

Orthorectifying ASAR and Extracting a DEM with RADARSAT data



TUTORIAL

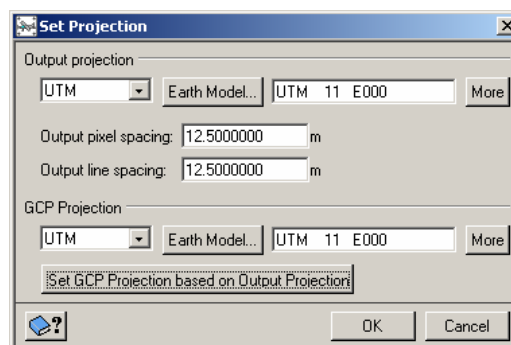
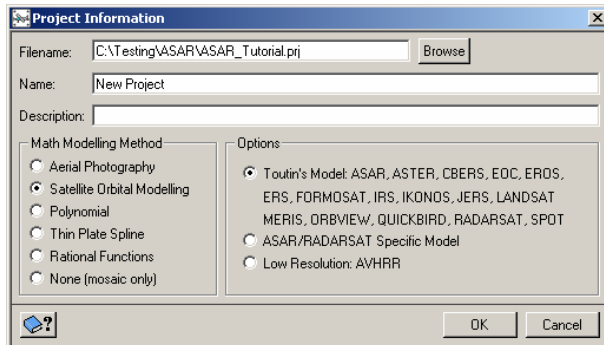
ASAR (Advanced Synthetic Aperture Radar) is a radar sensor aboard the Envisat satellite that operates in the C-band. It has 5 mutually exclusive modes of operation: global monitoring, wave mode, image mode, alternating polarization mode and wide swath. This sensor is in a sun synchronous orbit at 800 km and has a repeat cycle of 35 days. ASAR's image mode has 7 swaths of up to 100 km and is able to collect data with VV or HH polarization.

ASAR is supported in both Toutin's model and the ASAR specific model. Therefore, you can correct data with or without GCPs. A minimum of 8 GCPs are required for high accuracy. The ASAR specific model allows you to orthorectify the imagery without collecting GCPs. However, even if you use this model, it is recommended that you collect GCPs to improve the model. You are forced to collect GCPs if you choose to orthorectify the image using the rigorous model. The following QuickGuide will guide you through correcting ASAR data using with the ASAR specific model.

ASAR sensor support and Radiometric Terrain Correction for Geomatica OrthoEngine was developed in conjunction with the Canadian Space Agency (CSA) and the Earth Observation Application Development Program (EOADP).

1. Project Setup

Start OrthoEngine and click New on the File menu to start a new project. Give your project a file name, and select the Satellite Orbital Modeling as the math modeling method. Under Options, choose ASAR/RADARSAT Specific Model, and click Accept. OrthoEngine prompts you to set up the projection information for the output files, the output pixel spacing, and the projection of your GCPs. Enter the appropriate projection information for your project.



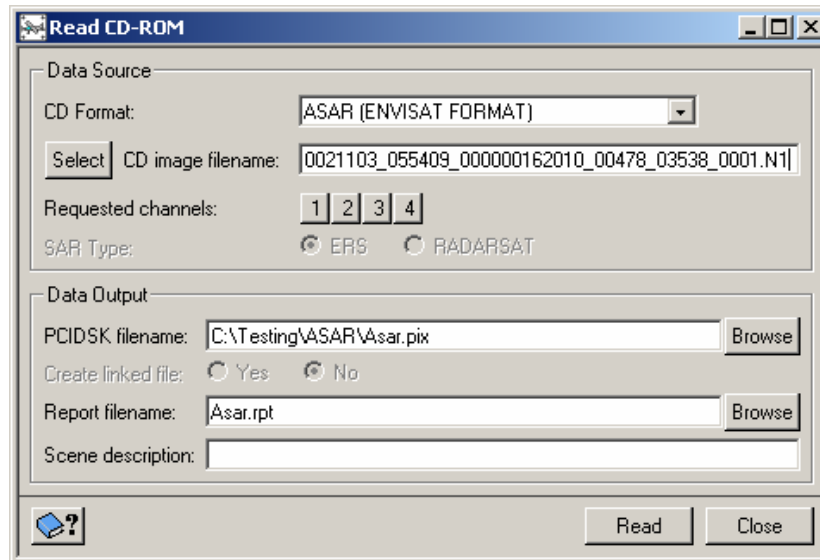
2. Data Input

For both ASAR specific modeling and rigorous modeling in OrthoEngine, you will need to order level 1B data. Level 1B products are geolocated engineering foundation products. More information about this product can be found at:

<http://envisat.esa.int/dataproducts/asar/CNTR2-2.htm#eph.asar.prodalg.orgprod>.

At the time this document was written (January, 2004), ASAR data is distributed as a *.N1 file.

To import ASAR data for orthorectification, select Data Input under Processing Steps, and select Read Data From CD-ROM. This choice also applies to data on your hard drive that was copied from a CD-ROM. Select ASAR (ENVISAT FORMAT) for CD Format. Then, select the appropriate channels, supply an output file name, a scene description, and a report file name.



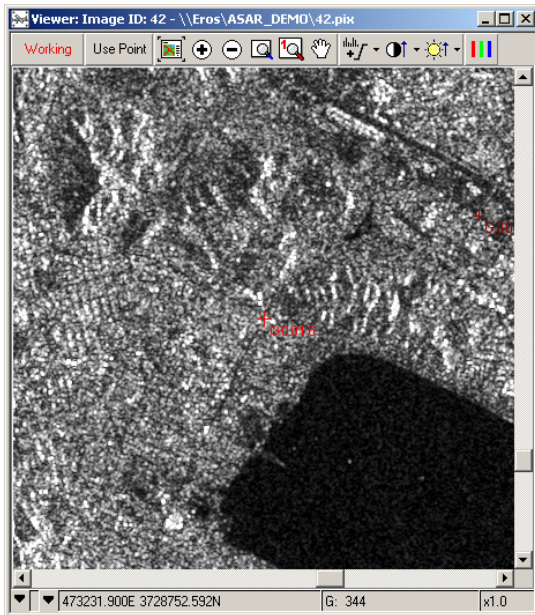
The screenshot shows the 'Read CD-ROM' dialog box with the following fields and options:

- Data Source:**
 - CD Format: ASAR (ENVISAT FORMAT)
 - Select CD image filename: 0021103_055409_000000162010_00478_03538_0001.N1
 - Requested channels: 1 2 3 4
 - SAR Type: ERS RADARSAT
- Data Output:**
 - PCIDSK filename: C:\Testing\ASAR\Asar.pix (with a Browse button)
 - Create linked file: Yes No
 - Report filename: Asar.rpt (with a Browse button)
 - Scene description: (empty text field)

At the bottom of the dialog, there is a help icon (question mark in a blue square) on the left, and 'Read' and 'Close' buttons on the right.

3. Collect GCPs and Tie Points

Select the GCP/TP Collection processing step. Collect GCPs for the project using manual entry, from geocoded images, vectors, chip databases, or a text file. If you set up your project using the ASAR specific model, you can orthorectify the imagery without collecting any GCPs. However, you can collect a few GCPs to improve the accuracy of the model. If you have multiple scenes in one project, you can also collect tie points to pull the scenes together.



GCP Collection for 42

Ground control source: Manual entry

Filename: Browse

DEM: Browse

Auto locate

Working Image: 42

Point Projection: LONG/LAT E000

Point ID: G0016 GCP

Image pixel: 4508.0 +/- 1.0 P

Image line: 7005.0 +/- 1.0 L

Easting (X): 117d21'57.60" W +/- 1.000 m

Northing (Y): 33d41'04.20" N +/- 1.000 m

Elevation (Z): 389.839 +/- 1.000 m

Accept Delete New Point Extract Elevation

Reference Images:

Image ID	Status
85	Available

Open Image

Accepted Points: 30 Total

Residual units: Ground Pixels

RMS: 2.06 X RMS: 1.39 Y RMS: 1.51

Point ID	Residual	Res X	Res Y	Type	Im.
7	4.54	1.92	-4.11	GCP	
G0015	4.49	-2.87	3.45	GCP	
G0014	3.89	2.73	-2.77	GCP	
39	3.58	-2.55	2.51	GCP	
G0017	3.20	-0.09	3.20	GCP	
G0016	2.02	-1.71	-1.08	GCP	
113	1.99	1.93	0.48	GCP	

Close

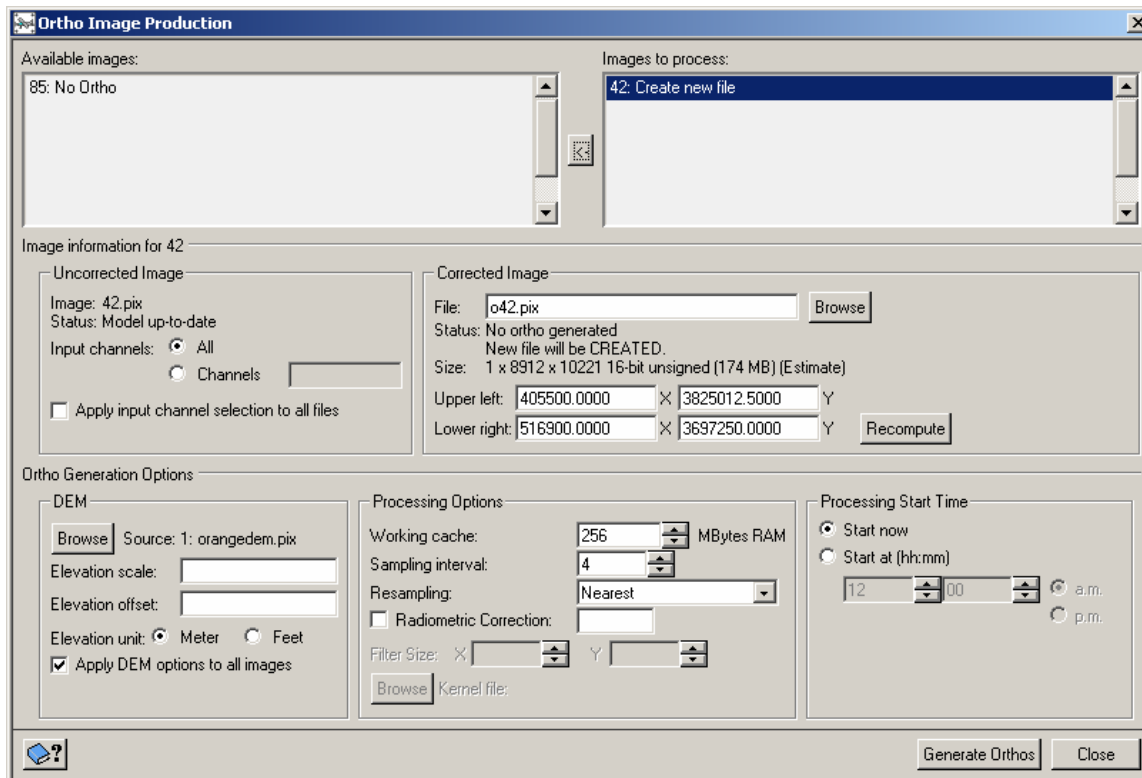
For the ASAR specific model, 8 GCPs are recommended. The rigorous N model requires a minimum of 8 GCPs per scene and possibly more, depending on the accuracy of the GCPs and the accuracy requirements of the project. Once you have collected your GCPs, run the model calculation and proceed to the residual report panel (under the Reports processing step) to review the initial results.

4. Generating Ortho Images

To generate the ortho images, go to the Ortho Generation processing step. Select the files to be processed, select the DEM file to be used, and set your processing options. Click Generate Orthos when the set up of the panel is complete.

Note that a new feature called Radiometric Correction has been added in v9.1 under Processing Options. This option allows you to correct or reduce some of the radiometric distortion inherent in SAR imagery due to mountains, hills and other sloping terrain features. The Radiometric Terrain Correction uses the DEM and the math model to restore the radiometric uniformity to the image. Therefore, this correction is dependent on the accuracy of the DEM and the math model.

If Radiometric Correction is enabled with a default value of 0, only Radiometric Terrain Correction will be applied to the orthorectified image. However, if a value larger than zero to two is used, Land Cover Correction will also be applied to the image. The Land Cover Correction is an experimental algorithm designed to compensate for the scattering of the radar signal due to the texture and composition of the surface, particularly for areas with uniform vegetation. Please refer to the Help or the OrthoEngine Manual for more detailed information on Radiometric Correction.



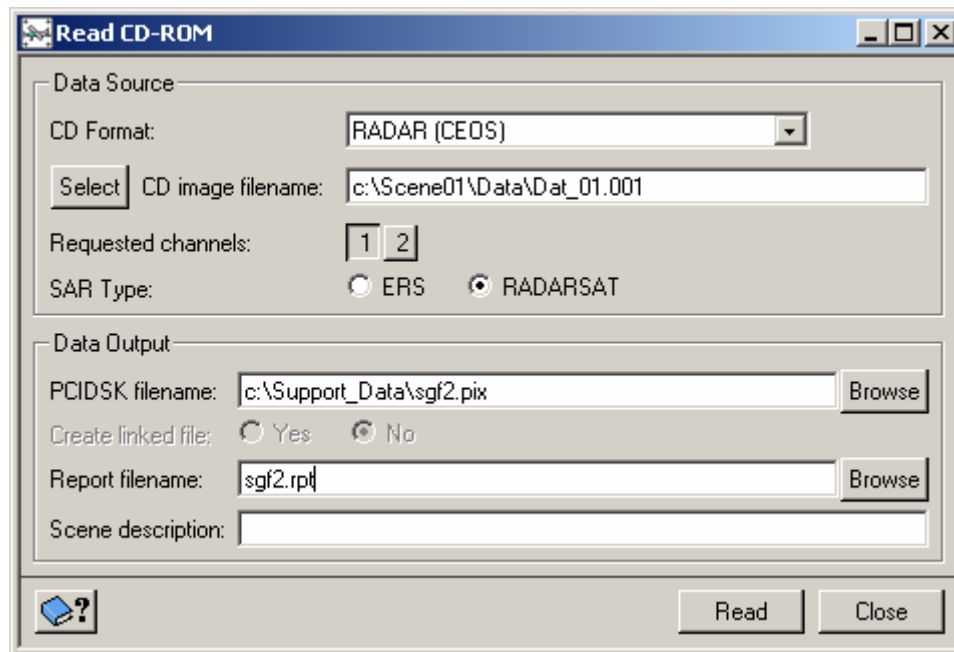
The estimated accuracy of ortho images generated with the ASAR specific model and a minimum of 8 GCPs is 1 to 2 pixels (or 30 to 60 m). The rigorous model with accurate and uniformly distributed GCPs will give comparable accuracy. The accuracy is significantly lower for the specific model with no additional GCPs collected.

5. Extracting a DEM

It is possible to extract a DEM using a stereo pair comprised of ASAR and RADARSAT images.

5a. Radarsat Data Input

To import your Radarsat data to extract a DEM, select Data Input under Processing Steps, and select Read Data From CD-ROM. This choice also applies to data on your hard drive that was copied from a CD-ROM. Select RADAR (CEOS) for CD Format. Select the appropriate channels, supply and output file name, a scene description, and a report file name.

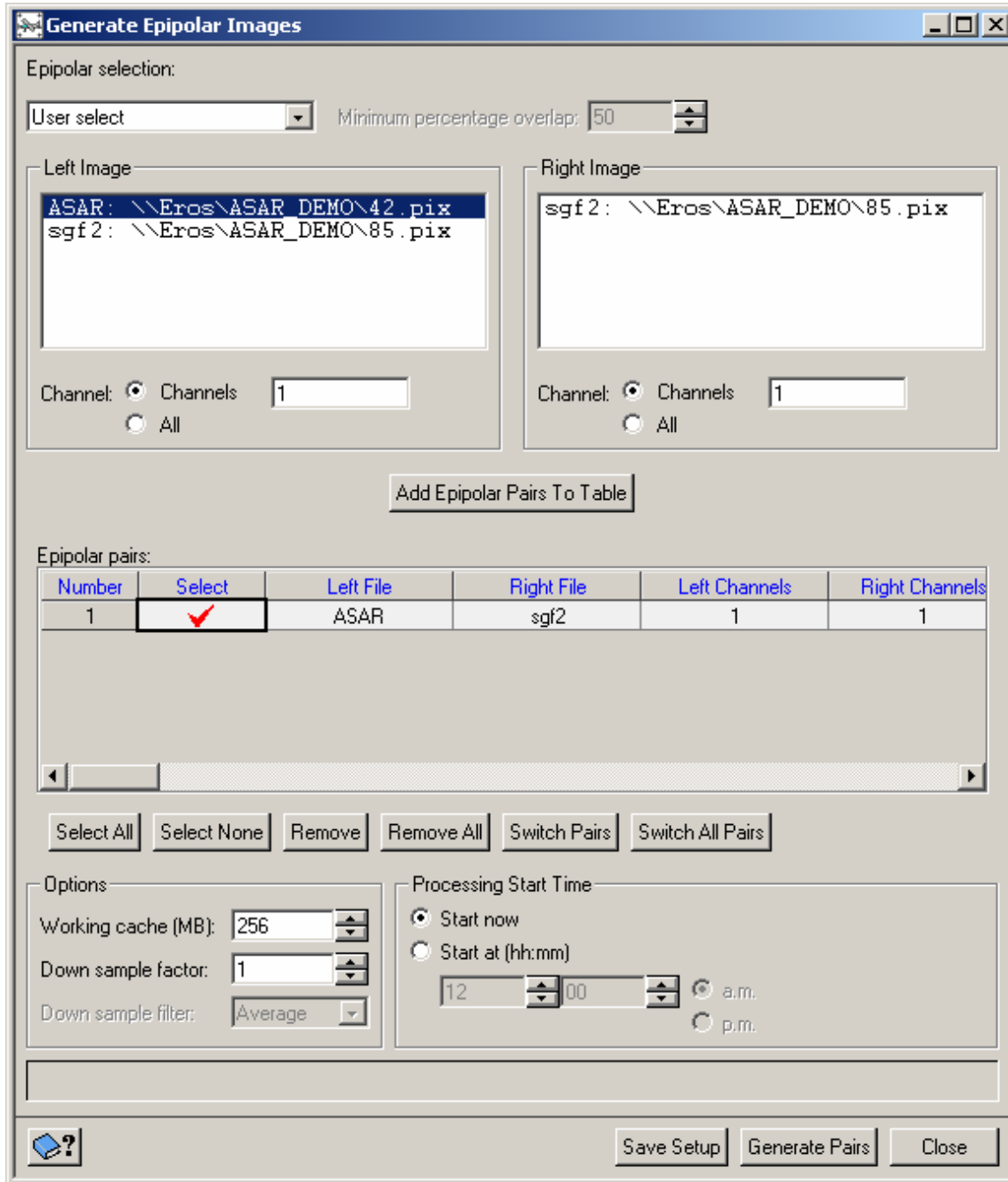


5b. Collect GCPs and Tie Points for the Radarsat Image

Collect GCPs on the RADARSAT image. If you are using the ASAR/RADARSAT specific model, you do not need to collect GCPs. However, it is recommended that you collect about 10 to 12 GCPs for your Radarsat Scene to improve the accuracy of the model.

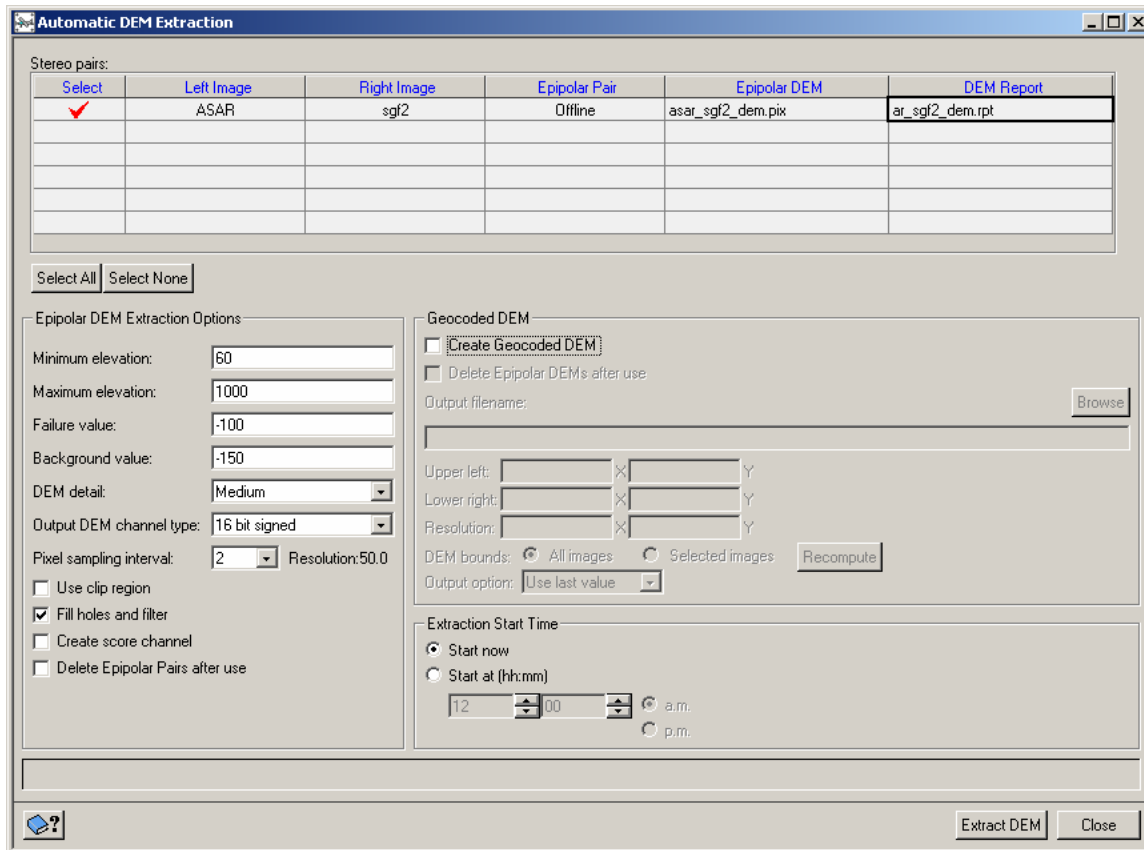
5c. Create Epipolar Images

On the OrthoEngine window in the Processing Step list, select DEM From Stereo and click the Create Epipolar Image icon. Under Epipolar Selection choose Maximum Overlapping Pairs and set the Minimum Percentage Overlap to an appropriate value for your project. This will allow OrthoEngine to automatically select the right and left images for the epipolar pair. Set the Working Cache, the Down Sample Factor and The Down Sample Filter as desired.



5d. Extract DEM Automatically

On the OrthoEngine window in the Processing Step list, select DEM From Stereo and click the Extract DEM automatically icon. Select the Epipolar pair from the Stereo Pair Selection table. Enter a Minimum and Maximum Elevation noting that if you are working with a Specific Model project, the values should be in reference to the ellipsoid not mean sea level (the difference can be up to 200 m). Choose the DEM detail desired from the drop-down list. Set the Pixel Sampling Interval based on the desired resolution of the output DEM.



5e. Edit the DEM

Click the Manually edit generated DEM icon from the DEM from Stereo Processing Step selection. Load the Epipolar DEM and edit the failed pixels (value of -100) in the DEM.

5f. Geocode the DEM

Once the DEM has been edited, return to the Automatic DEM Extraction window and select Create Geocoded DEM. Browse to the folder where the DEM will be saved and type a filename for the geocoded DEM.

The DEM accuracy will be between 30 and 50 m