



Terrain Correction on ALOS-1 PALSAR (CEOS) Format Intensity Data using ASF MapReady

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Terrain correction removes the geometric distortions in SAR imagery (such as layover, foreshortening, shadow) by making use of the height information from a digital elevation model (DEM). The process of terrain correction can be split up in two separate parts:

- **Geometric Terrain Correction (GTC)** adjusts the position of ridge lines and valleys
- **Radiometric Terrain Correction (RTC)** adjusts the brightness of the pixels with respect to the observation geometry, defined by incidence angle as well as the slope and aspect of the local terrain.

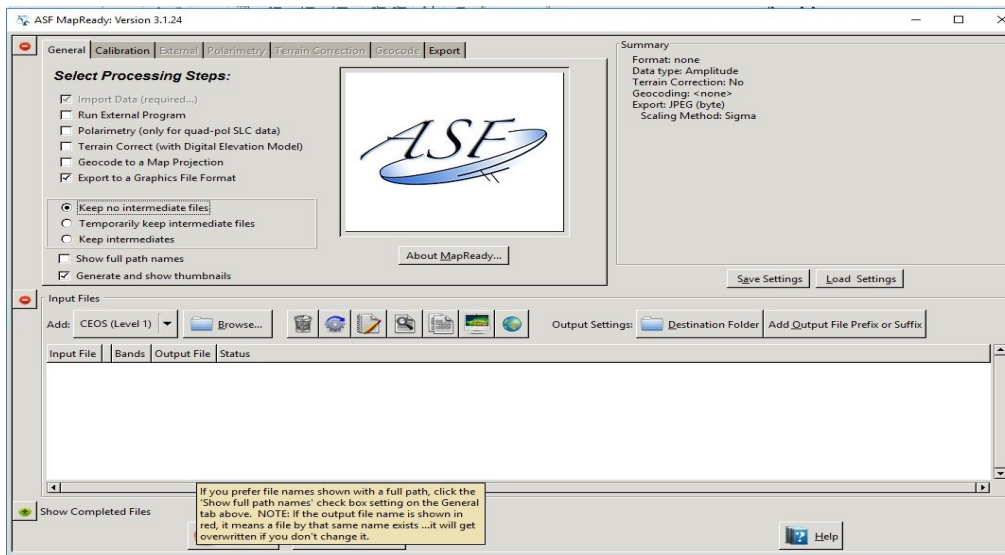
To go through this module, you must have ASF MapReady installed already. The following datasets are used:

- ALOS-1 PALSAR intensity image
- SRTM 30 meter DEM

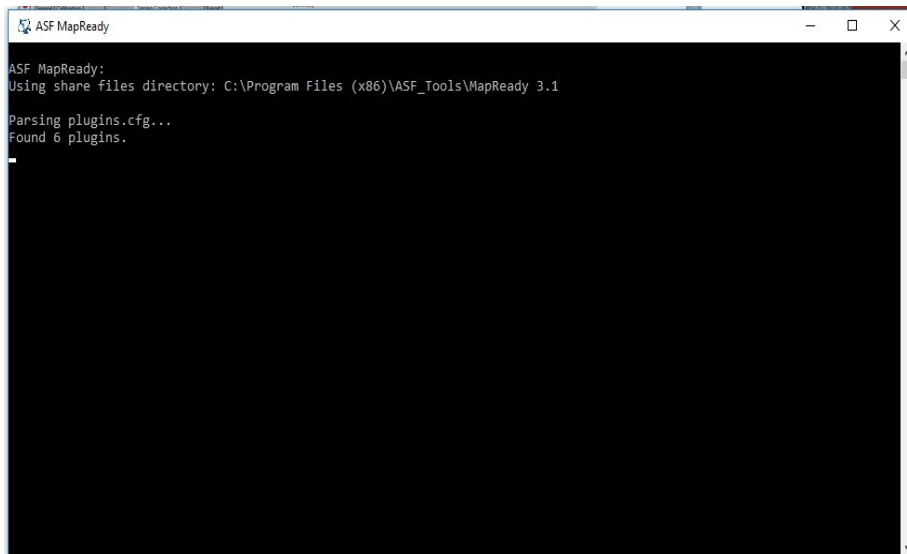
Caution note about ASF MapReady: In the file input / output, ASF MapReady has a bug that if the file path is too long, the software will not perform the execution. In this case, please check in the input / output file path window whether the full path is being displayed or not; if not, then store the data in a shorter overall file path, and then select the shorter path for the input / output files.

The processing takes about 10 minutes on a good desktop computer. The processing steps are as follows:

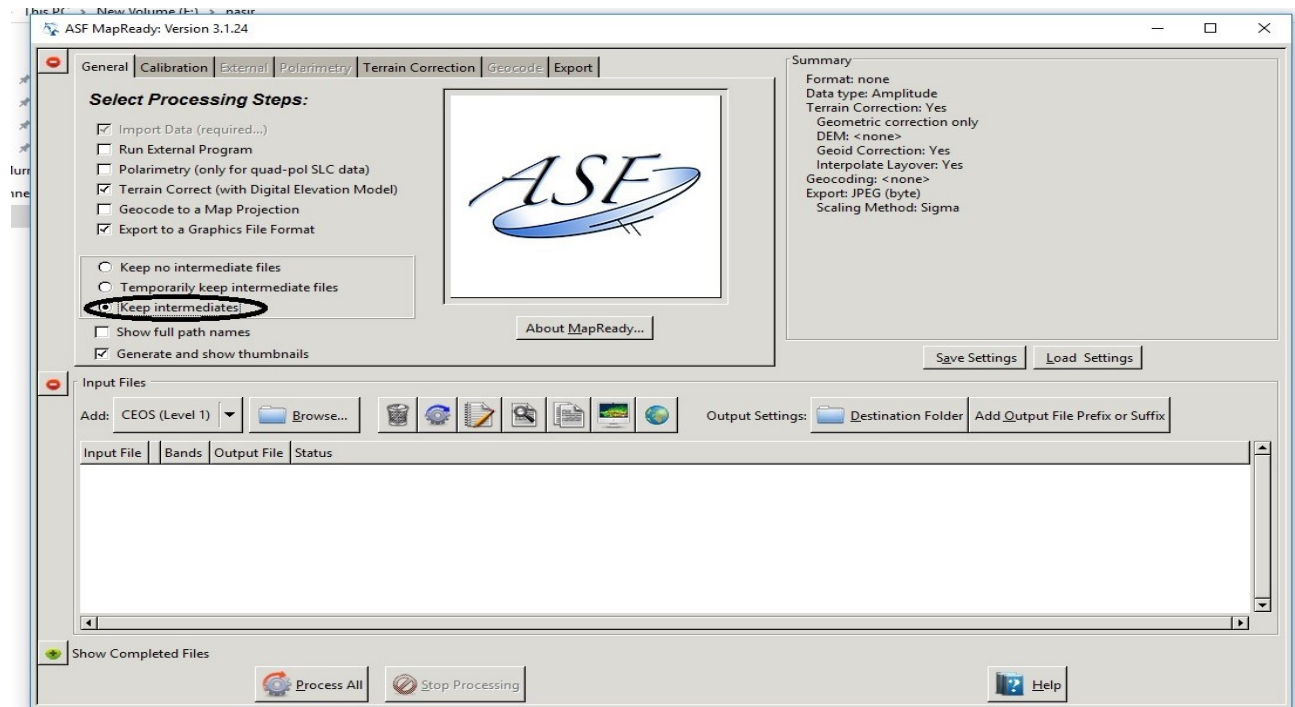
1. The ALOS-1 PALSAR image is stored as a **.zip** file. Make a new folder, we will call it "Processing", copy the full **.zip** file and the DEM **.tiff** file there. Unzip the SAR zip file two times to extract the data. Make sure to unzip inside the sub-folders, not "unzip here."
2. Open ASF MapReady. This GUI will pop up:



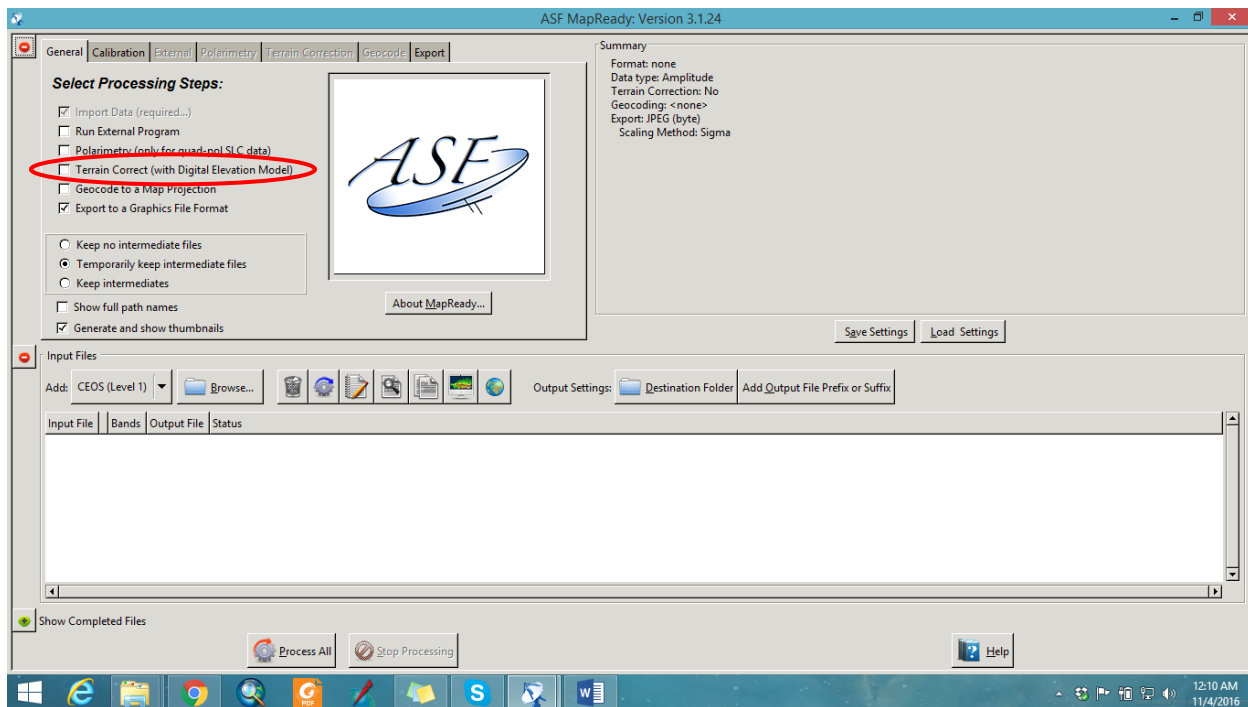
A DOS window (shown below) will also run behind the ASF GUI and describe the processes being performed. It is good to keep following the DOS window as different processes are run, to understand what kind of steps are being executed.



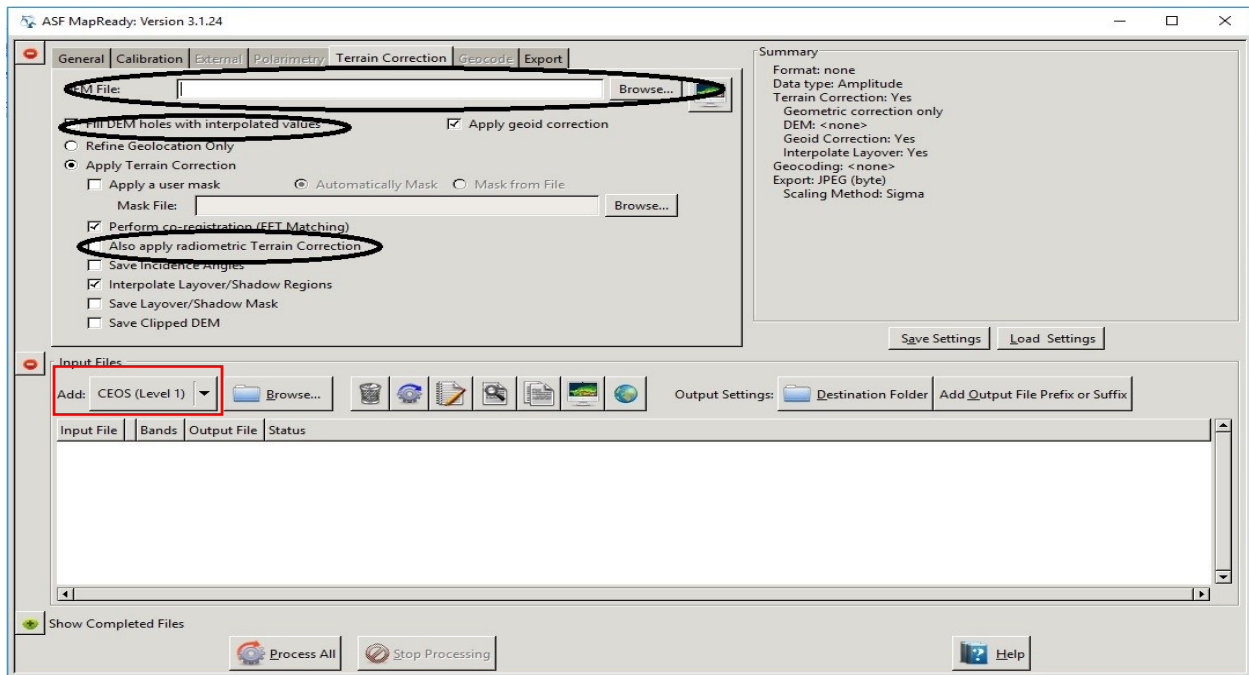
3. Select ***“Keep intermediates”*** before starting any process to keep intermediate results for further analysis, e.g. errors, warnings, and results of each processing step. If you will not select this option, all files generated through Terrain Correction process will be automatically deleted by the system whenever the software will be closed.



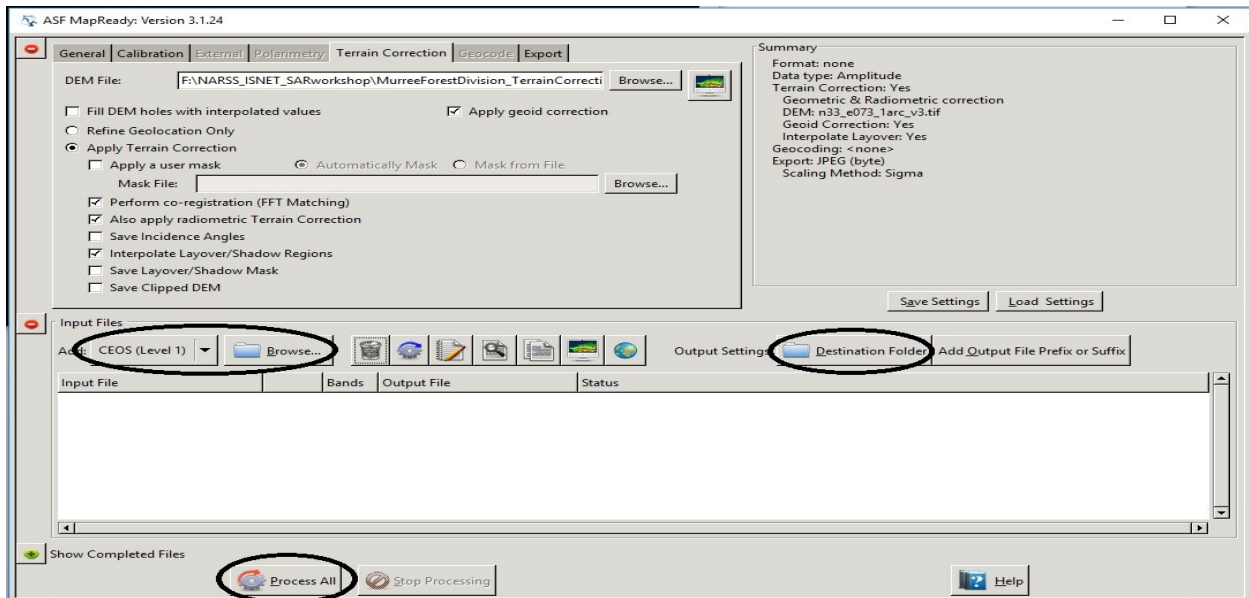
4. Under the heading of “**Select Processing Steps**”, check the ‘**terrain correct (with Digital Elevation Model)**’ which is highlighted in the fig below. Once you check the ‘**terrain correct**’ option, you will see the ‘**terrain correctin**’ tab activated. There are also other options you can check according to the requirement (gecode to map projection, export to graphics file format etc). Once you check the **terrain correction with DEM** in this GUI, the **summary** section on the top right side would also get modified.



5. In correction tab you will find multiple options to select for applying different operations and get multiple outputs. Terrain correction process mainly requires “**Digital Elevation Model (DEM)**” to remove terrain-related distortions.
6. Terrain correction process is mainly divided into two steps i.e. **Geometric Terrain Correction (GTC)** and **Radiometric Terrain Correction (RTC)** to remove terrain-associated errors from SAR image. GTC is main component of this process while RTC is optional, but mostly (e.g. for forest biomass applications) we require radiometrically terrain corrected image so also check option “Also apply Radiometric Terrain Correction”.
7. Select “**Fill DEM holes with interpolation values**” option if your DEM is not already filled. You can also generate clipped DEM, incidence angles image etc. based upon your future processing requirements.
8. The DEM file is downloaded from USGS EarthExplorer and is stored as a GeoTIFF (.tiff) file. Give path to the DEM file.
9. Now load **CEOS format** data from “Add” option under “Input Files.” We are using ALOS-1 PALSAR data in this processing, so we have to choose SAR CEOS-1 format to browse. It will automatically lead us to select the file with extension .5_UA. In this specific case, select the **LED-ALPSRP238010660-H1.5_UA** ALOS-1 PALSAR file as input.
10. Save the output files in the “Processing” folder created earlier.



11. Perform the processing by clicking “Process All” at the bottom. The processing sequence and steps will be displayed in the text DOS window.





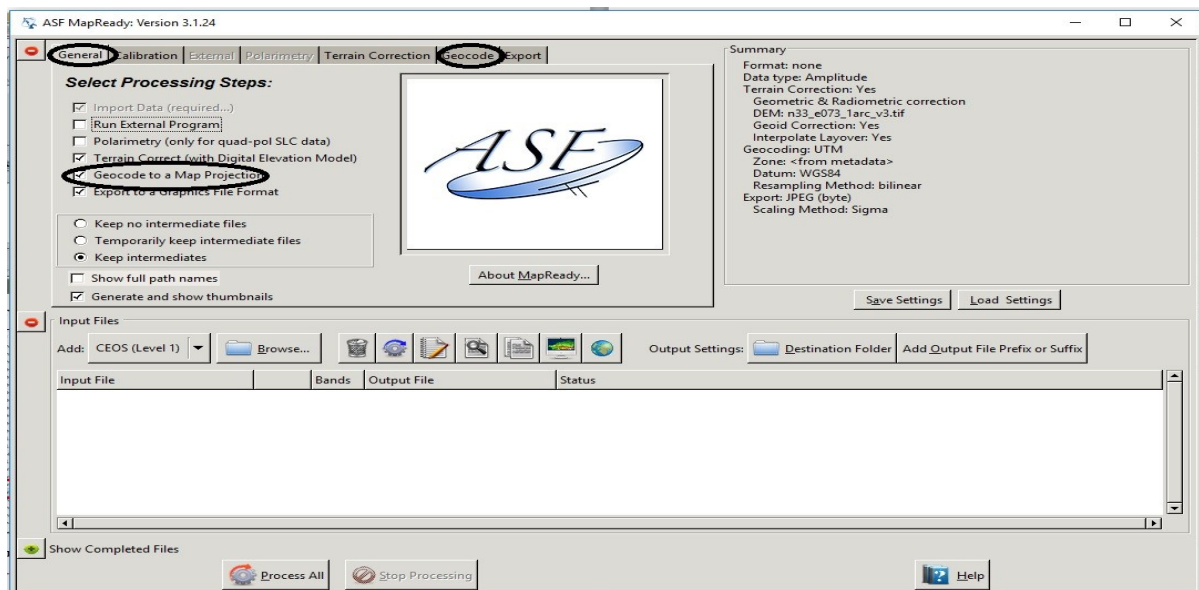
12. Following snapshot is representing the generated files during GTC/RTC process.

Name	Date modified	Type	Size
imported_dem.meta	3/4/2015 9:51 AM	META File	6 KB
import_slant.meta	3/4/2015 9:51 AM	META File	15 KB
import.meta	3/4/2015 9:51 AM	META File	26 KB
geocoded_dem_kayar_dem_ell_tc_smoot...	3/4/2015 9:53 AM	META File	15 KB
geocoded_dem_kayar_dem_ell_tc_smoot...	3/4/2015 9:52 AM	META File	15 KB
geocoded_dem_kayar_dem_ell_tc_smoot...	3/4/2015 9:53 AM	META File	15 KB
geocoded_dem_kayar_dem_ell_tc_smoot...	3/4/2015 9:52 AM	META File	15 KB
geocoded_dem_kayar_dem_ell_tc_smoot...	3/4/2015 9:52 AM	META File	15 KB
geocoded_dem_kayar_dem_ell_tc_smoot...	3/4/2015 9:57 AM	META File	15 KB
geocoded_dem_kayar_dem_ell_tc_smoot...	3/4/2015 10:16 AM	META File	6 KB
geocoded_dem_kayar_dem_ell_tc_smoot...	3/4/2015 9:51 AM	META File	6 KB
geocoded_dem_kayar_dem_ell_tc_smoot...	3/4/2015 9:51 AM	META File	6 KB
ALPSRP220210540-H1.5_UA_thumb.meta	3/4/2015 10:17 AM	META File	15 KB
ALPSRP220210540-H1.5_UA_overlay.meta	3/4/2015 10:17 AM	META File	17 KB
mapready.log	3/4/2015 10:17 AM	LOG File	15 KB
ALPSRP220210540-H1.5_UA_overlay.kml	3/4/2015 10:17 AM	KML File	10 KB
tercorr_side_products.img	3/4/2015 10:16 AM	IMG File	1,428,303 KB
terrain_correct_mask.img	3/4/2015 9:57 AM	IMG File	357,076 KB
terrain_correct_before_rtc.img	3/4/2015 9:57 AM	IMG File	357,076 KB
terrain_correct.img	3/4/2015 10:16 AM	IMG File	357,076 KB
imported_dem.img	3/4/2015 9:51 AM	IMG File	748 KB
import_slant.img	3/4/2015 9:51 AM	IMG File	342,518 KB
import.img	3/4/2015 9:51 AM	IMG File	410,508 KB
geocoded_dem_kayar_dem_ell_tc_smoot...	3/4/2015 9:53 AM	IMG File	357,149 KB

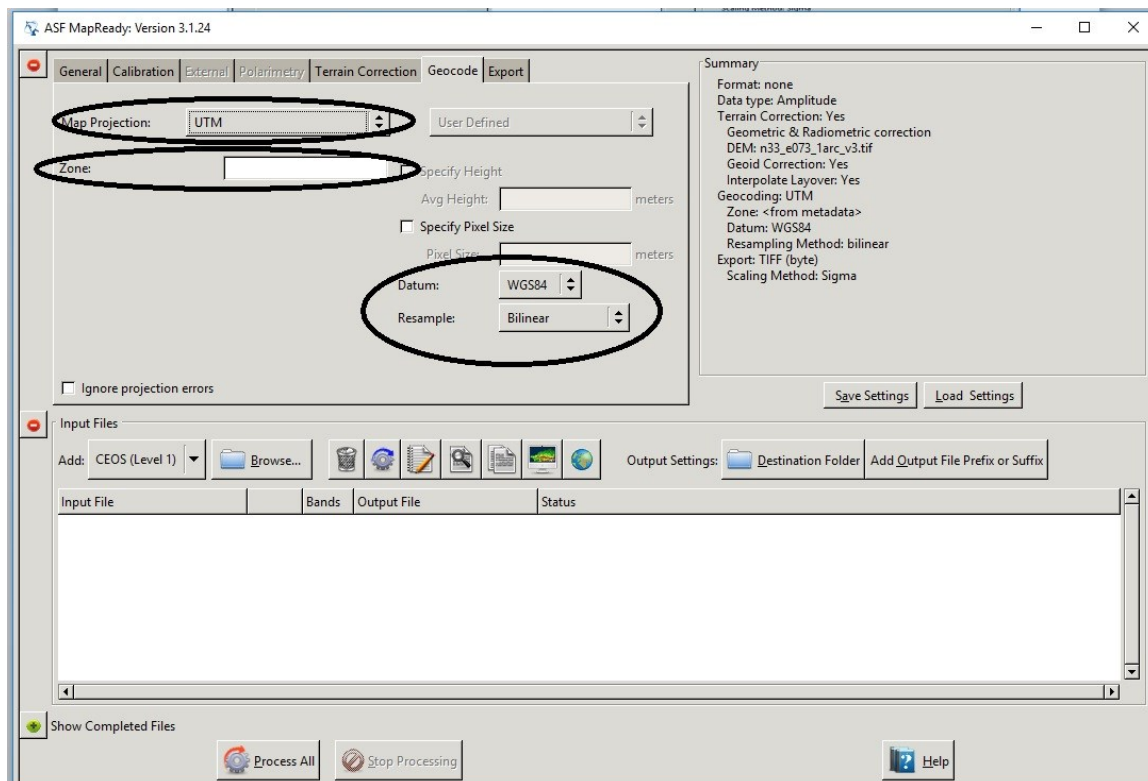
13. In the output **Processing** directory, the two major outputs will be the geometrically corrected image with name **“terrain_correct_before_rtc.img”** and radiometrically terrain corrected image with name **“terrain_correct.img”**

14. You can right-click on the input file and click **“View Input”** and do the same with the output file, and you can immediately see the difference between the two in ASF Viewer.

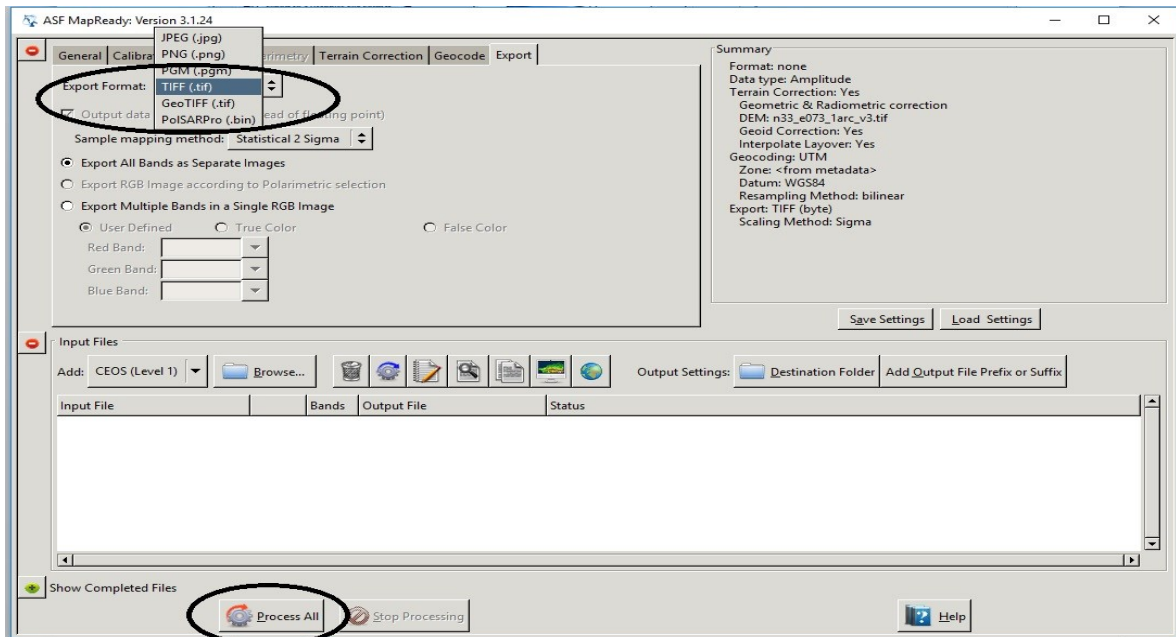
15. Now you can perform geocoding process on the **“terrain_correct.img”** file. Geocoding process is required to reproject / or align the SAR image with respective projection system from SAR system used geographic coordinate system. Go to **“General”** tab and activate the **“Geocode to Map Projection”**, this will activate the **“Geocode”** tab. **Make sure to “deactivate”** the **“Terrain Correction”** tab.



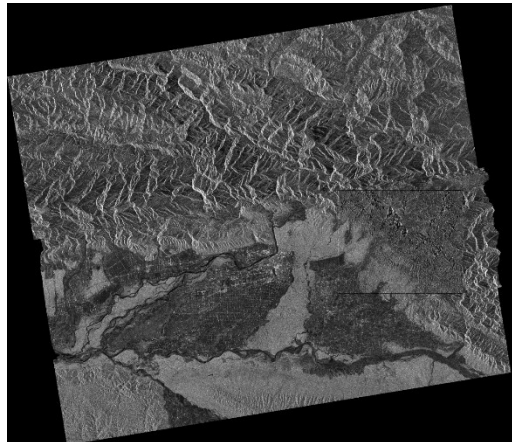
16. Navigate to the “**Geocode**” tab and set the parameters in ‘Geocode’ tab, such as ‘Map Projection’, ‘Zone’, ‘Datum’ and ‘Resample.’ Keep the Datum as the generic WGS84, and this dataset falls in the UTM Zone 43N. The input file “**terrain_correct.img**” is in **ASF internal format**, so select the input file via Browse. Click “Process All” to process. Geocoded output file with name “**geocoding.img**” will be generated.



17. “.img” is ASF internal format and is not compatible to work with other remote sensing software (like ESA SNAP, ERDAS Imagine, or ENVI), so we should export the final geocoded output from “.img” format to “**GeoTiff (.tiff)**” format to use it in other remote sensing software. To perform this, activate the “Export” option in “General” tab. **Make sure that the other tabs of “Terrain Correction” or “Geocoding” are deactivated.** Now go to the “Export” tab and select export file format. In this step, make sure that the “Amplitude” option is selected in the “Calibration” tab.



18. Final output after geocoding and exporting process will be something like this:



19. Complete work flow is as follows:

