ALOS PALSAR

Orthorectification Tutorial

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ALOS PALSAR Orthorectification Tutorial

In this tutorial you will calibrate, multilook, speckle filter, deskew, terrain correct an ALOS-1 PALSAR SAR data product.

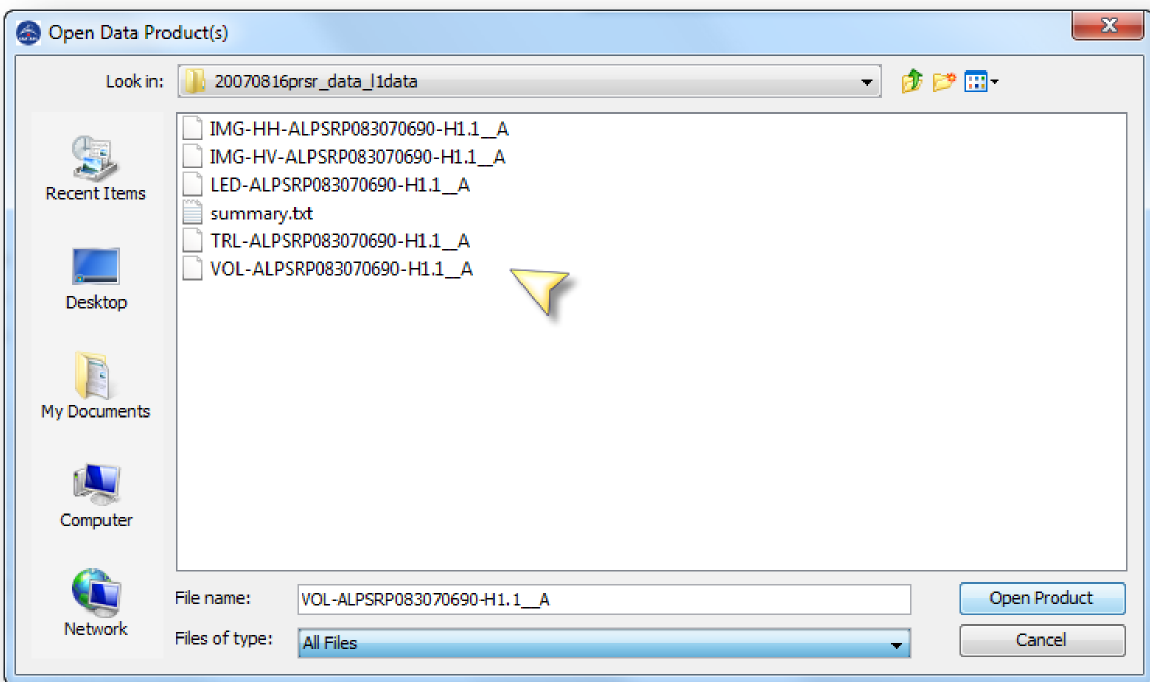
Open a Product

Step 1 - Open a product: Use the **Open Product** button in the top toolbar and browse for the location of an ALOS PALSAR product in CEOS data format.

For this part of the tutorial we will use the ALOS L1.1 data product over Mt. Fuji, Japan. The data set is available from as a demonstration InSAR dataset from JAXA.

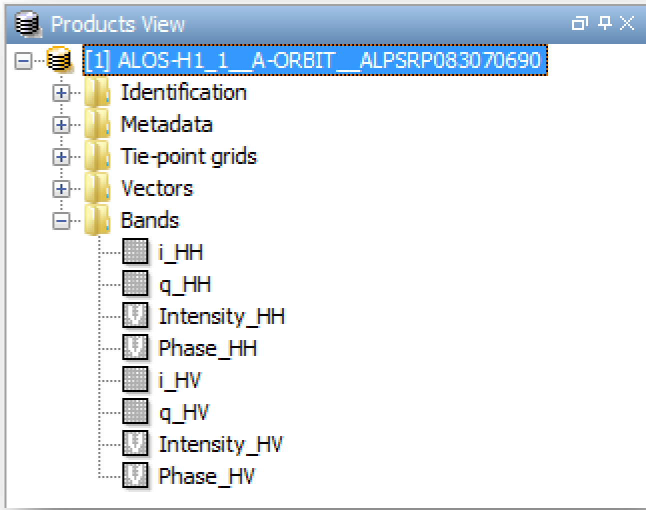
Select the **Volume Descriptor** file and press **Open Product**. The volume descriptor may start with VOL or VDR.

If the product is zipped, it can also be opened by selecting the zip file directly.



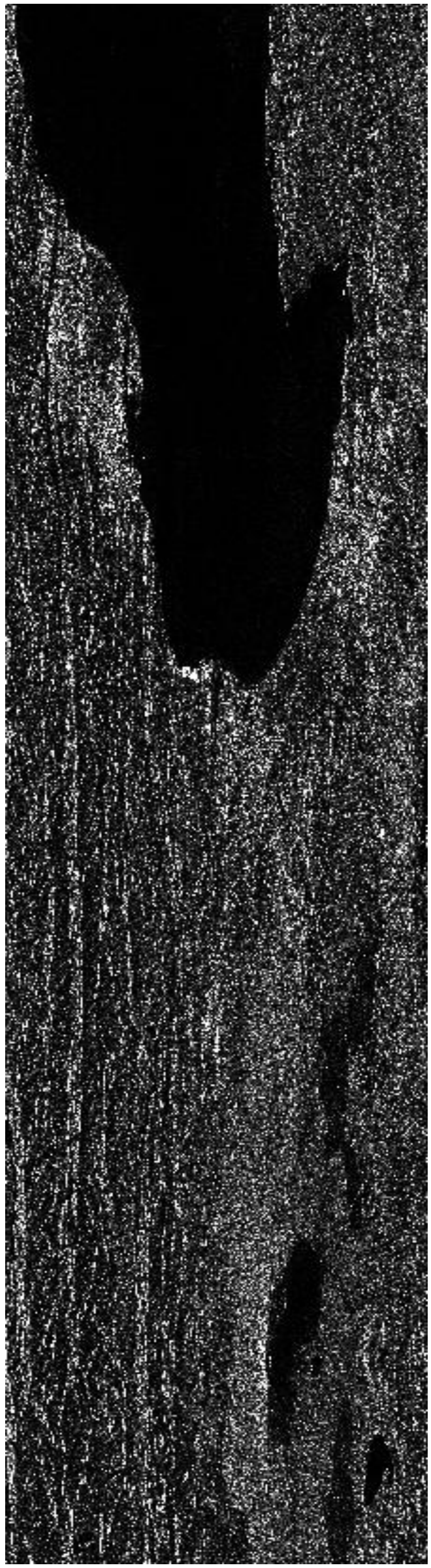
Open the Volume Descriptor

In the **Products View** you will see the opened products. Each product consists of metadata and raster bands and may contain support information such as tie point grids or vector data.



Products View

Double-click on the **Intensity_HH** band to view the raster data.



Intensity_HH Band

The product is a ALOS PALSAR Level 1.1 Single Look Complex (SLC) data product. It is a slant range image containing complex data that has not been multilooked.

The image can appear stretched in the azimuth direction (y axis) and contains a lot of noise.

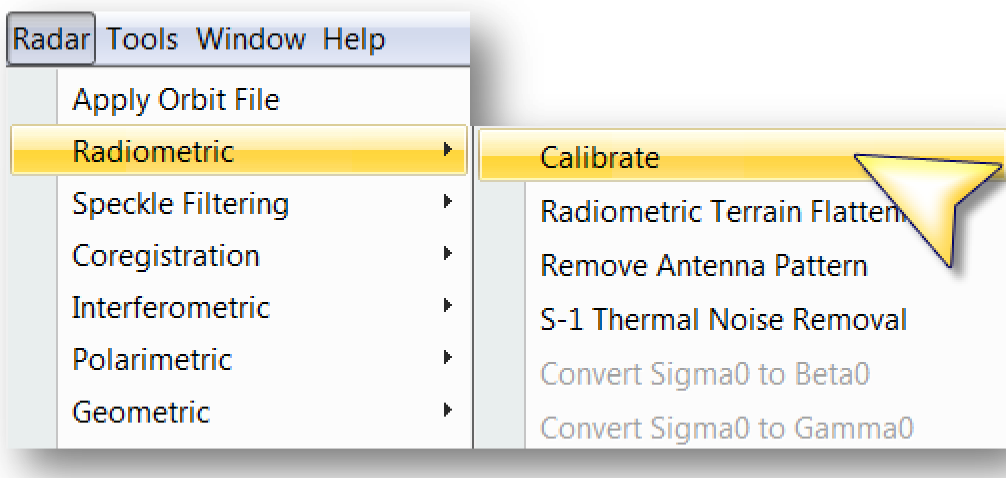
Calibrating the Data

To properly work with the SAR data, the data should first be calibrated. This is especially true when preparing data for mosaicking where you could have several data products at different incidence angles and relative levels of brightness.

Calibration radiometrically corrects a SAR image so that the pixel values truly represent the radar backscatter of the reflecting surface.

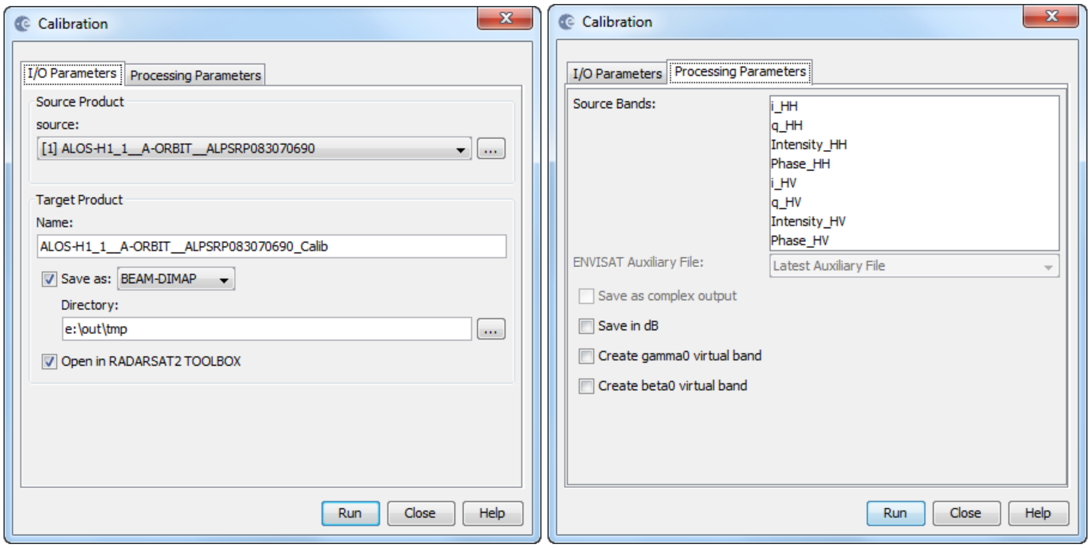
The corrections that get applied during calibration are mission-specific, therefore the software will automatically determine what kind of input product you have and what corrections need to be applied based on the product's metadata. Calibration is essential for quantitative use of SAR data.

Step 2 - Calibrate the product: From the **Radar** menu, go to **Radiometric** and select **Calibrate**.



Radar Menu

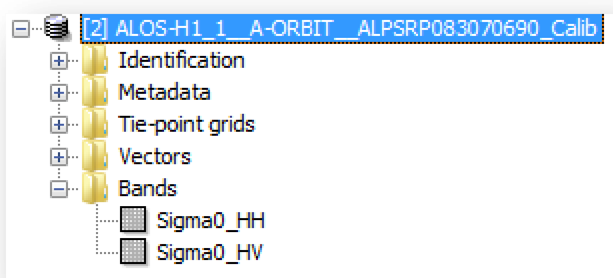
The source product should be your newly created subset. The target product will be the new file you will create. Also select the directory in which the target product will be saved to.



Calibration Dialog

If you don't select any source bands, then the calibration operator will automatically select all real and imaginary (i, q) bands. Uncheck 'Save in complex' so that the calibration operator will produce a single Sigma0 band per real and imaginary pair.

After the calibration, a new product will be produced containing the calibrated Sigma0 bands.



Sigma0 Bands

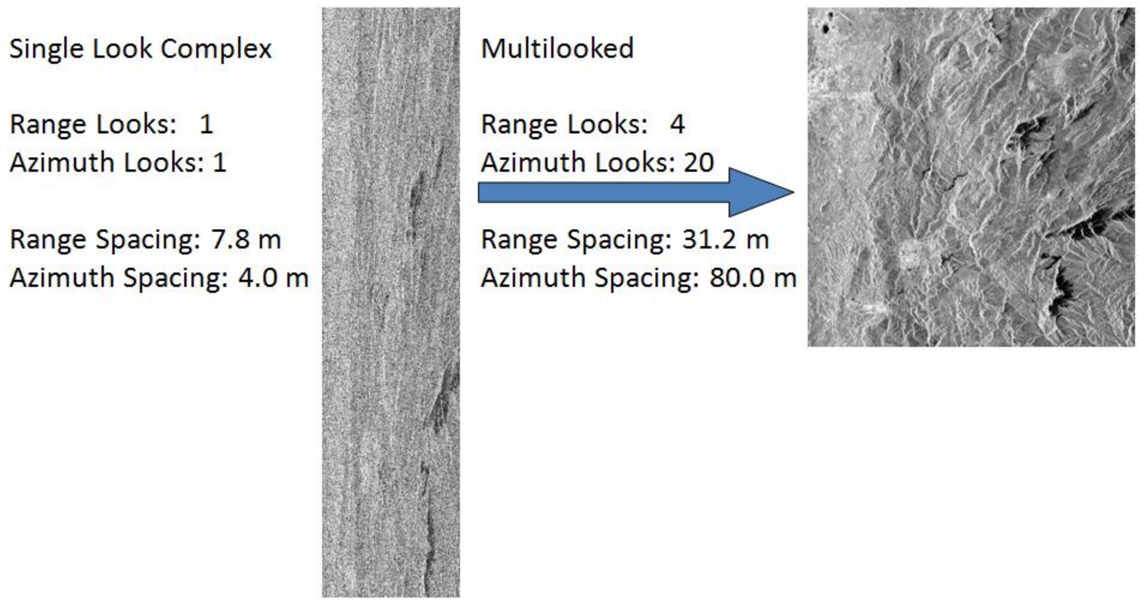
Multilooking

Multilook processing can be used to produce a product with nominal image pixel size.

Multiple looks may be generated by averaging over range and/or azimuth resolution cells improving radiometric resolution but degrading spatial resolution.

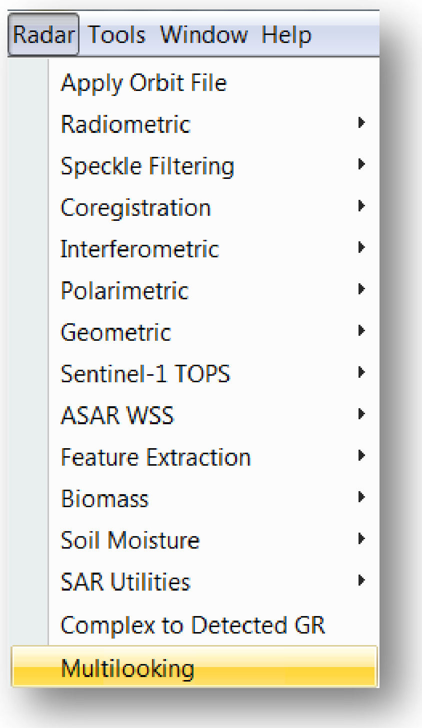
As a result, the image will have less noise and approximate square pixel spacing after being converted from slant range to ground range.

Multilooking can be an optional step since it is not necessary when terrain correcting an image.



Multilooking an SLC product

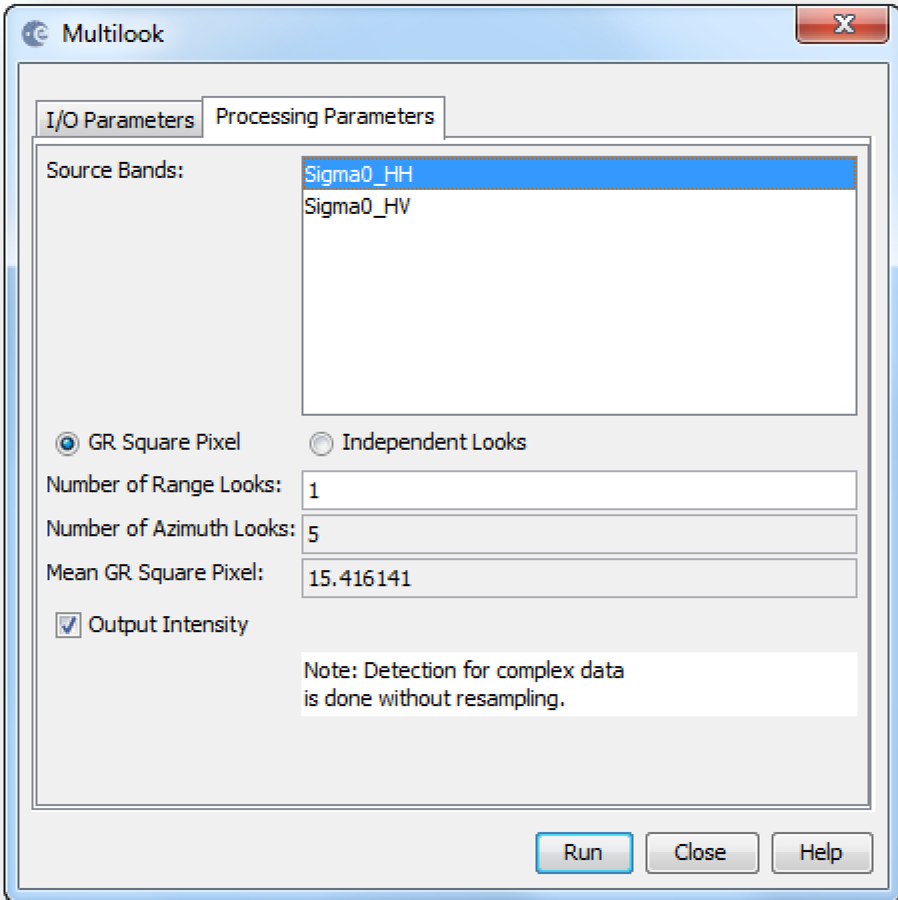
Step 3 - Multilook the Sigma0_HH band: From the **Radar** menu, select **Multilooking**.



Select Multilooking

In the **Multilook** dialog, select the **Sigma0_HH** band to only produce an output for this band.

Specify the number of range looks while the number of azimuth looks is computed based on the ground range spacing and the azimuth spacing.



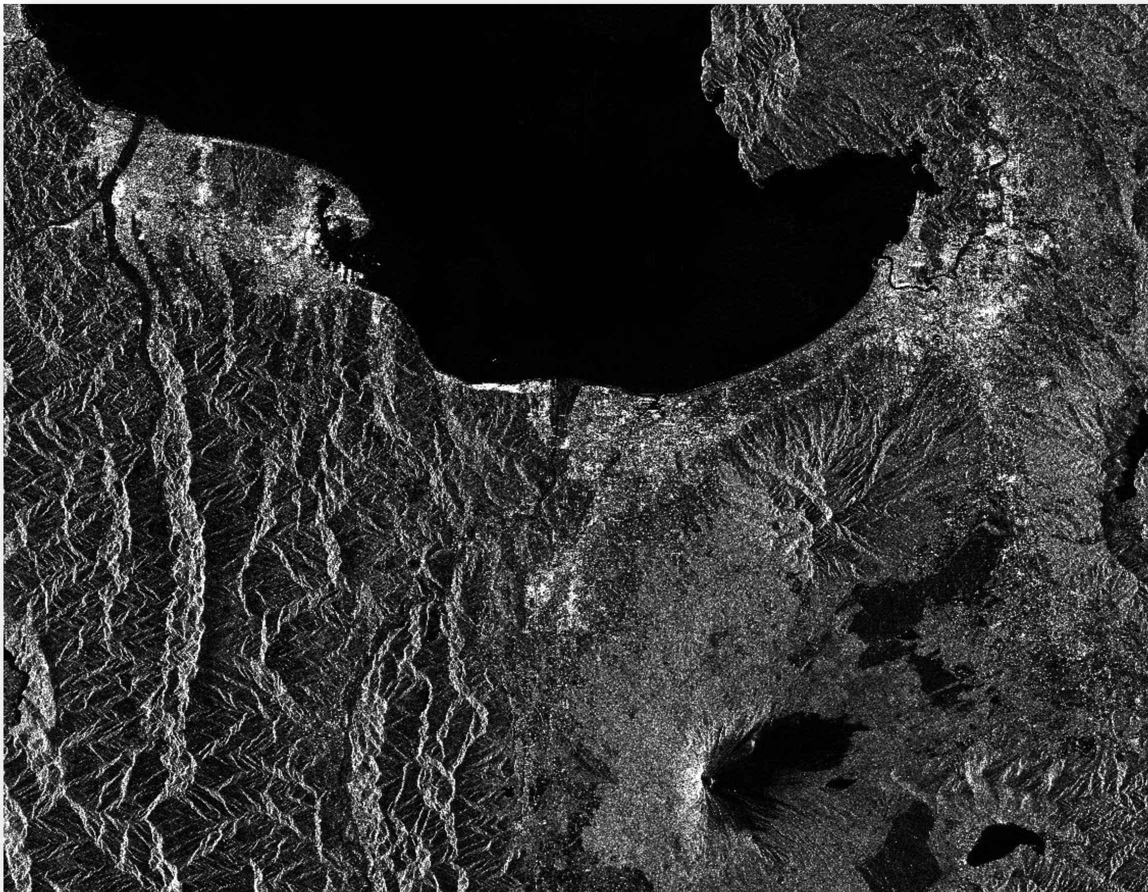
Select Sigma0_HH band

Multilooking will produce a ground range square pixel using 1 look in range and 5 looks in azimuth. The resulting mean ground range pixel size will be 15.42 m.

Press **Run** to begin processing.

When complete, a new product will be created and will be available in the **Products View**.

In the new product, open the multilooked band.



Multilooked Band

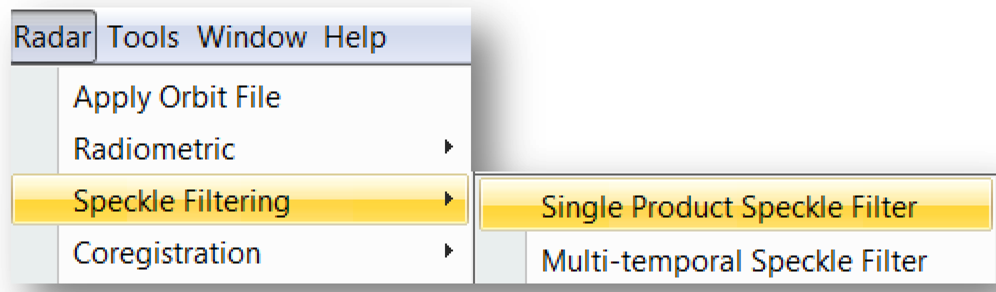
The image now looks more proportional; however, it remains with a lot of noise.

Speckle Reduction

Speckle is caused by random constructive and destructive interference resulting in salt and pepper noise throughout the image.

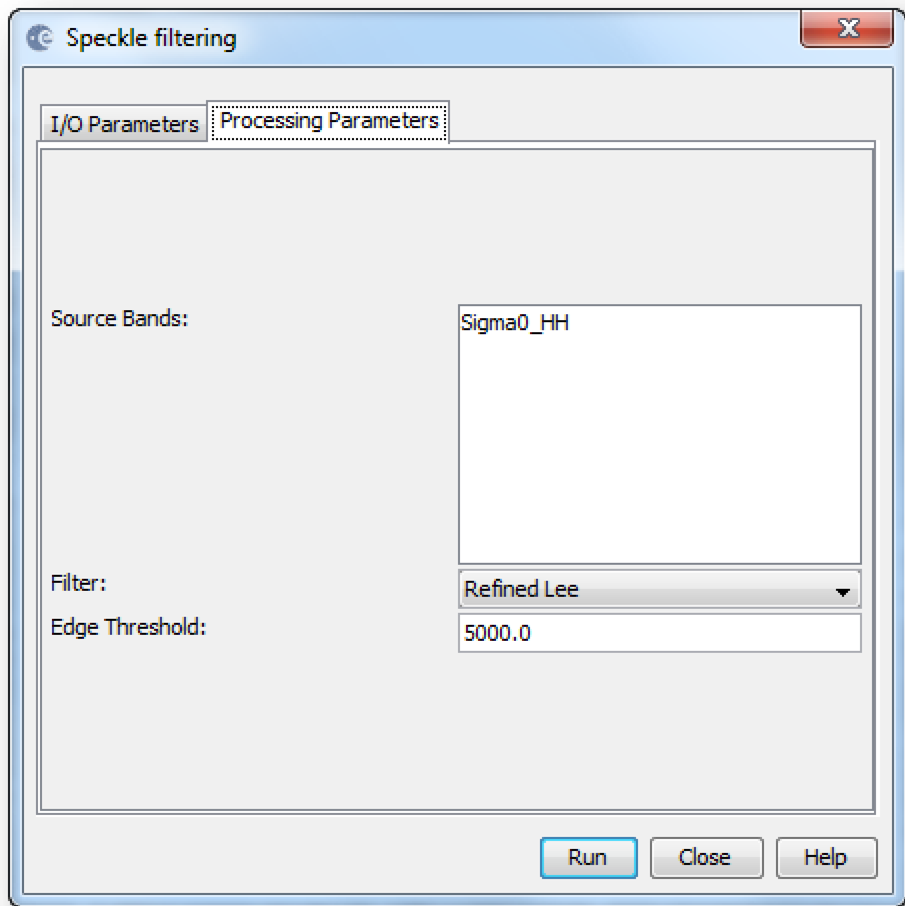
Speckle filters can be applied to the data to reduce the amount of speckle at the cost of blurred features or reduced resolution.

Step 4 - Speckle Filtering: Select the multilooked product and then select **Speckle Filtering/Single Product** from the **Radar** menu.



Select Single Product Speckle Filtering

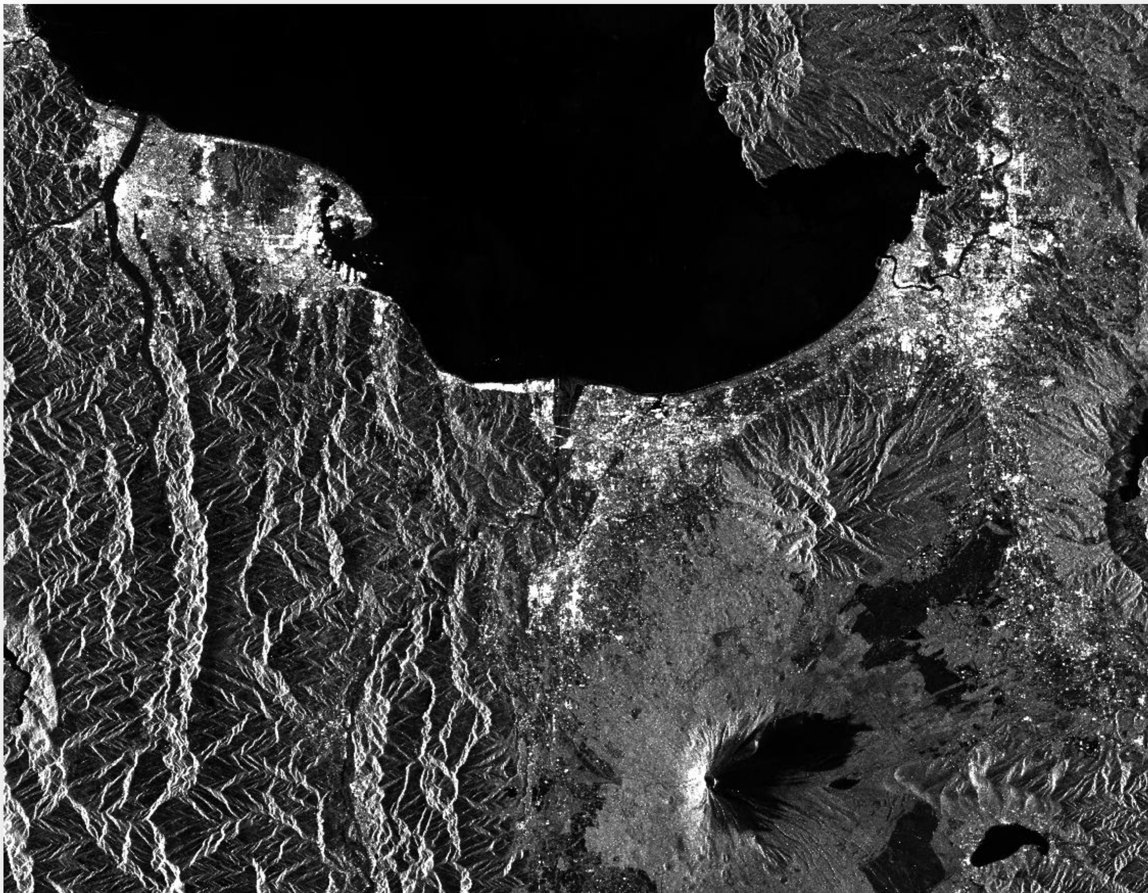
From the **Speckle Filter** dialog, select the **Refined Lee** speckle filter. The Refined Lee filter averages the image while preserving edges.



Select Refined Lee

Press **Run** to process.

Open the newly created speckle filtered product.



Speckle Filtered Result

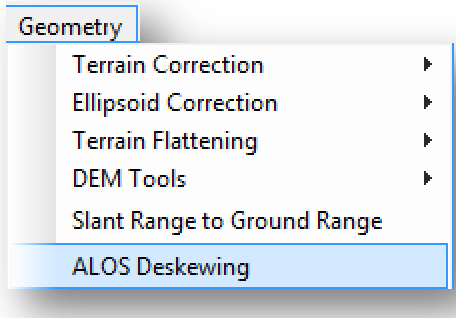
The final processing which we will do to this product will be to terrain correct.

ALOS Deskewing

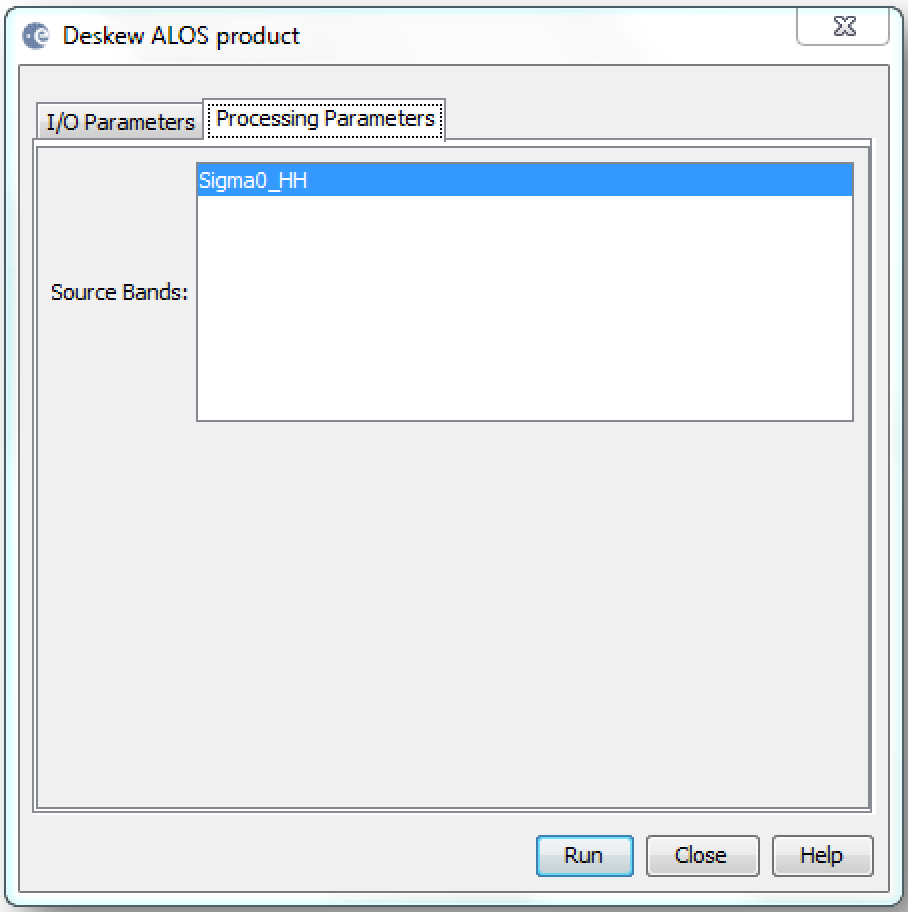
For ALOS-1 L1.1 data, the annotated times are not zero Doppler times, i.e. the data is distributed in squinted geometry. Therefore, the data generally needs to be deskewed to transfer the data into a zero Doppler like geometry before applying standard SAR processing.

Note that for ALOS-2 deskewing is not needed.

Step 5 - Deskewing: Select the speckle filtered product and then select **ALOS Deskewing** from the **Geometry** menu.



Select ALOS Deskewing



Press Run

The resulting product will have adjusted all the pixels to a more zero Doppler like geometry. Notice the gap along the top of the image.

Dewskewed Image

The product can now be terrain corrected.

Terrain Correction

Terrain Correction will geocode the image by correcting SAR geometric distortions using a digital elevation model (DEM) and producing a map projected product.

Geocoding converts an image from Slant Range or Ground Range Geometry into a Map Coordinate System. Terrain Geocoding involves using a Digital Elevation Model (DEM) to correct for inherent SAR geometry effects such as **foreshortening**, **layover** and **shadow**.

Foreshortening

- The period of time a slope is illuminated by the transmitted pulse of the radar energy determines the length of the slope on radar imagery.
- This results in shortening of a terrain slope on radar imagery in all cases except when the local angle of incidence (θ) is equal to 90˚.

Layover

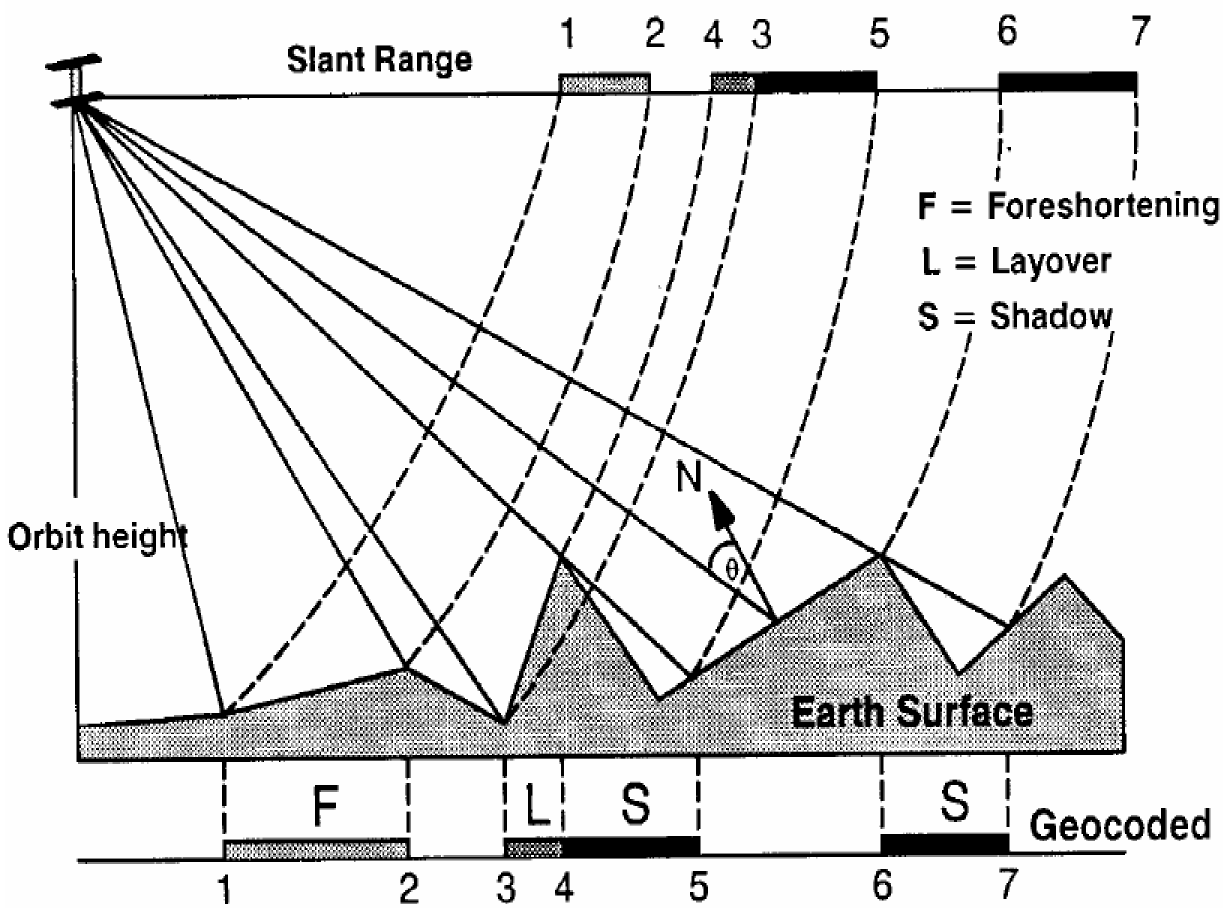
- When the top of the terrain slope is closer to the radar platform than the bottom the former will be recorded sooner than the latter.
- The sequence at which the points along the terrain are imaged produces an image that appears inverted.

- Radar layover is dependant on the difference in slant range distance between the top and bottom of the feature.

Shadow

- The back-slope is obscured from the imaging beam causing no return area or radar shadow

The effects of these distortions can be seen below. The distance between 1 and 2 can appear shorter than it should and the return for 4 can occur before the return for 3 due to the elevation.

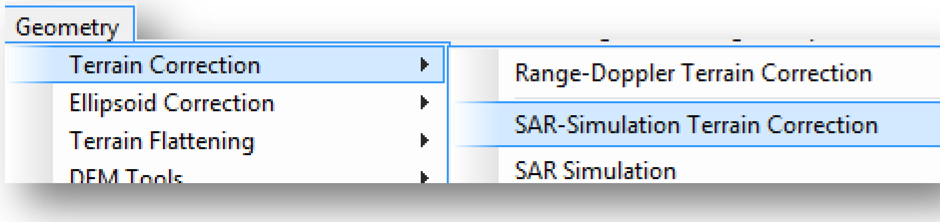


SAR Geometric Effects

Even after deskewing, the product will have a significant positional error. For missions such as ALOS-1 and ERS where the product timing and orbit data are not accurate enough, it is recommended to use the SAR Simulation Terrain Correction.

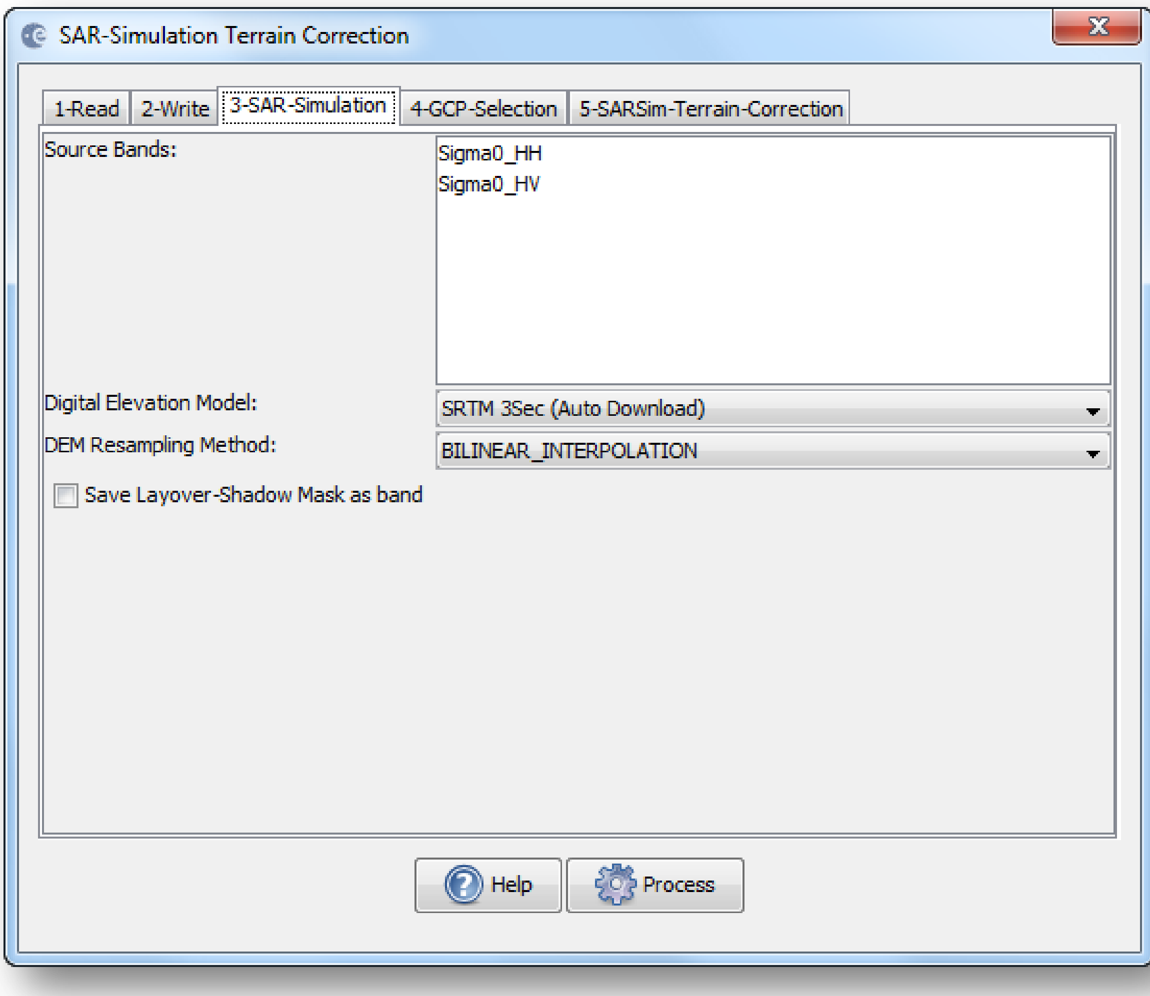
The SAR Simulation Terrain Correction works the same as the Rangle Doppler Terrain Correction with the extra steps of simulating an image based on a DEM and then coregistering the simulated image with the input image. Once the DEM and the input product have been accurately matched, the terrain correction using the Range Doppler method can proceed.

Step 6 - Terrain Correction: Select the deskewed product and then select **SAR Simulation Terrain Correction** from the **Geometry/Terrain Correction** menu.



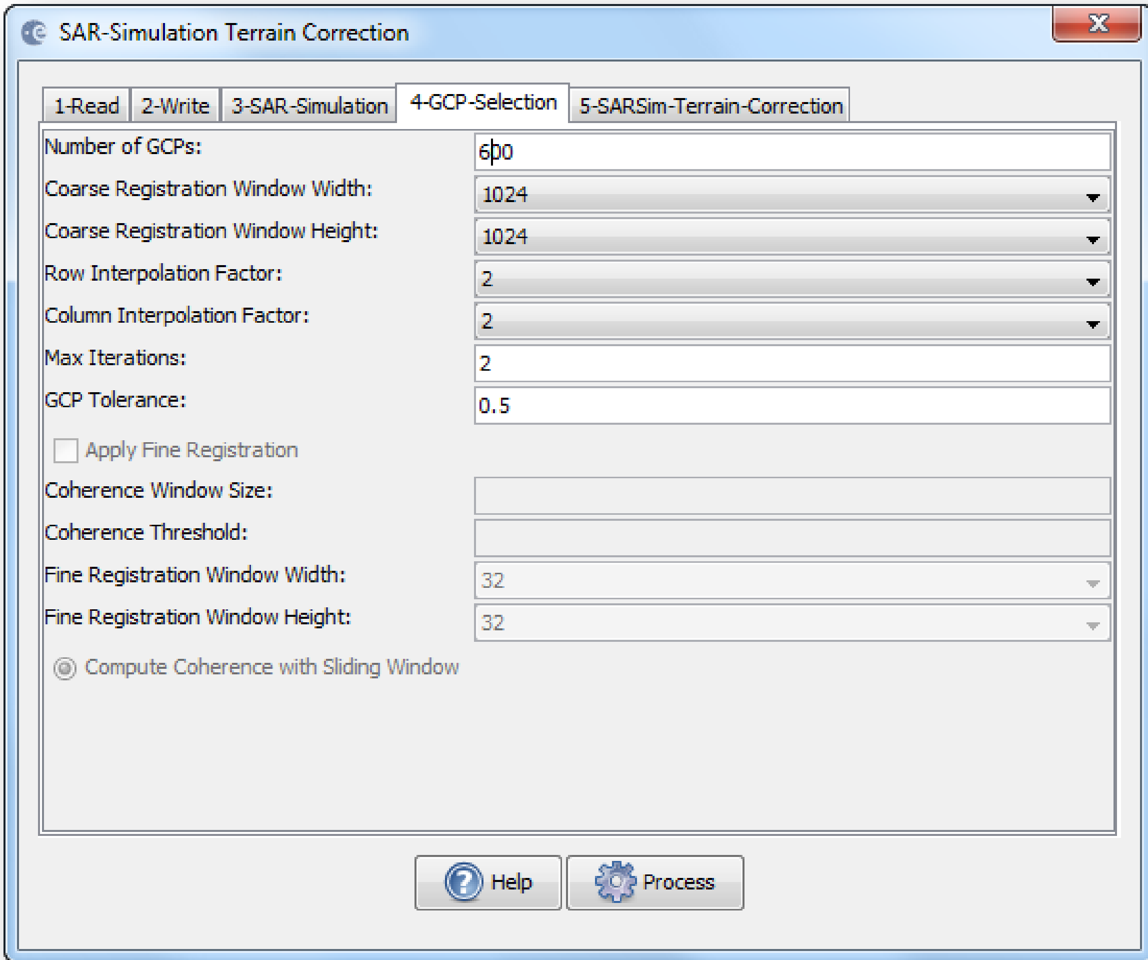
Select SAR Simulation Terrain Correction

By default, the terrain correction will use the SRTM 3 sec DEM. The software will automatically determine the DEM tiles needed and download them automatically from internet servers.



SAR Simulation Terrain Correction Dialog

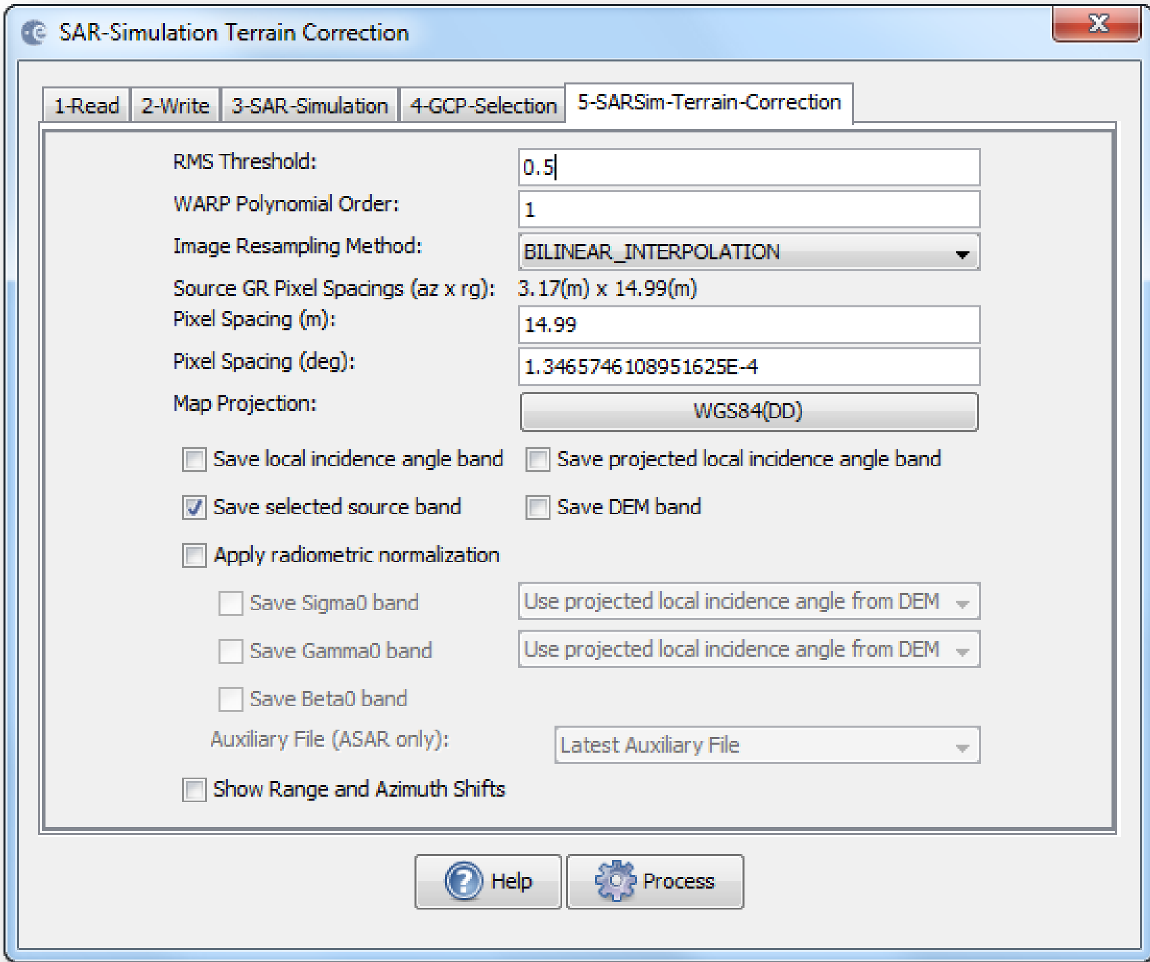
In the GCP Selection tab, you may need to select a large window depending on how far apart the georeferencing of the product is from the actual geographic position. For ALOS-1, a window size of 1024 may be needed for some products.



Select a Window Width and Height

In the Terrain Correction tab, the RMS threshold represents the cut off for the pixel accuracy of the coregistration. You may also select the output pixel spacing and the map projection.

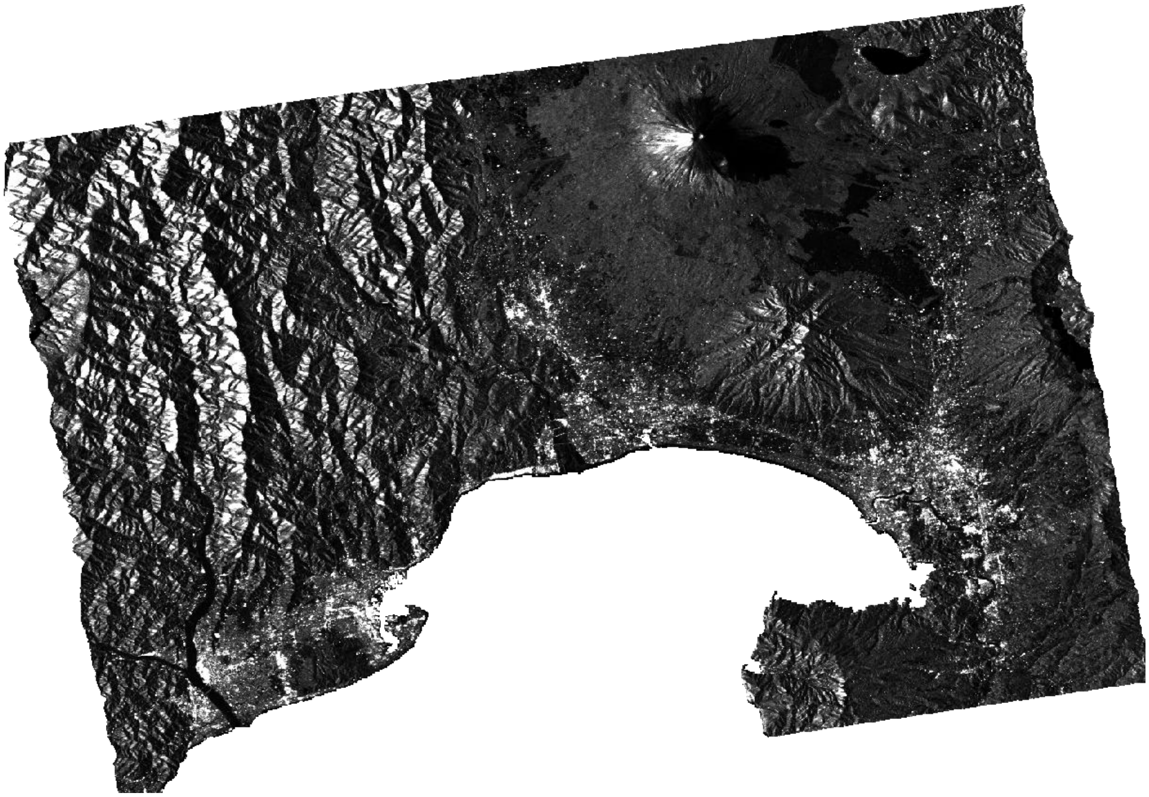
As you have already calibrated this product, there is no need to apply radiometric normalization.



Select the RMS Threshold

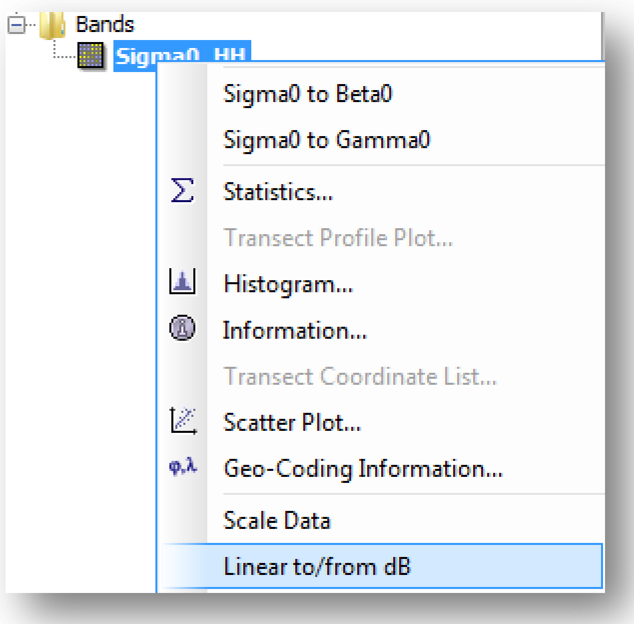
Press **Run** to process.

Open the terrain corrected product.



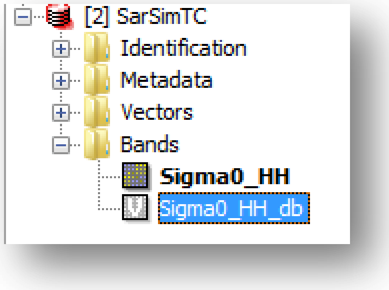
Terrain Corrected Image

To view the image in decibel scaling, right-click on the terrain corrected **Sigma0_HH** band and select **Linear to/from dB** convert the data using a virtual band.



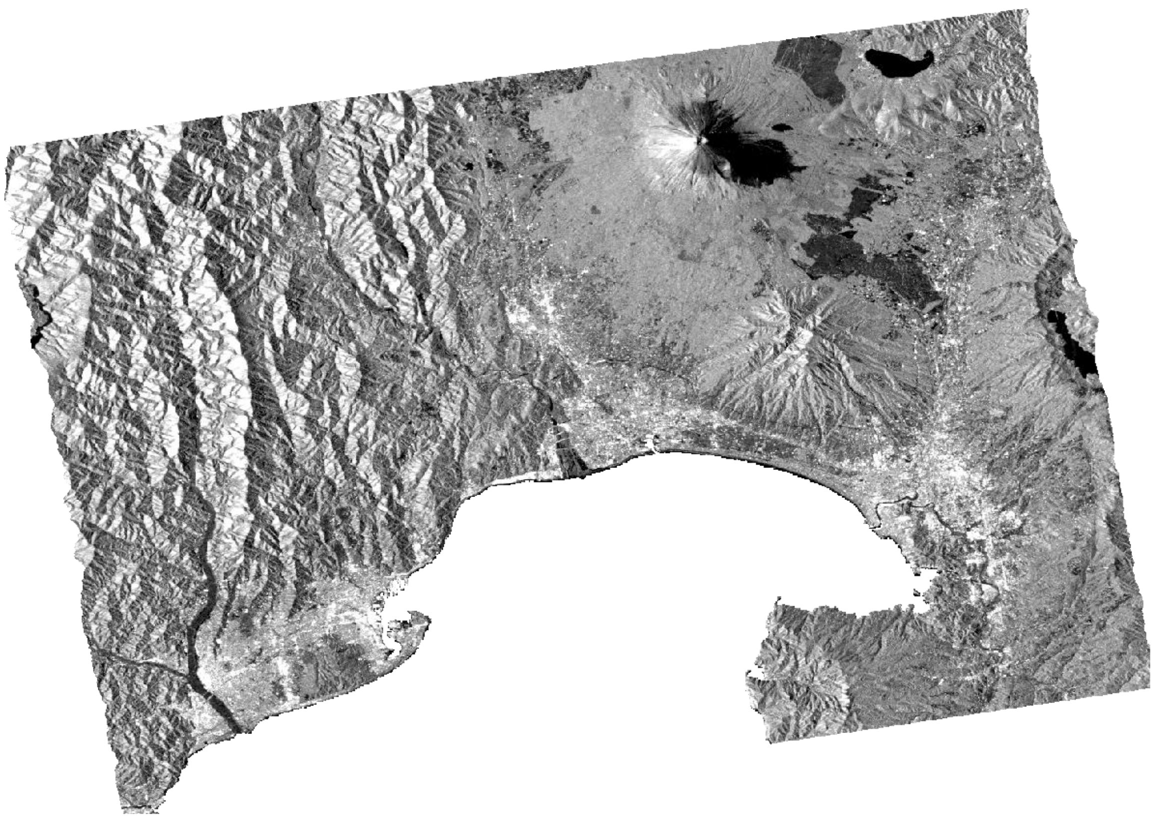
Select Linear to/from dB

A new virtual band will be created with the expression 10*log10(Sigma0_HH).

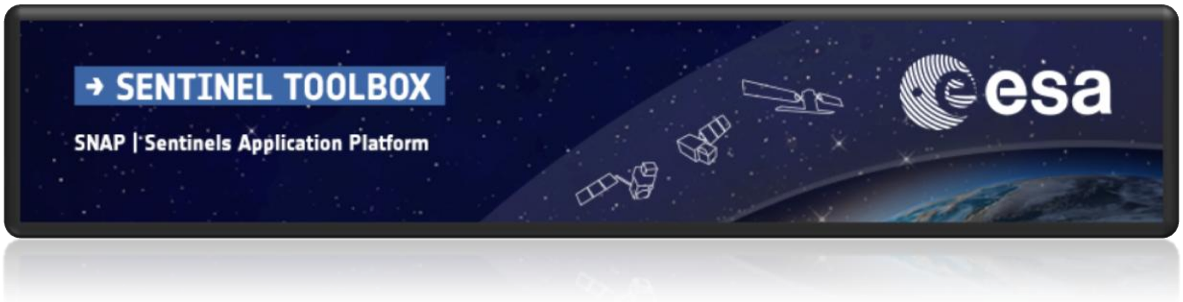


New Sigma0_HH_dB band

Double-click on the new **Intensity_VH_dB** band to open it.



Terrain Corrected Band in dB



For more tutorials visit the Sentinel Toolboxes website

http://step.esa.int/main/doc/tutorials/

Send comments to the SNAP Forum

http://forum.step.esa.int/