11th Advanced Training Course on Land RS

ESA SNAP Toolbox Introduction

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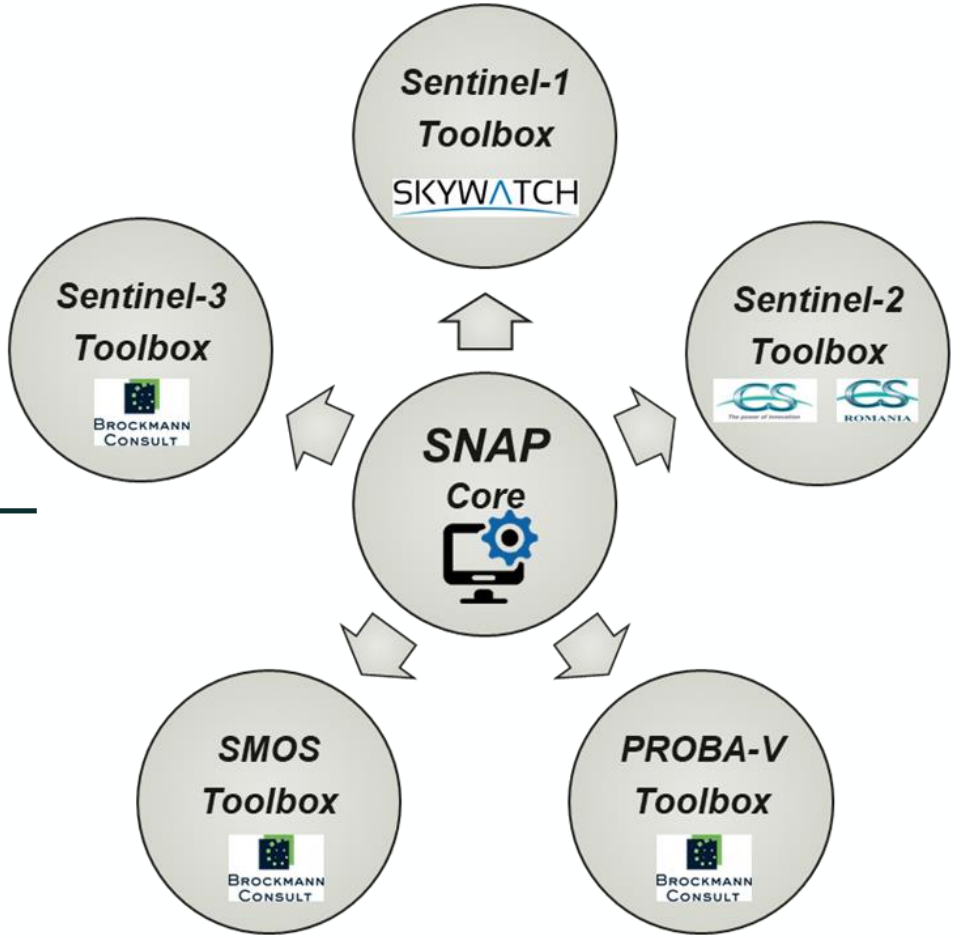
Summary

1. SNAP Overview: main characteristics, architecture & downloads
2. STEP & its main resources (including Forum)
3. SNAP Toolboxes
4. SNAP 9: New features
5. Useful links
6. How to use SNAP: Desktop, GUI, CLI, API
7. Processing platforms using SNAP
8. SNAP: What is coming (cloud-ready architecture, toolboxes)
9. Reminder of Sentinel-1, Sentinel-2 & Sentinel-3 and their User Guides
10. Exploring the SNAP GUI

1. SNAP Overview

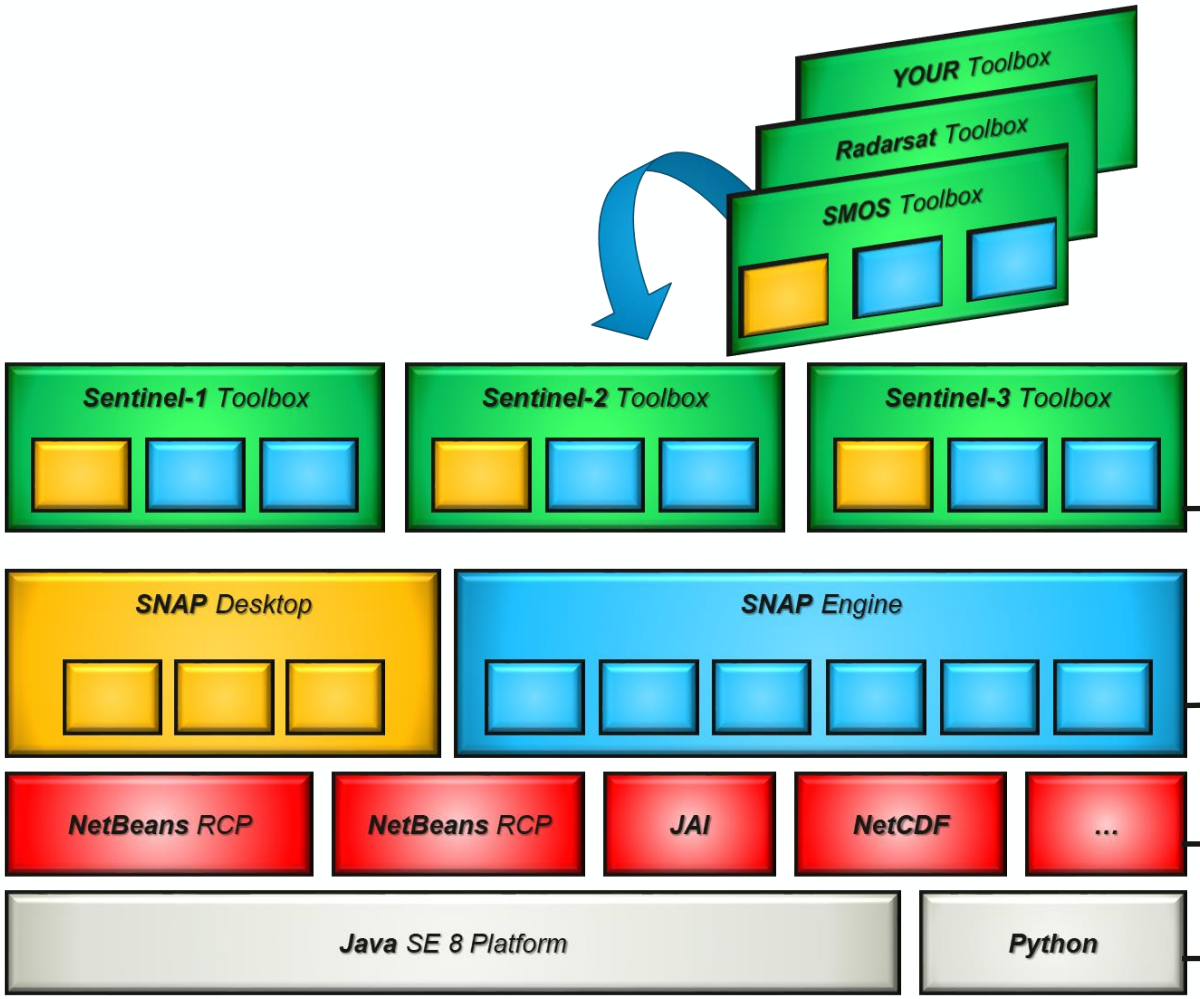
Download it at

step.esa.int



- *Free and open source software*
- *Common Java core framework*
- *Joint development of SNAP platform for Sentinel and other toolboxes*
- *Interchangeable Java/Python plugins*
- *Portable engine to Cloud infrastructure*
- *User friendly: single installation, intuitive GUI, online help, tutorials*
- *Active user forum to communicate with the developers and within the science community*

1. SNAP Overview: Architecture



*Any **combination of toolboxes add-ons** is allowed, even none, as SNAP Desktop is a already a useful stand-alone application for EO data exploitation*

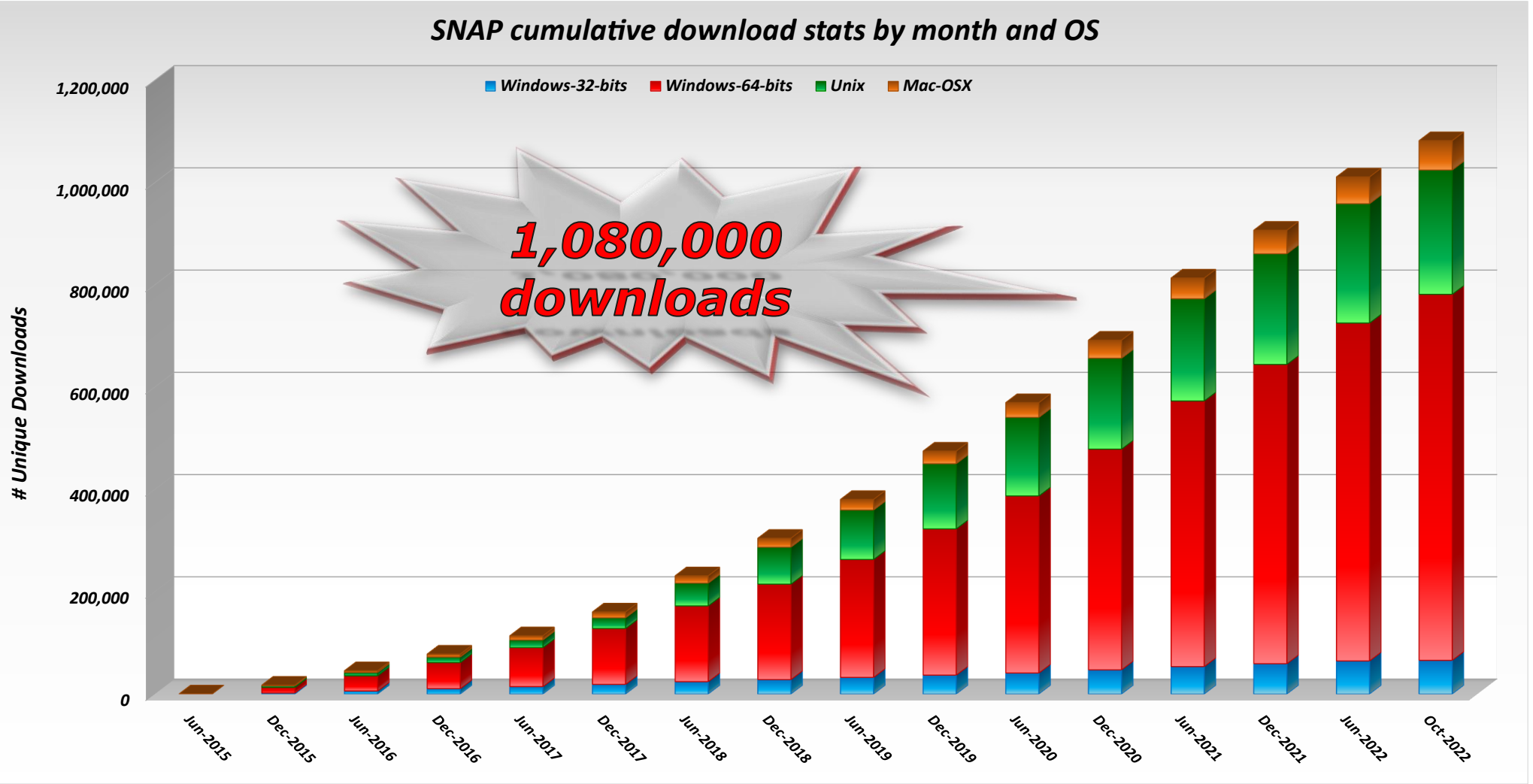
SNAP layer

3rd party library layer

Programming language layer

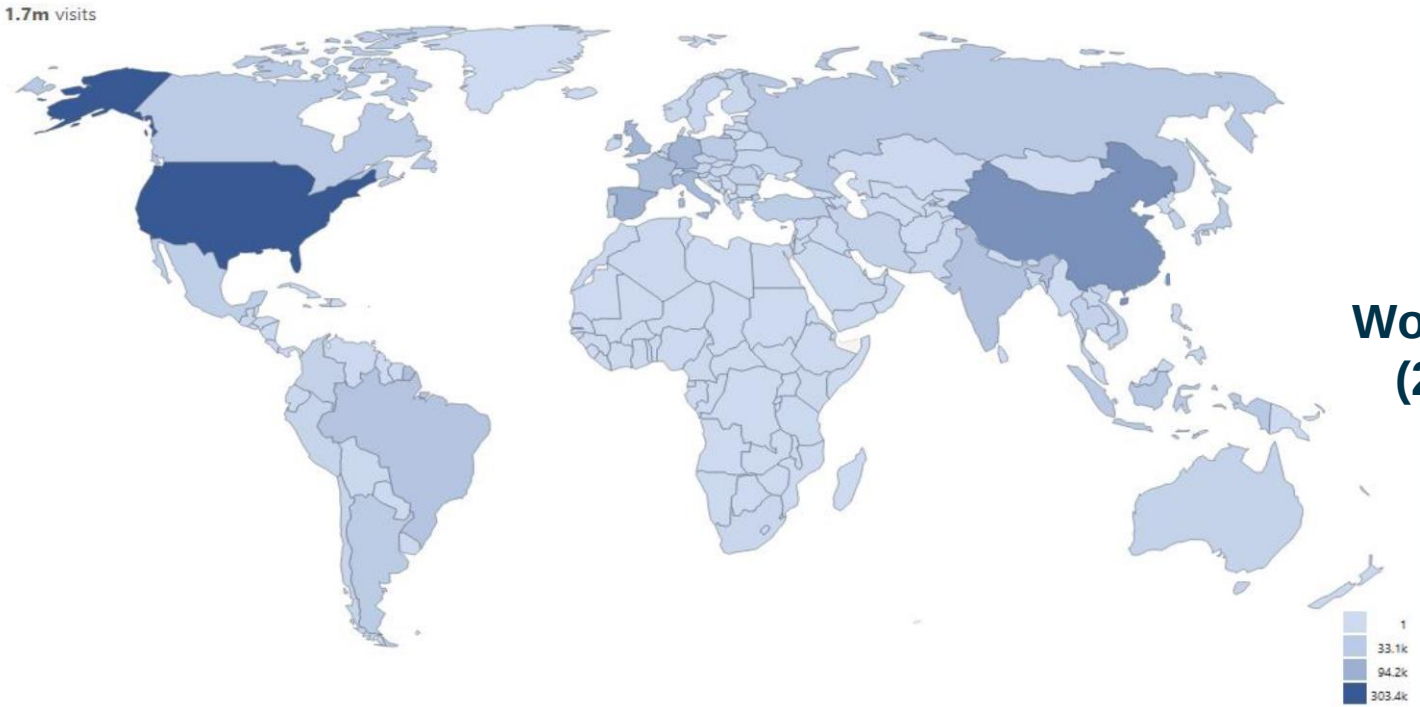
NetBeans github Java

1. SNAP Overview: Downloads



2. STEP

STEP is the ESA community platform for accessing the software and its documentation, communicating with the developers, dialoguing within the science community, promoting results and achievements as well as providing tutorials and material for training scientists using the Toolboxes.



World Map of visits on STEP (2015/06/15 – 2022/10/31)

STEP Forum

- ✓ Since June 2015 STEP website reached almost **1˙700˙000** visit sessions
- ✓ **12˙057** discussion topics have been created, with a total of **82˙376** posts since June 2015

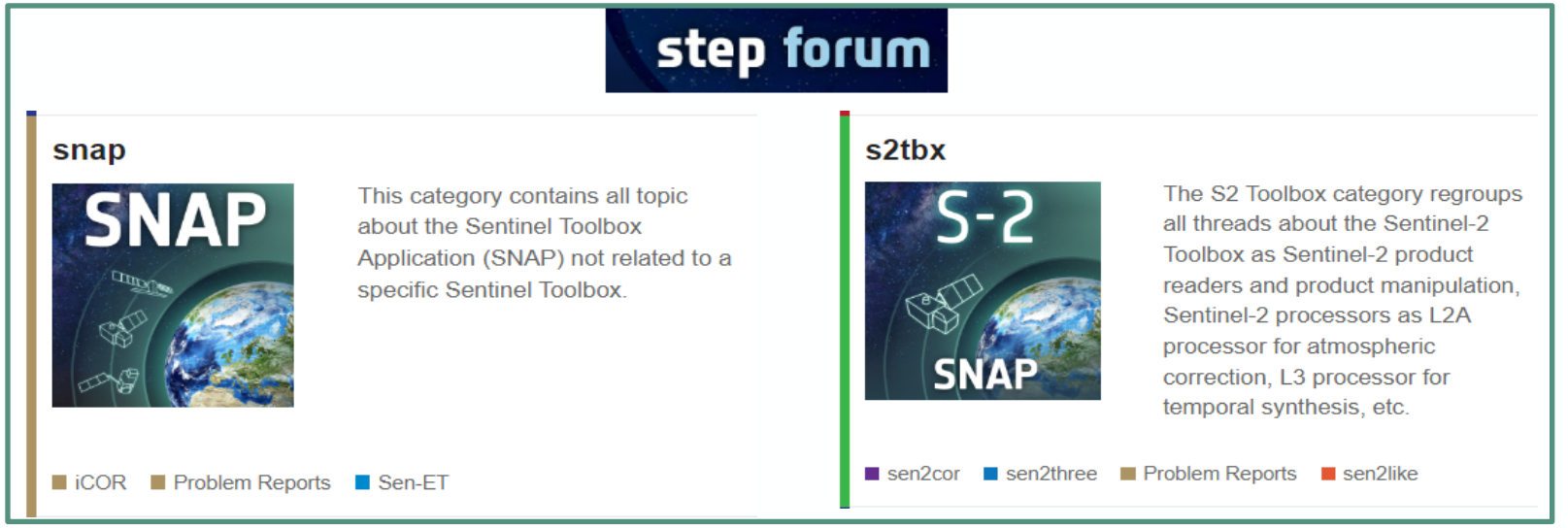
2. STEP

Accessible from http://step.esa.int/main/

Download SNAP & **Tutorials** (beginner & advanced)

Community:

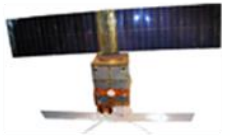
- STEP Forum https://forum.step.esa.int/
- Developers section: Forum, Wiki, API doc
- Issue Reporting



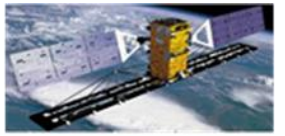
3. SNAP & SAR: Sentinel-1 Toolbox

Sentinel-1

ENVISAT

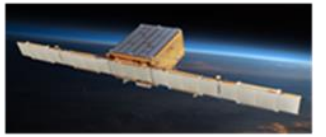

ERS-1

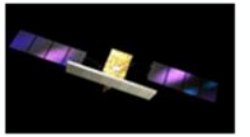
TerraSAR-X


RADARSAT

KOMPSAT-5

ALOS 1&2

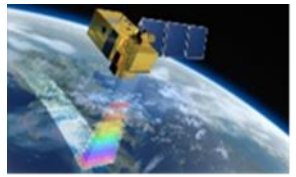

ICEYE


COSMO-SkyMed

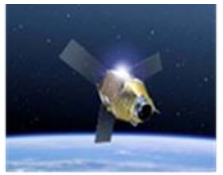
Main features

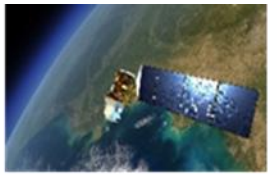
- *Absolute calibration, Multilooking, Speckle filtering, Precise orbits handling*
- *Coregistration of detected and complex products*
- *Full support of Sentinel-1 TOPS interferometry, debursting, slice assembly*
- *Terrain Correction*
- *SAR simulation and Layover and shadow masks*
- *Applications: oil spill detection, ship detection, wind field estimation etc.*
- *Fully integrated and featured InSAR tools for Stripmap and Zero-Doppler focused data*
- *Compatibility with PolSARpro Toolbox (Reader, Writer)*
- *Integrated Export to SNAPHU (interferometric phase unwrapping) and STAMPS (PS InSAR)*

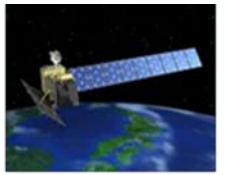
3. SNAP & Optical HR: Sentinel-2 Toolbox


Sentinel-2

SPOT


Pleiades


Landsat


ALOS AVNIR

RapidEye

Kompsat

Ikonos

Worldview

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Main features

Sen2Cor and i-Cor for Atmospheric Correction

L2B biophysical processor (LAI, fAPAR, …)

Radiance to Reflectance Processor

Radiometric Indices

Vegetation indices: DVI, RVI, PVI, IPVI, WDVI, TNDVI, GNDVI, GEMI, ARVI, NDI45, MTCI, MCARI, REIP, S2REP, IRECI, PSSRa

Soil indices: SAVI, TSAVI, MSAVI, MSAVI2, BI, BI2, RI, CI

Water indices: NDWI, NDWI2, MNDWI, NDPI, NDTI

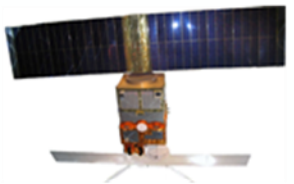
IdePix Processor: pixel classification

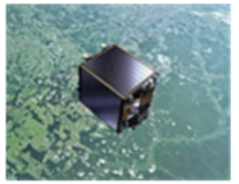
OTB tools: Pansharpening, Rasterization, Segmentation, …

3. SNAP & Optical / Thermal MR: Sentinel-3 Toolbox

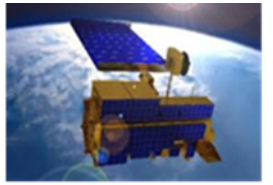
Sentinel-3

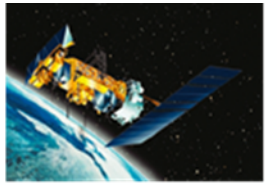
ENVISAT


ERS


Proba-V

SPOT VGT


MODIS


AVHRR

VIIRS

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Main features

- Visualizing spectrum of pixels
- *Uncertainty visualization and propagation of uncertainty in BandMaths*
- *Pixel extraction tool*
- *Specific sensor processors:*
  - *S3 OLCI Radiometry, S3 SLSTR PDU stitching*
  - *AATSR/SLSTR Regridding*
  - *Performs radiometric corrections on MERIS*
- Optical water type classification based on atmospherically corrected reflectances
- FU (Forel-Ule) Classification used to derive the hue angle and FU value
- *IdePix Processor: pixel classification*
- FLH (Fluorescence Line Height) / MCI (Maximum Chlorophyll Index) retrieval
- Case-2 C2RCC water processor
- MERIS FUB-CSIRO Coastal Water Processor

4. SNAP 9: New Features

SNAP features	*Introducing new ZNAP data format* *Smaller footprint on disk, faster writing, and it uses a single file or directory; It is Zarr based and can easily be read with Python/Xarray*
	Support for the high-resolution Copernicus DEM
	Improved Colour Manipulation Tool, e.g., auto-applied colour schemes based on band-name
S1TBX features	*S1 ARD functionality enhanced with the addition of a Noise Power Image and Gamma-to-Sigma ratio image*
	Support for SAR missions Cosmo-Skymed SG, Gaofen-3 and Spacety
S2TBX features	*Added new plugins adapter for MAJA and Sen2Cor tools*
	Support for Landsat processed by ESA and Landsat L2
	Added windowed reading of products in Graph Builder
S3TBX features	*New pre-processing operators for Sentinel-3 data. The OLCI Anomaly Detection operator, and operator for harmonising OLCI A and B data*
	OLCI L2 Land and Water products contain masks recommended by the QWG

5. Useful links

- **SNAP download**

  http://step.esa.int/main/download/snap-download/

- **STEP website**

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

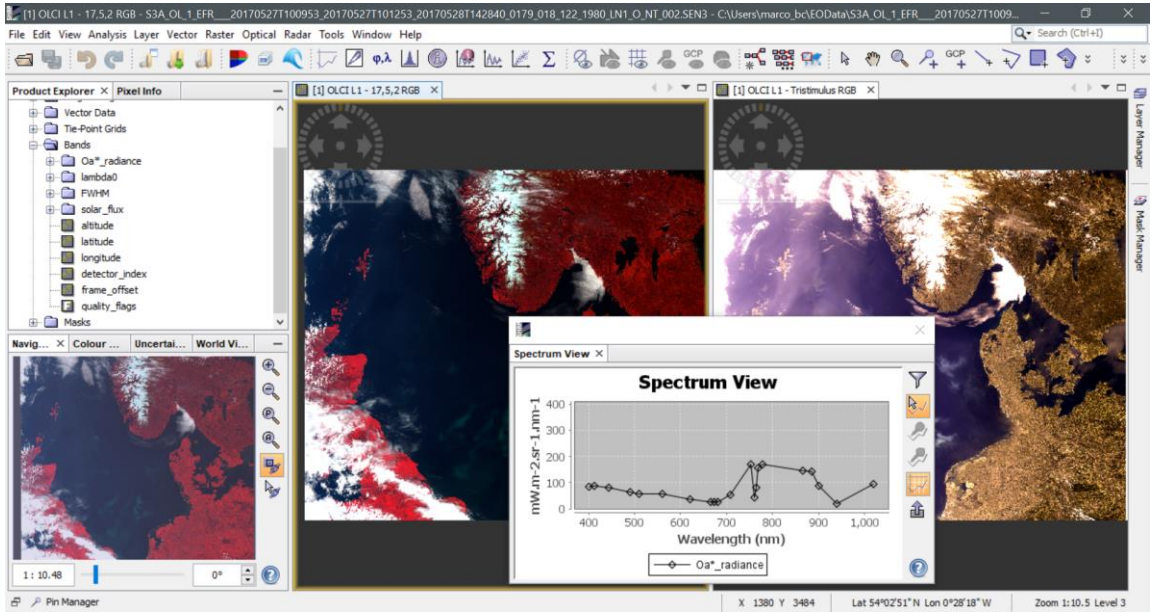
- **SNAP user forum**

  https://forum.step.esa.int/

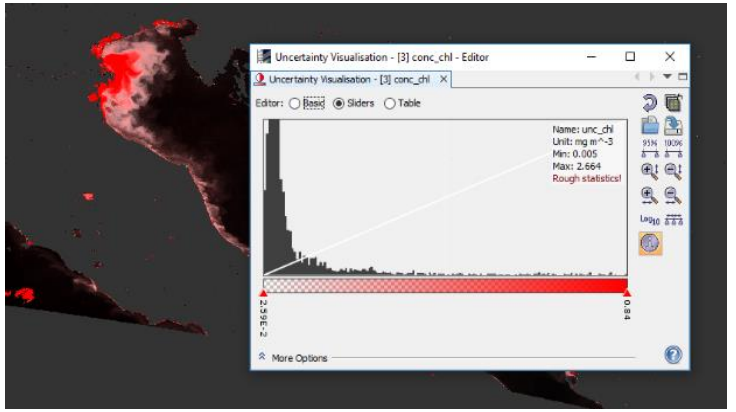
- **Copernicus Open Access Hub (download Sentinel data)**

  https://scihub.copernicus.eu/

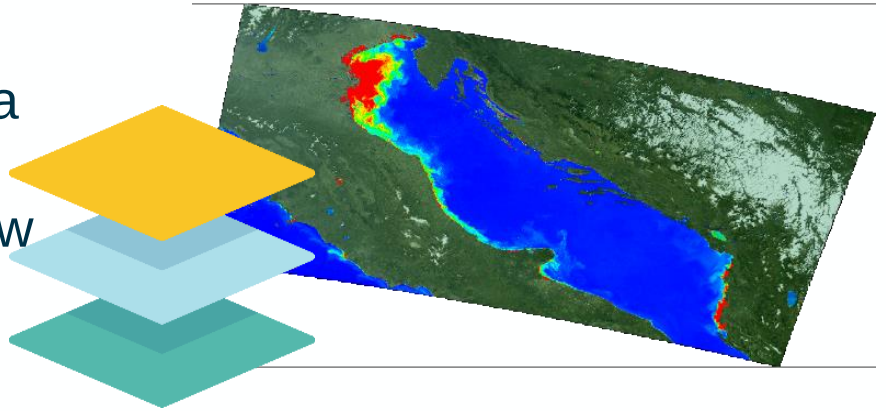
6. How to use SNAP: On Desktop



Display uncertainty information



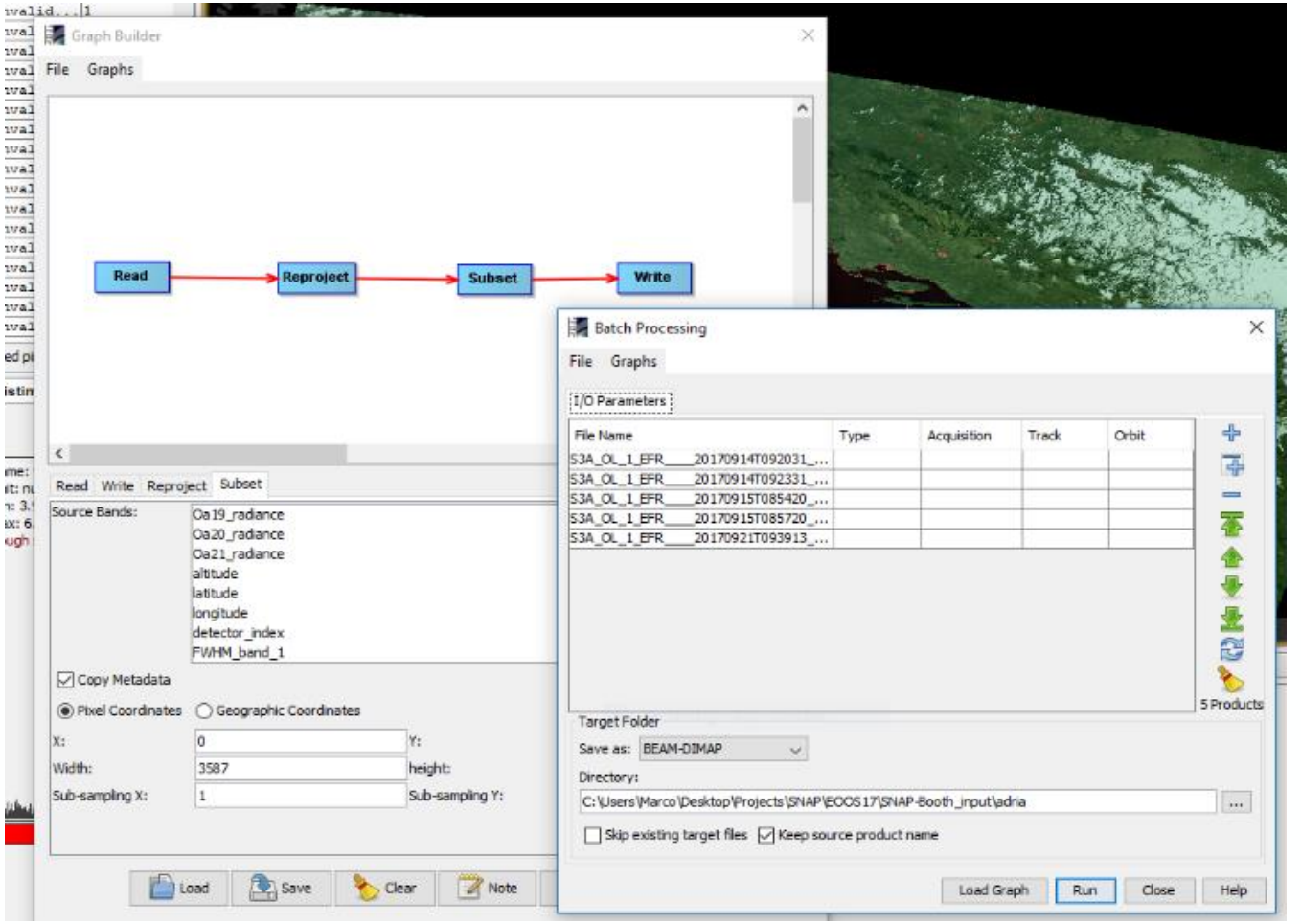
Layer data sources in one view



Fast visualisation by tiled image pyramids

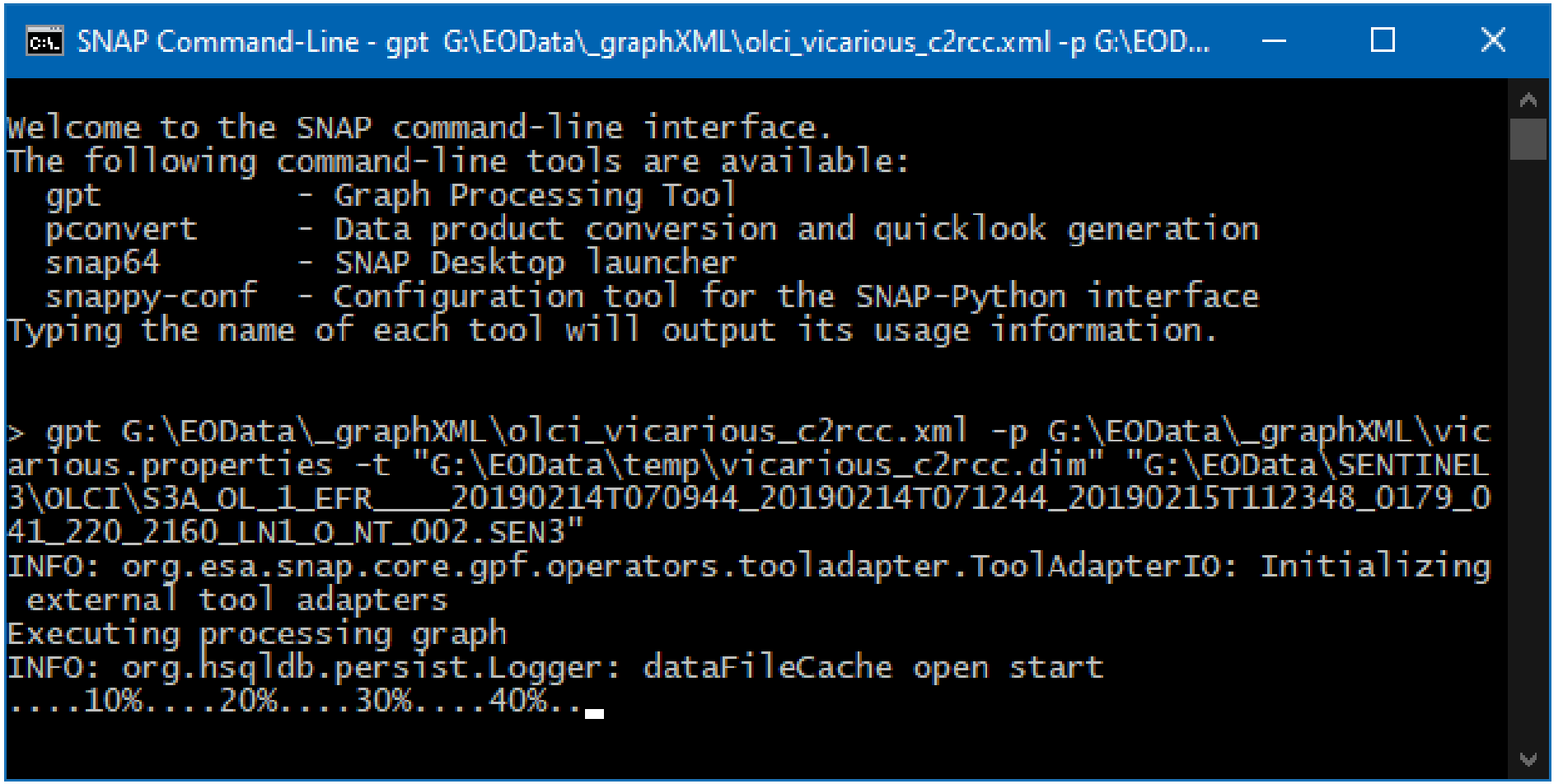
6. How to use SNAP: GUI processing

Batch processing within the GUI



6. How to use SNAP: CLI processing

Powerful data processing via the Command Line Interface



6. How to use SNAP: API usage for processing

Create your own plugin:
Use Java or Python to implement your own processing steps or
to script the processing of your data

```
source = ProductIO.readProduct('G:/EoData/S3/S3A_OL_1_EFR____20200216T101647_..._2160_LN1_O_NT_002.SEN3')

parameters = HashMap()
parameters.put('salinity', 32)
parameters.put('temperature', 10.3)
parameters.put('outputAsRrs', True)
result1 = GPF.createProduct('c2rcc.olci', parameters, source)
parameters = HashMap()
parameters.put('crs', 'EPSG:4326')
result2 = GPF.createProduct('reproject', parameters, result1)

ProductIO.writeProduct(result2, 'G:/EoData/temp/S3A_OL_1_EFR____20200216T101647_C2RCC_WGS84.dim')
```

7. Processing Platforms using SNAP

European Space Agency & national Space Agencies

- Thematic Exploitation Platforms (TEPs),
- Mission Exploitation Platforms (e.g. Proba-V MEP)

European Commission

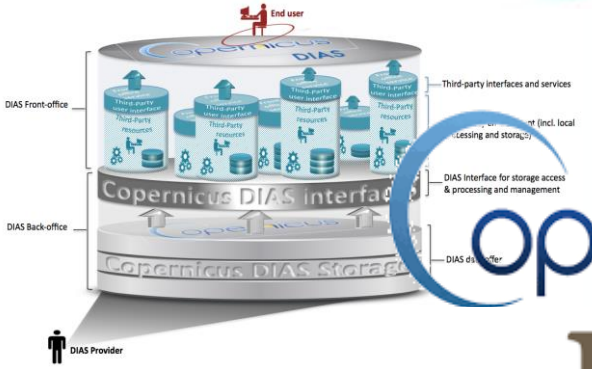
- Copernicus Data and Information Access Services (DIAS)

Copernicus Collaborative Ground Segments

- CODE-DE,
- CEMS

tep thematic exploitation platform

proba-v mep



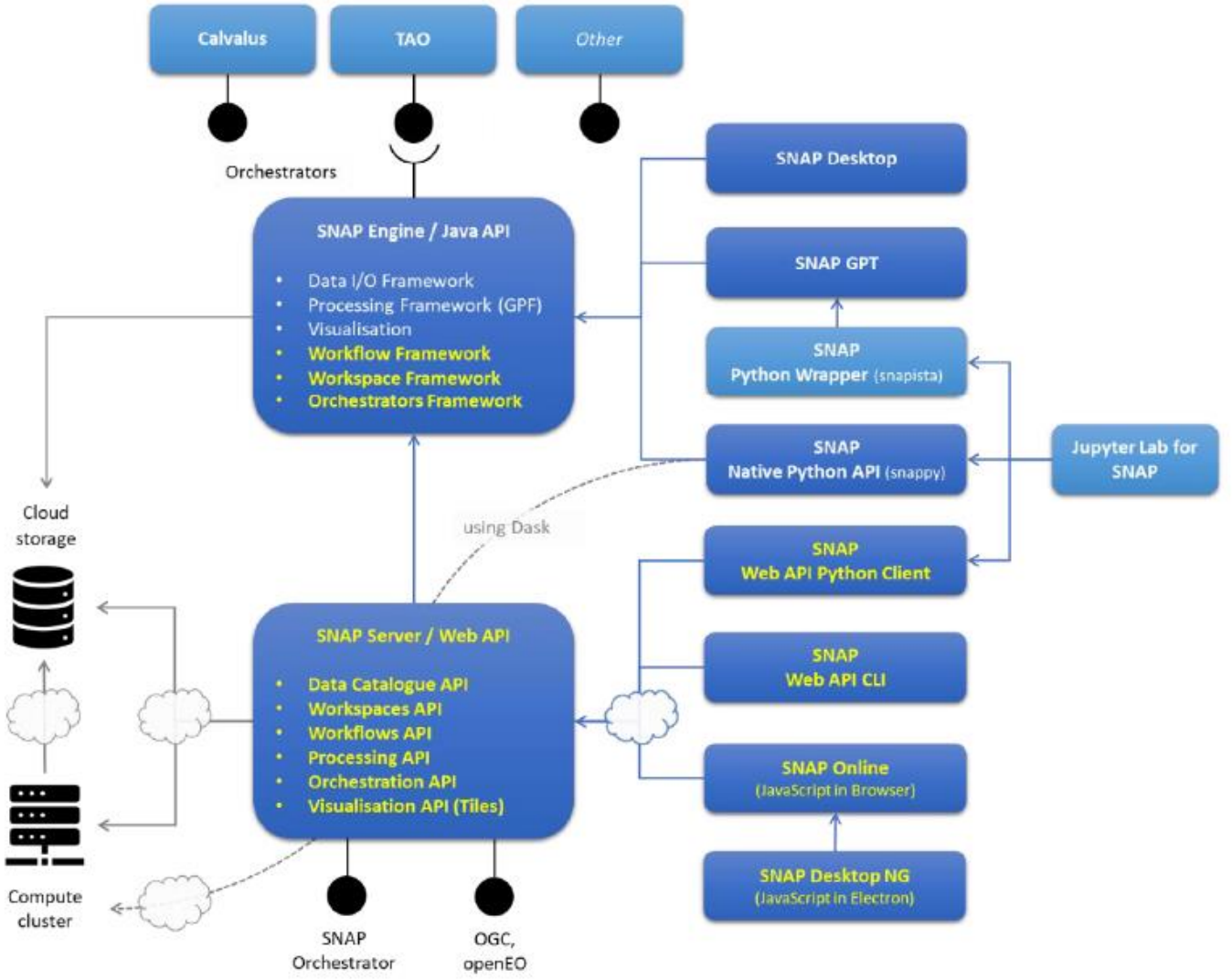
opernicus

eodc

CODE-DE

CEMS An ISIC Facility

8. SNAP: What is coming - cloud-ready architecture



8. SNAP: What is coming - Toolboxes

→ Currently SNAP has the following configuration:

- Sentinel-1 Toolbox (S1TBX)
- Sentinel-2 Toolbox (S2TBX)
- Sentinel-3 Toolbox (S3TBX)

In addition:

- CHRIS-Box
- PROBA-V Toolbox
- Radarsat Polarimetric Toolkit
- SMOS-Box
- Plugins (e.g Sen2Cor, IdePix, Sen2Coral,…)

8. SNAP: What is coming - Toolboxes

→ Future evolution of SNAP:

- Updated SNAP **documentation, help & tutorials**
- **New functionalities** (new classification algorithms, fusion operators, recommended graphs, change detection tools, improvements in image segmentation, etc)
- **Architectural improvements** (reorganisation of the toolboxes & restructuring of modules):
  - **SNAP General**
  - **Microwave Toolbox** (former S1 tbx & Radarsat)
  - **Optical Toolbox** (former S2 tbx,S3 tbx & Proba-V tbx) (inc. hyperspectral missions)

- Enhanced **user support** & **community** management

- Enhancement of **usability of snappy**, with snappy as official **Python API** + official **python wrapper** (based on snapista)

8. SNAP: What is coming – SNAP General Toolbox

Some example:

- → Transition to a new internal format (ZARR)
- → Product Groups functionality (to enable staking images which reside in many physical files)
- → Support for spatially tiny subsets (to facilitate automatic extraction of subsets by using coordinate information)
- → Support for NetCDF domain product
- → Generation and exploitation of uncertainty (by improving the functionality of existing tools e.g. Band Math to include uncertainty fields
- → New classification algorithms (including Support-Vector Machine and rule-based classifier)
- → Fusion operators & recommended graphs (for combining S1-S2, S2-S3, optical-optical, as well as multispectral-hyperspectral-SAR)
- → Automatic relative geolocation adjustment
- → Change detection tool (e.g. for multi-band optical & SAR data)
- → New change detection algorithms
- → Improvement of analysis tools & in image segmentation
- → Enhancement of the time series tool

8. SNAP: What is coming – Optical Toolbox

Some example:

- → Support for new optical missions & product formats (PRISMA, EnMAP, FLEX, Landsat Collection 1 and 2, Level 1 and 2)
- → Generic cloud detection operators (over land, coast and ocean)
- → Optical and hyperspectral combination operators
- → Performance improvements for Sentinel-2 processing
- → Visualisation enhancements for Sentinel-3 & Prova-V products
- → Common optical tools (provision of tools easily usable on similar sensors)
- → Solutions for pre-processing each S3 sensor and “S3 like” sensors (Proba-V etc) for clouds, cloud shadow and atmospheric correction, beyond the methods provided with the products
- → Processor for S3 L1B SLSTR-OLCI Synergy, to generate user-friendly L1C Synergy products
- → S3 specific pre-defined visualization settings, to improve the user experience when opening S3 products

8. SNAP: What is coming – Microwave Toolbox

Some example:

- → Support for new SAR missions and product formats (BIOMASS Level-1, Level-2 & Level-3, NISAR Level-1, Cosmo-Skymed NG Level-1, ALOS Level-1.5)
- → Support for S1 Extended Timing Annotation Dataset (ETAD) (auxiliary product providing correction dataset to S1 SLC products, to improve geodetic accuracy)
- → Viewer for S1 ETAD products
- → S1 ETAD corrected SLC, to enable resampling of the SLC burst to apply ETAD corrections
- → S1 ETAD improved coregistration
- → S1 ETAD phase screens
- → S1 ETAD improved interferograms
- → S1 ETAD improved InSAR image selection tool
- → S1 ETAD improved geometric and radiometric terrain correction
- → Viewing S1 VW Level-1 products
- → Further processing of S1 VW Level-1 products
- → Model-based decomposition of S1 dual-pol SLC products

9. Copernicus Sentinel-1 reminder

Sentinel-1 User Guide: https://sentinel.esa.int/web/sentinel/user-guides/sentinel-1-sar

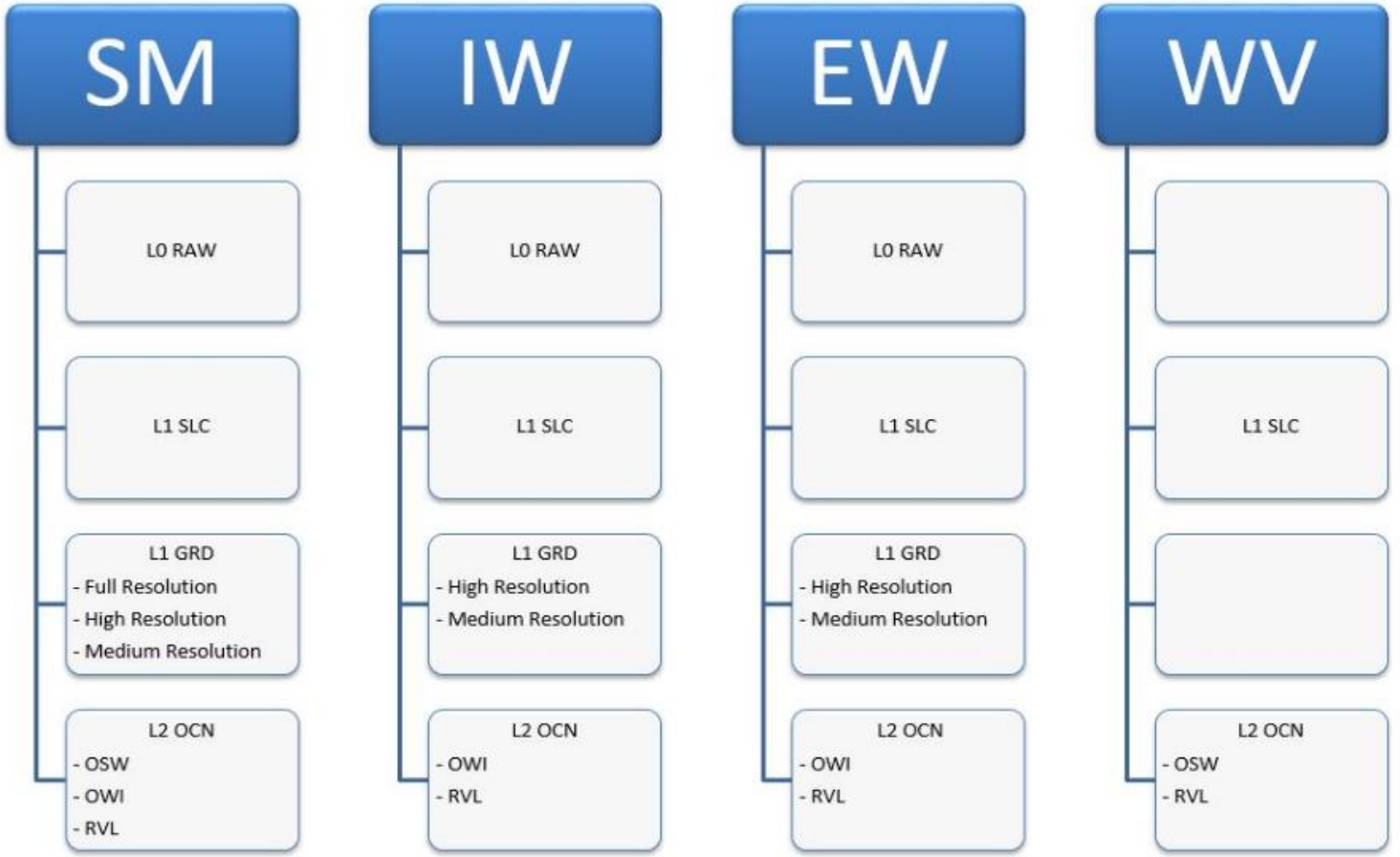
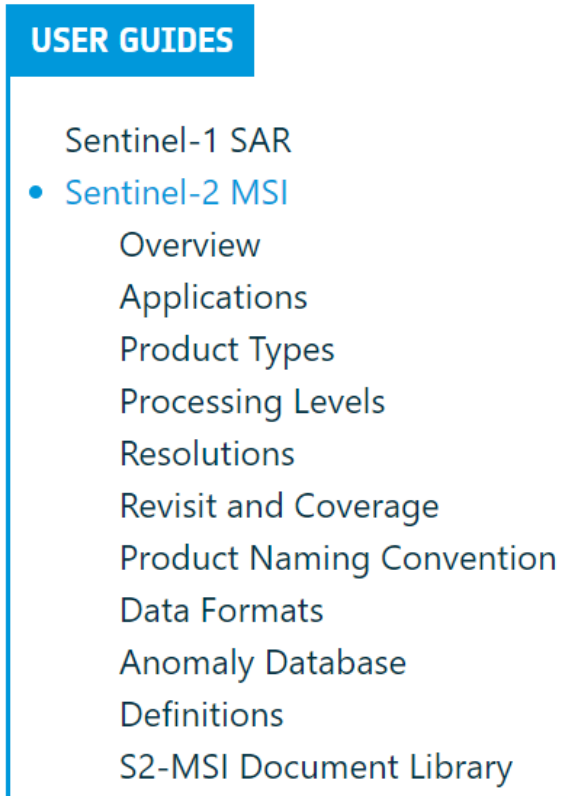


Figure 1: Product Levels From Modes

9. Copernicus Sentinel-2 reminder

Sentinel-2 User Guide: https://sentinel.esa.int/web/sentinel/user-guides/sentinel-2-msi



13 spectral bands ranging from the Visible (VNIR) and Near Infra-Red (NIR) to the Short Wave Infra-Red (SWIR):

- 4 x 10m Bands: the three classical RGB bands (Blue, Green & Red) & a NIR band
- 6 x 20m Bands: 4 narrow Bands in the VNIR vegetation red edge spectral domain & 2 wider SWIR bands for snow/ice/cloud detection, or vegetation moisture stress assessment;
- 3 x 60m Bands mainly for cloud screening & atmospheric correction

9. Copernicus Sentinel-3 reminder

Sentinel-3 User Guides:

https://sentinel.esa.int/web/sentinel/user-guides/sentinel-3-slstr & https://sentinel.esa.int/web/sentinel/user-guides/sentinel-3-olci

Sentinel-3 SLSTR User Guide

The Sentinel-3 SLSTR User Guide provides a high-level description of the instrument and the available instrument products. It also provides an introduction to relevant application areas.

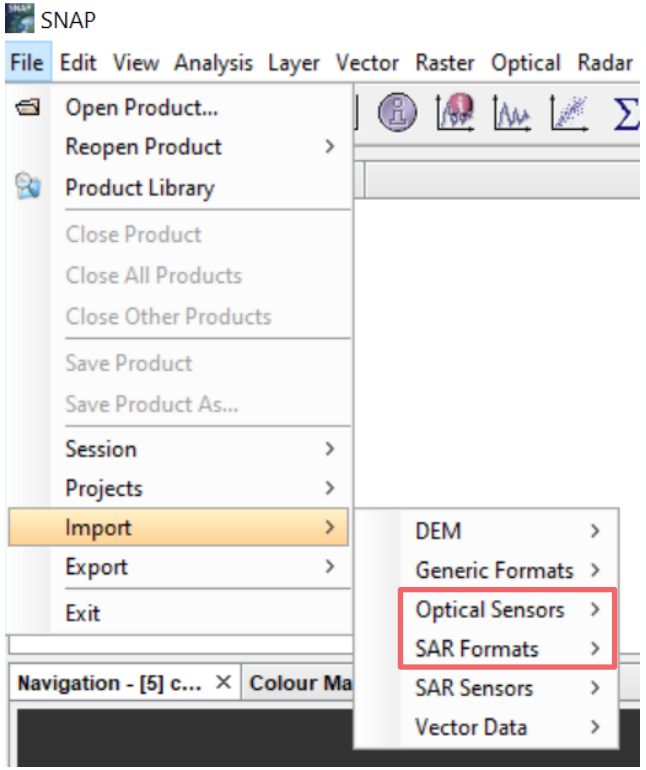
We invite the users to read the SLSTR Land User Handbook which provides a summary of key information needed for users interested in SLSTR land products and their applications.

Sentinel-3 OLCI User Guide

The SENTINEL-3 OLCI User Guide provides a high level description of the available instrument modes and products. It also provides an introduction to relevant application areas, information on data distribution, product formatting and software tools available from ESA.

10. Exploring the SNAP GUI: Importing data

Importing data:



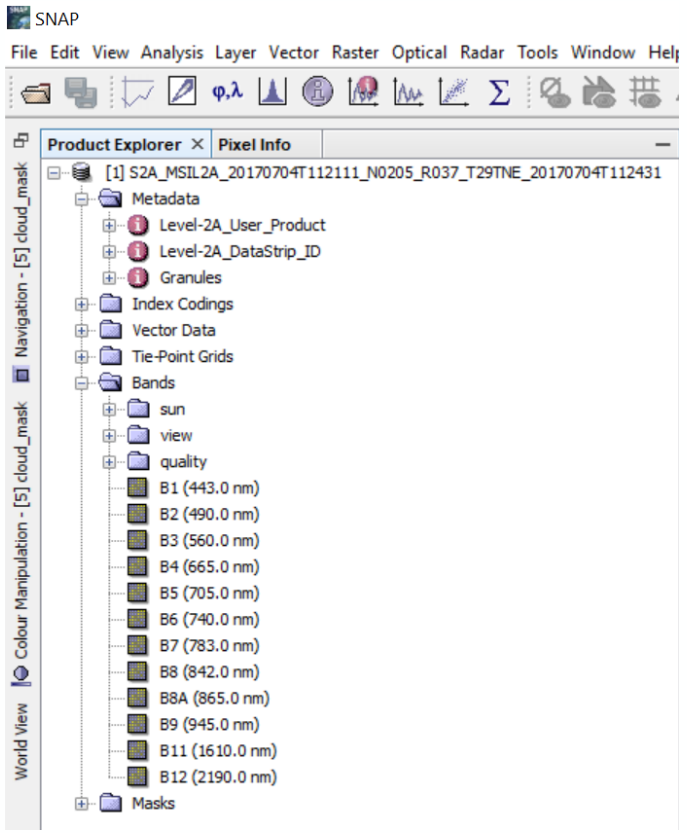
File > Open Product, or File > Import

OR

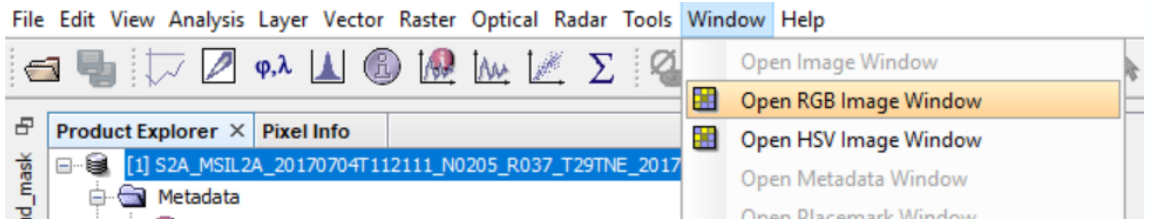
Drag and drop the data into the Product Explorer window (header or the “ZIP”)

10. Exploring the SNAP GUI: Metadata & Visualisation

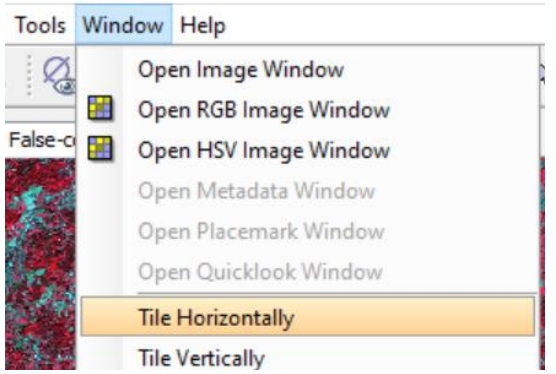
Displaying metadata & bands:

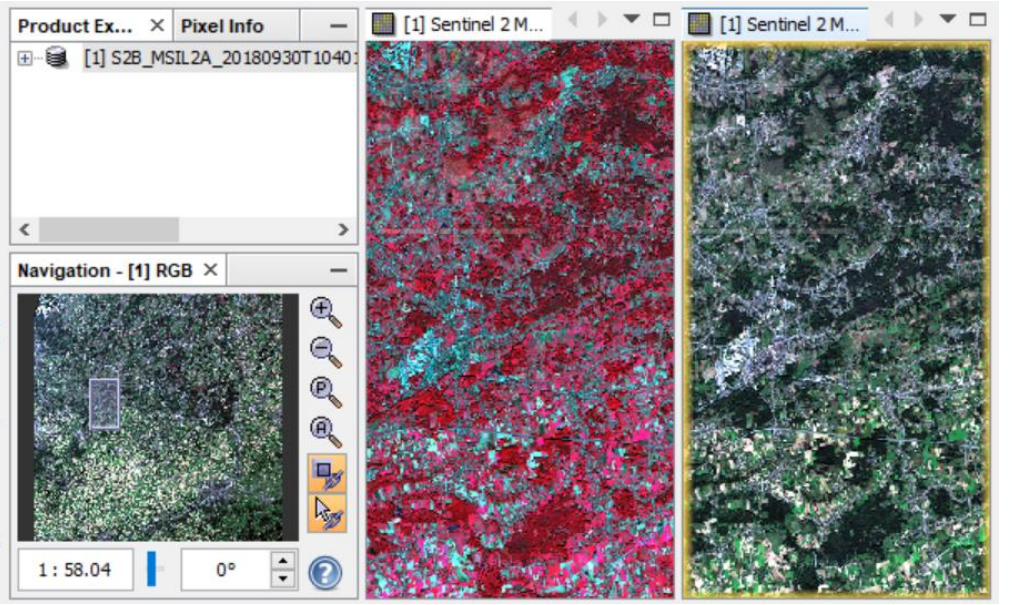


Visualize RGB:

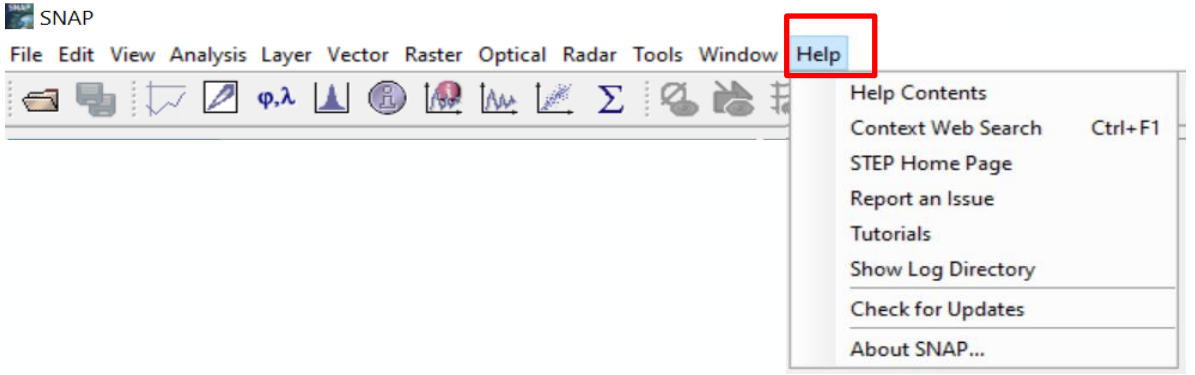


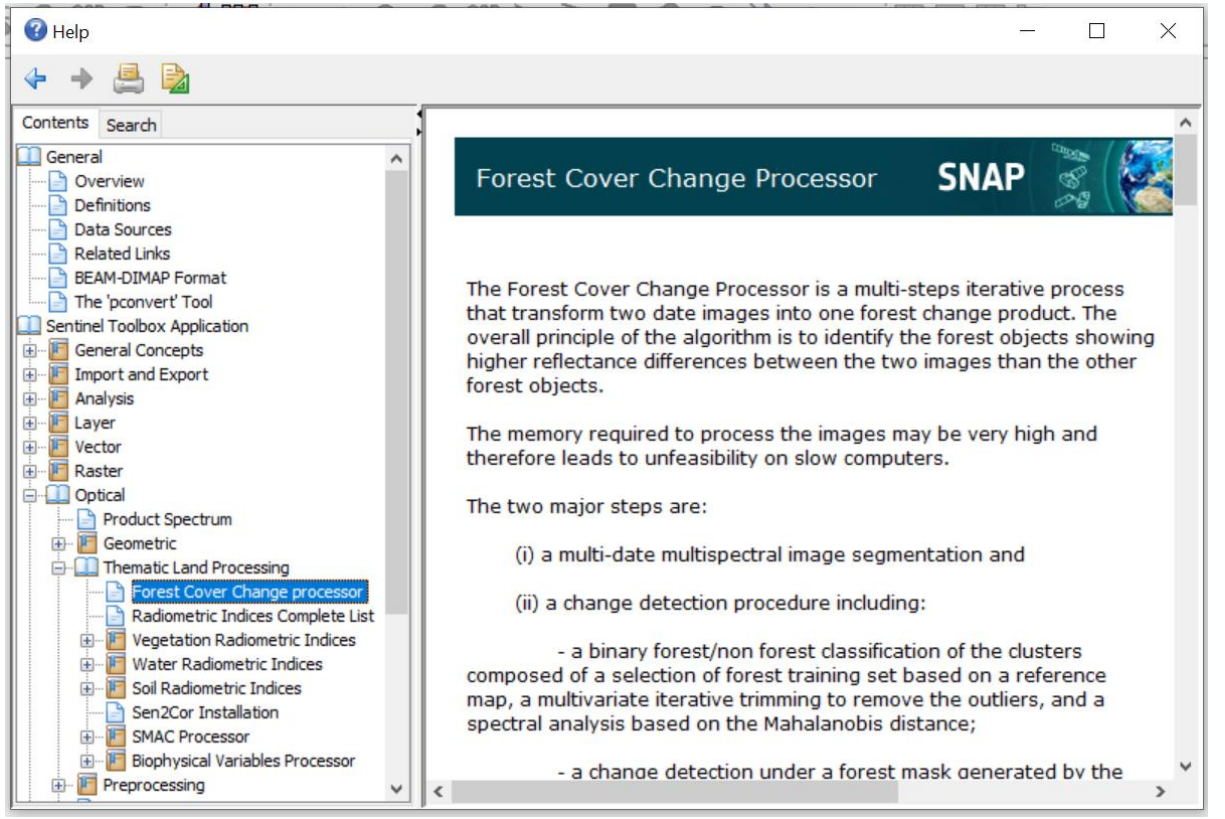
Tile windows & Coordinate navigation:



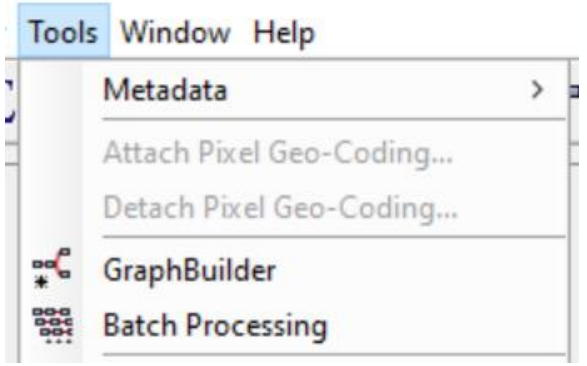


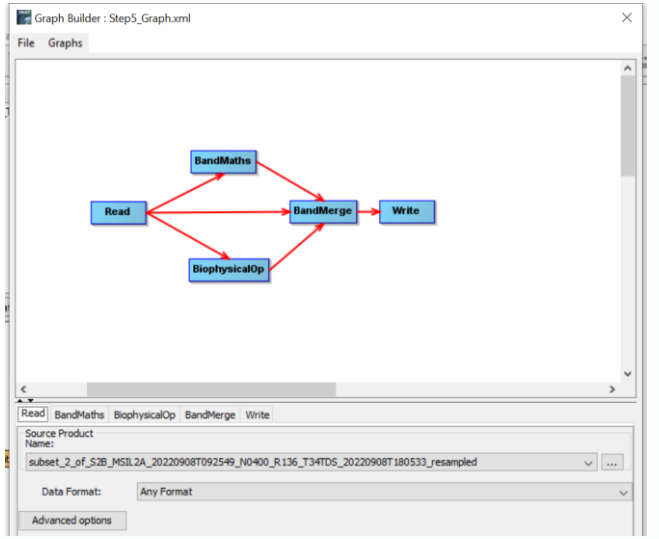
10. Exploring the SNAP GUI: Help function

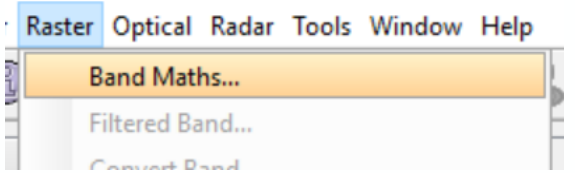


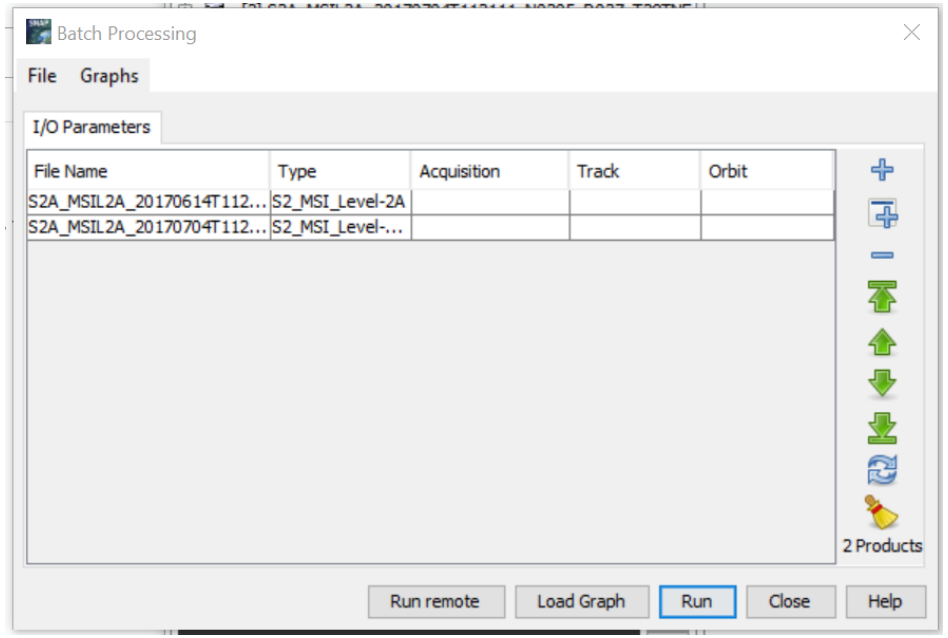


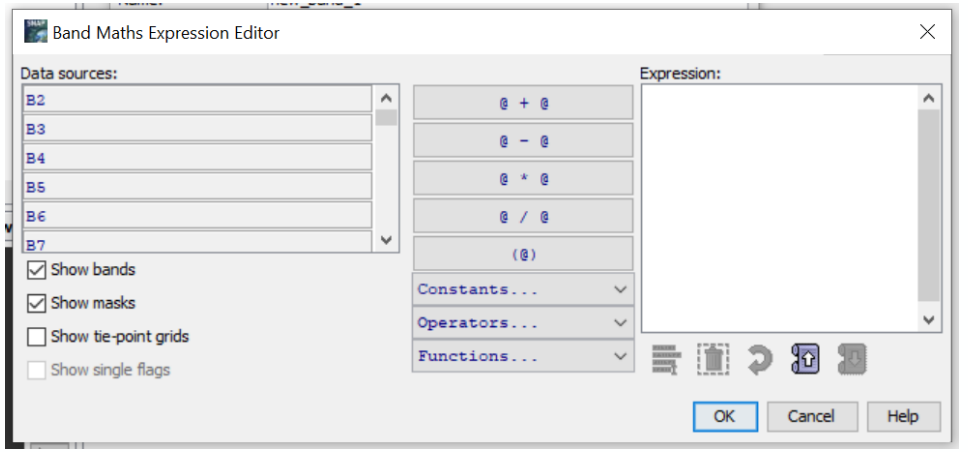
10. SNAP GUI: Graph, Batch processing & Band Maths





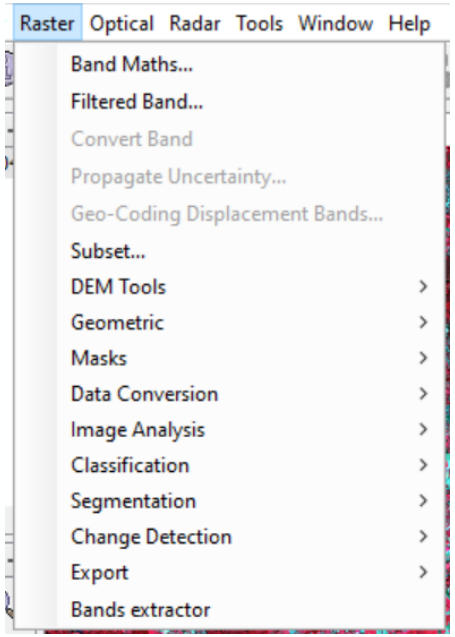


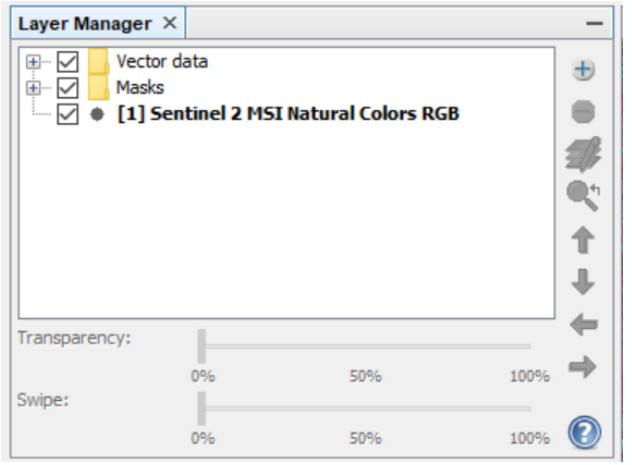


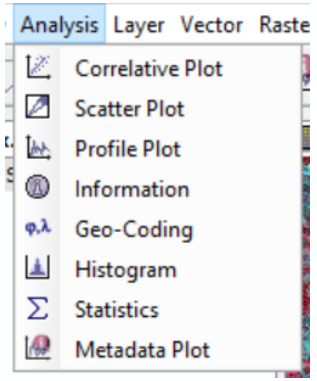


10. Exploring the SNAP GUI: Optical, Radar & generic tools

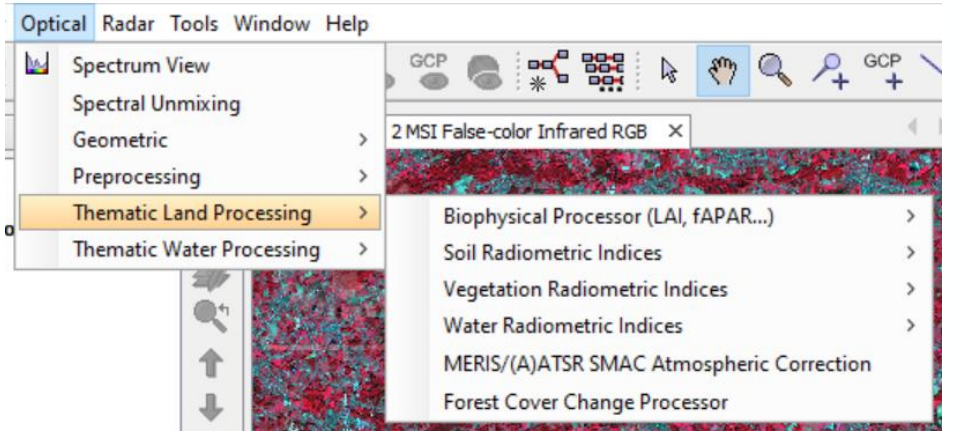
Generic tools:



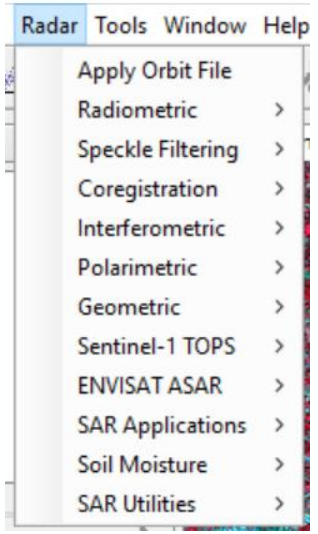




Optical tools:



SAR tools:



Thank you for your attention