Data processing of spaceborne SAR data

Earth Observation

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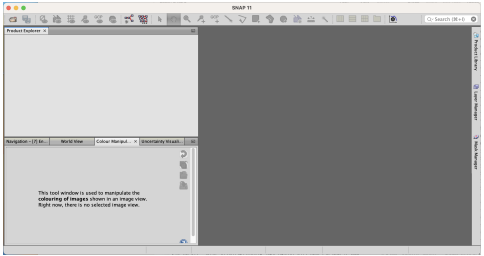
1 Introduction

SNAP

1 Introduction

This presentation is to train on opening a S1 SLC product ad making the necessary steps to generate a usable SLC image.



- Install the Desktop version of SNAP 11.
- Open the SLC folder.

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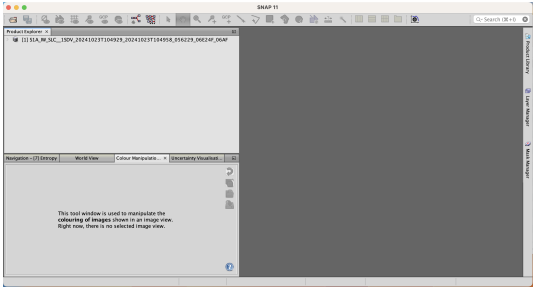
2 Preliminary analysis

The SLC S1 product

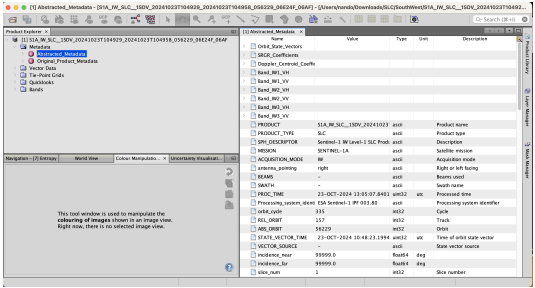
2 Preliminary analysis



- Just drag and drop one of the SLC *.zip data in the Product Explorer window.
- Let's assume using "S1A_IW_SLC__1SDV_20241023T104929_20241023T104958_056229_06E24F_06AF" product in the "South West" folder.

Metadata

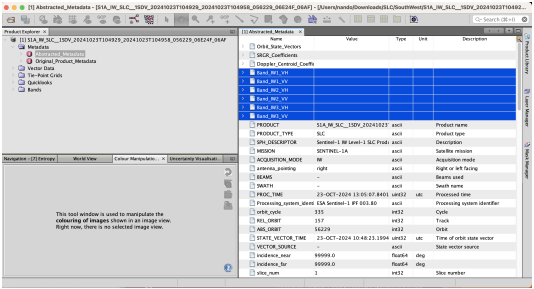
2 Preliminary analysis



- Double-click on the [1] product.
- Double click on Metadata.
- Double click on Abstracted_Metadata.
- Look at the sensor's parameters.

Metadata - Subswaths

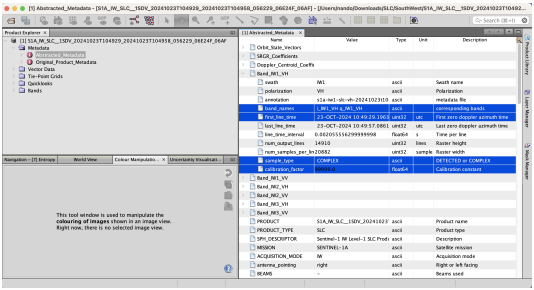
2 Preliminary analysis



- There are 3 subswaths termed as Band_IWx_xx.
- The subswaths are linked to the S1 ScanSAR acquisition.
- Each subswath includes two polarimetric channels VV and VH.

Metadata - Subswath

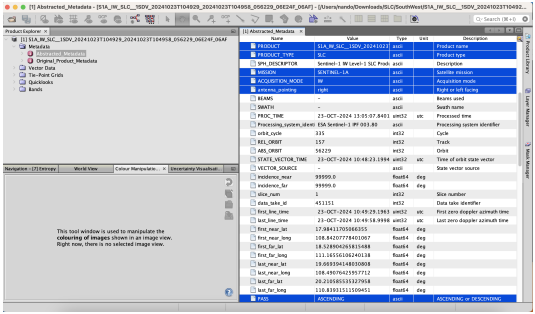
2 Preliminary analysis



- Double-click on the first subswath to have info:
- It is a matrix of complex number consisting of the in-phase i_ and quadrature q_ components.
- It includes the acquisition data and time.
- It tells you that measurements are complex numbers.
- The calibration is NOT (99999.0) applied.

Metadata

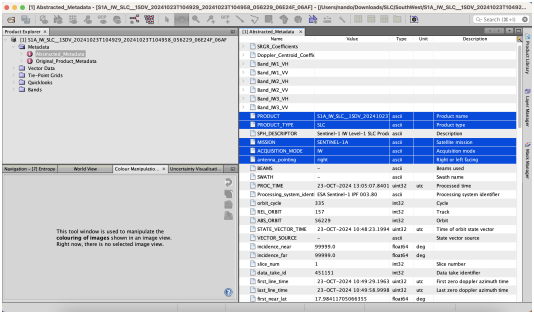
2 Preliminary analysis



- You can see the name of the product,
- the product type that in this case is a “Single Look Complex”.
- The acquisition mode that in this case is “Interferometric Wide” (IW).
- The antenna pointing direction that in this case is “right”.

Metadata

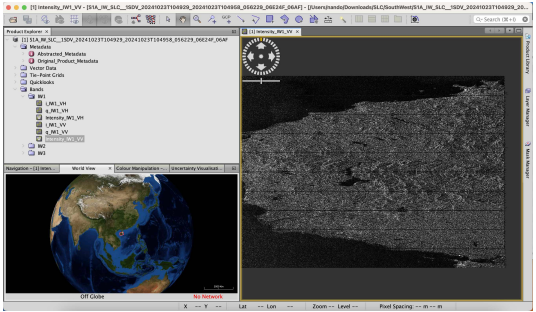
2 Preliminary analysis



- The orbiting pass is “ascending”
- The azimuth looks and range looks are both equal to “1” implying the no multi-looking was done.
- The range spacing and azimuth spacing that are linked to the spatial resolution and they indicate that a non-square pixel is available.

Bands

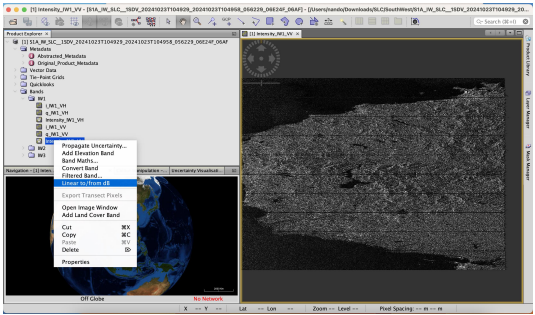
2 Preliminary analysis



- Double-click on Bands.
- Double-click on IW1 subswath.
- You have in-phase and quadrature components of both VV and VH channels together with their intensity.
- Double-click on Intensity_IW1_VV band.
- By moving the mouse in the top-left corner of the image you can zoom-in and navigate the image.
- The bottom-left World View panel shows the image location.

Linear to dB

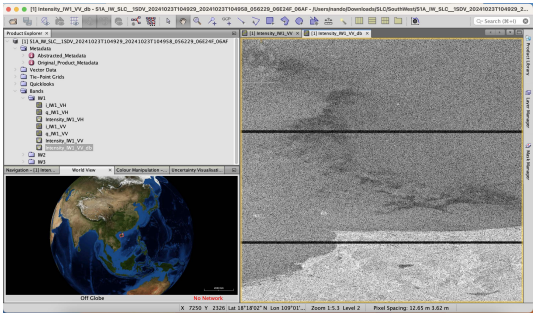
2 Preliminary analysis



- Right-click on intensity_IW1_VV.
- Click on Linear to/from dB to generate a “virtual band” that includes the dB (10*log10(intensity IW1 VV)) version of the image to better visualize it.

Linear to dB

2 Preliminary analysis



- Double-click the Intensity_IW_VV_db to show the dB image.
- Zoom-in and navigate to show some coastal features and processes.
- You can also see “Dark horizontal stripes” related to the “azimuth bursts”.
- Those dark lines need to be removed.

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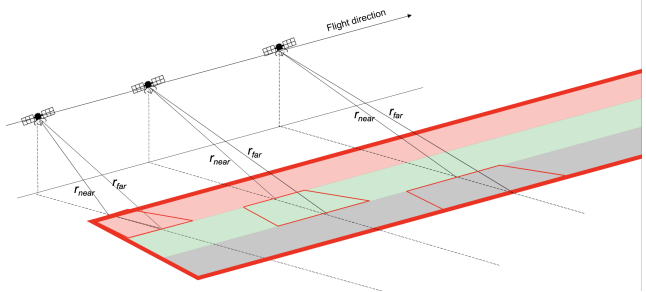
ScanSAR

3 TOPS processing

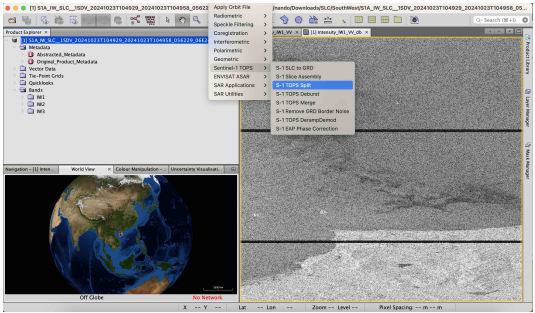
The Sentinel-1 IW acquisition mode is a special ScanSAR mode



- The three stripes colored in red, green and gray stand for three subswaths that allow extending the swath in the range direction.
- Each subswath includes bursts that aligned in the azimuth direction.

TOPS processing

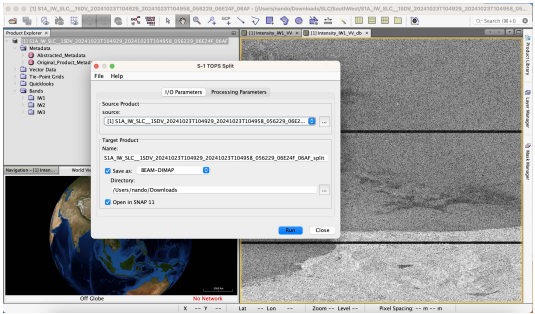
3 TOPS processing



- To play with “subswaths” and “bursts” use the Radar menu.
- Go to the Sentinel-1 TOPS menu.
- Go to the S-1 TOPS Split menu to select the subswaths and bursts you want to process.

TOPS processing

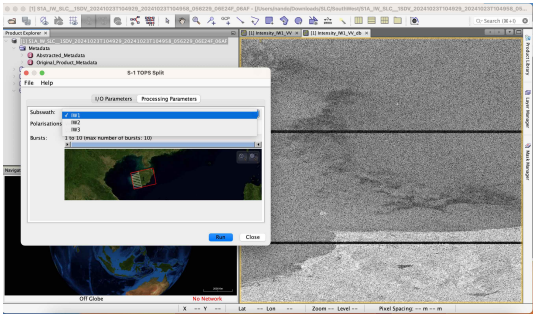
3 TOPS processing



- Click on the S-1 TOPS Deburst menu to open the dialog window.
- The I/O parameters window is ok.
- Click on the Processing Parameters window.

TOPS processing

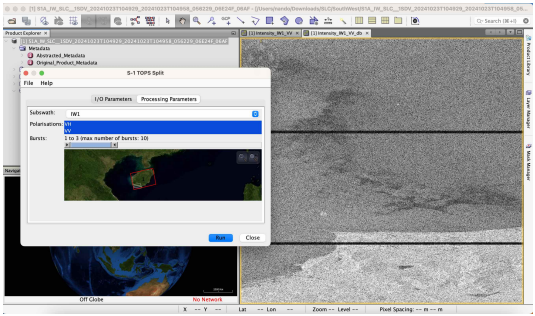
3 TOPS processing



- Scroll the Subswath menu to select the subswaths to be processed.
- You can visually inspect the location of the selected subswaths in the below panel.
- Click on the Processing Parameters window.
- You can also decide to select all the available subswaths (this is the choice made when delivering the GRD product).

TOPS processing

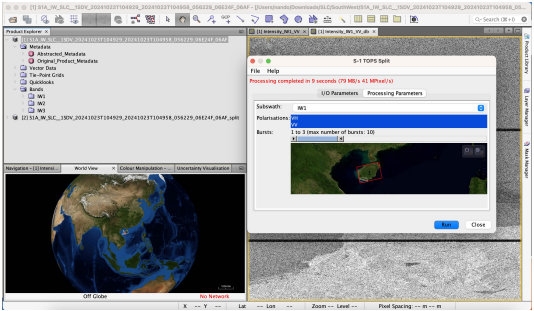
3 TOPS processing



- Let's assume to select the subswath IW1.
- Select the two polarization channels VH and VV.
- By moving the right and left arrows in the Bursts section you can select the number of bursts to be processed.
- You can also process all the bursts (this is the choice made when delivering the GRD product).
- Let's assume to select 3 bursts (you can see them highlighted in white)

Splitting

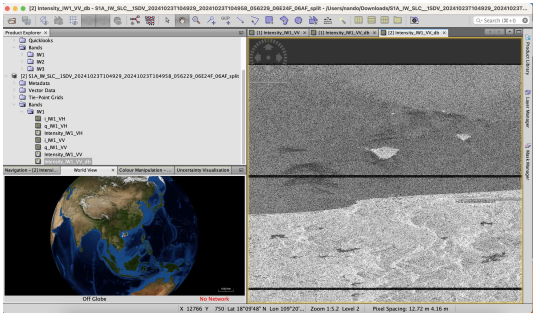
3 TOPS processing



- After pushing the Run button.
- A new product [2] appears in the Product Explorer window.
- Click on the [2] product to see the bands it consist of.
- Now just one subswath IW1 appears which consists of three bursts.

Splitting

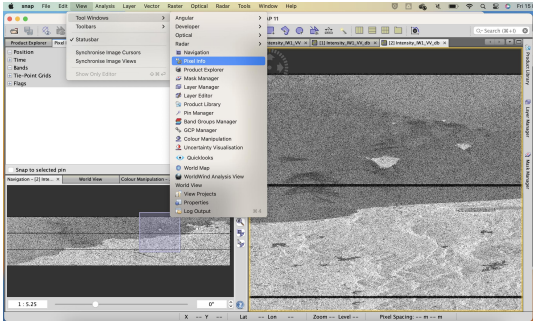
3 TOPS processing



- Click on the Intensity_IW_VV band to show the intensity VV image.

Splitting

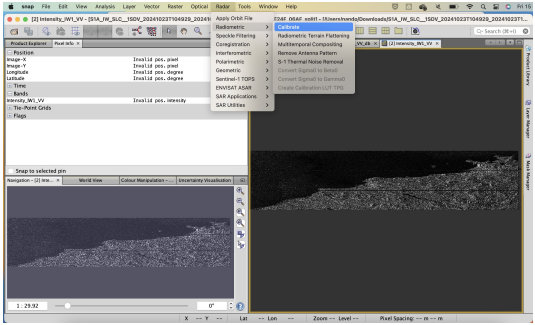
3 TOPS processing



- Click on the View menu and then on Tool Windows to select Pixel info.
- The Pixel Info windows appear.
- Surfing the image the intensity value is displayed on the Pixel Info window.
- The values observed are all integers, in the radar jargon they are Digital Numbers (DN).
- Calibration is needed to convert DN into floating points.

Calibration

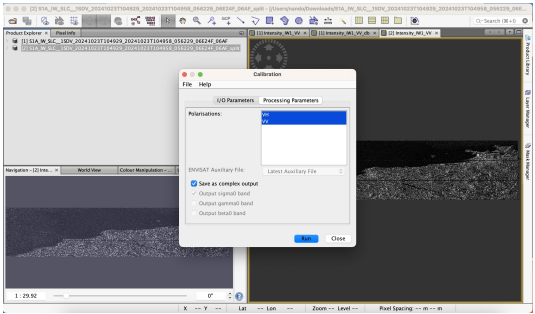
3 TOPS processing



- Click on the Radar menu and then on Radiometric menu to select Calibrate function.

Calibration

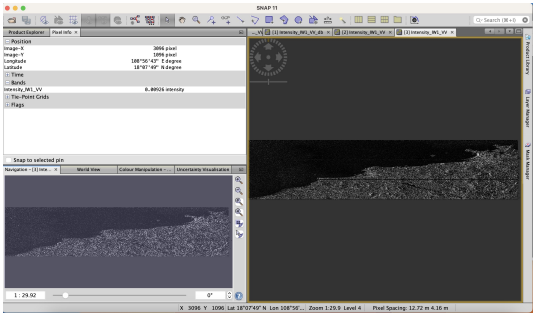
3 TOPS processing



- The calibration window appears.
- Click on the Input Parameters menu to select the VV and VH channels.
- Select the Save as a complex output function to save the complex channels together with the intensity.

Calibration

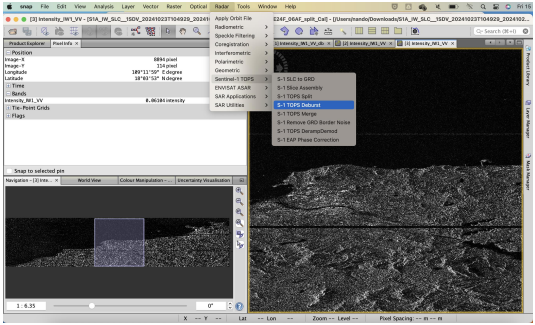
3 TOPS processing



- After pressing the run button, a new product [3] appears in the Product Explorer window.
- Click on the Intensity_IW1_VV band to show the intensity product.
- Open the Pixel Info window and surf the image.
- The intensity image consists now of calibrated “floating point” numbers.

Debursting

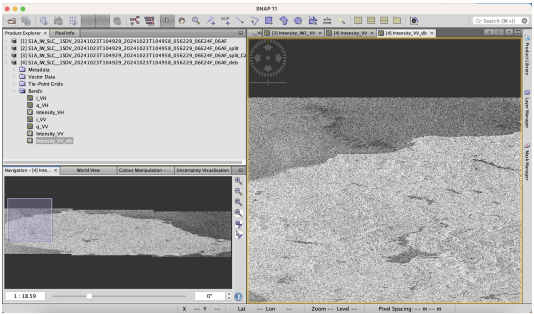
3 TOPS processing



- To deal with the horizontal bars in the image the de-bursting is needed.
- Go to the Sentinel-1 TOPS menu.
- Go to the S-1 TOPS Deburst menu to run debursting.
- In the Processing parameters window select the VV and VH polarimetric channels.

Debursting

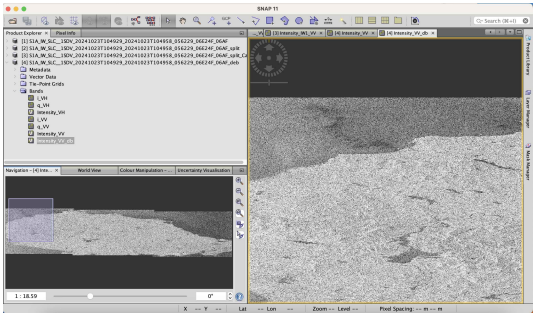
3 TOPS processing



- After pressing the run button a new product [4] appears in the Product Explorer window.
- By clicking on the Intensity band in dB the image appearing does not contain any horizontal bar.

Terrain correction

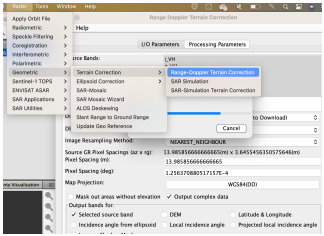
3 TOPS processing



- This step is particular useful when dealing with coastal areas.
- It consists of properly reprojecting on to a geo-map (e.g. WGS84, UTM, ...) the measurements.
- Click the Radar menu, then Geometric menu, then the Terrain correction menu and, finally, the Range-Doppler terrain correction function.

Terrain correction (1)

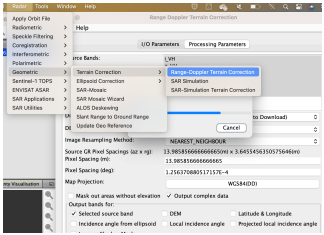
3 TOPS processing



- Click the Processing Parameters window to:
- Select the input bands (both intensity and i-q components can be selected.
- Select the Digital Elevation Model (DEM) to be used in the land area. A fair option is “Copernicus 30m”.
- Select the Resampling Method. An accurate enough option is the “Nearest_neighbour” method for both DEM and Image resampling. Note that keeping the default “Bilinear” interpolation may result in artifact when exporting the imagery in Matlab

Terrain correction (2)

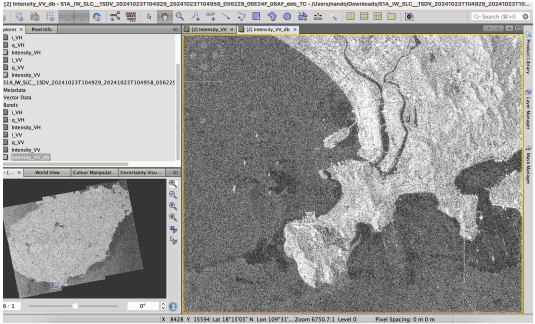
3 TOPS processing



- Note that the native pixel is rectangular (i.e., the pixel spacing is around 14×4m). By this processing a square pixel is obtained. The default pixel spacing is around 14×14m. A different value can be selected to resample the image.
- The Map projection bar allows selecting the map to be used for the reprojection. The default “WGS84” is ok.
- De-select the button “Mask out areas without elevation” to avoid masking out ocean.
- Select the button “Output complex data” to generate an output products that includes the i-q components.

Terrain correction

3 TOPS processing



- After pressing the run button a new product [5] appears in the Product Explorer window.
- By clicking on the Intensity band in dB the image appears correctly projected on the geographic grid.
- The Sanya city is on the bottom part of the image and by zooming-in it can be well-recognized.
- The two rivers, the harbor together with some bright metallic targets and few dark areas can be visualized.