What's New in SARscape® 5.5
October 2018

The newest release of SARscape – version 5.5 – introduces some algorithmic improvements and new features.

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1 Import Data

1.1 New features

1.1.1 Generic SAR Data import

This tool allows importing SAR data considering a single sensor at a time (i.e. only Sentinel-1 data, COSMO-SkyMed, etc).
Users have only to make sure data come from the same sensor, there is no need to know which the sensor is since SARscape will automatically recognize sensor type and data format. The import functionality only requires the Input file List.

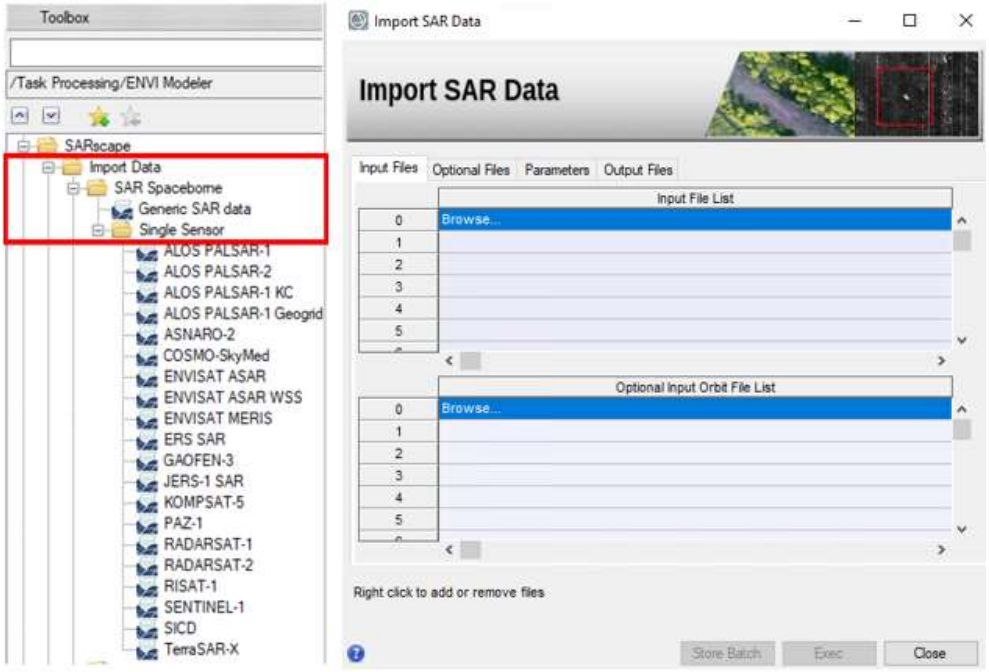

Figure 1 Generic SAR Data import tool in SARscape Toolbox and Generic SAR Data import tool panel.

1.1.2 PAZ-1 import

PAZ-1 products, from the Spanish X-band SAR mission can now be imported. The supported products are:

SSC Single Look Slant Range Complex
MG Multi Look Ground Range Detected
GEC Geocoded Ellipsoid Corrected
EEC Enhanced Ellipsoid Corrected

SARscape imports COSAR (.cos) and TIFF format.

Figure 2 Import PAZ-1 panel.

1.1.3 ASNARO-2 import

ASNARO-2 products, from the Japanese X-band SAR mission can now be imported. The supported product types are Level 1.1 (slc) and Level 1.5 (geocoded images).
SARscape imports CEOS format (NITF 2.1 and GeoTIFF coming soon).

Figure 3 Import ASNARO-2 panel.

1.1.4 ECMWF download

This tool allows querying and downloading of (mainly) meteorological data provided by the European Center Medium Weather Forecast Web-API Hub. The download can be done filtering by product type. This panel allows users to superimpose ECMWF meteorological data to SAR data having the same spatial and temporal resolution.

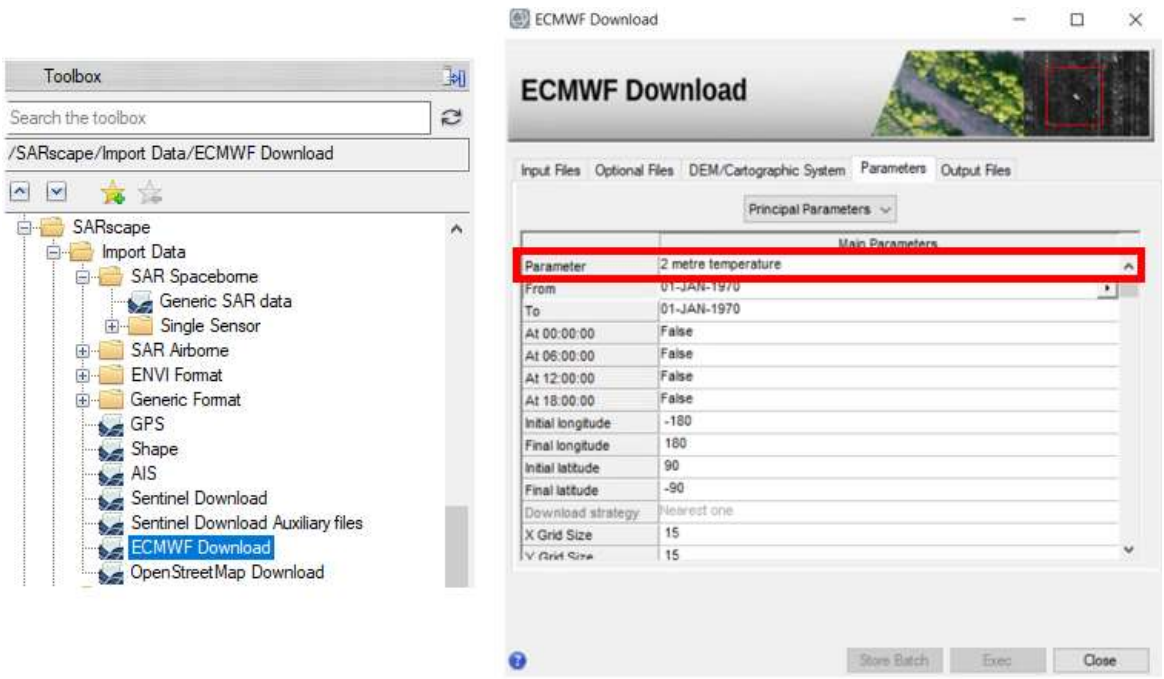

Figure 4 ECMWF download tool in SARscape Toolbox and ECMWF download tool panel.

1.1.5 OpenStreetMap Download

This tool allows downloading OpenStreetMap data and converts them into shapefile (.shp) format. The geographic region can be defined setting: coordinate system, a vector, a bounding box, a known shape file.

OpenStreetMap data could be then embedded and integrated to SAR data by the user.

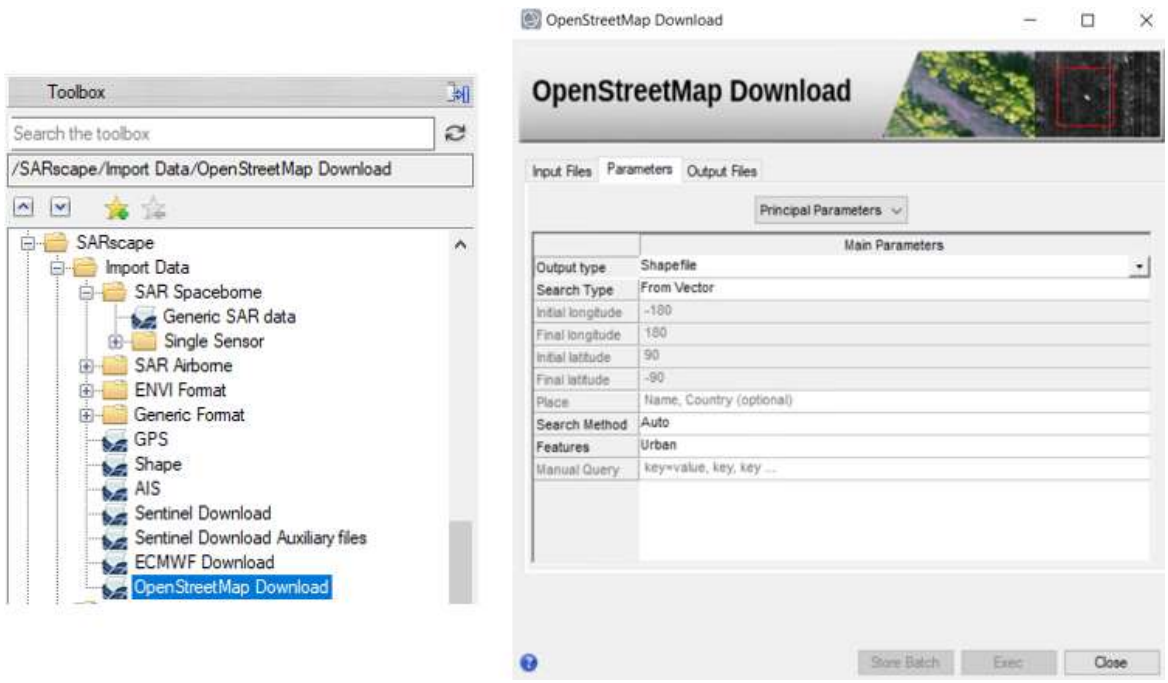

Figure 5 OpenStreetMap download tool in SARscape Toolbox and OpenStreetMap download tool panel.

1.2 Improvements

1.2.1 SICD

Original products, provided in SICD format (Sensor Independent Complex Data, imaging data format used by U.S. government), are imported into the SARscape Data Format for further processing. Only Single Look Complex data, containing a real and an imaginary component, are supported (Phase + Module complex products are not yet supported).

The supported sensors are: ALOS-2, CosmoSkymed, RADARSAT-2, Sentinel-1 A and Sentinel1-B, TerraSAR-X, TandemX.

Figure 6 Import SICD tool panel.

1.2.2 RISAT-1 Level 2 Data supported

Improvements on supported products allow importing not only Single Look Complex (slant range) or Multi Look (Ground Range), but also Level 2 Data (geocoded products).

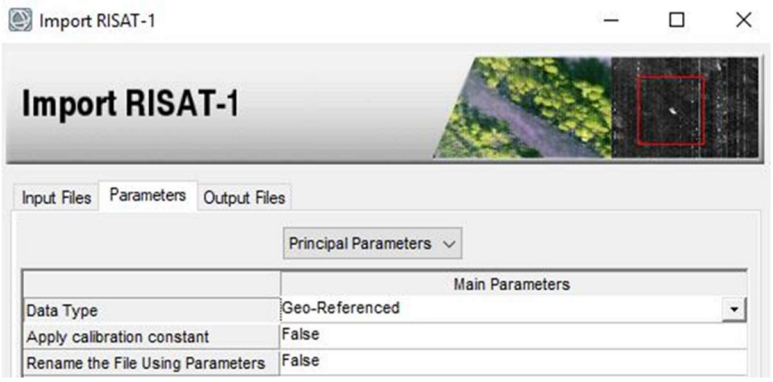

Figure 7 Import RISAT-1 panel.

1.2.3 Sentinel-1 download panel

A new field manager is available now to set sensing period (the earliest and latest acquisition date). A specific panel clearly specifies day, month and year. Moreover, the Sentinel-1 data could be automatically unzipped in the selected directory.

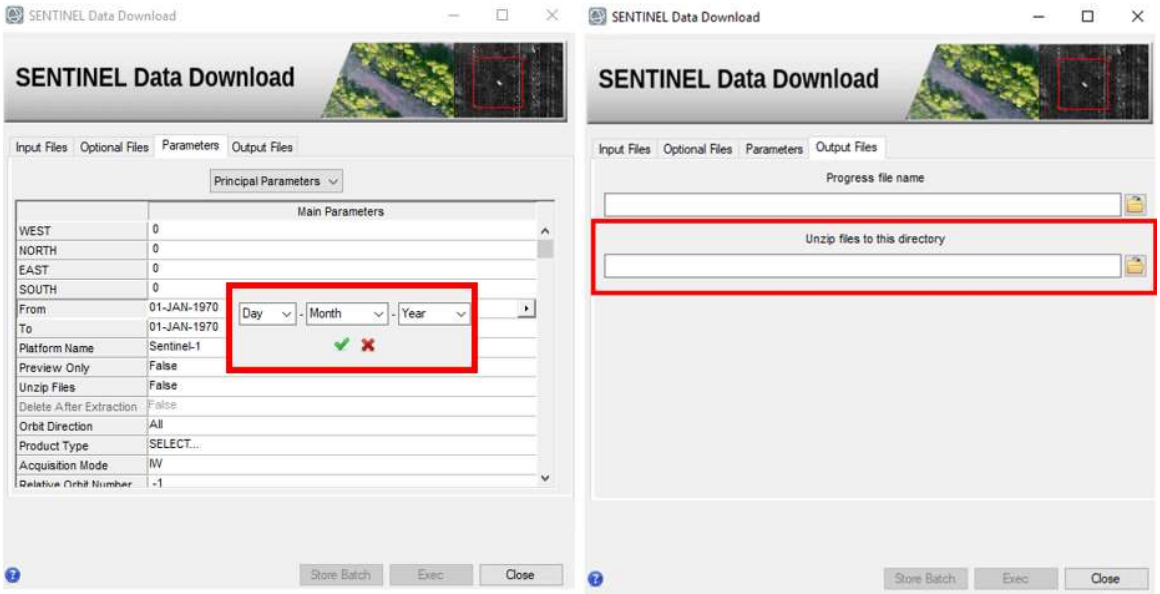

Figure 8 Sentinel Data download tool panel improvements for dates and unzip function.

1.2.4 Sentinel-1 Amazon format

Sentinel-1 import tool supports Amazon format file included in the manifest.safe.

1.2.5 Sentinel-1 import: .kml and .kmz format ingestion for area of interest

In addition to the already supported shape files, Google Earth file (.kml or .kmz) can be uploaded to specify a region of interest.

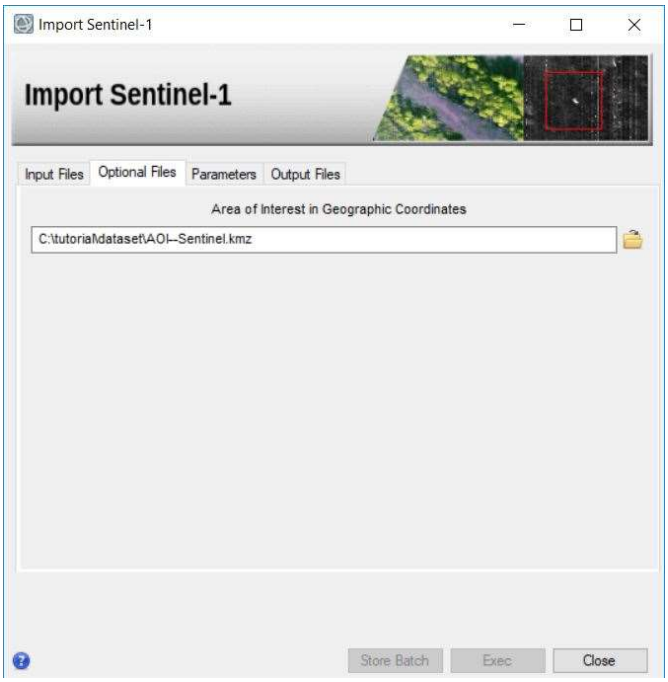

Figure 9 Import Sentinel-1 tool panel.

1.2.6 AIS new message management

Message 27 (Long-RANGE Automatic Identification System Broadcast Message format) of NMEA in the AIS import is now supported.

2 Basic Module

2.1 New features

2.1.1 SAR AIS Classification

This tool allows importing AIS marine traffic information to be matched with SAR image to detect ship or similar objects over water bodies after masking land areas.

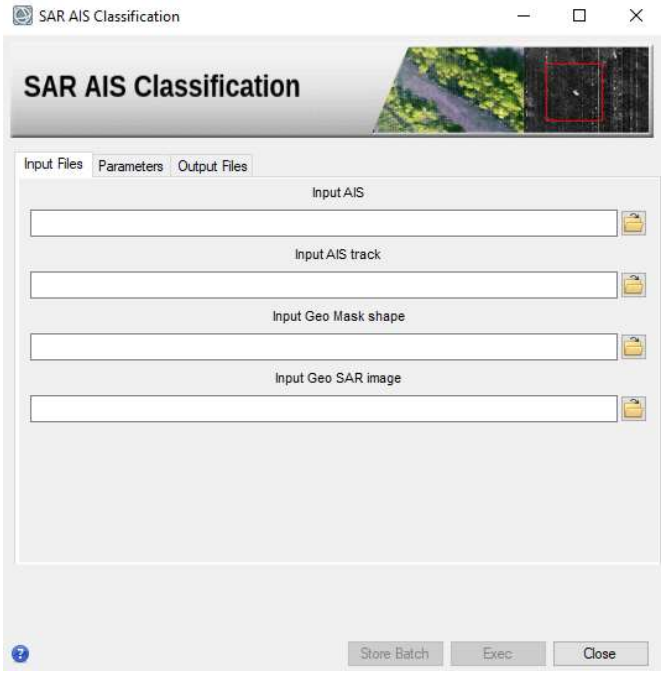

Figure 10 SAR AIS Classification tool panel.

2.1.2 MICCD workflow (multi inverse coherence change detection)

The final purpose of this processing chain is to generate an RGB color composite (MICCD) for the visualisation and identification of coherence temporal changes. It identifies the changes in a direct way.

2.2 Improvements

2.2.1 Workflows with Import and Sample selection

Workflows have now two more steps. Users have the opportunity to import generic SAR data and subsample them with the Sample Selection in SAR geometry tool. In case data have already been imported and subsampled, a flag in Input>Parameters allows skipping both the import step and the sample selection step.

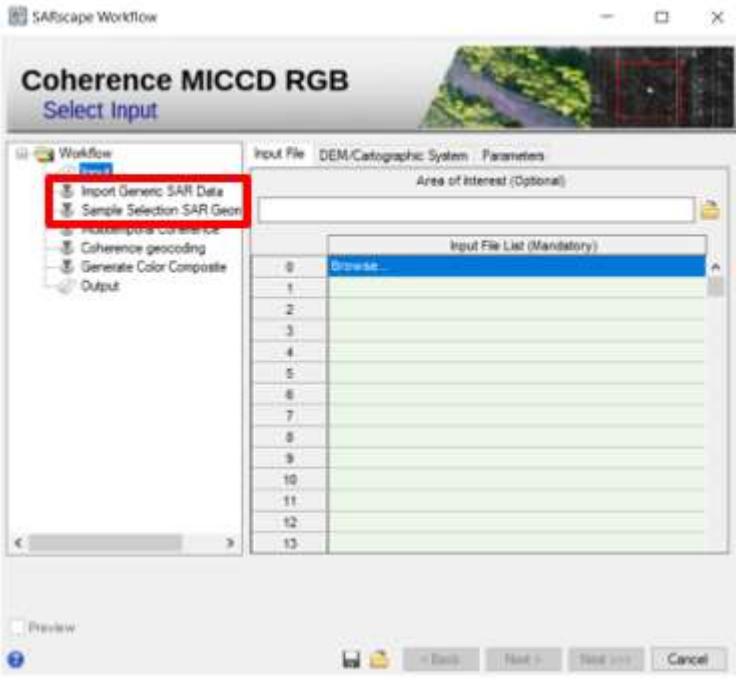

Figure 11 Import SAR Data and Sample selection steps the MICCD-RGB workflow panel.

3 Interferometry

3.1 New features

3.1.1 New workflow without GCP

InSAR DEM Workflow, Stereo DEM Workflow, DinSAR Displacement Workflow, DInSAR MAI Displacement Workflow, Amplitude Tracking Workflow are now available without a mandatory Ground Control Point file.

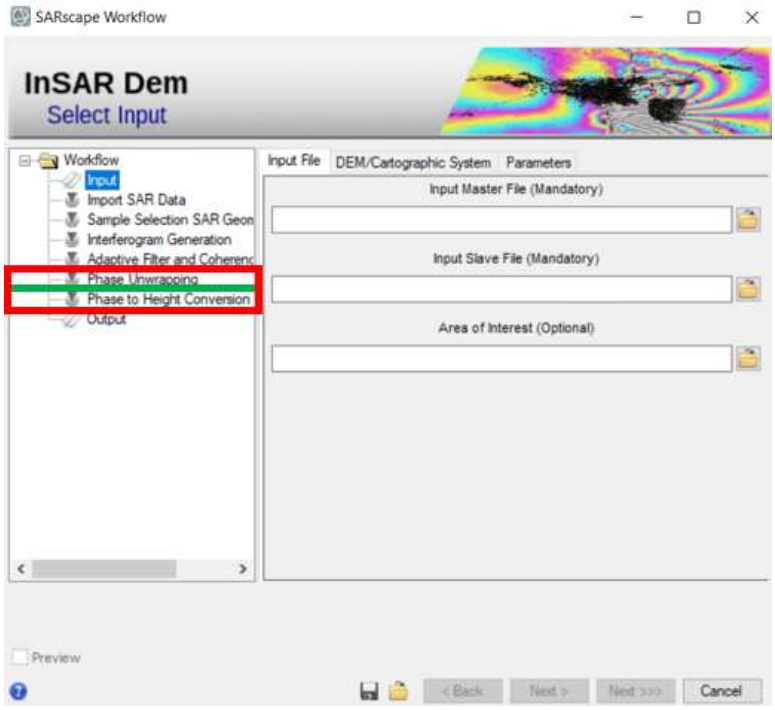

Figure 12 InSAR Dem Workflow panel shows the missing GCP step.

3.1.2 Modeling: Slant range combination

This new panel allows to add or subtract a modelled displacement map to the wrapped or unwrapped interferometric fringes, i.e. in slant range geometry. Typical use of this panel is the subtraction of modelled fringes to simplify the unwrapping when a strong signal (for instance due to an earthquake) is present. After the unwrapping, the modelled signal can be added back with the same panel.

3.1.3 Modeling: Calculate statistics

This new function, available within the Non-Linear inversion panel, allows the assessment of the modelled source parameter uncertainties and all the parameter trade-offs. This is carried out by adding some *ad hoc* noise (correlated in space, for InSAR) and performing the inversion for an arbitrary number of times, set by the user. The output is a grid of scatter plots and probability distributions involving all the parameters retrieved by inversion.

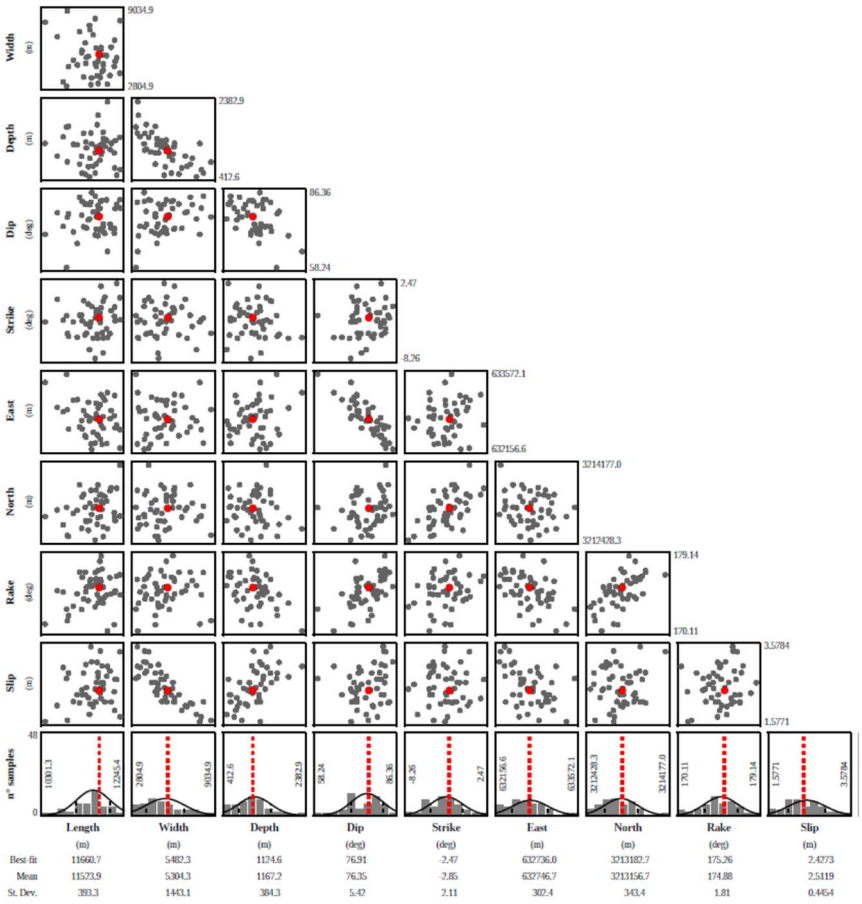

Figure 13 Graphical statistics for Modeling tool.

3.2 Improvements

3.2.1 Workflows with Import and Sample selection

Two more steps have been added to the workflows. Users have the opportunity to import generic SAR data and subsample them with the Sample Selection in SAR geometry tool. In case data have already been imported and subsampled, in Input>Parameters a flag allows skipping both the import step and the sample selection step.

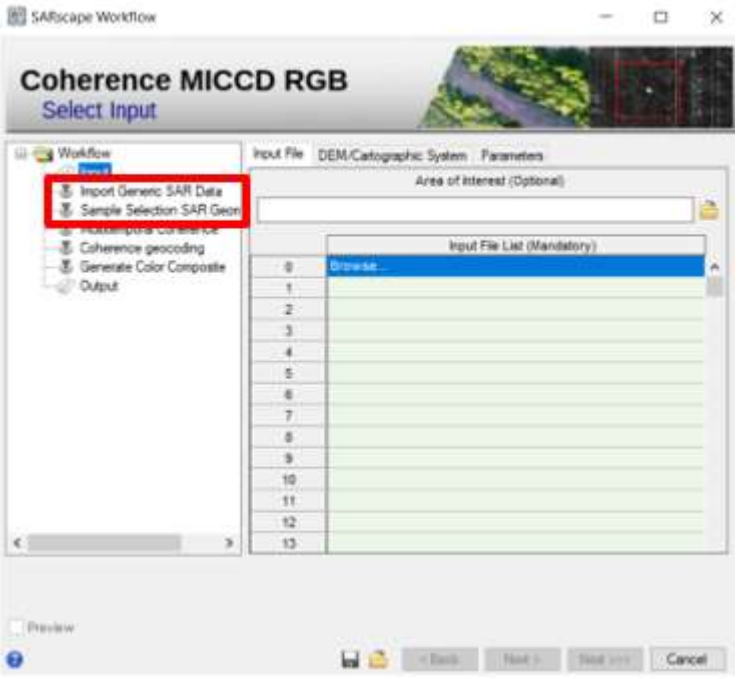

Figure 14 Import SAR Data and Sample selection steps in the MICCD-RGB workflow panel.

3.2.2 Modeling: algorithm

Several algorithms have been strongly improved. In the Linear Inversion, a new damping approach is introduced, based on spatial relationship among all the sources and not limited to every single source. Introduced a new option for the linear inversion of Okada sources: distributed slip with rake variable and constrained in an arbitrary range, set by the user (between 0 and 180).

For the Non-Linear and Linear inversion is now possible to introduce "fixed sources", that are sources whose parameters are completely known; it is useful when there are InSAR maps containing signal from several events and the user wants to model only some of them, while the others have been already modelled with different InSAR datasets.

3.2.3 Modeling: Report (result visualization)

After any inversion, a new panel with a synthetic report is created, to immediately assess the quality of the results. Information are provided about the modelled sources (source parameters, geodetic moment, event magnitude, etc.) and datasets (RMS of the residuals, RMS of the original dataset, suggested dataset weight, orbital parameters assessed for InSAR, etc.). Parameters to fix after a non-linear inversion are highlighted with an "***": this suggests the change of the parameter searching range.

4 Interferometric Stacking

4.1 New features

4.1.1 Incremental PS

It allows to perform incremental PS processing in case new acquisitions are available. To perform the incremental PS the connection network generated in the Connection Graph step will be updated using the PS Edit Connection Graph tool (Files should not be moved or renamed). The incremental mode allows to save processing time whenever a new acquisition is added to an existing stack. In fact, it is not necessary to perform again the whole interferometry on all the images but just on the added images.

New images can be added if the Interferometric workflow has been already executed. The interferometric process will take into account only for added images. Starting from the first step workflow each step has to be executed. The auxiliary file will be automatically updated and there is no need to edit it.

Either single images included in the connection network can be removed.

New opportunity to apply the water body mask in the First Inversion tool is available.

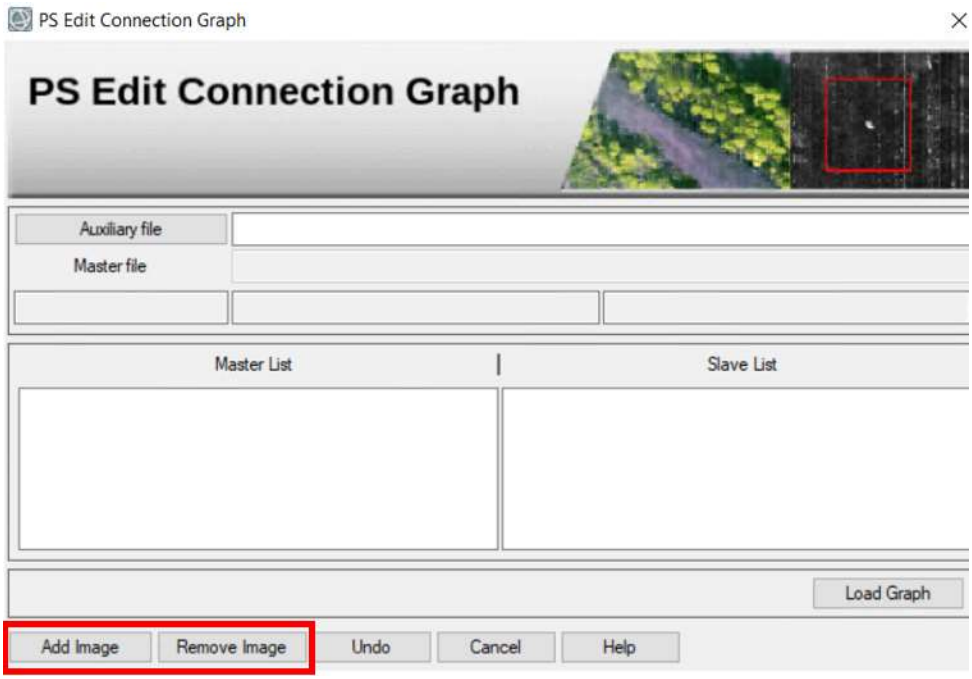

Figure 15 PS Edit Connection Graph tool panel for Incremental PS processing.

4.2 Improvements

4.2.1 SBAS capabilities

- Report, auxiliary and parameters ascii files have been renewed;
- Software code refactoring and full multi thread parallel exploitation for First Inversion, Second Inversion, Geocoding;
- Improvements on intermittent SBAS capability with the opportunity to control the graph disconnection percentage during the first and second inversion step.
  - First Inversion: Min valid interferograms % (minimum percentage of valid phase measurements to respect the initial interferograms in the connection graph);
  - Second Inversion: Min valid interferograms % (minimum percentage of valid phase measurements with respect the initial interferograms in the connection graph) and Min valid acquisitions % (minimum percentage of valid acquisitions, with at least one valid phase measure).
- The Height Wavelet size: updated way to express the resolution of the kept residual topography obtained from processing data.

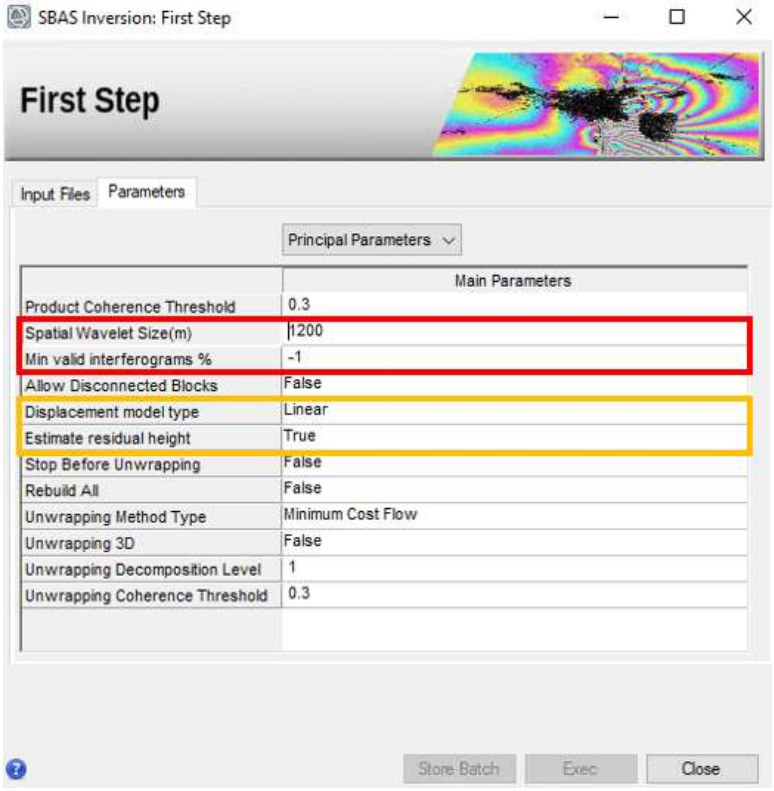

Figure 16 First Step tool panel shows improvements on Principal Parameters.

- Cluster bug fixing for large node number with respect to the stacking image number.
- Bug fixing: first date wrong value in the displacement time series by the high pass component of the atmospheric estimation.

- New displacement model types have been added, now it is possible to estimate the displacement model without retrieving any residual topography.
- Refactoring of geocoding and shape generation.
- New opportunity to apply the water body mask in the Geocoding tool.

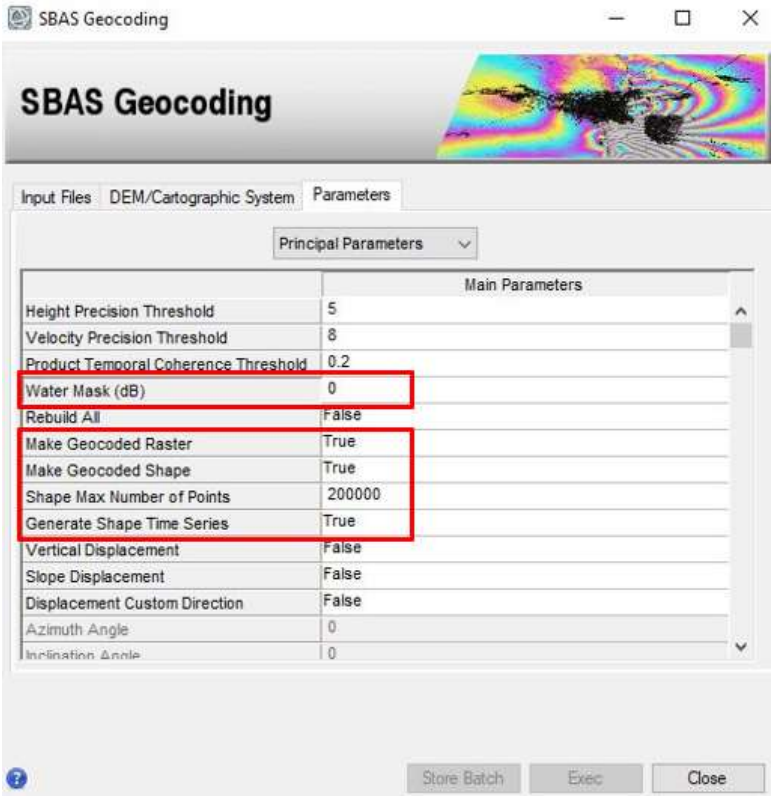

Figure 17 SBAS Geocoding tool panel shows improvements on Principal Parameters.

- New output layers added (RMSE, date counter for intermitted SBAS, valid interferogram percentage among them).
- Geocoded shapes are in their cartographic position and not on regular grid as before.
- Speed up first inversion:2-3 times.
- Second inversion 3-5 times.
- Geocoding and Shape generation 5-10 times depending on the dataset size and stack acquisition number (the larger the dataset, the higher the speed up).

5 General Tools

5.1 New features

5.1.1 Data Export: Generate SIDD

A Sensor Independent Derived Data (SIDD) format for SAR products as 8-bit nitf image can be obtained from any SARscape product. This tool is mostly intended to optimize the scaling of the original histogram for image visualization purposes.

5.1.2 Data Export: MICCD (multi inverse coherence change detection) generate color composite

It allows users to generate a coherence RGB color composite (MICCD) for the visualisation and identification of coherent temporal changes. It identifies changes in a direct way.

The coherence color combination is obtained as Red = input [1-(Coherence)]; Green = input 2 [(1-Coherence)]; Blue = input 3 [(1-Coherence)].

5.1.3 DEM Extraction: DTED

Starting from SARscpae 5.4.1 patch 20180410 DTED import is available.

A new fild is now available in SARscape Common Preferences. It allows to set the DTED directory root, in the three sub directories, dted0, dted1 and dted2 can be found in order to define one of the three available levels for the DTED dataset.

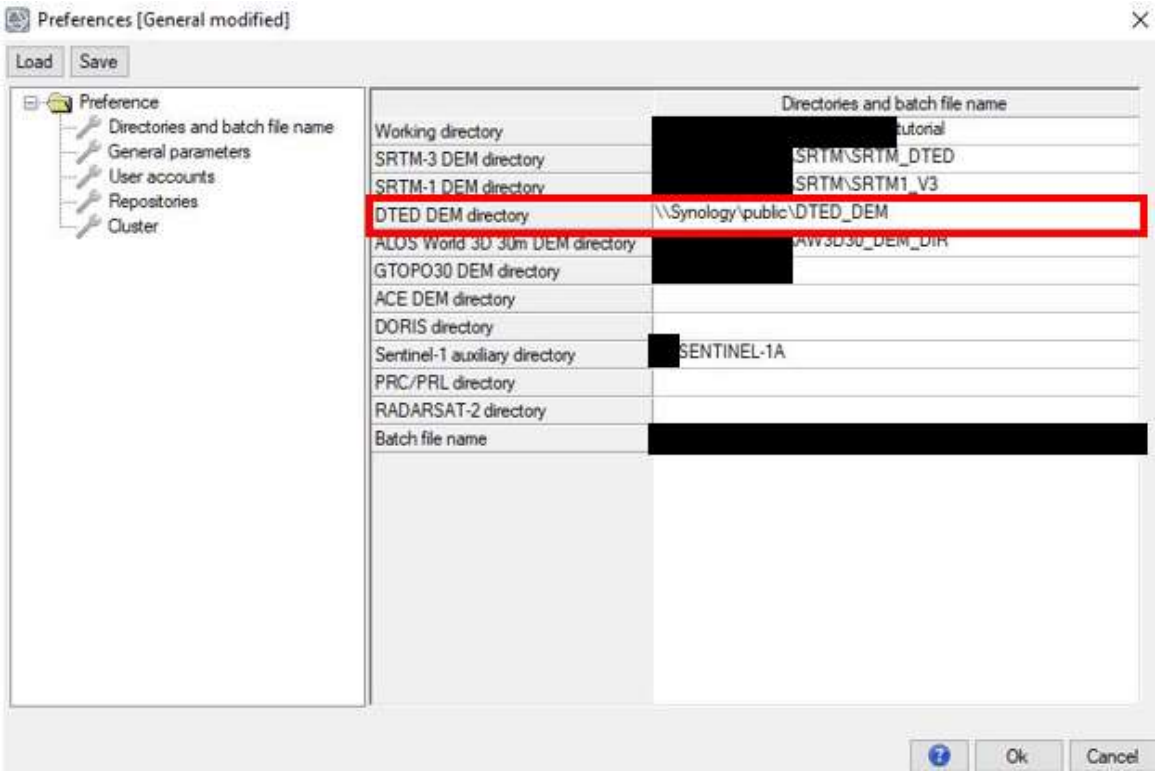

Figure 18 SARscape Common Preferences panel shows the DTED directory

In each directory there are the sub directories wXXX or eXXX, each of these directories contain the files nXX.dt0 or sXX.dt0 for DTED0, nXX.dt 1 or sXX.dt 1 for DTED1 nXX.dt2 or sXX.dt 2 for DTED2.

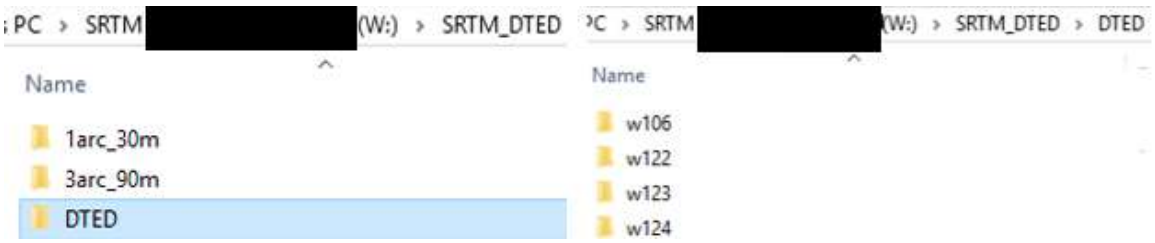

Figure 19 Sub directories in the DTED directory.

The DTED DEM Extraction requires the definition of the DEM level in Source DEM Type: DTED-0, DTED-1 and DTED-2

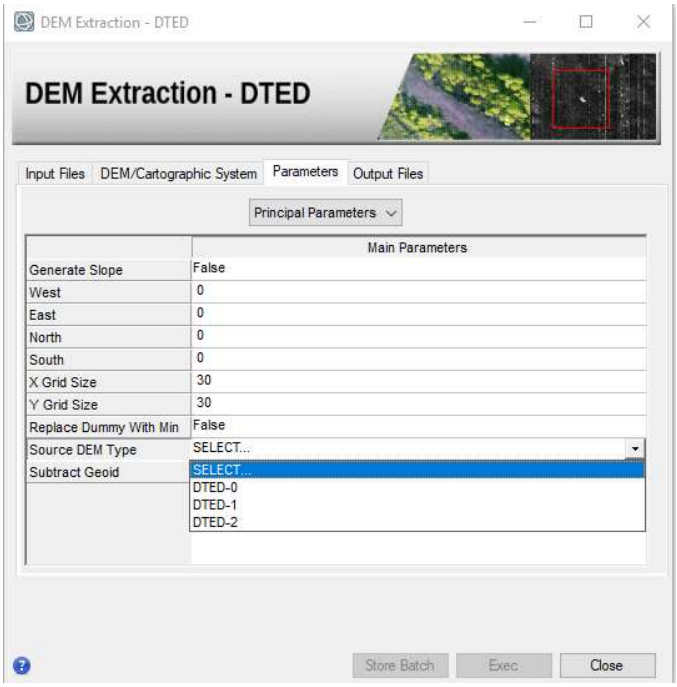

Figure 20 DEM Extraction -DTED tool panel.

5.2 Improvements

5.2.1 Sample Selection: kml and kmz format ingestion for area of interest

In addition to the already supported shape files, Google Earth file (.kml or .kmz) can be uploaded to specify a region of interest for the subsample.

5.2.2 GPS- GPS Filtering Undersampling

The output GPS shape files are used for visualization purposes but also for the Modeling Tool. In fact, the names and the number of fields that characterize the attribute file (.dbf) of this shape file are created to be imported in the Modeling Tool.

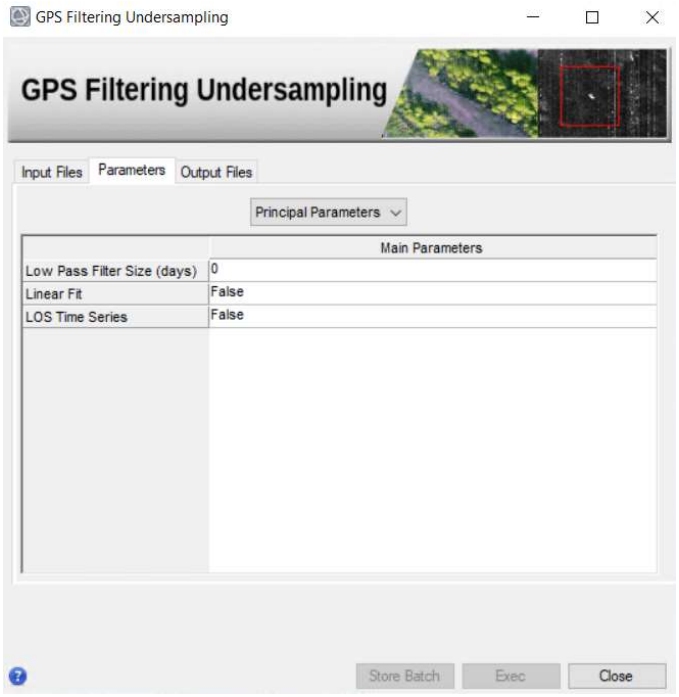

Figure 21 GPS Filtering Undersampling tool panel.

6 Preferences

6.1 New features

6.1.1 Preferences common and specific

The Preferences management has been split into two menus: Preferences Common and Specific.

Common preferences are used to specify general parameters in SARscape. Common Preferences are now related to Directories and batch file name, General Parameters, User accounts, Repositories and Cluster parameters.

Specific preferences, especially the ones related to sensor or settings, are now in a specific panel. Here it is possible to load the specific thirteen different settings, as in the previous Preference panel, and more specific preferences for processing analysis.

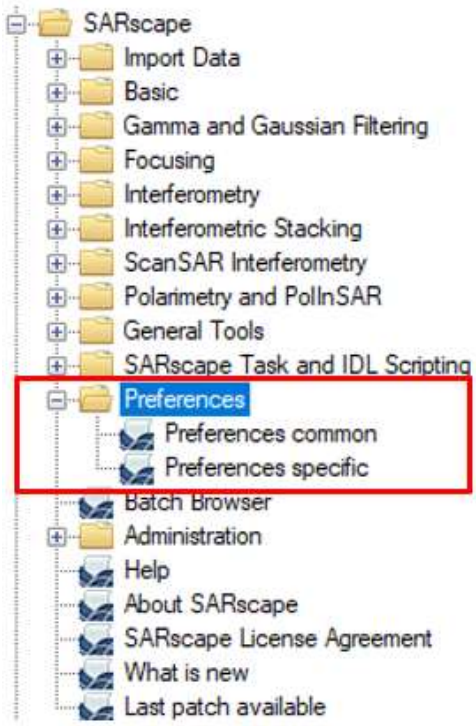

Figure 22 Preferences menu in SARscape Toolbox.

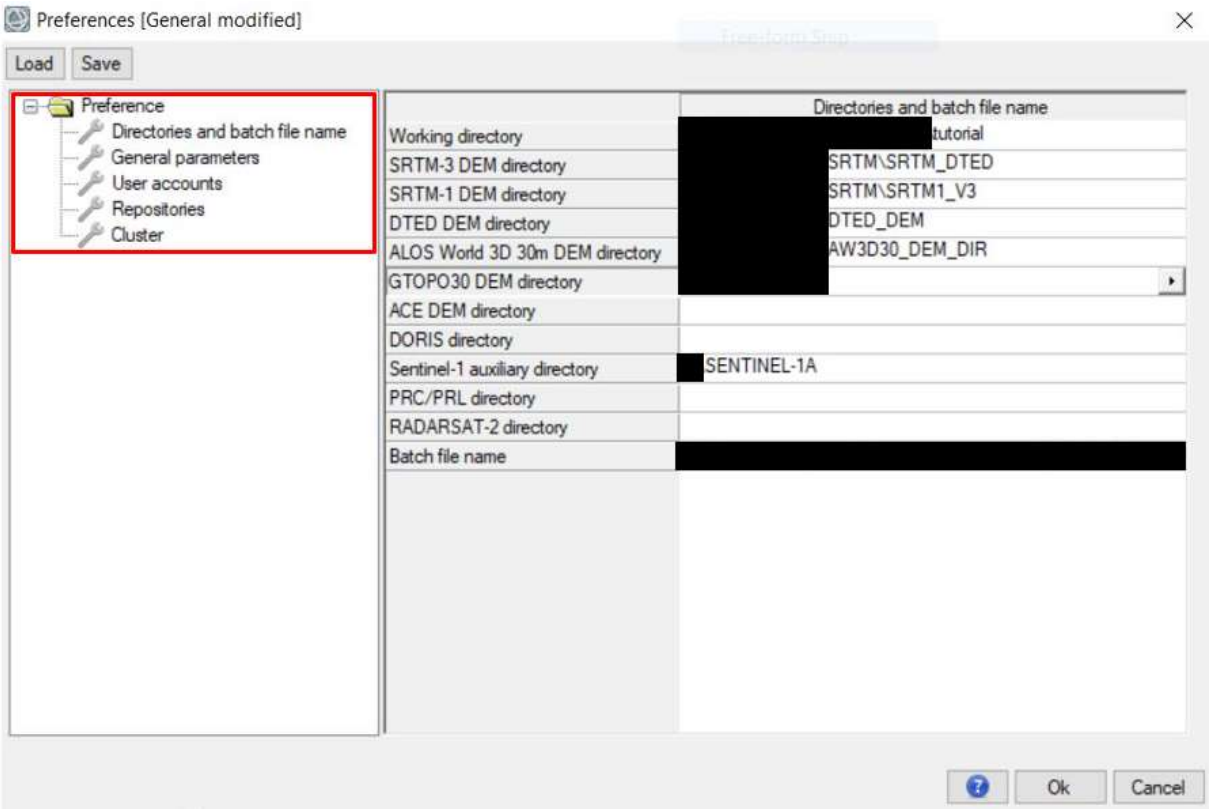

Figure 23 Preference Common tool panel.

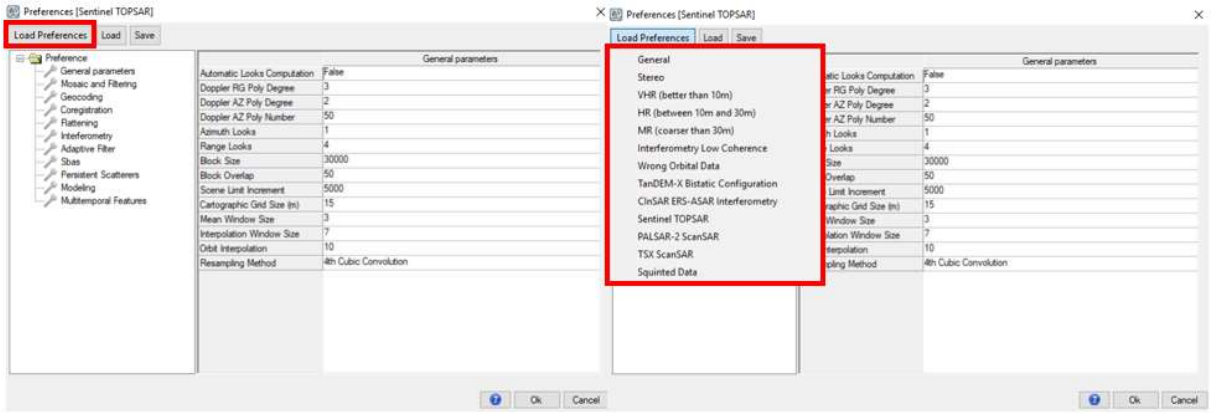

Figure 24 Preference specific tool panels, panel on the right shows specific thirteen different settings.

6.1.2 Proxy server supported

If a proxy server is being used for accessing the external network, the server address (URL) , username and password can be included in Preferences >User accounts or in Downloading tools.

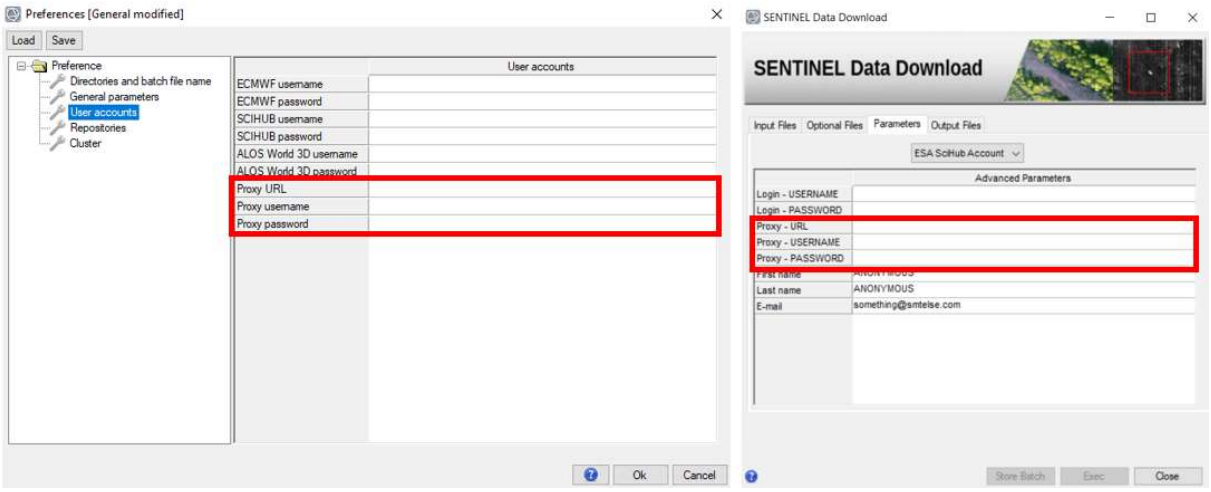

Figure 25 Proxy Parameters in the Preferences common panel (left) and in in the Sentinel Data Download.

7 New features graphic interface

7.1 New features

7.1.1 Add List (Input File and Output File)

Users can add List of files in tools that require the Input File List. To add a list, the following steps need to be done:

-select the input files from a folder;

-hold the shift key and right click on "copy as path" (for Windows)

-copy and paste the selected files in the list.

Files in the list will be opened.

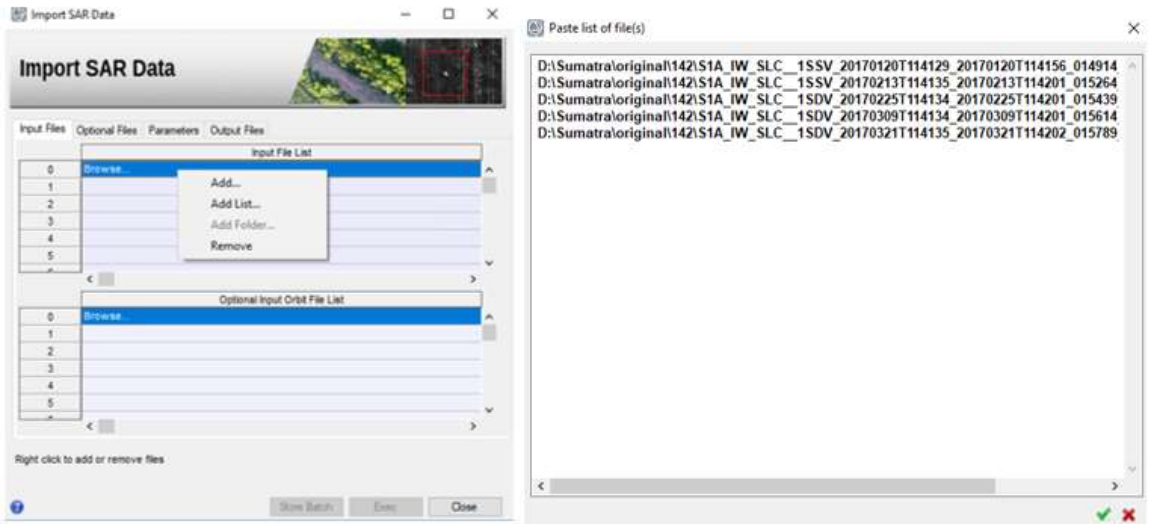

Figure 26 Add List function in Import SAR Data tool panel.

8 SARscape in ENVI Modeler

8.1 New features

8.1.1 New Visual programming supported by ENVI Modeler.

SARscape Modeler is a tool that allows users to create workflows without knowledge on programming and without writing any code. SARscape Modeler is based on the Visual Programming of ENVI Modeler.

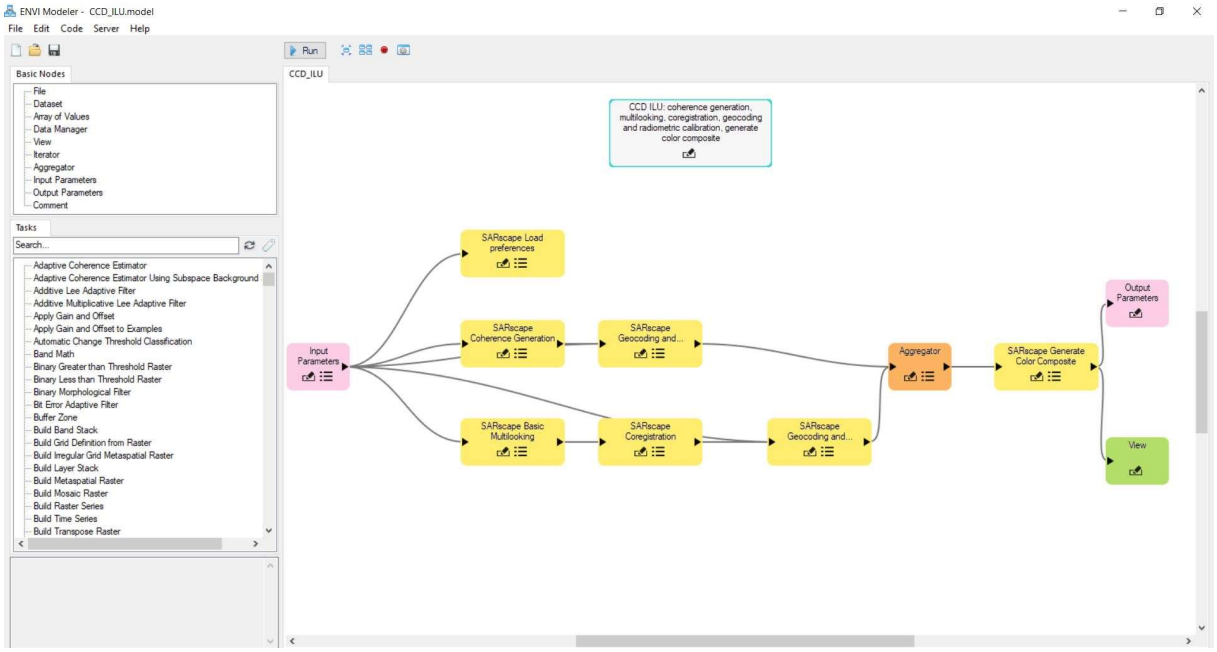

Figure 27 SARscape model Example in ENVI modeler.

9 SARscape in ArcGIS Pro

9.1 New features

SARscape is now integrated in ArcGIS Pro thanks to ENVI migration tools. Part of SARscape tasks are available for ArcGIS. Moreover, some workflows will be included as Metatask: Download Sentinel1Import, DataPreparation, ITS, CCD, CCD Time Line, CDD ILU, InSAR DEM Generation, InSAR Displacement Generation.

SARscape in ArcGIS Pro supports two Cartographic System: GEO-GLOBAL and UTM Cartographic System.

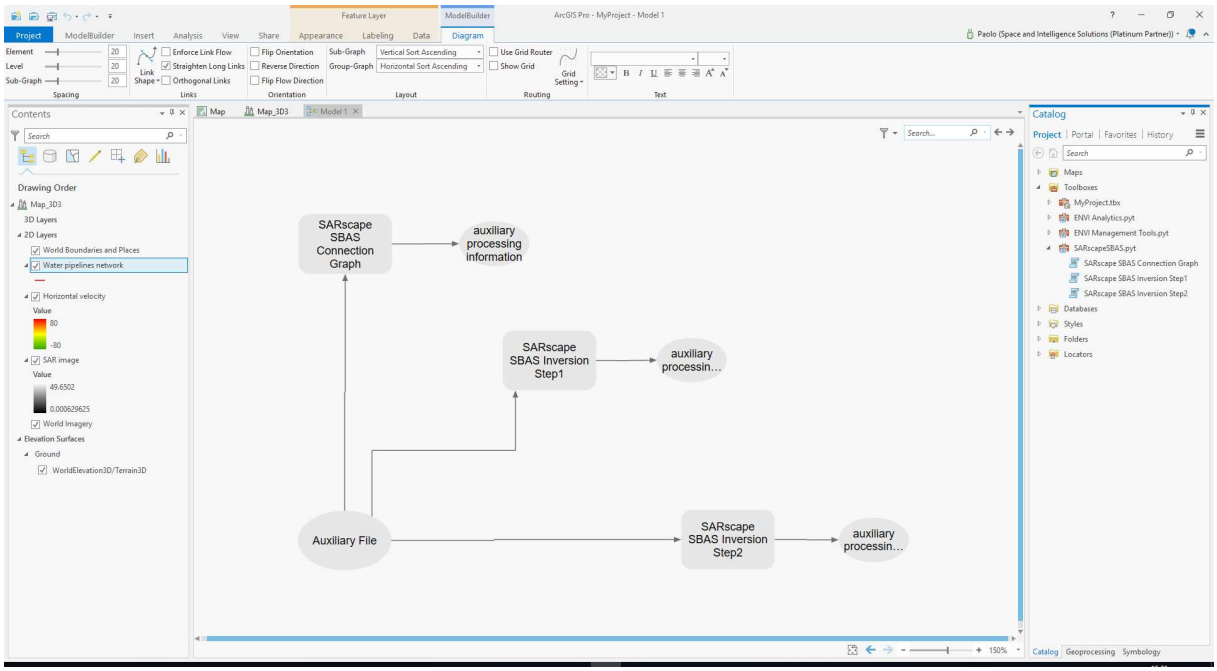

Figure 28 Workflow example in ArcGIS Pro.

10 End-of-Life (EOL) announcement

With SARscape 5.5.1, the scansar interferometry generation ENVISAT ASAR WS will reach end-of-life. This module will no longer be available starting from the next SARscape (sub-) release.

Focusing and ENVISAT ASAR WS and ASAR AP reached end of life.

Generate automatic task pro in batch browser reached end of life.