POLITECNICO DI MILANO
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Sentinel Application Platform (SNAP) Basics

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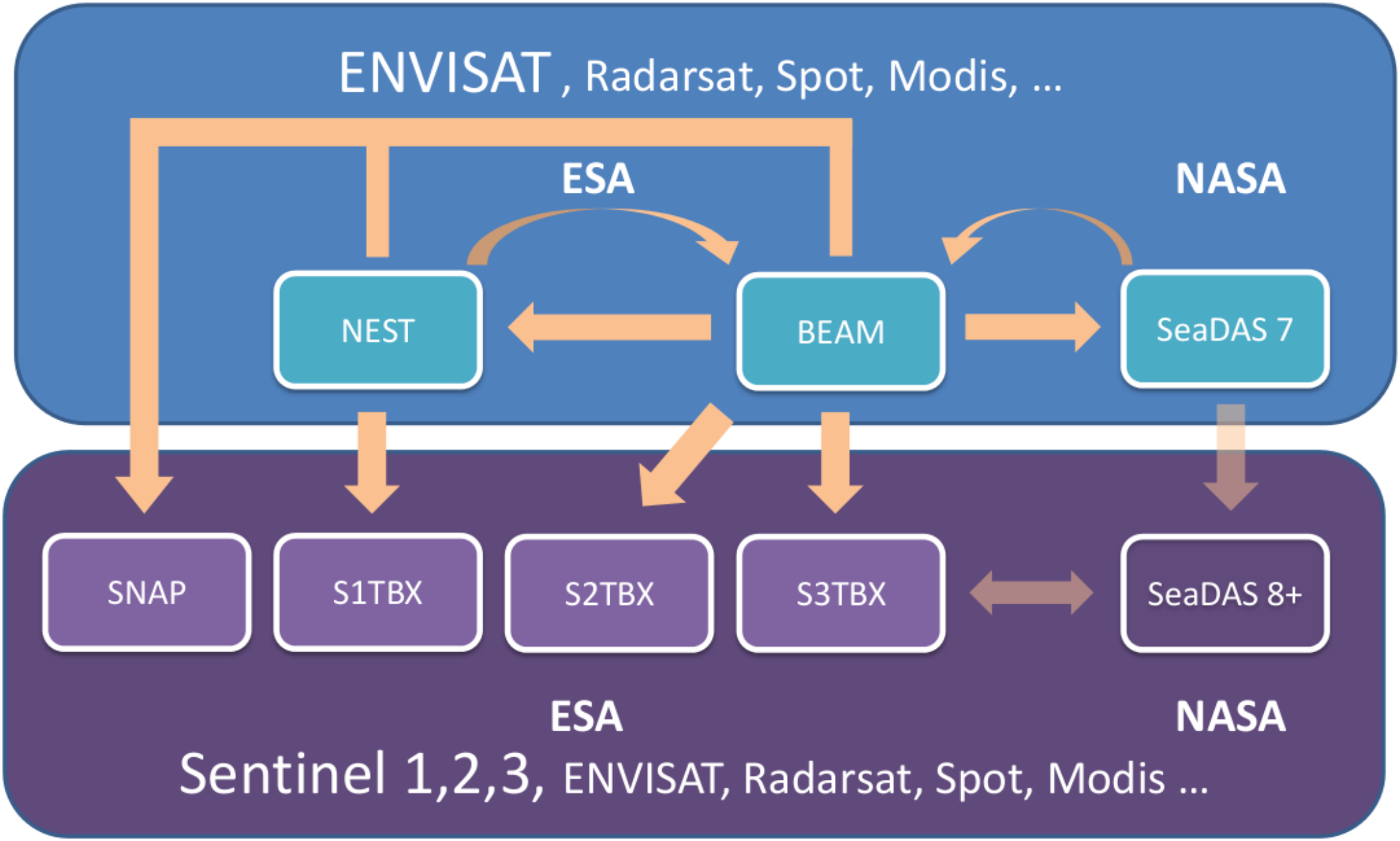
What is SNAP?

- A common architecture for all Sentinel toolboxes (Sentinel-1, Sentinel-2 & Sentinel 3) and others
- Ideal for Earth Observation (EO) analysis and processing
- One application, one installation on end-user's computer
- Available for Mac OS X, Windows and Unix (http://step.esa.int/main/download/)
- Fully open-source with GPL 3 license and the source is available on GitHub (https://github.com/senbox-org/)
- It is a ESA SEOM (Scientific Exploitation of Operational Missions) funded activity.

Toolbox Evolution



Architecture

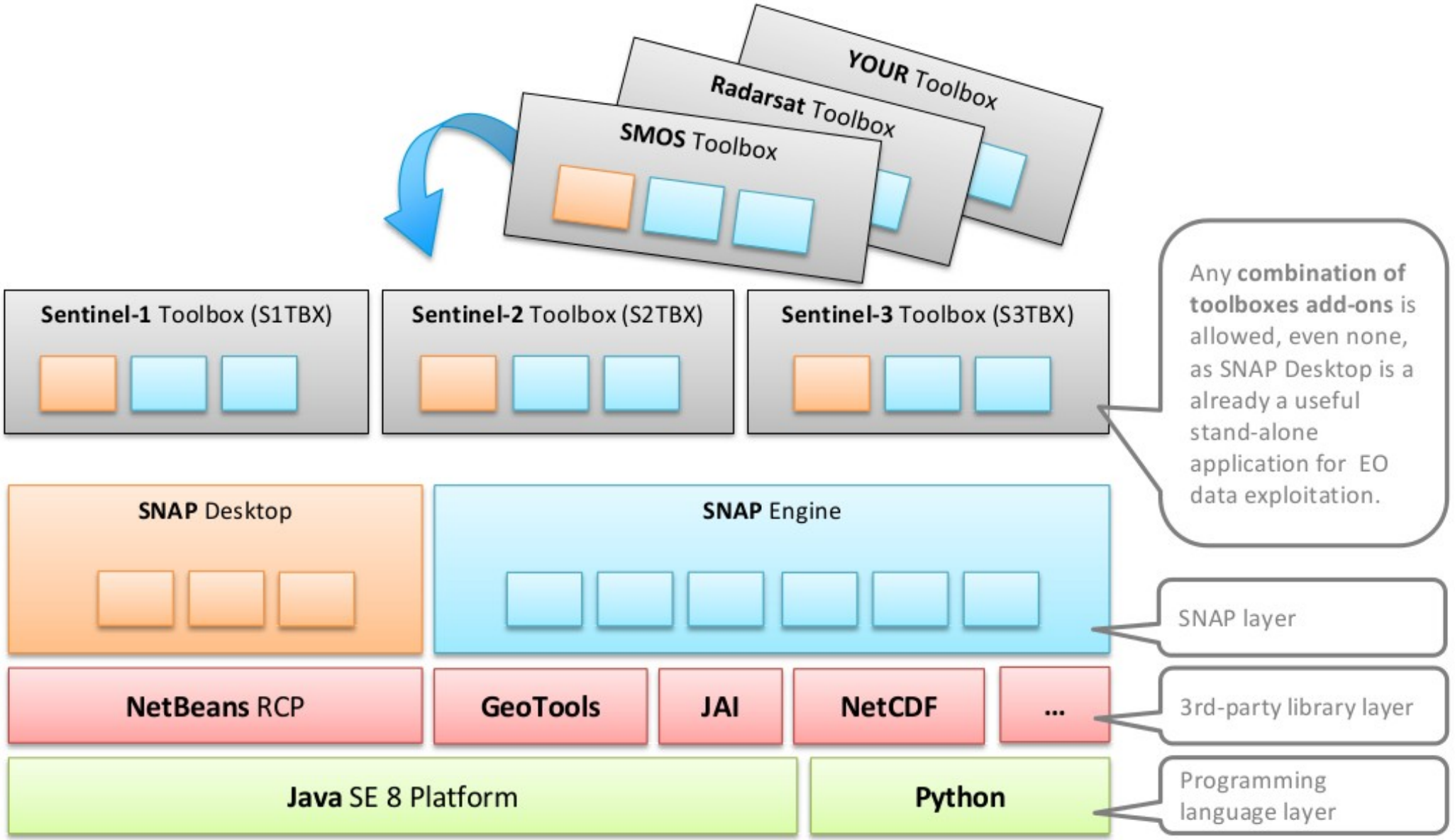
- High-level architecture comprises two subsystems:
  - **SNAP Desktop**: the graphical user interface
  - **SNAP Engine**: the core and command-line interface
- Dynamic, module-based architecture, with various extension points and extensions
- Install and update of extension modules
- Write a plugin, with Java or Python, use it in all toolboxes
- **SNAP Desktop**
  - Modern, intuitive and rich user interface
  - Fast display of giga-pixel images
  - Large portfolio of analysis and visualisation functions

Architecture

- Operator interfaces and graph builder for processing (Majority of SNAP “functions” are implemented as operators. Processing chains (“graphs”) can be created using “Graphical Graph Builder”)

- **SNAP Engine**
  - SNAP core code base with command-line interface, no GUI
  - Python API allowing to use also numpy, scipy, pandas, etc with SNAP
  - Common, generic I/O formats: NetCDF, HDF, GeoTIFF, Shapefiles, ...
  - Common, generic functions: reprojection, subset, geo-coding, collocation, band maths, image filters, masking tools, ...

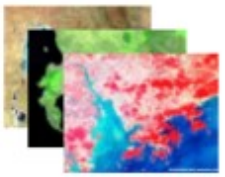
Architecture



Application modes

I

Interactive Exploration



SNAP Desktop

PC, notebook, tablet

II

bulk / NRT processing

SNAP Graph Processing Framework

PC, notebook server

III

EO data processing centre

SNAP Graph Processing Framework

cluster, cloud

IV

Cloud Exploitation Platform

PC, notebook, tablet

Sentinel-1

- The mission is composed of a constellation of two satellites, SENTINEL-1A and SENTINEL-1B, sharing the same orbital plane, operating day and night performing C-band synthetic aperture radar (SAR) imaging, enabling them to acquire imagery regardless of the weather.
- The constellation will cover the entire world’s land masses on a bi-weekly basis, sea-ice zones, Europe's coastal zones and shipping routes on a daily basis and open ocean continuously by wave imagettes.
- Provides different resolutions (down to 5 m) and coverage (up to 400 km).

Sentinel-2

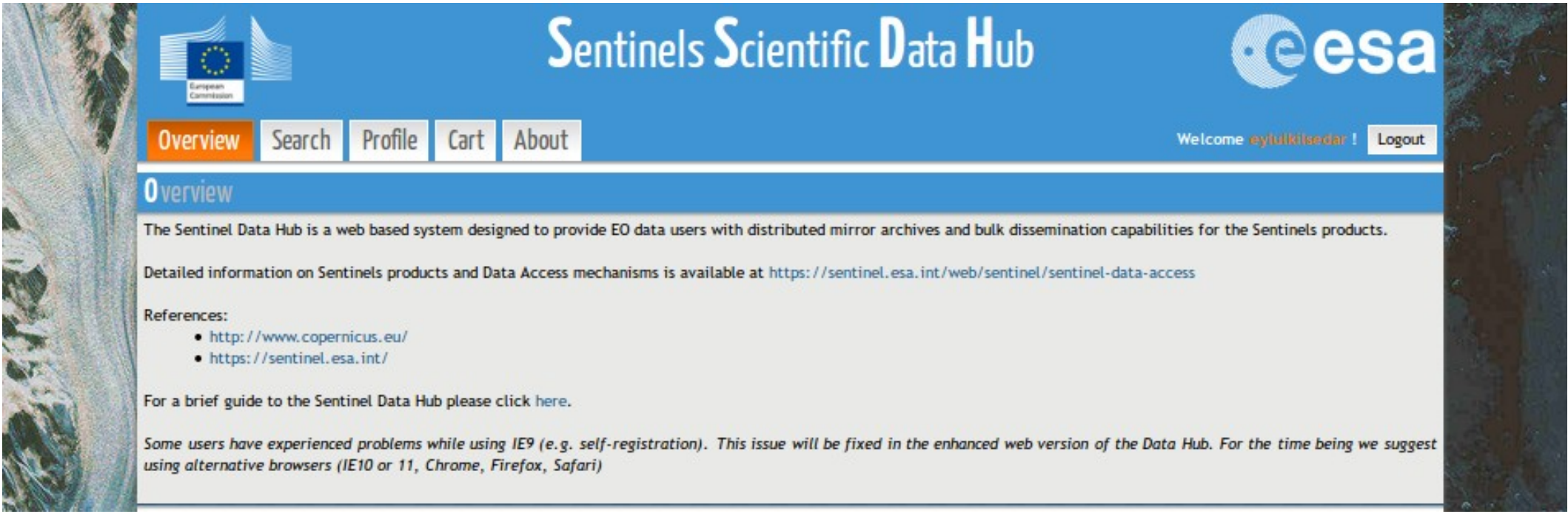
- The full SENTINEL-2 mission comprises twin polar-orbiting satellites in the same orbit, positioned at 180° to each other.
- Wide-swath, high-resolution, high revisit time, multi-spectral imaging mission
- SENTINEL-2 carries an optical instrument payload that will sample 13 spectral bands: four bands at 10 m, six bands at 20 m and three bands at 60 m spatial resolution. The orbital swath width will be 290 km.
- Contributes to ongoing multispectral observations and benefit Copernicus services and applications such as land management, agriculture and forestry, disaster control, humanitarian relief operations, risk mapping and security concerns.

Sentinel-3

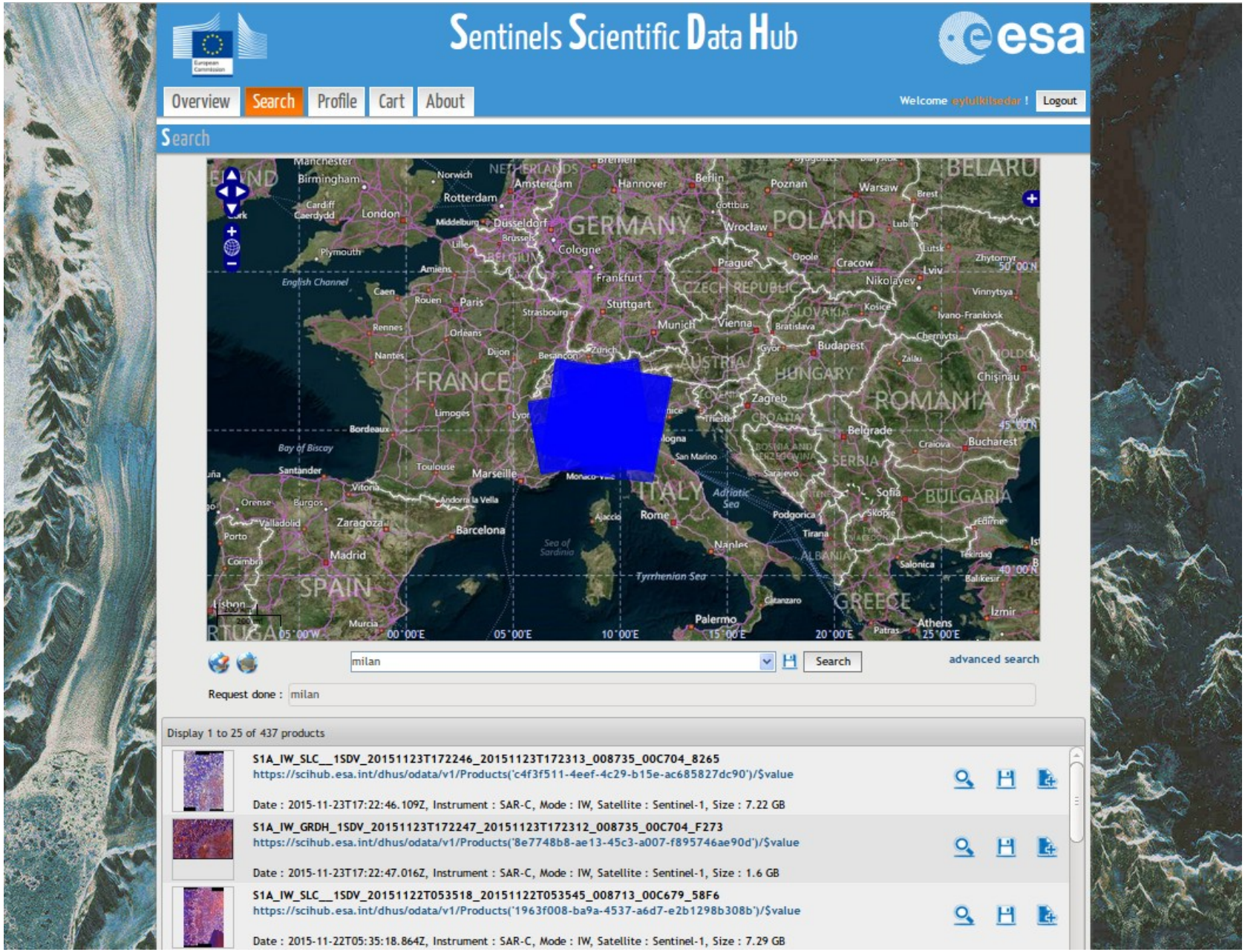
- SENTINEL-3 is a European Earth Observation satellite mission developed to support Copernicus ocean, land, atmospheric, emergency, security and cryospheric applications.
- The main objective of the SENTINEL-3 mission is to measure sea surface topography, sea and land surface temperature, and ocean and land surface colour with high accuracy and reliability to support ocean forecasting systems, environmental monitoring and climate monitoring.
- Provides medium-resolution imagery

Sentinel Data Hub

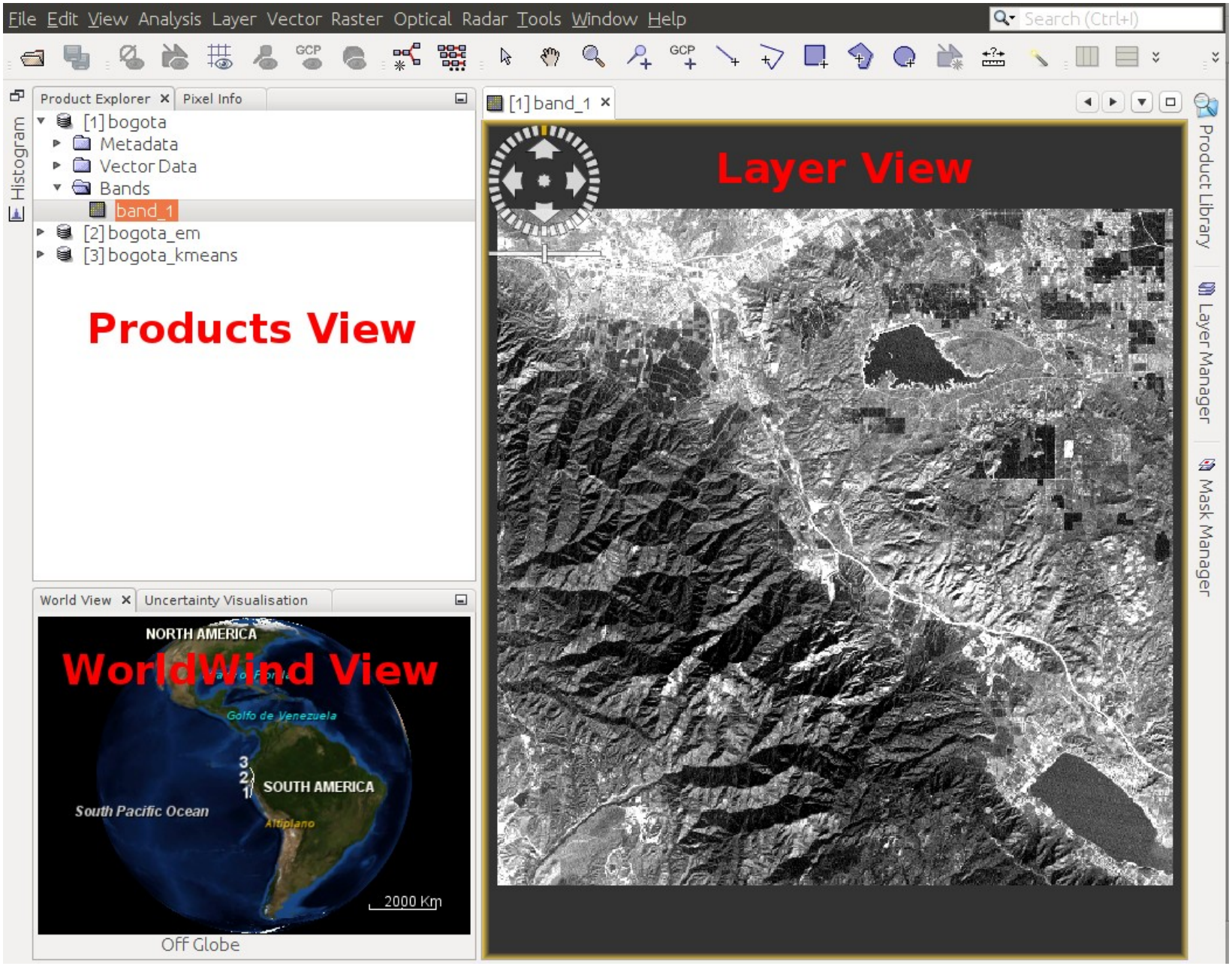
- ✔ After registration it is possible to download data (Link: https://scihub.esa.int/dhus/)



Sentinel Data Hub



SNAP Desktop



Functions–Image Analysis on TIF

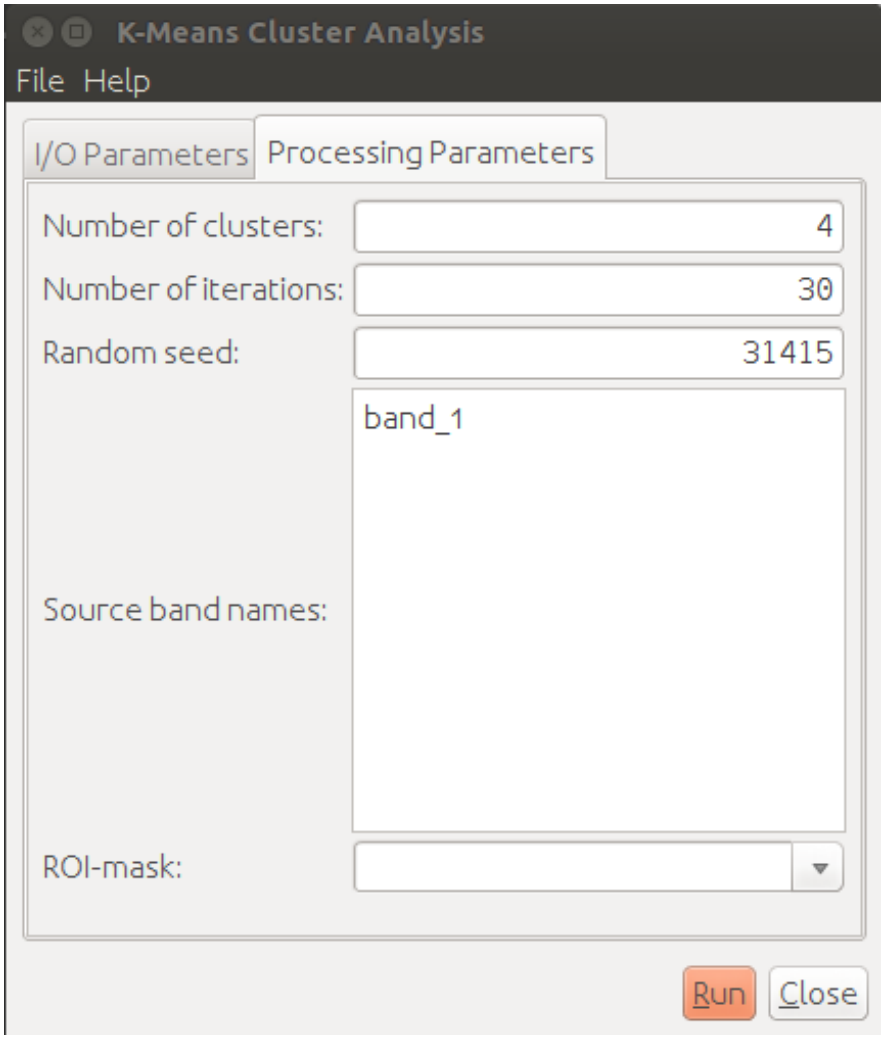
- ✔ Expectation Maximization (EM) cluster analysis
- ✔ K-means cluster analysis
- ✔ Principal component analysis

- ✔ Save as: GeoTIFF, NetCDF, BEAM-DIMAP, CSV, PNG, JPG and more

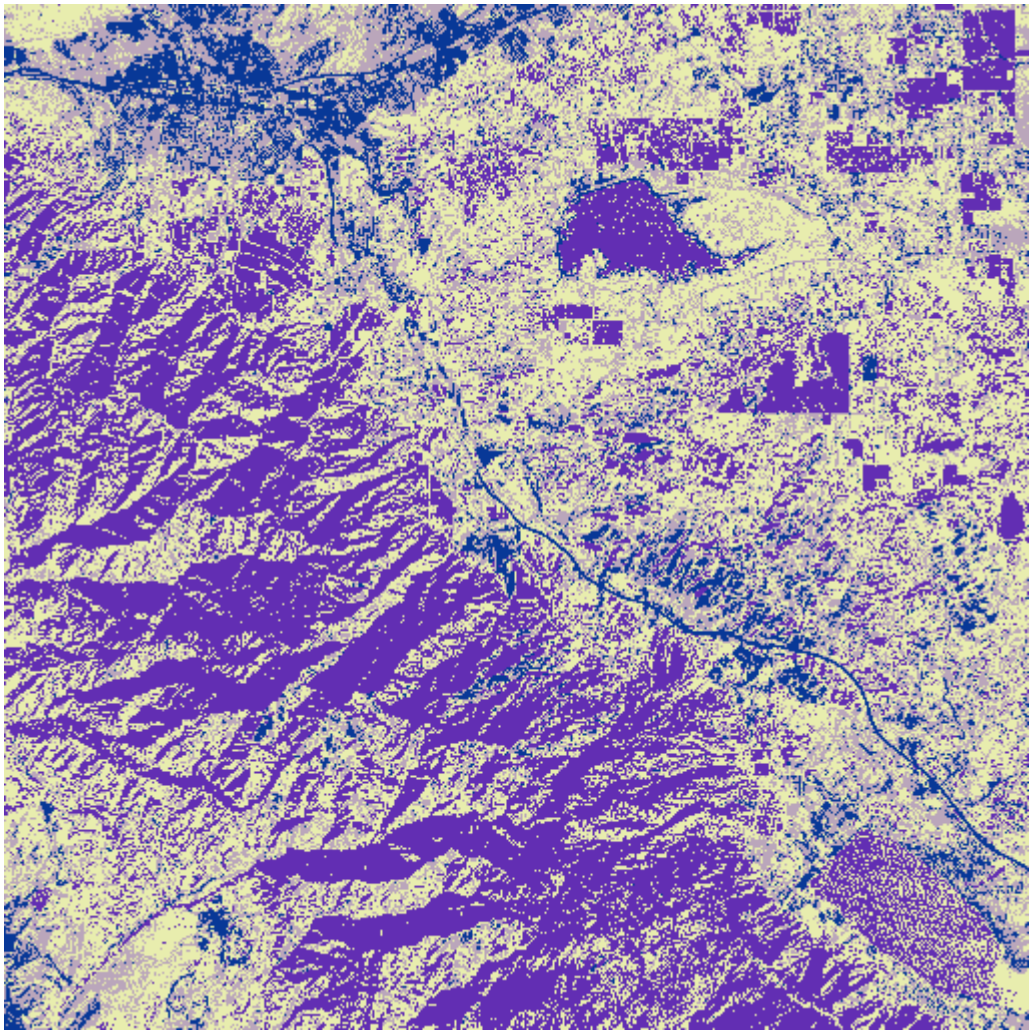
Functions–Image Analysis on TIF

✔ K-means cluster analysis

Set the processing parameters

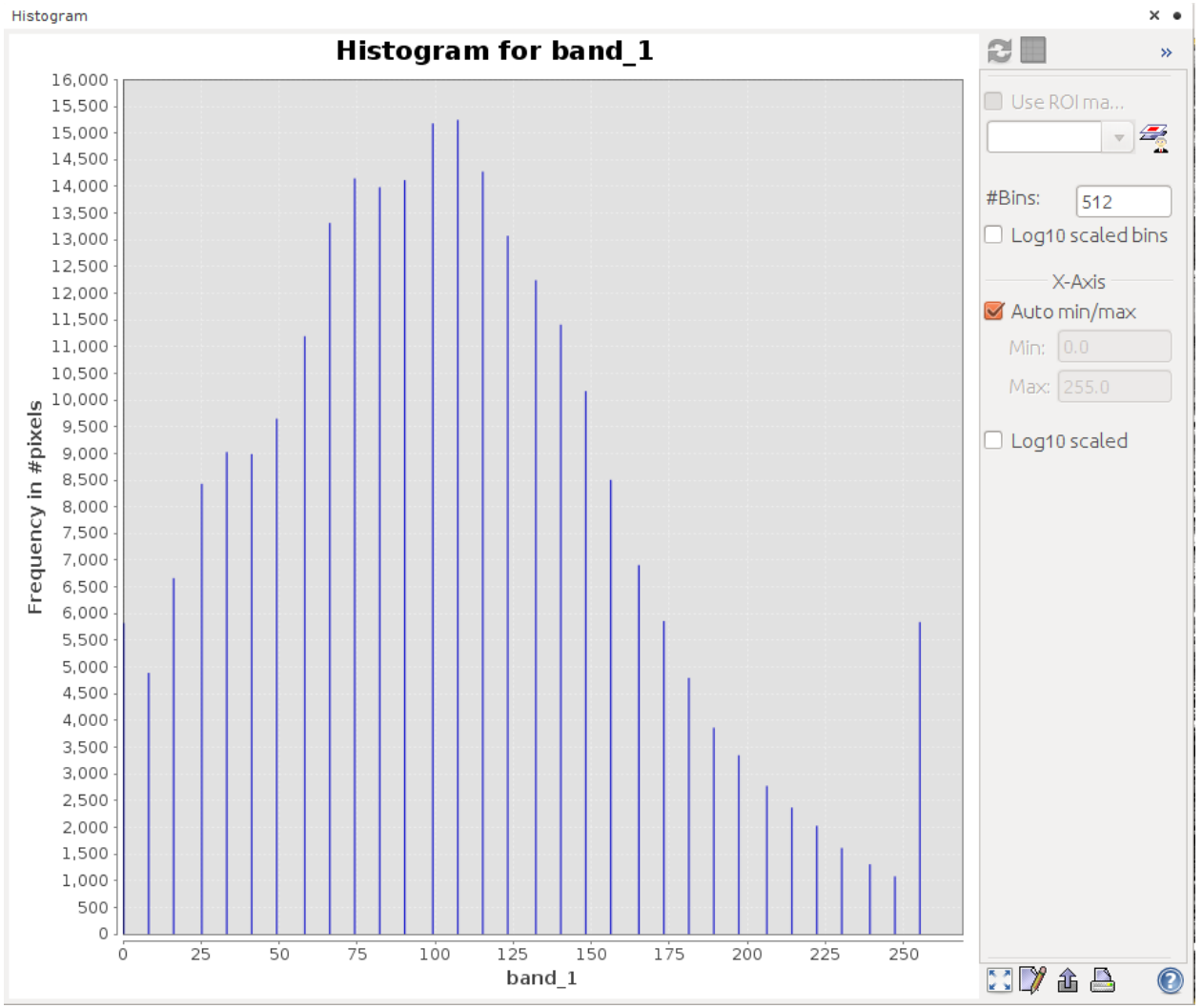


Result



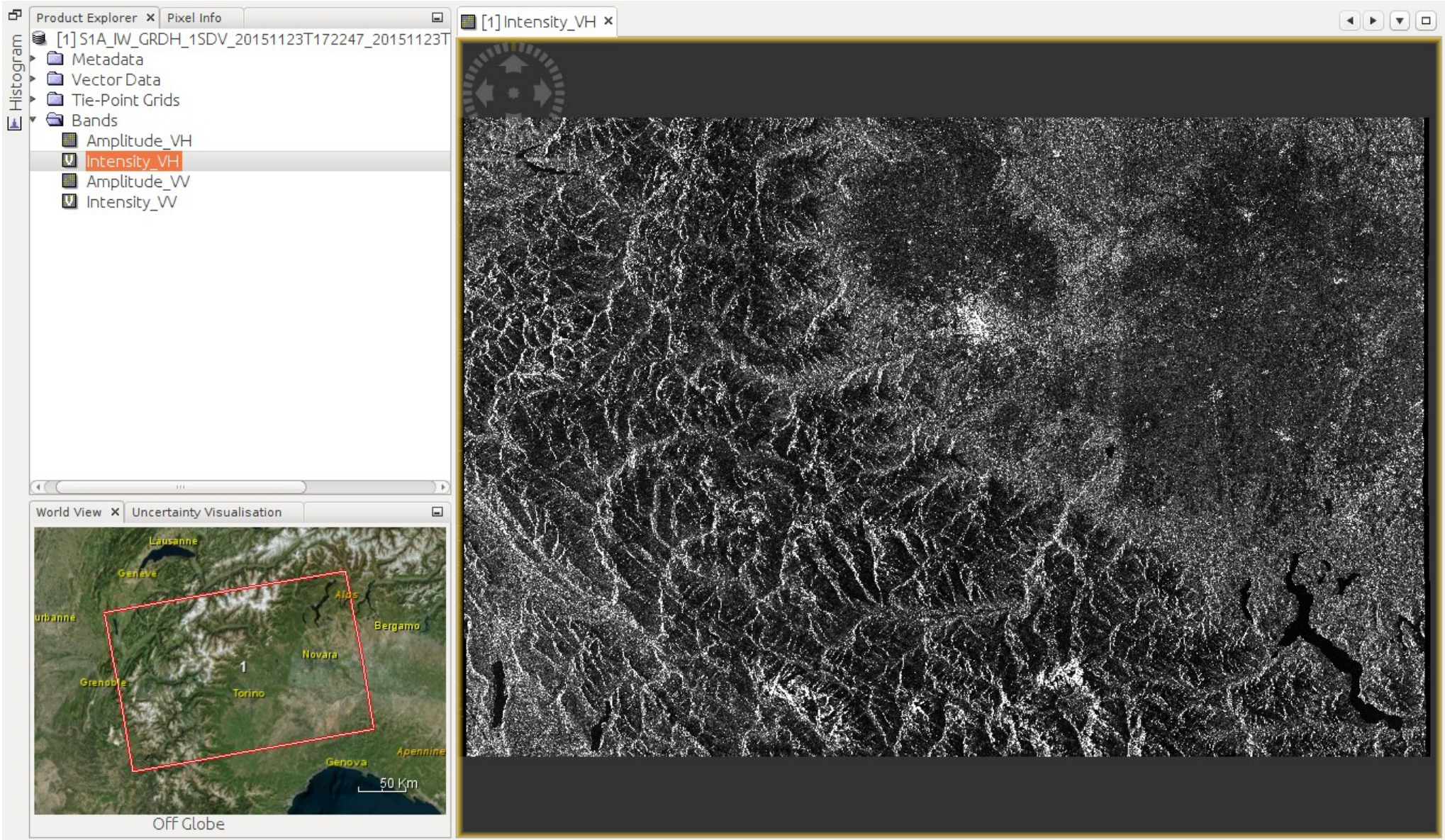
Functions–Analysis

- ✔ Correlative plot
- ✔ Scatter plot
- ✔ Profile plot
- ✔ Information
- ✔ Geo-coding
- ✔ Histogram
- ✔ Statistics



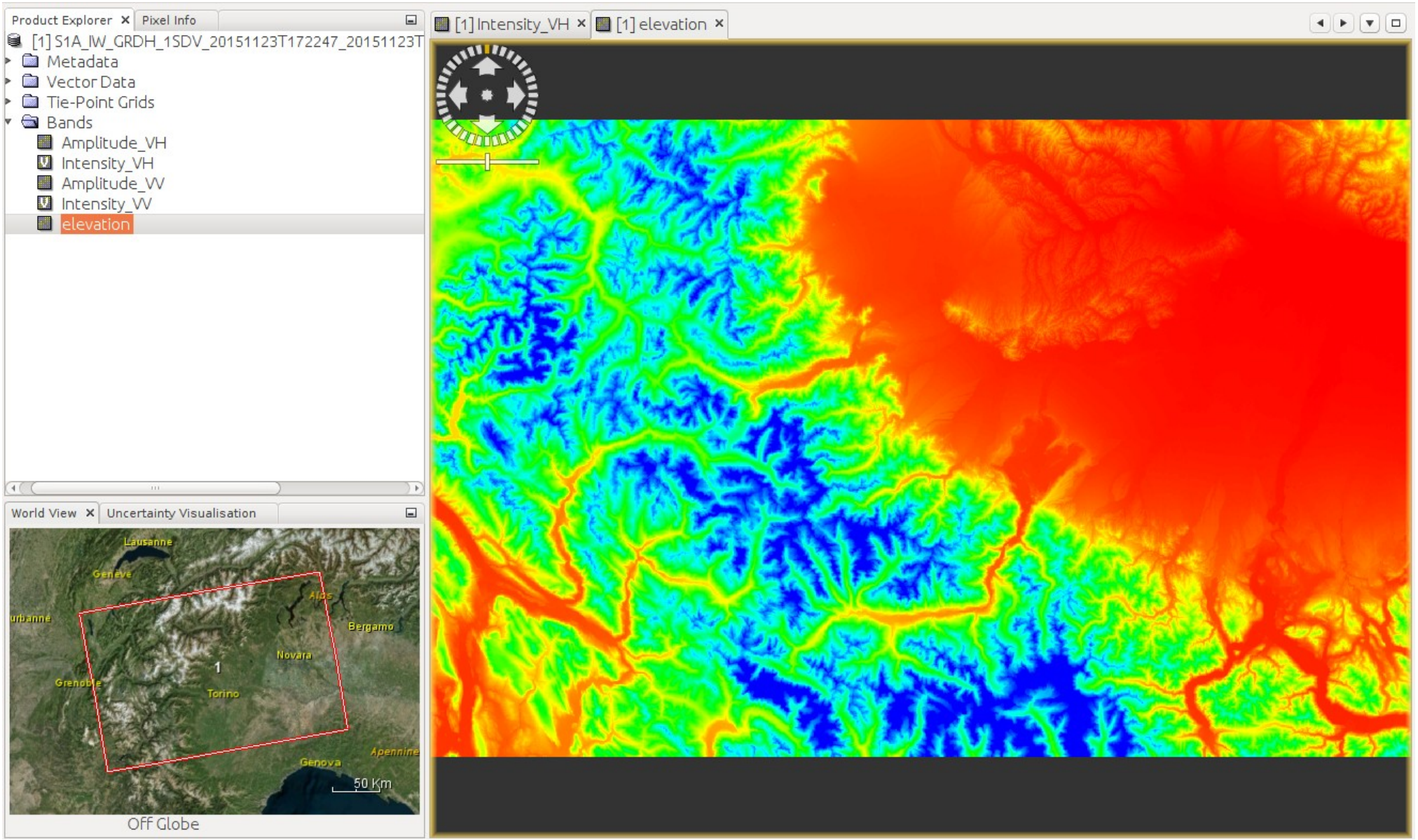
Functions–Sentinel-1 Data

- ✔ Resolution: 25715 x 16698



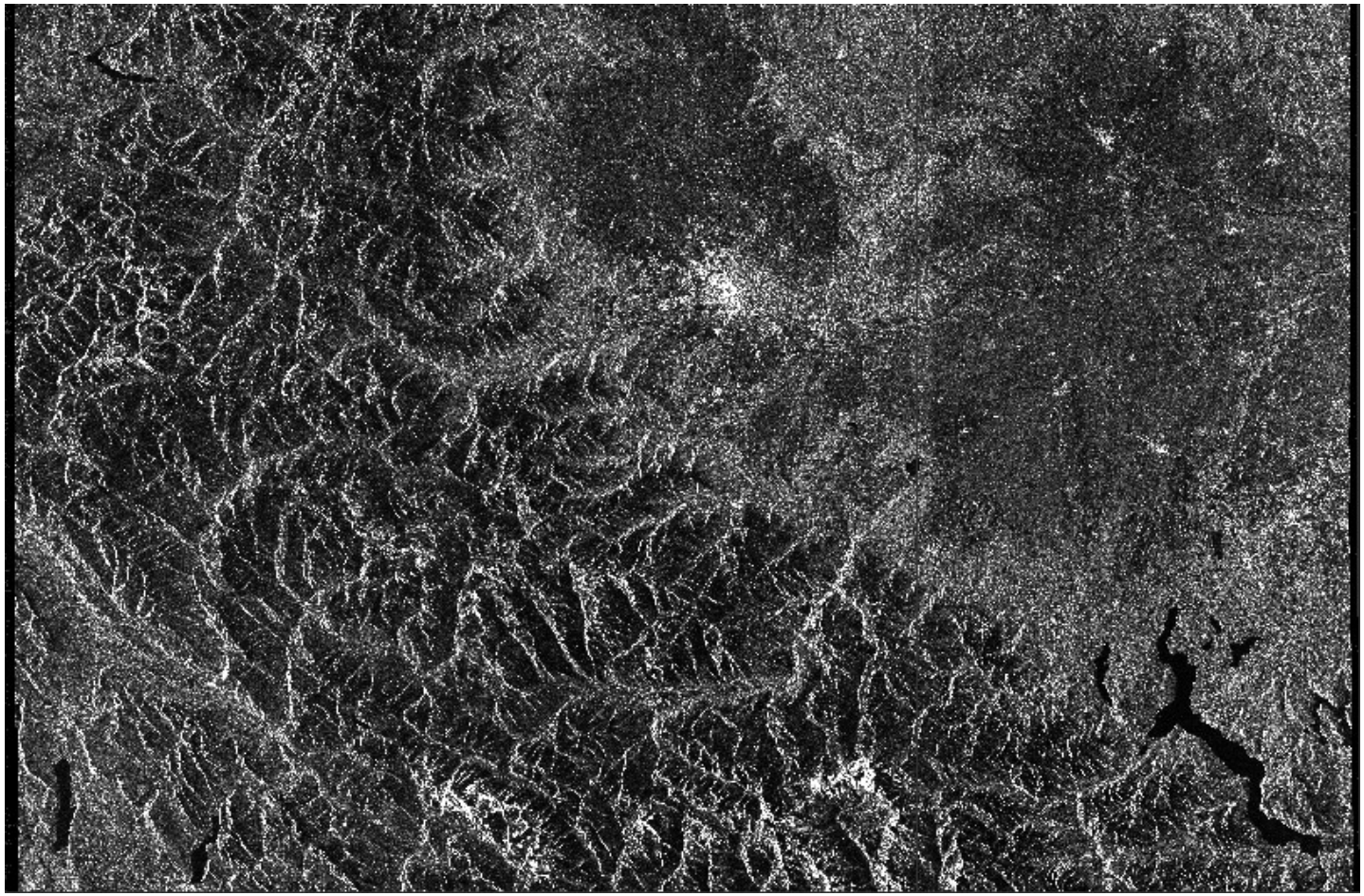
Functions–Sentinel-1 Data

- The elevation band



Functions–Sentinel-1 Data

- Radar → Radiometric → **Calibrate**
  - 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.



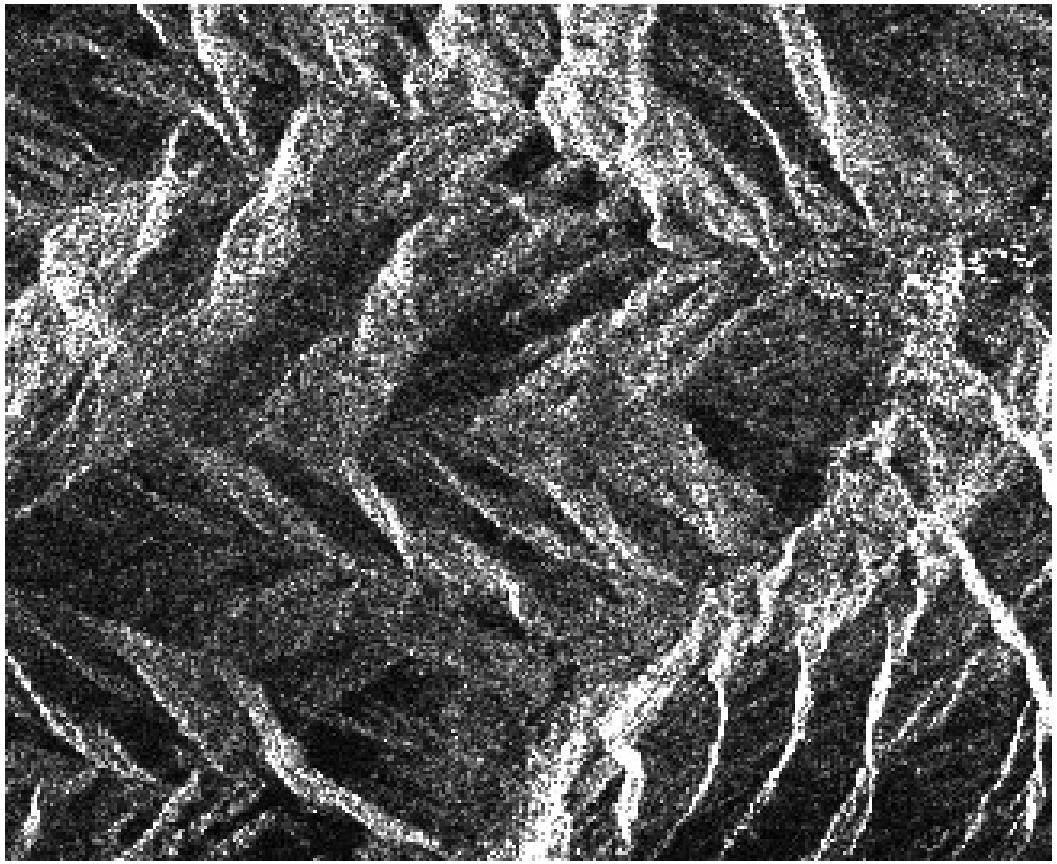
Functions–Sentinel-1 Data

- Radar → **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.

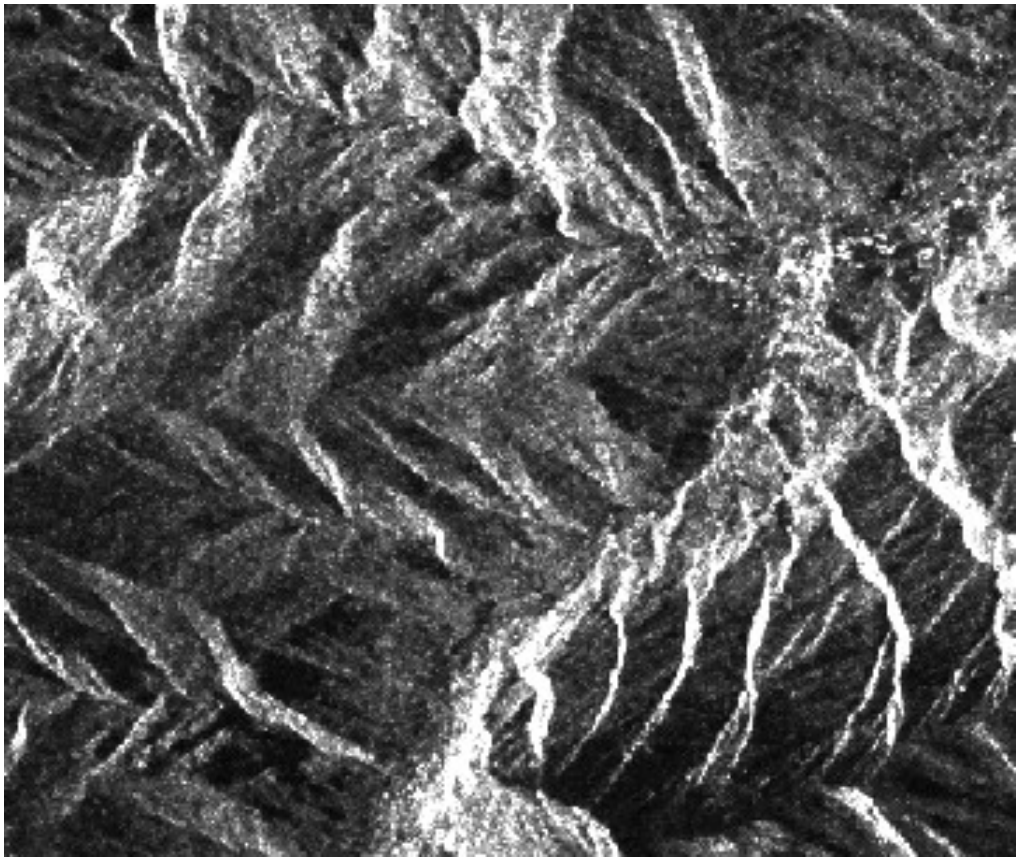
- Radar → Speckle Filtering → **Single Product Speckle Filter**
  - Speckle is caused by random constructive and destructive interference resulting in salt and pepper noise throughout the image. Speckle filters can be applied to the data to reduce the amount of speckle at the cost of blurred features or reduced resolution.

Functions–Sentinel-1 Data

Before

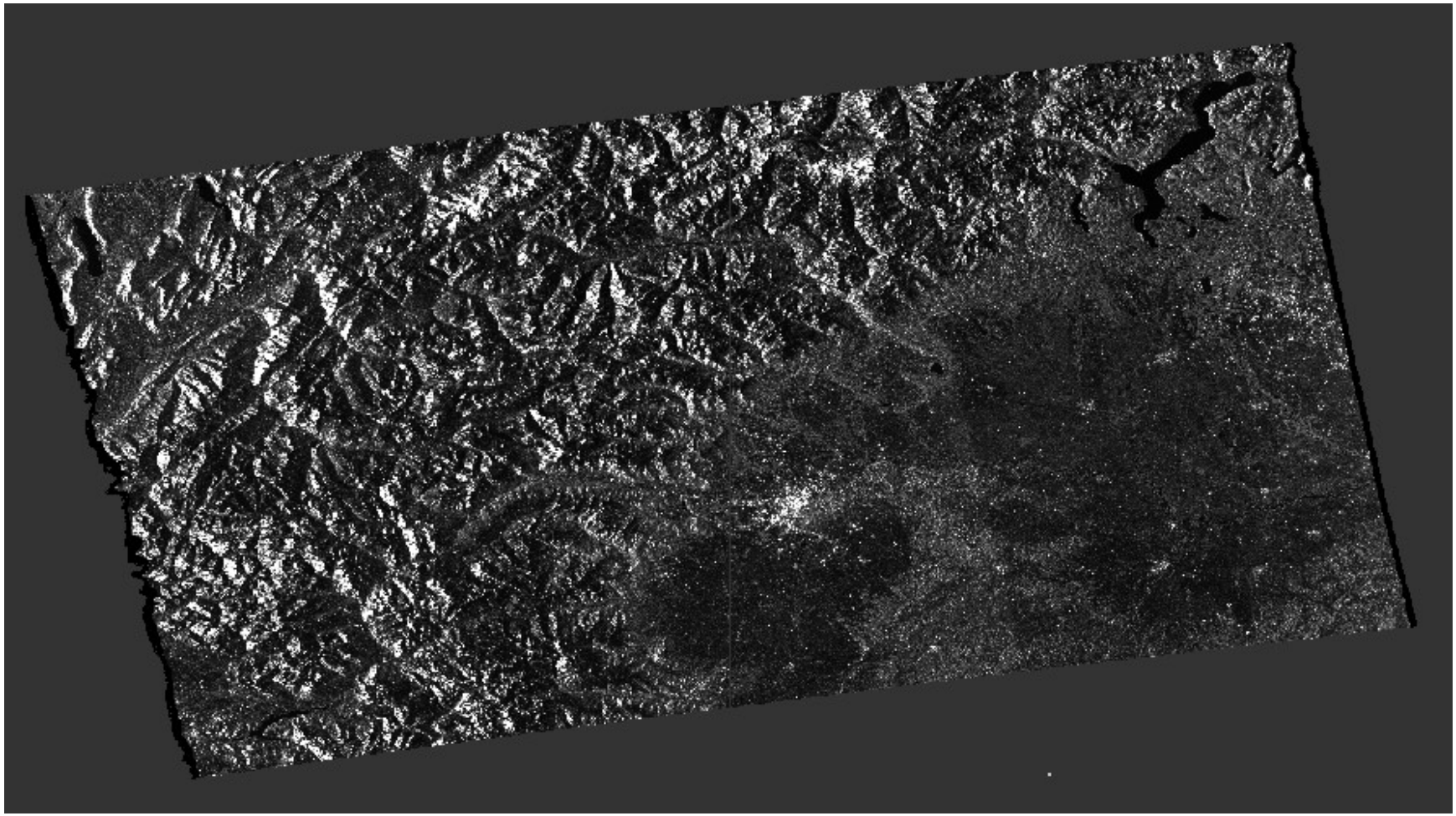


After



Functions–Sentinel-1 Data

- Radar → Geometric → Terrain Correction → **Range-Doppler 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.



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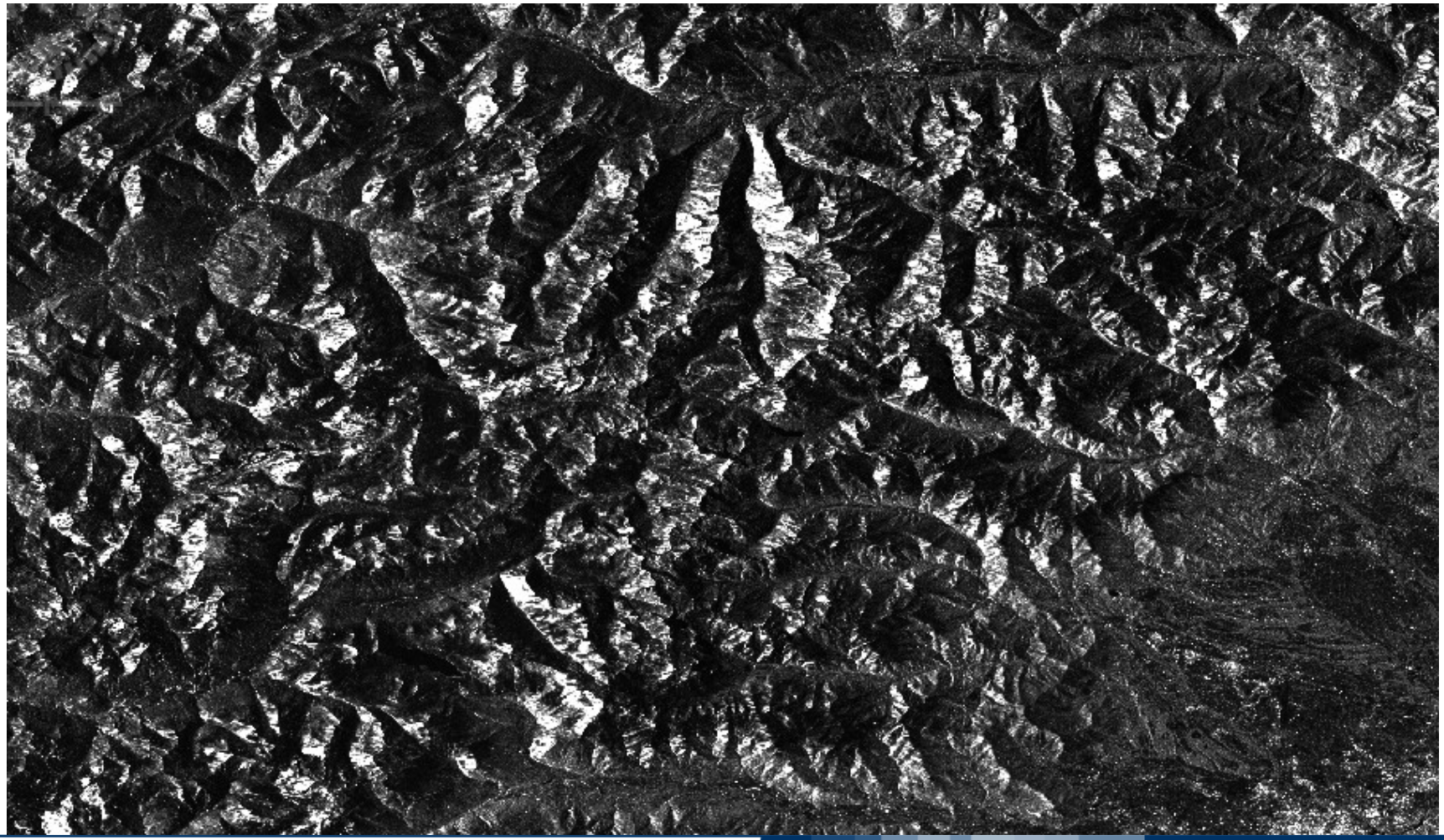

Functions–Sentinel-2 Data

- Add the xml file
- Using the 3 of 13 bands, it is possible to create RGB or HSV
- Right click on the layer and then click on “Open RGB Image Window”

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References

- SNAP official website: http://step.esa.int/main/
- Download: http://step.esa.int/main/download/
- Tutorials: http://step.esa.int/main/doc/tutorials/
- Tutorial on Sentinel-1 Toolbox: http://sentinel1.s3.amazonaws.com/docs/S1TBX%20SAR%20Basics%20Tutorial.pdf
- Useful video on Sentinel-1 Toolbox: https://www.youtube.com/watch?v=10x7UI7oD3E
- Useful video on Sentinel-2 Toolbox: https://www.youtube.com/watch?v=clbCYaH7xos
- More information on satellites: https://sentinel.esa.int/web/sentinel/missions