

CV-580 PolGASP Format Definition

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AF Wind^{*}, KP Murnaghan^{*}

Canada Centre for Remote Sensing

Natural Resources Canada

Abstract

This document defines the file format of all the CV-580 PolGASP related files. The main files in this set are comprised of a header file and image file pair for each polarization. In addition, an input parameter file, and master log and header files are produced during processing by PolGASP. Finally, two composite images are created from the magnitude data for a quick look at the final product.

^{*} Under contract to CCRS from Prologic Systems Ltd.

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1 Introduction

Data from the Convair-580 (CV-580) C/X SAR system is processed by the Polarimetric Generalized Airborne SAR Processor (PolGASP). PolGASP produces Single Look Complex (SLC) imagery that is focussed in azimuth and usually motion compensated. The imagery is further processed by ComplexCAL to yield radiometric and phase calibrated results. Both PolGASP and ComplexCAL have been developed by the Canada Centre for Remote Sensing (CCRS). PolGASP extends the capabilities of GASP to efficiently deal with polarimetric data.

The processed imagery is stored in four “.img” files, one for each polarization. Each of the image files has an associated header file (“.hdr”), which contains information specific to that polarization. A master header file is also created that contains most of the same information. Some processing steps deal with polarizations individually and do not update the master header file. Therefore, the polarization header files take precedence. The header files provide image dimensions, image structure, and radar system parameters.

Two summary images are generated for viewing purposes. They are not meant for analysis. The TIFF and PCI Pix files are colour composites of three (HH, HV, VV) and four (HH, HV, VH, VV) channels, respectively. These composites are based on amplitude only and are not full resolution.

Prior to processing with PolGASP, input parameters are set using PolGASP_Setup and stored in an “inpar” file. This file is described in the following sections but is not required by the end user. In addition to this, a duplicate set of files is produced for the noise block as well as several other files are produced during processing. These files are not required by the end user to analyze the data.

Table 1. Files associated with the PolGASP format

Type	Naming Convention	Description	Approximate Data Volume	
.inpar	l#p#.inpar	Input parameter file (text)	4.6 kB	
.log	l#p#polgasp.log	Log file (text)	11.0 kB	
.hdr	l#p#polgasp.hdr	Master header file (text)	6.0 kB	
.hdr	l#p#[hv][hv]polgasp.hdr	Polarization header file (text)	3.5 kB/chan	
			PRF/v=2.32	PRF/v=2.57
.img	l#p#[hv][hv]polgasp.img	Imagery data	36.25 MB/km/chan	40.16 MB/km/chan
.pix	l#p#.pix	Colour Composite PCI Pix file (HH, HV, VH, VV)	9.06 MB/km	10.04 MB/km
.tif	l#p#.tif	Colour composite TIFF file	1.70 MB/km	1.88 MB/km

		(HH, HV, VV)=(R, G, B)		
--	--	------------------------	--	--

The files associated with the PolGASP imagery are outlined in Table 1. The approximate data volume of the imagery is based on processing a half swath of 2048 pixels and given in bytes per km in the azimuth direction. Figure 1 presents another view of the PolGASP file structure.

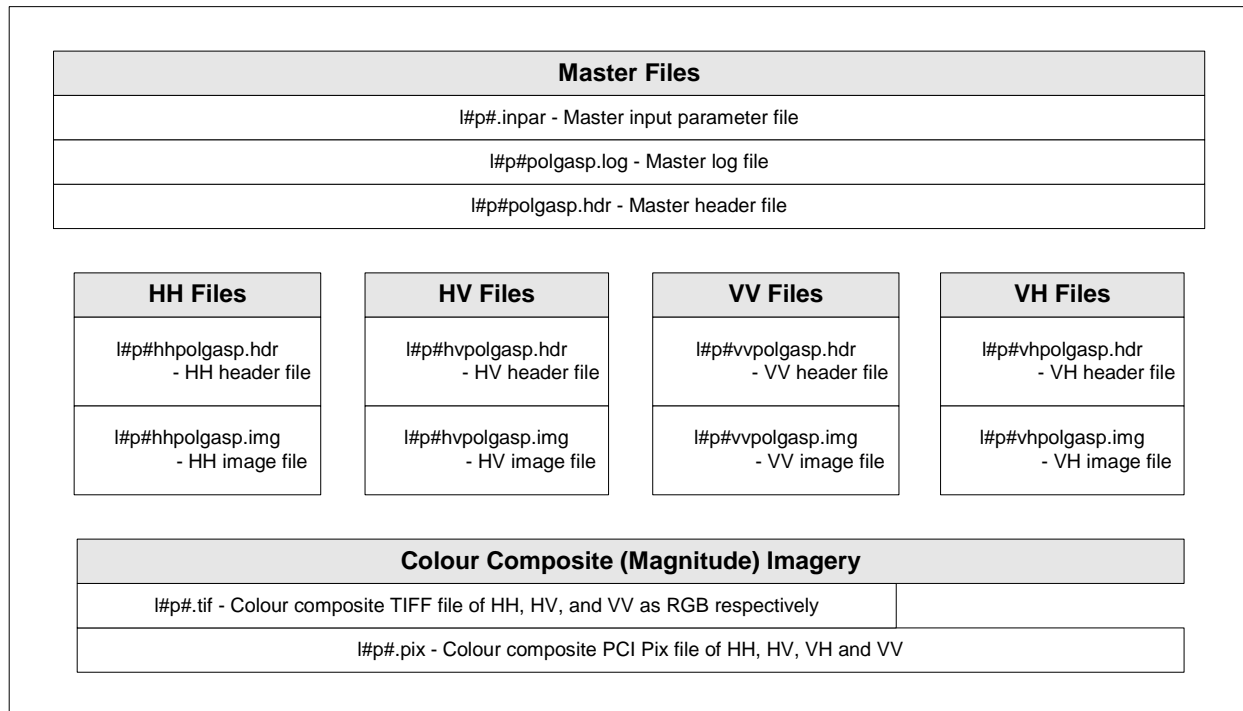


Figure 1. Files associated with the PolGASP format.

1.1 Naming Conventions

All of the PolGASP files described here follow the same naming convention. The file name begins with the line and pass of the image. If the file is specific to a polarization, the polarization is recorded next. If the file pertains to the noise block, an 'n' is recorded next. Finally, the file type is recorded including its extension. As examples, the master PolGASP header file for line 2 pass 3 would be 'l2p3polgasp.hdr', and the horizontal transmit, vertical receive PolGASP image file for the noise block of line 6 pass 3 would be 'l6p3hvnpolgasp.img'. General examples for each file type can be found in Table 1.

The inpar, and header files also follow naming and format conventions for their keys and values. These files reserve the first 22 columns for key names and the values begin in column 24. The inpar and master header files begin with parameters common to all polarizations and then present the polarization dependent parameters. These parameters are recorded for each polarization using a key ending in "_n" where n=1, 2, 3, or 4. All the polarization dependent parameters are listed for polarization 1, and then repeated for polarizations 2, 3, and 4 accordingly. The

polarizations are usually numbered 1 through 4 for HH, HV, VV, and VH respectively. The polarization header files do not require the “_n” convention as they only record parameters pertaining to their own polarization.

2 Inpar File

Prior to processing imagery with PolGASP, many parameters must be initialized. The program PolGASP_Setup is used to produce an “inpar” file, which contains all the necessary input parameters for PolGASP.

The format and naming conventions applied to the inpar file are explained in §1.1. The inpar file contains one exception to the normal presentation of polarization dependent parameters. In the normal situation, all of the polarization dependent parameters are presented for the first polarization and then repeated for the second, third, and fourth. The exceptions to this repetition are the prefix and suffix lines and samples for each polarization. In these cases, the first polarization is used as a reference, and so the relative values are only provided for the second, third, and fourth polarizations. These parameters provide further flexibility but are not required in the case of the CV-580 data and are therefore set to zero.

We provide a partial listing of an example file here. The listing is truncated when the repetition becomes apparent. A full listing is available in appendix A. Table 2, presenting the keys and their descriptions for the inpar file follows the partial listing.

```
mission_id           ALL
xv_detect           n
calibrate           Y
mocomp             Y
verbose            Y
nadir              n
uniform            n
double_prec        n
no_iq_balance      n
repeat             n
oversample         n
cal_block          n
delay_radcal       Y
delay_align        n
mocom_par_file     l6p3.prm
polgasp_version    7
polgasp_release    2
polgasp_patch      1
number_files       4
memblocks          1024
gps_elev_offset    -50.0000000000
nadir_width        0
altitude           0.0000000000
transmt_pwr_reading -2.6500000000
boresight_offset_h -3.3300000000
boresight_offset_v -3.3300000000
prfoverv           2.3200000000
moc_sar_offset     0
noise_rf_gain_inpar l6p3_rf_gain.inpar
noise_gen_inpar    l6p3_rf_gen.inpar
rf_gain_on         25-JUN-2002 17:31:55.07600
rf_gen_on          YYYYYYYYYY
```

```

master_file
master_dir
master_start_line      0
master_stop_line       264094744
master_prf_file        £a
master_near_srd        0.0000000000
master_moc_sar_offset  0.0000000000
signal_file_1          16p3hh.sig
signal_dir_1           /hosts/mercator/merc3/cv580/25jun02/16p3
noise_file_1           16p3hhn.sig
noise_dir_1            /hosts/mercator/merc3/cv580/25jun02/16p3
sigdmp_version_1      2
sigdmp_release_1      1
sigdmp_patch_1        0
start_line_1          1
stop_line_1            91850
start_sample_1         1
stop_sample_1          2048
range_shift_1          0.0000000000
azimuth_shift_1       0.0000000000
beamwidth_1            3.0300000000
frequency_offset_1    0.0000000000
wtfunc_pedestal_1     0.0000000000
wtfunc_exponent_1     1.0000000000
mean_real_1            -0.0583520707
mean_img_1             0.2868087617
stddev_real_1          8.0024614666
stddev_img_1           8.2673590886
IQ_balance_1           0.9674023832
mean_mag_1             11.5097471760
signal_file_2          16p3hv.sig
signal_dir_2           /hosts/mercator/merc3/cv580/25jun02/16p3
noise_file_2           16p3hvn.sig
noise_dir_2            /hosts/mercator/merc3/cv580/25jun02/16p3
sigdmp_version_2      2
sigdmp_release_2      1
sigdmp_patch_2        0
start_line_2          1
stop_line_2            91850
prefix_lines_2         0
suffix_lines_2         0
start_sample_2         1
stop_sample_2          2048
prefix_samples_2       0
suffix_samples_2       0
range_shift_2          0.0000000000
azimuth_shift_2       0.0000000000
.
.
.

```

Table 2. Explanation of keys in the master PolGASP input parameter file

Key	Comments
mission_id	Mission identification
xv_detect	Generate an xv image file on output (y/n)
calibrate	Generate a calibrated image (y/n)
mocomp	Apply post flight motion compensation (y/n)

verbose	Verbose output in log file (y/n)
nadir	Nadir line present (y/n)
uniform	Uniform azimuth spacing (y/n)
double_prec	Double precision calculations (y/n)
no_iq_balance	Do not calculate IQ Balance (y/n)
repeat	Synthesize repeat pass (y/n)
oversample	Oversample in the range direction (y/n)
cal_block	Generate a calibrated noise block image (y/n)
delay_radcal	Delay running RadCAL (y/n)
delay_align	Delay running align (y/n)
mocom_par_file	Motion compensation parameter file
polgasp_version	Version, release, and patch of PolGASP_Setup used
polgasp_release	
polgasp_patch	
number_files	Number of polarizations
memblocks	Memory limit for transpose (MB)
gps_elev_offset	GPS elevation offset (m)
nadir_width	Range cells to nadir point
altitude	Altitude above terrain (m)
transmt_pwr_reading	Transmitter power reading (dBm)
boresight_offset_h	Boresight depression offset angle horizontal antenna (deg)
boresight_offset_v	Boresight depression offset angle vertical antenna (deg)
prfoverv	Pulse Repetition Frequency/Velocity (Hz/m/s) or (m^{-1})
moc_sar_offset	Mocomp to SAR offset in lines
noise_rf_gain_inpar	Input parameter file for noise block
noise_gen_inpar	Input parameter file for noise generator block (not used)
rf_gain_on	Start time for processing noise block
rf_gen_on	Time the noise generator was turned on (not used)
master_file	(empty)
master_dir	(empty)
master_start_line	These values do not contain valid information for CV-580 products (not used)
master_stop_line	
master_prf_file	
master_near_srd	
master_moc_sar_offset	

signal_file_1	Image signal file for first polarization
signal_dir_1	Directory of image signal file
noise_file_1	Noise block signal file
noise_dir_1	Directory of noise block signal file
sigdmp_version_1	Version, release, and patch of SigDmp used to dump signal data
sigdmp_release_1	
sigdmp_patch_1	
start_line_1	Start line number of image
stop_line_1	Stop line number of image
start_sample_1	Start sample number of image
stop_sample_1	Stop sample number of image
range_shift_1	Range shift
azimuth_shift_1	Azimuth shift
beamwidth_1	Processor Beamwidth (deg)
frequency_offset_1	Frequency offset (Hz)
wfunc_pedestal_1	Weighting function pedestal
wfunc_exponent_1	Weighting function exponent
mean_real_1	Mean value of real components (~0)
mean_img_1	Mean value of imaginary component (~0)
stddev_real_1	Standard Deviation of real components
stddev_img_1	Standard Deviation of imaginary components
IQ_balance_1	IQ balance between real and imaginary components (~1)
mean_mag_1	Mean magnitude of the complex values
signal_file_2	Everything for the first polarization is repeated for the last three polarizations with the addition of prefix and suffix lines and samples, which are set to zero.
signal_dir_2	
noise_file_2	
noise_dir_2	
sigdmp_version_2	
sigdmp_release_2	
sigdmp_patch_2	
start_line_2	
stop_line_2	
prefix_lines_2	Number of lines to process before the first polarization (zero)
suffix_lines_2	Number of lines to process after the first polarization (zero)
start_sample_2	


```

COMMAND: transcribe2.0 l6p3hhpolgasp.img 1024 l6p3polgasp.log
  sig file      : /hosts/mercator/merc3/cv580/25jun02/l6p3/l6p3hh.sig
  sig hdr       : /hosts/mercator/merc3/cv580/25jun02/l6p3/l6p3hh.hdr
  dest file     : l6p3hhpolgasp.img
  dest hdr      : l6p3hhpolgasp.hdr
  source lines  : 116910
  source samples: 2048
  output lines  : 91850
  output samples: 2048
  start line    : 1
  start sample  : 1
  range shift   : 0.000000
  memory buffer : 1024
sample 0 of 2048
transcribe completed successfully

```

```
Finished Transcribe : Fri Aug 30 13:22:25 2002
```

Each signal file is first transposed so that the imagery is stored in range lines from the near to far range. This is opposite the signal data, which is stored in azimuth lines from the start to end of the line. The data are transposed with the program Transcribe, which also applies a range shift when required. The log file contains the relevant signal file names and sizes as well as destination file names and sizes. Also listed is where the transposition begins, any range shift applied and the size of the memory buffer allowed (measured in MB). The start time, end time, and completion status of transcribe are also recorded in the log file.

```

Azimuth focussing...
  pri           : 0.431035      sample_size    : 4.000000
  start_range   : 7908.675396   wavelength     : 0.056565
  velocity      : 140.042243    fft_size       : 131072
  numlines      : 2048          numsamples     : 91850
  max 2D ref    : 1             moc sar offset : 0
  max ref length: 1975
Post flight motion compensation applied
IQ balance on signal data

<<< file (l6p3hhpolgasp.img) >>>
  beamwidth     : 0.052883      pedestal       : 0.000000
  power         : 1.000000      freq_offset    : 0.000000
  azimuth shift : 0.000000

```

After each polarization has been run through Transcribe independently, the data is azimuth focussed. Again several relevant parameters are listed for QC purposes, first those common to all polarizations and then those particular to each.

We begin by describing the parameters common to all polarizations. The pri is the azimuth dimension of the pixels and is based on the PRF/v used when acquiring the data. The PRF/v can be set to either 2.32 or 2.57 m⁻¹ and so the azimuth size is either 43 or 39 cm respectively. The sample size is the slant range dimension of each pixel and is always four metres. The start range is the slant range distance to the first range line. It is also known as the near slant range distance. The wavelength is measured in metres, as were the previous three values. The velocity is the plane's ground speed and is identical to the value recorded at the beginning of the log file. During focussing, the data is put through a Fast Fourier Transform (FFT) and back again. The size of this transform is specified by fft_size and is a power of two equal to or larger than the number of samples being processed. The number of lines and samples are recorded next. The

After the noise data is processed and focussed, two status messages are provided. The first indicates when the copy of PolGASP called to process the noise block finished. The second indicates the completion status of that process.

The original PolGASP then continues its analysis by determining the mean I^2 level of the noise block for each polarization. Again, this is calculated across the same range as the processed image but the azimuth portion is restrained to valid focussed data. This is because the edges of the imagery where focussing could not be completed are filled with zero padding. Therefore, reading the first four entries we see that analysis was performed on samples 988-3109 and all 2048 lines. We note again that the noise block actually contains 4096 samples. The last entry records the mean value of I^2 over this region for the polarization.

```
radCAL3.0 delayed by request...
Stop time of Processing : Fri Aug 30 15:06:09 2002
<<< Successful completion >>>
```

There are three final messages at the end of the log file. The first refers to radCAL, an outdated program to calibrate the CV-580 imagery that should always be turned off during PolGASP_Setup. Then the final stop time and completion status of the original PolGASP are recorded.

4 Master Header File

The master PolGASP header file records parameters common to all polarizations as well as parameters dependent upon polarization. The format and naming conventions applied to the master header file are explained in §1.1.

An example master PolGASP header file is listed here. Notice that it is truncated, as one can readily identify the repeating pattern of the individual polarization parameters. A full listing is provided in C.

```
mission_id          ALL
mission            5
line               6
pass               3
polgasp_version    7
polgasp_release    2
polgasp_patch      1
number_files       4
number_lines       91850
number_samples     2048
datatype           1
number_format      float32
complex_flag       1
STC                Test
system_mode        Lead In
clutterlock_status Manual
antenna_look_direction Port
Proc'd_Rec'd_Channel_Pol Dual Ch. Near (A Copol, B Crosspol)
swath_mode         Nadir
recorded_sig_HDDR_chan Both Near
mocom_status       Off
```

```

mocomp                y
mocomp_par_file      l6p3.prm
nadir                 n
nadir_width           0
altitude              7065.9836103028
double_prec           n
range_gate_delay      66.0500030518
sample_size           4.0000000000
saw_delay             13.2890000000
wavelength            0.0565646000
fft_size              131072
prfoverv              2.3199984459
groundspeed           140.0422431330
boresight_dep_angle  39.0008103802
boresight_offset_h   -3.3300000000
boresight_offset_v   -3.3300000000
transmt_pwr_reading  -2.6500000000
signal_file_1         l6p3hh.sig
signal_dir_1          /hosts/mercator/merc3/cv580/25jun02/l6p3
ancillary_file_1     l6p3hh.anc
noise_file_1          l6p3hhn.sig
noise_dir_1           /hosts/mercator/merc3/cv580/25jun02/l6p3
polgasp_image_file_1 l6p3hhpolgasp.img
range_shift_1         0.0000000000
azimuth_shift_1      0.0000000000
rnglinenum_firstline_1 1
rnglinenum_lastline_1 91850
iqsampnum_firstsamp_1 1
iqsampnum_lastsamp_1 2048
time_first_line_1    25-JUN-2002 17:26:47.35100
time_last_line_1     25-JUN-2002 17:31:30.15800
frequency_band_1     C
Tx_polarization_1    Horizontal
Rx_polarization_1    Horizontal
ref_size_near_1      971
ref_size_far_1       1975
first_valid_near_1   486
last_valid_near_1    91365
first_valid_far_1    988
last_valid_far_1     90863
beamwidth_1          3.0299999998
near_srd_1            7908.6753957160
far_srd_1             16096.6753957160
frequency_offset_1   0.0000000000
wtfunc_pedestal_1    0.0000000000
wtfunc_exponent_1    1.0000000000
mean_real_1           -0.0583520707
mean_img_1            0.2868087617
IQ_balance_1         0.9674023832
rf_gain_1             23.0000000000
signal_file_2         l6p3hv.sig
signal_dir_2          /hosts/mercator/merc3/cv580/25jun02/l6p3
.
.
.

```

Table 3. Explanation of keys in the master PolGASP header file

Key	Comments
mission_id	Mission identification
mission	Mission number
line	Line number
pass	Pass number
polgasp_version	Version, release, and patch of PolGASP used to process imagery
polgasp_release	
polgasp_patch	
number_files	Number of polarizations
number_lines	Number of azimuth lines processed
number_samples	Number of range samples processed
datatype	Datatype and number_format are set to "1" and "float32" respectively, being redundant in indicating that the data is 32 bit float
number_format	
complex_flag	Complex numbers (0=no,1=yes)
STC	Sensitivity Time Control mode (Test/Ice/Land/Smooth Water/Rough Water)
system_mode	System Mode (Lead In/On-Line/Standby)
clutterlock_status	Clutter lock setting (Auto/Manual)
antenna_look_direction	Look direction of the antenna (Port/Starboard)
Procd_Recd_Channel_Pol	Channel set-up for recording and processing
swath_mode	Swath mode of the antenna
recorded_sig_HDDR_chan	Recording set-up (Both Near/Both Far) – No longer applicable
mocom_status	Motion compensation status (On/Off)
mocomp	Post flight motion compensation applied (y/n)
mocom_par_file	Motion compensation parameter file
nadir	Nadir line present (y/n)
nadir_width	Range cells to nadir point
altitude	Altitude above terrain (m)
double_prec	Double Precision Calculations (y/n)
range_gate_delay	Range Gate Delay (μ s)
sample_size	Sample size - range (m)
saw_delay	SAW delay (μ s)
wavelength	Wavelength (m)
fft_size	FFT size (power of two for sorting efficiency)
prfoverv	Pulse Repetition Frequency/Velocity (Hz/m/s) or (m^{-1})

groundspeed	Ground speed (m/s)
boresight_dep_angle	Boresight Depression Angle (deg)
boresight_offset_h	Boresight depression offset angle - horizontal antenna (deg)
boresight_offset_v	Boresight depression offset angle - vertical antenna (deg)
transmt_pwr_reading	Transmitter power reading (dBm)
signal_file_1	Image signal file for first polarization
signal_dir_1	Directory of image signal file
ancillary_file_1	Image ancillary file
noise_file_1	Noise block signal file
noise_dir_1	Directory of noise block signal file
polgasp_image_file_1	Image file produced on output
range_shift_1	Range shift
azimuth_shift_1	Azimuth shift
rnglinenum_firstline_1	Start line number from signal data
rnglinenum_lastline_1	Stop line number from signal data
iqsampnum_firstsamp_1	Start sample number from signal data
iqsampnum_lastsamp_1	Stop sample number from signal data
time_first_line_1	Time of start line (DD-MMM-YYYY hh:mm:ss.sssss)
time_last_line_1	Time of stop line (DD-MMM-YYYY hh:mm:ss.sssss)
frequency_band_1	Frequency band (C/X)
Tx_polarization_1	Transmit polarization (Horizontal/Vertical)
Rx_polarization_1	Receiving polarization (Horizontal/Vertical)
ref_size_near_1	Beam width at near edge
ref_size_far_1	Beam width at far edge
first_valid_near_1	These four entries describe the trapezoid shape actually processed. The rest of the image is padded with zeros.
last_valid_near_1	
first_valid_far_1	
last_valid_far_1	
beamwidth_1	Processor Beamwidth (deg)
near_srd_1	Range to first range sample (m)
far_srd_1	Range to last range sample (m)
frequency_offset_1	Frequency offset (Hz)
wfunc_pedestal_1	Weighting function pedestal
wfunc_exponent_1	Weighting function exponent
mean_real_1	Mean value of real components (~0)

mean_img_1	Mean value of imaginary component (~0)
IQ_balance_1	IQ balance between real and imaginary values (~1)
rf_gain_1	Fine gain throughout image - assumed constant (dB)
signal_file_2	The parameter list is then repeated for the second, third, and fourth polarizations
signal_dir_2	
...	

A similar master header file is created for the noise imagery and is called `l#p#_rf_gainpolgasp.hdr`. The noise block is used only in calibrating the data and so its corresponding files are unnecessary for data analysis by the user.

5 Polarization Header Files

The polarization header file records all the parameters of its corresponding image. Most of the parameters recorded here were already presented in the master header file and are simply repeated in the individual header file. The format and naming conventions applied to the polarization header file are explained in §1.1.

One significant difference between the master and polarization header files is in their values of lines and samples. The individual header files have the values reversed from the master header file because the polarizations are transposed separately by the program transcribe. Therefore, transcribe updates the polarization header files individually to correct the values of lines and samples. The master header file is not updated because its values apply to all channels while transcribe deals with only one polarization at a time. The individual polarization header files therefore accurately reflect the number of lines and samples in the image where the master header file does not.

Initially, all of the PolGASP header files are created during processing by PolGASP. During calibration, ComplexCAL modifies the polarization header files again. Specifically, 19 extra keys relating to calibration are added to the end of the file. These keys begin with the `relcal_version`, `_release`, and `_patch`. An example file listing is presented first followed by a table of explanations.

```
mission_id          ALL
mission            5
line               6
pass               3
polgasp_version    7
polgasp_release    2
polgasp_patch      1
file_number        1
number_files       4
number_lines       2048
number_samples     91850
header_offset      0
number_channels    1
```

```

datatype                1
number_format          float32
complex_flag           1
transposed              1
STC                     Test
system_mode             Lead In
clutterlock_status     Manual
antenna_look_direction Port
ProcD_Recd_Channel_Pol Dual Ch. Near (A Copol, B Crosspol)
swath_mode              Nadir
recorded_sig_HDDR_chan Both Near
mocom_status           Off
mocomp                  y
mocom_par_file         l6p3.prm
repeat                  n
nadir                  n
nadir_width            0
altitude                7065.9836103028
transmt_pwr_reading    -2.6500000000
boresight_dep_angle    39.0008103802
boresight_offset_h     -3.3300000000
boresight_offset_v     -3.3300000000
double_prec            n
slave_prf_file         l6p3prf.mat
start_line              1
stop_line               91850
start_sample            1
stop_sample             2048
signal_file             l6p3hh.sig
signal_dir              /hosts/mercator/merc3/cv580/25jun02/l6p3
ancillary_file         l6p3hh.anc
noise_file              l6p3hhn.sig
noise_dir               /hosts/mercator/merc3/cv580/25jun02/l6p3
polgasp_image_file     l6p3hhpolgasp.img
range_shift             0.0000000000
azimuth_shift          0.0000000000
rnglinenum_firstline   1
rnglinenum_lastline    91850
iqsampnum_firstsamp    1
iqsampnum_lastsamp     2048
time_first_line        25-JUN-2002 17:26:47.35100
time_last_line         25-JUN-2002 17:31:30.15800
frequency_band         C
prfoverv               2.3199984459
Tx_polarization        Horizontal
Rx_polarization        Horizontal
ref_size_near          971
ref_size_far           1975
first_valid_near       486
last_valid_near        91365
first_valid_far        988
last_valid_far         90863
groundspeed            140.0422431330
beamwidth               3.0299999998
near_srd                7908.6753957160
far_srd                 16096.6753957160
frequency_offset       0.0000000000
wtfunc_pedestal        0.0000000000
wtfunc_exponent        1.0000000000
range_gate_delay       66.0500030518
sample_size             4.0000000000
sample_size_az         0.4319003109
saw_delay               13.2890000000
wavelength              0.0565646000

```

```

fft_size          131072
moc_sar_offset    0
mean_real         -0.0583520707
mean_img         0.2868087617
stddev_real      8.0024614666
stddev_img       8.2673590886
IQ_balance       0.9674023832
rf_gain          23.0000000000
coarse_attenuation 6.0000000000
mean_S_noise_floor 0.0000000000
mean_S_noise_gen 0.0000000000
rf_gain_floor    23.0000000000
rf_gain_gen      23.0000000000
mean_S_noise_rf_gain 0.0032807934
rf_gain_gain     58.0000000000
coarse_atten_gain 6.0000000000
relcal_version    3
relcal_release    0
relcal_patch      0
noise_sigma_file 16p3hhpolgaspga.txt
gain_file         16p3hhgain.dat
sigma_numlines   2048
sigma_numsamples 91850
DN_n_square1     0.0000000000
DN_n_square2     0.0000000000
DN_cal_square    0.0000000000
DN_gain_square   0.0032807934
radCAL_g         1.0000000000
radCAL_gn        1.0000000000
radCAL_gcal      1.0000000000
radCAL_ggain     1.0000000000
K_prime          116.0500000000
Phase_corr       0.0000000000
Calibrated       yes
Range_Phase_Corr yes

```

Table 4. Explanation of keys in the PolGASP polarization header file

Key	Comments
mission_id	Mission identification
mission	Mission number
line	Line number
pass	Pass number
polgasp_version	Version, release, and patch of PolGASP used to process image
polgasp_release	
polgasp_patch	
file_number	Polarization number
number_files	Number of polarizations
number_lines	Number of range samples processed NB. Reversed from master header
number_samples	Number of azimuth lines processed NB. Reversed from master header
header_offset	Header offset

number_channels	Number of channels in this file
datatype	Datatype and number_format are set to "1" and "float32" respectively, being redundant in indicating that the data is 32 bit float
number_format	
complex_flag	Complex numbers used (0=no, 1=yes)
transposed	Data transposed (0=no, 1=yes)
STC	Sensitivity Time Control mode (Test/Ice/Land/Smooth Water/Rough Water)
system_mode	System Mode (Lead In/On-Line/Standby)
clutterlock_status	Clutter lock setting (Auto/Manual)
antenna_look_direction	Look direction of the antenna (Port/Starboard)
Procd_Recd_Channel_Pol	Channel set-up for recording and processing
swath_mode	Swath mode of the antenna
recorded_sig_HDDR_chan	Recording set-up (Both Near/Both Far) – No longer applicable
mocom_status	Motion compensation status (On/Off)
mocomp	Post flight motion compensation applied (y/n)
mocom_par_file	Mocomp parameter file
repeat	Synthesize repeat pass (y/n)
nadir	Nadir line present (y/n)
nadir_width	Range cells to nadir point
altitude	Altitude above terrain (m)
transmt_pwr_reading	Transmitter power reading (dBm)
boresight_dep_angle	Boresight Depression Angle (deg)
boresight_offset_h	Boresight depression offset angle horizontal antenna (deg)
boresight_offset_v	Boresight depression offset angle vertical antenna (deg)
double_prec	Double precision calculations (y/n)
slave_prf_file	PRF file for this pass
start_line	Start line number from signal data
stop_line	Stop line number from signal data
start_sample	Start sample number from signal data
stop_sample	Stop sample number from signal data
signal_file	Image signal file for first polarization
signal_dir	Directory of image signal file
ancillary_file	Image ancillary file
noise_file	Noise block signal file
noise_dir	Directory of noise block signal file
polgasp_image_file	Image file produced on output

range_shift	Range shift
azimuth_shift	Azimuth shift
rnglinenum_firstline	Start line number
rnglinenum_lastline	Stop line number
iqsampnum_firstsamp	Start sample number
iqsampnum_lastsamp	Stop sample number
time_first_line	Time of start line
time_last_line	Time of stop line
frequency_band	Frequency band (C/X)
prfoverv	Pulse Repetition Frequency/Velocity (Hz/m/s) or (m^{-1})
Tx_polarization	Transmit polarization (Horizontal/Vertical)
Rx_polarization	Receiving polarization (Horizontal/Vertical)
ref_size_near	Beam width at near edge
ref_size_far	Beam width at far edge
first_valid_near	These four entries describe the trapezoid shape actually processed. The rest is padded with zeroes.
last_valid_near	
first_valid_far	
last_valid_far	
groundspeed	Ground speed (m/s)
beamwidth	Processor Beamwidth (deg)
near_srd	Range to first range sample (m)
far_srd	Range to last range sample (m)
frequency_offset	Frequency offset (Hz)
wfunc_pedestal	Weighting function pedestal
wfunc_exponent	Weighting function exponent
range_gate_delay	Range Gate Delay (μs)
sample_size	Sample size - range (m)
sample_size_az	Sample size - azimuth (m)
saw_delay	SAW delay (μs)
wavelength	Wavelength (m)
fft_size	FFT size (power of two for sorting efficiency)
moc_sar_offset	Mocomp to SAR offset in lines
mean_real	Mean value of real components (~0)
mean_img	Mean value of imaginary component (~0)
stddev_real	Standard Deviation of real values

stddev_img	Standard Deviation of imaginary values
IQ_balance	IQ balance between real and imaginary values (~1)
rf_gain	Fine gain at start of image (dB)
coarse_attenuation	Coarse attenuation at start of image (dB)
mean_S_noise_floor	Mean value of noise floor intensity (set to 0)
mean_S_noise_gen	Mean value of oscillator on intensity (set to 0)
rf_gain_floor	Fine gain at start of noise floor (dB)
rf_gain_gen	Fine gain at start of oscillator on (dB)
mean_S_noise_rf_gain	Mean value of noise block (I^2)
rf_gain_gain	Fine gain at start of noise section (dB)
coarse_atten_gain	Coarse attenuation at start of noise section (dB)
relcal_version	Version, release, and patch of ComplexCAL used to calibrate image
relcal_release	
relcal_patch	
noise_sigma_file	Noise sigma file
gain_file	Gain file containing incidence angles and antenna pattern calculations
sigma_numlines	Number of lines in noise sigma file
sigma_numsamples	Number of samples each line is based on in the noise sigma file
DN_n_square1	Set to 0 (zero)
DN_n_square2	Set to 0 (zero)
DN_cal_square	Set to 0 (zero)
DN_gain_square	Mean value of noise block (I^2)
radCAL_g	Set to 1 (one)
radCAL_gn	Set to 1 (one)
radCAL_gcal	Set to 1 (one)
radCAL_ggain	Set to 1 (one)
K_prime	K' used for magnitude calibration (dB)
Phase_corr	Phase correction used for phase calibration (rad)
Calibrated	ComplexCAL successful (yes/no)
Range_Phase_Corr	Range dependent phase correction applied (yes/no)

There are two possible pixel sizes depending on the PRF/v chosen for the pass. The azimuth spacing is determined by the reciprocal value of the PRF/v. The PRF/v can be set as either 2.32 or 2.57 m^{-1} , which results in an azimuth spacing of either 0.43 or 0.39 m. These two possibilities result in slightly different image sizes as seen in Table 1. The range spacing is always set to 4.0 m, so the PolGASP pixels are rectangular rather than square.

Again, PolGASP produces similar polarization header files for the noise block. As mentioned above, the noise block is only used for calibration and is not necessary for analysis.

6 Polarization Image Files

The processed imagery is stored as 32 bit complex floating-point data in rapid azimuth order. This order is opposite from the signal data because the data is transposed during processing. Figure 2 clearly shows the difference between the two orders.

Since the data is stored in complex IQ format, $\sigma^o = 10 \cdot \log_{10}(I^2 + Q^2)$.

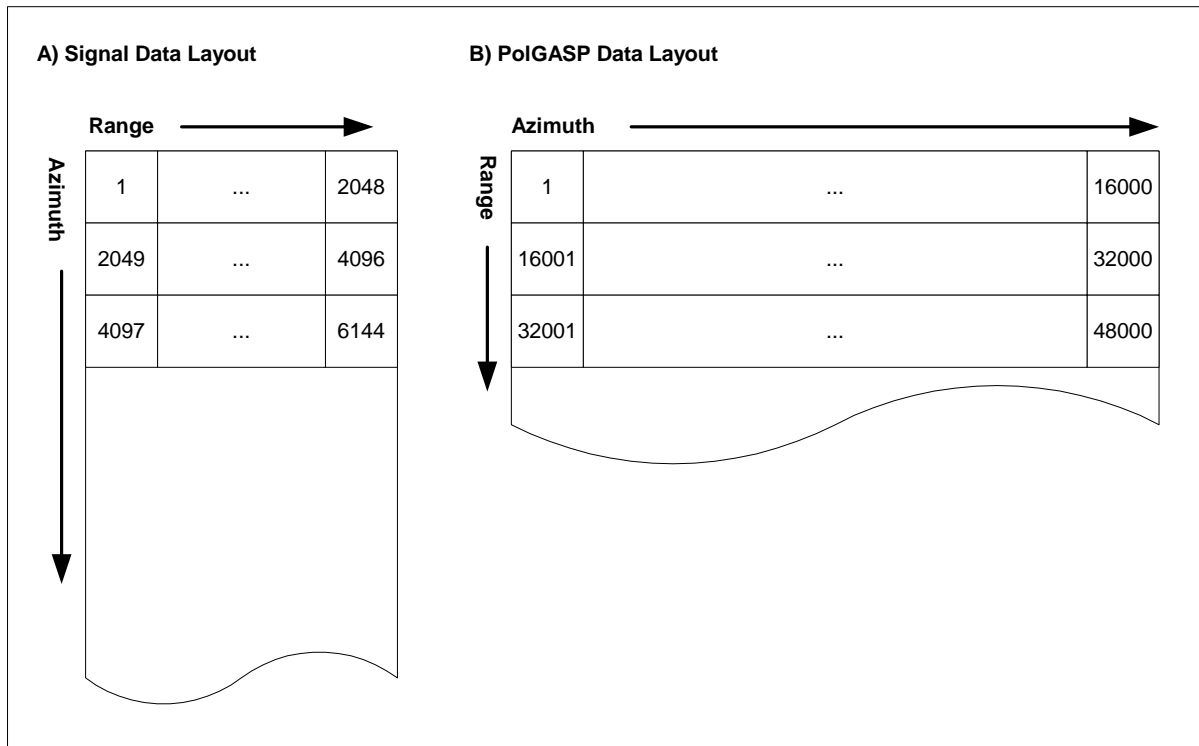


Figure 2. Comparison of Signal and PolGASP data layout.

The comparison uses a half swath image (2048 pixels in range) that is 16000 lines long in the azimuth direction. The numbers represent pixel location in the file. A) The signal data is ordered from near to far range and recorded one azimuth line after another. In this way the data is ordered in chronological order of acquisition. B) The PolGASP data is transposed from the signal data so that entire range lines are recorded one after another from near to far range. Pixel 1 is the same in the two layouts.

7 Colour Composite Image Files

Both the TIFF and the PCI® Pix image files go through some initial processing. The complex image data from each polarization is first converted to magnitude only, and also decimated by 8 in the azimuth direction. The decimation is done to closer approximate square pixels for viewing purposes. For further viewing ease, a 1% crop is applied to each channel during creation. It is obvious then that these images are only meant as quick look tools and not for polarimetric analysis.

The PCI Pix image file is a composite image of all four polarizations so that the user may view any combination in PCI. The tiff file is a colour composite of HH, HV, and VV, which compose the RGB channels, respectively. The tiff file is more compact as it only contains 3 of the 4 channels and requires $\frac{1}{4}$ of the bits per pixel.

8 Acknowledgements

The development of the PolGASP processor has been long and involved a large number of dedicated individuals. We would like to acknowledge in particular the following people for their work in designing, coding, and testing the PolGASP software at CCRS: Karim Mattar, Peter Farris-Manning, John Wolfe, Stefan Nedelcu, Ian Neeson, John Wessels, and Wenhong Liu. And the work goes on...

A. Example PolGASP Input Parameter File

```

mission_id          ALL
xv_detect           n
calibrate           Y
mocomp              Y
verbose             Y
nadir               n
uniform             n
double_prec         n
no_iq_balance       n
repeat              n
oversample          n
cal_block           n
delay_radcal        Y
delay_align         n
mocomp_par_file     16p3.prm
polgasp_version      7
polgasp_release     2
polgasp_patch       1
number_files        4
memblocks           1024
gps_elev_offset     -50.0000000000
nadir_width         0
altitude            0.0000000000
transmt_pwr_reading -2.6500000000
boresight_offset_h -3.3300000000
boresight_offset_v -3.3300000000
prfoverv            2.3200000000
moc_sar_offset      0
noise_rf_gain_inpar 16p3_rf_gain.inpar
noise_gen_inpar     16p3_rf_gen.inpar
rf_gain_on          25-JUN-2002 17:31:55.07600
rf_gen_on           YYYYYYYY
master_file
master_dir
master_start_line   0
master_stop_line    264094744
master_prf_file      fa
master_near_srd     0.0000000000
master_moc_sar_offset 0.0000000000
signal_file_1       16p3hh.sig
signal_dir_1        /hosts/mercator/merc3/cv580/25jun02/16p3
noise_file_1        16p3hhn.sig
noise_dir_1         /hosts/mercator/merc3/cv580/25jun02/16p3
sigdmp_version_1    2
sigdmp_release_1    1
sigdmp_patch_1      0
start_line_1        1
stop_line_1         91850
start_sample_1      1
stop_sample_1       2048
range_shift_1       0.0000000000
azimuth_shift_1     0.0000000000
beamwidth_1         3.0300000000
frequency_offset_1  0.0000000000
wtfunc_pedestal_1  0.0000000000
wtfunc_exponent_1  1.0000000000
mean_real_1         -0.0583520707
mean_img_1          0.2868087617
stddev_real_1       8.0024614666
stddev_img_1        8.2673590886
IQ_balance_1        0.9674023832

```

```

mean_mag_1          11.5097471760
signal_file_2       l6p3hv.sig
signal_dir_2        /hosts/mercator/merc3/cv580/25jun02/l6p3
noise_file_2        l6p3hvn.sig
noise_dir_2         /hosts/mercator/merc3/cv580/25jun02/l6p3
sigdmp_version_2    2
sigdmp_release_2    1
sigdmp_patch_2      0
start_line_2        1
stop_line_2         91850
prefix_lines_2      0
suffix_lines_2      0
start_sample_2      1
stop_sample_2       2048
prefix_samples_2    0
suffix_samples_2    0
range_shift_2       0.0000000000
azimuth_shift_2     0.0000000000
beamwidth_2         3.0300000000
frequency_offset_2  0.0000000000
wtfunc_pedestal_2   0.0000000000
wtfunc_exponent_2   1.0000000000
mean_real_2         -0.2385011759
mean_img_2          -0.3854228404
stddev_real_2       6.5140914383
stddev_img_2        6.7295754221
IQ_balance_2        0.9670433915
mean_mag_2          9.3768868077
signal_file_3       l6p3vv.sig
signal_dir_3        /hosts/mercator/merc3/cv580/25jun02/l6p3
noise_file_3        l6p3vvn.sig
noise_dir_3         /hosts/mercator/merc3/cv580/25jun02/l6p3
sigdmp_version_3    2
sigdmp_release_3    1
sigdmp_patch_3      0
start_line_3        1
stop_line_3         91850
prefix_lines_3      0
suffix_lines_3      0
start_sample_3      1
stop_sample_3       2048
prefix_samples_3    0
suffix_samples_3    0
range_shift_3       1.2500000000
azimuth_shift_3     0.5000000000
beamwidth_3         3.0300000000
frequency_offset_3  0.0000000000
wtfunc_pedestal_3   0.0000000000
wtfunc_exponent_3   1.0000000000
mean_real_3         -0.4974109026
mean_img_3          0.2641106849
stddev_real_3       5.6938698364
stddev_img_3        5.9279273917
IQ_balance_3        0.9632187606
mean_mag_3          8.2387892882
signal_file_4       l6p3vh.sig
signal_dir_4        /hosts/mercator/merc3/cv580/25jun02/l6p3
noise_file_4        l6p3vhn.sig
noise_dir_4         /hosts/mercator/merc3/cv580/25jun02/l6p3
sigdmp_version_4    2
sigdmp_release_4    1
sigdmp_patch_4      0
start_line_4        1
stop_line_4         91850

```

```
prefix_lines_4          0
suffix_lines_4          0
start_sample_4          1
stop_sample_4           2048
prefix_samples_4        0
suffix_samples_4        0
range_shift_4           1.2500000000
azimuth_shift_4         0.5000000000
beamwidth_4             3.0300000000
frequency_offset_4      0.0000000000
wtfunc_pedestal_4      0.0000000000
wtfunc_exponent_4      1.0000000000
mean_real_4             -0.2535955575
mean_img_4              -1.3022815201
stddev_real_4           6.5332930066
stddev_img_4            6.6815450282
IQ_balance_4            0.9604744564
mean_mag_4              9.4386020860
```

B. Example PolGASP Log File

```
polGASP
Polarimetric Generalized Airborne SAR Processor
(Version 7.02.01)
```

```
Parameter file name : l6p3
Start time of Processing : Fri Aug 30 13:18:03 2002
```

```
georeferencing range line 1
georeferencing range line 2048
looking at line 45926 in /hosts/mercator/merc3/cv580/25jun02/l6p3/l6p3hh.anc
Valid rangedelay = 66.050003
Valid groundspeed = 140.042243 found in gps data
gps elevation 7115.983610, offset -50.000000, altitude 7065.983610
Mission Designation : ALL
```

```
<< File #1 (/hosts/mercator/merc3/cv580/25jun02/l6p3/l6p3hh.sig) >>
```

```
Transcribe Raw SAR Data to floating point...
```

```
Start Transcribe : Fri Aug 30 13:20:41 2002
```

```
COMMAND: transcribe2.0 l6p3hhpolgasp.img 1024 l6p3polgasp.log
  sig file      : /hosts/mercator/merc3/cv580/25jun02/l6p3/l6p3hh.sig
  sig hdr       : /hosts/mercator/merc3/cv580/25jun02/l6p3/l6p3hh.hdr
  dest file     : l6p3hhpolgasp.img
  dest hdr      : l6p3hhpolgasp.hdr
  source lines  : 116910
  source samples: 2048
  output lines  : 91850
  output samples: 2048
  start line    : 1
  start sample  : 1
  range shift   : 0.000000
  memory buffer : 1024
sample 0 of 2048
transcribe completed successfully
```

```
Finished Transcribe : Fri Aug 30 13:22:25 2002
```

```
<< File #2 (/hosts/mercator/merc3/cv580/25jun02/l6p3/l6p3hv.sig) >>
```

```
Transcribe Raw SAR Data to floating point...
```

```
Start Transcribe : Fri Aug 30 13:22:25 2002
```

```
COMMAND: transcribe2.0 l6p3hvpolgasp.img 1024 l6p3polgasp.log
  sig file      : /hosts/mercator/merc3/cv580/25jun02/l6p3/l6p3hv.sig
  sig hdr       : /hosts/mercator/merc3/cv580/25jun02/l6p3/l6p3hv.hdr
  dest file     : l6p3hvpolgasp.img
  dest hdr      : l6p3hvpolgasp.hdr
  source lines  : 116910
  source samples: 2048
  output lines  : 91850
```

```
output samples: 2048
start line    : 1
start sample  : 1
range shift   : 0.000000
memory buffer : 1024
sample 0 of 2048
transcribe completed successfully

Finished Transcribe : Fri Aug 30 13:24:14 2002
```

```
<< File #3 (/hosts/mercator/merc3/cv580/25jun02/l6p3/l6p3vv.sig) >>
```

```
Transcribe Raw SAR Data to floating point...
```

```
Start Transcribe : Fri Aug 30 13:24:14 2002
```

```
COMMAND: transcribe2.0 l6p3vvpolgasp.img 1024 l6p3polgasp.log
sig file      : /hosts/mercator/merc3/cv580/25jun02/l6p3/l6p3vv.sig
sig hdr       : /hosts/mercator/merc3/cv580/25jun02/l6p3/l6p3vv.hdr
dest file     : l6p3vvpolgasp.img
dest hdr      : l6p3vvpolgasp.hdr
source lines  : 116910
source samples: 2048
output lines  : 91850
output samples: 2048
start line    : 1
start sample  : 1
range shift   : 1.250000
memory buffer : 1024
sample 0 of 2048
sample 1461 of 2048
transcribe completed successfully
```

```
Finished Transcribe : Fri Aug 30 13:40:44 2002
```

```
<< File #4 (/hosts/mercator/merc3/cv580/25jun02/l6p3/l6p3vh.sig) >>
```

```
Transcribe Raw SAR Data to floating point...
```

```
Start Transcribe : Fri Aug 30 13:40:44 2002
```

```
COMMAND: transcribe2.0 l6p3vhpolgasp.img 1024 l6p3polgasp.log
sig file      : /hosts/mercator/merc3/cv580/25jun02/l6p3/l6p3vh.sig
sig hdr       : /hosts/mercator/merc3/cv580/25jun02/l6p3/l6p3vh.hdr
dest file     : l6p3vhpolgasp.img
dest hdr      : l6p3vhpolgasp.hdr
source lines  : 116910
source samples: 2048
output lines  : 91850
output samples: 2048
start line    : 1
start sample  : 1
range shift   : 1.250000
memory buffer : 1024
sample 0 of 2048
sample 1461 of 2048
transcribe completed successfully
```

```
Finished Transcribe : Fri Aug 30 13:57:45 2002
```



```
dest hdr      : l6p3hhnpolgasp.hdr
source lines  : 16910
source samples: 2048
output lines  : 4096
output samples: 2048
start line    : 1
start sample  : 1
range shift   : 0.000000
memory buffer : 1024
sample 0 of 2048
transcribe completed successfully
```

Finished Transcribe : Fri Aug 30 15:03:48 2002

<< File #2 (/hosts/mercator/merc3/cv580/25jun02/l6p3/l6p3hvn.sig) >>

Transcribe Raw SAR Data to floating point...

Start Transcribe : Fri Aug 30 15:03:48 2002

```
COMMAND: transcribe2.0 l6p3hvnpolgasp.img 1024 l6p3polgasp.log
sig file   : /hosts/mercator/merc3/cv580/25jun02/l6p3/l6p3hvn.sig
sig hdr    : /hosts/mercator/merc3/cv580/25jun02/l6p3/l6p3hvn.hdr
dest file  : l6p3hvnpolgasp.img
dest hdr   : l6p3hvnpolgasp.hdr
source lines : 16910
source samples: 2048
output lines  : 4096
output samples: 2048
start line    : 1
start sample  : 1
range shift   : 0.000000
memory buffer : 1024
sample 0 of 2048
transcribe completed successfully
```

Finished Transcribe : Fri Aug 30 15:03:52 2002

<< File #3 (/hosts/mercator/merc3/cv580/25jun02/l6p3/l6p3vvn.sig) >>

Transcribe Raw SAR Data to floating point...

Start Transcribe : Fri Aug 30 15:03:52 2002

```
COMMAND: transcribe2.0 l6p3vvnpolgasp.img 1024 l6p3polgasp.log
sig file   : /hosts/mercator/merc3/cv580/25jun02/l6p3/l6p3vvn.sig
sig hdr    : /hosts/mercator/merc3/cv580/25jun02/l6p3/l6p3vvn.hdr
dest file  : l6p3vvnpolgasp.img
dest hdr   : l6p3vvnpolgasp.hdr
source lines : 16910
source samples: 2048
output lines  : 4096
output samples: 2048
start line    : 1
start sample  : 1
range shift   : 1.250000
memory buffer : 1024
sample 0 of 2048
transcribe completed successfully
```

Finished Transcribe : Fri Aug 30 15:04:18 2002

<< File #4 (/hosts/mercator/merc3/cv580/25jun02/l6p3/l6p3vhn.sig) >>

Transcribe Raw SAR Data to floating point...

Start Transcribe : Fri Aug 30 15:04:18 2002

```
COMMAND: transcribe2.0 l6p3vhnpolgasp.img 1024 l6p3polgasp.log
  sig file      : /hosts/mercator/merc3/cv580/25jun02/l6p3/l6p3vhn.sig
  sig hdr       : /hosts/mercator/merc3/cv580/25jun02/l6p3/l6p3vhn.hdr
  dest file     : l6p3vhnpolgasp.img
  dest hdr      : l6p3vhnpolgasp.hdr
  source lines  : 16910
  source samples: 2048
  output lines  : 4096
  output samples: 2048
  start line    : 1
  start sample  : 1
  range shift   : 1.250000
  memory buffer : 1024
sample 0 of 2048
transcribe completed successfully
```

Finished Transcribe : Fri Aug 30 15:04:43 2002

Azimuth focussing...

```
  pri           :      0.431035   sample_size    :      4.000000
  start_range   : 7908.675396   wavelength     :      0.056565
  velocity      : 140.042243   fft_size      :      4096
  numlines      :      2048     numsamples     :      4096
  max 2D ref    :      1        moc sar offset:      0
  max ref length:      1975
```

IQ balance on signal data

<<< file (l6p3hhnpolgasp.img) >>>

```
  beamwidth     :      0.052883   pedestal       :      0.000000
  power         :      1.000000   freq_offset    :      0.000000
  azimuth shift :      0.000000
```

<<< file (l6p3hvnpolgasp.img) >>>

```
  beamwidth     :      0.052883   pedestal       :      0.000000
  power         :      1.000000   freq_offset    :      0.000000
  azimuth shift :      0.000000
```

<<< file (l6p3vvnpolgasp.img) >>>

```
  beamwidth     :      0.052883   pedestal       :      0.000000
  power         :      1.000000   freq_offset    :      0.000000
  azimuth shift :      0.500000
```

<<< file (l6p3vhnpolgasp.img) >>>

```
  beamwidth     :      0.052883   pedestal       :      0.000000
  power         :      1.000000   freq_offset    :      0.000000
  azimuth shift :      0.500000
  0  100  200  300  400  500  600  700  800  900
  1000 1100 1200 1300 1400 1500 1600 1700 1800 1900
  2000
```

Stop time of Processing : Fri Aug 30 15:06:07 2002

<<< Successful completion >>>
Calculating mean DN² for l6p3hhnpolgasp.img


```
start sample      : 988
stop sample       : 3109
number of lines   : 2048
number of samples total: 4096
mean value: 3.280793e-03
Calculating mean DN^2 for l6p3hvnpolgasp.img
start sample      : 988
stop sample       : 3109
number of lines   : 2048
number of samples total: 4096
mean value: 2.062538e-03
Calculating mean DN^2 for l6p3vvnpolgasp.img
start sample      : 988
stop sample       : 3109
number of lines   : 2048
number of samples total: 4096
mean value: 2.845444e-03
Calculating mean DN^2 for l6p3vhnpolgasp.img
start sample      : 988
stop sample       : 3109
number of lines   : 2048
number of samples total: 4096
mean value: 1.817555e-03
```

radCAL3.0 delayed by request...

Stop time of Processing : Fri Aug 30 15:06:09 2002

<<< Successful completion >>>

C. Example PolGASP Master Header File

```

mission_id          ALL
mission            5
line              6
pass              3
polgasp_version    7
polgasp_release    2
polgasp_patch      1
number_files       4
number_lines       91850
number_samples     2048
datatype           1
number_format      float32
complex_flag       1
STC                Test
system_mode        Lead In
clutterlock_status Manual
antenna_look_direction Port
ProcD_Recd_Channel_Pol Dual Ch. Near (A Copol, B Crosspol)
swath_mode         Nadir
recorded_sig_HDDR_chan Both Near
mocom_status       Off
mocomp            Y
mocomp_par_file    l6p3.prm
nadir              n
nadir_width        0
altitude           7065.9836103028
double_prec        n
range_gate_delay   66.0500030518
sample_size        4.0000000000
saw_delay          13.2890000000
wavelength         0.0565646000
fft_size           131072
prfoverv          2.3199984459
groundspeed        140.0422431330
boresight_dep_angle 39.0008103802
boresight_offset_h -3.3300000000
boresight_offset_v -3.3300000000
transmt_pwr_reading -2.6500000000
signal_file_1      l6p3hh.sig
signal_dir_1       /hosts/mercator/merc3/cv580/25jun02/l6p3
ancillary_file_1   l6p3hh.anc
noise_file_1       l6p3hhn.sig
noise_dir_1        /hosts/mercator/merc3/cv580/25jun02/l6p3
polgasp_image_file_1 l6p3hhpolgasp.img
range_shift_1      0.0000000000
azimuth_shift_1    0.0000000000
rnglinenum_firstline_1 1
rnglinenum_lastline_1 91850
iqsampnum_firstsamp_1 1
iqsampnum_lastsamp_1 2048
time_first_line_1  25-JUN-2002 17:26:47.35100
time_last_line_1   25-JUN-2002 17:31:30.15800
frequency_band_1   C
Tx_polarization_1  Horizontal
Rx_polarization_1  Horizontal
ref_size_near_1    971
ref_size_far_1     1975
first_valid_near_1 486
last_valid_near_1  91365
first_valid_far_1  988
last_valid_far_1   90863

```

```

beamwidth_1          3.0299999998
near_srd_1           7908.6753957160
far_srd_1            16096.6753957160
frequency_offset_1  0.0000000000
wtfunc_pedestal_1   0.0000000000
wtfunc_exponent_1   1.0000000000
mean_real_1          -0.0583520707
mean_img_1           0.2868087617
IQ_balance_1         0.9674023832
rf_gain_1            23.0000000000
signal_file_2        16p3hv.sig
signal_dir_2         /hosts/mercator/merc3/cv580/25jun02/16p3
ancillary_file_2     16p3hv.anc
noise_file_2         16p3hvn.sig
noise_dir_2         /hosts/mercator/merc3/cv580/25jun02/16p3
polgasp_image_file_2 16p3hvpolgasp.img
prefix_lines_2       0
suffix_lines_2       0
prefix_samples_2     0
suffix_samples_2     0
range_shift_2        0.0000000000
azimuth_shift_2      0.0000000000
rnglinenum_firstline_2 1
rnglinenum_lastline_2 91850
iqsampnum_firstsamp_2 1
iqsampnum_lastsamp_2 2048
time_first_line_2    25-JUN-2002 17:26:47.35100
time_last_line_2     25-JUN-2002 17:31:30.15800
frequency_band_2     C
Tx_polarization_2    Horizontal
Rx_polarization_2    Vertical
ref_size_near_2      971
ref_size_far_2       1975
first_valid_near_2   486
last_valid_near_2    91365
first_valid_far_2    988
last_valid_far_2     90863
beamwidth_2          3.0299999998
near_srd_2           7908.6753957160
far_srd_2            16096.6753957160
frequency_offset_2   0.0000000000
wtfunc_pedestal_2   0.0000000000
wtfunc_exponent_2   1.0000000000
mean_real_2          -0.2385011759
mean_img_2           -0.3854228404
IQ_balance_2         0.9670433915
rf_gain_2            24.0000000000
signal_file_3        16p3vv.sig
signal_dir_3         /hosts/mercator/merc3/cv580/25jun02/16p3
ancillary_file_3     16p3vv.anc
noise_file_3         16p3vvn.sig
noise_dir_3         /hosts/mercator/merc3/cv580/25jun02/16p3
polgasp_image_file_3 16p3vvpolgasp.img
prefix_lines_3       0
suffix_lines_3       0
prefix_samples_3     0
suffix_samples_3     0
range_shift_3        1.2500000000
azimuth_shift_3      0.5000000000
rnglinenum_firstline_3 2
rnglinenum_lastline_3 91851
iqsampnum_firstsamp_3 1
iqsampnum_lastsamp_3 2048
time_first_line_3    25-JUN-2002 17:26:47.35200

```

```

time_last_line_3      25-JUN-2002 17:31:30.16000
frequency_band_3     C
Tx_polarization_3    Vertical
Rx_polarization_3    Vertical
ref_size_near_3      971
ref_size_far_3       1975
first_valid_near_3   486
last_valid_near_3    91365
first_valid_far_3    988
last_valid_far_3     90863
beamwidth_3          3.0299999998
near_srd_3            7908.6753957160
far_srd_3             16096.6753957160
frequency_offset_3   0.0000000000
wtfunc_pedestal_3    0.0000000000
wtfunc_exponent_3    1.0000000000
mean_real_3          -0.4974109026
mean_img_3           0.2641106849
IQ_balance_3         0.9632187606
rf_gain_3            23.0000000000
signal_file_4        16p3vh.sig
signal_dir_4         /hosts/mercator/merc3/cv580/25jun02/16p3
ancillary_file_4     16p3vh.anc
noise_file_4         16p3vhn.sig
noise_dir_4          /hosts/mercator/merc3/cv580/25jun02/16p3
polgasp_image_file_4 16p3vhpolgasp.img
prefix_lines_4       0
suffix_lines_4       0
prefix_samples_4     0
suffix_samples_4     0
range_shift_4        1.2500000000
azimuth_shift_4      0.5000000000
rnglinenum_firstline_4 2
rnglinenum_lastline_4 91851
iqsampnum_firstsamp_4 1
iqsampnum_lastsamp_4 2048
time_first_line_4    25-JUN-2002 17:26:47.35200
time_last_line_4     25-JUN-2002 17:31:30.16000
frequency_band_4     C
Tx_polarization_4    Vertical
Rx_polarization_4    Horizontal
ref_size_near_4      971
ref_size_far_4       1975
first_valid_near_4   486
last_valid_near_4    91365
first_valid_far_4    988
last_valid_far_4     90863
beamwidth_4          3.0299999998
near_srd_4            7908.6753957160
far_srd_4             16096.6753957160
frequency_offset_4   0.0000000000
wtfunc_pedestal_4    0.0000000000
wtfunc_exponent_4    1.0000000000
mean_real_4          -0.2535955575
mean_img_4           -1.3022815201
IQ_balance_4         0.9604744564
rf_gain_4            24.0000000000

```