delta_vel.(m/s):  0.1594

*** azimuth line: 6  azimuth center line: 89572 ***
az. block: 6  t_focus(s): 79469.7336  near_fd(Hz): 0.0  far_fd(Hz): 0.0  vf0(m/s): 7203.44  vf2 (m/s):
7204.16  vfdot(m/s)/m: 1.651e-05

patch:  11  az_line:  89572  r_pixel: 1180  r_offset (samples):355.0155  az_offset (samples):-788.4793
SNR:    2.33

patch:  12  az_line:  89572  r_pixel: 3228  r_offset (samples):448.9909  az_offset (samples):-769.3095
SNR:    2.79

*** azimuth line: 7  azimuth center line: 105956 ***
az. block: 7  t_focus(s): 79477.3521  near_fd(Hz): 0.0  far_fd(Hz): 0.0  vf0(m/s): 7203.30  vf2 (m/s):
7204.05  vfdot(m/s)/m: 1.723e-05

patch:  13  az_line: 105956  r_pixel: 1180  r_offset (samples):-98.0707  az_offset (samples):994.0771
SNR:    2.23

patch:  14  az_line: 105956  r_pixel: 3228  r_offset (samples):-460.0431  az_offset (samples):985.5481
SNR:    2.26

number of autofocus offsets above SNR threshold: 9 of 14 total patches
average estimated autofocus velocity (m/s): 7204.8566
average range offset between looks (pixels): 0.01126
average delta velocity (m/s): 0.775

patch:  1  az.time(s):-22.8482  rng(m):  -9588.67  r_off(pix):  0.018  af_vel.(m/s): 7204.9311  del_v.
(m/s):   0.850  SNR:  32.19
patch:  2  az.time(s):-22.8482  rng(m):   9598.04  r_off(pix):  0.010  af_vel.(m/s): 7204.8107  del_v.
(m/s):   0.729  SNR:  16.88
patch:  3  az.time(s):-15.2297  rng(m):  -9588.67  r_off(pix):  0.029  af_vel.(m/s): 7205.6918  del_v.
(m/s):   1.610  SNR:  12.83
patch:  4  az.time(s):-15.2297  rng(m):   9598.04  r_off(pix):  0.004  af_vel.(m/s): 7205.2868  del_v.
(m/s):   1.205  SNR:  30.57
patch:  5  az.time(s): -7.6111  rng(m):  -9588.67  r_off(pix):  0.021  af_vel.(m/s): 7205.4499  del_v.
(m/s):   1.369  SNR:  14.03
patch:  6  az.time(s): -7.6111  rng(m):   9598.04  r_off(pix):  0.000  af_vel.(m/s): 7205.3656  del_v.
(m/s):   1.284  SNR:  25.32
patch:  7  az.time(s):  0.0074  rng(m):  -9588.67  r_off(pix):  0.011  af_vel.(m/s): 7204.1950  del_v.
(m/s):   0.114  SNR:  14.06
patch:  9  az.time(s):  7.6260  rng(m):  -9588.67  r_off(pix):  0.000  af_vel.(m/s): 7203.7378  del_v.
(m/s):  -0.344  SNR:  16.47
patch: 10  az.time(s):  7.6260  rng(m):   9598.04  r_off(pix):  0.007  af_vel.(m/s): 7204.2408  del_v.
(m/s):   0.159  SNR:  13.88

initial autofocus vel. poly. coeff.: vel.x:  7204.8566  vel.y:  0.000e+00  acc.x:   0.000e+00
initial fit autofocus vel.(m/s): 7204.8566  sigma (m/s): 0.62981

patch:  1  az.time(s):-22.8482  rng(m):  -9588.67  r_off(pix):  0.018  af_vel.(m/s): 7204.9311  del_v.
(m/s):   0.850  SNR:  32.19
patch:  2  az.time(s):-22.8482  rng(m):   9598.04  r_off(pix):  0.010  af_vel.(m/s): 7204.8107  del_v.
(m/s):   0.729  SNR:  16.88
patch:  3  az.time(s):-15.2297  rng(m):  -9588.67  r_off(pix):  0.029  af_vel.(m/s): 7205.6918  del_v.
(m/s):   1.610  SNR:  12.83
patch:  4  az.time(s):-15.2297  rng(m):   9598.04  r_off(pix):  0.004  af_vel.(m/s): 7205.2868  del_v.
(m/s):   1.205  SNR:  30.57
patch:  5  az.time(s): -7.6111  rng(m):  -9588.67  r_off(pix):  0.021  af_vel.(m/s): 7205.4499  del_v.
(m/s):   1.369  SNR:  14.03
```

```
patch:  6  az.time(s): -7.6111  rng(m):   9598.04  r_off(pix):  0.000  af_vel.(m/s): 7205.3656  del_v.
(m/s):   1.284  SNR:  25.32
patch:  7  az.time(s):  0.0074  rng(m):  -9588.67  r_off(pix):  0.011  af_vel.(m/s): 7204.1950  del_v.
(m/s):   0.114  SNR:  14.06
patch:  9  az.time(s):  7.6260  rng(m):  -9588.67  r_off(pix):  0.000  af_vel.(m/s): 7203.7378  del_v.
(m/s):  -0.344  SNR:  16.47
patch: 10  az.time(s):  7.6260  rng(m):   9598.04  r_off(pix):  0.007  af_vel.(m/s): 7204.2408  del_v.
(m/s):   0.159  SNR:  13.88

number of valid autofocus patch estimates after culling: 9
average autofocus velocity (m/s):  7204.8566
average range offset between looks (pixels): 0.01126
average velocity delta (m/s): 0.7752

new estimated autofocus velocity poly. coeff.: vel.x:  7204.8566  vel.y:  0.000e+00  acc.x:   0.000e+00
autofocus velocity std. dev.(m/s):  0.6298
average velocity std. dev.  (m/s):  0.2099
updating effective velocity parameters in MSP processing parameter file: raw_WBs/p20071020_4.slc.par

initial azimuth chirp rate (Hz/sec**2): -497.5205
estimated azimuth chirp rate error (Hz/sec**2): -0.1071
estimated azimuth quadratic phase error (deg.): 57.622
estimated SLC phase error (deg.): 19.207

user time (s):        26.940
system time (s):       0.940
elapsed time (s):     51.240


az_proc raw_WBs/20071020_4.sar_par raw_WBs/p20071020_4.slc.par /media/d1/20071020_4.rc
slc_WBs/20071020_4.slc 16384 0 -49 0 2.12
*** SAR Range-Doppler azimuth compression for range-compressed data ***
*** Copyright 2010, Gamma Remote Sensing, v2.7 30-Dec-2010 clw/uw ***

MSP SAR sensor parameter file: raw_WBs/20071020_4.sar_par
MSP processing parameter file: raw_WBs/p20071020_4.slc.par
range compressed input data:   /media/d1/20071020_4.rc
output SLC image:              slc_WBs/20071020_4.slc

SAR sensor description: ALPSRS092604500
scene description: ALPSRS092604500

azimuth deskew of data: ON
azimuth patch size (lines): 16384
output SLC format: FCOMPLEX (pairs of 4-byte float (re,im))
SAR receiver gain (dB):  24.0000
processor radiometric calibration factor (dB): -49.0000
processor radiometric calibration factor:  1.258925e-05
output SLC type: sigma0 (SQR(re)+SQR(im) => sigma0) (default)

Kaiser window parameter for azimuth reference function:     2.1200
IQ mode raw data, number of compressed range samples: 4408
SAR geometry: right-looking
prefilter decimation factor:      1
points in the azimuth FFT:    16384
range compressed SLC width (samples):   4408
slant range of raw SAR data (near, center, far) (m):          864103.943   885834.211   907564.480
slant range of range compressed data (near,center,far) (m):   863167.092   883810.612   904454.133
approximate center time of image segment (sec.):   79454.4892
pulse repetition frequency (Hz): 2150.53763
Doppler centroid range compressed data (near, center, far)(Hz):0.000  0.000  0.000
Doppler centroid at center swath (radians/sample): 0.00000

SAR GEOMETRY from state vectors:
nominal raw data center latitude, longitude (deg.): -43.351083  172.255985
geoid radius at center of raw data swath (m): 6368104.475
radial distance of SAR from earth center (m): 7079834.538
nominal SAR altitude (m): 711730.063
along-track SAR velocity magnitude (m/s): 7579.9856
approximate azimuth sample spacing along the orbit track (m): 3.52469
angle between sub-radar point and center swath relative to earth center (deg.): 4.474602
slant range:   863167.092  fdd (Hz/s):     -509.366  v_focus:     7203.704
slant range:   883810.612  fdd (Hz/s):     -497.521  v_focus:     7204.081
slant range:   904454.133  fdd (Hz/s):     -486.201  v_focus:     7204.348
effective SAR velocity cross-track rate (m/s)/m:  1.559e-05
eff. velocity from PROC_par file (center-swath) (m/s): 7204.8566
```

```
lines offset to first echo:            0
radar center frequency (Hz): 1.2700000e+09
radar wavelength (m):            0.2360571
radar wavevector (radians/m):      26.6172
radians/slant range pixel:        498.7278
slant range SLC pixel size:       9.368514
slant range of raw SAR data (near,center,far) (m):            864103.943   885834.211   907564.480
slant range of range compressed data (near,center,far) (m):   863167.092   883810.612   904454.133
angle between vel.+look vec. (center swath)(deg.):     90.00000
Doppler squint angle (degrees):      -0.0000
az. depth of focus (range m, samples):                 141.9258      15.1492
range at closest approach (near, far swath)(m):     863167.0919  904454.1331
ranges along the synth. aperture (near swath)(m):   863301.0788  863167.0919  863301.0788
ranges along the synth. aperture (far swath)(m):    904594.5038  904454.1331  904594.5038
RM relative to aperture center min,max: (samples):       0.0000      14.9832
RM min,max (range samples):     0       15

SAR data buffer size (Mbytes):    551.125
allocating patch memory cols: 16384   rows: 4408
creating FFTW plans: 16384

antenna pattern file: PALSAR_20071020_4.antpat
antenna pattern starting angle (deg.):  -3.10000  angular step (deg.):   0.10000  samples: 67

synthetic aperture time (s) (min, max): 3.37759   max: 3.53852
synthetic aperture length samples min: 7263  max: 7609
SLC slant range, zero-Doppler geometry (near range):   863167.092
SLC slant range, zero-Doppler geometry (center):       883810.612
SLC slant range, zero-Doppler geometry (far range):    904454.133
first non-zero range sample: 6   last non-zero range sample: 4386   number of samples: 4381

patch center slant range:            883810.61250
image center Doppler, azimuth angle:      0.00000     90.00000
image deskew at center swath (pixels):        0.000

processed Doppler bandwidth (Hz):              1720.430
az. chirp rate, near, center, far range (Hz/s):   -509.36588   -497.52054   -486.20093
aperture duration: near, far range (s):         3.37759      3.53852
far range az.ref.length (meters, samples):    25492.116     7609
near range az.ref.length (meters, samples):   24332.926     7263
number of azimuth patches: 14
number of azimuth patches: 14
azimuth offset to center of first SLC image line (s):      1.78374
first, last azimuth line in output buffer:   3836   12547
number of output image lines/patch:          8712
azimuth deskew near, far range (samples): 0  0
SLC image geometry: deskewed (zero-Doppler)
nominal azimuth angle:      90.0000 (right looking)

**** Radiometric Calibration Parameters ****
output SLC image file:   slc_WBs/20071020_4.slc
output SLC format: FCOMPLEX (pairs of 4-byte-float)
output SLC type: sigma0   (SQR(re)+SQR(im) corresponds to sigma0)
SAR receiver gain [dB]:                 24.0000
radiometric calibration factor [dB]:   -49.0000
Kaiser azimuth window parameter:         2.1200

     pixel      range  look_ang   inc_ang   sin_inc   cos_inc ant_gain2  pow_fact     vel_x
    number        [m]     [deg]     [deg]      [dB]      [dB]      [dB]      [dB]     [m/s]
         0  863167.1    32.450    36.620     1.837     0.955     0.580   -61.511    7204.535
       400  866914.5    32.781    37.008     1.877     0.977     0.295   -61.720    7204.593
       800  870661.9    33.107    37.390     1.915     0.999     0.117   -61.822    7204.652
      1200  874409.3    33.427    37.765     1.952     1.021     0.025   -61.841    7204.710
      1600  878156.7    33.741    38.134     1.988     1.043    -0.000   -61.791    7204.768
      2000  881904.1    34.050    38.497     2.022     1.064     0.040   -61.680    7204.827
      2400  885651.5    34.353    38.854     2.056     1.086     0.137   -61.513    7204.885
      2800  889398.9    34.652    39.206     2.089     1.108     0.306   -61.273    7204.944
      3200  893146.3    34.945    39.553     2.121     1.129     0.555   -60.956    7205.002
      3600  896893.7    35.234    39.894     2.152     1.151     0.897   -60.546    7205.061
      4000  900641.1    35.518    40.231     2.183     1.172     1.354   -60.023    7205.119
      4400  904388.6    35.798    40.562     2.212     1.194     1.944   -59.366    7205.177

PATCH: 1   line offset: 0  center time offset (s): -24.38088
Doppler centroid (center swath) (Hz):      0.000

FORWARD AZIMUTH FFT size: 16384   range bins: 4408
```

```
azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3024   closest range (m):  863223.3030
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.4503   aperture (s): 3.37703   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.53564
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30238   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 2190   range bin: 2196   range (m): 883740.3481   closest range (m):  883740.3486
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.6670   aperture (s): 3.45699   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.85550
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34808   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 4379   range bin: 4385   range (m): 904248.0253   closest range (m):  904248.0258
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.4235   aperture (s): 3.53690   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7205.17521
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02526   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000

PATCH: 2   line offset: 8712  center time offset (s): -20.32980
Doppler centroid (center swath) (Hz):      0.000

FORWARD AZIMUTH FFT size: 16384   range bins: 4408

azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3024   closest range (m):  863223.3030
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.4503   aperture (s): 3.37703   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.53564
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30237   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 2190   range bin: 2196   range (m): 883740.3481   closest range (m):  883740.3486
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.6670   aperture (s): 3.45699   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.85550
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34807   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 4379   range bin: 4385   range (m): 904248.0253   closest range (m):  904248.0258
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.4235   aperture (s): 3.53690   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7205.17521
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02525   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000
```

```
PATCH: 3   line offset: 17424  center time offset (s): -16.27872
Doppler centroid (center swath) (Hz):      0.000

FORWARD AZIMUTH FFT size: 16384   range bins: 4408

azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3024   closest range (m):  863223.3030
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.4503   aperture (s): 3.37703   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.53564
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30236   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 2190   range bin: 2196   range (m): 883740.3481   closest range (m):  883740.3486
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.6670   aperture (s): 3.45699   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.85550
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34806   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 4379   range bin: 4385   range (m): 904248.0252   closest range (m):  904248.0258
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.4235   aperture (s): 3.53690   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7205.17521
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02525   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000

PATCH: 4   line offset: 26136  center time offset (s): -12.22764
Doppler centroid (center swath) (Hz):      0.000

FORWARD AZIMUTH FFT size: 16384   range bins: 4408

azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3024   closest range (m):  863223.3030
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.4503   aperture (s): 3.37703   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.53564
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30235   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 2190   range bin: 2196   range (m): 883740.3481   closest range (m):  883740.3486
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.6670   aperture (s): 3.45699   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.85550
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34805   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 4379   range bin: 4385   range (m): 904248.0252   closest range (m):  904248.0258
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.4235   aperture (s): 3.53690   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7205.17521
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
```

```
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02524   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000

PATCH: 5   line offset: 34848  center time offset (s):  -8.17656
Doppler centroid (center swath) (Hz):      0.000

FORWARD AZIMUTH FFT size: 16384   range bins: 4408

azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3023   closest range (m):  863223.3030
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.4503   aperture (s): 3.37703   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.53564
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30234   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 2190   range bin: 2196   range (m): 883740.3480   closest range (m):  883740.3486
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.6670   aperture (s): 3.45699   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.85550
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34805   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 4379   range bin: 4385   range (m): 904248.0252   closest range (m):  904248.0258
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.4235   aperture (s): 3.53690   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7205.17521
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02523   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000

PATCH: 6   line offset: 43560  center time offset (s):  -4.12548
Doppler centroid (center swath) (Hz):      0.000

FORWARD AZIMUTH FFT size: 16384   range bins: 4408

azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3023   closest range (m):  863223.3030
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.4503   aperture (s): 3.37703   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.53564
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30233   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 2190   range bin: 2196   range (m): 883740.3480   closest range (m):  883740.3486
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.6670   aperture (s): 3.45699   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.85550
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34804   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000
```

```
line: 4379   range bin: 4385   range (m): 904248.0252   closest range (m):  904248.0258
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.4235   aperture (s): 3.53690   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7205.17521
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02522   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000

PATCH: 7   line offset: 52272  center time offset (s):  -0.07440
Doppler centroid (center swath) (Hz):      0.000

FORWARD AZIMUTH FFT size: 16384   range bins: 4408

azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3023   closest range (m):  863223.3030
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.4503   aperture (s): 3.37703   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.53564
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30233   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 2190   range bin: 2196   range (m): 883740.3480   closest range (m):  883740.3486
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.6670   aperture (s): 3.45699   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.85550
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34803   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 4379   range bin: 4385   range (m): 904248.0252   closest range (m):  904248.0258
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.4235   aperture (s): 3.53690   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7205.17521
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02522   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000

PATCH: 8   line offset: 60984  center time offset (s):   3.97668
Doppler centroid (center swath) (Hz):      0.000

FORWARD AZIMUTH FFT size: 16384   range bins: 4408

azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3023   closest range (m):  863223.3030
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.4503   aperture (s): 3.37703   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.53564
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30232   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 2190   range bin: 2196   range (m): 883740.3480   closest range (m):  883740.3486
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.6670   aperture (s): 3.45699   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.85550
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
```

```
offset: 0
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34802   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 4379   range bin: 4385   range (m): 904248.0252   closest range (m):  904248.0258
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.4235   aperture (s): 3.53690   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7205.17521
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02521   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000

PATCH: 9   line offset: 69696  center time offset (s):   8.02776
Doppler centroid (center swath) (Hz):      0.000

FORWARD AZIMUTH FFT size: 16384   range bins: 4408

azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3023   closest range (m):  863223.3030
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.4503   aperture (s): 3.37703   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.53564
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30231   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 2190   range bin: 2196   range (m): 883740.3480   closest range (m):  883740.3486
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.6670   aperture (s): 3.45699   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.85550
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34801   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 4379   range bin: 4385   range (m): 904248.0252   closest range (m):  904248.0258
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.4235   aperture (s): 3.53690   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7205.17521
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02520   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000

PATCH: 10   line offset: 78408  center time offset (s):  12.07884
Doppler centroid (center swath) (Hz):      0.000

FORWARD AZIMUTH FFT size: 16384   range bins: 4408

azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3023   closest range (m):  863223.3030
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.4503   aperture (s): 3.37703   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.53564
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30230   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000
```

```
line: 2190   range bin: 2196   range (m): 883740.3480   closest range (m):  883740.3486
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.6670   aperture (s): 3.45699   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.85550
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34801   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 4379   range bin: 4385   range (m): 904248.0252   closest range (m):  904248.0258
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.4235   aperture (s): 3.53690   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7205.17521
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02519   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000

PATCH: 11   line offset: 87120  center time offset (s):  16.12992
Doppler centroid (center swath) (Hz):      0.000

FORWARD AZIMUTH FFT size: 16384   range bins: 4408

azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3023   closest range (m):  863223.3030
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.4503   aperture (s): 3.37703   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.53564
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30229   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 2190   range bin: 2196   range (m): 883740.3480   closest range (m):  883740.3486
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.6670   aperture (s): 3.45699   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.85550
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34800   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 4379   range bin: 4385   range (m): 904248.0252   closest range (m):  904248.0258
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.4235   aperture (s): 3.53690   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7205.17521
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02519   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000

PATCH: 12   line offset: 95832  center time offset (s):  20.18100
Doppler centroid (center swath) (Hz):      0.000

FORWARD AZIMUTH FFT size: 16384   range bins: 4408

azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3023   closest range (m):  863223.3030
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.4503   aperture (s): 3.37703   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.53564
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
```

```
offset: 0
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30228   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 2190   range bin: 2196   range (m): 883740.3480   closest range (m):  883740.3486
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.6670   aperture (s): 3.45699   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.85550
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34799   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 4379   range bin: 4385   range (m): 904248.0252   closest range (m):  904248.0258
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.4235   aperture (s): 3.53690   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7205.17521
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02518   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000

PATCH: 13   line offset: 104544  center time offset (s):  24.23208
Doppler centroid (center swath) (Hz):      0.000

FORWARD AZIMUTH FFT size: 16384   range bins: 4408

azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3023   closest range (m):  863223.3030
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.4503   aperture (s): 3.37703   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.53564
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30227   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 2190   range bin: 2196   range (m): 883740.3480   closest range (m):  883740.3486
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.6670   aperture (s): 3.45699   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.85550
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34798   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 4379   range bin: 4385   range (m): 904248.0252   closest range (m):  904248.0258
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.4235   aperture (s): 3.53690   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7205.17521
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02517   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000

PATCH: 14   line offset: 113256  center time offset (s):  28.28316
Doppler centroid (center swath) (Hz):      0.000

WARNING: end of range compressed data, number of lines in last patch: 7993

FORWARD AZIMUTH FFT size: 16384   range bins: 4408

azimuth forward FFT at range bin:      0
azimuth forward FFT at range bin:   1000
azimuth forward FFT at range bin:   2000
azimuth forward FFT at range bin:   3000
```

```
azimuth forward FFT at range bin:   4000

line: 0   range bin: 6   range (m): 863223.3023   closest range (m):  863223.3030
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -509.4503   aperture (s): 3.37703   aperture (samples): 7263  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.53564
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 863223.30298  range(fd)(planar): 863223.30298   range(fd) (geo): 863223.30227   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 2190   range bin: 2196   range (m): 883740.3480   closest range (m):  883740.3486
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -497.6670   aperture (s): 3.45699   aperture (samples): 7435  bandwidth (Hz):
1720.430  vel_x (m/x): 7204.85550
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 883740.34864  range(fd)(planar): 883740.34864   range(fd) (geo): 883740.34797   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): -0.00000  deskew (pixels): -0.00000   deskew (geo) pixels: 0.00000

line: 4379   range bin: 4385   range (m): 904248.0252   closest range (m):  904248.0258
ref. Doppler centroid (Hz): 0.000  actual Dop.(Hz): 0.000   centroid index: 0   null index: 8192
Doppler rate (Hz/s): -486.4235   aperture (s): 3.53690   aperture (samples): 7607  bandwidth (Hz):
1720.430  vel_x (m/x): 7205.17521
Doppler tracking t_offset (s): -0.00000  reference function offset (samples): 0   frequency bins
offset: 0
rca (m): 904248.02579  range(fd)(planar): 904248.02579   range(fd) (geo): 904248.02516   dt (sec):
0.000000  az. pix: 0.00000
deskew (m): 0.00000  deskew (pixels): 0.00000   deskew (geo) pixels: 0.00000

geolocation track time, Doppler, range 1:     79428.083        0.0000   863167.0919
geolocation track time, Doppler, range 2:     79428.083        0.0000   904463.5016
geolocation track time, Doppler, range 3:     79480.911        0.0000   863167.0919
geolocation track time, Doppler, range 4:     79480.911        0.0000   904463.5016
geolocation track time, Doppler, range 5:     79454.496        0.0000   883815.2968
geoid radius at image center:  6368104.325

***** calculation of sensor velocity vector track angle at scene center ****
SAR position vector (x,y,z) (m):      -5054895.177   158145.197 -4954501.211
SAR velocity vector (vx,vy,vz)(m/s):      5195.839     1698.025    -5251.300
sensor latitude, longitude at image center (decimal deg.):    -44.584374    178.208054
sensor north, east velocities (m/s):  -7348.27654  -1859.66994
sensor track angle (decimal deg.):  -165.798021

***** calculation of swath velocity vector track angle at scene center ****
geolocation track time, Doppler, range:       79454.543        0.0000   883815.2968
delta time along track (s):     0.046500
north swath velocity (m/s):   -6512.1584
east swath velocity (m/s):    -2116.1045
track angle (deg):   -161.998599
along track swath velocity (m/s):   6847.34290
along-track azimuth sample spacing (m):     3.184014

output SLC: slc_WBs/20071020_4.slc
output SLC width: 4408  lines: 113609

user time (s):       355.160
system time (s):       4.580
elapsed time (s):    363.810


par_MSP raw_WBs/20071020_4.sar_par raw_WBs/p20071020_4.slc.par slc_WBs/20071020_4.slc.par
*** ISP image parameter file from MSP processing parameter and sensor files ***
*** Copyright 2010, Gamma Remote Sensing, v3.3 2-Oct-2010 clw/uw ***

MSP SAR sensor parameters:   raw_WBs/20071020_4.sar_par
MSP processing parameters:   raw_WBs/p20071020_4.slc.par
ISP image parameter file:    slc_WBs/20071020_4.slc.par

image format: fcomplex (pairs of 4-byte float (re,im))
MSP PROC_par description: ALPSRS092604500
number of range and azimuth samples: 4408  113609
range pixel spacing, azimuth pixel spacing (m): 9.368514  3.184014
PRF (Hz): 2150.537634
3 dB processed Doppler bandwidth (Hz): 1720.4301
```

```
receiver attenuator gain (dB): 24.0000
calibration gain factor (dB):  -49.0000

approximate image center latitude (deg.): -43.35148400   longitude (deg.): 172.25570900
track heading (deg.): -161.99860
approximate scene center (x,y,z) (m): -4602867.193    625955.611  -4355978.177
earth geocentric radius (center of SAR data)(m):  6368104.325
SAR altitude above geoid (m):   711695.687
radial distance of radar from earth center (m):  7079800.012
incidence angle mid-swath (deg):       38.660

UTC start,center,end along-track azimuth times (s):  79428.08258  79454.49644  79480.91030
range to center of raw data (m):     885834.211
range to center of image data (m):   883810.613
delta time between center of the image data and raw data along-track   (s):      0.00744
delta range between center of the image data and raw data across-track (m):  -2023.59900

MSP Doppler poly. coeff.:     0.00000  0.00000e+00  0.00000e+00  0.00000e+00  0.00000e+00  0.00000e+00
ISP Doppler poly. coeff.:     0.00000  0.00000e+00  0.00000e+00  0.00000e+00  0.00000e+00  0.00000e+00

number of state vectors: 15
time interval between state vectors (s):   60.00000
time of first state vector UTC (s):  79020.00000
time of last state vector UTC (s):   79860.00000

SAR position vector x,y,z (m):   -6686000.400   -627859.824  -2235750.477
SAR velocity vector x,y,z (m/s):    2176.6518     1823.9415    -7041.7373

SAR position vector x,y,z (m):   -6541540.355   -517843.563  -2653431.860
SAR velocity vector x,y,z (m/s):    2637.0595     1841.3612    -6876.2764

SAR position vector x,y,z (m):   -6369767.543   -407124.800  -3060347.108
SAR velocity vector x,y,z (m/s):    3086.7547     1847.3669    -6682.9925

SAR position vector x,y,z (m):   -6171382.280   -296386.186  -3454850.699
SAR velocity vector x,y,z (m/s):    3523.8274     1842.0421    -6462.6992

SAR position vector x,y,z (m):   -5947197.799   -186303.465  -3835349.211
SAR velocity vector x,y,z (m/s):    3946.4250     1825.5334    -6216.3191

SAR position vector x,y,z (m):   -5698136.573    -77541.745  -4200307.723
SAR velocity vector x,y,z (m/s):    4352.7602     1798.0484    -5944.8788

SAR position vector x,y,z (m):   -5425226.172     29248.132  -4548255.915
SAR velocity vector x,y,z (m/s):    4741.1182     1759.8547    -5649.5041

SAR position vector x,y,z (m):   -5129594.688    133433.116  -4877793.863
SAR velocity vector x,y,z (m/s):    5109.8640     1711.2776    -5331.4148

SAR position vector x,y,z (m):   -4812465.771    234401.361  -5187597.504
SAR velocity vector x,y,z (m/s):    5457.4487     1652.6980    -4991.9190

SAR position vector x,y,z (m):   -4475153.260    331565.472  -5476423.765
SAR velocity vector x,y,z (m/s):    5782.4159     1584.5497    -4632.4070

SAR position vector x,y,z (m):   -4119055.446    424365.579  -5743115.294
SAR velocity vector x,y,z (m/s):    6083.4075     1507.3158    -4254.3449

SAR position vector x,y,z (m):   -3745649.050    512272.231  -5986604.815
SAR velocity vector x,y,z (m/s):    6359.1683     1421.5266    -3859.2681

SAR position vector x,y,z (m):   -3356482.899    594789.122  -6205919.084
SAR velocity vector x,y,z (m/s):    6608.5504     1327.7562    -3448.7742

SAR position vector x,y,z (m):   -2953171.403    671455.607  -6400182.431
SAR velocity vector x,y,z (m/s):    6830.5162     1226.6186    -3024.5175

SAR position vector x,y,z (m):   -2537387.834    741849.017  -6568620.002
SAR velocity vector x,y,z (m/s):    7024.1421     1118.7651    -2588.2031

ISP image parameter file: slc_WBs/20071020_4.slc.par

user time (s):         0.000
system time (s):       0.000
elapsed time (s):      0.170
```

```
multi_look slc_WBs/20071020_4.slc slc_WBs/20071020_4.slc.par mli_WBs/20071020_4.mli
mli_WBs/20071020_4.mli.par 3 16
*** ISP Calculate a Multi-Look Intensity (MLI) image from an SLC image ***
*** Copyright 2010, Gamma Remote Sensing, v3.7 17-Nov-2010 clw/uw ***
SLC image file:           slc_WBs/20071020_4.slc
SLC image parameter file: slc_WBs/20071020_4.slc.par
MLI image file:           mli_WBs/20071020_4.mli
MLI image parameter file: mli_WBs/20071020_4.mli.par
radar sensor: PALSAR

NOTICE: retaining incidence angle at image center for entire SLC image frame
NOTICE: retaining doppler parameters for entire SLC image frame

SLC format: fcomplex (pairs of 4-byte float (re,im))
range looks:                    3
azimuth looks:                 16
offset to starting line:        0
number of lines:           113609
relative output scale factor: 1.000000
output exponent: 1.000000

SLC title:                       ALPSRS092604500
input line header size (bytes):                0
SLC range sample spacing (m):            9.36851
SLC azimuth sample spacing (m):          3.18401
SLC image range samples:                    4408
SLC image azimuth lines:                  113609

MLI range sample spacing (m):           28.10554
MLI azimuth sample spacing (m):         50.94422
MLI image range samples:                    1469
MLI image azimuth lines:                    7100

multi-look output line:       0
multi-look output line:     500
multi-look output line:    1000
multi-look output line:    1500
multi-look output line:    2000
multi-look output line:    2500
multi-look output line:    3000
multi-look output line:    3500
multi-look output line:    4000
multi-look output line:    4500
multi-look output line:    5000
multi-look output line:    5500
multi-look output line:    6000
multi-look output line:    6500
multi-look output line:    7000

user time (s):          9.150
system time (s):        2.910
elapsed time (s):      60.850


raspwr mli_WBs/20071020_4.mli 1469 1 0 1 1 0.6 0.4
*** DISP raspwr: generate raster image of intensity image (power-law scale) ***
*** Copyright 2008, Gamma Remote Sensing, v2.5 11-Sep-2008 clw ***
FLOAT data: mli_WBs/20071020_4.mli
input image width: 1469   height: 7100
output SUN RASTER format image filename: mli_WBs/20071020_4.mli.ras
range looks: 1   azimuth looks: 1
output image width: 1469   height: 7100
relative scale factor:    0.600  exponent:    0.400
file: mli_WBs/20071020_4.mli  ave. intensity:  3.62379e-02  average:  1.97559e-01  scale factor:
3.64447e+02

line 0
line 400
line 800
line 1200
line 1600
line 2000
line 2400
line 2800
line 3200
line 3600
line 4000
```

```
line 4400
line 4800
line 5200
line 5600
line 6000
line 6400
line 6800
7100 display lines

rm -f /media/d1/20071020_4.rc 1
```

5 Appendix 3: Terrain Geocoding using mk_geo

The different steps in geocoding are automated using the mk_geo script. The script is called 4 times, each time with a different mode. The details on mk_geo are documented in mk_geo.html in the DIFF/html directory.

5.1 Mode 0: Calculate Initial Lookup table, generate Simulated Image, resample Simulated Image to RDC and Display

```
./mk_geo nz_WBs2_20071020.mli nz_WBs2_20071020.mli.par DEM/nz.dem DEM/nz.dem_par geo_WBs2/nz_WBs2.dem
geo_WBs2/nz_WBs2.dem_par geo_WBs2 nz_WBs2 5.555555556e-4 0 2

*** ./mk_geo processing start: Sun Apr 10 15:38:25 2011  mode: 0 ***
MLI image: nz_WBs2_20071020.mli
MLI parameter file: nz_WBs2_20071020.mli.par
MLI width: 4154   lines: 7084
MLI pixel spacing (m) range: 28.105542  azimuth: 50.931552

input DEM: DEM/nz.dem
DEM parameter file: DEM/nz.dem_par
DEM width: 6001   lines: 6001
DEM posting Northing (deg): -8.333333e-04
DEM posting Easting (deg):  8.333333e-04
output posting (deg): 5.555556e-04

output DEM segment: geo_WBs2/nz_WBs2.dem
DEM segment parameter file: geo_WBs2/nz_WBs2.dem_par
DEM interpolation factor northing: 1.49999999388  easting: 1.49999999388
DEM interpolation factor northing: 1.49999999388  easting: 1.49999999388
output terrain geocoded product directory: geo_WBs2

rm -f geo_WBs2/nz_WBs2.dem geo_WBs2/nz_WBs2.dem_par

gc_map nz_WBs2_20071020.mli.par - DEM/nz.dem_par DEM/nz.dem geo_WBs2/nz_WBs2.dem_par
geo_WBs2/nz_WBs2.dem geo_WBs2/nz_WBs2_0.map_to_rdc 1.49999999388 1.49999999388 geo_WBs2/nz_WBs2_0.sim -
- - - - - 8 2 2
*** Calculate lookup table and DEM related products for terrain-corrected geocoding ***
*** Copyright 2011, Gamma Remote Sensing, v5.1 6-Feb-2011 clw/uw  ***
image parameter file: nz_WBs2_20071020.mli.par
using ISP SLC/MLI image parameter file values for calculating lookup table
DEM parameter file: DEM/nz.dem_par
creating new DEM segment parameter file: geo_WBs2/nz_WBs2.dem_par
no output file for parameter u
no output file for parameter v
no output file for parameter linc
no output file for parameter psi
no output file for normalized pixel area
no output file for layover/shadow map
SLC slant range pixel spacing (m):  28.105542
SLC azimuth pixel spacing (m):      50.931552
effective PRF (Hz):                  2150.538
radar center frequency (Hz):        1.27000e+09
Doppler centroid (Hz):                  0.000
center swath inc. angle (deg.):        38.179
number of range samples:                 4154
number of azimuth lines:                 7084
number of range looks:                      3
number of azimuth looks:                   16
radar wavelength (m):              0.23605705
SLC deskew ON: 1
lr+dem:           -1 (normal)
azimuth angle: 90.0000 (right looking)

input image cross-track width:         4154
input image lines:                     7084
offset (SLC-1 lines) of input image:      0
input image looks range:    1  azimuth    1
input image slant range pixel spacing (m):  28.105542
input image azimuth pixel spacing (m):      50.931552
image center lat (deg.): -43.4047229 lon: (deg.) 172.3378445  earth radius (m): 6368084.4965  altitude
(m): 711751.6403
radar velocity (m/s): 7579.969028  approx. SAR focus velocity (m/s): 7188.863488
layover/shadow mode 2: true location
DEM INTEGER*2 data read, lines, width: 6001 6001
```

```
Determine DEM paramter file for DEM segment covering geocoded SAR image
lookup table frame size (pixels):      8
starting DEM line: 719
ending DEM line:   5090
dp.nlines:   6001
starting DEM col:    662
ending DEM col:   5026
dp.nlines:   6001
starting DEM line:    719   column:    662
ending DEM line:     5090   column:   5026

**** NEW DEM GEOCODING SEGMENT PARAMETERS ****
latitude, northing, S oversampling factor for DEM segment: 1.50000
longitude, easting, C oversampling factor for DEM segment: 1.50000
output DEM segment parameter file: geo_WBs2/nz_WBs2.dem_par
image center time (s): 79455.015148
error threshold for geocoding along track (samples): 0.010000   t_error: 7.4400000e-05

line:    400   column:   3274
hgt[1][j],hgt[0][j],hgt[1][j-1]:     470.2948     478.7775     478.7777
slope angles u,v (deg.):              11.7870      63.9153
look angle, nominal incid. angle (deg.):      36.4139      41.1662
simulated SAR image intensity:         2.1780
local incidence angle (deg.):         30.8540
projection angle psi (deg.):          59.6091
pixel normalization factor:            0.7686

line:    800   column:   3274
hgt[1][j],hgt[0][j],hgt[1][j-1]:     589.6833     573.3405     585.9631
slope angles u,v (deg.):              14.6447    -162.4637
look angle, nominal incid. angle (deg.):      36.0475      40.7257
simulated SAR image intensity:         0.8867
local incidence angle (deg.):         46.8834
projection angle psi (deg.):          46.4543
pixel normalization factor:            1.0559

line:   1200   column:   3274
hgt[1][j],hgt[0][j],hgt[1][j-1]:    1557.0367    1573.2603    1575.9998
slope angles u,v (deg.):              24.3391      71.2650
look angle, nominal incid. angle (deg.):      35.7115      40.2230
simulated SAR image intensity:         6.5676
local incidence angle (deg.):         18.5829
projection angle psi (deg.):          72.9949
pixel normalization factor:            0.4529

line:   1600   column:   3274
hgt[1][j],hgt[0][j],hgt[1][j-1]:    1103.6528    1087.7776    1123.7776
slope angles u,v (deg.):              32.6396     131.0764
look angle, nominal incid. angle (deg.):      35.3124      39.8115
simulated SAR image intensity:         5.8573
local incidence angle (deg.):         25.2294
projection angle psi (deg.):          76.5859
pixel normalization factor:            0.3623

line:   2000   column:   3274
hgt[1][j],hgt[0][j],hgt[1][j-1]:    1314.9766    1289.7269    1336.7777
slope angles u,v (deg.):              38.5826     138.4173
look angle, nominal incid. angle (deg.):      34.9361      39.3498
simulated SAR image intensity:         6.0404
local incidence angle (deg.):         30.1528
projection angle psi (deg.):          79.5896
pixel normalization factor:            0.2850

line:   2400   column:   3274
hgt[1][j],hgt[0][j],hgt[1][j-1]:     855.7780     831.1991     852.0003
slope angles u,v (deg.):              21.6897    -169.0501
look angle, nominal incid. angle (deg.):      34.5279      38.9322
simulated SAR image intensity:         0.9078
local incidence angle (deg.):         47.2881
projection angle psi (deg.):          50.2808
pixel normalization factor:            1.0169

line:   2800   column:   3274
hgt[1][j],hgt[0][j],hgt[1][j-1]:     669.5554     673.1110     678.5183
slope angles u,v (deg.):              11.8008      89.2331
look angle, nominal incid. angle (deg.):      34.1263      38.4915
```

```
simulated SAR image intensity:         2.7358
local incidence angle (deg.):         26.7861
projection angle psi (deg.):          63.2151
pixel normalization factor:            0.7240

line:   3200   column:   3274
hgt[1][j],hgt[0][j],hgt[1][j-1]:     118.7311     118.0960     119.5185
slope angles u,v (deg.):               1.3216     107.8330
look angle, nominal incid. angle (deg.):      33.7056      38.0754
simulated SAR image intensity:         1.3580
local incidence angle (deg.):         37.0266
projection angle psi (deg.):          52.9835
pixel normalization factor:            0.9762

line:   3600   column:   3274
hgt[1][j],hgt[0][j],hgt[1][j-1]:      54.1852      54.6132      55.0000
slope angles u,v (deg.):               1.1090      57.3161
look angle, nominal incid. angle (deg.):      33.3000      37.6188
simulated SAR image intensity:         1.3834
local incidence angle (deg.):         36.5418
projection angle psi (deg.):          53.4598
pixel normalization factor:            0.9754

line:   4000   column:   3274
hgt[1][j],hgt[0][j],hgt[1][j-1]:      -1.0000      -1.0000      -1.0000
slope angles u,v (deg.):               0.2083      -1.5189
look angle, nominal incid. angle (deg.):      32.8901      37.1574
simulated SAR image intensity:         1.3197
local incidence angle (deg.):         37.1556
projection angle psi (deg.):          52.8454
pixel normalization factor:            0.9999

line:   4400   column:   3274
hgt[1][j],hgt[0][j],hgt[1][j-1]:      -1.0000      -1.0000      -1.0000
slope angles u,v (deg.):               0.2083      -1.5167
look angle, nominal incid. angle (deg.):      32.4779      36.6874
simulated SAR image intensity:         1.3433
local incidence angle (deg.):         36.6738
projection angle psi (deg.):          53.3272
pixel normalization factor:            0.9997

line:   4800   column:   3274
hgt[1][j],hgt[0][j],hgt[1][j-1]:      -1.0000      -1.0000      -1.0000
slope angles u,v (deg.):               0.2084      -1.5145
look angle, nominal incid. angle (deg.):      32.0610      36.2132
simulated SAR image intensity:         1.3678
local incidence angle (deg.):         36.1873
projection angle psi (deg.):          53.8136
pixel normalization factor:            0.9994

line:   5200   column:   3274
hgt[1][j],hgt[0][j],hgt[1][j-1]:      -1.0000      -1.0000      -1.0000
slope angles u,v (deg.):               0.2084      -1.5124
look angle, nominal incid. angle (deg.):      31.6395      35.7348
simulated SAR image intensity:         1.3932
local incidence angle (deg.):         35.6963
projection angle psi (deg.):          54.3047
pixel normalization factor:            0.9990

line:   5600   column:   3274
hgt[1][j],hgt[0][j],hgt[1][j-1]:      -1.0000      -1.0000      -1.0000
slope angles u,v (deg.):               0.2083      -1.5102
look angle, nominal incid. angle (deg.):      31.2133      35.2522
simulated SAR image intensity:         1.4194
local incidence angle (deg.):         35.2006
projection angle psi (deg.):          54.8004
pixel normalization factor:            0.9987

line:   6000   column:   3274
hgt[1][j],hgt[0][j],hgt[1][j-1]:      -1.0000      -1.0000      -1.0000
slope angles u,v (deg.):               0.2083      -1.5081
look angle, nominal incid. angle (deg.):      30.7825      34.7654
simulated SAR image intensity:         1.4466
local incidence angle (deg.):         34.7003
projection angle psi (deg.):          55.3007
pixel normalization factor:            0.9983
```

```
line:   6400   column:   3274
hgt[1][j],hgt[0][j],hgt[1][j-1]:      -1.0000      -1.0000      -1.0000
slope angles u,v (deg.):               0.2083      -1.5060
look angle, nominal incid. angle (deg.):      30.3470      34.2744
simulated SAR image intensity:         1.4747
local incidence angle (deg.):         34.1953
projection angle psi (deg.):          55.8057
pixel normalization factor:            0.9979

user time (s):       184.140
system time (s):       0.610
elapsed time (s):    186.750


geocode geo_WBs2/nz_WBs2_0.map_to_rdc geo_WBs2/nz_WBs2_0.sim 6548 geo_WBs2/nz_WBs2_0.sim_rdc 4154 7084
2 0 1 1 2 8
*** Forward geocoding transformation using a lookup table ***
*** Copyright 2011, Gamma Remote Sensing, v3.3 7-Apr-2011 uw/clw ***
input/output data format: float
interpolation algorithm: convolution with (1/r)**2 weighting
interpolation oversampling factor: 2
interpolation search radius: 8
number of points used for interpolation: 4
number of entries in the interpolation search table: 208

input data width, nlines:       6548    6557
output data width, nlines:      4154    7084
interpolation arrays width: 8322  lines: 1008
number of elements in the interpolation arrays: 8388576
number of output lines/block: 497
number of output blocks: 15
output block:  1   starting line:      0
output block:  2   starting line:    497
output block:  3   starting line:    994
output block:  4   starting line:   1491
output block:  5   starting line:   1988
output block:  6   starting line:   2485
output block:  7   starting line:   2982
output block:  8   starting line:   3479
output block:  9   starting line:   3976
output block: 10   starting line:   4473
output block: 11   starting line:   4970
output block: 12   starting line:   5467
output block: 13   starting line:   5964
output block: 14   starting line:   6461
output block: 15   starting line:   6958

output data file: geo_WBs2/nz_WBs2_0.sim_rdc
output file width: 4154   lines: 7084

user time (s):        13.270
system time (s):       1.250
elapsed time (s):     14.560


raspwr geo_WBs2/nz_WBs2_0.sim_rdc 4154 1 0 1 1
*** DISP raspwr: generate raster image of intensity image (power-law scale) ***
*** Copyright 2008, Gamma Remote Sensing, v2.5 11-Sep-2008 clw ***
FLOAT data: geo_WBs2/nz_WBs2_0.sim_rdc
input image width: 4154   height: 7084
output SUN RASTER format image filename: geo_WBs2/nz_WBs2_0.sim_rdc.ras
range looks: 1   azimuth looks: 1
output image width: 4154   height: 7084
relative scale factor:    1.000  exponent:    0.350
file: geo_WBs2/nz_WBs2_0.sim_rdc  ave. intensity:  1.48652e+00  average:  1.07533e+00  scale factor:
1.11594e+02

line 0
line 400
line 800
line 1200
line 1600
line 2000
line 2400
line 2800
line 3200
line 3600
```

```
line 4000
line 4400
line 4800
line 5200
line 5600
line 6000
line 6400
line 6800
7084 display lines

dis2ras geo_WBs2/nz_WBs2_0.sim_rdc.ras nz_WBs2_20071020.mli.ras&

simulated SAR image in map coordinates: geo_WBs2/nz_WBs2_0.sim
simulated SAR image in range-Doppler coordinates: geo_WBs2/nz_WBs2_0.sim_rdc
raster image of simulated SAR image in RDC: geo_WBs2/nz_WBs2_0.sim_rdc.ras
DEM segment parameter file for geocoded SAR image: geo_WBs2/nz_WBs2.dem_par
DEM segment width: 6548   lines: 6557
*** ./mk_geo mode: 0 completed  Sun Apr 10 15:41:49 2011 ***
```

5.2 Mode 2: Determine Initial Offset between the SAR Image and Simulated Image in Range-Doppler Coordinates

```
./mk_geo nz_WBs2_20071020.mli nz_WBs2_20071020.mli.par DEM/nz.dem DEM/nz.dem_par geo_WBs2/nz_WBs2.dem
geo_WBs2/nz_WBs2.dem_par geo_WBs2 nz_WBs2 5.555555556e-4 2 2

*** ./mk_geo processing start: Sun Apr 10 15:42:33 2011  mode: 2 ***
MLI image: nz_WBs2_20071020.mli
MLI parameter file: nz_WBs2_20071020.mli.par
MLI width: 4154   lines: 7084
MLI pixel spacing (m) range: 28.105542  azimuth: 50.931552

input DEM: DEM/nz.dem
DEM parameter file: DEM/nz.dem_par
DEM width: 6001   lines: 6001
DEM posting Northing (deg): -8.333333e-04
DEM posting Easting (deg):  8.333333e-04
output posting (deg): 5.555556e-04

output DEM segment: geo_WBs2/nz_WBs2.dem
DEM segment parameter file: geo_WBs2/nz_WBs2.dem_par
DEM interpolation factor northing: 1.49999999388  easting: 1.49999999388
DEM interpolation factor northing: 1.49999999388  easting: 1.49999999388
output terrain geocoded product directory: geo_WBs2

#create DIFF_PAR parameter file to store offset parameters between the actual and simulated radar
#images. The file nz_WBs2.diff_par.in has the following values:

create_diff_par nz_WBs2_20071020.mli.par - geo_WBs2/nz_WBs2.diff_par 1 < geo_WBs2/nz_WBs2.diff_par.in
*** create DIFF_par parameter file for image registration and geocoding
*** Copyright 2008, Gamma Remote Sensing, v2.6 10-Mar-2008 clw/uw ***
PAR_type 1: (ISP image parameter files)
NOTE: No second ISP image parameter file provided
output DIFF/GEO parameter file: geo_WBs2/nz_WBs2.diff_par

user time (s):         0.000
system time (s):       0.000
elapsed time (s):      0.000


set_value geo_WBs2/nz_WBs2.diff_par geo_WBs2/nz_WBs2.diff_par initial_range_offset 0
*** Update keyword:value in text parameter files ***
*** Copyright 2006, Gamma Remote Sensing, v1.4 20-Nov-2006 clw ***

keyword found: initial_range_offset
current value: 0
new value:  0

set_value geo_WBs2/nz_WBs2.diff_par geo_WBs2/nz_WBs2.diff_par initial_azimuth_offset 0
*** Update keyword:value in text parameter files ***
*** Copyright 2006, Gamma Remote Sensing, v1.4 20-Nov-2006 clw ***

keyword found: initial_azimuth_offset
current value: 0
new value:  0

set_value geo_WBs2/nz_WBs2.diff_par geo_WBs2/nz_WBs2.diff_par initial_range_offset 0
*** Update keyword:value in text parameter files ***
*** Copyright 2006, Gamma Remote Sensing, v1.4 20-Nov-2006 clw ***

keyword found: initial_range_offset
current value: 0
new value:  0

set_value geo_WBs2/nz_WBs2.diff_par geo_WBs2/nz_WBs2.diff_par initial_azimuth_offset 0
*** Update keyword:value in text parameter files ***
*** Copyright 2006, Gamma Remote Sensing, v1.4 20-Nov-2006 clw ***

keyword found: initial_azimuth_offset
current value: 0
new value:  0

init_offsetm geo_WBs2/nz_WBs2_0.sim_rdc nz_WBs2_20071020.mli geo_WBs2/nz_WBs2.diff_par 1 1 2077 3542 0
0 10 1024 1
*** Initial offset estimation for multi-look intensity images ***
*** Copyright 2008, Gamma Remote Sensing, v3.3 12-Feb-2008 clw/uw ***
```

```
FFT patch size: 1024
MLI-1 image: geo_WBs2/nz_WBs2_0.sim_rdc
MLI-2 image: nz_WBs2_20071020.mli
DIFF/GEO image parameter file: geo_WBs2/nz_WBs2.diff_par

initial offset estimate (range,azimuth): 0  0
number of range looks:   1
number of azimuth looks: 1
points/line image 1:     4154
points/line image 2:     4154
window size range: 1024  azimuth: 1024
region center (range, azimuth):   2077    3542
correlation SNR threshold:      10.000
initial offset estimate (range, azimuth): 0  0
offset search window sizes (range, azimuth pixels): 1024  1024
image oversampling factor: 2
oversampled offset search window sizes (range, azimuth pixels): 2048  2048

starting line: MLI-1: 3030    MLI-2: 3030

starting range sample: MLI-1: 1565   MLI-2: 1565
interp. filter bandwidth:      0.500  FIR length: 257
bp_filter: bw:  3.1416  wc:  0.0000  nfft: 2048  nps: 257   Kaiser beta:   0.500
bp_filter: bw:  3.1416  wc:  0.0000  nfft: 2048  nps: 257   Kaiser beta:   0.500
average image 1 intensity:  1.325e+00  clip1:  5.302e+01
average image 2 intensity:  2.202e-02  clip2:  8.810e-01

offset estimate range:     -0.508  azimuth:      2.195
correlation SNR:     40.852
output DIFF/GEO parameter file: geo_WBs2/nz_WBs2.diff_par
Note: copying initial range and azimuth offset to constant terms in the offset polynomials

user time (s):         1.710
system time (s):       0.060
elapsed time (s):      1.780

creating DIFF/GEO parameter file: geo_WBs2/nz_WBs2.diff_par

initial offset patch center range: 2077  azimuth: 3542
initial offset range (pixels): 0  azimuth: 0
number of looks for initial offset estimate range: 1  azimuth: 1


initial range offset (samples): -0.50835   azimuth offset (lines): 2.19521
setting range and azimuth offset polynomial values to initial offsets in file:
geo_WBs2/nz_WBs2.diff_par

*** ./mk_geo mode: 2 completed  Sun Apr 10 15:42:33 2011 ***
```

5.3 Mode 3: Measure Offsets between the SAR Mosaic and the Simulated SAR image

```
./mk_geo nz_WBs2_20071020.mli nz_WBs2_20071020.mli.par DEM/nz.dem DEM/nz.dem_par geo_WBs2/nz_WBs2.dem
geo_WBs2/nz_WBs2.dem_par geo_WBs2 nz_WBs2 5.555555556e-4 3 2

*** ./mk_geo processing start: Sun Apr 10 15:42:44 2011  mode: 3 ***
MLI image: nz_WBs2_20071020.mli
MLI parameter file: nz_WBs2_20071020.mli.par
MLI width: 4154   lines: 7084
MLI pixel spacing (m) range: 28.105542  azimuth: 50.931552

input DEM: DEM/nz.dem
DEM parameter file: DEM/nz.dem_par
DEM width: 6001   lines: 6001
DEM posting Northing (deg): -8.333333e-04
DEM posting Easting (deg):  8.333333e-04
output posting (deg): 5.555556e-04

output DEM segment: geo_WBs2/nz_WBs2.dem
DEM segment parameter file: geo_WBs2/nz_WBs2.dem_par
DEM interpolation factor northing: 1.49999999388  easting: 1.49999999388
DEM interpolation factor northing: 1.49999999388  easting: 1.49999999388
output terrain geocoded product directory: geo_WBs2

offset_pwrm geo_WBs2/nz_WBs2_0.sim_rdc nz_WBs2_20071020.mli geo_WBs2/nz_WBs2.diff_par
geo_WBs2/nz_WBs2.offs geo_WBs2/nz_WBs2.snr
*** Offsets between MLI images using intensity cross-correlation ***
*** Copyright 2008, Gamma Remote Sensing, v3.4 clw/uw 18-Mar-2008 ***
MLI-1 image: geo_WBs2/nz_WBs2_0.sim_rdc
MLI-2 image: nz_WBs2_20071020.mli
DIFF/GEO image parameter file: geo_WBs2/nz_WBs2.diff_par
MLI oversampling factor: 2
initial offset estimate (range, azimuth): -1  2
offset search window sizes (range, azimuth pixels): 256  256
oversampled offset search window sizes (range, azimuth pixels): 512  512
first range, last range, points: 48  4106  20
first az. line, last az. line, points:  48  7036  20
number of offset estimates:    400
correlation SNR threshold:     10.000

starting lines: MLI-1: -80   MLI-2: -78
interp. filter bandwidth:      0.500  FIR length: 65
bp_filter: bw:  3.1416  wc:  0.0000  nfft: 512  nps: 65   Kaiser beta:   0.500
bp_filter: bw:  3.1416  wc:  0.0000  nfft: 512  nps: 65   Kaiser beta:   0.500
average MLI-1 intensity:  1.484e+00  clip1:  7.421e+00
average MLI-2 intensity:  2.316e-02  clip2:  1.158e-01
search line:     1    offsets above SNR threshold:     0

search line:     2   MLI-1:    415   MLI-2:    417  azoff_init:    2  roff_init:   -1
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
   474     415       -0.5700        2.1450      22.420
   687     415       -0.5700        2.1175      19.718
   900     415       -0.6040        2.0664      36.205
  1113     415       -0.6594        2.0439      30.486
  1326     415       -0.6533        2.0408      40.504
  1539     415       -0.6742        2.0561      38.556
  1752     415       -0.6682        2.1004      34.942
  1965     415       -0.6284        2.1004      29.379
  2178     415       -0.6812        2.0676      23.119
  2391     415       -0.7146        1.9804      18.247
  2817     415       -0.4177        2.3139      25.681
  3030     415       -0.4122        2.2940      17.462
  3243     415       -0.3701        2.3567      22.754
  3456     415       -0.3854        2.2940      32.135
  3669     415       -0.3376        2.2312      23.493
  3882     415       -0.3698        2.2850      27.154
search line:     2    offsets above SNR threshold:    16

search line:     3   MLI-1:    782   MLI-2:    784  azoff_init:    2  roff_init:   -1
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
   474     782       -0.5454        2.2224      28.834
   687     782       -0.4941        2.1413      31.567
   900     782       -0.5857        2.0872      36.305
  1113     782       -0.6181        2.0427      42.075
  1326     782       -0.6671        2.0206      35.467
```

```
  1539     782       -0.7187        2.0045      21.992
  1752     782       -0.6937        2.0520      23.817
  1965     782       -0.6655        2.0384      40.258
  2178     782       -0.6802        2.0779      31.441
  2391     782       -0.8106        2.2983      24.914
  2604     782       -0.7294        2.1401      13.823
  2817     782       -0.5132        2.0884      20.144
  3030     782       -0.3550        2.3280      38.624
  3243     782       -0.1986        2.1034      22.514
  3456     782       -0.3405        2.3391      19.896
  3669     782       -0.3701        2.2363      23.344
  3882     782       -0.4242        2.2898      37.517
search line:     3    offsets above SNR threshold:    17

search line:     4   MLI-1:   1149   MLI-2:   1151  azoff_init:    2  roff_init:   -1
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
   687    1149       -0.6174        2.0780      12.333
   900    1149       -0.5706        2.0831      45.957
  1113    1149       -0.6258        2.1007      51.850
  1326    1149       -0.6660        2.0441      35.265
  1539    1149       -0.6805        2.0563      30.866
  1752    1149       -0.6791        2.0273      29.294
  1965    1149       -0.6387        2.0960      44.479
  2178    1149       -0.6218        2.1532      38.022
  2391    1149       -0.6185        2.0450      19.245
  2604    1149       -0.6128        2.1601      30.558
  2817    1149       -0.5915        2.1362      26.524
  3030    1149       -0.3709        2.2475      26.895
  3243    1149       -0.5110        2.2607      12.076
  3456    1149       -0.5654        2.1599      27.070
  3669    1149       -0.3912        2.3363      34.035
  3882    1149       -0.1849        2.0828      30.996
search line:     4    offsets above SNR threshold:    16

search line:     5   MLI-1:   1516   MLI-2:   1518  azoff_init:    2  roff_init:   -1
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
   687    1516       -0.4603        2.0234      27.608
   900    1516       -0.5957        2.0820      18.989
  1113    1516       -0.6873        2.0330      46.806
  1326    1516       -0.6190        2.0981      43.516
  1539    1516       -0.6854        2.0317      34.483
  1752    1516       -0.5711        2.0999      30.019
  1965    1516       -0.5941        2.0981      20.948
  2178    1516       -0.6267        2.0599      29.964
  2391    1516       -0.5519        2.0878      29.329
  2604    1516       -0.5224        2.0781      15.908
  2817    1516       -0.5560        2.1038      27.091
  3030    1516       -0.4686        2.3067      33.454
  3243    1516       -0.3839        2.2225      24.281
  3456    1516       -0.5138        2.2087      34.032
  3669    1516       -0.4483        2.3146      23.861
  3882    1516       -0.3087        2.3182      36.909
search line:     5    offsets above SNR threshold:    16

search line:     6   MLI-1:   1883   MLI-2:   1885  azoff_init:    2  roff_init:   -1
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
   900    1883       -0.6373        2.0434      16.035
  1113    1883       -0.7740        2.1502      38.439
  1326    1883       -0.6444        2.0541      27.202
  1539    1883       -0.4576        1.9881      18.741
  1752    1883       -0.6010        2.1156      42.200
  1965    1883       -0.6557        2.0824      20.466
  2178    1883       -0.6619        2.0623      33.224
  2391    1883       -0.6279        2.0662      39.731
  2604    1883       -0.5721        2.0708      29.768
  2817    1883       -0.4939        2.1986      37.578
  3030    1883       -0.5376        2.1537      30.683
  3243    1883       -0.4487        2.2060      28.505
  3456    1883       -0.4763        2.2658      23.932
  3669    1883       -0.5685        2.1402      17.197
  3882    1883       -0.3423        2.4185      23.697
search line:     6    offsets above SNR threshold:    15

search line:     7   MLI-1:   2250   MLI-2:   2252  azoff_init:    2  roff_init:   -1
```

```
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
   900    2250       -0.6323        1.9426      20.097
  1113    2250       -0.6226        2.0004      38.382
  1326    2250       -0.7062        2.0456      41.110
  1539    2250       -0.7138        2.0634      48.470
  1752    2250       -0.6368        1.9781      21.913
  2178    2250       -0.6046        2.1533      39.004
  2391    2250       -0.6185        2.1099      35.238
  2604    2250       -0.6458        2.1166      43.570
  2817    2250       -0.6097        2.1012      25.609
  3030    2250       -0.4921        2.1127      35.731
  3243    2250       -0.5437        2.1263      29.097
  3456    2250       -0.5871        2.1479      20.872
  3669    2250       -0.6030        2.1200      28.974
  3882    2250       -0.5388        2.2466      22.913
search line:     7    offsets above SNR threshold:    14

search line:     8   MLI-1:   2617   MLI-2:   2619  azoff_init:    2  roff_init:   -1
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
  1113    2617       -0.8486        2.0048      75.772
  1326    2617       -0.7079        1.9772      30.483
  1539    2617       -0.6562        2.0354      22.576
  1752    2617       -0.7723        2.0961      34.873
  1965    2617       -0.6742        2.1827      30.701
  2178    2617       -0.7021        2.1354      43.319
  2391    2617       -0.6921        2.0798      40.822
  2604    2617       -0.6596        2.0180      23.778
  2817    2617       -0.6773        2.0186      29.455
  3030    2617       -0.5945        2.0854      23.628
  3243    2617       -0.5137        2.1593      24.438
  3456    2617       -0.6879        2.0889      28.385
  3669    2617       -0.5017        2.2175      28.650
  3882    2617       -0.5959        2.1963      24.719
search line:     8    offsets above SNR threshold:    14

search line:     9   MLI-1:   2984   MLI-2:   2986  azoff_init:    2  roff_init:   -1
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
  1752    2984       -0.4795        2.2761      16.196
  1965    2984       -0.4854        2.1847      23.805
  2178    2984       -0.5466        2.1494      37.168
  2391    2984       -0.5666        2.0603      17.511
  2604    2984       -0.7074        1.9710      24.647
  2817    2984       -0.6877        2.0002      21.515
  3030    2984       -0.7073        2.0200      20.723
  3243    2984       -0.5838        2.1395      16.709
  3456    2984       -0.4765        2.2002      26.850
  3669    2984       -0.5452        2.1358      19.493
  3882    2984       -0.6762        2.1616      20.778
search line:     9    offsets above SNR threshold:    11

search line:    10   MLI-1:   3351   MLI-2:   3353  azoff_init:    2  roff_init:   -1
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
  1752    3351       -2.1740        1.3554      14.452
  1965    3351        0.7175        2.2237      10.030
  2391    3351       -0.6157        2.1391      23.821
  2604    3351       -0.5535        2.1525      40.958
  2817    3351       -0.4960        2.2404      32.943
  3030    3351       -0.6205        2.1184      34.180
  3243    3351       -0.5773        2.1391      35.500
  3456    3351       -0.6100        2.0774      16.436
  3669    3351       -0.5640        2.1603      17.718
  3882    3351       -0.5888        2.1114      25.806
search line:    10    offsets above SNR threshold:    10

search line:    11   MLI-1:   3718   MLI-2:   3720  azoff_init:    2  roff_init:   -1
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
   474    3718       -0.2192        2.4112     105.010
   687    3718       -0.7231        2.2944      25.407
   900    3718       -0.7229        2.1284      26.174
  1113    3718       -0.6568        2.0848      23.733
  1326    3718       -0.5539        2.1842      25.366
  1539    3718       -0.4701        2.1986      15.515
```

```
  2604    3718       -0.6243        2.1633      25.211
  2817    3718       -0.6506        2.1166      31.748
  3030    3718       -0.6593        2.1093      22.193
  3243    3718       -0.7306        2.0063      33.961
  3456    3718       -0.6325        2.1718      22.624
  3669    3718       -0.8020        2.6028      13.934
  3882    3718       -0.5605        2.1050      14.713
search line:    11    offsets above SNR threshold:    13

search line:    12   MLI-1:   4085   MLI-2:   4087  azoff_init:    2  roff_init:   -1
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
   474    4085       -0.5374        1.9852      18.416
   687    4085       -0.6197        1.8690      15.090
   900    4085       -0.6478        2.0495      16.816
  1113    4085       -0.6556        2.0898      33.593
  1326    4085       -0.6162        2.1276      38.513
  1539    4085       -0.6746        2.2979      18.745
  1752    4085        1.1038        2.5741      19.725
  1965    4085        0.9762        2.7865      11.634
  2178    4085        0.9265        2.8792      15.204
  2391    4085        0.9806        2.8751      13.020
  2817    4085       -0.1444        2.2882      15.607
  3030    4085       -0.5939        2.1719      17.605
  3243    4085       -0.6149        2.2552      13.879
  3456    4085       -0.6999        1.9982      16.686
  3669    4085       -0.6906        2.0461      20.537
  3882    4085       -0.7090        2.0277      27.238
search line:    12    offsets above SNR threshold:    16

search line:    13   MLI-1:   4452   MLI-2:   4454  azoff_init:    2  roff_init:   -1
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
  1965    4452       -2.1504        1.5116      22.970
  2178    4452        1.0448        2.8054      14.477
  2391    4452        1.0425        2.8018      12.680
  2604    4452        1.0937        1.6600      13.927
  2817    4452        1.0041        2.1416      13.634
  3030    4452        0.9919        2.5180      12.484
  3243    4452        0.9990        2.6757      12.102
  3456    4452       -0.6257        2.1823      14.226
  3669    4452       -0.6630        2.0457      37.366
  3882    4452       -0.7145        2.1601      28.785
search line:    13    offsets above SNR threshold:    10

search line:    14   MLI-1:   4819   MLI-2:   4821  azoff_init:    2  roff_init:   -1
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
  2178    4819        1.1126        2.3341      10.481
  2817    4819        0.9215        2.9239      21.145
  3030    4819       -2.4741        1.4963      23.798
  3243    4819       -2.5537        1.3043      21.647
  3456    4819       -0.6929        2.2253      19.219
  3669    4819       -0.6761        2.1703      28.019
  3882    4819       -0.7961        2.3162      24.911
search line:    14    offsets above SNR threshold:     7

search line:    15   MLI-1:   5186   MLI-2:   5188  azoff_init:    2  roff_init:   -1
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
  2604    5186        1.0518        2.2135      11.453
  2817    5186        1.2271        2.7084      23.475
  3030    5186        0.9687        2.7869      28.207
  3243    5186       -1.9014        1.6530      10.639
  3456    5186       -0.5081        2.7887      14.136
  3669    5186       -0.6259        2.0772      44.689
  3882    5186       -0.6848        2.0621      34.230
search line:    15    offsets above SNR threshold:     7

search line:    16   MLI-1:   5553   MLI-2:   5555  azoff_init:    2  roff_init:   -1
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
  3030    5553        1.1083        2.8911      17.924
  3243    5553       -2.4118        1.5044      13.896
  3669    5553       -0.5033        2.2175      24.205
  3882    5553       -0.6203        2.0988      36.025
search line:    16    offsets above SNR threshold:     4
```

```
search line:    17   MLI-1:   5920   MLI-2:   5922  azoff_init:    2  roff_init:   -1
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
  3669    5920       -0.6557        2.2909      20.694
  3882    5920       -0.7673        2.1939      15.630
search line:    17    offsets above SNR threshold:     2

search line:    18   MLI-1:   6287   MLI-2:   6289  azoff_init:    2  roff_init:   -1
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
  3456    6287       -0.6439        2.2125      27.501
  3669    6287       -0.6508        2.1432      25.867
  3882    6287       -0.5848        2.1433      29.931
search line:    18    offsets above SNR threshold:     3

search line:    19   MLI-1:   6654   MLI-2:   6656  azoff_init:    2  roff_init:   -1
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
  3456    6654       -0.5379        2.1924      12.358
  3669    6654       -0.5850        2.1199      46.813
  3882    6654       -0.6078        2.1031      25.993
search line:    19    offsets above SNR threshold:     3
search line:    20    offsets above SNR threshold:     0

number of offsets above SNR threshold: 194 of 400
output binary offset file: geo_WBs2/nz_WBs2.offs
output binary SNR file: geo_WBs2/nz_WBs2.snr
output DIFF/GEO parameter file: geo_WBs2/nz_WBs2.diff_par

user time (s):        19.390
system time (s):       0.020
elapsed time (s):     19.450


offset_fitm geo_WBs2/nz_WBs2.offs geo_WBs2/nz_WBs2.snr geo_WBs2/nz_WBs2.diff_par geo_WBs2/nz_WBs2.coffs
- 10 3
*** Range and azimuth offset polynomial estimation ***
*** Copyright 2008, Gamma Remote Sensing, v3.1 27-May-2008 clw/uw ***
offsets: geo_WBs2/nz_WBs2.offs
SNR data: geo_WBs2/nz_WBs2.snr
DIFF/GEO offset parameters: geo_WBs2/nz_WBs2.diff_par
culled offsets (fcomplex): geo_WBs2/nz_WBs2.coffs

number of offset polynomial parameters: 3: a0 + a1*x + a2*y
number of range samples: 20  number of azimuth samples: 20
number of samples in offset map: 400
range sample spacing: 213  azimuth sample spacing: 367
solution: 194 offset estimates accepted out of 400 samples

range fit SVD singular values:        1.59867e+02   1.50178e+06   4.52485e+05
azimuth fit SVD singular values:      1.59867e+02   1.50178e+06   4.52485e+05
range offset poly. coeff.:              -0.60355  -2.76336e-06   2.03678e-05
azimuth offset poly. coeff.:             2.10061   2.45367e-06   1.60182e-05
model fit std. dev. (samples) range:   0.5662  azimuth:   0.2272
range, azimuth error thresholds:     1.41552     0.56796
SNR threshold:    10.00000

range fit SVD singular values:        1.58186e+02   1.43759e+06   4.45088e+05
azimuth fit SVD singular values:      1.58186e+02   1.43759e+06   4.45088e+05

*** improved least-squares polynomial coefficients 1 ***
solution: 172 offset estimates accepted out of 400 samples
range offset poly. coeff.:              -0.57625  -1.35711e-08  -1.53465e-06
azimuth offset poly. coeff.:             2.11008   2.60281e-06   9.95359e-06
model fit std. dev. (samples) range:     0.1865  azimuth:     0.1120
range, azimuth error thresholds:     0.46624     0.27999
SNR threshold:    10.00000

range fit SVD singular values:        1.57958e+02   1.43280e+06   4.43746e+05
azimuth fit SVD singular values:      1.57958e+02   1.43280e+06   4.43746e+05

*** improved least-squares polynomial coefficients 2 ***
solution: 168 offset estimates accepted out of 400 samples
range offset poly. coeff.:              -0.57991   9.12420e-07  -6.84678e-07
azimuth offset poly. coeff.:             2.11112   1.53931e-06   1.05805e-05
model fit std. dev. (samples) range:     0.1208  azimuth:     0.0979
```

```
range, azimuth error thresholds:     0.30210     0.24481
SNR threshold:    10.00000

range fit SVD singular values:        1.48582e+02   1.38450e+06   3.74472e+05
azimuth fit SVD singular values:      1.48582e+02   1.38450e+06   3.74472e+05

*** improved least-squares polynomial coefficients 3 ***
solution: 163 offset estimates accepted out of 400 samples
range offset poly. coeff.:              -0.68313   6.46634e-05  -3.45640e-05
azimuth offset poly. coeff.:             2.03442   5.27972e-05  -1.68179e-05
model fit std. dev. (samples) range:     0.0923  azimuth:     0.0829
range, azimuth error thresholds:     0.23082     0.20713
SNR threshold:    10.00000

range fit SVD singular values:        1.47237e+02   1.37631e+06   3.65164e+05
azimuth fit SVD singular values:      1.47237e+02   1.37631e+06   3.65164e+05

*** improved least-squares polynomial coefficients 4 ***
solution: 158 offset estimates accepted out of 400 samples
range offset poly. coeff.:              -0.68566   6.84631e-05  -3.74347e-05
azimuth offset poly. coeff.:             2.02701   5.70223e-05  -1.91135e-05
model fit std. dev. (samples) range:     0.0874  azimuth:     0.0768

total number of culling iterations: 4
final solution: 158 offset estimates accepted out of 400 samples

final range offset poly. coeff.:              -0.68566   6.84631e-05  -3.74347e-05
final range offset poly. coeff. errors:     5.93436e-04   2.54511e-07   1.72506e-07

final azimuth offset poly. coeff.:             2.02701   5.70223e-05  -1.91135e-05
final azimuth offset poly. coeff. errors:   5.21940e-04   2.23848e-07   1.51722e-07

final model fit std. dev. (samples) range:     0.0874  azimuth:     0.0768

binary culled offsets: geo_WBs2/nz_WBs2.coffs
updating DIFF/GEO parameters: geo_WBs2/nz_WBs2.diff_par

user time (s):         0.000
system time (s):       0.000
elapsed time (s):      0.000


cat geo_WBs2/nz_WBs2.diff_par
Gamma DIFF&GEO Processing Parameters
title: nz_WBs2
initial_range_offset:                    -1
initial_azimuth_offset:                   2
range_samp_1:                          4154
az_samp_1:                             7084
first_nonzero_range_pixel_1:              0
number_of_nonzero_range_pixels_1:      4154
range_pixel_spacing_1:            28.105542
az_pixel_spacing_1:               50.931552
range_samp_2:                          4154
az_samp_2:                             7084
first_nonzero_range_pixel_2:              0
number_of_nonzero_range_pixels_2:      4154
range_pixel_spacing_2:            28.105542
az_pixel_spacing_2:               50.931552
offset_estimation_starting_range:        48
offset_estimation_ending_range:        4106
offset_estimation_range_samples:         20
offset_estimation_range_spacing:        213
offset_estimation_starting_azimuth:      48
offset_estimation_ending_azimuth:      7036
offset_estimation_azimuth_samples:       20
offset_estimation_azimuth_spacing:      367
offset_estimation_patch_width:          256
offset_estimation_patch_height:         256
offset_estimation_threshhold:         10.00
range_offset_polynomial:          -0.68566    6.8463e-05   -3.7435e-05    0.0000e+00    0.0000e+00
0.0000e+00
azimuth_offset_polynomial:         2.02701    5.7022e-05   -1.9113e-05    0.0000e+00    0.0000e+00
0.0000e+00
starting_azimuth_line:                    0
map_azimuth_lines:                        0
map_width:                                0
```

```
first_map_range_pixel:                   0
number_map_range_pixels:                 0
range_looks:                             0
azimuth_looks:                           0
diff_phase_fit:       0.00000    0.0000e+00    0.0000e+00    0.0000e+00    0.0000e+00    0.0000e+00

number of range patches:    20   patch width:  256
number of azimuth patches:  20   patch height: 256

DIFF/GEO offset parameter file: geo_WBs2/nz_WBs2.diff_par

*** ./mk_geo mode: 3 completed  Sun Apr 10 15:42:44 2011 ***
```

5.4 Mode 4: Generate DEM in Range-Doppler Coordinates and Geocoded Image Products

In this mode we apply correction to the lookup table, resample simulated SAR image to RDC, resample DEM to RDC, and resample the SAR image to map coordinates and display

```
./mk_geo nz_WBs2_20071020.mli nz_WBs2_20071020.mli.par DEM/nz.dem DEM/nz.dem_par geo_WBs2/nz_WBs2.dem
geo_WBs2/nz_WBs2.dem_par geo_WBs2 nz_WBs2 5.555555556e-4 4 2

*** ./mk_geo processing start: Sun Apr 10 15:43:12 2011  mode: 4 ***
MLI image: nz_WBs2_20071020.mli
MLI parameter file: nz_WBs2_20071020.mli.par
MLI width: 4154   lines: 7084
MLI pixel spacing (m) range: 28.105542  azimuth: 50.931552

input DEM: DEM/nz.dem
DEM parameter file: DEM/nz.dem_par
DEM width: 6001   lines: 6001
DEM posting Northing (deg): -8.333333e-04
DEM posting Easting (deg):  8.333333e-04
output posting (deg): 5.555556e-04

output DEM segment: geo_WBs2/nz_WBs2.dem
DEM segment parameter file: geo_WBs2/nz_WBs2.dem_par
DEM interpolation factor northing: 1.49999999388  easting: 1.49999999388
DEM interpolation factor northing: 1.49999999388  easting: 1.49999999388
output terrain geocoded product directory: geo_WBs2

gc_map_fine geo_WBs2/nz_WBs2_0.map_to_rdc 6548 geo_WBs2/nz_WBs2.diff_par geo_WBs2/nz_WBs2_1.map_to_rdc
1
*** Geocoding lookup table refinement using DIFF_par offset polynomials ***
*** Copyright 2011, Gamma Remote Sensing, v2.1 8-Apr-2011 clw/uw ***

NOTE: simulated SAR image is reference
input lookup table width:    6548

range offset polynomial:   a0 + a1*r + a2*az+ a3*r*az + a4*r*r + a5*az*az
range offset polynomial coeff.:       -0.6857    6.8463e-05   -3.7435e-05    0.0000e+00    0.0000e+00
0.0000e+00

azimuth offset polynomial: b0 + b1*r + b2*az+ b3*r*az + b4*r*r + b5*az*az
azimuth offset polynomial coeff.:      2.0270    5.7022e-05   -1.9113e-05    0.0000e+00    0.0000e+00
0.0000e+00

input lookup table width: 6548  lines: 6557
processing line:      0
processing line:   1000
processing line:   2000
processing line:   3000
processing line:   4000
processing line:   5000
processing line:   6000
user time (s):         0.610
system time (s):       0.200
elapsed time (s):      0.820


geocode geo_WBs2/nz_WBs2_1.map_to_rdc geo_WBs2/nz_WBs2_0.sim 6548 geo_WBs2/nz_WBs2_1.sim_rdc 4154 7084
2 0 1 1 2 8
*** Forward geocoding transformation using a lookup table ***
*** Copyright 2011, Gamma Remote Sensing, v3.3 7-Apr-2011 uw/clw ***
input/output data format: float
interpolation algorithm: convolution with (1/r)**2 weighting
interpolation oversampling factor: 2
interpolation search radius: 8
number of points used for interpolation: 4
number of entries in the interpolation search table: 208

input data width, nlines:       6548    6557
output data width, nlines:      4154    7084
interpolation arrays width: 8322  lines: 1008
number of elements in the interpolation arrays: 8388576
number of output lines/block: 497
number of output blocks: 15
output block:  1   starting line:      0
output block:  2   starting line:    497
```

```
output block:  3   starting line:    994
output block:  4   starting line:   1491
output block:  5   starting line:   1988
output block:  6   starting line:   2485
output block:  7   starting line:   2982
output block:  8   starting line:   3479
output block:  9   starting line:   3976
output block: 10   starting line:   4473
output block: 11   starting line:   4970
output block: 12   starting line:   5467
output block: 13   starting line:   5964
output block: 14   starting line:   6461
output block: 15   starting line:   6958

output data file: geo_WBs2/nz_WBs2_1.sim_rdc
output file width: 4154   lines: 7084

user time (s):        13.060
system time (s):       1.230
elapsed time (s):     14.320


raspwr geo_WBs2/nz_WBs2_1.sim_rdc 4154 1 0 1 1 0.8 0.4
*** DISP raspwr: generate raster image of intensity image (power-law scale) ***
*** Copyright 2008, Gamma Remote Sensing, v2.5 11-Sep-2008 clw ***
FLOAT data: geo_WBs2/nz_WBs2_1.sim_rdc
input image width: 4154   height: 7084
output SUN RASTER format image filename: geo_WBs2/nz_WBs2_1.sim_rdc.ras
range looks: 1   azimuth looks: 1
output image width: 4154   height: 7084
relative scale factor:    0.800  exponent:    0.400
file: geo_WBs2/nz_WBs2_1.sim_rdc  ave. intensity:  1.48705e+00  average:  1.09211e+00  scale factor:
8.79034e+01

line 0
line 400
line 800
line 1200
line 1600
line 2000
line 2400
line 2800
line 3200
line 3600
line 4000
line 4400
line 4800
line 5200
line 5600
line 6000
line 6400
line 6800
7084 display lines

geocode geo_WBs2/nz_WBs2_1.map_to_rdc geo_WBs2/nz_WBs2.dem 6548 geo_WBs2/nz_WBs2_dem.rdc 4154 7084 2 0
1 1 2 8
*** Forward geocoding transformation using a lookup table ***
*** Copyright 2011, Gamma Remote Sensing, v3.3 7-Apr-2011 uw/clw ***
input/output data format: float
interpolation algorithm: convolution with (1/r)**2 weighting
interpolation oversampling factor: 2
interpolation search radius: 8
number of points used for interpolation: 4
number of entries in the interpolation search table: 208

input data width, nlines:       6548    6557
output data width, nlines:      4154    7084
interpolation arrays width: 8322  lines: 1008
number of elements in the interpolation arrays: 8388576
number of output lines/block: 497
number of output blocks: 15
output block:  1   starting line:      0
output block:  2   starting line:    497
output block:  3   starting line:    994
output block:  4   starting line:   1491
output block:  5   starting line:   1988
output block:  6   starting line:   2485
```

```
output block:  7   starting line:   2982
output block:  8   starting line:   3479
output block:  9   starting line:   3976
output block: 10   starting line:   4473
output block: 11   starting line:   4970
output block: 12   starting line:   5467
output block: 13   starting line:   5964
output block: 14   starting line:   6461
output block: 15   starting line:   6958

output data file: geo_WBs2/nz_WBs2_dem.rdc
output file width: 4154   lines: 7084

user time (s):        13.180
system time (s):       1.470
elapsed time (s):     15.180


rashgt geo_WBs2/nz_WBs2_dem.rdc geo_WBs2/nz_WBs2_1.sim_rdc 4154 1 1 0 1 1 100
*** DISP rashgt: generate raster image of height + intensity data ***
*** Copyright 2005, Gamma Remote Sensing, v2.2 9-Sep-2005 clw ***
height data filename: geo_WBs2/nz_WBs2_dem.rdc
input image width: 4154
height data lines: 7084
intensity image: geo_WBs2/nz_WBs2_1.sim_rdc
intensity image lines: 7084
output SUN RASTER format image filename: geo_WBs2/nz_WBs2_dem.rdc.ras
range looks: 1   azimuth looks: 1
output image width: 4154   height: 7084
relative scale factor:    1.000   exponent:    0.350
average:  1.07520e+00   scale factor:  1.30208e+02
meters/color cycle  100.000

line 0
line 400
line 800
line 1200
line 1600
line 2000
line 2400
line 2800
line 3200
line 3600
line 4000
line 4400
line 4800
line 5200
line 5600
line 6000
line 6400
line 6800
7084 display lines

geocode_back nz_WBs2_20071020.mli 4154 geo_WBs2/nz_WBs2_1.map_to_rdc geo_WBs2/nz_WBs2_map.mli 6548 6557
2 0
*** Backward geocoding transformation using a lookup table  ***
*** Copyright 2006, Gamma Remote Sensing, v2.4 4-Jan-2006 clw/uw ***
input data filename:  nz_WBs2_20071020.mli
output data filename: geo_WBs2/nz_WBs2_map.mli
lookup table: geo_WBs2/nz_WBs2_1.map_to_rdc

interpolation mode: quadratic spline of the log(data)
input/output data format: float
number lines in the input data file: 7084
number of lines in the input lookup table: 6557
number of output lines: 6557
input data width, nlines:       4154    7084
output data width, nlines:      6548    6557

interpolating DATA into output geometry...

output data line:    400
output data line:    800
output data line:   1200
output data line:   1600
output data line:   2000
output data line:   2400
```

```
output data line:   2800
output data line:   3200
output data line:   3600
output data line:   4000
output data line:   4400
output data line:   4800
output data line:   5200
output data line:   5600
output data line:   6000
output data line:   6400

user time (s):        11.830
system time (s):       0.280
elapsed time (s):     12.200


raspwr geo_WBs2/nz_WBs2_map.mli 6548 1 0 1 1 0.6 0.4
*** DISP raspwr: generate raster image of intensity image (power-law scale) ***
*** Copyright 2008, Gamma Remote Sensing, v2.5 11-Sep-2008 clw ***
FLOAT data: geo_WBs2/nz_WBs2_map.mli
input image width: 6548   height: 6557
output SUN RASTER format image filename: geo_WBs2/nz_WBs2_map.mli.ras
range looks: 1   azimuth looks: 1
output image width: 6548   height: 6557
relative scale factor:    0.600  exponent:    0.400
file: geo_WBs2/nz_WBs2_map.mli  ave. intensity:  4.25386e-02  average:  1.91006e-01  scale factor:
3.76951e+02

line 0
line 400
line 800
line 1200
line 1600
line 2000
line 2400
line 2800
line 3200
line 3600
line 4000
line 4400
line 4800
line 5200
line 5600
line 6000
line 6400
6557 display lines

disras_dem_par geo_WBs2/nz_WBs2_map.mli.ras geo_WBs2/nz_WBs2.dem_par&

dis2ras geo_WBs2/nz_WBs2_1.sim_rdc.ras nz_WBs2_20071020.mli.ras&

disras geo_WBs2/nz_WBs2_dem.rdc.ras&
lookup table (MAP --> SAR RDC):
DEM segment parameter file for geocoded SAR image: geo_WBs2/nz_WBs2.dem_par
DEM segment width: 6548   lines: 6557

terrain geocoded SAR image: geo_WBs2/nz_WBs2_map.mli
terrain geocoded SAR image raster file: geo_WBs2/nz_WBs2_map.mli.ras
terrain geocoded SAR image DEM parameter file: geo_WBs2/nz_WBs2.dem_par
DEM in SAR RDC coordinates: geo_WBs2/nz_WBs2_dem.rdc
DEM in SAR RDC coordinates raster image: geo_WBs2/nz_WBs2_dem.rdc.ras

*** ./mk_geo mode: 4 completed  Sun Apr 10 15:43:12 2011 ***
```

6 Appendix 4: SLC Coregistration and Resampling using a Terrain Model

```
./SLC_resamp_lt_all SLC_WBs2_4_tab slc_WBs2/20071020_4.slc slc_WBs2/20071020_4.slc.par
mli_WBs2/20071020_4.mli.par geo_WBs2/nz_WBs2_dem_4.rdc mli_WBs2 rslc_WBs2 RSLC_WBs2_4_tab 0 0

SLC_resamp_lt_all log file: rslc_WBs2/20071020_4_20101028_4_resamp_lt.log   mode: 0
initial SLC offset looks range: 1   azimuth: 5
resampled RSLC data directory: rslc_WBs2
reference SLC: rslc_WBs2/20071020_4.rslc
reference SLC parameters: rslc_WBs2/20071020_4.rslc.par
reference MLI: mli_WBs2//20071020_4.mli
reference MLI parameters: mli_WBs2/20071020_4.mli.par
SLC-2: slc_WBs2/20101028_4.slc
SLC-2 parameter file: slc_WBs2/20101028_4.slc.par
SLC-2 range samples: 4400   azimuth lines: 113262

MLI-2: mli_WBs2/20101028_4.mli
MLI-2 parameter file: mli_WBs2/20101028_4.mli.par

MLI-2 range samples:  1466

lookup table refinement DIFF_par: rslc_WBs2/20071020_4_20101028_4_lt0.diff_par
reference MLI image resampled into geometry of MLI-2: rslc_WBs2/20071020_4_lt0.mli
initial lookup table: rslc_WBs2/20071020_4_20101028_4.lt0
updated lookup table: rslc_WBs2/20071020_4_20101028_4.lt1
SLC offset parameter file: rslc_WBs2/20071020_4_20101028_4.off

rdc_trans mli_WBs2/20071020_4.mli.par geo_WBs2/nz_WBs2_dem_4.rdc mli_WBs2/20101028_4.mli.par
rslc_WBs2/20071020_4_20101028_4.lt0
*** Derive lookup table for SLC/MLI coregistration (considering terrain heights) ***
*** Copyright 2010, Gamma Remote Sensing, v1.6 30-Jun-2010 clw/uw ***
DEM in range-Doppler coordinates: geo_WBs2/nz_WBs2_dem_4.rdc
reference SLC/MLI ISP image parameter file: mli_WBs2/20071020_4.mli.par
reference SLC/MLI slant range pixel spacing (m):   28.105542
reference SLC/MLI azimuth pixel spacing (m):       50.944224
reference SLC/MLI radar center frequency (Hz):     1.27000e+09
reference SLC/MLI PRF (Hz):                        2150.5376
reference SLC/MLI Doppler centroid (Hz):              0.000
reference SLC/MLI center swath inc. angle (deg.):     38.660
reference SLC/MLI number of range samples:              1466
reference SLC/MLI number of azimuth lines:              7084
reference SLC/MLI azimuth angle:      90.0000 (right looking)

SLC/MLI 2 ISP image parameter file: mli_WBs2/20101028_4.mli.par
SLC/MLI 2 slant range pixel spacing (m):   28.105542
SLC/MLI 2 azimuth pixel spacing (m):       50.943584
SLC/MLI 2 radar center frequency (Hz):     1.27000e+09
SLC/MLI 2 PRF (Hz):                        2150.5376
SLC/MLI 2 Doppler centroid (Hz):              0.000
SLC/MLI 2 center swath inc. angle (deg.):     38.651
SLC/MLI 2 number of range samples:              1466
SLC/MLI 2 number of azimuth lines:              7078
SLC/MLI 2 deskew ON: 1
SLC/MLI 2 azimuth angle:      90.0000 (right looking)

*** TCN matrix ***
 6.861648e-01  2.236943e-01 -6.921985e-01
-1.412473e-01  9.744060e-01  1.748777e-01
 7.136015e-01 -2.222370e-02  7.001993e-01

center time of the reference MLI (s):  79455.01515
center time of MLI-2 (s):              79407.97576
image center slant range (m):   883703.774   Doppler frequency (Hz):      0.000
MLI-1 center lat (deg.): -43.3853221 lon: (deg.) 172.2619312  earth radius (m): 6368091.7227  altitude
(m): 711698.3257
MLI-1 radar velocity (m/s): 7579.821733  approx. SAR focus velocity (m/s): 7188.751271
MLI-1 position vector (image center) (m)   -5.05214853e+06  1.57339154e+05 -4.95726404e+06
MLI-1 SAR velocity vector (image center) (m/s)  5.19871707e+03  1.69563369e+03 -5.24898702e+03
error threshold for geocoding along track:   0.0500 samples   2.325e-05 sec.
output lookup table: rslc_WBs2/20071020_4_20101028_4.lt0


azimuth line:      0
azimuth line:    400
azimuth line:    800
azimuth line:   1200
```

```
azimuth line:   1600
azimuth line:   2000
azimuth line:   2400
azimuth line:   2800
azimuth line:   3200
azimuth line:   3600
azimuth line:   4000
azimuth line:   4400
azimuth line:   4800
azimuth line:   5200
azimuth line:   5600
azimuth line:   6000
azimuth line:   6400
azimuth line:   6800

user time (s):        46.660
system time (s):       0.370
elapsed time (s):     50.530


geocode rslc_WBs2/20071020_4_20101028_4.lt0 mli_WBs2//20071020_4.mli 1466 rslc_WBs2/20071020_4_lt0.mli
1466 7078 2 0 - - 4
*** Forward geocoding transformation using a lookup table ***
*** Copyright 2011, Gamma Remote Sensing, v3.3 7-Apr-2011 uw/clw ***
input/output data format: float
interpolation algorithm: convolution with (1/r)**2 weighting
interpolation oversampling factor: 4
interpolation search radius: 16
number of points used for interpolation: 4
number of entries in the interpolation search table: 812

input data width, nlines:       1466    7084
output data width, nlines:      1466    7078
interpolation arrays width: 5892  lines: 1423
number of elements in the interpolation arrays: 8384316
number of output lines/block: 348
number of output blocks: 21
output block:  1   starting line:      0
output block:  2   starting line:    348
output block:  3   starting line:    696
output block:  4   starting line:   1044
output block:  5   starting line:   1392
output block:  6   starting line:   1740
output block:  7   starting line:   2088
output block:  8   starting line:   2436
output block:  9   starting line:   2784
output block: 10   starting line:   3132
output block: 11   starting line:   3480
output block: 12   starting line:   3828
output block: 13   starting line:   4176
output block: 14   starting line:   4524
output block: 15   starting line:   4872
output block: 16   starting line:   5220
output block: 17   starting line:   5568
output block: 18   starting line:   5916
output block: 19   starting line:   6264
output block: 20   starting line:   6612
output block: 21   starting line:   6960

output data file: rslc_WBs2/20071020_4_lt0.mli
output file width: 1466   lines: 7078

user time (s):         7.670
system time (s):       0.570
elapsed time (s):      9.130


raspwr rslc_WBs2/20071020_4_lt0.mli 1466 1 0 1 1 0.6 0.4
*** DISP raspwr: generate raster image of intensity image (power-law scale) ***
*** Copyright 2008, Gamma Remote Sensing, v2.5 11-Sep-2008 clw ***
FLOAT data: rslc_WBs2/20071020_4_lt0.mli
input image width: 1466   height: 7078
output SUN RASTER format image filename: rslc_WBs2/20071020_4_lt0.mli.ras
range looks: 1   azimuth looks: 1
output image width: 1466   height: 7078
relative scale factor:    0.600  exponent:    0.400
file: rslc_WBs2/20071020_4_lt0.mli  ave. intensity:  3.67443e-02  average:  2.00051e-01  scale factor:
```

```
3.59907e+02

line 0
line 400
line 800
line 1200
line 1600
line 2000
line 2400
line 2800
line 3200
line 3600
line 4000
line 4400
line 4800
line 5200
line 5600
line 6000
line 6400
line 6800
7078 display lines
*** ref. SLC: rslc_WBs2/20071020_4.rslc   SLC-2: slc_WBs2/20101028_4.slc  END: Sun Apr 10 16:09:30 2011
***

./SLC_resamp_lt_all SLC_WBs2_4_tab slc_WBs2/20071020_4.slc slc_WBs2/20071020_4.slc.par
mli_WBs2/20071020_4.mli.par geo_WBs2/nz_WBs2_dem_4.rdc mli_WBs2 rslc_WBs2 RSLC_WBs2_4_tab 1 0

SLC_resamp_lt_all log file: rslc_WBs2/20071020_4_20101028_4_resamp_lt.log   mode: 1
initial SLC offset looks range: 1   azimuth: 5
resampled RSLC data directory: rslc_WBs2
reference SLC: rslc_WBs2/20071020_4.rslc
reference SLC parameters: rslc_WBs2/20071020_4.rslc.par
reference MLI: mli_WBs2//20071020_4.mli
reference MLI parameters: mli_WBs2/20071020_4.mli.par
SLC-2: slc_WBs2/20101028_4.slc
SLC-2 parameter file: slc_WBs2/20101028_4.slc.par
SLC-2 range samples: 4400   azimuth lines: 113262

MLI-2: mli_WBs2/20101028_4.mli
MLI-2 parameter file: mli_WBs2/20101028_4.mli.par

MLI-2 range samples:  1466

lookup table refinement DIFF_par: rslc_WBs2/20071020_4_20101028_4_lt0.diff_par
reference MLI image resampled into geometry of MLI-2: rslc_WBs2/20071020_4_lt0.mli
initial lookup table: rslc_WBs2/20071020_4_20101028_4.lt0
updated lookup table: rslc_WBs2/20071020_4_20101028_4.lt1
SLC offset parameter file: rslc_WBs2/20071020_4_20101028_4.off

create_diff_par mli_WBs2/20101028_4.mli.par - rslc_WBs2/20071020_4_20101028_4_lt0.diff_par 1 < .in
*** create DIFF_par parameter file for image registration and geocoding
*** Copyright 2008, Gamma Remote Sensing, v2.6 10-Mar-2008 clw/uw ***
PAR_type 1: (ISP image parameter files)
NOTE: No second ISP image parameter file provided
output DIFF/GEO parameter file: rslc_WBs2/20071020_4_20101028_4_lt0.diff_par

user time (s):         0.010
system time (s):       0.000
elapsed time (s):      0.000


init_offsetm rslc_WBs2/20071020_4_lt0.mli mli_WBs2/20101028_4.mli
rslc_WBs2/20071020_4_20101028_4_lt0.diff_par 1 1 733 3542
*** Initial offset estimation for multi-look intensity images ***
*** Copyright 2008, Gamma Remote Sensing, v3.3 12-Feb-2008 clw/uw ***
MLI-1 image: rslc_WBs2/20071020_4_lt0.mli
MLI-2 image: mli_WBs2/20101028_4.mli
DIFF/GEO image parameter file: rslc_WBs2/20071020_4_20101028_4_lt0.diff_par

initial offset estimate (range,azimuth): 0  0
number of range looks:   1
number of azimuth looks: 1
points/line image 1:     1466
points/line image 2:     1466
window size range: 1024  azimuth: 1024
region center (range, azimuth):    733    3542
correlation SNR threshold:       7.000
```

```
initial offset estimate (range, azimuth): 0  0
offset search window sizes (range, azimuth pixels): 1024  1024
image oversampling factor: 2
oversampled offset search window sizes (range, azimuth pixels): 2048  2048

starting line: MLI-1: 3030    MLI-2: 3030

starting range sample: MLI-1: 221   MLI-2: 221
interp. filter bandwidth:      0.500  FIR length: 257
bp_filter: bw:  3.1416  wc:  0.0000  nfft: 2048  nps: 257   Kaiser beta:   0.500
bp_filter: bw:  3.1416  wc:  0.0000  nfft: 2048  nps: 257   Kaiser beta:   0.500
average image 1 intensity:  3.143e-02  clip1:  1.257e+00
average image 2 intensity:  2.656e-02  clip2:  1.063e+00

offset estimate range:      0.048  azimuth:     -0.086
correlation SNR:     70.343
output DIFF/GEO parameter file: rslc_WBs2/20071020_4_20101028_4_lt0.diff_par

user time (s):         1.580
system time (s):       0.060
elapsed time (s):      1.860

#measure offset of simulated I image and actctual  radar image
offset_pwrm rslc_WBs2/20071020_4_lt0.mli mli_WBs2/20101028_4.mli
rslc_WBs2/20071020_4_20101028_4_lt0.diff_par rslc_WBs2/20071020_4_20101028_4_lt0.offs
rslc_WBs2/20071020_4_20101028_4_lt0.snr

*** Offsets between MLI images using intensity cross-correlation ***
*** Copyright 2008, Gamma Remote Sensing, v3.4 clw/uw 18-Mar-2008 ***
MLI-1 image: rslc_WBs2/20071020_4_lt0.mli
MLI-2 image: mli_WBs2/20101028_4.mli
DIFF/GEO image parameter file: rslc_WBs2/20071020_4_20101028_4_lt0.diff_par
MLI oversampling factor: 2
initial offset estimate (range, azimuth): 0  0
offset search window sizes (range, azimuth pixels): 256  256
oversampled offset search window sizes (range, azimuth pixels): 512  512
first range, last range, points: 48  1418  20
first az. line, last az. line, points:  48  7030  20
number of offset estimates:    400
correlation SNR threshold:     10.000

starting lines: MLI-1: -80   MLI-2: -80
interp. filter bandwidth:      0.500  FIR length: 65
bp_filter: bw:  3.1416  wc:  0.0000  nfft: 512  nps: 65   Kaiser beta:   0.500
bp_filter: bw:  3.1416  wc:  0.0000  nfft: 512  nps: 65   Kaiser beta:   0.500
average MLI-1 intensity:  3.547e-02  clip1:  1.774e-01
average MLI-2 intensity:  2.996e-02  clip2:  1.498e-01
search line:     1    offsets above SNR threshold:     0

search line:     2   MLI-1:    415   MLI-2:    415  azoff_init:    0  roff_init:    0
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
   192     415        0.0631       -0.0892      40.245
   264     415        0.0757       -0.0657      36.496
   336     415        0.0755       -0.0215      28.014
   408     415        0.0609       -0.0084      27.558
   480     415        0.0598       -0.0658      26.911
   552     415        0.0472       -0.1284      25.495
   624     415        0.0472       -0.1493      24.183
   696     415        0.0412       -0.1529      22.587
   768     415        0.0339       -0.1340      21.772
   840     415        0.0373       -0.0958      17.961
   912     415        0.0401       -0.0913      17.844
   984     415        0.0560       -0.0731      17.063
  1056     415        0.0742       -0.0930      13.100
  1200     415        0.0601       -0.0916      12.255
  1272     415        0.0752       -0.0800      19.800
search line:     2    offsets above SNR threshold:    15

search line:     3   MLI-1:    782   MLI-2:    782  azoff_init:    0  roff_init:    0
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
   192     782        0.0715       -0.0393      34.044
   264     782        0.0835       -0.0004      23.534
   336     782        0.0600        0.0214      29.880
   408     782        0.0365       -0.0177      38.011
   480     782        0.0380       -0.0835      40.286
```

```
   552     782        0.0409       -0.1232      38.231
   624     782        0.0702       -0.1379      32.974
   696     782        0.0739       -0.1053      30.290
   768     782        0.0676       -0.0709      33.910
   840     782        0.0536       -0.0430      27.526
   912     782        0.0819       -0.0623      24.377
   984     782        0.0768       -0.0747      16.273
  1056     782        0.0833       -0.1002      14.620
  1128     782        0.0846       -0.1004      14.411
  1200     782        0.0750       -0.0653      17.913
  1272     782        0.0832       -0.0291      20.620
search line:     3    offsets above SNR threshold:    16

search line:     4   MLI-1:   1149   MLI-2:   1149  azoff_init:    0  roff_init:    0
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
   192    1149        0.0936       -0.0145      34.156
   264    1149        0.0545        0.0120      30.663
   336    1149        0.0099       -0.0023      33.820
   408    1149        0.0036       -0.0512      41.948
   480    1149        0.0075       -0.1080      41.784
   552    1149        0.0384       -0.1154      39.639
   624    1149        0.0671       -0.0830      41.178
   696    1149        0.0662       -0.0403      40.421
   768    1149        0.0555       -0.0179      30.339
   840    1149        0.0552       -0.0353      22.938
   912    1149        0.0708       -0.0704      24.516
   984    1149        0.0390       -0.0948      31.907
  1056    1149        0.0291       -0.0795      30.660
  1128    1149        0.0058       -0.0592      29.075
  1200    1149       -0.0086       -0.0028      26.040
  1272    1149        0.0445       -0.0010      34.457
search line:     4    offsets above SNR threshold:    16

search line:     5   MLI-1:   1516   MLI-2:   1516  azoff_init:    0  roff_init:    0
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
   192    1516        0.0956       -0.0369      24.274
   264    1516        0.0586       -0.0182      25.606
   336    1516        0.0115       -0.0436      14.684
   552    1516        0.0604       -0.1270      19.416
   624    1516        0.0688       -0.1052      26.671
   696    1516        0.0530       -0.0737      29.128
   768    1516        0.0490       -0.0549      32.398
   840    1516        0.0574       -0.1029      26.186
   912    1516        0.0394       -0.1285      27.446
   984    1516        0.0379       -0.1441      29.202
  1056    1516        0.0177       -0.1380      21.331
  1128    1516       -0.0058       -0.0920      18.440
  1200    1516        0.0079       -0.0715      18.625
  1272    1516        0.0547       -0.0559      23.599
search line:     5    offsets above SNR threshold:    14

search line:     6   MLI-1:   1883   MLI-2:   1883  azoff_init:    0  roff_init:    0
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
   192    1883        0.0754        0.0166      33.732
   264    1883        0.0061       -0.0453      40.912
   336    1883        0.0156       -0.0811      27.960
   408    1883        0.0442       -0.1144      31.156
   480    1883        0.0648       -0.0972      22.929
   552    1883        0.0796       -0.0648      37.659
   624    1883        0.0748       -0.0355      38.141
   696    1883        0.0334       -0.0251      37.013
   768    1883        0.0335       -0.0695      33.058
   840    1883        0.0327       -0.1123      39.612
   912    1883        0.0272       -0.1193      40.458
   984    1883        0.0280       -0.1137      30.384
  1056    1883        0.0287       -0.0882      23.068
  1128    1883        0.0547       -0.0421      26.798
  1200    1883        0.0628       -0.0159      24.044
  1272    1883        0.0728       -0.0166      23.343
search line:     6    offsets above SNR threshold:    16

search line:     7   MLI-1:   2250   MLI-2:   2250  azoff_init:    0  roff_init:    0
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

```
   192    2250        0.0620        0.0268      11.936
   552    2250        0.0779       -0.0122      16.409
   624    2250        0.0524       -0.0054      27.545
   696    2250        0.0131       -0.0391      43.415
   768    2250        0.0256       -0.0557      47.849
   840    2250        0.0230       -0.0945      36.811
   912    2250        0.0340       -0.0867      39.728
   984    2250        0.0399       -0.0704      40.202
  1056    2250        0.0335       -0.0383      46.810
  1128    2250        0.0444       -0.0155      43.412
  1200    2250        0.0520       -0.0221      39.665
  1272    2250        0.0708       -0.0215      28.593
search line:     7    offsets above SNR threshold:    12

search line:     8   MLI-1:   2617   MLI-2:   2617  azoff_init:    0  roff_init:    0
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
   192    2617       -0.0114       -0.0318      34.464
   264    2617        0.0168       -0.0994      38.025
   336    2617        0.0628       -0.1464      17.266
   408    2617        0.0837       -0.1309      21.792
   480    2617        0.0932       -0.0993      23.340
   552    2617        0.0740       -0.0258      32.728
   624    2617        0.0217       -0.0275      56.503
   696    2617        0.0185       -0.0948      52.714
   768    2617        0.0178       -0.1469      55.131
   840    2617        0.0247       -0.1640      51.557
   912    2617        0.0423       -0.1162      43.618
   984    2617        0.0534       -0.0691      30.459
  1056    2617        0.0538       -0.0431      37.545
  1128    2617        0.0610       -0.0482      19.524
  1200    2617        0.0698       -0.0947      33.884
  1272    2617        0.0497       -0.1118      42.936
search line:     8    offsets above SNR threshold:    16

search line:     9   MLI-1:   2984   MLI-2:   2984  azoff_init:    0  roff_init:    0
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
   408    2984        0.1116       -0.0999      13.575
   480    2984        0.1112       -0.0394      10.533
   624    2984       -0.0060       -0.0887      24.916
   696    2984        0.0042       -0.1511      31.641
   768    2984        0.0265       -0.1646      43.260
   840    2984        0.0561       -0.1496      24.907
   912    2984        0.0674       -0.1109      10.575
   984    2984        0.0671       -0.0624      16.124
  1056    2984        0.0710       -0.0337      23.980
  1128    2984        0.0806       -0.0742      20.520
  1200    2984        0.0643       -0.1038      28.067
  1272    2984        0.0596       -0.1084      22.018
search line:     9    offsets above SNR threshold:    12

search line:    10   MLI-1:   3351   MLI-2:   3351  azoff_init:    0  roff_init:    0
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
   192    3351        0.0369       -0.0143      20.375
   264    3351        0.0700       -0.0848      40.631
   336    3351        0.0926       -0.0485      43.237
   408    3351        0.1075       -0.0284      36.100
   480    3351        0.0791       -0.0225      38.358
   552    3351        0.0392       -0.0352      30.298
   624    3351        0.0236       -0.0893      28.471
   696    3351        0.0387       -0.1230      41.596
   768    3351        0.0482       -0.1387      53.387
   840    3351        0.0614       -0.0847      29.551
   912    3351        0.0757       -0.0365      17.551
   984    3351        0.0510       -0.0316      27.816
  1056    3351        0.0533       -0.0442      18.351
  1128    3351        0.0595       -0.0860      22.847
  1200    3351        0.0523       -0.1034      28.107
  1272    3351        0.0487       -0.1004      36.125
search line:    10    offsets above SNR threshold:    16

search line:    11   MLI-1:   3718   MLI-2:   3718  azoff_init:    0  roff_init:    0
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
   192    3718        0.0201       -0.0498      10.279
```

```
   264    3718        0.0550       -0.0657      12.341
   336    3718        0.1041       -0.0345      19.440
   408    3718        0.0896       -0.0065      15.472
   480    3718        0.0716       -0.0083      15.530
   552    3718        0.0399       -0.0539      11.304
   624    3718        0.0431       -0.1192      15.394
   696    3718        0.0523       -0.1373      12.819
   768    3718        0.0654       -0.1404      23.388
   840    3718        0.0897       -0.0965      25.578
   912    3718        0.0933       -0.0360      16.256
   984    3718        0.0746       -0.0403      22.456
  1056    3718        0.0367       -0.0943      37.343
  1128    3718        0.0321       -0.1269      30.716
  1200    3718        0.0416       -0.1216      17.637
  1272    3718        0.0516       -0.0892      14.115
search line:    11    offsets above SNR threshold:    16

search line:    12   MLI-1:   4085   MLI-2:   4085  azoff_init:    0  roff_init:    0
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
   192    4085        0.0690       -0.0673      32.351
   264    4085        0.1180       -0.0700      43.642
   336    4085        0.1255       -0.0494      55.666
   408    4085        0.0440       -0.0199      49.208
   480    4085       -0.0128       -0.0627      46.591
   552    4085        0.0012       -0.1098      51.330
   624    4085        0.0064       -0.1499      50.965
   696    4085        0.0348       -0.1456      41.938
   768    4085        0.0750       -0.0834      38.124
   840    4085        0.1065        0.0006      22.655
   912    4085        0.0836       -0.0098      26.357
   984    4085        0.0410       -0.0259      23.464
  1056    4085       -0.0012       -0.0716      29.907
  1128    4085        0.0086       -0.0786      33.465
  1200    4085        0.0207       -0.0765      43.697
  1272    4085        0.0401       -0.0624      27.256
search line:    12    offsets above SNR threshold:    16

search line:    13   MLI-1:   4452   MLI-2:   4452  azoff_init:    0  roff_init:    0
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
   192    4452        0.1487       -0.0167      12.882
   264    4452        0.1359       -0.0110      15.967
   336    4452        0.0789       -0.0183      31.264
   408    4452        0.0120       -0.0292      41.121
   480    4452       -0.0302       -0.0896      31.302
   552    4452       -0.0056       -0.1129      29.863
   624    4452        0.0797       -0.1236      29.829
   696    4452        0.1143       -0.1047      27.332
   768    4452        0.0839       -0.0650      16.825
   840    4452        0.0657       -0.0314      14.350
   912    4452        0.0403       -0.0599      16.636
   984    4452        0.0373       -0.0660      25.716
  1056    4452        0.0296       -0.0819      20.533
  1128    4452        0.0016       -0.1028      26.693
  1200    4452       -0.0027       -0.0637      29.087
  1272    4452        0.0226       -0.0587      44.848
search line:    13    offsets above SNR threshold:    16

search line:    14   MLI-1:   4819   MLI-2:   4819  azoff_init:    0  roff_init:    0
range   azimuth       r_offset     az_offset      SNR
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
   480    4819        0.0887       -0.2636      17.225
   624    4819        0.1040       -0.0759      11.509
   696    4819        0.1083       -0.0492      15.970
   768    4819        0.0395       -0.0160      29.714
   840    4819        0.0731       -0.0981      29.378
   912    4819        0.0736       -0.1257      30.747
   984    4819        0.0927       -0.1393      32.227
  1056    4819        0.1050       -0.1216      24.990
  1128    4819        0.0943       -0.0633      14.863
  1200    4819        0.0870       -0.0443      16.801
  1272    4819        0.0793       -0.0315      13.282
search line:    14    offsets above SNR threshold:    11

search line:    15   MLI-1:   5186   MLI-2:   5186  azoff_init:    0  roff_init:    0
range   azimuth       r_offset     az_offset      SNR
```

```
+++++++++++++++++++++++++++++++++++++++++++++++++++++++
   840    5186       -0.0303       -0.1095      35.875
   912    5186        0.0221       -0.1405      14.009
   984    5186        0.0419       -0.1343      11.687
  1056    5186        0.0330       -0.1035      13.656
  1128    5186        0.0580       -0.0482      22.099
  1200    5186        0.0540       -0.0242      39.716
  1272    5186        0.0433       -0.0316      44.014
search line:    15    offsets above SNR threshold:     7

search line:    16   MLI-1:   5553   MLI-2:   5553  azoff_init:    0  roff_init:    0
range   azimuth       r_offset     az_offset      SNR
+++++++++++++++++++++++++++++++++++++++++++++++++++++++
  1200    5553       -0.1128       -0.1043      41.300
  1272    5553        0.0356       -0.1037      16.226
search line:    16    offsets above SNR threshold:     2

search line:    17   MLI-1:   5920   MLI-2:   5920  azoff_init:    0  roff_init:    0
range   azimuth       r_offset     az_offset      SNR
+++++++++++++++++++++++++++++++++++++++++++++++++++++++
search line:    17    offsets above SNR threshold:     0

search line:    18   MLI-1:   6287   MLI-2:   6287  azoff_init:    0  roff_init:    0
range   azimuth       r_offset     az_offset      SNR
+++++++++++++++++++++++++++++++++++++++++++++++++++++++
search line:    18    offsets above SNR threshold:     0

search line:    19   MLI-1:   6654   MLI-2:   6654  azoff_init:    0  roff_init:    0
range   azimuth       r_offset     az_offset      SNR
+++++++++++++++++++++++++++++++++++++++++++++++++++++++
search line:    19    offsets above SNR threshold:     0
search line:    20    offsets above SNR threshold:     0

number of offsets above SNR threshold: 201 of 400
output binary offset file: rslc_WBs2/20071020_4_20101028_4_lt0.offs
output binary SNR file: rslc_WBs2/20071020_4_20101028_4_lt0.snr
output DIFF/GEO parameter file: rslc_WBs2/20071020_4_20101028_4_lt0.diff_par

user time (s):        17.260
system time (s):       0.020
elapsed time (s):     18.210


offset_fitm rslc_WBs2/20071020_4_20101028_4_lt0.offs rslc_WBs2/20071020_4_20101028_4_lt0.snr
rslc_WBs2/20071020_4_20101028_4_lt0.diff_par rslc_WBs2/20071020_4_20101028_4_lt0.coffs -  3
*** Range and azimuth offset polynomial estimation ***
*** Copyright 2008, Gamma Remote Sensing, v3.1 27-May-2008 clw/uw ***
offsets: rslc_WBs2/20071020_4_20101028_4_lt0.offs
SNR data: rslc_WBs2/20071020_4_20101028_4_lt0.snr
DIFF/GEO offset parameters: rslc_WBs2/20071020_4_20101028_4_lt0.diff_par
culled offsets (fcomplex): rslc_WBs2/20071020_4_20101028_4_lt0.coffs

number of offset polynomial parameters: 4: a0 + a1*x + a2*y + a3*x*y
number of range samples: 20  number of azimuth samples: 20
number of samples in offset map: 400
range sample spacing: 72  azimuth sample spacing: 367
solution: 201 offset estimates accepted out of 400 samples

range fit SVD singular values:        1.12861e+09   8.26254e+01   4.98996e+05   1.47170e+05
azimuth fit SVD singular values:      1.12861e+09   8.26254e+01   4.98996e+05   1.47170e+05
range offset poly. coeff.:               0.04100   1.26653e-05   6.64323e-06  -1.14032e-08
azimuth offset poly. coeff.:            -0.04387  -3.27142e-05  -6.66281e-06   5.39694e-09
model fit std. dev. (samples) range:   0.0336  azimuth:   0.0447
range, azimuth error thresholds:     0.08390     0.11166
SNR threshold:     3.00000

range fit SVD singular values:        1.09376e+09   8.19357e+01   4.90339e+05   1.44690e+05
azimuth fit SVD singular values:      1.09376e+09   8.19357e+01   4.90339e+05   1.44690e+05

*** improved least-squares polynomial coefficients 1 ***
solution: 198 offset estimates accepted out of 400 samples
range offset poly. coeff.:               0.04989  -4.79069e-06   2.26798e-06  -3.23843e-09
azimuth offset poly. coeff.:            -0.04395  -3.43103e-05  -6.45504e-06   5.94731e-09
model fit std. dev. (samples) range:     0.0313  azimuth:     0.0432
range, azimuth error thresholds:     0.07833     0.10801
SNR threshold:     3.00000
```

```
range fit SVD singular values:        1.09155e+09   8.16792e+01   4.83200e+05   1.44515e+05
azimuth fit SVD singular values:      1.09155e+09   8.16792e+01   4.83200e+05   1.44515e+05

*** improved least-squares polynomial coefficients 2 ***
solution: 196 offset estimates accepted out of 400 samples
range offset poly. coeff.:               0.04867  -3.94609e-06   3.09895e-06  -3.87485e-09
azimuth offset poly. coeff.:            -0.04366  -3.46410e-05  -6.64622e-06   6.16589e-09
model fit std. dev. (samples) range:     0.0303  azimuth:     0.0432

total number of culling iterations: 2
final solution: 196 offset estimates accepted out of 400 samples

final range offset poly. coeff.:              0.04867  -3.94609e-06   3.09895e-06  -3.87485e-09
final range offset poly. coeff. errors:    3.71126e-04   4.88865e-07   1.29172e-07   1.59672e-10

final azimuth offset poly. coeff.:           -0.04366  -3.46410e-05  -6.64622e-06   6.16589e-09
final azimuth offset poly. coeff. errors:  5.28635e-04   6.96343e-07   1.83993e-07   2.27438e-10

final model fit std. dev. (samples) range:     0.0303  azimuth:     0.0432

binary culled offsets: rslc_WBs2/20071020_4_20101028_4_lt0.coffs
updating DIFF/GEO parameters: rslc_WBs2/20071020_4_20101028_4_lt0.diff_par

user time (s):         0.000
system time (s):       0.000
elapsed time (s):      0.000


gc_map_fine rslc_WBs2/20071020_4_20101028_4.lt0 1466 rslc_WBs2/20071020_4_20101028_4_lt0.diff_par
rslc_WBs2/20071020_4_20101028_4.lt1
*** Geocoding lookup table refinement using DIFF_par offset polynomials ***
*** Copyright 2011, Gamma Remote Sensing, v2.1 8-Apr-2011 clw/uw ***

NOTE: simulated SAR image is reference
input lookup table width:    1466

range offset polynomial:   a0 + a1*r + a2*az+ a3*r*az + a4*r*r + a5*az*az
range offset polynomial coeff.:        0.0487   -3.9461e-06    3.0989e-06   -3.8749e-09    0.0000e+00
0.0000e+00

azimuth offset polynomial: b0 + b1*r + b2*az+ b3*r*az + b4*r*r + b5*az*az
azimuth offset polynomial coeff.:     -0.0437   -3.4641e-05   -6.6462e-06    6.1659e-09    0.0000e+00
0.0000e+00

input lookup table width: 1466  lines: 7084

processing line:      0
processing line:   1000
processing line:   2000
processing line:   3000
processing line:   4000
processing line:   5000
processing line:   6000
processing line:   7000
user time (s):         0.210
system time (s):       0.040
elapsed time (s):      0.250

*** ref. SLC: rslc_WBs2/20071020_4.rslc   SLC-2: slc_WBs2/20101028_4.slc  END: Sun Apr 10 16:14:19 2011
***

./SLC_resamp_lt_all SLC_WBs2_4_tab slc_WBs2/20071020_4.slc slc_WBs2/20071020_4.slc.par
mli_WBs2/20071020_4.mli.par geo_WBs2/nz_WBs2_dem_4.rdc mli_WBs2 rslc_WBs2 RSLC_WBs2_4_tab 2 0

SLC_resamp_lt_all log file: rslc_WBs2/20071020_4_20101028_4_resamp_lt.log   mode: 2
initial SLC offset looks range: 1   azimuth: 5
resampled RSLC data directory: rslc_WBs2
reference SLC: rslc_WBs2/20071020_4.rslc
reference SLC parameters: rslc_WBs2/20071020_4.rslc.par
reference MLI: mli_WBs2//20071020_4.mli
reference MLI parameters: mli_WBs2/20071020_4.mli.par
SLC-2: slc_WBs2/20101028_4.slc
SLC-2 parameter file: slc_WBs2/20101028_4.slc.par
SLC-2 range samples: 4400   azimuth lines: 113262

MLI-2: mli_WBs2/20101028_4.mli
MLI-2 parameter file: mli_WBs2/20101028_4.mli.par
```

```
MLI-2 range samples:  1466

lookup table refinement DIFF_par: rslc_WBs2/20071020_4_20101028_4_lt0.diff_par
reference MLI image resampled into geometry of MLI-2: rslc_WBs2/20071020_4_lt0.mli
initial lookup table: rslc_WBs2/20071020_4_20101028_4.lt0
updated lookup table: rslc_WBs2/20071020_4_20101028_4.lt1
SLC offset parameter file: rslc_WBs2/20071020_4_20101028_4.off

SLC_interp_lt slc_WBs2/20101028_4.slc slc_WBs2/20071020_4.slc.par slc_WBs2/20101028_4.slc.par
rslc_WBs2/20071020_4_20101028_4.lt1 mli_WBs2/20071020_4.mli.par mli_WBs2/20101028_4.mli.par -
rslc_WBs2/20101028_4.rslc rslc_WBs2/20101028_4.rslc.par
*** SLC image resampling via a lookup table and SINC interpolation ***
*** Copyright 2008, Gamma Remote Sensing, v1.7 28-Nov-2008 clw ***

SLC-2 image: slc_WBs2/20101028_4.slc
SLC-1 ISP image parameter file: slc_WBs2/20071020_4.slc.par
SLC-2 ISP image parameter file: slc_WBs2/20101028_4.slc.par
input lookup table: rslc_WBs2/20071020_4_20101028_4.lt1
SLC/MLI ISP image parameter file of reference MLI (lookup table dimension): mli_WBs2/20071020_4.mli.par
SLC/MLI ISP image parameter file of MLI2 (lookup table values): mli_WBs2/20101028_4.mli.par
SLC format: FCOMPLEX
number of offset sample points for polynomial estimation: 4096
number of offset sample points for polynomial estimation: 9

lookup table size range:  1466  azimuth: 7084
lookup table looks range: 3  azimuth: 16
number of SLC data blocks: 60  lines/block: 1906
range and azimuth offset range increment: 69  azimuth increment: 1772

SLC-1, SLC-2 PARAMETERS:
SLC-1 range samples:   4400
SLC-1 azimuth lines: 113346
SLC-1 range pixel size (m):      9.36851
SLC-1 azimuth pixel size (m):    3.18401

SLC-2 range samples:   4400
SLC-2 azimuth lines: 113262
resampled SLC-2 width (samples):   4400
resampled SLC-2 lines: 113346

block:  0  SLC-1 start line:      0  SLC-1 end line:   1905  SLC-1 lines:  1906
block:  0  SLC-1 range pixel: 0  SLC-1 starting line: 0  LT range:    -0.333  LT line:   -0.469
block:  0  SLC-1 range pixel:  4400  SLC-1 starting line: 0  LT range:  1466.333  LT line:    -0.469
block:  0  SLC start line:      0  min. LT line:     -0.469  LT start line:      0

block:  0  SLC-1 range pixel:     0  SLC-1 start line:   1905  LT range:    -0.333  LT end line:
118.594
block:  0  SLC-1 range pixel:  4400  SLC-1 start line:   1905  LT range:  1466.333  LT end line:
118.594
block:  0  SLC-1 start line:   1905   start LT line:    118.594  end LT line:    120  LT lines: 121
number of range looks: 3  azimuth looks: 16

block:  0  SLC-2R output start line:      0  SLC-2R end line :   1905
LT start line:      0   LT end line:    120  lines:   121
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:      0  max:   2061
number of range pixels per block:  4400
number of azimuth lines per block: 2062
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0418  azimuth (rad):     0.0339
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:      0
output line:    400
output line:    800
output line:   1200
output line:   1600

block:  1  SLC-1 start line:   1906  SLC-1 end line:   3811  SLC-1 lines:  1906
block:  1  SLC-1 range pixel: 0  SLC-1 starting line: 1906  LT range:    -0.333  LT line:  118.656
block:  1  SLC-1 range pixel:  4400  SLC-1 starting line: 1906  LT range:  1466.333  LT line:   118.656
block:  1  SLC start line:   1906  min. LT line:    118.656  LT start line:    117

block:  1  SLC-1 range pixel:     0  SLC-1 start line:   3811  LT range:    -0.333  LT end line:
237.719
block:  1  SLC-1 range pixel:  4400  SLC-1 start line:   3811  LT range:  1466.333  LT end line:
237.719
```

```
block:  1  SLC-1 start line:   3811   start LT line:    237.719  end LT line:    239  LT lines: 123
number of range looks: 3  azimuth looks: 16

block:  1  SLC-2R output start line:   1906  SLC-2R end line :   3811
LT start line:    117   LT end line:    239  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:   1736  max:   3965
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0349  azimuth (rad):     0.0300
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:   2000
output line:   2400
output line:   2800
output line:   3200
output line:   3600

block:  2  SLC-1 start line:   3812  SLC-1 end line:   5717  SLC-1 lines:  1906
block:  2  SLC-1 range pixel: 0  SLC-1 starting line: 3812  LT range:    -0.333  LT line:  237.781
block:  2  SLC-1 range pixel:  4400  SLC-1 starting line: 3812  LT range:  1466.333  LT line:   237.781
block:  2  SLC start line:   3812  min. LT line:    237.781  LT start line:    236

block:  2  SLC-1 range pixel:     0  SLC-1 start line:   5717  LT range:    -0.333  LT end line:
356.844
block:  2  SLC-1 range pixel:  4400  SLC-1 start line:   5717  LT range:  1466.333  LT end line:
356.844
block:  2  SLC-1 start line:   5717   start LT line:    356.844  end LT line:    358  LT lines: 123
number of range looks: 3  azimuth looks: 16

block:  2  SLC-2R output start line:   3812  SLC-2R end line :   5717
LT start line:    236   LT end line:    358  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:   3640  max:   5869
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0392  azimuth (rad):     0.0221
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:   4000
output line:   4400
output line:   4800
output line:   5200
output line:   5600

block:  3  SLC-1 start line:   5718  SLC-1 end line:   7623  SLC-1 lines:  1906
block:  3  SLC-1 range pixel: 0  SLC-1 starting line: 5718  LT range:    -0.333  LT line:  356.906
block:  3  SLC-1 range pixel:  4400  SLC-1 starting line: 5718  LT range:  1466.333  LT line:   356.906
block:  3  SLC start line:   5718  min. LT line:    356.906  LT start line:    355

block:  3  SLC-1 range pixel:     0  SLC-1 start line:   7623  LT range:    -0.333  LT end line:
475.969
block:  3  SLC-1 range pixel:  4400  SLC-1 start line:   7623  LT range:  1466.333  LT end line:
475.969
block:  3  SLC-1 start line:   7623   start LT line:    475.969  end LT line:    477  LT lines: 123
number of range looks: 3  azimuth looks: 16

block:  3  SLC-2R output start line:   5718  SLC-2R end line :   7623
LT start line:    355   LT end line:    477  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:   5544  max:   7773
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0271  azimuth (rad):     0.0136
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:   6000
output line:   6400
output line:   6800
output line:   7200
output line:   7600

block:  4  SLC-1 start line:   7624  SLC-1 end line:   9529  SLC-1 lines:  1906
block:  4  SLC-1 range pixel: 0  SLC-1 starting line: 7624  LT range:    -0.333  LT line:  476.031
block:  4  SLC-1 range pixel:  4400  SLC-1 starting line: 7624  LT range:  1466.333  LT line:   476.031
block:  4  SLC start line:   7624  min. LT line:    476.031  LT start line:    475
```

```
block:  4  SLC-1 range pixel:     0  SLC-1 start line:   9529  LT range:    -0.333  LT end line:
595.094
block:  4  SLC-1 range pixel:  4400  SLC-1 start line:   9529  LT range:  1466.333  LT end line:
595.094
block:  4  SLC-1 start line:   9529   start LT line:    595.094  end LT line:    597  LT lines: 123
number of range looks: 3  azimuth looks: 16

block:  4  SLC-2R output start line:   7624  SLC-2R end line :   9529
LT start line:    475   LT end line:    597  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:   7464  max:   9693
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0224  azimuth (rad):     0.0200
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:   8000
output line:   8400
output line:   8800
output line:   9200

block:  5  SLC-1 start line:   9530  SLC-1 end line:  11435  SLC-1 lines:  1906
block:  5  SLC-1 range pixel: 0  SLC-1 starting line: 9530  LT range:    -0.333  LT line:  595.156
block:  5  SLC-1 range pixel:  4400  SLC-1 starting line: 9530  LT range:  1466.333  LT line:   595.156
block:  5  SLC start line:   9530  min. LT line:    595.156  LT start line:    594

block:  5  SLC-1 range pixel:     0  SLC-1 start line:  11435  LT range:    -0.333  LT end line:
714.219
block:  5  SLC-1 range pixel:  4400  SLC-1 start line:  11435  LT range:  1466.333  LT end line:
714.219
block:  5  SLC-1 start line:  11435   start LT line:    714.219  end LT line:    716  LT lines: 123
number of range looks: 3  azimuth looks: 16

block:  5  SLC-2R output start line:   9530  SLC-2R end line :  11435
LT start line:    594   LT end line:    716  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:   9368  max:  11597
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0170  azimuth (rad):     0.0077
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:   9600
output line:  10000
output line:  10400
output line:  10800
output line:  11200

block:  6  SLC-1 start line:  11436  SLC-1 end line:  13341  SLC-1 lines:  1906
block:  6  SLC-1 range pixel: 0  SLC-1 starting line: 11436  LT range:    -0.333  LT line:  714.281
block:  6  SLC-1 range pixel:  4400  SLC-1 starting line: 11436  LT range:  1466.333  LT line:
714.281
block:  6  SLC start line:  11436  min. LT line:    714.281  LT start line:    713

block:  6  SLC-1 range pixel:     0  SLC-1 start line:  13341  LT range:    -0.333  LT end line:
833.344
block:  6  SLC-1 range pixel:  4400  SLC-1 start line:  13341  LT range:  1466.333  LT end line:
833.344
block:  6  SLC-1 start line:  13341   start LT line:    833.344  end LT line:    835  LT lines: 123
number of range looks: 3  azimuth looks: 16

block:  6  SLC-2R output start line:  11436  SLC-2R end line :  13341
LT start line:    713   LT end line:    835  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  11272  max:  13501
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0164  azimuth (rad):     0.0130
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  11600
output line:  12000
output line:  12400
output line:  12800
output line:  13200

block:  7  SLC-1 start line:  13342  SLC-1 end line:  15247  SLC-1 lines:  1906
```

```
block:  7  SLC-1 range pixel: 0  SLC-1 starting line: 13342  LT range:    -0.333  LT line:  833.406
block:  7  SLC-1 range pixel:  4400  SLC-1 starting line: 13342  LT range:  1466.333  LT line:
833.406
block:  7  SLC start line:  13342  min. LT line:    833.406  LT start line:    832

block:  7  SLC-1 range pixel:     0  SLC-1 start line:  15247  LT range:    -0.333  LT end line:
952.469
block:  7  SLC-1 range pixel:  4400  SLC-1 start line:  15247  LT range:  1466.333  LT end line:
952.469
block:  7  SLC-1 start line:  15247   start LT line:    952.469  end LT line:    954  LT lines: 123
number of range looks: 3  azimuth looks: 16

block:  7  SLC-2R output start line:  13342  SLC-2R end line :  15247
LT start line:    832   LT end line:    954  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  13176  max:  15405
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0162  azimuth (rad):     0.0332
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  13600
output line:  14000
output line:  14400
output line:  14800
output line:  15200

block:  8  SLC-1 start line:  15248  SLC-1 end line:  17153  SLC-1 lines:  1906
block:  8  SLC-1 range pixel: 0  SLC-1 starting line: 15248  LT range:    -0.333  LT line:  952.531
block:  8  SLC-1 range pixel:  4400  SLC-1 starting line: 15248  LT range:  1466.333  LT line:
952.531
block:  8  SLC start line:  15248  min. LT line:    952.531  LT start line:    951

block:  8  SLC-1 range pixel:     0  SLC-1 start line:  17153  LT range:    -0.333  LT end line:
1071.594
block:  8  SLC-1 range pixel:  4400  SLC-1 start line:  17153  LT range:  1466.333  LT end line:
1071.594
block:  8  SLC-1 start line:  17153   start LT line:   1071.594  end LT line:   1073  LT lines: 123
number of range looks: 3  azimuth looks: 16

block:  8  SLC-2R output start line:  15248  SLC-2R end line :  17153
LT start line:    951   LT end line:   1073  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  15080  max:  17309
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0321  azimuth (rad):     0.0246
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  15600
output line:  16000
output line:  16400
output line:  16800

block:  9  SLC-1 start line:  17154  SLC-1 end line:  19059  SLC-1 lines:  1906
block:  9  SLC-1 range pixel: 0  SLC-1 starting line: 17154  LT range:    -0.333  LT line: 1071.656
block:  9  SLC-1 range pixel:  4400  SLC-1 starting line: 17154  LT range:  1466.333  LT line:
1071.656
block:  9  SLC start line:  17154  min. LT line:   1071.656  LT start line:   1070

block:  9  SLC-1 range pixel:     0  SLC-1 start line:  19059  LT range:    -0.333  LT end line:
1190.719
block:  9  SLC-1 range pixel:  4400  SLC-1 start line:  19059  LT range:  1466.333  LT end line:
1190.719
block:  9  SLC-1 start line:  19059   start LT line:   1190.719  end LT line:   1192  LT lines: 123
number of range looks: 3  azimuth looks: 16

block:  9  SLC-2R output start line:  17154  SLC-2R end line :  19059
LT start line:   1070   LT end line:   1192  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  16984  max:  19213
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0079  azimuth (rad):     0.0512
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  17200
```

```
output line:  17600
output line:  18000
output line:  18400
output line:  18800

block: 10  SLC-1 start line:  19060  SLC-1 end line:  20965  SLC-1 lines:  1906
block: 10  SLC-1 range pixel: 0  SLC-1 starting line: 19060  LT range:    -0.333  LT line: 1190.781
block: 10  SLC-1 range pixel:  4400  SLC-1 starting line: 19060  LT range:  1466.333  LT line:
1190.781
block: 10  SLC start line:  19060  min. LT line:   1190.781  LT start line:   1189

block: 10  SLC-1 range pixel:     0  SLC-1 start line:  20965  LT range:    -0.333  LT end line:
1309.844
block: 10  SLC-1 range pixel:  4400  SLC-1 start line:  20965  LT range:  1466.333  LT end line:
1309.844
block: 10  SLC-1 start line:  20965   start LT line:   1309.844  end LT line:   1311  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 10  SLC-2R output start line:  19060  SLC-2R end line :  20965
LT start line:   1189   LT end line:   1311  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  18888  max:  21117
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0176  azimuth (rad):     0.0523
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  19200
output line:  19600
output line:  20000
output line:  20400
output line:  20800

block: 11  SLC-1 start line:  20966  SLC-1 end line:  22871  SLC-1 lines:  1906
block: 11  SLC-1 range pixel: 0  SLC-1 starting line: 20966  LT range:    -0.333  LT line: 1309.906
block: 11  SLC-1 range pixel:  4400  SLC-1 starting line: 20966  LT range:  1466.333  LT line:
1309.906
block: 11  SLC start line:  20966  min. LT line:   1309.906  LT start line:   1308

block: 11  SLC-1 range pixel:     0  SLC-1 start line:  22871  LT range:    -0.333  LT end line:
1428.969
block: 11  SLC-1 range pixel:  4400  SLC-1 start line:  22871  LT range:  1466.333  LT end line:
1428.969
block: 11  SLC-1 start line:  22871   start LT line:   1428.969  end LT line:   1430  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 11  SLC-2R output start line:  20966  SLC-2R end line :  22871
LT start line:   1308   LT end line:   1430  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  20792  max:  23021
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0363  azimuth (rad):     0.0433
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  21200
output line:  21600
output line:  22000
output line:  22400
output line:  22800

block: 12  SLC-1 start line:  22872  SLC-1 end line:  24777  SLC-1 lines:  1906
block: 12  SLC-1 range pixel: 0  SLC-1 starting line: 22872  LT range:    -0.333  LT line: 1429.031
block: 12  SLC-1 range pixel:  4400  SLC-1 starting line: 22872  LT range:  1466.333  LT line:
1429.031
block: 12  SLC start line:  22872  min. LT line:   1429.031  LT start line:   1428

block: 12  SLC-1 range pixel:     0  SLC-1 start line:  24777  LT range:    -0.333  LT end line:
1548.094
block: 12  SLC-1 range pixel:  4400  SLC-1 start line:  24777  LT range:  1466.333  LT end line:
1548.094
block: 12  SLC-1 start line:  24777   start LT line:   1548.094  end LT line:   1550  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 12  SLC-2R output start line:  22872  SLC-2R end line :  24777
LT start line:   1428   LT end line:   1550  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  22712  max:  24941
```

```
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0105  azimuth (rad):     0.0363
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  23200
output line:  23600
output line:  24000
output line:  24400

block: 13  SLC-1 start line:  24778  SLC-1 end line:  26683  SLC-1 lines:  1906
block: 13  SLC-1 range pixel: 0  SLC-1 starting line: 24778  LT range:    -0.333  LT line: 1548.156
block: 13  SLC-1 range pixel:  4400  SLC-1 starting line: 24778  LT range:  1466.333  LT line:
1548.156
block: 13  SLC start line:  24778  min. LT line:   1548.156  LT start line:   1547

block: 13  SLC-1 range pixel:     0  SLC-1 start line:  26683  LT range:    -0.333  LT end line:
1667.219
block: 13  SLC-1 range pixel:  4400  SLC-1 start line:  26683  LT range:  1466.333  LT end line:
1667.219
block: 13  SLC-1 start line:  26683   start LT line:   1667.219  end LT line:   1669  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 13  SLC-2R output start line:  24778  SLC-2R end line :  26683
LT start line:   1547   LT end line:   1669  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  24616  max:  26845
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0329  azimuth (rad):     0.0254
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  24800
output line:  25200
output line:  25600
output line:  26000
output line:  26400

block: 14  SLC-1 start line:  26684  SLC-1 end line:  28589  SLC-1 lines:  1906
block: 14  SLC-1 range pixel: 0  SLC-1 starting line: 26684  LT range:    -0.333  LT line: 1667.281
block: 14  SLC-1 range pixel:  4400  SLC-1 starting line: 26684  LT range:  1466.333  LT line:
1667.281
block: 14  SLC start line:  26684  min. LT line:   1667.281  LT start line:   1666

block: 14  SLC-1 range pixel:     0  SLC-1 start line:  28589  LT range:    -0.333  LT end line:
1786.344
block: 14  SLC-1 range pixel:  4400  SLC-1 start line:  28589  LT range:  1466.333  LT end line:
1786.344
block: 14  SLC-1 start line:  28589   start LT line:   1786.344  end LT line:   1788  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 14  SLC-2R output start line:  26684  SLC-2R end line :  28589
LT start line:   1666   LT end line:   1788  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  26520  max:  28749
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0219  azimuth (rad):     0.0250
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  26800
output line:  27200
output line:  27600
output line:  28000
output line:  28400

block: 15  SLC-1 start line:  28590  SLC-1 end line:  30495  SLC-1 lines:  1906
block: 15  SLC-1 range pixel: 0  SLC-1 starting line: 28590  LT range:    -0.333  LT line: 1786.406
block: 15  SLC-1 range pixel:  4400  SLC-1 starting line: 28590  LT range:  1466.333  LT line:
1786.406
block: 15  SLC start line:  28590  min. LT line:   1786.406  LT start line:   1785

block: 15  SLC-1 range pixel:     0  SLC-1 start line:  30495  LT range:    -0.333  LT end line:
1905.469
block: 15  SLC-1 range pixel:  4400  SLC-1 start line:  30495  LT range:  1466.333  LT end line:
1905.469
```

```
block: 15  SLC-1 start line:  30495   start LT line:   1905.469  end LT line:   1907  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 15  SLC-2R output start line:  28590  SLC-2R end line :  30495
LT start line:   1785   LT end line:   1907  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  28424  max:  30653
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0195  azimuth (rad):     0.0306
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  28800
output line:  29200
output line:  29600
output line:  30000
output line:  30400

block: 16  SLC-1 start line:  30496  SLC-1 end line:  32401  SLC-1 lines:  1906
block: 16  SLC-1 range pixel: 0  SLC-1 starting line: 30496  LT range:    -0.333  LT line: 1905.531
block: 16  SLC-1 range pixel:  4400  SLC-1 starting line: 30496  LT range:  1466.333  LT line:
1905.531
block: 16  SLC start line:  30496  min. LT line:   1905.531  LT start line:   1904

block: 16  SLC-1 range pixel:     0  SLC-1 start line:  32401  LT range:    -0.333  LT end line:
2024.594
block: 16  SLC-1 range pixel:  4400  SLC-1 start line:  32401  LT range:  1466.333  LT end line:
2024.594
block: 16  SLC-1 start line:  32401   start LT line:   2024.594  end LT line:   2026  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 16  SLC-2R output start line:  30496  SLC-2R end line :  32401
LT start line:   1904   LT end line:   2026  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  30328  max:  32557
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0177  azimuth (rad):     0.0262
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  30800
output line:  31200
output line:  31600
output line:  32000
output line:  32400

block: 17  SLC-1 start line:  32402  SLC-1 end line:  34307  SLC-1 lines:  1906
block: 17  SLC-1 range pixel: 0  SLC-1 starting line: 32402  LT range:    -0.333  LT line: 2024.656
block: 17  SLC-1 range pixel:  4400  SLC-1 starting line: 32402  LT range:  1466.333  LT line:
2024.656
block: 17  SLC start line:  32402  min. LT line:   2024.656  LT start line:   2023

block: 17  SLC-1 range pixel:     0  SLC-1 start line:  34307  LT range:    -0.333  LT end line:
2143.719
block: 17  SLC-1 range pixel:  4400  SLC-1 start line:  34307  LT range:  1466.333  LT end line:
2143.719
block: 17  SLC-1 start line:  34307   start LT line:   2143.719  end LT line:   2145  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 17  SLC-2R output start line:  32402  SLC-2R end line :  34307
LT start line:   2023   LT end line:   2145  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  32232  max:  34461
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0169  azimuth (rad):     0.0267
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  32800
output line:  33200
output line:  33600
output line:  34000

block: 18  SLC-1 start line:  34308  SLC-1 end line:  36213  SLC-1 lines:  1906
block: 18  SLC-1 range pixel: 0  SLC-1 starting line: 34308  LT range:    -0.333  LT line: 2143.781
block: 18  SLC-1 range pixel:  4400  SLC-1 starting line: 34308  LT range:  1466.333  LT line:
2143.781
```

```
block: 18  SLC start line:  34308  min. LT line:   2143.781  LT start line:   2142

block: 18  SLC-1 range pixel:     0  SLC-1 start line:  36213  LT range:    -0.333  LT end line:
2262.844
block: 18  SLC-1 range pixel:  4400  SLC-1 start line:  36213  LT range:  1466.333  LT end line:
2262.844
block: 18  SLC-1 start line:  36213   start LT line:   2262.844  end LT line:   2264  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 18  SLC-2R output start line:  34308  SLC-2R end line :  36213
LT start line:   2142   LT end line:   2264  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  34136  max:  36365
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0146  azimuth (rad):     0.0178
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  34400
output line:  34800
output line:  35200
output line:  35600
output line:  36000

block: 19  SLC-1 start line:  36214  SLC-1 end line:  38119  SLC-1 lines:  1906
block: 19  SLC-1 range pixel: 0  SLC-1 starting line: 36214  LT range:    -0.333  LT line: 2262.906
block: 19  SLC-1 range pixel:  4400  SLC-1 starting line: 36214  LT range:  1466.333  LT line:
2262.906
block: 19  SLC start line:  36214  min. LT line:   2262.906  LT start line:   2261

block: 19  SLC-1 range pixel:     0  SLC-1 start line:  38119  LT range:    -0.333  LT end line:
2381.969
block: 19  SLC-1 range pixel:  4400  SLC-1 start line:  38119  LT range:  1466.333  LT end line:
2381.969
block: 19  SLC-1 start line:  38119   start LT line:   2381.969  end LT line:   2383  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 19  SLC-2R output start line:  36214  SLC-2R end line :  38119
LT start line:   2261   LT end line:   2383  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  36040  max:  38269
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0067  azimuth (rad):     0.0248
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  36400
output line:  36800
output line:  37200
output line:  37600
output line:  38000

block: 20  SLC-1 start line:  38120  SLC-1 end line:  40025  SLC-1 lines:  1906
block: 20  SLC-1 range pixel: 0  SLC-1 starting line: 38120  LT range:    -0.333  LT line: 2382.031
block: 20  SLC-1 range pixel:  4400  SLC-1 starting line: 38120  LT range:  1466.333  LT line:
2382.031
block: 20  SLC start line:  38120  min. LT line:   2382.031  LT start line:   2381

block: 20  SLC-1 range pixel:     0  SLC-1 start line:  40025  LT range:    -0.333  LT end line:
2501.094
block: 20  SLC-1 range pixel:  4400  SLC-1 start line:  40025  LT range:  1466.333  LT end line:
2501.094
block: 20  SLC-1 start line:  40025   start LT line:   2501.094  end LT line:   2503  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 20  SLC-2R output start line:  38120  SLC-2R end line :  40025
LT start line:   2381   LT end line:   2503  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  37960  max:  40189
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0063  azimuth (rad):     0.0217
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  38400
output line:  38800
output line:  39200
```

```
output line:  39600
output line:  40000

block: 21  SLC-1 start line:  40026  SLC-1 end line:  41931  SLC-1 lines:  1906
block: 21  SLC-1 range pixel: 0  SLC-1 starting line: 40026  LT range:    -0.333  LT line: 2501.156
block: 21  SLC-1 range pixel:  4400  SLC-1 starting line: 40026  LT range:  1466.333  LT line:
2501.156
block: 21  SLC start line:  40026  min. LT line:   2501.156  LT start line:   2500

block: 21  SLC-1 range pixel:     0  SLC-1 start line:  41931  LT range:    -0.333  LT end line:
2620.219
block: 21  SLC-1 range pixel:  4400  SLC-1 start line:  41931  LT range:  1466.333  LT end line:
2620.219
block: 21  SLC-1 start line:  41931   start LT line:   2620.219  end LT line:   2622  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 21  SLC-2R output start line:  40026  SLC-2R end line :  41931
LT start line:   2500   LT end line:   2622  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  39864  max:  42093
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0105  azimuth (rad):     0.0405
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  40400
output line:  40800
output line:  41200
output line:  41600

block: 22  SLC-1 start line:  41932  SLC-1 end line:  43837  SLC-1 lines:  1906
block: 22  SLC-1 range pixel: 0  SLC-1 starting line: 41932  LT range:    -0.333  LT line: 2620.281
block: 22  SLC-1 range pixel:  4400  SLC-1 starting line: 41932  LT range:  1466.333  LT line:
2620.281
block: 22  SLC start line:  41932  min. LT line:   2620.281  LT start line:   2619

block: 22  SLC-1 range pixel:     0  SLC-1 start line:  43837  LT range:    -0.333  LT end line:
2739.344
block: 22  SLC-1 range pixel:  4400  SLC-1 start line:  43837  LT range:  1466.333  LT end line:
2739.344
block: 22  SLC-1 start line:  43837   start LT line:   2739.344  end LT line:   2741  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 22  SLC-2R output start line:  41932  SLC-2R end line :  43837
LT start line:   2619   LT end line:   2741  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  41768  max:  43997
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0113  azimuth (rad):     0.0326
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  42000
output line:  42400
output line:  42800
output line:  43200
output line:  43600

block: 23  SLC-1 start line:  43838  SLC-1 end line:  45743  SLC-1 lines:  1906
block: 23  SLC-1 range pixel: 0  SLC-1 starting line: 43838  LT range:    -0.333  LT line: 2739.406
block: 23  SLC-1 range pixel:  4400  SLC-1 starting line: 43838  LT range:  1466.333  LT line:
2739.406
block: 23  SLC start line:  43838  min. LT line:   2739.406  LT start line:   2738

block: 23  SLC-1 range pixel:     0  SLC-1 start line:  45743  LT range:    -0.333  LT end line:
2858.469
block: 23  SLC-1 range pixel:  4400  SLC-1 start line:  45743  LT range:  1466.333  LT end line:
2858.469
block: 23  SLC-1 start line:  45743   start LT line:   2858.469  end LT line:   2860  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 23  SLC-2R output start line:  43838  SLC-2R end line :  45743
LT start line:   2738   LT end line:   2860  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  43672  max:  45901
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
```

```
phase gradient/sample range (rad):    -0.0256  azimuth (rad):     0.0336
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  44000
output line:  44400
output line:  44800
output line:  45200
output line:  45600

block: 24  SLC-1 start line:  45744  SLC-1 end line:  47649  SLC-1 lines:  1906
block: 24  SLC-1 range pixel: 0  SLC-1 starting line: 45744  LT range:    -0.333  LT line: 2858.531
block: 24  SLC-1 range pixel:  4400  SLC-1 starting line: 45744  LT range:  1466.333  LT line:
2858.531
block: 24  SLC start line:  45744  min. LT line:   2858.531  LT start line:   2857

block: 24  SLC-1 range pixel:     0  SLC-1 start line:  47649  LT range:    -0.333  LT end line:
2977.594
block: 24  SLC-1 range pixel:  4400  SLC-1 start line:  47649  LT range:  1466.333  LT end line:
2977.594
block: 24  SLC-1 start line:  47649   start LT line:   2977.594  end LT line:   2979  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 24  SLC-2R output start line:  45744  SLC-2R end line :  47649
LT start line:   2857   LT end line:   2979  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  45576  max:  47805
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0245  azimuth (rad):     0.0266
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  46000
output line:  46400
output line:  46800
output line:  47200
output line:  47600

block: 25  SLC-1 start line:  47650  SLC-1 end line:  49555  SLC-1 lines:  1906
block: 25  SLC-1 range pixel: 0  SLC-1 starting line: 47650  LT range:    -0.333  LT line: 2977.656
block: 25  SLC-1 range pixel:  4400  SLC-1 starting line: 47650  LT range:  1466.333  LT line:
2977.656
block: 25  SLC start line:  47650  min. LT line:   2977.656  LT start line:   2976

block: 25  SLC-1 range pixel:     0  SLC-1 start line:  49555  LT range:    -0.333  LT end line:
3096.719
block: 25  SLC-1 range pixel:  4400  SLC-1 start line:  49555  LT range:  1466.333  LT end line:
3096.719
block: 25  SLC-1 start line:  49555   start LT line:   3096.719  end LT line:   3098  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 25  SLC-2R output start line:  47650  SLC-2R end line :  49555
LT start line:   2976   LT end line:   3098  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  47480  max:  49709
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0232  azimuth (rad):     0.0078
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  48000
output line:  48400
output line:  48800
output line:  49200

block: 26  SLC-1 start line:  49556  SLC-1 end line:  51461  SLC-1 lines:  1906
block: 26  SLC-1 range pixel: 0  SLC-1 starting line: 49556  LT range:    -0.333  LT line: 3096.781
block: 26  SLC-1 range pixel:  4400  SLC-1 starting line: 49556  LT range:  1466.333  LT line:
3096.781
block: 26  SLC start line:  49556  min. LT line:   3096.781  LT start line:   3095

block: 26  SLC-1 range pixel:     0  SLC-1 start line:  51461  LT range:    -0.333  LT end line:
3215.844
block: 26  SLC-1 range pixel:  4400  SLC-1 start line:  51461  LT range:  1466.333  LT end line:
3215.844
block: 26  SLC-1 start line:  51461   start LT line:   3215.844  end LT line:   3217  LT lines: 123
number of range looks: 3  azimuth looks: 16
```

```
block: 26  SLC-2R output start line:  49556  SLC-2R end line :  51461
LT start line:   3095   LT end line:   3217  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  49384  max:  51613
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0230  azimuth (rad):     0.0068
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  49600
output line:  50000
output line:  50400
output line:  50800
output line:  51200

block: 27  SLC-1 start line:  51462  SLC-1 end line:  53367  SLC-1 lines:  1906
block: 27  SLC-1 range pixel: 0  SLC-1 starting line: 51462  LT range:    -0.333  LT line: 3215.906
block: 27  SLC-1 range pixel:  4400  SLC-1 starting line: 51462  LT range:  1466.333  LT line:
3215.906
block: 27  SLC start line:  51462  min. LT line:   3215.906  LT start line:   3214

block: 27  SLC-1 range pixel:     0  SLC-1 start line:  53367  LT range:    -0.333  LT end line:
3334.969
block: 27  SLC-1 range pixel:  4400  SLC-1 start line:  53367  LT range:  1466.333  LT end line:
3334.969
block: 27  SLC-1 start line:  53367   start LT line:   3334.969  end LT line:   3336  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 27  SLC-2R output start line:  51462  SLC-2R end line :  53367
LT start line:   3214   LT end line:   3336  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  51288  max:  53517
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0149  azimuth (rad):     0.0344
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  51600
output line:  52000
output line:  52400
output line:  52800
output line:  53200

block: 28  SLC-1 start line:  53368  SLC-1 end line:  55273  SLC-1 lines:  1906
block: 28  SLC-1 range pixel: 0  SLC-1 starting line: 53368  LT range:    -0.333  LT line: 3335.031
block: 28  SLC-1 range pixel:  4400  SLC-1 starting line: 53368  LT range:  1466.333  LT line:
3335.031
block: 28  SLC start line:  53368  min. LT line:   3335.031  LT start line:   3334

block: 28  SLC-1 range pixel:     0  SLC-1 start line:  55273  LT range:    -0.333  LT end line:
3454.094
block: 28  SLC-1 range pixel:  4400  SLC-1 start line:  55273  LT range:  1466.333  LT end line:
3454.094
block: 28  SLC-1 start line:  55273   start LT line:   3454.094  end LT line:   3456  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 28  SLC-2R output start line:  53368  SLC-2R end line :  55273
LT start line:   3334   LT end line:   3456  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  53208  max:  55437
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0228  azimuth (rad):    -0.0139
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  53600
output line:  54000
output line:  54400
output line:  54800
output line:  55200

block: 29  SLC-1 start line:  55274  SLC-1 end line:  57179  SLC-1 lines:  1906
block: 29  SLC-1 range pixel: 0  SLC-1 starting line: 55274  LT range:    -0.333  LT line: 3454.156
block: 29  SLC-1 range pixel:  4400  SLC-1 starting line: 55274  LT range:  1466.333  LT line:
3454.156
block: 29  SLC start line:  55274  min. LT line:   3454.156  LT start line:   3453
```

```
block: 29  SLC-1 range pixel:     0  SLC-1 start line:  57179  LT range:    -0.333  LT end line:
3573.219
block: 29  SLC-1 range pixel:  4400  SLC-1 start line:  57179  LT range:  1466.333  LT end line:
3573.219
block: 29  SLC-1 start line:  57179   start LT line:   3573.219  end LT line:   3575  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 29  SLC-2R output start line:  55274  SLC-2R end line :  57179
LT start line:   3453   LT end line:   3575  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  55112  max:  57341
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0266  azimuth (rad):    -0.0375
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  55600
output line:  56000
output line:  56400
output line:  56800

block: 30  SLC-1 start line:  57180  SLC-1 end line:  59085  SLC-1 lines:  1906
block: 30  SLC-1 range pixel: 0  SLC-1 starting line: 57180  LT range:    -0.333  LT line: 3573.281
block: 30  SLC-1 range pixel:  4400  SLC-1 starting line: 57180  LT range:  1466.333  LT line:
3573.281
block: 30  SLC start line:  57180  min. LT line:   3573.281  LT start line:   3572

block: 30  SLC-1 range pixel:     0  SLC-1 start line:  59085  LT range:    -0.333  LT end line:
3692.344
block: 30  SLC-1 range pixel:  4400  SLC-1 start line:  59085  LT range:  1466.333  LT end line:
3692.344
block: 30  SLC-1 start line:  59085   start LT line:   3692.344  end LT line:   3694  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 30  SLC-2R output start line:  57180  SLC-2R end line :  59085
LT start line:   3572   LT end line:   3694  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  57016  max:  59245
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0250  azimuth (rad):     0.0221
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  57200
output line:  57600
output line:  58000
output line:  58400
output line:  58800

block: 31  SLC-1 start line:  59086  SLC-1 end line:  60991  SLC-1 lines:  1906
block: 31  SLC-1 range pixel: 0  SLC-1 starting line: 59086  LT range:    -0.333  LT line: 3692.406
block: 31  SLC-1 range pixel:  4400  SLC-1 starting line: 59086  LT range:  1466.333  LT line:
3692.406
block: 31  SLC start line:  59086  min. LT line:   3692.406  LT start line:   3691

block: 31  SLC-1 range pixel:     0  SLC-1 start line:  60991  LT range:    -0.333  LT end line:
3811.469
block: 31  SLC-1 range pixel:  4400  SLC-1 start line:  60991  LT range:  1466.333  LT end line:
3811.469
block: 31  SLC-1 start line:  60991   start LT line:   3811.469  end LT line:   3813  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 31  SLC-2R output start line:  59086  SLC-2R end line :  60991
LT start line:   3691   LT end line:   3813  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  58920  max:  61149
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0202  azimuth (rad):     0.0285
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  59200
output line:  59600
output line:  60000
output line:  60400
output line:  60800
```

```
block: 32  SLC-1 start line:  60992  SLC-1 end line:  62897  SLC-1 lines:  1906
block: 32  SLC-1 range pixel: 0  SLC-1 starting line: 60992  LT range:    -0.333  LT line: 3811.531
block: 32  SLC-1 range pixel:  4400  SLC-1 starting line: 60992  LT range:  1466.333  LT line:
3811.531
block: 32  SLC start line:  60992  min. LT line:   3811.531  LT start line:   3810

block: 32  SLC-1 range pixel:     0  SLC-1 start line:  62897  LT range:    -0.333  LT end line:
3930.594
block: 32  SLC-1 range pixel:  4400  SLC-1 start line:  62897  LT range:  1466.333  LT end line:
3930.594
block: 32  SLC-1 start line:  62897   start LT line:   3930.594  end LT line:   3932  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 32  SLC-2R output start line:  60992  SLC-2R end line :  62897
LT start line:   3810   LT end line:   3932  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  60824  max:  63053
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0245  azimuth (rad):     0.0540
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  61200
output line:  61600
output line:  62000
output line:  62400
output line:  62800

block: 33  SLC-1 start line:  62898  SLC-1 end line:  64803  SLC-1 lines:  1906
block: 33  SLC-1 range pixel: 0  SLC-1 starting line: 62898  LT range:    -0.333  LT line: 3930.656
block: 33  SLC-1 range pixel:  4400  SLC-1 starting line: 62898  LT range:  1466.333  LT line:
3930.656
block: 33  SLC start line:  62898  min. LT line:   3930.656  LT start line:   3929

block: 33  SLC-1 range pixel:     0  SLC-1 start line:  64803  LT range:    -0.333  LT end line:
4049.719
block: 33  SLC-1 range pixel:  4400  SLC-1 start line:  64803  LT range:  1466.333  LT end line:
4049.719
block: 33  SLC-1 start line:  64803   start LT line:   4049.719  end LT line:   4051  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 33  SLC-2R output start line:  62898  SLC-2R end line :  64803
LT start line:   3929   LT end line:   4051  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  62728  max:  64957
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0227  azimuth (rad):     0.0779
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  63200
output line:  63600
output line:  64000
output line:  64400
output line:  64800

block: 34  SLC-1 start line:  64804  SLC-1 end line:  66709  SLC-1 lines:  1906
block: 34  SLC-1 range pixel: 0  SLC-1 starting line: 64804  LT range:    -0.333  LT line: 4049.781
block: 34  SLC-1 range pixel:  4400  SLC-1 starting line: 64804  LT range:  1466.333  LT line:
4049.781
block: 34  SLC start line:  64804  min. LT line:   4049.781  LT start line:   4048

block: 34  SLC-1 range pixel:     0  SLC-1 start line:  66709  LT range:    -0.333  LT end line:
4168.844
block: 34  SLC-1 range pixel:  4400  SLC-1 start line:  66709  LT range:  1466.333  LT end line:
4168.844
block: 34  SLC-1 start line:  66709   start LT line:   4168.844  end LT line:   4170  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 34  SLC-2R output start line:  64804  SLC-2R end line :  66709
LT start line:   4048   LT end line:   4170  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  64632  max:  66861
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0277  azimuth (rad):     0.0333
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000
```

```
output line:  65200
output line:  65600
output line:  66000
output line:  66400

block: 35  SLC-1 start line:  66710  SLC-1 end line:  68615  SLC-1 lines:  1906
block: 35  SLC-1 range pixel: 0  SLC-1 starting line: 66710  LT range:    -0.333  LT line: 4168.906
block: 35  SLC-1 range pixel:  4400  SLC-1 starting line: 66710  LT range:  1466.333  LT line:
4168.906
block: 35  SLC start line:  66710  min. LT line:   4168.906  LT start line:   4167

block: 35  SLC-1 range pixel:     0  SLC-1 start line:  68615  LT range:    -0.333  LT end line:
4287.969
block: 35  SLC-1 range pixel:  4400  SLC-1 start line:  68615  LT range:  1466.333  LT end line:
4287.969
block: 35  SLC-1 start line:  68615   start LT line:   4287.969  end LT line:   4289  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 35  SLC-2R output start line:  66710  SLC-2R end line :  68615
LT start line:   4167   LT end line:   4289  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  66537  max:  68765
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0160  azimuth (rad):     0.0187
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  66800
output line:  67200
output line:  67600
output line:  68000
output line:  68400

block: 36  SLC-1 start line:  68616  SLC-1 end line:  70521  SLC-1 lines:  1906
block: 36  SLC-1 range pixel: 0  SLC-1 starting line: 68616  LT range:    -0.333  LT line: 4288.031
block: 36  SLC-1 range pixel:  4400  SLC-1 starting line: 68616  LT range:  1466.333  LT line:
4288.031
block: 36  SLC start line:  68616  min. LT line:   4288.031  LT start line:   4287

block: 36  SLC-1 range pixel:     0  SLC-1 start line:  70521  LT range:    -0.333  LT end line:
4407.094
block: 36  SLC-1 range pixel:  4400  SLC-1 start line:  70521  LT range:  1466.333  LT end line:
4407.094
block: 36  SLC-1 start line:  70521   start LT line:   4407.094  end LT line:   4409  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 36  SLC-2R output start line:  68616  SLC-2R end line :  70521
LT start line:   4287   LT end line:   4409  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  68457  max:  70685
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0190  azimuth (rad):     0.0138
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  68800
output line:  69200
output line:  69600
output line:  70000
output line:  70400

block: 37  SLC-1 start line:  70522  SLC-1 end line:  72427  SLC-1 lines:  1906
block: 37  SLC-1 range pixel: 0  SLC-1 starting line: 70522  LT range:    -0.333  LT line: 4407.156
block: 37  SLC-1 range pixel:  4400  SLC-1 starting line: 70522  LT range:  1466.333  LT line:
4407.156
block: 37  SLC start line:  70522  min. LT line:   4407.156  LT start line:   4406

block: 37  SLC-1 range pixel:     0  SLC-1 start line:  72427  LT range:    -0.333  LT end line:
4526.219
block: 37  SLC-1 range pixel:  4400  SLC-1 start line:  72427  LT range:  1466.333  LT end line:
4526.219
block: 37  SLC-1 start line:  72427   start LT line:   4526.219  end LT line:   4528  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 37  SLC-2R output start line:  70522  SLC-2R end line :  72427
LT start line:   4406   LT end line:   4528  lines:   123
```

```
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  70361  max:  72589
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0242  azimuth (rad):     0.0211
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  70800
output line:  71200
output line:  71600
output line:  72000
output line:  72400

block: 38  SLC-1 start line:  72428  SLC-1 end line:  74333  SLC-1 lines:  1906
block: 38  SLC-1 range pixel: 0  SLC-1 starting line: 72428  LT range:    -0.333  LT line: 4526.281
block: 38  SLC-1 range pixel:  4400  SLC-1 starting line: 72428  LT range:  1466.333  LT line:
4526.281
block: 38  SLC start line:  72428  min. LT line:   4526.281  LT start line:   4525

block: 38  SLC-1 range pixel:     0  SLC-1 start line:  74333  LT range:    -0.333  LT end line:
4645.344
block: 38  SLC-1 range pixel:  4400  SLC-1 start line:  74333  LT range:  1466.333  LT end line:
4645.344
block: 38  SLC-1 start line:  74333   start LT line:   4645.344  end LT line:   4647  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 38  SLC-2R output start line:  72428  SLC-2R end line :  74333
LT start line:   4525   LT end line:   4647  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  72265  max:  74493
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0262  azimuth (rad):     0.0359
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  72800
output line:  73200
output line:  73600
output line:  74000

block: 39  SLC-1 start line:  74334  SLC-1 end line:  76239  SLC-1 lines:  1906
block: 39  SLC-1 range pixel: 0  SLC-1 starting line: 74334  LT range:    -0.333  LT line: 4645.406
block: 39  SLC-1 range pixel:  4400  SLC-1 starting line: 74334  LT range:  1466.333  LT line:
4645.406
block: 39  SLC start line:  74334  min. LT line:   4645.406  LT start line:   4644

block: 39  SLC-1 range pixel:     0  SLC-1 start line:  76239  LT range:    -0.333  LT end line:
4764.469
block: 39  SLC-1 range pixel:  4400  SLC-1 start line:  76239  LT range:  1466.333  LT end line:
4764.469
block: 39  SLC-1 start line:  76239   start LT line:   4764.469  end LT line:   4766  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 39  SLC-2R output start line:  74334  SLC-2R end line :  76239
LT start line:   4644   LT end line:   4766  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  74169  max:  76397
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0282  azimuth (rad):     0.1156
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  74400
output line:  74800
output line:  75200
output line:  75600
output line:  76000

block: 40  SLC-1 start line:  76240  SLC-1 end line:  78145  SLC-1 lines:  1906
block: 40  SLC-1 range pixel: 0  SLC-1 starting line: 76240  LT range:    -0.333  LT line: 4764.531
block: 40  SLC-1 range pixel:  4400  SLC-1 starting line: 76240  LT range:  1466.333  LT line:
4764.531
block: 40  SLC start line:  76240  min. LT line:   4764.531  LT start line:   4763

block: 40  SLC-1 range pixel:     0  SLC-1 start line:  78145  LT range:    -0.333  LT end line:
4883.594
block: 40  SLC-1 range pixel:  4400  SLC-1 start line:  78145  LT range:  1466.333  LT end line:
```

```
4883.594
block: 40  SLC-1 start line:  78145   start LT line:   4883.594  end LT line:   4885  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 40  SLC-2R output start line:  76240  SLC-2R end line :  78145
LT start line:   4763   LT end line:   4885  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  76073  max:  78301
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0080  azimuth (rad):     0.0691
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  76400
output line:  76800
output line:  77200
output line:  77600
output line:  78000

block: 41  SLC-1 start line:  78146  SLC-1 end line:  80051  SLC-1 lines:  1906
block: 41  SLC-1 range pixel: 0  SLC-1 starting line: 78146  LT range:    -0.333  LT line: 4883.656
block: 41  SLC-1 range pixel:  4400  SLC-1 starting line: 78146  LT range:  1466.333  LT line:
4883.656
block: 41  SLC start line:  78146  min. LT line:   4883.656  LT start line:   4882

block: 41  SLC-1 range pixel:     0  SLC-1 start line:  80051  LT range:    -0.333  LT end line:
5002.719
block: 41  SLC-1 range pixel:  4400  SLC-1 start line:  80051  LT range:  1466.333  LT end line:
5002.719
block: 41  SLC-1 start line:  80051   start LT line:   5002.719  end LT line:   5004  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 41  SLC-2R output start line:  78146  SLC-2R end line :  80051
LT start line:   4882   LT end line:   5004  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  77977  max:  80205
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0367  azimuth (rad):    -0.0464
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  78400
output line:  78800
output line:  79200
output line:  79600
output line:  80000

block: 42  SLC-1 start line:  80052  SLC-1 end line:  81957  SLC-1 lines:  1906
block: 42  SLC-1 range pixel: 0  SLC-1 starting line: 80052  LT range:    -0.333  LT line: 5002.781
block: 42  SLC-1 range pixel:  4400  SLC-1 starting line: 80052  LT range:  1466.333  LT line:
5002.781
block: 42  SLC start line:  80052  min. LT line:   5002.781  LT start line:   5001

block: 42  SLC-1 range pixel:     0  SLC-1 start line:  81957  LT range:    -0.333  LT end line:
5121.844
block: 42  SLC-1 range pixel:  4400  SLC-1 start line:  81957  LT range:  1466.333  LT end line:
5121.844
block: 42  SLC-1 start line:  81957   start LT line:   5121.844  end LT line:   5123  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 42  SLC-2R output start line:  80052  SLC-2R end line :  81957
LT start line:   5001   LT end line:   5123  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  79881  max:  82109
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0348  azimuth (rad):     0.0135
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  80400
output line:  80800
output line:  81200
output line:  81600

block: 43  SLC-1 start line:  81958  SLC-1 end line:  83863  SLC-1 lines:  1906
block: 43  SLC-1 range pixel: 0  SLC-1 starting line: 81958  LT range:    -0.333  LT line: 5121.906
block: 43  SLC-1 range pixel:  4400  SLC-1 starting line: 81958  LT range:  1466.333  LT line:
```

```
5121.906
block: 43  SLC start line:  81958  min. LT line:   5121.906  LT start line:   5120

block: 43  SLC-1 range pixel:     0  SLC-1 start line:  83863  LT range:    -0.333  LT end line:
5240.969
block: 43  SLC-1 range pixel:  4400  SLC-1 start line:  83863  LT range:  1466.333  LT end line:
5240.969
block: 43  SLC-1 start line:  83863   start LT line:   5240.969  end LT line:   5242  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 43  SLC-2R output start line:  81958  SLC-2R end line :  83863
LT start line:   5120   LT end line:   5242  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  81785  max:  84013
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0228  azimuth (rad):     0.0130
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  82000
output line:  82400
output line:  82800
output line:  83200
output line:  83600

block: 44  SLC-1 start line:  83864  SLC-1 end line:  85769  SLC-1 lines:  1906
block: 44  SLC-1 range pixel: 0  SLC-1 starting line: 83864  LT range:    -0.333  LT line: 5241.031
block: 44  SLC-1 range pixel:  4400  SLC-1 starting line: 83864  LT range:  1466.333  LT line:
5241.031
block: 44  SLC start line:  83864  min. LT line:   5241.031  LT start line:   5240

block: 44  SLC-1 range pixel:     0  SLC-1 start line:  85769  LT range:    -0.333  LT end line:
5360.094
block: 44  SLC-1 range pixel:  4400  SLC-1 start line:  85769  LT range:  1466.333  LT end line:
5360.094
block: 44  SLC-1 start line:  85769   start LT line:   5360.094  end LT line:   5362  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 44  SLC-2R output start line:  83864  SLC-2R end line :  85769
LT start line:   5240   LT end line:   5362  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  83705  max:  85933
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0396  azimuth (rad):     0.0083
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  84000
output line:  84400
output line:  84800
output line:  85200
output line:  85600

block: 45  SLC-1 start line:  85770  SLC-1 end line:  87675  SLC-1 lines:  1906
block: 45  SLC-1 range pixel: 0  SLC-1 starting line: 85770  LT range:    -0.333  LT line: 5360.156
block: 45  SLC-1 range pixel:  4400  SLC-1 starting line: 85770  LT range:  1466.333  LT line:
5360.156
block: 45  SLC start line:  85770  min. LT line:   5360.156  LT start line:   5359

block: 45  SLC-1 range pixel:     0  SLC-1 start line:  87675  LT range:    -0.333  LT end line:
5479.219
block: 45  SLC-1 range pixel:  4400  SLC-1 start line:  87675  LT range:  1466.333  LT end line:
5479.219
block: 45  SLC-1 start line:  87675   start LT line:   5479.219  end LT line:   5481  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 45  SLC-2R output start line:  85770  SLC-2R end line :  87675
LT start line:   5359   LT end line:   5481  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  85609  max:  87837
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0329  azimuth (rad):     0.0135
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  86000
output line:  86400
```

```
output line:  86800
output line:  87200
output line:  87600

block: 46  SLC-1 start line:  87676  SLC-1 end line:  89581  SLC-1 lines:  1906
block: 46  SLC-1 range pixel: 0  SLC-1 starting line: 87676  LT range:    -0.333  LT line: 5479.281
block: 46  SLC-1 range pixel:  4400  SLC-1 starting line: 87676  LT range:  1466.333  LT line:
5479.281
block: 46  SLC start line:  87676  min. LT line:   5479.281  LT start line:   5478

block: 46  SLC-1 range pixel:     0  SLC-1 start line:  89581  LT range:    -0.333  LT end line:
5598.344
block: 46  SLC-1 range pixel:  4400  SLC-1 start line:  89581  LT range:  1466.333  LT end line:
5598.344
block: 46  SLC-1 start line:  89581   start LT line:   5598.344  end LT line:   5600  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 46  SLC-2R output start line:  87676  SLC-2R end line :  89581
LT start line:   5478   LT end line:   5600  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  87513  max:  89741
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0322  azimuth (rad):     0.0177
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  88000
output line:  88400
output line:  88800
output line:  89200

block: 47  SLC-1 start line:  89582  SLC-1 end line:  91487  SLC-1 lines:  1906
block: 47  SLC-1 range pixel: 0  SLC-1 starting line: 89582  LT range:    -0.333  LT line: 5598.406
block: 47  SLC-1 range pixel:  4400  SLC-1 starting line: 89582  LT range:  1466.333  LT line:
5598.406
block: 47  SLC start line:  89582  min. LT line:   5598.406  LT start line:   5597

block: 47  SLC-1 range pixel:     0  SLC-1 start line:  91487  LT range:    -0.333  LT end line:
5717.469
block: 47  SLC-1 range pixel:  4400  SLC-1 start line:  91487  LT range:  1466.333  LT end line:
5717.469
block: 47  SLC-1 start line:  91487   start LT line:   5717.469  end LT line:   5719  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 47  SLC-2R output start line:  89582  SLC-2R end line :  91487
LT start line:   5597   LT end line:   5719  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  89417  max:  91645
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0244  azimuth (rad):     0.0164
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  89600
output line:  90000
output line:  90400
output line:  90800
output line:  91200

block: 48  SLC-1 start line:  91488  SLC-1 end line:  93393  SLC-1 lines:  1906
block: 48  SLC-1 range pixel: 0  SLC-1 starting line: 91488  LT range:    -0.333  LT line: 5717.531
block: 48  SLC-1 range pixel:  4400  SLC-1 starting line: 91488  LT range:  1466.333  LT line:
5717.531
block: 48  SLC start line:  91488  min. LT line:   5717.531  LT start line:   5716

block: 48  SLC-1 range pixel:     0  SLC-1 start line:  93393  LT range:    -0.333  LT end line:
5836.594
block: 48  SLC-1 range pixel:  4400  SLC-1 start line:  93393  LT range:  1466.333  LT end line:
5836.594
block: 48  SLC-1 start line:  93393   start LT line:   5836.594  end LT line:   5838  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 48  SLC-2R output start line:  91488  SLC-2R end line :  93393
LT start line:   5716   LT end line:   5838  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  91321  max:  93549
number of range pixels per block:  4400
number of azimuth lines per block: 2229
```

```
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0289  azimuth (rad):     0.0165
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  91600
output line:  92000
output line:  92400
output line:  92800
output line:  93200

block: 49  SLC-1 start line:  93394  SLC-1 end line:  95299  SLC-1 lines:  1906
block: 49  SLC-1 range pixel: 0  SLC-1 starting line: 93394  LT range:    -0.333  LT line: 5836.656
block: 49  SLC-1 range pixel:  4400  SLC-1 starting line: 93394  LT range:  1466.333  LT line:
5836.656
block: 49  SLC start line:  93394  min. LT line:   5836.656  LT start line:   5835

block: 49  SLC-1 range pixel:     0  SLC-1 start line:  95299  LT range:    -0.333  LT end line:
5955.719
block: 49  SLC-1 range pixel:  4400  SLC-1 start line:  95299  LT range:  1466.333  LT end line:
5955.719
block: 49  SLC-1 start line:  95299   start LT line:   5955.719  end LT line:   5957  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 49  SLC-2R output start line:  93394  SLC-2R end line :  95299
LT start line:   5835   LT end line:   5957  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  93225  max:  95453
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0273  azimuth (rad):     0.0097
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  93600
output line:  94000
output line:  94400
output line:  94800
output line:  95200

block: 50  SLC-1 start line:  95300  SLC-1 end line:  97205  SLC-1 lines:  1906
block: 50  SLC-1 range pixel: 0  SLC-1 starting line: 95300  LT range:    -0.333  LT line: 5955.781
block: 50  SLC-1 range pixel:  4400  SLC-1 starting line: 95300  LT range:  1466.333  LT line:
5955.781
block: 50  SLC start line:  95300  min. LT line:   5955.781  LT start line:   5954

block: 50  SLC-1 range pixel:     0  SLC-1 start line:  97205  LT range:    -0.333  LT end line:
6074.844
block: 50  SLC-1 range pixel:  4400  SLC-1 start line:  97205  LT range:  1466.333  LT end line:
6074.844
block: 50  SLC-1 start line:  97205   start LT line:   6074.844  end LT line:   6076  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 50  SLC-2R output start line:  95300  SLC-2R end line :  97205
LT start line:   5954   LT end line:   6076  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  95129  max:  97357
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0282  azimuth (rad):     0.0120
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  95600
output line:  96000
output line:  96400
output line:  96800
output line:  97200

block: 51  SLC-1 start line:  97206  SLC-1 end line:  99111  SLC-1 lines:  1906
block: 51  SLC-1 range pixel: 0  SLC-1 starting line: 97206  LT range:    -0.333  LT line: 6074.906
block: 51  SLC-1 range pixel:  4400  SLC-1 starting line: 97206  LT range:  1466.333  LT line:
6074.906
block: 51  SLC start line:  97206  min. LT line:   6074.906  LT start line:   6073

block: 51  SLC-1 range pixel:     0  SLC-1 start line:  99111  LT range:    -0.333  LT end line:
6193.969
block: 51  SLC-1 range pixel:  4400  SLC-1 start line:  99111  LT range:  1466.333  LT end line:
6193.969
block: 51  SLC-1 start line:  99111   start LT line:   6193.969  end LT line:   6195  LT lines: 123
```

```
number of range looks: 3  azimuth looks: 16

block: 51  SLC-2R output start line:  97206  SLC-2R end line :  99111
LT start line:   6073   LT end line:   6195  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  97033  max:  99261
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0264  azimuth (rad):     0.0110
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  97600
output line:  98000
output line:  98400
output line:  98800

block: 52  SLC-1 start line:  99112  SLC-1 end line: 101017  SLC-1 lines:  1906
block: 52  SLC-1 range pixel: 0  SLC-1 starting line: 99112  LT range:    -0.333  LT line: 6194.031
block: 52  SLC-1 range pixel:  4400  SLC-1 starting line: 99112  LT range:  1466.333  LT line:
6194.031
block: 52  SLC start line:  99112  min. LT line:   6194.031  LT start line:   6193

block: 52  SLC-1 range pixel:     0  SLC-1 start line: 101017  LT range:    -0.333  LT end line:
6313.094
block: 52  SLC-1 range pixel:  4400  SLC-1 start line: 101017  LT range:  1466.333  LT end line:
6313.094
block: 52  SLC-1 start line: 101017   start LT line:   6313.094  end LT line:   6315  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 52  SLC-2R output start line:  99112  SLC-2R end line : 101017
LT start line:   6193   LT end line:   6315  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  98953  max: 101181
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0236  azimuth (rad):     0.0077
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  99200
output line:  99600
output line: 100000
output line: 100400
output line: 100800

block: 53  SLC-1 start line: 101018  SLC-1 end line: 102923  SLC-1 lines:  1906
block: 53  SLC-1 range pixel: 0  SLC-1 starting line: 101018  LT range:    -0.333  LT line: 6313.156
block: 53  SLC-1 range pixel:  4400  SLC-1 starting line: 101018  LT range:  1466.333  LT line:
6313.156
block: 53  SLC start line: 101018  min. LT line:   6313.156  LT start line:   6312

block: 53  SLC-1 range pixel:     0  SLC-1 start line: 102923  LT range:    -0.333  LT end line:
6432.219
block: 53  SLC-1 range pixel:  4400  SLC-1 start line: 102923  LT range:  1466.333  LT end line:
6432.219
block: 53  SLC-1 start line: 102923   start LT line:   6432.219  end LT line:   6434  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 53  SLC-2R output start line: 101018  SLC-2R end line : 102923
LT start line:   6312   LT end line:   6434  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min: 100857  max: 103085
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0192  azimuth (rad):     0.0119
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line: 101200
output line: 101600
output line: 102000
output line: 102400
output line: 102800

block: 54  SLC-1 start line: 102924  SLC-1 end line: 104829  SLC-1 lines:  1906
block: 54  SLC-1 range pixel: 0  SLC-1 starting line: 102924  LT range:    -0.333  LT line: 6432.281
block: 54  SLC-1 range pixel:  4400  SLC-1 starting line: 102924  LT range:  1466.333  LT line:
6432.281
block: 54  SLC start line: 102924  min. LT line:   6432.281  LT start line:   6431
```

```
block: 54  SLC-1 range pixel:     0  SLC-1 start line: 104829  LT range:    -0.333  LT end line:
6551.344
block: 54  SLC-1 range pixel:  4400  SLC-1 start line: 104829  LT range:  1466.333  LT end line:
6551.344
block: 54  SLC-1 start line: 104829   start LT line:   6551.344  end LT line:   6553  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 54  SLC-2R output start line: 102924  SLC-2R end line : 104829
LT start line:   6431   LT end line:   6553  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min: 102761  max: 104989
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0189  azimuth (rad):     0.0129
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line: 103200
output line: 103600
output line: 104000
output line: 104400
output line: 104800

block: 55  SLC-1 start line: 104830  SLC-1 end line: 106735  SLC-1 lines:  1906
block: 55  SLC-1 range pixel: 0  SLC-1 starting line: 104830  LT range:    -0.333  LT line: 6551.406
block: 55  SLC-1 range pixel:  4400  SLC-1 starting line: 104830  LT range:  1466.333  LT line:
6551.406
block: 55  SLC start line: 104830  min. LT line:   6551.406  LT start line:   6550

block: 55  SLC-1 range pixel:     0  SLC-1 start line: 106735  LT range:    -0.333  LT end line:
6670.469
block: 55  SLC-1 range pixel:  4400  SLC-1 start line: 106735  LT range:  1466.333  LT end line:
6670.469
block: 55  SLC-1 start line: 106735   start LT line:   6670.469  end LT line:   6672  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 55  SLC-2R output start line: 104830  SLC-2R end line : 106735
LT start line:   6550   LT end line:   6672  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min: 104665  max: 106893
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0249  azimuth (rad):     0.0134
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line: 105200
output line: 105600
output line: 106000
output line: 106400

block: 56  SLC-1 start line: 106736  SLC-1 end line: 108641  SLC-1 lines:  1906
block: 56  SLC-1 range pixel: 0  SLC-1 starting line: 106736  LT range:    -0.333  LT line: 6670.531
block: 56  SLC-1 range pixel:  4400  SLC-1 starting line: 106736  LT range:  1466.333  LT line:
6670.531
block: 56  SLC start line: 106736  min. LT line:   6670.531  LT start line:   6669

block: 56  SLC-1 range pixel:     0  SLC-1 start line: 108641  LT range:    -0.333  LT end line:
6789.594
block: 56  SLC-1 range pixel:  4400  SLC-1 start line: 108641  LT range:  1466.333  LT end line:
6789.594
block: 56  SLC-1 start line: 108641   start LT line:   6789.594  end LT line:   6791  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 56  SLC-2R output start line: 106736  SLC-2R end line : 108641
LT start line:   6669   LT end line:   6791  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min: 106569  max: 108797
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0205  azimuth (rad):     0.0180
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line: 106800
output line: 107200
output line: 107600
output line: 108000
output line: 108400
```

```
block: 57  SLC-1 start line: 108642  SLC-1 end line: 110547  SLC-1 lines:  1906
block: 57  SLC-1 range pixel: 0  SLC-1 starting line: 108642  LT range:    -0.333  LT line: 6789.656
block: 57  SLC-1 range pixel:  4400  SLC-1 starting line: 108642  LT range:  1466.333  LT line:
6789.656
block: 57  SLC start line: 108642  min. LT line:   6789.656  LT start line:   6788

block: 57  SLC-1 range pixel:     0  SLC-1 start line: 110547  LT range:    -0.333  LT end line:
6908.719
block: 57  SLC-1 range pixel:  4400  SLC-1 start line: 110547  LT range:  1466.333  LT end line:
6908.719
block: 57  SLC-1 start line: 110547   start LT line:   6908.719  end LT line:   6910  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 57  SLC-2R output start line: 108642  SLC-2R end line : 110547
LT start line:   6788   LT end line:   6910  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min: 108473  max: 110701
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0235  azimuth (rad):     0.0204
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line: 108800
output line: 109200
output line: 109600
output line: 110000
output line: 110400

block: 58  SLC-1 start line: 110548  SLC-1 end line: 112453  SLC-1 lines:  1906
block: 58  SLC-1 range pixel: 0  SLC-1 starting line: 110548  LT range:    -0.333  LT line: 6908.781
block: 58  SLC-1 range pixel:  4400  SLC-1 starting line: 110548  LT range:  1466.333  LT line:
6908.781
block: 58  SLC start line: 110548  min. LT line:   6908.781  LT start line:   6907

block: 58  SLC-1 range pixel:     0  SLC-1 start line: 112453  LT range:    -0.333  LT end line:
7027.844
block: 58  SLC-1 range pixel:  4400  SLC-1 start line: 112453  LT range:  1466.333  LT end line:
7027.844
block: 58  SLC-1 start line: 112453   start LT line:   7027.844  end LT line:   7029  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 58  SLC-2R output start line: 110548  SLC-2R end line : 112453
LT start line:   6907   LT end line:   7029  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min: 110377  max: 112605
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0250  azimuth (rad):     0.0192
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line: 110800
output line: 111200
output line: 111600
output line: 112000
output line: 112400

block: 59  SLC-1 start line: 112454  SLC-1 end line: 113345  SLC-1 lines:   892
block: 59  SLC-1 range pixel: 0  SLC-1 starting line: 112454  LT range:    -0.333  LT line: 7027.906
block: 59  SLC-1 range pixel:  4400  SLC-1 starting line: 112454  LT range:  1466.333  LT line:
7027.906
block: 59  SLC start line: 112454  min. LT line:   7027.906  LT start line:   7026

block: 59  SLC-1 range pixel:     0  SLC-1 start line: 113345  LT range:    -0.333  LT end line:
7083.594
block: 59  SLC-1 range pixel:  4400  SLC-1 start line: 113345  LT range:  1466.333  LT end line:
7083.594
block: 59  SLC-1 start line: 113345   start LT line:   7083.594  end LT line:   7084  LT lines: 59
number of range looks: 3  azimuth looks: 16

block: 59  SLC-2R output start line: 112454  SLC-2R end line : 113345
LT start line:   7026   LT end line:   7084  lines:    59
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min: 112281  max: 113261
number of range pixels per block:  4400
number of azimuth lines per block: 981
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 981
phase gradient/sample range (rad):     0.0000  azimuth (rad):     0.0000
```

```
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line: 112800
output line: 113200

number of locations used for L.S fit for offset polynomials: 4096

range offset poly. coeff.:           1.041e+02  1.982e-03  5.434e-05
range offset poly. coeff. errors:    4.654e-03  1.399e-06  5.446e-08

azimuth offset poly. coeff.:        -2.461e+00 -1.303e-03  9.053e-06
azimuth offset poly. coeff. errors:  4.569e-03  1.373e-06  5.346e-08
offset model fit std. dev. (samples) range:   0.1141  azimuth:   0.1120

output resampled SLC parameter file: rslc_WBs2/20101028_4.rslc.par
output resampled SLC file: rslc_WBs2/20101028_4.rslc
output resampled SLC width: 4400  lines: 113346

user time (s):       327.560
system time (s):       8.420
elapsed time (s):    422.480

*** ref. SLC: rslc_WBs2/20071020_4.rslc   SLC-2: slc_WBs2/20101028_4.slc  END: Sun Apr 10 16:32:34 2011
***

./SLC_resamp_lt_all SLC_WBs2_4_tab slc_WBs2/20071020_4.slc slc_WBs2/20071020_4.slc.par
mli_WBs2/20071020_4.mli.par geo_WBs2/nz_WBs2_dem_4.rdc mli_WBs2 rslc_WBs2 RSLC_WBs2_4_tab 3 0

SLC_resamp_lt_all log file: rslc_WBs2/20071020_4_20101028_4_resamp_lt.log   mode: 3
initial SLC offset looks range: 1   azimuth: 5
resampled RSLC data directory: rslc_WBs2
reference SLC: rslc_WBs2/20071020_4.rslc
reference SLC parameters: rslc_WBs2/20071020_4.rslc.par
reference MLI: mli_WBs2//20071020_4.mli
reference MLI parameters: mli_WBs2/20071020_4.mli.par
SLC-2: slc_WBs2/20101028_4.slc
SLC-2 parameter file: slc_WBs2/20101028_4.slc.par
SLC-2 range samples: 4400   azimuth lines: 113262

MLI-2: mli_WBs2/20101028_4.mli
MLI-2 parameter file: mli_WBs2/20101028_4.mli.par

MLI-2 range samples:  1466

lookup table refinement DIFF_par: rslc_WBs2/20071020_4_20101028_4_lt0.diff_par
reference MLI image resampled into geometry of MLI-2: rslc_WBs2/20071020_4_lt0.mli
initial lookup table: rslc_WBs2/20071020_4_20101028_4.lt0
updated lookup table: rslc_WBs2/20071020_4_20101028_4.lt1
SLC offset parameter file: rslc_WBs2/20071020_4_20101028_4.off

create_offset rslc_WBs2/20071020_4.rslc.par rslc_WBs2/20101028_4.rslc.par
rslc_WBs2/20071020_4_20101028_4.off < create_offset.in
*** ISP offset/interferogram parameter file creation/update ***
*** Copyright 2006 Gamma Remote Sensing v4.8 clw/uw 14-Feb-2008 ***

SLC-1 title: ALPSRS092604500
SLC-1 Doppler centroid at center swath (Hz):      0.000
SLC-1 number of range samples:             4400
SLC-1 number of image lines:             113346
SLC-1 slant range pixel spacing (m):   9.368514
SLC-1 azimuth sample spacing (m):      3.184014

SLC-2 title: ALPSRS253644500
SLC-2 Doppler centroid at center swath (Hz):      0.000
SLC-2 number of range samples:             4400
SLC-2 number of lines:                   113346
SLC-2 slant range pixel spacing (m):   9.387084
SLC-2 azimuth sample spacing (m):      3.184003

OFFSET ALGORITHM: intensity cross-correlation

*** DEFAULT INTERFEROGRAM PARAMETERS ***
interferogram range looks:   1
interferogram azimuth looks: 1
interferogram range width pixels:   4400
interferogram azimuth lines:      113346
interferogram range pixel spacing (m):       9.36851
```

```
interferogram azimuth line spacing (m):      3.18401

interferogram/offset parameter file: rslc_WBs2/20071020_4_20101028_4.off

user time (s):         0.000
system time (s):       0.010
elapsed time (s):      0.000


offset_pwr rslc_WBs2/20071020_4.rslc rslc_WBs2/20101028_4.rslc rslc_WBs2/20071020_4.rslc.par
rslc_WBs2/20101028_4.rslc.par rslc_WBs2/20071020_4_20101028_4.off rslc_WBs2/20071020_4_20101028_4.offs
rslc_WBs2/20071020_4_20101028_4.snr
*** Offsets between SLC images using intensity cross-correlation ***
*** Copyright 2008, Gamma Remote Sensing, v3.3 18-Mar-2008 clw/uw ***
SLC-1 image: rslc_WBs2/20071020_4.rslc
SLC-2 image: rslc_WBs2/20101028_4.rslc
SLC-1 ISP image parameter file: rslc_WBs2/20071020_4.rslc.par
SLC-2 ISP image parameter file: rslc_WBs2/20101028_4.rslc.par
ISP interferogram/offset parameter file: rslc_WBs2/20071020_4_20101028_4.off
SLC format: FCOMPLEX (pairs of 4-byte float (re,im))

SLC oversampling factor: 2
initial offset estimate (range, azimuth): 0  0
offset search window sizes (range, azimuth pixels): 256  512
oversampled offset search window sizes (range, azimuth pixels): 512  1024
first range, last range, points:            48    4352      32
first az. line, last az. line, points:      48  113298      64
number of offset estimates:   2048
correlation SNR threshold:     12.000

starting lines: SLC-1: -208   SLC-2: -208  rwin: 256  azwin: 512
interp. filter bandwidth:      0.500  FIR length: 65
bp_filter: bw:  3.1416  wc:  0.0000  nfft: 512  nps: 65   Kaiser beta:   0.500
bp_filter: bw:  3.1416  wc:  0.0000  nfft: 1024  nps: 65   Kaiser beta:   0.500
average image 1 intensity:  3.570e-02  clip1:  1.785e-01
average image 2 intensity:  3.030e-02  clip2:  1.515e-01
search line:      0  offsets above SNR threshold:      0

search line:      1  SLC-1:   1845   SLC-2:   1845  azoff_init:    0  roff_init:    0
search line:      1  offsets above SNR threshold:      7

search line:      2  SLC-1:   3642   SLC-2:   3642  azoff_init:    0  roff_init:    0
search line:      2  offsets above SNR threshold:      2

search line:      3  SLC-1:   5439   SLC-2:   5439  azoff_init:    0  roff_init:    0
search line:      3  offsets above SNR threshold:      5

search line:      4  SLC-1:   7236   SLC-2:   7236  azoff_init:    0  roff_init:    0
search line:      4  offsets above SNR threshold:      4

search line:      5  SLC-1:   9033   SLC-2:   9033  azoff_init:    0  roff_init:    0
search line:      5  offsets above SNR threshold:      3

search line:      6  SLC-1:  10830   SLC-2:  10830  azoff_init:    0  roff_init:    0
search line:      6  offsets above SNR threshold:      1

search line:      7  SLC-1:  12627   SLC-2:  12627  azoff_init:    0  roff_init:    0
search line:      7  offsets above SNR threshold:      3

search line:      8  SLC-1:  14424   SLC-2:  14424  azoff_init:    0  roff_init:    0
search line:      8  offsets above SNR threshold:      9

search line:      9  SLC-1:  16221   SLC-2:  16221  azoff_init:    0  roff_init:    0
search line:      9  offsets above SNR threshold:      3

search line:     10  SLC-1:  18018   SLC-2:  18018  azoff_init:    0  roff_init:    0
search line:     10  offsets above SNR threshold:     12

search line:     11  SLC-1:  19815   SLC-2:  19815  azoff_init:    0  roff_init:    0
search line:     11  offsets above SNR threshold:      6

search line:     12  SLC-1:  21612   SLC-2:  21612  azoff_init:    0  roff_init:    0
search line:     12  offsets above SNR threshold:     11

search line:     13  SLC-1:  23409   SLC-2:  23409  azoff_init:    0  roff_init:    0
search line:     13  offsets above SNR threshold:     11
```

```
search line:     14  SLC-1:  25206   SLC-2:  25206  azoff_init:    0  roff_init:    0
search line:     14  offsets above SNR threshold:     9

search line:     15  SLC-1:  27003   SLC-2:  27003  azoff_init:    0  roff_init:    0
search line:     15  offsets above SNR threshold:     8

search line:     16  SLC-1:  28800   SLC-2:  28800  azoff_init:    0  roff_init:    0
search line:     16  offsets above SNR threshold:    12

search line:     17  SLC-1:  30597   SLC-2:  30597  azoff_init:    0  roff_init:    0
search line:     17  offsets above SNR threshold:    16

search line:     18  SLC-1:  32394   SLC-2:  32394  azoff_init:    0  roff_init:    0
search line:     18  offsets above SNR threshold:    13

search line:     19  SLC-1:  34191   SLC-2:  34191  azoff_init:    0  roff_init:    0
search line:     19  offsets above SNR threshold:     8

search line:     20  SLC-1:  35988   SLC-2:  35988  azoff_init:    0  roff_init:    0
search line:     20  offsets above SNR threshold:    17

search line:     21  SLC-1:  37785   SLC-2:  37785  azoff_init:    0  roff_init:    0
search line:     21  offsets above SNR threshold:    25

search line:     22  SLC-1:  39582   SLC-2:  39582  azoff_init:    0  roff_init:    0
search line:     22  offsets above SNR threshold:    22

search line:     23  SLC-1:  41379   SLC-2:  41379  azoff_init:    0  roff_init:    0
search line:     23  offsets above SNR threshold:    18

search line:     24  SLC-1:  43176   SLC-2:  43176  azoff_init:    0  roff_init:    0
search line:     24  offsets above SNR threshold:    21

search line:     25  SLC-1:  44973   SLC-2:  44973  azoff_init:    0  roff_init:    0
search line:     25  offsets above SNR threshold:    18

search line:     26  SLC-1:  46770   SLC-2:  46770  azoff_init:    0  roff_init:    0
search line:     26  offsets above SNR threshold:    18

search line:     27  SLC-1:  48567   SLC-2:  48567  azoff_init:    0  roff_init:    0
search line:     27  offsets above SNR threshold:    11

search line:     28  SLC-1:  50364   SLC-2:  50364  azoff_init:    0  roff_init:    0
search line:     28  offsets above SNR threshold:    18

search line:     29  SLC-1:  52161   SLC-2:  52161  azoff_init:    0  roff_init:    0
search line:     29  offsets above SNR threshold:    17

search line:     30  SLC-1:  53958   SLC-2:  53958  azoff_init:    0  roff_init:    0
search line:     30  offsets above SNR threshold:    23

search line:     31  SLC-1:  55755   SLC-2:  55755  azoff_init:    0  roff_init:    0
search line:     31  offsets above SNR threshold:    23

search line:     32  SLC-1:  57552   SLC-2:  57552  azoff_init:    0  roff_init:    0
search line:     32  offsets above SNR threshold:    10

search line:     33  SLC-1:  59349   SLC-2:  59349  azoff_init:    0  roff_init:    0
search line:     33  offsets above SNR threshold:    24

search line:     34  SLC-1:  61146   SLC-2:  61146  azoff_init:    0  roff_init:    0
search line:     34  offsets above SNR threshold:    14

search line:     35  SLC-1:  62943   SLC-2:  62943  azoff_init:    0  roff_init:    0
search line:     35  offsets above SNR threshold:    21

search line:     36  SLC-1:  64740   SLC-2:  64740  azoff_init:    0  roff_init:    0
search line:     36  offsets above SNR threshold:    25

search line:     37  SLC-1:  66537   SLC-2:  66537  azoff_init:    0  roff_init:    0
search line:     37  offsets above SNR threshold:    23

search line:     38  SLC-1:  68334   SLC-2:  68334  azoff_init:    0  roff_init:    0
search line:     38  offsets above SNR threshold:    21

search line:     39  SLC-1:  70131   SLC-2:  70131  azoff_init:    0  roff_init:    0
search line:     39  offsets above SNR threshold:    14
```

```
search line:     40  SLC-1:  71928   SLC-2:  71928  azoff_init:    0  roff_init:    0
search line:     40  offsets above SNR threshold:     20

search line:     41  SLC-1:  73725   SLC-2:  73725  azoff_init:    0  roff_init:    0
search line:     41  offsets above SNR threshold:     14

search line:     42  SLC-1:  75522   SLC-2:  75522  azoff_init:    0  roff_init:    0
search line:     42  offsets above SNR threshold:     11

search line:     43  SLC-1:  77319   SLC-2:  77319  azoff_init:    0  roff_init:    0
search line:     43  offsets above SNR threshold:     12

search line:     44  SLC-1:  79116   SLC-2:  79116  azoff_init:    0  roff_init:    0
search line:     44  offsets above SNR threshold:     11

search line:     45  SLC-1:  80913   SLC-2:  80913  azoff_init:    0  roff_init:    0
search line:     45  offsets above SNR threshold:      5

search line:     46  SLC-1:  82710   SLC-2:  82710  azoff_init:    0  roff_init:    0
search line:     46  offsets above SNR threshold:      4

search line:     47  SLC-1:  84507   SLC-2:  84507  azoff_init:    0  roff_init:    0
search line:     47  offsets above SNR threshold:      5

search line:     48  SLC-1:  86304   SLC-2:  86304  azoff_init:    0  roff_init:    0
search line:     48  offsets above SNR threshold:      4

search line:     49  SLC-1:  88101   SLC-2:  88101  azoff_init:    0  roff_init:    0
search line:     49  offsets above SNR threshold:      1

search line:     50  SLC-1:  89898   SLC-2:  89898  azoff_init:    0  roff_init:    0
search line:     50  offsets above SNR threshold:      0

search line:     51  SLC-1:  91695   SLC-2:  91695  azoff_init:    0  roff_init:    0
search line:     51  offsets above SNR threshold:      2

search line:     52  SLC-1:  93492   SLC-2:  93492  azoff_init:    0  roff_init:    0
search line:     52  offsets above SNR threshold:      0

search line:     53  SLC-1:  95289   SLC-2:  95289  azoff_init:    0  roff_init:    0
search line:     53  offsets above SNR threshold:      0

search line:     54  SLC-1:  97086   SLC-2:  97086  azoff_init:    0  roff_init:    0
search line:     54  offsets above SNR threshold:      0

search line:     55  SLC-1:  98883   SLC-2:  98883  azoff_init:    0  roff_init:    0
search line:     55  offsets above SNR threshold:      0

search line:     56  SLC-1: 100680   SLC-2: 100680  azoff_init:    0  roff_init:    0
search line:     56  offsets above SNR threshold:      0

search line:     57  SLC-1: 102477   SLC-2: 102477  azoff_init:    0  roff_init:    0
search line:     57  offsets above SNR threshold:      0

search line:     58  SLC-1: 104274   SLC-2: 104274  azoff_init:    0  roff_init:    0
search line:     58  offsets above SNR threshold:      0

search line:     59  SLC-1: 106071   SLC-2: 106071  azoff_init:    0  roff_init:    0
search line:     59  offsets above SNR threshold:      0

search line:     60  SLC-1: 107868   SLC-2: 107868  azoff_init:    0  roff_init:    0
search line:     60  offsets above SNR threshold:      0

search line:     61  SLC-1: 109665   SLC-2: 109665  azoff_init:    0  roff_init:    0
search line:     61  offsets above SNR threshold:      0

search line:     62  SLC-1: 111462   SLC-2: 111462  azoff_init:    0  roff_init:    0
search line:     62  offsets above SNR threshold:      0
search line:     63  offsets above SNR threshold:      0

number of offsets above SNR threshold: 615 of 2048
output binary offset file: rslc_WBs2/20071020_4_20101028_4.offs
output binary SNR file: rslc_WBs2/20071020_4_20101028_4.snr
writing OFF_par file: rslc_WBs2/20071020_4_20101028_4.off

user time (s):       269.000
```

```
system time (s):       2.870
elapsed time (s):    372.340


offset_fit rslc_WBs2/20071020_4_20101028_4.offs rslc_WBs2/20071020_4_20101028_4.snr
rslc_WBs2/20071020_4_20101028_4.off rslc_WBs2/20071020_4_20101028_4.coffs - - 3
*** Range and azimuth offset polynomial estimation ***
*** Copyright 2011, Gamma Remote Sensing, v3.2 11-Apr-2011 clw/uw ***
offsets: rslc_WBs2/20071020_4_20101028_4.offs
SNR data: rslc_WBs2/20071020_4_20101028_4.snr
ISP offset parameters: rslc_WBs2/20071020_4_20101028_4.off
culled offsets (fcomplex): rslc_WBs2/20071020_4_20101028_4.coffs

number of offset polynomial parameters: 3: a0 + a1*x + a2*y
number of range samples: 32  number of azimuth samples: 64
number of samples in offset map: 2048
range sample spacing: 138  azimuth sample spacing: 1797
solution: 615 offset estimates accepted out of 2048 samples

range fit SVD singular values:        2.36997e+07   1.42486e+02   4.86342e+05
azimuth fit SVD singular values:      2.36997e+07   1.42486e+02   4.86342e+05
range offset poly. coeff.:                0.08979   1.02148e-05  -1.45687e-06
azimuth offset poly. coeff.:              0.14272   1.19604e-04   1.02549e-05
model fit std. dev. (samples) range:   0.2848  azimuth:   3.1003
range, azimuth error thresholds:     0.7120     7.7508
SNR threshold:    12.0000

range fit SVD singular values:        2.34735e+07   1.41327e+02   4.84239e+05
azimuth fit SVD singular values:      2.34735e+07   1.41327e+02   4.84239e+05

*** improved least-squares polynomial coefficients 1 ***
solution: 609 offset estimates accepted out of 2048 samples
range offset poly. coeff.:                0.02692   1.11381e-05   3.48751e-08
azimuth offset poly. coeff.:              0.55866   1.57422e-05   4.95120e-06
model fit std. dev. (samples) range:   0.0908  azimuth:   0.8815
range, azimuth error thresholds:     0.2269     2.2037
SNR threshold:    12.0000

range fit SVD singular values:        2.27188e+07   1.38351e+02   4.72172e+05
azimuth fit SVD singular values:      2.27188e+07   1.38351e+02   4.72172e+05

*** improved least-squares polynomial coefficients 2 ***
solution: 574 offset estimates accepted out of 2048 samples
range offset poly. coeff.:                0.03894   1.06704e-05  -1.54307e-07
azimuth offset poly. coeff.:              0.43898   6.76258e-05   6.46395e-06
model fit std. dev. (samples) range:   0.0661  azimuth:   0.4805
range, azimuth error thresholds:     0.1653     1.2013
SNR threshold:    12.0000

range fit SVD singular values:        2.21004e+07   1.35942e+02   4.46796e+05
azimuth fit SVD singular values:      2.21004e+07   1.35942e+02   4.46796e+05

*** improved least-squares polynomial coefficients 3 ***
solution: 535 offset estimates accepted out of 2048 samples
range offset poly. coeff.:                0.04144   9.18597e-06  -1.59736e-07
azimuth offset poly. coeff.:              0.45536   9.76755e-05   5.30165e-06
model fit std. dev. (samples) range:   0.0587  azimuth:   0.3255
range, azimuth error thresholds:     0.1467     0.8139
SNR threshold:    12.0000

range fit SVD singular values:        2.17473e+07   1.34013e+02   4.36688e+05
azimuth fit SVD singular values:      2.17473e+07   1.34013e+02   4.36688e+05

*** improved least-squares polynomial coefficients 4 ***
solution: 515 offset estimates accepted out of 2048 samples
range offset poly. coeff.:                0.03956   9.75023e-06  -1.10963e-07
azimuth offset poly. coeff.:              0.46717   1.05898e-04   4.81165e-06
model fit std. dev. (samples) range:   0.0552  azimuth:   0.2932
range, azimuth error thresholds:     0.1379     0.7331
SNR threshold:    12.0000

range fit SVD singular values:        2.15807e+07   1.32719e+02   4.30945e+05
azimuth fit SVD singular values:      2.15807e+07   1.32719e+02   4.30945e+05

*** improved least-squares polynomial coefficients 5 ***
solution: 503 offset estimates accepted out of 2048 samples
range offset poly. coeff.:                0.03830   9.15714e-06  -5.36484e-08
```

```
azimuth offset poly. coeff.:              0.48026   1.01712e-04   4.69086e-06
model fit std. dev. (samples) range:   0.0539  azimuth:   0.2782
range, azimuth error thresholds:     0.1349     0.6954
SNR threshold:    12.0000

range fit SVD singular values:        2.13768e+07   1.30151e+02   4.25564e+05
azimuth fit SVD singular values:      2.13768e+07   1.30151e+02   4.25564e+05

*** improved least-squares polynomial coefficients 6 ***
solution: 490 offset estimates accepted out of 2048 samples
range offset poly. coeff.:                0.03513   8.41417e-06   5.41674e-08
azimuth offset poly. coeff.:              0.49438   1.02182e-04   4.36197e-06
model fit std. dev. (samples) range:   0.0516  azimuth:   0.2642
range, azimuth error thresholds:     0.1290     0.6605
SNR threshold:    12.0000

range fit SVD singular values:        2.10423e+07   1.28450e+02   4.13849e+05
azimuth fit SVD singular values:      2.10423e+07   1.28450e+02   4.13849e+05

*** improved least-squares polynomial coefficients 7 ***
solution: 474 offset estimates accepted out of 2048 samples
range offset poly. coeff.:                0.03263   9.69345e-06   7.80753e-08
azimuth offset poly. coeff.:              0.51539   1.05985e-04   3.88186e-06
model fit std. dev. (samples) range:   0.0494  azimuth:   0.2490
range, azimuth error thresholds:     0.1234     0.6224
SNR threshold:    12.0000

range fit SVD singular values:        2.08560e+07   1.27689e+02   4.05514e+05
azimuth fit SVD singular values:      2.08560e+07   1.27689e+02   4.05514e+05

*** improved least-squares polynomial coefficients 8 ***
solution: 465 offset estimates accepted out of 2048 samples
range offset poly. coeff.:                0.03089   1.00706e-05   8.69158e-08
azimuth offset poly. coeff.:              0.51784   1.15152e-04   3.58588e-06
model fit std. dev. (samples) range:   0.0480  azimuth:   0.2415

total number of culling iterations: 8
final solution: 465 offset estimates accepted out of 2048 samples

final range offset poly. coeff.:              0.03089   1.00706e-05   8.69158e-08
final range offset poly. coeff. errors:   3.75687e-04   1.20183e-07   7.59361e-09

final azimuth offset poly. coeff.:              0.51784   1.15152e-04   3.58588e-06
final azimuth offset poly. coeff. errors:   1.89141e-03   6.05064e-07   3.82303e-08

final model fit std. dev. (samples) range:   0.0480  azimuth:   0.2415

binary culled offsets: rslc_WBs2/20071020_4_20101028_4.coffs
updating ISP offset parameters: rslc_WBs2/20071020_4_20101028_4.off

user time (s):         0.010
system time (s):       0.000
elapsed time (s):      0.000

*** ref. SLC: rslc_WBs2/20071020_4.rslc   SLC-2: slc_WBs2/20101028_4.slc  END: Sun Apr 10 20:00:40 2011
***

./SLC_resamp_lt_all SLC_WBs2_4_tab slc_WBs2/20071020_4.slc slc_WBs2/20071020_4.slc.par
mli_WBs2/20071020_4.mli.par geo_WBs2/nz_WBs2_dem_4.rdc mli_WBs2 rslc_WBs2 RSLC_WBs2_4_tab 4 0

SLC_resamp_lt_all log file: rslc_WBs2/20071020_4_20101028_4_resamp_lt.log   mode: 4
initial SLC offset looks range: 1   azimuth: 5
resampled RSLC data directory: rslc_WBs2
reference SLC: rslc_WBs2/20071020_4.rslc
reference SLC parameters: rslc_WBs2/20071020_4.rslc.par
reference MLI: mli_WBs2//20071020_4.mli
reference MLI parameters: mli_WBs2/20071020_4.mli.par
SLC-2: slc_WBs2/20101028_4.slc
SLC-2 parameter file: slc_WBs2/20101028_4.slc.par
SLC-2 range samples: 4400   azimuth lines: 113262

MLI-2: mli_WBs2/20101028_4.mli
MLI-2 parameter file: mli_WBs2/20101028_4.mli.par

MLI-2 range samples:  1466

lookup table refinement DIFF_par: rslc_WBs2/20071020_4_20101028_4_lt0.diff_par
```

```
reference MLI image resampled into geometry of MLI-2: rslc_WBs2/20071020_4_lt0.mli
initial lookup table: rslc_WBs2/20071020_4_20101028_4.lt0
updated lookup table: rslc_WBs2/20071020_4_20101028_4.lt1
SLC offset parameter file: rslc_WBs2/20071020_4_20101028_4.off

SLC_interp_lt slc_WBs2/20101028_4.slc rslc_WBs2/20071020_4.rslc.par slc_WBs2/20101028_4.slc.par
rslc_WBs2/20071020_4_20101028_4.lt1 mli_WBs2/20071020_4.mli.par mli_WBs2/20101028_4.mli.par
rslc_WBs2/20071020_4_20101028_4.off rslc_WBs2/20101028_4.rslc rslc_WBs2/20101028_4.rslc.par
*** SLC image resampling via a lookup table and SINC interpolation ***
*** Copyright 2008, Gamma Remote Sensing, v1.7 28-Nov-2008 clw ***

SLC-2 image: slc_WBs2/20101028_4.slc
SLC-1 ISP image parameter file: rslc_WBs2/20071020_4.rslc.par
SLC-2 ISP image parameter file: slc_WBs2/20101028_4.slc.par
input lookup table: rslc_WBs2/20071020_4_20101028_4.lt1
SLC/MLI ISP image parameter file of reference MLI (lookup table dimension): mli_WBs2/20071020_4.mli.par
SLC/MLI ISP image parameter file of MLI2 (lookup table values): mli_WBs2/20101028_4.mli.par
ISP offset parameter file used for refinement: rslc_WBs2/20071020_4_20101028_4.off
SLC format: FCOMPLEX
number of offset sample points for polynomial estimation: 4096
number of offset sample points for polynomial estimation: 9

lookup table size range:  1466  azimuth: 7084
lookup table looks range: 3  azimuth: 16
number of SLC data blocks: 60  lines/block: 1906
range and azimuth offset range increment: 69  azimuth increment: 1772

SLC-1, SLC-2 PARAMETERS:
SLC-1 range samples:   4400
SLC-1 azimuth lines: 113346
SLC-1 range pixel size (m):      9.36851
SLC-1 azimuth pixel size (m):    3.18401

SLC-2 range samples:   4400
SLC-2 azimuth lines: 113262
resampled SLC-2 width (samples):   4400
resampled SLC-2 lines: 113346

block:  0  SLC-1 start line:      0  SLC-1 end line:   1905  SLC-1 lines:  1906
block:  0  SLC-1 range pixel: 0  SLC-1 starting line: 0  LT range:    -0.333  LT line:   -0.469
block:  0  SLC-1 range pixel:  4400  SLC-1 starting line: 0  LT range:  1466.333  LT line:    -0.469
block:  0  SLC start line:      0  min. LT line:     -0.469  LT start line:      0

block:  0  SLC-1 range pixel:     0  SLC-1 start line:   1905  LT range:    -0.333  LT end line:
118.594
block:  0  SLC-1 range pixel:  4400  SLC-1 start line:   1905  LT range:  1466.333  LT end line:
118.594
block:  0  SLC-1 start line:   1905   start LT line:    118.594  end LT line:    120  LT lines: 121
number of range looks: 3  azimuth looks: 16

block:  0  SLC-2R output start line:      0  SLC-2R end line :   1905
LT start line:      0   LT end line:    120  lines:   121
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:      0  max:   2061
number of range pixels per block:  4400
number of azimuth lines per block: 2062
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0418  azimuth (rad):     0.0339
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:      0
output line:    400
output line:    800
output line:   1200
output line:   1600

block:  1  SLC-1 start line:   1906  SLC-1 end line:   3811  SLC-1 lines:  1906
block:  1  SLC-1 range pixel: 0  SLC-1 starting line: 1906  LT range:    -0.333  LT line:  118.656
block:  1  SLC-1 range pixel:  4400  SLC-1 starting line: 1906  LT range:  1466.333  LT line:   118.656
block:  1  SLC start line:   1906  min. LT line:    118.656  LT start line:    117

block:  1  SLC-1 range pixel:     0  SLC-1 start line:   3811  LT range:    -0.333  LT end line:
237.719
block:  1  SLC-1 range pixel:  4400  SLC-1 start line:   3811  LT range:  1466.333  LT end line:
237.719
block:  1  SLC-1 start line:   3811   start LT line:    237.719  end LT line:    239  LT lines: 123
number of range looks: 3  azimuth looks: 16
```

```
block:  1  SLC-2R output start line:   1906  SLC-2R end line :   3811
LT start line:    117   LT end line:    239  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:   1736  max:   3965
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0349  azimuth (rad):     0.0300
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:   2000
output line:   2400
output line:   2800
output line:   3200
output line:   3600

block:  2  SLC-1 start line:   3812  SLC-1 end line:   5717  SLC-1 lines:  1906
block:  2  SLC-1 range pixel: 0  SLC-1 starting line: 3812  LT range:    -0.333  LT line:  237.781
block:  2  SLC-1 range pixel:  4400  SLC-1 starting line: 3812  LT range:  1466.333  LT line:   237.781
block:  2  SLC start line:   3812  min. LT line:    237.781  LT start line:    236

block:  2  SLC-1 range pixel:     0  SLC-1 start line:   5717  LT range:    -0.333  LT end line:
356.844
block:  2  SLC-1 range pixel:  4400  SLC-1 start line:   5717  LT range:  1466.333  LT end line:
356.844
block:  2  SLC-1 start line:   5717   start LT line:    356.844  end LT line:    358  LT lines: 123
number of range looks: 3  azimuth looks: 16

block:  2  SLC-2R output start line:   3812  SLC-2R end line :   5717
LT start line:    236   LT end line:    358  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:   3640  max:   5869
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0392  azimuth (rad):     0.0221
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:   4000
output line:   4400
output line:   4800
output line:   5200
output line:   5600

block:  3  SLC-1 start line:   5718  SLC-1 end line:   7623  SLC-1 lines:  1906
block:  3  SLC-1 range pixel: 0  SLC-1 starting line: 5718  LT range:    -0.333  LT line:  356.906
block:  3  SLC-1 range pixel:  4400  SLC-1 starting line: 5718  LT range:  1466.333  LT line:   356.906
block:  3  SLC start line:   5718  min. LT line:    356.906  LT start line:    355

block:  3  SLC-1 range pixel:     0  SLC-1 start line:   7623  LT range:    -0.333  LT end line:
475.969
block:  3  SLC-1 range pixel:  4400  SLC-1 start line:   7623  LT range:  1466.333  LT end line:
475.969
block:  3  SLC-1 start line:   7623   start LT line:    475.969  end LT line:    477  LT lines: 123
number of range looks: 3  azimuth looks: 16

block:  3  SLC-2R output start line:   5718  SLC-2R end line :   7623
LT start line:    355   LT end line:    477  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:   5544  max:   7773
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0271  azimuth (rad):     0.0136
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:   6000
output line:   6400
output line:   6800
output line:   7200
output line:   7600

block:  4  SLC-1 start line:   7624  SLC-1 end line:   9529  SLC-1 lines:  1906
block:  4  SLC-1 range pixel: 0  SLC-1 starting line: 7624  LT range:    -0.333  LT line:  476.031
block:  4  SLC-1 range pixel:  4400  SLC-1 starting line: 7624  LT range:  1466.333  LT line:   476.031
block:  4  SLC start line:   7624  min. LT line:    476.031  LT start line:    475

block:  4  SLC-1 range pixel:     0  SLC-1 start line:   9529  LT range:    -0.333  LT end line:
595.094
block:  4  SLC-1 range pixel:  4400  SLC-1 start line:   9529  LT range:  1466.333  LT end line:
```

```
595.094
block:  4  SLC-1 start line:   9529   start LT line:    595.094  end LT line:    597  LT lines: 123
number of range looks: 3  azimuth looks: 16

block:  4  SLC-2R output start line:   7624  SLC-2R end line :   9529
LT start line:    475   LT end line:    597  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:   7464  max:   9693
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0224  azimuth (rad):     0.0200
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:   8000
output line:   8400
output line:   8800
output line:   9200

block:  5  SLC-1 start line:   9530  SLC-1 end line:  11435  SLC-1 lines:  1906
block:  5  SLC-1 range pixel: 0  SLC-1 starting line: 9530  LT range:    -0.333  LT line:  595.156
block:  5  SLC-1 range pixel:  4400  SLC-1 starting line: 9530  LT range:  1466.333  LT line:   595.156
block:  5  SLC start line:   9530  min. LT line:    595.156  LT start line:    594

block:  5  SLC-1 range pixel:     0  SLC-1 start line:  11435  LT range:    -0.333  LT end line:
714.219
block:  5  SLC-1 range pixel:  4400  SLC-1 start line:  11435  LT range:  1466.333  LT end line:
714.219
block:  5  SLC-1 start line:  11435   start LT line:    714.219  end LT line:    716  LT lines: 123
number of range looks: 3  azimuth looks: 16

block:  5  SLC-2R output start line:   9530  SLC-2R end line :  11435
LT start line:    594   LT end line:    716  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:   9368  max:  11597
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0170  azimuth (rad):     0.0077
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:   9600
output line:  10000
output line:  10400
output line:  10800
output line:  11200

block:  6  SLC-1 start line:  11436  SLC-1 end line:  13341  SLC-1 lines:  1906
block:  6  SLC-1 range pixel: 0  SLC-1 starting line: 11436  LT range:    -0.333  LT line:  714.281
block:  6  SLC-1 range pixel:  4400  SLC-1 starting line: 11436  LT range:  1466.333  LT line:
714.281
block:  6  SLC start line:  11436  min. LT line:    714.281  LT start line:    713

block:  6  SLC-1 range pixel:     0  SLC-1 start line:  13341  LT range:    -0.333  LT end line:
833.344
block:  6  SLC-1 range pixel:  4400  SLC-1 start line:  13341  LT range:  1466.333  LT end line:
833.344
block:  6  SLC-1 start line:  13341   start LT line:    833.344  end LT line:    835  LT lines: 123
number of range looks: 3  azimuth looks: 16

block:  6  SLC-2R output start line:  11436  SLC-2R end line :  13341
LT start line:    713   LT end line:    835  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  11272  max:  13501
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0164  azimuth (rad):     0.0130
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  11600
output line:  12000
output line:  12400
output line:  12800
output line:  13200

block:  7  SLC-1 start line:  13342  SLC-1 end line:  15247  SLC-1 lines:  1906
block:  7  SLC-1 range pixel: 0  SLC-1 starting line: 13342  LT range:    -0.333  LT line:  833.406
block:  7  SLC-1 range pixel:  4400  SLC-1 starting line: 13342  LT range:  1466.333  LT line:
833.406
```

```
block:  7  SLC start line:  13342  min. LT line:    833.406  LT start line:    832

block:  7  SLC-1 range pixel:     0  SLC-1 start line:  15247  LT range:    -0.333  LT end line:
952.469
block:  7  SLC-1 range pixel:  4400  SLC-1 start line:  15247  LT range:  1466.333  LT end line:
952.469
block:  7  SLC-1 start line:  15247   start LT line:    952.469  end LT line:    954  LT lines: 123
number of range looks: 3  azimuth looks: 16

block:  7  SLC-2R output start line:  13342  SLC-2R end line :  15247
LT start line:    832   LT end line:    954  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  13176  max:  15405
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0162  azimuth (rad):     0.0332
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  13600
output line:  14000
output line:  14400
output line:  14800
output line:  15200

block:  8  SLC-1 start line:  15248  SLC-1 end line:  17153  SLC-1 lines:  1906
block:  8  SLC-1 range pixel: 0  SLC-1 starting line: 15248  LT range:    -0.333  LT line:  952.531
block:  8  SLC-1 range pixel:  4400  SLC-1 starting line: 15248  LT range:  1466.333  LT line:
952.531
block:  8  SLC start line:  15248  min. LT line:    952.531  LT start line:    951

block:  8  SLC-1 range pixel:     0  SLC-1 start line:  17153  LT range:    -0.333  LT end line:
1071.594
block:  8  SLC-1 range pixel:  4400  SLC-1 start line:  17153  LT range:  1466.333  LT end line:
1071.594
block:  8  SLC-1 start line:  17153   start LT line:   1071.594  end LT line:   1073  LT lines: 123
number of range looks: 3  azimuth looks: 16

block:  8  SLC-2R output start line:  15248  SLC-2R end line :  17153
LT start line:    951   LT end line:   1073  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  15080  max:  17309
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0321  azimuth (rad):     0.0246
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  15600
output line:  16000
output line:  16400
output line:  16800

block:  9  SLC-1 start line:  17154  SLC-1 end line:  19059  SLC-1 lines:  1906
block:  9  SLC-1 range pixel: 0  SLC-1 starting line: 17154  LT range:    -0.333  LT line: 1071.656
block:  9  SLC-1 range pixel:  4400  SLC-1 starting line: 17154  LT range:  1466.333  LT line:
1071.656
block:  9  SLC start line:  17154  min. LT line:   1071.656  LT start line:   1070

block:  9  SLC-1 range pixel:     0  SLC-1 start line:  19059  LT range:    -0.333  LT end line:
1190.719
block:  9  SLC-1 range pixel:  4400  SLC-1 start line:  19059  LT range:  1466.333  LT end line:
1190.719
block:  9  SLC-1 start line:  19059   start LT line:   1190.719  end LT line:   1192  LT lines: 123
number of range looks: 3  azimuth looks: 16

block:  9  SLC-2R output start line:  17154  SLC-2R end line :  19059
LT start line:   1070   LT end line:   1192  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  16984  max:  19213
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0079  azimuth (rad):     0.0512
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  17200
output line:  17600
output line:  18000
output line:  18400
```

```
output line:  18800

block: 10  SLC-1 start line:  19060  SLC-1 end line:  20965  SLC-1 lines:  1906
block: 10  SLC-1 range pixel: 0  SLC-1 starting line: 19060  LT range:    -0.333  LT line: 1190.781
block: 10  SLC-1 range pixel:  4400  SLC-1 starting line: 19060  LT range:  1466.333  LT line:
1190.781
block: 10  SLC start line:  19060  min. LT line:   1190.781  LT start line:   1189

block: 10  SLC-1 range pixel:     0  SLC-1 start line:  20965  LT range:    -0.333  LT end line:
1309.844
block: 10  SLC-1 range pixel:  4400  SLC-1 start line:  20965  LT range:  1466.333  LT end line:
1309.844
block: 10  SLC-1 start line:  20965   start LT line:   1309.844  end LT line:   1311  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 10  SLC-2R output start line:  19060  SLC-2R end line :  20965
LT start line:   1189   LT end line:   1311  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  18888  max:  21117
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0176  azimuth (rad):     0.0523
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  19200
output line:  19600
output line:  20000
output line:  20400
output line:  20800

block: 11  SLC-1 start line:  20966  SLC-1 end line:  22871  SLC-1 lines:  1906
block: 11  SLC-1 range pixel: 0  SLC-1 starting line: 20966  LT range:    -0.333  LT line: 1309.906
block: 11  SLC-1 range pixel:  4400  SLC-1 starting line: 20966  LT range:  1466.333  LT line:
1309.906
block: 11  SLC start line:  20966  min. LT line:   1309.906  LT start line:   1308

block: 11  SLC-1 range pixel:     0  SLC-1 start line:  22871  LT range:    -0.333  LT end line:
1428.969
block: 11  SLC-1 range pixel:  4400  SLC-1 start line:  22871  LT range:  1466.333  LT end line:
1428.969
block: 11  SLC-1 start line:  22871   start LT line:   1428.969  end LT line:   1430  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 11  SLC-2R output start line:  20966  SLC-2R end line :  22871
LT start line:   1308   LT end line:   1430  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  20792  max:  23021
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0363  azimuth (rad):     0.0433
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  21200
output line:  21600
output line:  22000
output line:  22400
output line:  22800

block: 12  SLC-1 start line:  22872  SLC-1 end line:  24777  SLC-1 lines:  1906
block: 12  SLC-1 range pixel: 0  SLC-1 starting line: 22872  LT range:    -0.333  LT line: 1429.031
block: 12  SLC-1 range pixel:  4400  SLC-1 starting line: 22872  LT range:  1466.333  LT line:
1429.031
block: 12  SLC start line:  22872  min. LT line:   1429.031  LT start line:   1428

block: 12  SLC-1 range pixel:     0  SLC-1 start line:  24777  LT range:    -0.333  LT end line:
1548.094
block: 12  SLC-1 range pixel:  4400  SLC-1 start line:  24777  LT range:  1466.333  LT end line:
1548.094
block: 12  SLC-1 start line:  24777   start LT line:   1548.094  end LT line:   1550  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 12  SLC-2R output start line:  22872  SLC-2R end line :  24777
LT start line:   1428   LT end line:   1550  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  22712  max:  24941
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
```

```
phase gradient/sample range (rad):    -0.0105  azimuth (rad):     0.0363
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  23200
output line:  23600
output line:  24000
output line:  24400

block: 13  SLC-1 start line:  24778  SLC-1 end line:  26683  SLC-1 lines:  1906
block: 13  SLC-1 range pixel: 0  SLC-1 starting line: 24778  LT range:    -0.333  LT line: 1548.156
block: 13  SLC-1 range pixel:  4400  SLC-1 starting line: 24778  LT range:  1466.333  LT line:
1548.156
block: 13  SLC start line:  24778  min. LT line:   1548.156  LT start line:   1547

block: 13  SLC-1 range pixel:     0  SLC-1 start line:  26683  LT range:    -0.333  LT end line:
1667.219
block: 13  SLC-1 range pixel:  4400  SLC-1 start line:  26683  LT range:  1466.333  LT end line:
1667.219
block: 13  SLC-1 start line:  26683   start LT line:   1667.219  end LT line:   1669  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 13  SLC-2R output start line:  24778  SLC-2R end line :  26683
LT start line:   1547   LT end line:   1669  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  24616  max:  26845
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0329  azimuth (rad):     0.0254
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  24800
output line:  25200
output line:  25600
output line:  26000
output line:  26400

block: 14  SLC-1 start line:  26684  SLC-1 end line:  28589  SLC-1 lines:  1906
block: 14  SLC-1 range pixel: 0  SLC-1 starting line: 26684  LT range:    -0.333  LT line: 1667.281
block: 14  SLC-1 range pixel:  4400  SLC-1 starting line: 26684  LT range:  1466.333  LT line:
1667.281
block: 14  SLC start line:  26684  min. LT line:   1667.281  LT start line:   1666

block: 14  SLC-1 range pixel:     0  SLC-1 start line:  28589  LT range:    -0.333  LT end line:
1786.344
block: 14  SLC-1 range pixel:  4400  SLC-1 start line:  28589  LT range:  1466.333  LT end line:
1786.344
block: 14  SLC-1 start line:  28589   start LT line:   1786.344  end LT line:   1788  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 14  SLC-2R output start line:  26684  SLC-2R end line :  28589
LT start line:   1666   LT end line:   1788  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  26520  max:  28749
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0219  azimuth (rad):     0.0250
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  26800
output line:  27200
output line:  27600
output line:  28000
output line:  28400

block: 15  SLC-1 start line:  28590  SLC-1 end line:  30495  SLC-1 lines:  1906
block: 15  SLC-1 range pixel: 0  SLC-1 starting line: 28590  LT range:    -0.333  LT line: 1786.406
block: 15  SLC-1 range pixel:  4400  SLC-1 starting line: 28590  LT range:  1466.333  LT line:
1786.406
block: 15  SLC start line:  28590  min. LT line:   1786.406  LT start line:   1785

block: 15  SLC-1 range pixel:     0  SLC-1 start line:  30495  LT range:    -0.333  LT end line:
1905.469
block: 15  SLC-1 range pixel:  4400  SLC-1 start line:  30495  LT range:  1466.333  LT end line:
1905.469
block: 15  SLC-1 start line:  30495   start LT line:   1905.469  end LT line:   1907  LT lines: 123
number of range looks: 3  azimuth looks: 16
```

```
block: 15  SLC-2R output start line:  28590  SLC-2R end line :  30495
LT start line:   1785   LT end line:   1907  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  28424  max:  30653
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0195  azimuth (rad):     0.0306
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  28800
output line:  29200
output line:  29600
output line:  30000
output line:  30400

block: 16  SLC-1 start line:  30496  SLC-1 end line:  32401  SLC-1 lines:  1906
block: 16  SLC-1 range pixel: 0  SLC-1 starting line: 30496  LT range:    -0.333  LT line: 1905.531
block: 16  SLC-1 range pixel:  4400  SLC-1 starting line: 30496  LT range:  1466.333  LT line:
1905.531
block: 16  SLC start line:  30496  min. LT line:   1905.531  LT start line:   1904

block: 16  SLC-1 range pixel:     0  SLC-1 start line:  32401  LT range:    -0.333  LT end line:
2024.594
block: 16  SLC-1 range pixel:  4400  SLC-1 start line:  32401  LT range:  1466.333  LT end line:
2024.594
block: 16  SLC-1 start line:  32401   start LT line:   2024.594  end LT line:   2026  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 16  SLC-2R output start line:  30496  SLC-2R end line :  32401
LT start line:   1904   LT end line:   2026  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  30328  max:  32557
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0177  azimuth (rad):     0.0262
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  30800
output line:  31200
output line:  31600
output line:  32000
output line:  32400

block: 17  SLC-1 start line:  32402  SLC-1 end line:  34307  SLC-1 lines:  1906
block: 17  SLC-1 range pixel: 0  SLC-1 starting line: 32402  LT range:    -0.333  LT line: 2024.656
block: 17  SLC-1 range pixel:  4400  SLC-1 starting line: 32402  LT range:  1466.333  LT line:
2024.656
block: 17  SLC start line:  32402  min. LT line:   2024.656  LT start line:   2023

block: 17  SLC-1 range pixel:     0  SLC-1 start line:  34307  LT range:    -0.333  LT end line:
2143.719
block: 17  SLC-1 range pixel:  4400  SLC-1 start line:  34307  LT range:  1466.333  LT end line:
2143.719
block: 17  SLC-1 start line:  34307   start LT line:   2143.719  end LT line:   2145  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 17  SLC-2R output start line:  32402  SLC-2R end line :  34307
LT start line:   2023   LT end line:   2145  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  32232  max:  34461
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0169  azimuth (rad):     0.0267
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  32800
output line:  33200
output line:  33600
output line:  34000

block: 18  SLC-1 start line:  34308  SLC-1 end line:  36213  SLC-1 lines:  1906
block: 18  SLC-1 range pixel: 0  SLC-1 starting line: 34308  LT range:    -0.333  LT line: 2143.781
block: 18  SLC-1 range pixel:  4400  SLC-1 starting line: 34308  LT range:  1466.333  LT line:
2143.781
block: 18  SLC start line:  34308  min. LT line:   2143.781  LT start line:   2142

block: 18  SLC-1 range pixel:     0  SLC-1 start line:  36213  LT range:    -0.333  LT end line:
```

```
2262.844
block: 18  SLC-1 range pixel:  4400  SLC-1 start line:  36213  LT range:  1466.333  LT end line:
2262.844
block: 18  SLC-1 start line:  36213   start LT line:   2262.844  end LT line:   2264  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 18  SLC-2R output start line:  34308  SLC-2R end line :  36213
LT start line:   2142   LT end line:   2264  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  34136  max:  36365
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0146  azimuth (rad):     0.0178
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  34400
output line:  34800
output line:  35200
output line:  35600
output line:  36000

block: 19  SLC-1 start line:  36214  SLC-1 end line:  38119  SLC-1 lines:  1906
block: 19  SLC-1 range pixel: 0  SLC-1 starting line: 36214  LT range:    -0.333  LT line: 2262.906
block: 19  SLC-1 range pixel:  4400  SLC-1 starting line: 36214  LT range:  1466.333  LT line:
2262.906
block: 19  SLC start line:  36214  min. LT line:   2262.906  LT start line:   2261

block: 19  SLC-1 range pixel:     0  SLC-1 start line:  38119  LT range:    -0.333  LT end line:
2381.969
block: 19  SLC-1 range pixel:  4400  SLC-1 start line:  38119  LT range:  1466.333  LT end line:
2381.969
block: 19  SLC-1 start line:  38119   start LT line:   2381.969  end LT line:   2383  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 19  SLC-2R output start line:  36214  SLC-2R end line :  38119
LT start line:   2261   LT end line:   2383  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  36040  max:  38269
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0067  azimuth (rad):     0.0248
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  36400
output line:  36800
output line:  37200
output line:  37600
output line:  38000

block: 20  SLC-1 start line:  38120  SLC-1 end line:  40025  SLC-1 lines:  1906
block: 20  SLC-1 range pixel: 0  SLC-1 starting line: 38120  LT range:    -0.333  LT line: 2382.031
block: 20  SLC-1 range pixel:  4400  SLC-1 starting line: 38120  LT range:  1466.333  LT line:
2382.031
block: 20  SLC start line:  38120  min. LT line:   2382.031  LT start line:   2381

block: 20  SLC-1 range pixel:     0  SLC-1 start line:  40025  LT range:    -0.333  LT end line:
2501.094
block: 20  SLC-1 range pixel:  4400  SLC-1 start line:  40025  LT range:  1466.333  LT end line:
2501.094
block: 20  SLC-1 start line:  40025   start LT line:   2501.094  end LT line:   2503  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 20  SLC-2R output start line:  38120  SLC-2R end line :  40025
LT start line:   2381   LT end line:   2503  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  37960  max:  40189
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0063  azimuth (rad):     0.0217
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  38400
output line:  38800
output line:  39200
output line:  39600
output line:  40000
```

```
block: 21  SLC-1 start line:  40026  SLC-1 end line:  41931  SLC-1 lines:  1906
block: 21  SLC-1 range pixel: 0  SLC-1 starting line: 40026  LT range:    -0.333  LT line: 2501.156
block: 21  SLC-1 range pixel:  4400  SLC-1 starting line: 40026  LT range:  1466.333  LT line:
2501.156
block: 21  SLC start line:  40026  min. LT line:   2501.156  LT start line:   2500

block: 21  SLC-1 range pixel:     0  SLC-1 start line:  41931  LT range:    -0.333  LT end line:
2620.219
block: 21  SLC-1 range pixel:  4400  SLC-1 start line:  41931  LT range:  1466.333  LT end line:
2620.219
block: 21  SLC-1 start line:  41931   start LT line:   2620.219  end LT line:   2622  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 21  SLC-2R output start line:  40026  SLC-2R end line :  41931
LT start line:   2500   LT end line:   2622  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  39864  max:  42093
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0105  azimuth (rad):     0.0405
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  40400
output line:  40800
output line:  41200
output line:  41600

block: 22  SLC-1 start line:  41932  SLC-1 end line:  43837  SLC-1 lines:  1906
block: 22  SLC-1 range pixel: 0  SLC-1 starting line: 41932  LT range:    -0.333  LT line: 2620.281
block: 22  SLC-1 range pixel:  4400  SLC-1 starting line: 41932  LT range:  1466.333  LT line:
2620.281
block: 22  SLC start line:  41932  min. LT line:   2620.281  LT start line:   2619

block: 22  SLC-1 range pixel:     0  SLC-1 start line:  43837  LT range:    -0.333  LT end line:
2739.344
block: 22  SLC-1 range pixel:  4400  SLC-1 start line:  43837  LT range:  1466.333  LT end line:
2739.344
block: 22  SLC-1 start line:  43837   start LT line:   2739.344  end LT line:   2741  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 22  SLC-2R output start line:  41932  SLC-2R end line :  43837
LT start line:   2619   LT end line:   2741  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  41768  max:  43997
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0113  azimuth (rad):     0.0326
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  42000
output line:  42400
output line:  42800
output line:  43200
output line:  43600

block: 23  SLC-1 start line:  43838  SLC-1 end line:  45743  SLC-1 lines:  1906
block: 23  SLC-1 range pixel: 0  SLC-1 starting line: 43838  LT range:    -0.333  LT line: 2739.406
block: 23  SLC-1 range pixel:  4400  SLC-1 starting line: 43838  LT range:  1466.333  LT line:
2739.406
block: 23  SLC start line:  43838  min. LT line:   2739.406  LT start line:   2738

block: 23  SLC-1 range pixel:     0  SLC-1 start line:  45743  LT range:    -0.333  LT end line:
2858.469
block: 23  SLC-1 range pixel:  4400  SLC-1 start line:  45743  LT range:  1466.333  LT end line:
2858.469
block: 23  SLC-1 start line:  45743   start LT line:   2858.469  end LT line:   2860  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 23  SLC-2R output start line:  43838  SLC-2R end line :  45743
LT start line:   2738   LT end line:   2860  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  43672  max:  45901
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0256  azimuth (rad):     0.0336
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000
```

```
output line:  44000
output line:  44400
output line:  44800
output line:  45200
output line:  45600

block: 24  SLC-1 start line:  45744  SLC-1 end line:  47649  SLC-1 lines:  1906
block: 24  SLC-1 range pixel: 0  SLC-1 starting line: 45744  LT range:    -0.333  LT line: 2858.531
block: 24  SLC-1 range pixel:  4400  SLC-1 starting line: 45744  LT range:  1466.333  LT line:
2858.531
block: 24  SLC start line:  45744  min. LT line:   2858.531  LT start line:   2857

block: 24  SLC-1 range pixel:     0  SLC-1 start line:  47649  LT range:    -0.333  LT end line:
2977.594
block: 24  SLC-1 range pixel:  4400  SLC-1 start line:  47649  LT range:  1466.333  LT end line:
2977.594
block: 24  SLC-1 start line:  47649   start LT line:   2977.594  end LT line:   2979  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 24  SLC-2R output start line:  45744  SLC-2R end line :  47649
LT start line:   2857   LT end line:   2979  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  45576  max:  47805
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0245  azimuth (rad):     0.0266
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  46000
output line:  46400
output line:  46800
output line:  47200
output line:  47600

block: 25  SLC-1 start line:  47650  SLC-1 end line:  49555  SLC-1 lines:  1906
block: 25  SLC-1 range pixel: 0  SLC-1 starting line: 47650  LT range:    -0.333  LT line: 2977.656
block: 25  SLC-1 range pixel:  4400  SLC-1 starting line: 47650  LT range:  1466.333  LT line:
2977.656
block: 25  SLC start line:  47650  min. LT line:   2977.656  LT start line:   2976

block: 25  SLC-1 range pixel:     0  SLC-1 start line:  49555  LT range:    -0.333  LT end line:
3096.719
block: 25  SLC-1 range pixel:  4400  SLC-1 start line:  49555  LT range:  1466.333  LT end line:
3096.719
block: 25  SLC-1 start line:  49555   start LT line:   3096.719  end LT line:   3098  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 25  SLC-2R output start line:  47650  SLC-2R end line :  49555
LT start line:   2976   LT end line:   3098  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  47480  max:  49709
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0232  azimuth (rad):     0.0078
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  48000
output line:  48400
output line:  48800
output line:  49200

block: 26  SLC-1 start line:  49556  SLC-1 end line:  51461  SLC-1 lines:  1906
block: 26  SLC-1 range pixel: 0  SLC-1 starting line: 49556  LT range:    -0.333  LT line: 3096.781
block: 26  SLC-1 range pixel:  4400  SLC-1 starting line: 49556  LT range:  1466.333  LT line:
3096.781
block: 26  SLC start line:  49556  min. LT line:   3096.781  LT start line:   3095

block: 26  SLC-1 range pixel:     0  SLC-1 start line:  51461  LT range:    -0.333  LT end line:
3215.844
block: 26  SLC-1 range pixel:  4400  SLC-1 start line:  51461  LT range:  1466.333  LT end line:
3215.844
block: 26  SLC-1 start line:  51461   start LT line:   3215.844  end LT line:   3217  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 26  SLC-2R output start line:  49556  SLC-2R end line :  51461
LT start line:   3095   LT end line:   3217  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  49384  max:  51613
```

```
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0230  azimuth (rad):     0.0068
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  49600
output line:  50000
output line:  50400
output line:  50800
output line:  51200

block: 27  SLC-1 start line:  51462  SLC-1 end line:  53367  SLC-1 lines:  1906
block: 27  SLC-1 range pixel: 0  SLC-1 starting line: 51462  LT range:    -0.333  LT line: 3215.906
block: 27  SLC-1 range pixel:  4400  SLC-1 starting line: 51462  LT range:  1466.333  LT line:
3215.906
block: 27  SLC start line:  51462  min. LT line:   3215.906  LT start line:   3214

block: 27  SLC-1 range pixel:     0  SLC-1 start line:  53367  LT range:    -0.333  LT end line:
3334.969
block: 27  SLC-1 range pixel:  4400  SLC-1 start line:  53367  LT range:  1466.333  LT end line:
3334.969
block: 27  SLC-1 start line:  53367   start LT line:   3334.969  end LT line:   3336  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 27  SLC-2R output start line:  51462  SLC-2R end line :  53367
LT start line:   3214   LT end line:   3336  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  51288  max:  53517
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0149  azimuth (rad):     0.0344
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  51600
output line:  52000
output line:  52400
output line:  52800
output line:  53200

block: 28  SLC-1 start line:  53368  SLC-1 end line:  55273  SLC-1 lines:  1906
block: 28  SLC-1 range pixel: 0  SLC-1 starting line: 53368  LT range:    -0.333  LT line: 3335.031
block: 28  SLC-1 range pixel:  4400  SLC-1 starting line: 53368  LT range:  1466.333  LT line:
3335.031
block: 28  SLC start line:  53368  min. LT line:   3335.031  LT start line:   3334

block: 28  SLC-1 range pixel:     0  SLC-1 start line:  55273  LT range:    -0.333  LT end line:
3454.094
block: 28  SLC-1 range pixel:  4400  SLC-1 start line:  55273  LT range:  1466.333  LT end line:
3454.094
block: 28  SLC-1 start line:  55273   start LT line:   3454.094  end LT line:   3456  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 28  SLC-2R output start line:  53368  SLC-2R end line :  55273
LT start line:   3334   LT end line:   3456  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  53208  max:  55437
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0228  azimuth (rad):    -0.0139
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  53600
output line:  54000
output line:  54400
output line:  54800
output line:  55200

block: 29  SLC-1 start line:  55274  SLC-1 end line:  57179  SLC-1 lines:  1906
block: 29  SLC-1 range pixel: 0  SLC-1 starting line: 55274  LT range:    -0.333  LT line: 3454.156
block: 29  SLC-1 range pixel:  4400  SLC-1 starting line: 55274  LT range:  1466.333  LT line:
3454.156
block: 29  SLC start line:  55274  min. LT line:   3454.156  LT start line:   3453

block: 29  SLC-1 range pixel:     0  SLC-1 start line:  57179  LT range:    -0.333  LT end line:
3573.219
block: 29  SLC-1 range pixel:  4400  SLC-1 start line:  57179  LT range:  1466.333  LT end line:
```

```
3573.219
block: 29  SLC-1 start line:  57179   start LT line:   3573.219  end LT line:   3575  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 29  SLC-2R output start line:  55274  SLC-2R end line :  57179
LT start line:   3453   LT end line:   3575  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  55112  max:  57341
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0266  azimuth (rad):    -0.0375
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  55600
output line:  56000
output line:  56400
output line:  56800

block: 30  SLC-1 start line:  57180  SLC-1 end line:  59085  SLC-1 lines:  1906
block: 30  SLC-1 range pixel: 0  SLC-1 starting line: 57180  LT range:    -0.333  LT line: 3573.281
block: 30  SLC-1 range pixel:  4400  SLC-1 starting line: 57180  LT range:  1466.333  LT line:
3573.281
block: 30  SLC start line:  57180  min. LT line:   3573.281  LT start line:   3572

block: 30  SLC-1 range pixel:     0  SLC-1 start line:  59085  LT range:    -0.333  LT end line:
3692.344
block: 30  SLC-1 range pixel:  4400  SLC-1 start line:  59085  LT range:  1466.333  LT end line:
3692.344
block: 30  SLC-1 start line:  59085   start LT line:   3692.344  end LT line:   3694  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 30  SLC-2R output start line:  57180  SLC-2R end line :  59085
LT start line:   3572   LT end line:   3694  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  57016  max:  59245
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0250  azimuth (rad):     0.0221
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  57200
output line:  57600
output line:  58000
output line:  58400
output line:  58800

block: 31  SLC-1 start line:  59086  SLC-1 end line:  60991  SLC-1 lines:  1906
block: 31  SLC-1 range pixel: 0  SLC-1 starting line: 59086  LT range:    -0.333  LT line: 3692.406
block: 31  SLC-1 range pixel:  4400  SLC-1 starting line: 59086  LT range:  1466.333  LT line:
3692.406
block: 31  SLC start line:  59086  min. LT line:   3692.406  LT start line:   3691

block: 31  SLC-1 range pixel:     0  SLC-1 start line:  60991  LT range:    -0.333  LT end line:
3811.469
block: 31  SLC-1 range pixel:  4400  SLC-1 start line:  60991  LT range:  1466.333  LT end line:
3811.469
block: 31  SLC-1 start line:  60991   start LT line:   3811.469  end LT line:   3813  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 31  SLC-2R output start line:  59086  SLC-2R end line :  60991
LT start line:   3691   LT end line:   3813  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  58920  max:  61149
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0202  azimuth (rad):     0.0285
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  59200
output line:  59600
output line:  60000
output line:  60400
output line:  60800

block: 32  SLC-1 start line:  60992  SLC-1 end line:  62897  SLC-1 lines:  1906
block: 32  SLC-1 range pixel: 0  SLC-1 starting line: 60992  LT range:    -0.333  LT line: 3811.531
block: 32  SLC-1 range pixel:  4400  SLC-1 starting line: 60992  LT range:  1466.333  LT line:
```

```
3811.531
block: 32  SLC start line:  60992  min. LT line:   3811.531  LT start line:   3810

block: 32  SLC-1 range pixel:     0  SLC-1 start line:  62897  LT range:    -0.333  LT end line:
3930.594
block: 32  SLC-1 range pixel:  4400  SLC-1 start line:  62897  LT range:  1466.333  LT end line:
3930.594
block: 32  SLC-1 start line:  62897   start LT line:   3930.594  end LT line:   3932  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 32  SLC-2R output start line:  60992  SLC-2R end line :  62897
LT start line:   3810   LT end line:   3932  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  60824  max:  63053
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0245  azimuth (rad):     0.0540
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  61200
output line:  61600
output line:  62000
output line:  62400
output line:  62800

block: 33  SLC-1 start line:  62898  SLC-1 end line:  64803  SLC-1 lines:  1906
block: 33  SLC-1 range pixel: 0  SLC-1 starting line: 62898  LT range:    -0.333  LT line: 3930.656
block: 33  SLC-1 range pixel:  4400  SLC-1 starting line: 62898  LT range:  1466.333  LT line:
3930.656
block: 33  SLC start line:  62898  min. LT line:   3930.656  LT start line:   3929

block: 33  SLC-1 range pixel:     0  SLC-1 start line:  64803  LT range:    -0.333  LT end line:
4049.719
block: 33  SLC-1 range pixel:  4400  SLC-1 start line:  64803  LT range:  1466.333  LT end line:
4049.719
block: 33  SLC-1 start line:  64803   start LT line:   4049.719  end LT line:   4051  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 33  SLC-2R output start line:  62898  SLC-2R end line :  64803
LT start line:   3929   LT end line:   4051  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  62728  max:  64957
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0227  azimuth (rad):     0.0779
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  63200
output line:  63600
output line:  64000
output line:  64400
output line:  64800

block: 34  SLC-1 start line:  64804  SLC-1 end line:  66709  SLC-1 lines:  1906
block: 34  SLC-1 range pixel: 0  SLC-1 starting line: 64804  LT range:    -0.333  LT line: 4049.781
block: 34  SLC-1 range pixel:  4400  SLC-1 starting line: 64804  LT range:  1466.333  LT line:
4049.781
block: 34  SLC start line:  64804  min. LT line:   4049.781  LT start line:   4048

block: 34  SLC-1 range pixel:     0  SLC-1 start line:  66709  LT range:    -0.333  LT end line:
4168.844
block: 34  SLC-1 range pixel:  4400  SLC-1 start line:  66709  LT range:  1466.333  LT end line:
4168.844
block: 34  SLC-1 start line:  66709   start LT line:   4168.844  end LT line:   4170  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 34  SLC-2R output start line:  64804  SLC-2R end line :  66709
LT start line:   4048   LT end line:   4170  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  64632  max:  66861
number of range pixels per block:  4400
number of azimuth lines per block: 2230
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0277  azimuth (rad):     0.0333
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  65200
output line:  65600
```

```
output line:  66000
output line:  66400

block: 35  SLC-1 start line:  66710  SLC-1 end line:  68615  SLC-1 lines:  1906
block: 35  SLC-1 range pixel: 0  SLC-1 starting line: 66710  LT range:    -0.333  LT line: 4168.906
block: 35  SLC-1 range pixel:  4400  SLC-1 starting line: 66710  LT range:  1466.333  LT line:
4168.906
block: 35  SLC start line:  66710  min. LT line:   4168.906  LT start line:   4167

block: 35  SLC-1 range pixel:     0  SLC-1 start line:  68615  LT range:    -0.333  LT end line:
4287.969
block: 35  SLC-1 range pixel:  4400  SLC-1 start line:  68615  LT range:  1466.333  LT end line:
4287.969
block: 35  SLC-1 start line:  68615   start LT line:   4287.969  end LT line:   4289  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 35  SLC-2R output start line:  66710  SLC-2R end line :  68615
LT start line:   4167   LT end line:   4289  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  66537  max:  68765
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0160  azimuth (rad):     0.0187
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  66800
output line:  67200
output line:  67600
output line:  68000
output line:  68400

block: 36  SLC-1 start line:  68616  SLC-1 end line:  70521  SLC-1 lines:  1906
block: 36  SLC-1 range pixel: 0  SLC-1 starting line: 68616  LT range:    -0.333  LT line: 4288.031
block: 36  SLC-1 range pixel:  4400  SLC-1 starting line: 68616  LT range:  1466.333  LT line:
4288.031
block: 36  SLC start line:  68616  min. LT line:   4288.031  LT start line:   4287

block: 36  SLC-1 range pixel:     0  SLC-1 start line:  70521  LT range:    -0.333  LT end line:
4407.094
block: 36  SLC-1 range pixel:  4400  SLC-1 start line:  70521  LT range:  1466.333  LT end line:
4407.094
block: 36  SLC-1 start line:  70521   start LT line:   4407.094  end LT line:   4409  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 36  SLC-2R output start line:  68616  SLC-2R end line :  70521
LT start line:   4287   LT end line:   4409  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  68457  max:  70685
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0190  azimuth (rad):     0.0138
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  68800
output line:  69200
output line:  69600
output line:  70000
output line:  70400

block: 37  SLC-1 start line:  70522  SLC-1 end line:  72427  SLC-1 lines:  1906
block: 37  SLC-1 range pixel: 0  SLC-1 starting line: 70522  LT range:    -0.333  LT line: 4407.156
block: 37  SLC-1 range pixel:  4400  SLC-1 starting line: 70522  LT range:  1466.333  LT line:
4407.156
block: 37  SLC start line:  70522  min. LT line:   4407.156  LT start line:   4406

block: 37  SLC-1 range pixel:     0  SLC-1 start line:  72427  LT range:    -0.333  LT end line:
4526.219
block: 37  SLC-1 range pixel:  4400  SLC-1 start line:  72427  LT range:  1466.333  LT end line:
4526.219
block: 37  SLC-1 start line:  72427   start LT line:   4526.219  end LT line:   4528  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 37  SLC-2R output start line:  70522  SLC-2R end line :  72427
LT start line:   4406   LT end line:   4528  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  70361  max:  72589
number of range pixels per block:  4400
number of azimuth lines per block: 2229
```

```
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0242  azimuth (rad):     0.0211
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  70800
output line:  71200
output line:  71600
output line:  72000
output line:  72400

block: 38  SLC-1 start line:  72428  SLC-1 end line:  74333  SLC-1 lines:  1906
block: 38  SLC-1 range pixel: 0  SLC-1 starting line: 72428  LT range:    -0.333  LT line: 4526.281
block: 38  SLC-1 range pixel:  4400  SLC-1 starting line: 72428  LT range:  1466.333  LT line:
4526.281
block: 38  SLC start line:  72428  min. LT line:   4526.281  LT start line:   4525

block: 38  SLC-1 range pixel:     0  SLC-1 start line:  74333  LT range:    -0.333  LT end line:
4645.344
block: 38  SLC-1 range pixel:  4400  SLC-1 start line:  74333  LT range:  1466.333  LT end line:
4645.344
block: 38  SLC-1 start line:  74333   start LT line:   4645.344  end LT line:   4647  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 38  SLC-2R output start line:  72428  SLC-2R end line :  74333
LT start line:   4525   LT end line:   4647  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  72265  max:  74493
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0262  azimuth (rad):     0.0359
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  72800
output line:  73200
output line:  73600
output line:  74000

block: 39  SLC-1 start line:  74334  SLC-1 end line:  76239  SLC-1 lines:  1906
block: 39  SLC-1 range pixel: 0  SLC-1 starting line: 74334  LT range:    -0.333  LT line: 4645.406
block: 39  SLC-1 range pixel:  4400  SLC-1 starting line: 74334  LT range:  1466.333  LT line:
4645.406
block: 39  SLC start line:  74334  min. LT line:   4645.406  LT start line:   4644

block: 39  SLC-1 range pixel:     0  SLC-1 start line:  76239  LT range:    -0.333  LT end line:
4764.469
block: 39  SLC-1 range pixel:  4400  SLC-1 start line:  76239  LT range:  1466.333  LT end line:
4764.469
block: 39  SLC-1 start line:  76239   start LT line:   4764.469  end LT line:   4766  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 39  SLC-2R output start line:  74334  SLC-2R end line :  76239
LT start line:   4644   LT end line:   4766  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  74169  max:  76397
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0282  azimuth (rad):     0.1156
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  74400
output line:  74800
output line:  75200
output line:  75600
output line:  76000

block: 40  SLC-1 start line:  76240  SLC-1 end line:  78145  SLC-1 lines:  1906
block: 40  SLC-1 range pixel: 0  SLC-1 starting line: 76240  LT range:    -0.333  LT line: 4764.531
block: 40  SLC-1 range pixel:  4400  SLC-1 starting line: 76240  LT range:  1466.333  LT line:
4764.531
block: 40  SLC start line:  76240  min. LT line:   4764.531  LT start line:   4763

block: 40  SLC-1 range pixel:     0  SLC-1 start line:  78145  LT range:    -0.333  LT end line:
4883.594
block: 40  SLC-1 range pixel:  4400  SLC-1 start line:  78145  LT range:  1466.333  LT end line:
4883.594
block: 40  SLC-1 start line:  78145   start LT line:   4883.594  end LT line:   4885  LT lines: 123
number of range looks: 3  azimuth looks: 16
```

```
block: 40  SLC-2R output start line:  76240  SLC-2R end line :  78145
LT start line:   4763   LT end line:   4885  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  76073  max:  78301
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0080  azimuth (rad):     0.0691
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  76400
output line:  76800
output line:  77200
output line:  77600
output line:  78000

block: 41  SLC-1 start line:  78146  SLC-1 end line:  80051  SLC-1 lines:  1906
block: 41  SLC-1 range pixel: 0  SLC-1 starting line: 78146  LT range:    -0.333  LT line: 4883.656
block: 41  SLC-1 range pixel:  4400  SLC-1 starting line: 78146  LT range:  1466.333  LT line:
4883.656
block: 41  SLC start line:  78146  min. LT line:   4883.656  LT start line:   4882

block: 41  SLC-1 range pixel:     0  SLC-1 start line:  80051  LT range:    -0.333  LT end line:
5002.719
block: 41  SLC-1 range pixel:  4400  SLC-1 start line:  80051  LT range:  1466.333  LT end line:
5002.719
block: 41  SLC-1 start line:  80051   start LT line:   5002.719  end LT line:   5004  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 41  SLC-2R output start line:  78146  SLC-2R end line :  80051
LT start line:   4882   LT end line:   5004  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  77977  max:  80205
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0367  azimuth (rad):    -0.0464
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  78400
output line:  78800
output line:  79200
output line:  79600
output line:  80000

block: 42  SLC-1 start line:  80052  SLC-1 end line:  81957  SLC-1 lines:  1906
block: 42  SLC-1 range pixel: 0  SLC-1 starting line: 80052  LT range:    -0.333  LT line: 5002.781
block: 42  SLC-1 range pixel:  4400  SLC-1 starting line: 80052  LT range:  1466.333  LT line:
5002.781
block: 42  SLC start line:  80052  min. LT line:   5002.781  LT start line:   5001

block: 42  SLC-1 range pixel:     0  SLC-1 start line:  81957  LT range:    -0.333  LT end line:
5121.844
block: 42  SLC-1 range pixel:  4400  SLC-1 start line:  81957  LT range:  1466.333  LT end line:
5121.844
block: 42  SLC-1 start line:  81957   start LT line:   5121.844  end LT line:   5123  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 42  SLC-2R output start line:  80052  SLC-2R end line :  81957
LT start line:   5001   LT end line:   5123  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  79881  max:  82109
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0348  azimuth (rad):     0.0135
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  80400
output line:  80800
output line:  81200
output line:  81600

block: 43  SLC-1 start line:  81958  SLC-1 end line:  83863  SLC-1 lines:  1906
block: 43  SLC-1 range pixel: 0  SLC-1 starting line: 81958  LT range:    -0.333  LT line: 5121.906
block: 43  SLC-1 range pixel:  4400  SLC-1 starting line: 81958  LT range:  1466.333  LT line:
5121.906
block: 43  SLC start line:  81958  min. LT line:   5121.906  LT start line:   5120
```

```
block: 43  SLC-1 range pixel:     0  SLC-1 start line:  83863  LT range:    -0.333  LT end line:
5240.969
block: 43  SLC-1 range pixel:  4400  SLC-1 start line:  83863  LT range:  1466.333  LT end line:
5240.969
block: 43  SLC-1 start line:  83863   start LT line:   5240.969  end LT line:   5242  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 43  SLC-2R output start line:  81958  SLC-2R end line :  83863
LT start line:   5120   LT end line:   5242  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  81785  max:  84013
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0228  azimuth (rad):     0.0130
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  82000
output line:  82400
output line:  82800
output line:  83200
output line:  83600

block: 44  SLC-1 start line:  83864  SLC-1 end line:  85769  SLC-1 lines:  1906
block: 44  SLC-1 range pixel: 0  SLC-1 starting line: 83864  LT range:    -0.333  LT line: 5241.031
block: 44  SLC-1 range pixel:  4400  SLC-1 starting line: 83864  LT range:  1466.333  LT line:
5241.031
block: 44  SLC start line:  83864  min. LT line:   5241.031  LT start line:   5240

block: 44  SLC-1 range pixel:     0  SLC-1 start line:  85769  LT range:    -0.333  LT end line:
5360.094
block: 44  SLC-1 range pixel:  4400  SLC-1 start line:  85769  LT range:  1466.333  LT end line:
5360.094
block: 44  SLC-1 start line:  85769   start LT line:   5360.094  end LT line:   5362  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 44  SLC-2R output start line:  83864  SLC-2R end line :  85769
LT start line:   5240   LT end line:   5362  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  83705  max:  85933
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0396  azimuth (rad):     0.0083
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  84000
output line:  84400
output line:  84800
output line:  85200
output line:  85600

block: 45  SLC-1 start line:  85770  SLC-1 end line:  87675  SLC-1 lines:  1906
block: 45  SLC-1 range pixel: 0  SLC-1 starting line: 85770  LT range:    -0.333  LT line: 5360.156
block: 45  SLC-1 range pixel:  4400  SLC-1 starting line: 85770  LT range:  1466.333  LT line:
5360.156
block: 45  SLC start line:  85770  min. LT line:   5360.156  LT start line:   5359

block: 45  SLC-1 range pixel:     0  SLC-1 start line:  87675  LT range:    -0.333  LT end line:
5479.219
block: 45  SLC-1 range pixel:  4400  SLC-1 start line:  87675  LT range:  1466.333  LT end line:
5479.219
block: 45  SLC-1 start line:  87675   start LT line:   5479.219  end LT line:   5481  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 45  SLC-2R output start line:  85770  SLC-2R end line :  87675
LT start line:   5359   LT end line:   5481  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  85609  max:  87837
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0329  azimuth (rad):     0.0135
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  86000
output line:  86400
output line:  86800
output line:  87200
output line:  87600
```

```
block: 46  SLC-1 start line:  87676  SLC-1 end line:  89581  SLC-1 lines:  1906
block: 46  SLC-1 range pixel: 0  SLC-1 starting line: 87676  LT range:    -0.333  LT line: 5479.281
block: 46  SLC-1 range pixel:  4400  SLC-1 starting line: 87676  LT range:  1466.333  LT line:
5479.281
block: 46  SLC start line:  87676  min. LT line:   5479.281  LT start line:   5478

block: 46  SLC-1 range pixel:     0  SLC-1 start line:  89581  LT range:    -0.333  LT end line:
5598.344
block: 46  SLC-1 range pixel:  4400  SLC-1 start line:  89581  LT range:  1466.333  LT end line:
5598.344
block: 46  SLC-1 start line:  89581   start LT line:   5598.344  end LT line:   5600  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 46  SLC-2R output start line:  87676  SLC-2R end line :  89581
LT start line:   5478   LT end line:   5600  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  87513  max:  89741
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0322  azimuth (rad):     0.0177
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  88000
output line:  88400
output line:  88800
output line:  89200

block: 47  SLC-1 start line:  89582  SLC-1 end line:  91487  SLC-1 lines:  1906
block: 47  SLC-1 range pixel: 0  SLC-1 starting line: 89582  LT range:    -0.333  LT line: 5598.406
block: 47  SLC-1 range pixel:  4400  SLC-1 starting line: 89582  LT range:  1466.333  LT line:
5598.406
block: 47  SLC start line:  89582  min. LT line:   5598.406  LT start line:   5597

block: 47  SLC-1 range pixel:     0  SLC-1 start line:  91487  LT range:    -0.333  LT end line:
5717.469
block: 47  SLC-1 range pixel:  4400  SLC-1 start line:  91487  LT range:  1466.333  LT end line:
5717.469
block: 47  SLC-1 start line:  91487   start LT line:   5717.469  end LT line:   5719  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 47  SLC-2R output start line:  89582  SLC-2R end line :  91487
LT start line:   5597   LT end line:   5719  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  89417  max:  91645
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0244  azimuth (rad):     0.0164
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  89600
output line:  90000
output line:  90400
output line:  90800
output line:  91200

block: 48  SLC-1 start line:  91488  SLC-1 end line:  93393  SLC-1 lines:  1906
block: 48  SLC-1 range pixel: 0  SLC-1 starting line: 91488  LT range:    -0.333  LT line: 5717.531
block: 48  SLC-1 range pixel:  4400  SLC-1 starting line: 91488  LT range:  1466.333  LT line:
5717.531
block: 48  SLC start line:  91488  min. LT line:   5717.531  LT start line:   5716

block: 48  SLC-1 range pixel:     0  SLC-1 start line:  93393  LT range:    -0.333  LT end line:
5836.594
block: 48  SLC-1 range pixel:  4400  SLC-1 start line:  93393  LT range:  1466.333  LT end line:
5836.594
block: 48  SLC-1 start line:  93393   start LT line:   5836.594  end LT line:   5838  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 48  SLC-2R output start line:  91488  SLC-2R end line :  93393
LT start line:   5716   LT end line:   5838  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  91321  max:  93549
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0289  azimuth (rad):     0.0165
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000
```

```
output line:  91600
output line:  92000
output line:  92400
output line:  92800
output line:  93200

block: 49  SLC-1 start line:  93394  SLC-1 end line:  95299  SLC-1 lines:  1906
block: 49  SLC-1 range pixel: 0  SLC-1 starting line: 93394  LT range:    -0.333  LT line: 5836.656
block: 49  SLC-1 range pixel:  4400  SLC-1 starting line: 93394  LT range:  1466.333  LT line:
5836.656
block: 49  SLC start line:  93394  min. LT line:   5836.656  LT start line:   5835

block: 49  SLC-1 range pixel:     0  SLC-1 start line:  95299  LT range:    -0.333  LT end line:
5955.719
block: 49  SLC-1 range pixel:  4400  SLC-1 start line:  95299  LT range:  1466.333  LT end line:
5955.719
block: 49  SLC-1 start line:  95299   start LT line:   5955.719  end LT line:   5957  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 49  SLC-2R output start line:  93394  SLC-2R end line :  95299
LT start line:   5835   LT end line:   5957  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  93225  max:  95453
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0273  azimuth (rad):     0.0097
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  93600
output line:  94000
output line:  94400
output line:  94800
output line:  95200

block: 50  SLC-1 start line:  95300  SLC-1 end line:  97205  SLC-1 lines:  1906
block: 50  SLC-1 range pixel: 0  SLC-1 starting line: 95300  LT range:    -0.333  LT line: 5955.781
block: 50  SLC-1 range pixel:  4400  SLC-1 starting line: 95300  LT range:  1466.333  LT line:
5955.781
block: 50  SLC start line:  95300  min. LT line:   5955.781  LT start line:   5954

block: 50  SLC-1 range pixel:     0  SLC-1 start line:  97205  LT range:    -0.333  LT end line:
6074.844
block: 50  SLC-1 range pixel:  4400  SLC-1 start line:  97205  LT range:  1466.333  LT end line:
6074.844
block: 50  SLC-1 start line:  97205   start LT line:   6074.844  end LT line:   6076  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 50  SLC-2R output start line:  95300  SLC-2R end line :  97205
LT start line:   5954   LT end line:   6076  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  95129  max:  97357
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0282  azimuth (rad):     0.0120
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  95600
output line:  96000
output line:  96400
output line:  96800
output line:  97200

block: 51  SLC-1 start line:  97206  SLC-1 end line:  99111  SLC-1 lines:  1906
block: 51  SLC-1 range pixel: 0  SLC-1 starting line: 97206  LT range:    -0.333  LT line: 6074.906
block: 51  SLC-1 range pixel:  4400  SLC-1 starting line: 97206  LT range:  1466.333  LT line:
6074.906
block: 51  SLC start line:  97206  min. LT line:   6074.906  LT start line:   6073

block: 51  SLC-1 range pixel:     0  SLC-1 start line:  99111  LT range:    -0.333  LT end line:
6193.969
block: 51  SLC-1 range pixel:  4400  SLC-1 start line:  99111  LT range:  1466.333  LT end line:
6193.969
block: 51  SLC-1 start line:  99111   start LT line:   6193.969  end LT line:   6195  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 51  SLC-2R output start line:  97206  SLC-2R end line :  99111
```

```
LT start line:   6073   LT end line:   6195  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  97033  max:  99261
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0264  azimuth (rad):     0.0110
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  97600
output line:  98000
output line:  98400
output line:  98800

block: 52  SLC-1 start line:  99112  SLC-1 end line: 101017  SLC-1 lines:  1906
block: 52  SLC-1 range pixel: 0  SLC-1 starting line: 99112  LT range:    -0.333  LT line: 6194.031
block: 52  SLC-1 range pixel:  4400  SLC-1 starting line: 99112  LT range:  1466.333  LT line:
6194.031
block: 52  SLC start line:  99112  min. LT line:   6194.031  LT start line:   6193

block: 52  SLC-1 range pixel:     0  SLC-1 start line: 101017  LT range:    -0.333  LT end line:
6313.094
block: 52  SLC-1 range pixel:  4400  SLC-1 start line: 101017  LT range:  1466.333  LT end line:
6313.094
block: 52  SLC-1 start line: 101017   start LT line:   6313.094  end LT line:   6315  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 52  SLC-2R output start line:  99112  SLC-2R end line : 101017
LT start line:   6193   LT end line:   6315  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min:  98953  max: 101181
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0236  azimuth (rad):     0.0077
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line:  99200
output line:  99600
output line: 100000
output line: 100400
output line: 100800

block: 53  SLC-1 start line: 101018  SLC-1 end line: 102923  SLC-1 lines:  1906
block: 53  SLC-1 range pixel: 0  SLC-1 starting line: 101018  LT range:    -0.333  LT line: 6313.156
block: 53  SLC-1 range pixel:  4400  SLC-1 starting line: 101018  LT range:  1466.333  LT line:
6313.156
block: 53  SLC start line: 101018  min. LT line:   6313.156  LT start line:   6312

block: 53  SLC-1 range pixel:     0  SLC-1 start line: 102923  LT range:    -0.333  LT end line:
6432.219
block: 53  SLC-1 range pixel:  4400  SLC-1 start line: 102923  LT range:  1466.333  LT end line:
6432.219
block: 53  SLC-1 start line: 102923   start LT line:   6432.219  end LT line:   6434  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 53  SLC-2R output start line: 101018  SLC-2R end line : 102923
LT start line:   6312   LT end line:   6434  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min: 100857  max: 103085
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0192  azimuth (rad):     0.0119
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line: 101200
output line: 101600
output line: 102000
output line: 102400
output line: 102800

block: 54  SLC-1 start line: 102924  SLC-1 end line: 104829  SLC-1 lines:  1906
block: 54  SLC-1 range pixel: 0  SLC-1 starting line: 102924  LT range:    -0.333  LT line: 6432.281
block: 54  SLC-1 range pixel:  4400  SLC-1 starting line: 102924  LT range:  1466.333  LT line:
6432.281
block: 54  SLC start line: 102924  min. LT line:   6432.281  LT start line:   6431

block: 54  SLC-1 range pixel:     0  SLC-1 start line: 104829  LT range:    -0.333  LT end line:
6551.344
```

```
block: 54  SLC-1 range pixel:  4400  SLC-1 start line: 104829  LT range:  1466.333  LT end line:
6551.344
block: 54  SLC-1 start line: 104829   start LT line:   6551.344  end LT line:   6553  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 54  SLC-2R output start line: 102924  SLC-2R end line : 104829
LT start line:   6431   LT end line:   6553  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min: 102761  max: 104989
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0189  azimuth (rad):     0.0129
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line: 103200
output line: 103600
output line: 104000
output line: 104400
output line: 104800

block: 55  SLC-1 start line: 104830  SLC-1 end line: 106735  SLC-1 lines:  1906
block: 55  SLC-1 range pixel: 0  SLC-1 starting line: 104830  LT range:    -0.333  LT line: 6551.406
block: 55  SLC-1 range pixel:  4400  SLC-1 starting line: 104830  LT range:  1466.333  LT line:
6551.406
block: 55  SLC start line: 104830  min. LT line:   6551.406  LT start line:   6550

block: 55  SLC-1 range pixel:     0  SLC-1 start line: 106735  LT range:    -0.333  LT end line:
6670.469
block: 55  SLC-1 range pixel:  4400  SLC-1 start line: 106735  LT range:  1466.333  LT end line:
6670.469
block: 55  SLC-1 start line: 106735   start LT line:   6670.469  end LT line:   6672  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 55  SLC-2R output start line: 104830  SLC-2R end line : 106735
LT start line:   6550   LT end line:   6672  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min: 104665  max: 106893
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0249  azimuth (rad):     0.0134
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line: 105200
output line: 105600
output line: 106000
output line: 106400

block: 56  SLC-1 start line: 106736  SLC-1 end line: 108641  SLC-1 lines:  1906
block: 56  SLC-1 range pixel: 0  SLC-1 starting line: 106736  LT range:    -0.333  LT line: 6670.531
block: 56  SLC-1 range pixel:  4400  SLC-1 starting line: 106736  LT range:  1466.333  LT line:
6670.531
block: 56  SLC start line: 106736  min. LT line:   6670.531  LT start line:   6669

block: 56  SLC-1 range pixel:     0  SLC-1 start line: 108641  LT range:    -0.333  LT end line:
6789.594
block: 56  SLC-1 range pixel:  4400  SLC-1 start line: 108641  LT range:  1466.333  LT end line:
6789.594
block: 56  SLC-1 start line: 108641   start LT line:   6789.594  end LT line:   6791  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 56  SLC-2R output start line: 106736  SLC-2R end line : 108641
LT start line:   6669   LT end line:   6791  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min: 106569  max: 108797
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0205  azimuth (rad):     0.0180
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line: 106800
output line: 107200
output line: 107600
output line: 108000
output line: 108400

block: 57  SLC-1 start line: 108642  SLC-1 end line: 110547  SLC-1 lines:  1906
block: 57  SLC-1 range pixel: 0  SLC-1 starting line: 108642  LT range:    -0.333  LT line: 6789.656
```

```
block: 57  SLC-1 range pixel:  4400  SLC-1 starting line: 108642  LT range:  1466.333  LT line:
6789.656
block: 57  SLC start line: 108642  min. LT line:   6789.656  LT start line:   6788

block: 57  SLC-1 range pixel:     0  SLC-1 start line: 110547  LT range:    -0.333  LT end line:
6908.719
block: 57  SLC-1 range pixel:  4400  SLC-1 start line: 110547  LT range:  1466.333  LT end line:
6908.719
block: 57  SLC-1 start line: 110547   start LT line:   6908.719  end LT line:   6910  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 57  SLC-2R output start line: 108642  SLC-2R end line : 110547
LT start line:   6788   LT end line:   6910  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min: 108473  max: 110701
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0235  azimuth (rad):     0.0204
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line: 108800
output line: 109200
output line: 109600
output line: 110000
output line: 110400

block: 58  SLC-1 start line: 110548  SLC-1 end line: 112453  SLC-1 lines:  1906
block: 58  SLC-1 range pixel: 0  SLC-1 starting line: 110548  LT range:    -0.333  LT line: 6908.781
block: 58  SLC-1 range pixel:  4400  SLC-1 starting line: 110548  LT range:  1466.333  LT line:
6908.781
block: 58  SLC start line: 110548  min. LT line:   6908.781  LT start line:   6907

block: 58  SLC-1 range pixel:     0  SLC-1 start line: 112453  LT range:    -0.333  LT end line:
7027.844
block: 58  SLC-1 range pixel:  4400  SLC-1 start line: 112453  LT range:  1466.333  LT end line:
7027.844
block: 58  SLC-1 start line: 112453   start LT line:   7027.844  end LT line:   7029  LT lines: 123
number of range looks: 3  azimuth looks: 16

block: 58  SLC-2R output start line: 110548  SLC-2R end line : 112453
LT start line:   6907   LT end line:   7029  lines:   123
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min: 110377  max: 112605
number of range pixels per block:  4400
number of azimuth lines per block: 2229
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 2048
phase gradient/sample range (rad):    -0.0250  azimuth (rad):     0.0192
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line: 110800
output line: 111200
output line: 111600
output line: 112000
output line: 112400

block: 59  SLC-1 start line: 112454  SLC-1 end line: 113345  SLC-1 lines:   892
block: 59  SLC-1 range pixel: 0  SLC-1 starting line: 112454  LT range:    -0.333  LT line: 7027.906
block: 59  SLC-1 range pixel:  4400  SLC-1 starting line: 112454  LT range:  1466.333  LT line:
7027.906
block: 59  SLC start line: 112454  min. LT line:   7027.906  LT start line:   7026

block: 59  SLC-1 range pixel:     0  SLC-1 start line: 113345  LT range:    -0.333  LT end line:
7083.594
block: 59  SLC-1 range pixel:  4400  SLC-1 start line: 113345  LT range:  1466.333  LT end line:
7083.594
block: 59  SLC-1 start line: 113345   start LT line:   7083.594  end LT line:   7084  LT lines: 59
number of range looks: 3  azimuth looks: 16

block: 59  SLC-2R output start line: 112454  SLC-2R end line : 113345
LT start line:   7026   LT end line:   7084  lines:    59
SLC-2 data segment range sample min:     0  max:  4399  azimuth line min: 112281  max: 113261
number of range pixels per block:  4400
number of azimuth lines per block: 981
phase gradient window range offset: 1176  azimuth offset: 0  range pixels: 2048  azimuth lines: 981
phase gradient/sample range (rad):     0.0000  azimuth (rad):     0.0000
Doppler phase/line (rad):     0.0000  mod_2PI:     0.0000

output line: 112800
```

```
output line: 113200

number of locations used for L.S fit for offset polynomials: 4096

range offset poly. coeff.:           1.041e+02  1.992e-03  5.443e-05
range offset poly. coeff. errors:    4.654e-03  1.399e-06  5.446e-08

azimuth offset poly. coeff.:        -1.943e+00 -1.188e-03  1.264e-05
azimuth offset poly. coeff. errors:  4.569e-03  1.373e-06  5.346e-08
offset model fit std. dev. (samples) range:   0.1141  azimuth:   0.1120

output resampled SLC parameter file: rslc_WBs2/20101028_4.rslc.par
output resampled SLC file: rslc_WBs2/20101028_4.rslc
output resampled SLC width: 4400  lines: 113346

user time (s):       330.760
system time (s):       7.780
elapsed time (s):    424.080


create_offset rslc_WBs2/20071020_4.rslc.par rslc_WBs2/20101028_4.rslc.par
rslc_WBs2/20071020_4_20101028_4_2.off < create_offset.in
*** ISP offset/interferogram parameter file creation/update ***
*** Copyright 2006 Gamma Remote Sensing v4.8 clw/uw 14-Feb-2008 ***

SLC-1 title: ALPSRS092604500
SLC-1 Doppler centroid at center swath (Hz):      0.000
SLC-1 number of range samples:             4400
SLC-1 number of image lines:             113346
SLC-1 slant range pixel spacing (m):   9.368514
SLC-1 azimuth sample spacing (m):      3.184014

SLC-2 title: ALPSRS253644500
SLC-2 Doppler centroid at center swath (Hz):      0.000
SLC-2 number of range samples:             4400
SLC-2 number of lines:                   113346
SLC-2 slant range pixel spacing (m):   9.387178
SLC-2 azimuth sample spacing (m):      3.184014

OFFSET ALGORITHM: intensity cross-correlation

*** DEFAULT INTERFEROGRAM PARAMETERS ***
interferogram range looks:   1
interferogram azimuth looks: 1
interferogram range width pixels:   4400
interferogram azimuth lines:      113346
interferogram range pixel spacing (m):       9.36851
interferogram azimuth line spacing (m):      3.18401

interferogram/offset parameter file: rslc_WBs2/20071020_4_20101028_4_2.off

user time (s):         0.010
system time (s):       0.000
elapsed time (s):      0.200


offset_pwr rslc_WBs2/20071020_4.rslc rslc_WBs2/20101028_4.rslc rslc_WBs2/20071020_4.rslc.par
rslc_WBs2/20101028_4.rslc.par rslc_WBs2/20071020_4_20101028_4_2.off
rslc_WBs2/20071020_4_20101028_4_2.offs rslc_WBs2/20071020_4_20101028_4_2.snr
*** Offsets between SLC images using intensity cross-correlation ***
*** Copyright 2008, Gamma Remote Sensing, v3.3 18-Mar-2008 clw/uw ***
SLC-1 image: rslc_WBs2/20071020_4.rslc
SLC-2 image: rslc_WBs2/20101028_4.rslc
SLC-1 ISP image parameter file: rslc_WBs2/20071020_4.rslc.par
SLC-2 ISP image parameter file: rslc_WBs2/20101028_4.rslc.par
ISP interferogram/offset parameter file: rslc_WBs2/20071020_4_20101028_4_2.off
SLC format: FCOMPLEX (pairs of 4-byte float (re,im))

SLC oversampling factor: 2
initial offset estimate (range, azimuth): 0  0
offset search window sizes (range, azimuth pixels): 256  512
oversampled offset search window sizes (range, azimuth pixels): 512  1024
first range, last range, points:            48    4352      32
first az. line, last az. line, points:      48  113298      64
number of offset estimates:   2048
correlation SNR threshold:     12.000
```

```
starting lines: SLC-1: -208   SLC-2: -208  rwin: 256  azwin: 512
interp. filter bandwidth:      0.500  FIR length: 65
bp_filter: bw:  3.1416  wc:  0.0000  nfft: 512  nps: 65   Kaiser beta:   0.500
bp_filter: bw:  3.1416  wc:  0.0000  nfft: 1024  nps: 65   Kaiser beta:   0.500
average image 1 intensity:  3.570e-02  clip1:  1.785e-01
average image 2 intensity:  3.024e-02  clip2:  1.512e-01
search line:      0  offsets above SNR threshold:      0

search line:      1  SLC-1:   1845   SLC-2:   1845  azoff_init:    0  roff_init:    0
search line:      1  offsets above SNR threshold:      7

search line:      2  SLC-1:   3642   SLC-2:   3642  azoff_init:    0  roff_init:    0
search line:      2  offsets above SNR threshold:      2

search line:      3  SLC-1:   5439   SLC-2:   5439  azoff_init:    0  roff_init:    0
search line:      3  offsets above SNR threshold:      5

search line:      4  SLC-1:   7236   SLC-2:   7236  azoff_init:    0  roff_init:    0
search line:      4  offsets above SNR threshold:      4

search line:      5  SLC-1:   9033   SLC-2:   9033  azoff_init:    0  roff_init:    0
search line:      5  offsets above SNR threshold:      3

search line:      6  SLC-1:  10830   SLC-2:  10830  azoff_init:    0  roff_init:    0
search line:      6  offsets above SNR threshold:      1

search line:      7  SLC-1:  12627   SLC-2:  12627  azoff_init:    0  roff_init:    0
search line:      7  offsets above SNR threshold:      3

search line:      8  SLC-1:  14424   SLC-2:  14424  azoff_init:    0  roff_init:    0
search line:      8  offsets above SNR threshold:      9

search line:      9  SLC-1:  16221   SLC-2:  16221  azoff_init:    0  roff_init:    0
search line:      9  offsets above SNR threshold:      3

search line:     10  SLC-1:  18018   SLC-2:  18018  azoff_init:    0  roff_init:    0
search line:     10  offsets above SNR threshold:     12

search line:     11  SLC-1:  19815   SLC-2:  19815  azoff_init:    0  roff_init:    0
search line:     11  offsets above SNR threshold:      6

search line:     12  SLC-1:  21612   SLC-2:  21612  azoff_init:    0  roff_init:    0
search line:     12  offsets above SNR threshold:     11

search line:     13  SLC-1:  23409   SLC-2:  23409  azoff_init:    0  roff_init:    0
search line:     13  offsets above SNR threshold:     11

search line:     14  SLC-1:  25206   SLC-2:  25206  azoff_init:    0  roff_init:    0
search line:     14  offsets above SNR threshold:      9

search line:     15  SLC-1:  27003   SLC-2:  27003  azoff_init:    0  roff_init:    0
search line:     15  offsets above SNR threshold:      8

search line:     16  SLC-1:  28800   SLC-2:  28800  azoff_init:    0  roff_init:    0
search line:     16  offsets above SNR threshold:     11

search line:     17  SLC-1:  30597   SLC-2:  30597  azoff_init:    0  roff_init:    0
search line:     17  offsets above SNR threshold:     16

search line:     18  SLC-1:  32394   SLC-2:  32394  azoff_init:    0  roff_init:    0
search line:     18  offsets above SNR threshold:     13

search line:     19  SLC-1:  34191   SLC-2:  34191  azoff_init:    0  roff_init:    0
search line:     19  offsets above SNR threshold:      8

search line:     20  SLC-1:  35988   SLC-2:  35988  azoff_init:    0  roff_init:    0
search line:     20  offsets above SNR threshold:     17

search line:     21  SLC-1:  37785   SLC-2:  37785  azoff_init:    0  roff_init:    0
search line:     21  offsets above SNR threshold:     25

search line:     22  SLC-1:  39582   SLC-2:  39582  azoff_init:    0  roff_init:    0
search line:     22  offsets above SNR threshold:     22

search line:     23  SLC-1:  41379   SLC-2:  41379  azoff_init:    0  roff_init:    0
search line:     23  offsets above SNR threshold:     18
```

```
search line:     24  SLC-1:  43176   SLC-2:  43176  azoff_init:    0  roff_init:    0
search line:     24  offsets above SNR threshold:     21

search line:     25  SLC-1:  44973   SLC-2:  44973  azoff_init:    0  roff_init:    0
search line:     25  offsets above SNR threshold:     18

search line:     26  SLC-1:  46770   SLC-2:  46770  azoff_init:    0  roff_init:    0
search line:     26  offsets above SNR threshold:     18

search line:     27  SLC-1:  48567   SLC-2:  48567  azoff_init:    0  roff_init:    0
search line:     27  offsets above SNR threshold:     11

search line:     28  SLC-1:  50364   SLC-2:  50364  azoff_init:    0  roff_init:    0
search line:     28  offsets above SNR threshold:     18

search line:     29  SLC-1:  52161   SLC-2:  52161  azoff_init:    0  roff_init:    0
search line:     29  offsets above SNR threshold:     17

search line:     30  SLC-1:  53958   SLC-2:  53958  azoff_init:    0  roff_init:    0
search line:     30  offsets above SNR threshold:     23

search line:     31  SLC-1:  55755   SLC-2:  55755  azoff_init:    0  roff_init:    0
search line:     31  offsets above SNR threshold:     23

search line:     32  SLC-1:  57552   SLC-2:  57552  azoff_init:    0  roff_init:    0
search line:     32  offsets above SNR threshold:     10

search line:     33  SLC-1:  59349   SLC-2:  59349  azoff_init:    0  roff_init:    0
search line:     33  offsets above SNR threshold:     24

search line:     34  SLC-1:  61146   SLC-2:  61146  azoff_init:    0  roff_init:    0
search line:     34  offsets above SNR threshold:     14

search line:     35  SLC-1:  62943   SLC-2:  62943  azoff_init:    0  roff_init:    0
search line:     35  offsets above SNR threshold:     21

search line:     36  SLC-1:  64740   SLC-2:  64740  azoff_init:    0  roff_init:    0
search line:     36  offsets above SNR threshold:     25

search line:     37  SLC-1:  66537   SLC-2:  66537  azoff_init:    0  roff_init:    0
search line:     37  offsets above SNR threshold:     23

search line:     38  SLC-1:  68334   SLC-2:  68334  azoff_init:    0  roff_init:    0
search line:     38  offsets above SNR threshold:     21

search line:     39  SLC-1:  70131   SLC-2:  70131  azoff_init:    0  roff_init:    0
search line:     39  offsets above SNR threshold:     14

search line:     40  SLC-1:  71928   SLC-2:  71928  azoff_init:    0  roff_init:    0
search line:     40  offsets above SNR threshold:     20

search line:     41  SLC-1:  73725   SLC-2:  73725  azoff_init:    0  roff_init:    0
search line:     41  offsets above SNR threshold:     14

search line:     42  SLC-1:  75522   SLC-2:  75522  azoff_init:    0  roff_init:    0
search line:     42  offsets above SNR threshold:     12

search line:     43  SLC-1:  77319   SLC-2:  77319  azoff_init:    0  roff_init:    0
search line:     43  offsets above SNR threshold:     12

search line:     44  SLC-1:  79116   SLC-2:  79116  azoff_init:    0  roff_init:    0
search line:     44  offsets above SNR threshold:     11

search line:     45  SLC-1:  80913   SLC-2:  80913  azoff_init:    0  roff_init:    0
search line:     45  offsets above SNR threshold:      5

search line:     46  SLC-1:  82710   SLC-2:  82710  azoff_init:    0  roff_init:    0
search line:     46  offsets above SNR threshold:      5

search line:     47  SLC-1:  84507   SLC-2:  84507  azoff_init:    0  roff_init:    0
search line:     47  offsets above SNR threshold:      5

search line:     48  SLC-1:  86304   SLC-2:  86304  azoff_init:    0  roff_init:    0
search line:     48  offsets above SNR threshold:      4

search line:     49  SLC-1:  88101   SLC-2:  88101  azoff_init:    0  roff_init:    0
search line:     49  offsets above SNR threshold:      1
```

```
search line:     50  SLC-1:  89898   SLC-2:  89898  azoff_init:    0  roff_init:    0
search line:     50  offsets above SNR threshold:      0

search line:     51  SLC-1:  91695   SLC-2:  91695  azoff_init:    0  roff_init:    0
search line:     51  offsets above SNR threshold:      2

search line:     52  SLC-1:  93492   SLC-2:  93492  azoff_init:    0  roff_init:    0
search line:     52  offsets above SNR threshold:      0

search line:     53  SLC-1:  95289   SLC-2:  95289  azoff_init:    0  roff_init:    0
search line:     53  offsets above SNR threshold:      0

search line:     54  SLC-1:  97086   SLC-2:  97086  azoff_init:    0  roff_init:    0
search line:     54  offsets above SNR threshold:      0

search line:     55  SLC-1:  98883   SLC-2:  98883  azoff_init:    0  roff_init:    0
search line:     55  offsets above SNR threshold:      0

search line:     56  SLC-1: 100680   SLC-2: 100680  azoff_init:    0  roff_init:    0
search line:     56  offsets above SNR threshold:      0

search line:     57  SLC-1: 102477   SLC-2: 102477  azoff_init:    0  roff_init:    0
search line:     57  offsets above SNR threshold:      0

search line:     58  SLC-1: 104274   SLC-2: 104274  azoff_init:    0  roff_init:    0
search line:     58  offsets above SNR threshold:      0

search line:     59  SLC-1: 106071   SLC-2: 106071  azoff_init:    0  roff_init:    0
search line:     59  offsets above SNR threshold:      0

search line:     60  SLC-1: 107868   SLC-2: 107868  azoff_init:    0  roff_init:    0
search line:     60  offsets above SNR threshold:      0

search line:     61  SLC-1: 109665   SLC-2: 109665  azoff_init:    0  roff_init:    0
search line:     61  offsets above SNR threshold:      0

search line:     62  SLC-1: 111462   SLC-2: 111462  azoff_init:    0  roff_init:    0
search line:     62  offsets above SNR threshold:      0
search line:     63  offsets above SNR threshold:      0

number of offsets above SNR threshold: 616 of 2048
output binary offset file: rslc_WBs2/20071020_4_20101028_4_2.offs
output binary SNR file: rslc_WBs2/20071020_4_20101028_4_2.snr
writing OFF_par file: rslc_WBs2/20071020_4_20101028_4_2.off

user time (s):       269.430
system time (s):       2.640
elapsed time (s):    352.080


offset_fit rslc_WBs2/20071020_4_20101028_4_2.offs rslc_WBs2/20071020_4_20101028_4_2.snr
rslc_WBs2/20071020_4_20101028_4_2.off rslc_WBs2/20071020_4_20101028_4_2.coffs - - 3
*** Range and azimuth offset polynomial estimation ***
*** Copyright 2011, Gamma Remote Sensing, v3.2 11-Apr-2011 clw/uw ***
offsets: rslc_WBs2/20071020_4_20101028_4_2.offs
SNR data: rslc_WBs2/20071020_4_20101028_4_2.snr
ISP offset parameters: rslc_WBs2/20071020_4_20101028_4_2.off
culled offsets (fcomplex): rslc_WBs2/20071020_4_20101028_4_2.coffs

number of offset polynomial parameters: 3: a0 + a1*x + a2*y
number of range samples: 32  number of azimuth samples: 64
number of samples in offset map: 2048
range sample spacing: 138  azimuth sample spacing: 1797
solution: 616 offset estimates accepted out of 2048 samples

range fit SVD singular values:        2.37961e+07   1.42895e+02   4.86606e+05
azimuth fit SVD singular values:      2.37961e+07   1.42895e+02   4.86606e+05
range offset poly. coeff.:               0.02359   6.87623e-06  -8.29083e-07
azimuth offset poly. coeff.:            -0.73843   1.84092e-04   1.03745e-05
model fit std. dev. (samples) range:   0.3128  azimuth:   3.3117
range, azimuth error thresholds:     0.7820     8.0000
SNR threshold:    12.0000

range fit SVD singular values:        2.35324e+07   1.41299e+02   4.84612e+05
azimuth fit SVD singular values:      2.35324e+07   1.41299e+02   4.84612e+05
```

```
*** improved least-squares polynomial coefficients 1 ***
solution: 609 offset estimates accepted out of 2048 samples
range offset poly. coeff.:                0.01020   9.35232e-07  -1.96912e-07
azimuth offset poly. coeff.:              0.08881   3.07012e-05  -2.13658e-06
model fit std. dev. (samples) range:   0.0836  azimuth:   0.8065
range, azimuth error thresholds:     0.2089     2.0163
SNR threshold:    12.0000

range fit SVD singular values:        2.28224e+07   1.39158e+02   4.74308e+05
azimuth fit SVD singular values:      2.28224e+07   1.39158e+02   4.74308e+05

*** improved least-squares polynomial coefficients 2 ***
solution: 576 offset estimates accepted out of 2048 samples
range offset poly. coeff.:                0.01419   9.74631e-07  -2.46727e-07
azimuth offset poly. coeff.:              0.00570   3.24373e-05  -4.29419e-07
model fit std. dev. (samples) range:   0.0617  azimuth:   0.4090
range, azimuth error thresholds:     0.1543     1.0226
SNR threshold:    12.0000

range fit SVD singular values:        2.21048e+07   1.36497e+02   4.58851e+05
azimuth fit SVD singular values:      2.21048e+07   1.36497e+02   4.58851e+05

*** improved least-squares polynomial coefficients 3 ***
solution: 540 offset estimates accepted out of 2048 samples
range offset poly. coeff.:                0.01643   5.26696e-07  -2.72605e-07
azimuth offset poly. coeff.:              0.02229   2.97886e-05  -8.12854e-07
model fit std. dev. (samples) range:   0.0545  azimuth:   0.2908
range, azimuth error thresholds:     0.1363     0.7270
SNR threshold:    12.0000

range fit SVD singular values:        2.18643e+07   1.33624e+02   4.38852e+05
azimuth fit SVD singular values:      2.18643e+07   1.33624e+02   4.38852e+05

*** improved least-squares polynomial coefficients 4 ***
solution: 519 offset estimates accepted out of 2048 samples
range offset poly. coeff.:                0.01674   7.08400e-08  -2.36877e-07
azimuth offset poly. coeff.:              0.01090   1.79369e-05  -2.98312e-07
model fit std. dev. (samples) range:   0.0526  azimuth:   0.2499
range, azimuth error thresholds:     0.1314     0.6246
SNR threshold:    12.0000

range fit SVD singular values:        2.14754e+07   1.30912e+02   4.21902e+05
azimuth fit SVD singular values:      2.14754e+07   1.30912e+02   4.21902e+05

*** improved least-squares polynomial coefficients 5 ***
solution: 499 offset estimates accepted out of 2048 samples
range offset poly. coeff.:                0.01158   6.83550e-08  -1.25702e-07
azimuth offset poly. coeff.:              0.04661   1.92508e-05  -1.04622e-06
model fit std. dev. (samples) range:   0.0513  azimuth:   0.2223
range, azimuth error thresholds:     0.1283     0.5557
SNR threshold:    12.0000

range fit SVD singular values:        2.13248e+07   1.30050e+02   4.16834e+05
azimuth fit SVD singular values:      2.13248e+07   1.30050e+02   4.16834e+05

*** improved least-squares polynomial coefficients 6 ***
solution: 489 offset estimates accepted out of 2048 samples
range offset poly. coeff.:                0.01056  -6.94865e-07  -6.98571e-08
azimuth offset poly. coeff.:              0.05073   2.11964e-05  -1.11701e-06
model fit std. dev. (samples) range:   0.0504  azimuth:   0.2107
range, azimuth error thresholds:     0.1259     0.5266
SNR threshold:    12.0000

range fit SVD singular values:        2.11732e+07   1.29110e+02   4.11641e+05
azimuth fit SVD singular values:      2.11732e+07   1.29110e+02   4.11641e+05

*** improved least-squares polynomial coefficients 7 ***
solution: 480 offset estimates accepted out of 2048 samples
range offset poly. coeff.:                0.00844  -1.09955e-06  -1.67102e-08
azimuth offset poly. coeff.:              0.04744   1.93940e-05  -1.00356e-06
model fit std. dev. (samples) range:   0.0491  azimuth:   0.2031

total number of culling iterations: 7
final solution: 480 offset estimates accepted out of 2048 samples

final range offset poly. coeff.:             0.00844  -1.09955e-06  -1.67102e-08
final range offset poly. coeff. errors:   3.80032e-04   1.20939e-07   7.72348e-09
```

```
final azimuth offset poly. coeff.:              0.04744   1.93940e-05  -1.00356e-06
final azimuth offset poly. coeff. errors:   1.57292e-03   5.00557e-07   3.19668e-08

final model fit std. dev. (samples) range:   0.0491  azimuth:   0.2031

binary culled offsets: rslc_WBs2/20071020_4_20101028_4_2.coffs
updating ISP offset parameters: rslc_WBs2/20071020_4_20101028_4_2.off

user time (s):         0.010
system time (s):       0.000
elapsed time (s):      0.010

residual offset polynomials 1:

range_offset_polynomial: 0.00844 -1.0996e-06 -1.6710e-08 0.0000e+00 0.0000e+00 0.0000e+00
azimuth_offset_polynomial: 0.04744 1.9394e-05 -1.0036e-06 0.0000e+00 0.0000e+00 0.0000e+00

*** ref. SLC: rslc_WBs2/20071020_4.rslc   SLC-2: slc_WBs2/20101028_4.slc  END: Sun Apr 10 20:28:54 2011
```

7 Appendix 5: Differential Interferometric Processing

```
 ./mk_diff_orb_2d RSLC_WBs2_5_tab itab_WB geo_WBs2/nz_WBs2_dem_5.rdc - rmli_WBs2/rmli_WBs2_5.ave
rmli_WBs2 diff0_orb_2d_WBs2 3 16 7 1 0

./mk_diff_orb_2d  RSLC_WBs2_5_tab itab_WB geo_WBs2/nz_WBs2_dem_5.rdc - rmli_WBs2/rmli_WBs2_5.ave
rmli_WBs2 diff0_orb_2d_WBs2 3 16 7 1 0

start: Sun Apr 10 23:04:18 2011  log file: diff0_orb_2d_WBs2/mk_diff_2d.log
itab:                   itab_WB
DEM data:               geo_WBs2/nz_WBs2_dem_5.rdc
deformation data:       -
baseline flag:
diff. directory:        diff0_orb_2d_WBs2
interf. looks range: 3  azimuth: 16
correlation window size: 7
NOTE: applying range spectral shift filtering
NOTE: not applying azimuth common band filtering

 1  rslc_WBs2/20071020_5.rslc  rslc_WBs2/20071020_5.rslc.par
 2  rslc_WBs2/20101028_5.rslc  rslc_WBs2/20101028_5.rslc.par

*** 1  SLC1: rslc_WBs2/20071020_5.rslc  SLC2: rslc_WBs2/20101028_5.rslc  OFF:
diff0_orb_2d_WBs2/20071020_5_20101028_5.off ***

create_offset rslc_WBs2/20071020_5.rslc.par rslc_WBs2/20101028_5.rslc.par
diff0_orb_2d_WBs2/20071020_5_20101028_5.off 1 3 16 < diff0_orb_2d_WBs2/off_par.in

*** ISP offset/interferogram parameter file creation/update ***
*** Copyright 2006 Gamma Remote Sensing v4.8 clw/uw 14-Feb-2008 ***

SLC-1 title: ALPSRS092604500
SLC-1 Doppler centroid at center swath (Hz):      0.000
SLC-1 number of range samples:             4652
SLC-1 number of image lines:             113346
SLC-1 slant range pixel spacing (m):   9.368514
SLC-1 azimuth sample spacing (m):      3.184375

SLC-2 title: ALPSRS253644500
SLC-2 Doppler centroid at center swath (Hz):      0.000
SLC-2 number of range samples:             4652
SLC-2 number of lines:                   113346
SLC-2 slant range pixel spacing (m):   9.384471
SLC-2 azimuth sample spacing (m):      3.184375

OFFSET ALGORITHM: intensity cross-correlation

*** DEFAULT INTERFEROGRAM PARAMETERS ***
interferogram range looks:   3
interferogram azimuth looks: 16
interferogram range width pixels:   1550
interferogram azimuth lines:        7084
interferogram range pixel spacing (m):      28.10554
interferogram azimuth line spacing (m):     50.95000

interferogram/offset parameter file: diff0_orb_2d_WBs2/20071020_5_20101028_5.off

user time (s):         0.010
system time (s):       0.000
elapsed time (s):      0.000


create_diff_par diff0_orb_2d_WBs2/20071020_5_20101028_5.off -
diff0_orb_2d_WBs2/20071020_5_20101028_5.diff_par < diff0_orb_2d_WBs2/diff_par.in

*** create DIFF_par parameter file for image registration and geocoding
*** Copyright 2008, Gamma Remote Sensing, v2.6 10-Mar-2008 clw/uw ***
PAR_type 0: OFF_par  (ISP interferogram/offset parameter files)
NOTE: No second OFF_par parameter file provided
output DIFF/GEO parameter file: diff0_orb_2d_WBs2/20071020_5_20101028_5.diff_par

user time (s):         0.010
system time (s):       0.000
elapsed time (s):      0.000

phase_sim_orb rslc_WBs2/20071020_5.rslc.par rslc_WBs2/20101028_5.rslc.par
```

```
diff0_orb_2d_WBs2/20071020_5_20101028_5.off geo_WBs2/nz_WBs2_dem_5.rdc
diff0_orb_2d_WBs2/20071020_5_20101028_5.sim_unw - 1104

*** Simulate unwrapped interferometric phase using DEM height and deformation rate using orbit geometry
alone ***
*** Copyright 2011, Gamma Remote Sensing, v1.4 22-Mar-2011 clw ***
SLC-1 SLC image parameter file: rslc_WBs2/20071020_5.rslc.par
SLC-2R image parameter file: rslc_WBs2/20101028_5.rslc.par
ISP interferogram/offset parameter file: diff0_orb_2d_WBs2/20071020_5_20101028_5.off
height map file: geo_WBs2/nz_WBs2_dem_5.rdc
output simulated interferometric phase: diff0_orb_2d_WBs2/20071020_5_20101028_5.sim_unw

NOTE: no deformation rate file entered: deformation rate set to 0.0

interf. lines: 7084   range samples: 1550
SLC-1 wavevector (rad/m):      -53.234464
SLC-2 wavevector (rad/m):      -53.234464
interf. slant range pixel (m):  28.105542
interf. azimuth pixel (m):      50.950000
SLC slant range pixel (m):       9.368514
SLC azimuth pixel (m):           3.184375
effective PRF (Hz):              2150.538
Doppler centroid (Hz):              0.000
SLC data are deskewed: zero Doppler is used for baseline estimation
SAR antenna azimuth angle (deg.):   90.00 (right looking)

output line:      0  SLC-1 azimuth line: 8.0
output line:    708  SLC-1 azimuth line: 11336.0
output line:   1416  SLC-1 azimuth line: 22664.0
output line:   2124  SLC-1 azimuth line: 33992.0
output line:   2832  SLC-1 azimuth line: 45320.0
output line:   3540  SLC-1 azimuth line: 56648.0
output line:   4248  SLC-1 azimuth line: 67976.0
output line:   4956  SLC-1 azimuth line: 79304.0
output line:   5664  SLC-1 azimuth line: 90632.0
output line:   6372  SLC-1 azimuth line: 101960.0
output line:   7080  SLC-1 azimuth line: 113288.0
simulated unwrapped phase: diff0_orb_2d_WBs2/20071020_5_20101028_5.sim_unw  width: 1550 lines: 7084

user time (s):        68.090
system time (s):       0.050
elapsed time (s):     68.290


SLC_diff_intf rslc_WBs2/20071020_5.rslc rslc_WBs2/20101028_5.rslc rslc_WBs2/20071020_5.rslc.par
rslc_WBs2/20101028_5.rslc.par diff0_orb_2d_WBs2/20071020_5_20101028_5.off
diff0_orb_2d_WBs2/20071020_5_20101028_5.sim_unw diff0_orb_2d_WBs2/20071020_5_20101028_5.diff 3 16 1 0

*** Differential interferogram generation from co-registered SLCs and a simulated interferogram ***
*** Copyright 2019, Gamma Remote Sensing, v2.4 clw/uw 29-Jun-2010 ***
NOTE: applying common range spectrum filtering
NOTE: not applying azimuth common band filter
SLC-1 phase: reference function center
SLC-2R phase: reference function center
lines in the simulated interferogram file: 7084

IMAGE/OFFSET PARAMETERS:

line offset relative to start of SLC-1:          0
number of lines to process SLC-1:           113344
SLC-1 range samples:                          4652
SLC-1 azimuth samples (along-track):        113346
SLC-1 line header size (bytes)                   0
SLC-1 range pixel size (m):                9.36851
SLC-1 azimuth pixel size (m):              3.18438

SLC-2 range samples:                          4652
SLC-2 azimuth samples (along-track):        113346
SLC-2 line header size (bytes)                   0

range_offset_polynomial:      0.0000e+00   0.0000e+00   0.0000e+00   0.0000e+00
azimuth_offset_polynomial:    0.0000e+00   0.0000e+00   0.0000e+00   0.0000e+00
number of lines in the simulated interferogram: 7084
resampled SLC-2R width (samples):             4652
interferogram range looks:                       3
interferogram azimuth looks:                    16
interferogram range pixel spacing (m):    28.10554
```

```
interferogram azimuth pixel spacing (m):  50.95000
interferogram width (samples):                1550
number of azimuth common band filters: 10
number of lines/input SLC data block:   1024
filtered lines/input SLC data block:     959
output lines/input SLC data block:        59

block:  0  output line:      0  SLC 1_start:      0  SLC 1_end:    991  overlap_save start line:    -32
SLC-1 phase gradients (rad/sample) range:  -0.008988   azimuth:   0.020743
range spectrum phase gradiant:     0.0000
number of range segments: 19

iter:  1  slant range(m):  914511.081   azimuth time:  79407.99119  Doppler-1:     0.000  Doppler-2:-12669.320
alpha(s): -26.452504
SLC-2 SAR position vector (m)  : -5.05206829e+06  1.57365323e+05 -4.95734505e+06
SLC-2 SAR velocity vector (m/s):  5.19880788e+03  1.69561927e+03 -5.24890102e+03
SLC-2 look vector (m):            3.27882599e+05  4.44485593e+05  7.28873156e+05

iter:  2  slant range(m):  894590.403   azimuth time:  79381.53869  Doppler-1:     0.000  Doppler-2:    49.604
alpha(s): 0.101313
SLC-2 SAR position vector (m)  : -5.18751277e+06  1.12193772e+05 -4.81656703e+06
SLC-2 SAR velocity vector (m/s):  5.04108355e+03  1.71935215e+03 -5.39423939e+03
SLC-2 look vector (m):            4.63327072e+05  4.89657143e+05  5.88095141e+05

iter:  3  slant range(m):  894590.108   azimuth time:  79381.64000  Doppler-1:     0.000  Doppler-2:    -0.199
alpha(s): -0.000407
SLC-2 SAR position vector (m)  : -5.18700201e+06  1.12367961e+05 -4.81711352e+06
SLC-2 SAR velocity vector (m/s):  5.04169546e+03  1.71926496e+03 -5.39369071e+03
SLC-2 look vector (m):            4.62816312e+05  4.89482954e+05  5.88641622e+05

iter:  4  slant range(m):  894590.108   azimuth time:  79381.63959  Doppler-1:     0.000  Doppler-2:     0.001
alpha(s): 0.000002
SLC-2 SAR position vector (m)  : -5.18700406e+06  1.12367261e+05 -4.81711132e+06
SLC-2 SAR velocity vector (m/s):  5.04169300e+03  1.71926531e+03 -5.39369291e+03
SLC-2 look vector (m):            4.62818365e+05  4.89483655e+05  5.88639426e+05

iter:  1  slant range(m):  895059.382   azimuth time:  79381.63959  Doppler-1:     0.000  Doppler-2:    -0.013
alpha(s): -0.000027
SLC-2 SAR position vector (m)  : -5.18700406e+06  1.12367261e+05 -4.81711132e+06
SLC-2 SAR velocity vector (m/s):  5.04169300e+03  1.71926531e+03 -5.39369291e+03
SLC-2 look vector (m):            4.62756481e+05  4.90195760e+05  5.88808842e+05

iter:  2  slant range(m):  895059.382   azimuth time:  79381.63957  Doppler-1:     0.000  Doppler-2:     0.000
alpha(s): 0.000000
SLC-2 SAR position vector (m)  : -5.18700420e+06  1.12367214e+05 -4.81711117e+06
SLC-2 SAR velocity vector (m/s):  5.04169284e+03  1.71926534e+03 -5.39369306e+03
SLC-2 look vector (m):            4.62756618e+05  4.90195807e+05  5.88808696e+05
is:    0 rpix:         0.0  ky1:     33.9329  ky2:     33.9944  dk:     0.06154  df: 2.30323e+06  rdf:  0.1440 rbw:
0.6214

iter:  1  slant range(m):  896936.458   azimuth time:  79381.63957  Doppler-1:     0.000  Doppler-2:    -0.056
alpha(s): -0.000114
SLC-2 SAR position vector (m)  : -5.18700420e+06  1.12367214e+05 -4.81711117e+06
SLC-2 SAR velocity vector (m/s):  5.04169284e+03  1.71926534e+03 -5.39369306e+03
SLC-2 look vector (m):            4.62510263e+05  4.93037756e+05  5.89485401e+05

iter:  2  slant range(m):  896936.458   azimuth time:  79381.63945  Doppler-1:     0.000  Doppler-2:     0.000
alpha(s): 0.000000
SLC-2 SAR position vector (m)  : -5.18700477e+06  1.12367018e+05 -4.81711056e+06
SLC-2 SAR velocity vector (m/s):  5.04169215e+03  1.71926544e+03 -5.39369368e+03
SLC-2 look vector (m):            4.62510839e+05  4.93037953e+05  5.89484784e+05

iter:  1  slant range(m):  897405.722   azimuth time:  79381.63945  Doppler-1:     0.000  Doppler-2:    -0.014
alpha(s): -0.000028
SLC-2 SAR position vector (m)  : -5.18700477e+06  1.12367018e+05 -4.81711056e+06
SLC-2 SAR velocity vector (m/s):  5.04169215e+03  1.71926544e+03 -5.39369368e+03
SLC-2 look vector (m):            4.62449543e+05  4.93746836e+05  5.89653722e+05

iter:  2  slant range(m):  897405.722   azimuth time:  79381.63942  Doppler-1:     0.000  Doppler-2:     0.000
alpha(s): 0.000000
SLC-2 SAR position vector (m)  : -5.18700491e+06  1.12366969e+05 -4.81711040e+06
SLC-2 SAR velocity vector (m/s):  5.04169198e+03  1.71926546e+03 -5.39369383e+03
SLC-2 look vector (m):            4.62449685e+05  4.93746884e+05  5.89653571e+05
is:    1 rpix:       250.0  ky1:     34.0855  ky2:     34.1466  dk:     0.06106  df: 2.27513e+06  rdf:  0.1422 rbw:
0.6229

iter:  1  slant range(m):  899282.758   azimuth time:  79381.63942  Doppler-1:     0.000  Doppler-2:    -0.055
alpha(s): -0.000114
SLC-2 SAR position vector (m)  : -5.18700491e+06  1.12366969e+05 -4.81711040e+06
SLC-2 SAR velocity vector (m/s):  5.04169198e+03  1.71926546e+03 -5.39369383e+03
SLC-2 look vector (m):            4.62205663e+05  4.96576079e+05  5.90328385e+05

iter:  2  slant range(m):  899282.758   azimuth time:  79381.63931  Doppler-1:     0.000  Doppler-2:     0.000
alpha(s): 0.000000
SLC-2 SAR position vector (m)  : -5.18700549e+06  1.12366774e+05 -4.81710979e+06
SLC-2 SAR velocity vector (m/s):  5.04169129e+03  1.71926556e+03 -5.39369445e+03
SLC-2 look vector (m):            4.62206236e+05  4.96576274e+05  5.90327771e+05
```

```
iter:  1  slant range(m):  899752.011   azimuth time:  79381.63931  Doppler-1:     0.000  Doppler-2:    -0.014
alpha(s): -0.000028
SLC-2 SAR position vector (m)  : -5.18700549e+06  1.12366774e+05 -4.81710979e+06
SLC-2 SAR velocity vector (m/s):  5.04169129e+03  1.71926556e+03 -5.39369445e+03
SLC-2 look vector (m):            4.62145519e+05  4.97282002e+05  5.90496242e+05

iter:  2  slant range(m):  899752.011   azimuth time:  79381.63928  Doppler-1:     0.000  Doppler-2:     0.000
alpha(s): 0.000000
SLC-2 SAR position vector (m)  : -5.18700563e+06  1.12366726e+05 -4.81710964e+06
SLC-2 SAR velocity vector (m/s):  5.04169112e+03  1.71926558e+03 -5.39369460e+03
SLC-2 look vector (m):            4.62145660e+05  4.97282050e+05  5.90496091e+05
is:    2 rpix:       500.0  ky1:     34.2362  ky2:     34.2968  dk:     0.06059  df: 2.24758e+06  rdf:  0.1405 rbw:
0.6243

iter:  1  slant range(m):  901629.006   azimuth time:  79381.63928  Doppler-1:     0.000  Doppler-2:    -0.055
alpha(s): -0.000113
SLC-2 SAR position vector (m)  : -5.18700563e+06  1.12366726e+05 -4.81710964e+06
SLC-2 SAR velocity vector (m/s):  5.04169112e+03  1.71926558e+03 -5.39369460e+03
SLC-2 look vector (m):            4.61903931e+05  5.00098754e+05  5.91169063e+05

iter:  2  slant range(m):  901629.006   azimuth time:  79381.63917  Doppler-1:     0.000  Doppler-2:     0.000
alpha(s): 0.000000
SLC-2 SAR position vector (m)  : -5.18700620e+06  1.12366531e+05 -4.81710903e+06
SLC-2 SAR velocity vector (m/s):  5.04169044e+03  1.71926568e+03 -5.39369521e+03
SLC-2 look vector (m):            4.61904502e+05  5.00098948e+05  5.91168452e+05

iter:  1  slant range(m):  902098.250   azimuth time:  79381.63917  Doppler-1:     0.000  Doppler-2:    -0.014
alpha(s): -0.000028
SLC-2 SAR position vector (m)  : -5.18700620e+06  1.12366531e+05 -4.81710903e+06
SLC-2 SAR velocity vector (m/s):  5.04169044e+03  1.71926568e+03 -5.39369521e+03
SLC-2 look vector (m):            4.61844353e+05  5.00801585e+05  5.91336468e+05

iter:  2  slant range(m):  902098.250   azimuth time:  79381.63914  Doppler-1:     0.000  Doppler-2:     0.000
alpha(s): 0.000000
SLC-2 SAR position vector (m)  : -5.18700634e+06  1.12366483e+05 -4.81710888e+06
SLC-2 SAR velocity vector (m/s):  5.04169027e+03  1.71926570e+03 -5.39369536e+03
SLC-2 look vector (m):            4.61844494e+05  5.00801633e+05  5.91336318e+05
is:    3 rpix:       750.0  ky1:     34.3851  ky2:     34.4452  dk:     0.06012  df: 2.22057e+06  rdf:  0.1388 rbw:
0.6258

iter:  1  slant range(m):  903975.206   azimuth time:  79381.63914  Doppler-1:     0.000  Doppler-2:    -0.055
alpha(s): -0.000113
SLC-2 SAR position vector (m)  : -5.18700634e+06  1.12366483e+05 -4.81710888e+06
SLC-2 SAR velocity vector (m/s):  5.04169027e+03  1.71926570e+03 -5.39369536e+03
SLC-2 look vector (m):            4.61605020e+05  5.03606102e+05  5.92007493e+05

iter:  2  slant range(m):  903975.206   azimuth time:  79381.63903  Doppler-1:     0.000  Doppler-2:     0.000
alpha(s): 0.000000
SLC-2 SAR position vector (m)  : -5.18700691e+06  1.12366289e+05 -4.81710827e+06
SLC-2 SAR velocity vector (m/s):  5.04168959e+03  1.71926580e+03 -5.39369597e+03
SLC-2 look vector (m):            4.61605589e+05  5.03606296e+05  5.92006885e+05

iter:  1  slant range(m):  904444.440   azimuth time:  79381.63903  Doppler-1:     0.000  Doppler-2:    -0.013
alpha(s): -0.000028
SLC-2 SAR position vector (m)  : -5.18700691e+06  1.12366289e+05 -4.81710827e+06
SLC-2 SAR velocity vector (m/s):  5.04168959e+03  1.71926580e+03 -5.39369597e+03
SLC-2 look vector (m):            4.61545999e+05  5.04305906e+05  5.92174458e+05

iter:  2  slant range(m):  904444.440   azimuth time:  79381.63900  Doppler-1:     0.000  Doppler-2:     0.000
alpha(s): 0.000000
SLC-2 SAR position vector (m)  : -5.18700705e+06  1.12366241e+05 -4.81710812e+06
SLC-2 SAR velocity vector (m/s):  5.04168942e+03  1.71926582e+03 -5.39369612e+03
SLC-2 look vector (m):            4.61546139e+05  5.04305954e+05  5.92174309e+05
is:    4 rpix:      1000.0  ky1:     34.5322  ky2:     34.5919  dk:     0.05966  df: 2.19408e+06  rdf:  0.1371 rbw:
0.6272

iter:  1  slant range(m):  906321.357   azimuth time:  79381.63900  Doppler-1:     0.000  Doppler-2:    -0.054
alpha(s): -0.000112
SLC-2 SAR position vector (m)  : -5.18700705e+06  1.12366241e+05 -4.81710812e+06
SLC-2 SAR velocity vector (m/s):  5.04168942e+03  1.71926582e+03 -5.39369612e+03
SLC-2 look vector (m):            4.61308885e+05  5.07098436e+05  5.92843733e+05

iter:  2  slant range(m):  906321.357   azimuth time:  79381.63889  Doppler-1:     0.000  Doppler-2:     0.000
alpha(s): 0.000000
SLC-2 SAR position vector (m)  : -5.18700762e+06  1.12366048e+05 -4.81710751e+06
SLC-2 SAR velocity vector (m/s):  5.04168874e+03  1.71926592e+03 -5.39369673e+03
SLC-2 look vector (m):            4.61309451e+05  5.07098629e+05  5.92843127e+05

iter:  1  slant range(m):  906790.582   azimuth time:  79381.63889  Doppler-1:     0.000  Doppler-2:    -0.013
alpha(s): -0.000028
SLC-2 SAR position vector (m)  : -5.18700762e+06  1.12366048e+05 -4.81710751e+06
SLC-2 SAR velocity vector (m/s):  5.04168874e+03  1.71926592e+03 -5.39369673e+03
SLC-2 look vector (m):            4.61250412e+05  5.07795272e+05  5.93010268e+05

iter:  2  slant range(m):  906790.582   azimuth time:  79381.63886  Doppler-1:     0.000  Doppler-2:     0.000
alpha(s): 0.000000
SLC-2 SAR position vector (m)  : -5.18700776e+06  1.12366001e+05 -4.81710737e+06
```

```
SLC-2 SAR velocity vector (m/s):  5.04168858e+03  1.71926595e+03 -5.39369688e+03
SLC-2 look vector (m):            4.61250551e+05  5.07795320e+05  5.93010119e+05
is:    5 rpix:      1250.0  ky1:     34.6775  ky2:     34.7367  dk:     0.05920  df: 2.16810e+06  rdf:  0.1355 rbw:
0.6286

iter:  1  slant range(m):  908667.461   azimuth time:  79381.63886  Doppler-1:     0.000  Doppler-2:    -0.054
alpha(s): -0.000112
SLC-2 SAR position vector (m)  : -5.18700776e+06  1.12366001e+05 -4.81710737e+06
SLC-2 SAR velocity vector (m/s):  5.04168858e+03  1.71926595e+03 -5.39369688e+03
SLC-2 look vector (m):            4.61015481e+05  5.10576056e+05  5.93677836e+05

iter:  2  slant range(m):  908667.461   azimuth time:  79381.63875  Doppler-1:     0.000  Doppler-2:     0.000
alpha(s): 0.000000
SLC-2 SAR position vector (m)  : -5.18700832e+06  1.12365808e+05 -4.81710676e+06
SLC-2 SAR velocity vector (m/s):  5.04168790e+03  1.71926604e+03 -5.39369749e+03
SLC-2 look vector (m):            4.61016045e+05  5.10576248e+05  5.93677232e+05

iter:  1  slant range(m):  909136.676   azimuth time:  79381.63875  Doppler-1:     0.000  Doppler-2:    -0.013
alpha(s): -0.000027
SLC-2 SAR position vector (m)  : -5.18700832e+06  1.12365808e+05 -4.81710676e+06
SLC-2 SAR velocity vector (m/s):  5.04168790e+03  1.71926604e+03 -5.39369749e+03
SLC-2 look vector (m):            4.60957547e+05  5.11269984e+05  5.93843952e+05

iter:  2  slant range(m):  909136.676   azimuth time:  79381.63872  Doppler-1:     0.000  Doppler-2:     0.000
alpha(s): 0.000000
SLC-2 SAR position vector (m)  : -5.18700846e+06  1.12365761e+05 -4.81710661e+06
SLC-2 SAR velocity vector (m/s):  5.04168773e+03  1.71926607e+03 -5.39369764e+03
SLC-2 look vector (m):            4.60957686e+05  5.11270031e+05  5.93843804e+05
is:    6 rpix:      1500.0  ky1:     34.8211  ky2:     34.8798  dk:     0.05875  df: 2.14261e+06  rdf:  0.1339 rbw:
0.6299

iter:  1  slant range(m):  911013.518   azimuth time:  79381.63872  Doppler-1:     0.000  Doppler-2:    -0.054
alpha(s): -0.000111
SLC-2 SAR position vector (m)  : -5.18700846e+06  1.12365761e+05 -4.81710661e+06
SLC-2 SAR velocity vector (m/s):  5.04168773e+03  1.71926607e+03 -5.39369764e+03
SLC-2 look vector (m):            4.60724765e+05  5.14039253e+05  5.94509855e+05

iter:  2  slant range(m):  911013.518   azimuth time:  79381.63861  Doppler-1:     0.000  Doppler-2:     0.000
alpha(s): 0.000000
SLC-2 SAR position vector (m)  : -5.18700902e+06  1.12365569e+05 -4.81710601e+06
SLC-2 SAR velocity vector (m/s):  5.04168706e+03  1.71926616e+03 -5.39369824e+03
SLC-2 look vector (m):            4.60725326e+05  5.14039445e+05  5.94509254e+05

iter:  1  slant range(m):  911482.724   azimuth time:  79381.63861  Doppler-1:     0.000  Doppler-2:    -0.013
alpha(s): -0.000027
SLC-2 SAR position vector (m)  : -5.18700902e+06  1.12365569e+05 -4.81710601e+06
SLC-2 SAR velocity vector (m/s):  5.04168706e+03  1.71926616e+03 -5.39369824e+03
SLC-2 look vector (m):            4.60667362e+05  5.14730331e+05  5.94675562e+05

iter:  2  slant range(m):  911482.724   azimuth time:  79381.63858  Doppler-1:     0.000  Doppler-2:     0.000
alpha(s): 0.000000
SLC-2 SAR position vector (m)  : -5.18700916e+06  1.12365522e+05 -4.81710587e+06
SLC-2 SAR velocity vector (m/s):  5.04168690e+03  1.71926618e+03 -5.39369839e+03
SLC-2 look vector (m):            4.60667500e+05  5.14730378e+05  5.94675415e+05
is:    7 rpix:      1750.0  ky1:     34.9630  ky2:     35.0213  dk:     0.05830  df: 2.11760e+06  rdf:  0.1323 rbw:
0.6313

iter:  1  slant range(m):  913359.530   azimuth time:  79381.63858  Doppler-1:     0.000  Doppler-2:    -0.053
alpha(s): -0.000111
SLC-2 SAR position vector (m)  : -5.18700916e+06  1.12365522e+05 -4.81710587e+06
SLC-2 SAR velocity vector (m/s):  5.04168690e+03  1.71926618e+03 -5.39369839e+03
SLC-2 look vector (m):            4.60436695e+05  5.17488313e+05  5.95339842e+05

iter:  2  slant range(m):  913359.530   azimuth time:  79381.63847  Doppler-1:     0.000  Doppler-2:     0.000
alpha(s): 0.000000
SLC-2 SAR position vector (m)  : -5.18700972e+06  1.12365331e+05 -4.81710527e+06
SLC-2 SAR velocity vector (m/s):  5.04168623e+03  1.71926628e+03 -5.39369899e+03
SLC-2 look vector (m):            4.60437254e+05  5.17488503e+05  5.95339243e+05

iter:  1  slant range(m):  913828.727   azimuth time:  79381.63847  Doppler-1:     0.000  Doppler-2:    -0.013
alpha(s): -0.000027
SLC-2 SAR position vector (m)  : -5.18700972e+06  1.12365331e+05 -4.81710527e+06
SLC-2 SAR velocity vector (m/s):  5.04168623e+03  1.71926628e+03 -5.39369899e+03
SLC-2 look vector (m):            4.60379815e+05  5.18176595e+05  5.95505150e+05

iter:  2  slant range(m):  913828.727   azimuth time:  79381.63844  Doppler-1:     0.000  Doppler-2:     0.000
alpha(s): 0.000000
SLC-2 SAR position vector (m)  : -5.18700986e+06  1.12365285e+05 -4.81710512e+06
SLC-2 SAR velocity vector (m/s):  5.04168606e+03  1.71926630e+03 -5.39369914e+03
SLC-2 look vector (m):            4.60379952e+05  5.18176642e+05  5.95505003e+05
is:    8 rpix:      2000.0  ky1:     35.1032  ky2:     35.1610  dk:     0.05785  df: 2.09305e+06  rdf:  0.1308 rbw:
0.6326

iter:  1  slant range(m):  915705.496   azimuth time:  79381.63844  Doppler-1:     0.000  Doppler-2:    -0.053
alpha(s): -0.000111
SLC-2 SAR position vector (m)  : -5.18700986e+06  1.12365285e+05 -4.81710512e+06
SLC-2 SAR velocity vector (m/s):  5.04168606e+03  1.71926630e+03 -5.39369914e+03
SLC-2 look vector (m):            4.60151231e+05  5.20923507e+05  5.96167846e+05
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iter:  2  slant range(m):  915705.496   azimuth time:  79381.63833  Doppler-1:     0.000  Doppler-2:     0.000
alpha(s): 0.000000
SLC-2 SAR position vector (m)  : -5.18701041e+06  1.12365094e+05 -4.81710452e+06
SLC-2 SAR velocity vector (m/s):  5.04168539e+03  1.71926640e+03 -5.39369974e+03
SLC-2 look vector (m):            4.60151788e+05  5.20923698e+05  5.96167249e+05

iter:  1  slant range(m):  916174.684   azimuth time:  79381.63833  Doppler-1:     0.000  Doppler-2:    -0.013
alpha(s): -0.000027
SLC-2 SAR position vector (m)  : -5.18701041e+06  1.12365094e+05 -4.81710452e+06
SLC-2 SAR velocity vector (m/s):  5.04168539e+03  1.71926640e+03 -5.39369974e+03
SLC-2 look vector (m):            4.60094866e+05  5.21609049e+05  5.96332765e+05

iter:  2  slant range(m):  916174.684   azimuth time:  79381.63831  Doppler-1:     0.000  Doppler-2:     0.000
alpha(s): 0.000000
SLC-2 SAR position vector (m)  : -5.18701055e+06  1.12365048e+05 -4.81710438e+06
SLC-2 SAR velocity vector (m/s):  5.04168523e+03  1.71926642e+03 -5.39369988e+03
SLC-2 look vector (m):            4.60095003e+05  5.21609096e+05  5.96332619e+05
is:    9 rpix:      2250.0  ky1:     35.2418  ky2:     35.2992  dk:     0.05741  df: 2.06896e+06  rdf:  0.1293 rbw:
0.6338

iter:  1  slant range(m):  918051.419   azimuth time:  79381.63831  Doppler-1:     0.000  Doppler-2:    -0.053
alpha(s): -0.000110
SLC-2 SAR position vector (m)  : -5.18701055e+06  1.12365048e+05 -4.81710438e+06
SLC-2 SAR velocity vector (m/s):  5.04168523e+03  1.71926642e+03 -5.39369988e+03
SLC-2 look vector (m):            4.59868334e+05  5.24345105e+05  5.96993915e+05

iter:  2  slant range(m):  918051.419   azimuth time:  79381.63820  Doppler-1:     0.000  Doppler-2:     0.000
alpha(s): 0.000000
SLC-2 SAR position vector (m)  : -5.18701111e+06  1.12364858e+05 -4.81710378e+06
SLC-2 SAR velocity vector (m/s):  5.04168456e+03  1.71926652e+03 -5.39370048e+03
SLC-2 look vector (m):            4.59868889e+05  5.24345294e+05  5.96993321e+05

iter:  1  slant range(m):  918520.598   azimuth time:  79381.63820  Doppler-1:     0.000  Doppler-2:    -0.013
alpha(s): -0.000027
SLC-2 SAR position vector (m)  : -5.18701111e+06  1.12364858e+05 -4.81710378e+06
SLC-2 SAR velocity vector (m/s):  5.04168456e+03  1.71926652e+03 -5.39370048e+03
SLC-2 look vector (m):            4.59812476e+05  5.25027957e+05  5.97158455e+05

iter:  2  slant range(m):  918520.598   azimuth time:  79381.63817  Doppler-1:     0.000  Doppler-2:     0.000
alpha(s): 0.000000
SLC-2 SAR position vector (m)  : -5.18701124e+06  1.12364812e+05 -4.81710364e+06
SLC-2 SAR velocity vector (m/s):  5.04168440e+03  1.71926654e+03 -5.39370063e+03
SLC-2 look vector (m):            4.59812612e+05  5.25028004e+05  5.97158309e+05
is:   10 rpix:      2500.0  ky1:     35.3787  ky2:     35.4357  dk:     0.05698  df: 2.04530e+06  rdf:  0.1278 rbw:
0.6351

iter:  1  slant range(m):  920397.298   azimuth time:  79381.63817  Doppler-1:     0.000  Doppler-2:    -0.052
alpha(s): -0.000110
SLC-2 SAR position vector (m)  : -5.18701124e+06  1.12364812e+05 -4.81710364e+06
SLC-2 SAR velocity vector (m/s):  5.04168440e+03  1.71926654e+03 -5.39370063e+03
SLC-2 look vector (m):            4.59587965e+05  5.27753363e+05  5.97818097e+05

iter:  2  slant range(m):  920397.298   azimuth time:  79381.63806  Doppler-1:     0.000  Doppler-2:     0.000
alpha(s): 0.000000
SLC-2 SAR position vector (m)  : -5.18701179e+06  1.12364623e+05 -4.81710304e+06
SLC-2 SAR velocity vector (m/s):  5.04168374e+03  1.71926663e+03 -5.39370122e+03
SLC-2 look vector (m):            4.59588518e+05  5.27753551e+05  5.97817505e+05

iter:  1  slant range(m):  940234.285   azimuth time:  79407.99119  Doppler-1:     0.000  Doppler-2:-12324.201
alpha(s): -26.455532
SLC-2 SAR position vector (m)  : -5.05206829e+06  1.57365323e+05 -4.95734505e+06
SLC-2 SAR velocity vector (m/s):  5.19880788e+03  1.69561927e+03 -5.24890102e+03
SLC-2 look vector (m):            3.24589107e+05  4.83432878e+05  7.38224271e+05

iter:  2  slant range(m):  920866.765   azimuth time:  79381.53566  Doppler-1:     0.000  Doppler-2:    48.891
alpha(s): 0.102790
SLC-2 SAR position vector (m)  : -5.18752803e+06  1.12188565e+05 -4.81655070e+06
SLC-2 SAR velocity vector (m/s):  5.04106526e+03  1.71935475e+03 -5.39425579e+03
SLC-2 look vector (m):            4.60048847e+05  5.28609636e+05  5.97429920e+05

iter:  3  slant range(m):  920866.469   azimuth time:  79381.63845  Doppler-1:     0.000  Doppler-2:    -0.199
alpha(s): -0.000418
SLC-2 SAR position vector (m)  : -5.18700983e+06  1.12365293e+05 -4.81710515e+06
SLC-2 SAR velocity vector (m/s):  5.04168609e+03  1.71926630e+03 -5.39369911e+03
SLC-2 look vector (m):            4.59530643e+05  5.28432908e+05  5.97984368e+05

iter:  4  slant range(m):  920866.469   azimuth time:  79381.63803  Doppler-1:     0.000  Doppler-2:     0.001
alpha(s): 0.000002
SLC-2 SAR position vector (m)  : -5.18701194e+06  1.12364574e+05 -4.81710289e+06
SLC-2 SAR velocity vector (m/s):  5.04168357e+03  1.71926666e+03 -5.39370138e+03
SLC-2 look vector (m):            4.59532751e+05  5.28433627e+05  5.97982113e+05
is:   11 rpix:      2750.0  ky1:     35.5141  ky2:     35.5707  dk:     0.05655  df: 2.02207e+06  rdf:  0.1264 rbw:
0.6363

iter:  1  slant range(m):  942072.578   azimuth time:  79407.99119  Doppler-1:     0.000  Doppler-2:-12300.238
alpha(s): -26.455704
SLC-2 SAR position vector (m)  : -5.05206829e+06  1.57365323e+05 -4.95734505e+06
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SLC-2 SAR velocity vector (m/s):  5.19880788e+03  1.69561927e+03 -5.24890102e+03
SLC-2 look vector (m):            3.24366452e+05  4.86147787e+05  7.38882586e+05

iter:  2  slant range(m):  922743.431   azimuth time:  79381.53549  Doppler-1:     0.000  Doppler-2:    48.822
alpha(s): 0.102854
SLC-2 SAR position vector (m)  : -5.18752890e+06  1.12188269e+05 -4.81654977e+06
SLC-2 SAR velocity vector (m/s):  5.04106422e+03  1.71935490e+03 -5.39425672e+03
SLC-2 look vector (m):            4.59827059e+05  5.31324841e+05  5.98087308e+05

iter:  3  slant range(m):  922743.135   azimuth time:  79381.63834  Doppler-1:     0.000  Doppler-2:    -0.199
alpha(s): -0.000418
SLC-2 SAR position vector (m)  : -5.18701038e+06  1.12365106e+05 -4.81710456e+06
SLC-2 SAR velocity vector (m/s):  5.04168543e+03  1.71926639e+03 -5.39369970e+03
SLC-2 look vector (m):            4.59308536e+05  5.31148003e+05  5.98642098e+05

iter:  4  slant range(m):  922743.135   azimuth time:  79381.63792  Doppler-1:     0.000  Doppler-2:     0.001
alpha(s): 0.000002
SLC-2 SAR position vector (m)  : -5.18701249e+06  1.12364387e+05 -4.81710230e+06
SLC-2 SAR velocity vector (m/s):  5.04168291e+03  1.71926675e+03 -5.39370197e+03
SLC-2 look vector (m):            4.59310646e+05  5.31148723e+05  5.98639840e+05

iter:  1  slant range(m):  942532.171   azimuth time:  79407.99119  Doppler-1:     0.000  Doppler-2:-12294.261
alpha(s): -26.455746
SLC-2 SAR position vector (m)  : -5.05206829e+06  1.57365323e+05 -4.95734505e+06
SLC-2 SAR velocity vector (m/s):  5.19880788e+03  1.69561927e+03 -5.24890102e+03
SLC-2 look vector (m):            3.24311035e+05  4.86825225e+05  7.39046984e+05

iter:  2  slant range(m):  923212.593   azimuth time:  79381.53544  Doppler-1:     0.000  Doppler-2:    48.804
alpha(s): 0.102869
SLC-2 SAR position vector (m)  : -5.18752911e+06  1.12188197e+05 -4.81654954e+06
SLC-2 SAR velocity vector (m/s):  5.04106397e+03  1.71935494e+03 -5.39425695e+03
SLC-2 look vector (m):            4.59771854e+05  5.32002351e+05  5.98251479e+05

iter:  3  slant range(m):  923212.298   azimuth time:  79381.63831  Doppler-1:     0.000  Doppler-2:    -0.199
alpha(s): -0.000419
SLC-2 SAR position vector (m)  : -5.18701051e+06  1.12365060e+05 -4.81710441e+06
SLC-2 SAR velocity vector (m/s):  5.04168527e+03  1.71926642e+03 -5.39369985e+03
SLC-2 look vector (m):            4.59253256e+05  5.31825488e+05  5.98806349e+05

iter:  4  slant range(m):  923212.298   azimuth time:  79381.63789  Doppler-1:     0.000  Doppler-2:     0.001
alpha(s): 0.000002
SLC-2 SAR position vector (m)  : -5.18701263e+06  1.12364340e+05 -4.81710216e+06
SLC-2 SAR velocity vector (m/s):  5.04168274e+03  1.71926678e+03 -5.39370211e+03
SLC-2 look vector (m):            4.59255366e+05  5.31826208e+05  5.98804092e+05
is:   12 rpix:      3000.0  ky1:     35.6480  ky2:     35.7041  dk:     0.05612  df: 1.99926e+06  rdf:  0.1250 rbw:
0.6375

iter:  1  slant range(m):  944370.615   azimuth time:  79407.99119  Doppler-1:     0.000  Doppler-2:-12270.409
alpha(s): -26.455911
SLC-2 SAR position vector (m)  : -5.05206829e+06  1.57365323e+05 -4.95734505e+06
SLC-2 SAR velocity vector (m/s):  5.19880788e+03  1.69561927e+03 -5.24890102e+03
SLC-2 look vector (m):            3.24090345e+05  4.89529879e+05  7.39703863e+05

iter:  2  slant range(m):  925089.225   azimuth time:  79381.53528  Doppler-1:     0.000  Doppler-2:    48.732
alpha(s): 0.102925
SLC-2 SAR position vector (m)  : -5.18752994e+06  1.12187913e+05 -4.81654865e+06
SLC-2 SAR velocity vector (m/s):  5.04106297e+03  1.71935508e+03 -5.39425785e+03
SLC-2 look vector (m):            4.59551995e+05  5.34707288e+05  5.98907467e+05

iter:  3  slant range(m):  925088.931   azimuth time:  79381.63820  Doppler-1:     0.000  Doppler-2:    -0.198
alpha(s): -0.000419
SLC-2 SAR position vector (m)  : -5.18701106e+06  1.12364874e+05 -4.81710383e+06
SLC-2 SAR velocity vector (m/s):  5.04168462e+03  1.71926651e+03 -5.39370043e+03
SLC-2 look vector (m):            4.59033110e+05  5.34530328e+05  5.99462644e+05

iter:  4  slant range(m):  925088.931   azimuth time:  79381.63779  Doppler-1:     0.000  Doppler-2:     0.001
alpha(s): 0.000002
SLC-2 SAR position vector (m)  : -5.18701317e+06  1.12364153e+05 -4.81710157e+06
SLC-2 SAR velocity vector (m/s):  5.04168209e+03  1.71926687e+03 -5.39370270e+03
SLC-2 look vector (m):            4.59035223e+05  5.34531048e+05  5.99460384e+05

iter:  1  slant range(m):  944830.245   azimuth time:  79407.99119  Doppler-1:     0.000  Doppler-2:-12264.460
alpha(s): -26.455952
SLC-2 SAR position vector (m)  : -5.05206829e+06  1.57365323e+05 -4.95734505e+06
SLC-2 SAR velocity vector (m/s):  5.19880788e+03  1.69561927e+03 -5.24890102e+03
SLC-2 look vector (m):            3.24035415e+05  4.90204777e+05  7.39867905e+05

iter:  2  slant range(m):  925558.379   azimuth time:  79381.53524  Doppler-1:     0.000  Doppler-2:    48.714
alpha(s): 0.102939
SLC-2 SAR position vector (m)  : -5.18753015e+06  1.12187844e+05 -4.81654844e+06
SLC-2 SAR velocity vector (m/s):  5.04106273e+03  1.71935511e+03 -5.39425806e+03
SLC-2 look vector (m):            4.59497269e+05  5.35382256e+05  5.99071293e+05

iter:  3  slant range(m):  925558.085   azimuth time:  79381.63818  Doppler-1:     0.000  Doppler-2:    -0.198
alpha(s): -0.000419
SLC-2 SAR position vector (m)  : -5.18701120e+06  1.12364827e+05 -4.81710368e+06
SLC-2 SAR velocity vector (m/s):  5.04168445e+03  1.71926653e+03 -5.39370058e+03
SLC-2 look vector (m):            4.58978317e+05  5.35205272e+05  5.99626541e+05
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iter:  4  slant range(m):  925558.085   azimuth time:  79381.63776  Doppler-1:     0.000  Doppler-2:     0.001
alpha(s): 0.000002
SLC-2 SAR position vector (m)  : -5.18701331e+06  1.12364107e+05 -4.81710142e+06
SLC-2 SAR velocity vector (m/s):  5.04168192e+03  1.71926689e+03 -5.39370285e+03
SLC-2 look vector (m):            4.58980430e+05  5.35205993e+05  5.99624281e+05
is:   13 rpix:      3250.0  ky1:     35.7803  ky2:     35.8360  dk:     0.05569  df: 1.97686e+06  rdf:  0.1236 rbw:
0.6387

iter:  1  slant range(m):  946668.839   azimuth time:  79407.99119  Doppler-1:     0.000  Doppler-2:-12240.719
alpha(s): -26.456110
SLC-2 SAR position vector (m)  : -5.05206829e+06  1.57365323e+05 -4.95734505e+06
SLC-2 SAR velocity vector (m/s):  5.19880788e+03  1.69561927e+03 -5.24890102e+03
SLC-2 look vector (m):            3.23816661e+05  4.92899364e+05  7.40523381e+05

iter:  2  slant range(m):  927434.979   azimuth time:  79381.53508  Doppler-1:     0.000  Doppler-2:    48.639
alpha(s): 0.102989
SLC-2 SAR position vector (m)  : -5.18753094e+06  1.12187572e+05 -4.81654758e+06
SLC-2 SAR velocity vector (m/s):  5.04106177e+03  1.71935525e+03 -5.39425892e+03
SLC-2 look vector (m):            4.59279311e+05  5.38077115e+05  5.99725916e+05

iter:  3  slant range(m):  927434.685   azimuth time:  79381.63807  Doppler-1:     0.000  Doppler-2:    -0.198
alpha(s): -0.000419
SLC-2 SAR position vector (m)  : -5.18701174e+06  1.12364642e+05 -4.81710310e+06
SLC-2 SAR velocity vector (m/s):  5.04168380e+03  1.71926663e+03 -5.39370116e+03
SLC-2 look vector (m):            4.58760106e+05  5.37900045e+05  6.00281435e+05

iter:  4  slant range(m):  927434.685   azimuth time:  79381.63765  Doppler-1:     0.000  Doppler-2:     0.001
alpha(s): 0.000002
SLC-2 SAR position vector (m)  : -5.18701385e+06  1.12363921e+05 -4.81710084e+06
SLC-2 SAR velocity vector (m/s):  5.04168127e+03  1.71926699e+03 -5.39370343e+03
SLC-2 look vector (m):            4.58762221e+05  5.37900766e+05  6.00279173e+05

iter:  1  slant range(m):  947128.506   azimuth time:  79407.99119  Doppler-1:     0.000  Doppler-2:-12234.798
alpha(s): -26.456148
SLC-2 SAR position vector (m)  : -5.05206829e+06  1.57365323e+05 -4.95734505e+06
SLC-2 SAR velocity vector (m/s):  5.19880788e+03  1.69561927e+03 -5.24890102e+03
SLC-2 look vector (m):            3.23762212e+05  4.93571769e+05  7.40687077e+05

iter:  2  slant range(m):  927904.125   azimuth time:  79381.53504  Doppler-1:     0.000  Doppler-2:    48.620
alpha(s): 0.103000
SLC-2 SAR position vector (m)  : -5.18753114e+06  1.12187506e+05 -4.81654738e+06
SLC-2 SAR velocity vector (m/s):  5.04106154e+03  1.71935528e+03 -5.39425913e+03
SLC-2 look vector (m):            4.59225056e+05  5.38749586e+05  5.99889404e+05

iter:  3  slant range(m):  927903.831   azimuth time:  79381.63804  Doppler-1:     0.000  Doppler-2:    -0.198
alpha(s): -0.000419
SLC-2 SAR position vector (m)  : -5.18701188e+06  1.12364595e+05 -4.81710296e+06
SLC-2 SAR velocity vector (m/s):  5.04168364e+03  1.71926665e+03 -5.39370131e+03
SLC-2 look vector (m):            4.58705793e+05  5.38572496e+05  6.00444986e+05

iter:  4  slant range(m):  927903.831   azimuth time:  79381.63762  Doppler-1:     0.000  Doppler-2:     0.001
alpha(s): 0.000002
SLC-2 SAR position vector (m)  : -5.18701399e+06  1.12363874e+05 -4.81710070e+06
SLC-2 SAR velocity vector (m/s):  5.04168111e+03  1.71926701e+03 -5.39370358e+03
SLC-2 look vector (m):            4.58707908e+05  5.38573217e+05  6.00442724e+05
is:   14 rpix:      3500.0  ky1:     35.9111  ky2:     35.9664  dk:     0.05528  df: 1.95485e+06  rdf:  0.1222 rbw:
0.6399

iter:  1  slant range(m):  948967.250   azimuth time:  79407.99119  Doppler-1:     0.000  Doppler-2:-12211.167
alpha(s): -26.456299
SLC-2 SAR position vector (m)  : -5.05206829e+06  1.57365323e+05 -4.95734505e+06
SLC-2 SAR velocity vector (m/s):  5.19880788e+03  1.69561927e+03 -5.24890102e+03
SLC-2 look vector (m):            3.23545366e+05  4.96256473e+05  7.41341183e+05

iter:  2  slant range(m):  929780.693   azimuth time:  79381.53489  Doppler-1:     0.000  Doppler-2:    48.542
alpha(s): 0.103044
SLC-2 SAR position vector (m)  : -5.18753190e+06  1.12187246e+05 -4.81654656e+06
SLC-2 SAR velocity vector (m/s):  5.04106063e+03  1.71935541e+03 -5.39425995e+03
SLC-2 look vector (m):            4.59008972e+05  5.41434550e+05  6.00542695e+05

iter:  3  slant range(m):  929780.399   azimuth time:  79381.63793  Doppler-1:     0.000  Doppler-2:    -0.198
alpha(s): -0.000420
SLC-2 SAR position vector (m)  : -5.18701242e+06  1.12364411e+05 -4.81710238e+06
SLC-2 SAR velocity vector (m/s):  5.04168299e+03  1.71926674e+03 -5.39370189e+03
SLC-2 look vector (m):            4.58489489e+05  5.41257385e+05  6.01098512e+05

iter:  4  slant range(m):  929780.399   azimuth time:  79381.63751  Doppler-1:     0.000  Doppler-2:     0.001
alpha(s): 0.000002
SLC-2 SAR position vector (m)  : -5.18701453e+06  1.12363689e+05 -4.81710011e+06
SLC-2 SAR velocity vector (m/s):  5.04168046e+03  1.71926710e+03 -5.39370416e+03
SLC-2 look vector (m):            4.58491606e+05  5.41258107e+05  6.01096248e+05

iter:  1  slant range(m):  949426.954   azimuth time:  79407.99119  Doppler-1:     0.000  Doppler-2:-12205.273
alpha(s): -26.456336
SLC-2 SAR position vector (m)  : -5.05206829e+06  1.57365323e+05 -4.95734505e+06
SLC-2 SAR velocity vector (m/s):  5.19880788e+03  1.69561927e+03 -5.24890102e+03
SLC-2 look vector (m):            3.23491391e+05  4.96926430e+05  7.41504541e+05
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iter:  2  slant range(m):  930249.831   azimuth time:  79381.53485  Doppler-1:     0.000  Doppler-2:    48.523
alpha(s): 0.103054
SLC-2 SAR position vector (m)  : -5.18753209e+06  1.12187182e+05 -4.81654636e+06
SLC-2 SAR velocity vector (m/s):  5.04106040e+03  1.71935544e+03 -5.39426015e+03
SLC-2 look vector (m):            4.58955184e+05  5.42104570e+05  6.00705854e+05

iter:  3  slant range(m):  930249.537   azimuth time:  79381.63791  Doppler-1:     0.000  Doppler-2:    -0.198
alpha(s): -0.000420
SLC-2 SAR position vector (m)  : -5.18701255e+06  1.12364365e+05 -4.81710223e+06
SLC-2 SAR velocity vector (m/s):  5.04168283e+03  1.71926676e+03 -5.39370204e+03
SLC-2 look vector (m):            4.58435650e+05  5.41927388e+05  6.01261725e+05

iter:  4  slant range(m):  930249.537   azimuth time:  79381.63749  Doppler-1:     0.000  Doppler-2:     0.001
alpha(s): 0.000002
SLC-2 SAR position vector (m)  : -5.18701467e+06  1.12363643e+05 -4.81709997e+06
SLC-2 SAR velocity vector (m/s):  5.04168029e+03  1.71926713e+03 -5.39370431e+03
SLC-2 look vector (m):            4.58437766e+05  5.41928110e+05  6.01259461e+05
is:   15 rpix:      3750.0  ky1:     36.0404  ky2:     36.0953  dk:     0.05486  df: 1.93322e+06  rdf:  0.1208 rbw:
0.6410

iter:  1  slant range(m):  951265.846   azimuth time:  79407.99119  Doppler-1:     0.000  Doppler-2:-12181.751
alpha(s): -26.456481
SLC-2 SAR position vector (m)  : -5.05206829e+06  1.57365323e+05 -4.95734505e+06
SLC-2 SAR velocity vector (m/s):  5.19880788e+03  1.69561927e+03 -5.24890102e+03
SLC-2 look vector (m):            3.23276428e+05  4.99601430e+05  7.42157310e+05

iter:  2  slant range(m):  932126.367   azimuth time:  79381.53471  Doppler-1:     0.000  Doppler-2:    48.443
alpha(s): 0.103091
SLC-2 SAR position vector (m)  : -5.18753281e+06  1.12186934e+05 -4.81654558e+06
SLC-2 SAR velocity vector (m/s):  5.04105953e+03  1.71935557e+03 -5.39426093e+03
SLC-2 look vector (m):            4.58740948e+05  5.44779818e+05  6.01357844e+05

iter:  3  slant range(m):  932126.073   azimuth time:  79381.63780  Doppler-1:     0.000  Doppler-2:    -0.197
alpha(s): -0.000420
SLC-2 SAR position vector (m)  : -5.18701309e+06  1.12364180e+05 -4.81710165e+06
SLC-2 SAR velocity vector (m/s):  5.04168218e+03  1.71926686e+03 -5.39370262e+03
SLC-2 look vector (m):            4.58221227e+05  5.44602572e+05  6.01913916e+05

iter:  4  slant range(m):  932126.073   azimuth time:  79381.63738  Doppler-1:     0.000  Doppler-2:     0.001
alpha(s): 0.000002
SLC-2 SAR position vector (m)  : -5.18701521e+06  1.12363458e+05 -4.81709939e+06
SLC-2 SAR velocity vector (m/s):  5.04167964e+03  1.71926722e+03 -5.39370489e+03
SLC-2 look vector (m):            4.58223345e+05  5.44603294e+05  6.01911650e+05

iter:  1  slant range(m):  951725.588   azimuth time:  79407.99119  Doppler-1:     0.000  Doppler-2:-12175.884
alpha(s): -26.456516
SLC-2 SAR position vector (m)  : -5.05206829e+06  1.57365323e+05 -4.95734505e+06
SLC-2 SAR velocity vector (m/s):  5.19880788e+03  1.69561927e+03 -5.24890102e+03
SLC-2 look vector (m):            3.23222920e+05  5.00268982e+05  7.42320338e+05

iter:  2  slant range(m):  932595.497   azimuth time:  79381.53467  Doppler-1:     0.000  Doppler-2:    48.422
alpha(s): 0.103100
SLC-2 SAR position vector (m)  : -5.18753299e+06  1.12186874e+05 -4.81654539e+06
SLC-2 SAR velocity vector (m/s):  5.04105932e+03  1.71935560e+03 -5.39426112e+03
SLC-2 look vector (m):            4.58687618e+05  5.45447431e+05  6.01520681e+05

iter:  3  slant range(m):  932595.204   azimuth time:  79381.63777  Doppler-1:     0.000  Doppler-2:    -0.197
alpha(s): -0.000420
SLC-2 SAR position vector (m)  : -5.18701323e+06  1.12364134e+05 -4.81710151e+06
SLC-2 SAR velocity vector (m/s):  5.04168202e+03  1.71926688e+03 -5.39370276e+03
SLC-2 look vector (m):            4.58167854e+05  5.45270170e+05  6.02076799e+05

iter:  4  slant range(m):  932595.204   azimuth time:  79381.63735  Doppler-1:     0.000  Doppler-2:     0.001
alpha(s): 0.000002
SLC-2 SAR position vector (m)  : -5.18701535e+06  1.12363412e+05 -4.81709924e+06
SLC-2 SAR velocity vector (m/s):  5.04167948e+03  1.71926724e+03 -5.39370504e+03
SLC-2 look vector (m):            4.58169972e+05  5.45270893e+05  6.02074533e+05
is:   16 rpix:      4000.0  ky1:     36.1684  ky2:     36.2228  dk:     0.05445  df: 1.91197e+06  rdf:  0.1195 rbw:
0.6422

iter:  1  slant range(m):  953564.627   azimuth time:  79407.99119  Doppler-1:     0.000  Doppler-2:-12152.470
alpha(s): -26.456653
SLC-2 SAR position vector (m)  : -5.05206829e+06  1.57365323e+05 -4.95734505e+06
SLC-2 SAR velocity vector (m/s):  5.19880788e+03  1.69561927e+03 -5.24890102e+03
SLC-2 look vector (m):            3.23009814e+05  5.02934452e+05  7.42971800e+05

iter:  2  slant range(m):  934472.002   azimuth time:  79381.53454  Doppler-1:     0.000  Doppler-2:    48.339
alpha(s): 0.103131
SLC-2 SAR position vector (m)  : -5.18753369e+06  1.12186637e+05 -4.81654465e+06
SLC-2 SAR velocity vector (m/s):  5.04105849e+03  1.71935572e+03 -5.39426187e+03
SLC-2 look vector (m):            4.58475206e+05  5.48113137e+05  6.02171402e+05

iter:  3  slant range(m):  934471.709   azimuth time:  79381.63767  Doppler-1:     0.000  Doppler-2:    -0.197
alpha(s): -0.000420
SLC-2 SAR position vector (m)  : -5.18701377e+06  1.12363950e+05 -4.81710093e+06
SLC-2 SAR velocity vector (m/s):  5.04168137e+03  1.71926697e+03 -5.39370334e+03
SLC-2 look vector (m):            4.57955287e+05  5.47935824e+05  6.02727686e+05
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iter:  4  slant range(m):  934471.709   azimuth time:  79381.63725  Doppler-1:     0.000  Doppler-2:     0.001
alpha(s): 0.000002
SLC-2 SAR position vector (m)  : -5.18701589e+06  1.12363228e+05 -4.81709867e+06
SLC-2 SAR velocity vector (m/s):  5.04167884e+03  1.71926733e+03 -5.39370562e+03
SLC-2 look vector (m):            4.57957406e+05  5.47936546e+05  6.02725419e+05

iter:  1  slant range(m):  954024.406   azimuth time:  79407.99119  Doppler-1:     0.000  Doppler-2:-12146.630
alpha(s): -26.456687
SLC-2 SAR position vector (m)  : -5.05206829e+06  1.57365323e+05 -4.95734505e+06
SLC-2 SAR velocity vector (m/s):  5.19880788e+03  1.69561927e+03 -5.24890102e+03
SLC-2 look vector (m):            3.22956768e+05  5.03599642e+05  7.43134506e+05

iter:  2  slant range(m):  934941.124   azimuth time:  79381.53450  Doppler-1:     0.000  Doppler-2:    48.318
alpha(s): 0.103137
SLC-2 SAR position vector (m)  : -5.18753386e+06  1.12186579e+05 -4.81654447e+06
SLC-2 SAR velocity vector (m/s):  5.04105828e+03  1.71935575e+03 -5.39426205e+03
SLC-2 look vector (m):            4.58422329e+05  5.48778386e+05  6.02333926e+05

iter:  3  slant range(m):  934940.831   azimuth time:  79381.63764  Doppler-1:     0.000  Doppler-2:    -0.197
alpha(s): -0.000420
SLC-2 SAR position vector (m)  : -5.18701390e+06  1.12363905e+05 -4.81710079e+06
SLC-2 SAR velocity vector (m/s):  5.04168121e+03  1.71926699e+03 -5.39370348e+03
SLC-2 look vector (m):            4.57902375e+05  5.48601060e+05  6.02890247e+05

iter:  4  slant range(m):  934940.831   azimuth time:  79381.63722  Doppler-1:     0.000  Doppler-2:     0.001
alpha(s): 0.000002
SLC-2 SAR position vector (m)  : -5.18701602e+06  1.12363182e+05 -4.81709852e+06
SLC-2 SAR velocity vector (m/s):  5.04167868e+03  1.71926736e+03 -5.39370576e+03
SLC-2 look vector (m):            4.57904494e+05  5.48601783e+05  6.02887980e+05
is:   17 rpix:      4250.0  ky1:     36.2949  ky2:     36.3489  dk:     0.05404  df: 1.89108e+06  rdf:  0.1182 rbw:
0.6433

iter:  1  slant range(m):  955863.593   azimuth time:  79407.99119  Doppler-1:     0.000  Doppler-2:-12123.324
alpha(s): -26.456818
SLC-2 SAR position vector (m)  : -5.05206829e+06  1.57365323e+05 -4.95734505e+06
SLC-2 SAR velocity vector (m/s):  5.19880788e+03  1.69561927e+03 -5.24890102e+03
SLC-2 look vector (m):            3.22745494e+05  5.06255750e+05  7.43784693e+05

iter:  2  slant range(m):  936817.599   azimuth time:  79381.53437  Doppler-1:     0.000  Doppler-2:    48.233
alpha(s): 0.103162
SLC-2 SAR position vector (m)  : -5.18753452e+06  1.12186354e+05 -4.81654376e+06
SLC-2 SAR velocity vector (m/s):  5.04105749e+03  1.71935586e+03 -5.39426276e+03
SLC-2 look vector (m):            4.58211715e+05  5.51434719e+05  6.02983407e+05

iter:  3  slant range(m):  936817.306   azimuth time:  79381.63753  Doppler-1:     0.000  Doppler-2:    -0.197
alpha(s): -0.000420
SLC-2 SAR position vector (m)  : -5.18701444e+06  1.12363721e+05 -4.81710022e+06
SLC-2 SAR velocity vector (m/s):  5.04168057e+03  1.71926709e+03 -5.39370406e+03
SLC-2 look vector (m):            4.57691638e+05  5.51257351e+05  6.03539860e+05

iter:  4  slant range(m):  936817.306   azimuth time:  79381.63711  Doppler-1:     0.000  Doppler-2:     0.001
alpha(s): 0.000002
SLC-2 SAR position vector (m)  : -5.18701656e+06  1.12362999e+05 -4.81709795e+06
SLC-2 SAR velocity vector (m/s):  5.04167803e+03  1.71926745e+03 -5.39370634e+03
SLC-2 look vector (m):            4.57693758e+05  5.51258074e+05  6.03537592e+05

iter:  1  slant range(m):  956323.408   azimuth time:  79407.99119  Doppler-1:     0.000  Doppler-2:-12117.511
alpha(s): -26.456850
SLC-2 SAR position vector (m)  : -5.05206829e+06  1.57365323e+05 -4.95734505e+06
SLC-2 SAR velocity vector (m/s):  5.19880788e+03  1.69561927e+03 -5.24890102e+03
SLC-2 look vector (m):            3.22692902e+05  5.06918621e+05  7.43947084e+05

iter:  2  slant range(m):  937286.714   azimuth time:  79381.53434  Doppler-1:     0.000  Doppler-2:    48.211
alpha(s): 0.103167
SLC-2 SAR position vector (m)  : -5.18753468e+06  1.12186299e+05 -4.81654359e+06
SLC-2 SAR velocity vector (m/s):  5.04105730e+03  1.71935589e+03 -5.39426293e+03
SLC-2 look vector (m):            4.58159285e+05  5.52097645e+05  6.03145624e+05

iter:  3  slant range(m):  937286.421   azimuth time:  79381.63751  Doppler-1:     0.000  Doppler-2:    -0.197
alpha(s): -0.000420
SLC-2 SAR position vector (m)  : -5.18701457e+06  1.12363676e+05 -4.81710007e+06
SLC-2 SAR velocity vector (m/s):  5.04168041e+03  1.71926711e+03 -5.39370421e+03
SLC-2 look vector (m):            4.57639181e+05  5.51920268e+05  6.03702107e+05

iter:  4  slant range(m):  937286.421   azimuth time:  79381.63709  Doppler-1:     0.000  Doppler-2:     0.001
alpha(s): 0.000002
SLC-2 SAR position vector (m)  : -5.18701669e+06  1.12362953e+05 -4.81709780e+06
SLC-2 SAR velocity vector (m/s):  5.04167787e+03  1.71926747e+03 -5.39370648e+03
SLC-2 look vector (m):            4.57641301e+05  5.51920991e+05  6.03699839e+05
is:   18 rpix:      4500.0  ky1:     36.4200  ky2:     36.4736  dk:     0.05364  df: 1.87055e+06  rdf:  0.1169 rbw:
0.6444

number of range filters: 16  min bandwidth: 0.250  max. bandwidth: 1.000

range fractional bandwidth:  0.250  filter taps: 23  rpg1:     0.0000 dks:    -0.0000
bp_filter: bw:  1.5708  wc:  0.0000  nfft: 23  nps: 23   Kaiser beta:   1.000
 0.250  0.225  0.158  0.074  0.000 -0.043 -0.050 -0.030 -0.000  0.022  0.027  0.017  0.017  0.027  0.022 -0.000
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-0.030 -0.050 -0.043  0.000  0.074  0.158  0.225
 0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
0.000  0.000  0.000  0.000  0.000  0.000  0.000

range fractional bandwidth:  0.300  filter taps: 23  rpg1:     0.0000 dks:    -0.0000
bp_filter: bw:  1.8850  wc:  0.0000  nfft: 23  nps: 23   Kaiser beta:   1.000
 0.300  0.257  0.150  0.032 -0.046 -0.061 -0.029  0.013  0.034  0.025  0.000 -0.019 -0.019  0.000  0.025  0.034
0.013 -0.029 -0.061 -0.046  0.032  0.150  0.257
 0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
0.000  0.000  0.000  0.000  0.000  0.000  0.000

range fractional bandwidth:  0.350  filter taps: 23  rpg1:     0.0000 dks:    -0.0000
bp_filter: bw:  2.1991  wc:  0.0000  nfft: 23  nps: 23   Kaiser beta:   1.000
 0.350  0.283  0.128 -0.016 -0.074 -0.043  0.015  0.041  0.021 -0.014 -0.027 -0.011 -0.011 -0.027 -0.014  0.021
0.041  0.015 -0.043 -0.074 -0.016  0.128  0.283
 0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
0.000  0.000  0.000  0.000  0.000  0.000  0.000

range fractional bandwidth:  0.400  filter taps: 23  rpg1:     0.0000 dks:    -0.0000
bp_filter: bw:  2.5133  wc:  0.0000  nfft: 23  nps: 23   Kaiser beta:   1.000
 0.400  0.302  0.093 -0.061 -0.074 -0.000  0.047  0.025 -0.021 -0.029 -0.000  0.022  0.022 -0.000 -0.029 -0.021
0.025  0.047 -0.000 -0.074 -0.061  0.093  0.302
 0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
0.000  0.000  0.000  0.000  0.000  0.000  0.000

range fractional bandwidth:  0.450  filter taps: 23  rpg1:     0.0000 dks:    -0.0000
bp_filter: bw:  2.8274  wc:  0.0000  nfft: 23  nps: 23   Kaiser beta:   1.000
 0.450  0.314  0.049 -0.093 -0.046  0.043  0.040 -0.019 -0.034  0.005  0.027  0.004  0.004  0.027  0.005 -0.034
-0.019  0.040  0.043 -0.046 -0.093  0.049  0.314
 0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
0.000  0.000  0.000  0.000  0.000  0.000  0.000

range fractional bandwidth:  0.500  filter taps: 23  rpg1:     0.0000 dks:    -0.0000
bp_filter: bw:  3.1416  wc:  0.0000  nfft: 23  nps: 23   Kaiser beta:   1.000
 0.500  0.318  0.000 -0.104 -0.000  0.061  0.000 -0.042 -0.000  0.031  0.000 -0.023 -0.023  0.000  0.031 -0.000
-0.042  0.000  0.061 -0.000 -0.104  0.000  0.318
 0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
0.000  0.000  0.000  0.000  0.000  0.000  0.000

range fractional bandwidth:  0.550  filter taps: 23  rpg1:     0.0000 dks:    -0.0000
bp_filter: bw:  3.4558  wc:  0.0000  nfft: 23  nps: 23   Kaiser beta:   1.000
 0.550  0.314 -0.049 -0.093  0.046  0.043 -0.040 -0.019  0.034  0.005 -0.027  0.004  0.004 -0.027  0.005  0.034
-0.019 -0.040  0.043  0.046 -0.093 -0.049  0.314
 0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
0.000  0.000  0.000  0.000  0.000  0.000  0.000

range fractional bandwidth:  0.600  filter taps: 23  rpg1:     0.0000 dks:    -0.0000
bp_filter: bw:  3.7699  wc:  0.0000  nfft: 23  nps: 23   Kaiser beta:   1.000
 0.600  0.302 -0.093 -0.061  0.074 -0.000 -0.047  0.025  0.021 -0.029  0.000  0.022  0.022  0.000 -0.029  0.021
0.025 -0.047 -0.000  0.074 -0.061 -0.093  0.302
 0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
0.000  0.000  0.000  0.000  0.000  0.000  0.000

range fractional bandwidth:  0.650  filter taps: 23  rpg1:     0.0000 dks:    -0.0000
bp_filter: bw:  4.0841  wc:  0.0000  nfft: 23  nps: 23   Kaiser beta:   1.000
 0.650  0.283 -0.128 -0.016  0.074 -0.043 -0.015  0.041 -0.021 -0.014  0.027 -0.011 -0.011  0.027 -0.014 -0.021
0.041 -0.015 -0.043  0.074 -0.016 -0.128  0.283
 0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
0.000  0.000  0.000  0.000  0.000  0.000  0.000

range fractional bandwidth:  0.700  filter taps: 23  rpg1:     0.0000 dks:    -0.0000
bp_filter: bw:  4.3982  wc:  0.0000  nfft: 23  nps: 23   Kaiser beta:   1.000
 0.700  0.257 -0.150  0.032  0.046 -0.061  0.029  0.013 -0.034  0.025  0.000 -0.019 -0.019  0.000  0.025 -0.034
0.013  0.029 -0.061  0.046  0.032 -0.150  0.257
 0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
0.000  0.000  0.000  0.000  0.000  0.000  0.000

range fractional bandwidth:  0.750  filter taps: 23  rpg1:     0.0000 dks:    -0.0000
bp_filter: bw:  4.7124  wc:  0.0000  nfft: 23  nps: 23   Kaiser beta:   1.000
 0.750  0.225 -0.158  0.074  0.000 -0.043  0.050 -0.030 -0.000  0.022 -0.027  0.017  0.017 -0.027  0.022 -0.000
-0.030  0.050 -0.043  0.000  0.074 -0.158  0.225
 0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
0.000  0.000  0.000  0.000  0.000  0.000  0.000

range fractional bandwidth:  0.800  filter taps: 23  rpg1:     0.0000 dks:    -0.0000
bp_filter: bw:  5.0265  wc:  0.0000  nfft: 23  nps: 23   Kaiser beta:   1.000
 0.800  0.187 -0.150  0.099 -0.046 -0.000  0.029 -0.040  0.034 -0.018 -0.000  0.014  0.014 -0.000 -0.018  0.034
-0.040  0.029 -0.000 -0.046  0.099 -0.150  0.187
 0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
0.000  0.000  0.000  0.000  0.000  0.000  0.000

range fractional bandwidth:  0.850  filter taps: 23  rpg1:     0.0000 dks:    -0.0000
bp_filter: bw:  5.3407  wc:  0.0000  nfft: 23  nps: 23   Kaiser beta:   1.000
 0.850  0.144 -0.128  0.103 -0.074  0.043 -0.015 -0.007  0.021 -0.027  0.027 -0.021 -0.021  0.027 -0.027  0.021
-0.007 -0.015  0.043 -0.074  0.103 -0.128  0.144
 0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
0.000  0.000  0.000  0.000  0.000  0.000  0.000
```

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range fractional bandwidth:  0.900  filter taps: 23  rpg1:     0.0000 dks:    -0.0000
bp_filter: bw:  5.6549  wc:  0.0000  nfft: 23  nps: 23   Kaiser beta:   1.000
 0.900  0.098 -0.093  0.085 -0.074  0.061 -0.047  0.034 -0.021  0.009  0.000 -0.007 -0.007  0.000  0.009 -0.021
0.034 -0.047  0.061 -0.074  0.085 -0.093  0.098
 0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
0.000  0.000  0.000  0.000  0.000  0.000  0.000

range fractional bandwidth:  0.950  filter taps: 23  rpg1:     0.0000 dks:    -0.0000
bp_filter: bw:  5.9690  wc:  0.0000  nfft: 23  nps: 23   Kaiser beta:   1.000
 0.950  0.050 -0.049  0.047 -0.046  0.043 -0.040  0.037 -0.034  0.030 -0.027  0.023  0.023 -0.027  0.030 -0.034
0.037 -0.040  0.043 -0.046  0.047 -0.049  0.050
 0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
0.000  0.000  0.000  0.000  0.000  0.000  0.000

range fractional bandwidth:  1.000  filter taps: 23  rpg1:     0.0000 dks:    -0.0000
bp_filter: bw:  6.2832  wc:  0.0000  nfft: 23  nps: 23   Kaiser beta:   1.000
 1.000  0.000 -0.000  0.000 -0.000  0.000 -0.000  0.000 -0.000  0.000 -0.000  0.000  0.000 -0.000  0.000 -0.000
0.000 -0.000  0.000 -0.000  0.000 -0.000  0.000
 0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
0.000  0.000  0.000  0.000  0.000  0.000  0.000
range common band filter: line:      0  range:      0  shift:  0.10593  rbw0:   0.6378  rbw:   0.6378  index:  8
range common band filter: line:      0  range:    465  shift:  0.15712  rbw0:   0.5866  rbw:   0.5866  index:  7
range common band filter: line:      0  range:    930  shift:  0.19191  rbw0:   0.5518  rbw:   0.5518  index:  6
range common band filter: line:      0  range:   1395  shift:  0.07983  rbw0:   0.6639  rbw:   0.6639  index:  8
range common band filter: line:      0  range:   1860  shift:  0.09748  rbw0:   0.6463  rbw:   0.6463  index:  8
range common band filter: line:      0  range:   2325  shift:  0.14224  rbw0:   0.6015  rbw:   0.6015  index:  7
range common band filter: line:      0  range:   2790  shift:  0.14892  rbw0:   0.5948  rbw:   0.5948  index:  7
range common band filter: line:      0  range:   3255  shift:  0.02637  rbw0:   0.7174  rbw:   0.7174  index:  9
range common band filter: line:      0  range:   3720  shift:  0.08802  rbw0:   0.6557  rbw:   0.6557  index:  8
range common band filter: line:      0  range:   4185  shift:  0.02853  rbw0:   0.7152  rbw:   0.7152  index:  9
range common band filter: line:      0  range:   4650  shift: 98.78289  rbw0:   0.2500  rbw:   0.2500  index:  0
block:  1  output line:     59  SLC l_start:    944  SLC l_end:   1935  overlap_save start line:    912
block:  2  output line:    118  SLC l_start:   1888  SLC l_end:   2879  overlap_save start line:   1856
block:  3  output line:    177  SLC l_start:   2832  SLC l_end:   3823  overlap_save start line:   2800
block:  4  output line:    236  SLC l_start:   3776  SLC l_end:   4767  overlap_save start line:   3744
block:  5  output line:    295  SLC l_start:   4720  SLC l_end:   5711  overlap_save start line:   4688
block:  6  output line:    354  SLC l_start:   5664  SLC l_end:   6655  overlap_save start line:   5632
block:  7  output line:    413  SLC l_start:   6608  SLC l_end:   7599  overlap_save start line:   6576
block:  8  output line:    472  SLC l_start:   7552  SLC l_end:   8543  overlap_save start line:   7520
block:  9  output line:    531  SLC l_start:   8496  SLC l_end:   9487  overlap_save start line:   8464
block: 10  output line:    590  SLC l_start:   9440  SLC l_end:  10431  overlap_save start line:   9408
block: 11  output line:    649  SLC l_start:  10384  SLC l_end:  11375  overlap_save start line:  10352
block: 12  output line:    708  SLC l_start:  11328  SLC l_end:  12319  overlap_save start line:  11296
block: 13  output line:    767  SLC l_start:  12272  SLC l_end:  13263  overlap_save start line:  12240
block: 14  output line:    826  SLC l_start:  13216  SLC l_end:  14207  overlap_save start line:  13184
block: 15  output line:    885  SLC l_start:  14160  SLC l_end:  15151  overlap_save start line:  14128
block: 16  output line:    944  SLC l_start:  15104  SLC l_end:  16095  overlap_save start line:  15072
block: 17  output line:   1003  SLC l_start:  16048  SLC l_end:  17039  overlap_save start line:  16016
block: 18  output line:   1062  SLC l_start:  16992  SLC l_end:  17983  overlap_save start line:  16960
block: 19  output line:   1121  SLC l_start:  17936  SLC l_end:  18927  overlap_save start line:  17904
block: 20  output line:   1180  SLC l_start:  18880  SLC l_end:  19871  overlap_save start line:  18848
block: 21  output line:   1239  SLC l_start:  19824  SLC l_end:  20815  overlap_save start line:  19792
block: 22  output line:   1298  SLC l_start:  20768  SLC l_end:  21759  overlap_save start line:  20736
block: 23  output line:   1357  SLC l_start:  21712  SLC l_end:  22703  overlap_save start line:  21680
block: 24  output line:   1416  SLC l_start:  22656  SLC l_end:  23647  overlap_save start line:  22624
block: 25  output line:   1475  SLC l_start:  23600  SLC l_end:  24591  overlap_save start line:  23568
block: 26  output line:   1534  SLC l_start:  24544  SLC l_end:  25535  overlap_save start line:  24512
block: 27  output line:   1593  SLC l_start:  25488  SLC l_end:  26479  overlap_save start line:  25456
block: 28  output line:   1652  SLC l_start:  26432  SLC l_end:  27423  overlap_save start line:  26400
block: 29  output line:   1711  SLC l_start:  27376  SLC l_end:  28367  overlap_save start line:  27344
block: 30  output line:   1770  SLC l_start:  28320  SLC l_end:  29311  overlap_save start line:  28288
range common band filter: line:   1771  range:      0  shift:  0.10707  rbw0:   0.6367  rbw:   0.6367  index:  8
range common band filter: line:   1771  range:    465  shift:  0.09919  rbw0:   0.6446  rbw:   0.6446  index:  8
range common band filter: line:   1771  range:    930  shift:  0.18287  rbw0:   0.5609  rbw:   0.5609  index:  6
range common band filter: line:   1771  range:   1395  shift:  0.04703  rbw0:   0.6967  rbw:   0.6967  index:  9
range common band filter: line:   1771  range:   1860  shift:  0.03042  rbw0:   0.7133  rbw:   0.7133  index:  9
range common band filter: line:   1771  range:   2325  shift:  0.08746  rbw0:   0.6563  rbw:   0.6563  index:  8
range common band filter: line:   1771  range:   2790  shift:  0.46290  rbw0:   0.2808  rbw:   0.2808  index:  1
range common band filter: line:   1771  range:   3255  shift:  0.14394  rbw0:   0.5998  rbw:   0.5998  index:  7
range common band filter: line:   1771  range:   3720  shift:  0.17018  rbw0:   0.5736  rbw:   0.5736  index:  6
range common band filter: line:   1771  range:   4185  shift:  0.11646  rbw0:   0.6273  rbw:   0.6273  index:  8
range common band filter: line:   1771  range:   4650  shift: 98.12669  rbw0:   0.2500  rbw:   0.2500  index:  0
block: 31  output line:   1829  SLC l_start:  29264  SLC l_end:  30255  overlap_save start line:  29232
block: 32  output line:   1888  SLC l_start:  30208  SLC l_end:  31199  overlap_save start line:  30176
block: 33  output line:   1947  SLC l_start:  31152  SLC l_end:  32143  overlap_save start line:  31120
block: 34  output line:   2006  SLC l_start:  32096  SLC l_end:  33087  overlap_save start line:  32064
block: 35  output line:   2065  SLC l_start:  33040  SLC l_end:  34031  overlap_save start line:  33008
block: 36  output line:   2124  SLC l_start:  33984  SLC l_end:  34975  overlap_save start line:  33952
block: 37  output line:   2183  SLC l_start:  34928  SLC l_end:  35919  overlap_save start line:  34896
block: 38  output line:   2242  SLC l_start:  35872  SLC l_end:  36863  overlap_save start line:  35840
block: 39  output line:   2301  SLC l_start:  36816  SLC l_end:  37807  overlap_save start line:  36784
block: 40  output line:   2360  SLC l_start:  37760  SLC l_end:  38751  overlap_save start line:  37728
block: 41  output line:   2419  SLC l_start:  38704  SLC l_end:  39695  overlap_save start line:  38672
block: 42  output line:   2478  SLC l_start:  39648  SLC l_end:  40639  overlap_save start line:  39616
block: 43  output line:   2537  SLC l_start:  40592  SLC l_end:  41583  overlap_save start line:  40560
block: 44  output line:   2596  SLC l_start:  41536  SLC l_end:  42527  overlap_save start line:  41504
block: 45  output line:   2655  SLC l_start:  42480  SLC l_end:  43471  overlap_save start line:  42448
block: 46  output line:   2714  SLC l_start:  43424  SLC l_end:  44415  overlap_save start line:  43392
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block: 47  output line:   2773  SLC l_start:  44368  SLC l_end:  45359  overlap_save start line:  44336
block: 48  output line:   2832  SLC l_start:  45312  SLC l_end:  46303  overlap_save start line:  45280
block: 49  output line:   2891  SLC l_start:  46256  SLC l_end:  47247  overlap_save start line:  46224
block: 50  output line:   2950  SLC l_start:  47200  SLC l_end:  48191  overlap_save start line:  47168
block: 51  output line:   3009  SLC l_start:  48144  SLC l_end:  49135  overlap_save start line:  48112
block: 52  output line:   3068  SLC l_start:  49088  SLC l_end:  50079  overlap_save start line:  49056
block: 53  output line:   3127  SLC l_start:  50032  SLC l_end:  51023  overlap_save start line:  50000
block: 54  output line:   3186  SLC l_start:  50976  SLC l_end:  51967  overlap_save start line:  50944
block: 55  output line:   3245  SLC l_start:  51920  SLC l_end:  52911  overlap_save start line:  51888
block: 56  output line:   3304  SLC l_start:  52864  SLC l_end:  53855  overlap_save start line:  52832
block: 57  output line:   3363  SLC l_start:  53808  SLC l_end:  54799  overlap_save start line:  53776
block: 58  output line:   3422  SLC l_start:  54752  SLC l_end:  55743  overlap_save start line:  54720
block: 59  output line:   3481  SLC l_start:  55696  SLC l_end:  56687  overlap_save start line:  55664
block: 60  output line:   3540  SLC l_start:  56640  SLC l_end:  57631  overlap_save start line:  56608
range common band filter: line:   3542  range:      0  shift:  0.15375  rbw0:   0.5900  rbw:   0.5900  index:  7
range common band filter: line:   3542  range:    465  shift:  0.14620  rbw0:   0.5975  rbw:   0.5975  index:  7
range common band filter: line:   3542  range:    930  shift:  0.13231  rbw0:   0.6114  rbw:   0.6114  index:  7
range common band filter: line:   3542  range:   1395  shift:  0.05177  rbw0:   0.6920  rbw:   0.6920  index:  9
range common band filter: line:   3542  range:   1860  shift:  0.15022  rbw0:   0.5935  rbw:   0.5935  index:  7
range common band filter: line:   3542  range:   2325  shift:  0.08085  rbw0:   0.6629  rbw:   0.6629  index:  8
range common band filter: line:   3542  range:   2790  shift:  0.03682  rbw0:   0.7069  rbw:   0.7069  index:  9
range common band filter: line:   3542  range:   3255  shift:  0.12631  rbw0:   0.6174  rbw:   0.6174  index:  7
range common band filter: line:   3542  range:   3720  shift:  0.20215  rbw0:   0.5416  rbw:   0.5416  index:  6
range common band filter: line:   3542  range:   4185  shift:  0.22928  rbw0:   0.5145  rbw:   0.5145  index:  5
range common band filter: line:   3542  range:   4650  shift: 106.63720  rbw0:   0.2500  rbw:   0.2500  index:  0
block: 61  output line:   3599  SLC l_start:  57584  SLC l_end:  58575  overlap_save start line:  57552
block: 62  output line:   3658  SLC l_start:  58528  SLC l_end:  59519  overlap_save start line:  58496
block: 63  output line:   3717  SLC l_start:  59472  SLC l_end:  60463  overlap_save start line:  59440
block: 64  output line:   3776  SLC l_start:  60416  SLC l_end:  61407  overlap_save start line:  60384
block: 65  output line:   3835  SLC l_start:  61360  SLC l_end:  62351  overlap_save start line:  61328
block: 66  output line:   3894  SLC l_start:  62304  SLC l_end:  63295  overlap_save start line:  62272
block: 67  output line:   3953  SLC l_start:  63248  SLC l_end:  64239  overlap_save start line:  63216
block: 68  output line:   4012  SLC l_start:  64192  SLC l_end:  65183  overlap_save start line:  64160
block: 69  output line:   4071  SLC l_start:  65136  SLC l_end:  66127  overlap_save start line:  65104
block: 70  output line:   4130  SLC l_start:  66080  SLC l_end:  67071  overlap_save start line:  66048
block: 71  output line:   4189  SLC l_start:  67024  SLC l_end:  68015  overlap_save start line:  66992
block: 72  output line:   4248  SLC l_start:  67968  SLC l_end:  68959  overlap_save start line:  67936
block: 73  output line:   4307  SLC l_start:  68912  SLC l_end:  69903  overlap_save start line:  68880
block: 74  output line:   4366  SLC l_start:  69856  SLC l_end:  70847  overlap_save start line:  69824
block: 75  output line:   4425  SLC l_start:  70800  SLC l_end:  71791  overlap_save start line:  70768
block: 76  output line:   4484  SLC l_start:  71744  SLC l_end:  72735  overlap_save start line:  71712
block: 77  output line:   4543  SLC l_start:  72688  SLC l_end:  73679  overlap_save start line:  72656
block: 78  output line:   4602  SLC l_start:  73632  SLC l_end:  74623  overlap_save start line:  73600
block: 79  output line:   4661  SLC l_start:  74576  SLC l_end:  75567  overlap_save start line:  74544
block: 80  output line:   4720  SLC l_start:  75520  SLC l_end:  76511  overlap_save start line:  75488
block: 81  output line:   4779  SLC l_start:  76464  SLC l_end:  77455  overlap_save start line:  76432
block: 82  output line:   4838  SLC l_start:  77408  SLC l_end:  78399  overlap_save start line:  77376
block: 83  output line:   4897  SLC l_start:  78352  SLC l_end:  79343  overlap_save start line:  78320
block: 84  output line:   4956  SLC l_start:  79296  SLC l_end:  80287  overlap_save start line:  79264
block: 85  output line:   5015  SLC l_start:  80240  SLC l_end:  81231  overlap_save start line:  80208
block: 86  output line:   5074  SLC l_start:  81184  SLC l_end:  82175  overlap_save start line:  81152
block: 87  output line:   5133  SLC l_start:  82128  SLC l_end:  83119  overlap_save start line:  82096
block: 88  output line:   5192  SLC l_start:  83072  SLC l_end:  84063  overlap_save start line:  83040
block: 89  output line:   5251  SLC l_start:  84016  SLC l_end:  85007  overlap_save start line:  83984
block: 90  output line:   5310  SLC l_start:  84960  SLC l_end:  85951  overlap_save start line:  84928
range common band filter: line:   5313  range:      0  shift:  0.15129  rbw0:   0.5925  rbw:   0.5925  index:  7
range common band filter: line:   5313  range:    465  shift:  0.14607  rbw0:   0.5977  rbw:   0.5977  index:  7
range common band filter: line:   5313  range:    930  shift:  0.14416  rbw0:   0.5996  rbw:   0.5996  index:  7
range common band filter: line:   5313  range:   1395  shift:  0.14477  rbw0:   0.5990  rbw:   0.5990  index:  7
range common band filter: line:   5313  range:   1860  shift:  0.13613  rbw0:   0.6076  rbw:   0.6076  index:  7
range common band filter: line:   5313  range:   2325  shift:  0.13435  rbw0:   0.6094  rbw:   0.6094  index:  7
range common band filter: line:   5313  range:   2790  shift:  0.13292  rbw0:   0.6108  rbw:   0.6108  index:  7
range common band filter: line:   5313  range:   3255  shift:  0.15797  rbw0:   0.5858  rbw:   0.5858  index:  7
range common band filter: line:   5313  range:   3720  shift:  0.34645  rbw0:   0.3973  rbw:   0.3973  index:  3
range common band filter: line:   5313  range:   4185  shift:  0.09781  rbw0:   0.6459  rbw:   0.6459  index:  8
range common band filter: line:   5313  range:   4650  shift: 106.92581  rbw0:   0.2500  rbw:   0.2500  index:  0
block: 91  output line:   5369  SLC l_start:  85904  SLC l_end:  86895  overlap_save start line:  85872
block: 92  output line:   5428  SLC l_start:  86848  SLC l_end:  87839  overlap_save start line:  86816
block: 93  output line:   5487  SLC l_start:  87792  SLC l_end:  88783  overlap_save start line:  87760
block: 94  output line:   5546  SLC l_start:  88736  SLC l_end:  89727  overlap_save start line:  88704
block: 95  output line:   5605  SLC l_start:  89680  SLC l_end:  90671  overlap_save start line:  89648
block: 96  output line:   5664  SLC l_start:  90624  SLC l_end:  91615  overlap_save start line:  90592
block: 97  output line:   5723  SLC l_start:  91568  SLC l_end:  92559  overlap_save start line:  91536
block: 98  output line:   5782  SLC l_start:  92512  SLC l_end:  93503  overlap_save start line:  92480
block: 99  output line:   5841  SLC l_start:  93456  SLC l_end:  94447  overlap_save start line:  93424
block: 100  output line:   5900  SLC l_start:  94400  SLC l_end:  95391  overlap_save start line:  94368
block: 101  output line:   5959  SLC l_start:  95344  SLC l_end:  96335  overlap_save start line:  95312
block: 102  output line:   6018  SLC l_start:  96288  SLC l_end:  97279  overlap_save start line:  96256
block: 103  output line:   6077  SLC l_start:  97232  SLC l_end:  98223  overlap_save start line:  97200
block: 104  output line:   6136  SLC l_start:  98176  SLC l_end:  99167  overlap_save start line:  98144
block: 105  output line:   6195  SLC l_start:  99120  SLC l_end: 100111  overlap_save start line:  99088
block: 106  output line:   6254  SLC l_start: 100064  SLC l_end: 101055  overlap_save start line: 100032
block: 107  output line:   6313  SLC l_start: 101008  SLC l_end: 101999  overlap_save start line: 100976
block: 108  output line:   6372  SLC l_start: 101952  SLC l_end: 102943  overlap_save start line: 101920
block: 109  output line:   6431  SLC l_start: 102896  SLC l_end: 103887  overlap_save start line: 102864
block: 110  output line:   6490  SLC l_start: 103840  SLC l_end: 104831  overlap_save start line: 103808
block: 111  output line:   6549  SLC l_start: 104784  SLC l_end: 105775  overlap_save start line: 104752
block: 112  output line:   6608  SLC l_start: 105728  SLC l_end: 106719  overlap_save start line: 105696
```

```
block: 113  output line:   6667  SLC l_start: 106672  SLC l_end: 107663  overlap_save start line: 106640
block: 114  output line:   6726  SLC l_start: 107616  SLC l_end: 108607  overlap_save start line: 107584
block: 115  output line:   6785  SLC l_start: 108560  SLC l_end: 109551  overlap_save start line: 108528
block: 116  output line:   6844  SLC l_start: 109504  SLC l_end: 110495  overlap_save start line: 109472
block: 117  output line:   6903  SLC l_start: 110448  SLC l_end: 111439  overlap_save start line: 110416
block: 118  output line:   6962  SLC l_start: 111392  SLC l_end: 112383  overlap_save start line: 111360
block: 119  output line:   7021  SLC l_start: 112336  SLC l_end: 113327  overlap_save start line: 112304
block: 120  output line:   7080  SLC l_start: 113280  SLC l_end: 113346  overlap_save start line: 113248

output interferogram: diff0_orb_2d_WBs2/20071020_5_20101028_5.diff
output interferogram width: 1550  lines: 7084

user time (s):       164.310
system time (s):       7.130
elapsed time (s):    547.510


rasmph_pwr diff0_orb_2d_WBs2/20071020_5_20101028_5.diff rmli_WBs2/rmli_WBs2_5.ave 1550 1 1 0 1 1 0.6
0.4
*** DISP rasmph_pwr: generate raster image of interferogram phase + intensity data ***
*** Copyright 2005, Gamma Remote Sensing, v2.5 10-Oct-2005 clw ***
input complex image filename:   diff0_orb_2d_WBs2/20071020_5_20101028_5.diff
input complex image width:   1550   height: 7084
input intensity image filename: rmli_WBs2/rmli_WBs2_5.ave
input intensity image width: 1550   height: 7084
output SUN RASTER format image filename: diff0_orb_2d_WBs2/20071020_5_20101028_5.diff.ras
range looks: 1   azimuth looks: 1
output image width: 1550   height: 7084
relative scale factor:    0.600   exponent:    0.400
average:  2.53171e-01   scale factor:  3.31792e+02

line 0
line 400
line 800
line 1200
line 1600
line 2000
line 2400
line 2800
line 3200
line 3600
line 4000
line 4400
line 4800
line 5200
line 5600
line 6000
line 6400
line 6800
7084 display lines

cc_wave diff0_orb_2d_WBs2/20071020_5_20101028_5.diff rmli_WBs2/20071020_5.rmli
rmli_WBs2/20101028_5.rmli diff0_orb_2d_WBs2/20071020_5_20101028_5.cc 1550 7 7 1
*** Interferogram coherence estimation ***
*** Copyright 2006, Gamma Remote Sensing, v5.5 27-Feb-2006 clw/uw ***
interferogram: diff0_orb_2d_WBs2/20071020_5_20101028_5.diff
intensity image 1: rmli_WBs2/20071020_5.rmli
intensity image 2: rmli_WBs2/20101028_5.rmli
output correlation: diff0_orb_2d_WBs2/20071020_5_20101028_5.cc
interferogram  width: 1550   lines: 7084

coherence estimated with linear weighting of samples

processing window (xmin, xmax, ymin, ymax): 0  1549  0  7083
processing window width, height:  1550  7084

weights:
 0.000 0.099 0.209 0.250 0.209 0.099 0.000
 0.099 0.293 0.441 0.500 0.441 0.293 0.099
 0.209 0.441 0.646 0.750 0.646 0.441 0.209
 0.250 0.500 0.750 1.000 0.750 0.500 0.250
 0.209 0.441 0.646 0.750 0.646 0.441 0.209
 0.099 0.293 0.441 0.500 0.441 0.293 0.099
 0.000 0.099 0.209 0.250 0.209 0.099 0.000
number of NULL lines at beginning of output coherence file: 3


processing line: 400
processing line: 800
```

```
processing line: 1200
processing line: 1600
processing line: 2000
processing line: 2400
processing line: 2800
processing line: 3200
processing line: 3600
processing line: 4000
processing line: 4400
processing line: 4800
processing line: 5200
processing line: 5600
processing line: 6000
processing line: 6400
processing line: 6800
number of NULL lines at end of output coherence file: 3
total number of output lines: 7084

user time (s):         2.530
system time (s):       0.100
elapsed time (s):      2.750


rascc diff0_orb_2d_WBs2/20071020_5_20101028_5.cc rmli_WBs2/rmli_WBs2_5.ave 1550 1 1 0  1 1 .1 .9 0.6
0.4
*** DISP rascc: generate raster image of correlation coefficient + intensity data ***
*** Copyright 2010, Gamma Remote Sensing, v2.3 25-Nov-2010 clw/uw ***
input correlation data: diff0_orb_2d_WBs2/20071020_5_20101028_5.cc
input image width: 1550
correlation data lines: 7084
intensity image: rmli_WBs2/rmli_WBs2_5.ave
intensity image lines: 7084
output SUN RASTER format image filename: diff0_orb_2d_WBs2/20071020_5_20101028_5.cc.ras
range looks: 1   azimuth looks: 1
output image width: 1550   height: 7084
relative scale factor:    0.600   exponent:    0.400
average:  2.53171e-01   scale factor:  3.31792e+02
minimum correlation: 0.100  maximum correlation: 0.900

line 0
line 400
line 800
line 1200
line 1600
line 2000
line 2400
line 2800
line 3200
line 3600
line 4000
line 4400
line 4800
line 5200
line 5600
line 6000
line 6400
line 6800
7084 display lines

 ./mk_diff_orb_2d processing end: Sun Apr 10 23:14:40 2011
```