ENVI SARscape and SAR analytics in ArcPro

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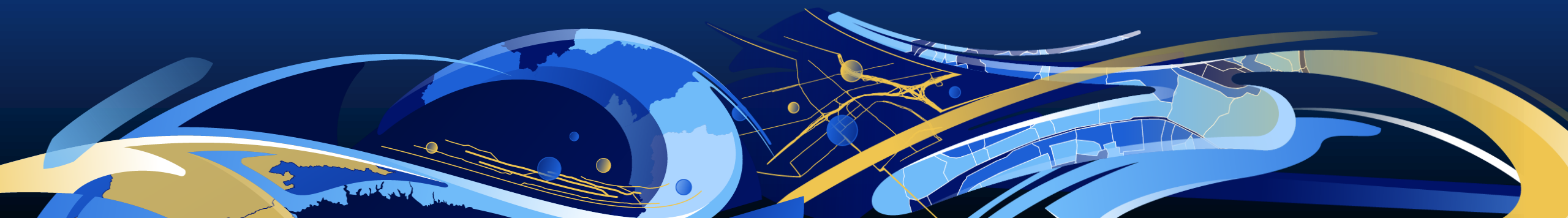
ESRI India



ENVI – Data Analytics Anywhere

ENVI

ENVI uses scientifically proven analytics to deliver expert-level results. It integrates with existing workflows, supports today's popular sensors, and can easily be customized.

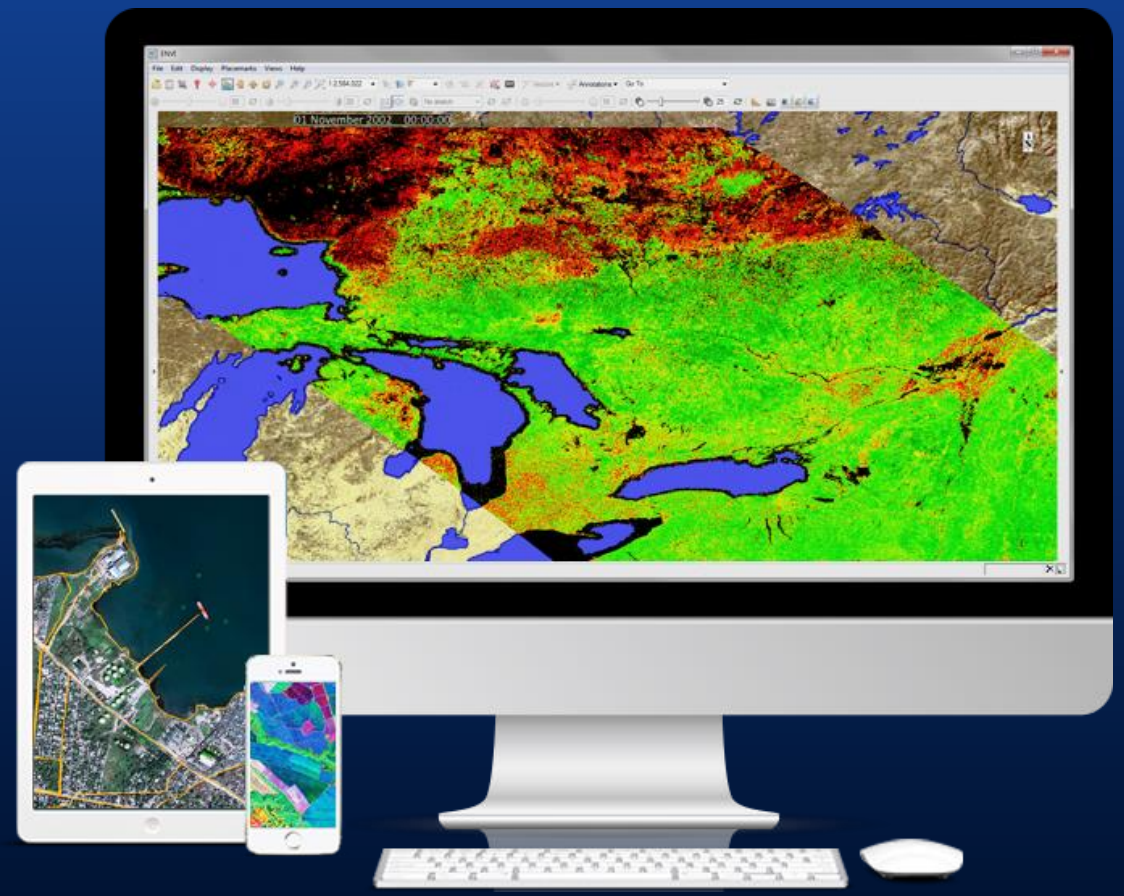
ENVI for the Enterprise

Deploying data analytic capabilities within an enterprise environment takes advantage of using lightweight browser-based clients and apps to access all ENVI functionalities.

ENVI on Partner & Cloud Platforms

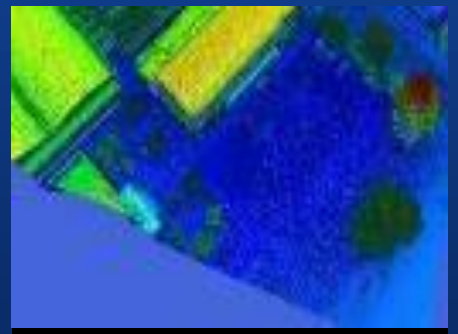
ENVI Analytics can be used on partner platforms or integrated as analytical components within workflows created on any public or private cloud service architecture.

ENVI image analysis software is used by GIS professionals, scientists, and image analysts to extract meaningful information from imagery to make better decisions.



ENVI

ENVI image analysis software uses scientifically-proven analytics to deliver expert-level results.



Data support

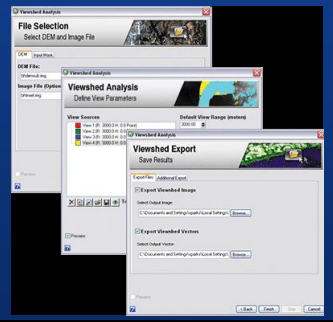
Hyperspectral, multispectral, SAR, LiDAR, radar, FMV, panchromatic and more

ArcGIS integration

Workflows and automated tools to execute ENVI analytics and access results within any ArcGIS environment

Automated workflows

Change detection, anomaly detection, viewshed analysis and more



Extensible modules

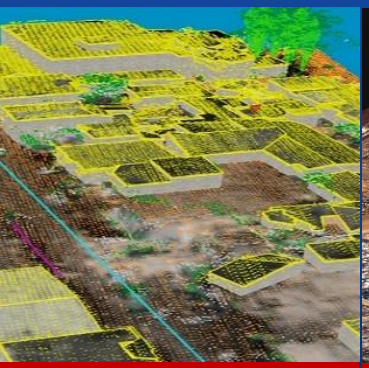
Deep learning, SAR analytics, feature extraction, DEM extraction, atmospheric correction, photogrammetry and NITF

Accessible

Accessible when and where you need in enterprise, partner platforms and in the cloud

ENVI Modules

Use ENVI Modules to quickly and easily perform highly-specialized tasks that require advanced image analysis tools.



FX
Feature Extraction Module

Find and extract specific objects of interest from all types of imagery with the ENVI Feature Extraction Module (ENVI FX).

DEM
DEM Extraction Module

The ENVI DEM Extraction Module is used to quickly and easily create spatially accurate DEMs from geospatial imagery.

ACM
Atmospheric Correction Module

Remove atmospheric interference from imagery with the ENVI Atmospheric Correction Module (ENVI ACM).

Photogrammetry
Photogrammetry Module

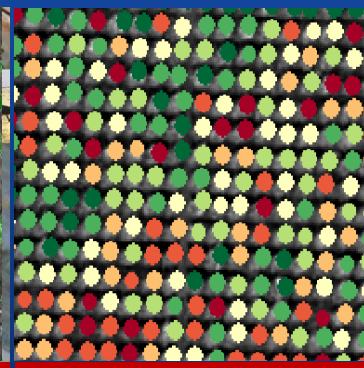
Register imagery to ground coordinates and geometrically correct them to remove distortions that happen during image capture with the ENVI Photogrammetry Module.

NITF
JITC Compliant NITF Module

Read, edit, and deliver NITF files using the ENVI NITF Module, certified by the Joint Interoperability Test Command (JITC).

ENVI DL
Deep Learning Module

Easy to use – no programming required, Quickly create and retrain classifiers
Works with multi-modal geospatial data and imagery to solve problems across industries, Automate analytics with deep learning for faster, more accurate results,



ENVI CS
Crop Science Module

Monitor crop health down to the individual plant level, Detect plant stress and target specific field locations for remediation, Monitor crop growth for harvest and yield predictions, Track changes over time and report results in a single image

Short Introduction To Synthetic Aperture Radar

SAR (Synthetic Aperture Radar)

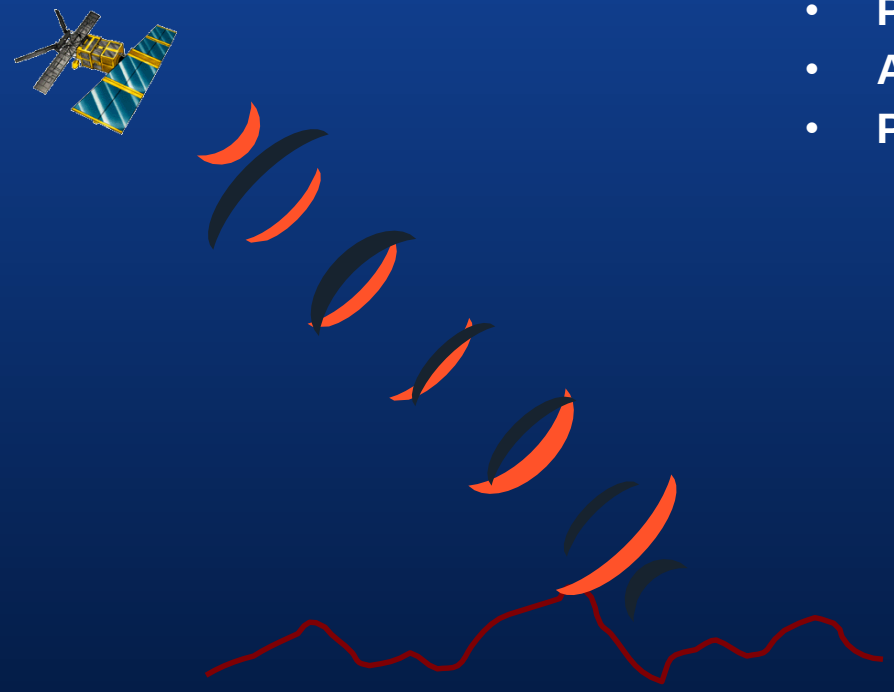
- Emits own radiation
- Microwave
- One channel

Why using SAR?

- Sunlight independent
  - day / night acquisitions
- “See through” clouds
- No weather influence
- No atmospheric influence
- Sensitivity to surface parameters (roughness, geometric shape, water content)

Challenges

- Side looking geometry (geometric distortions, speckle)
- InSAR error sources (decorrelation)



Information derived from the electromagnetic waves

- Propagation direction
- Wavelength
- Polarization
- Amplitude
- Phase

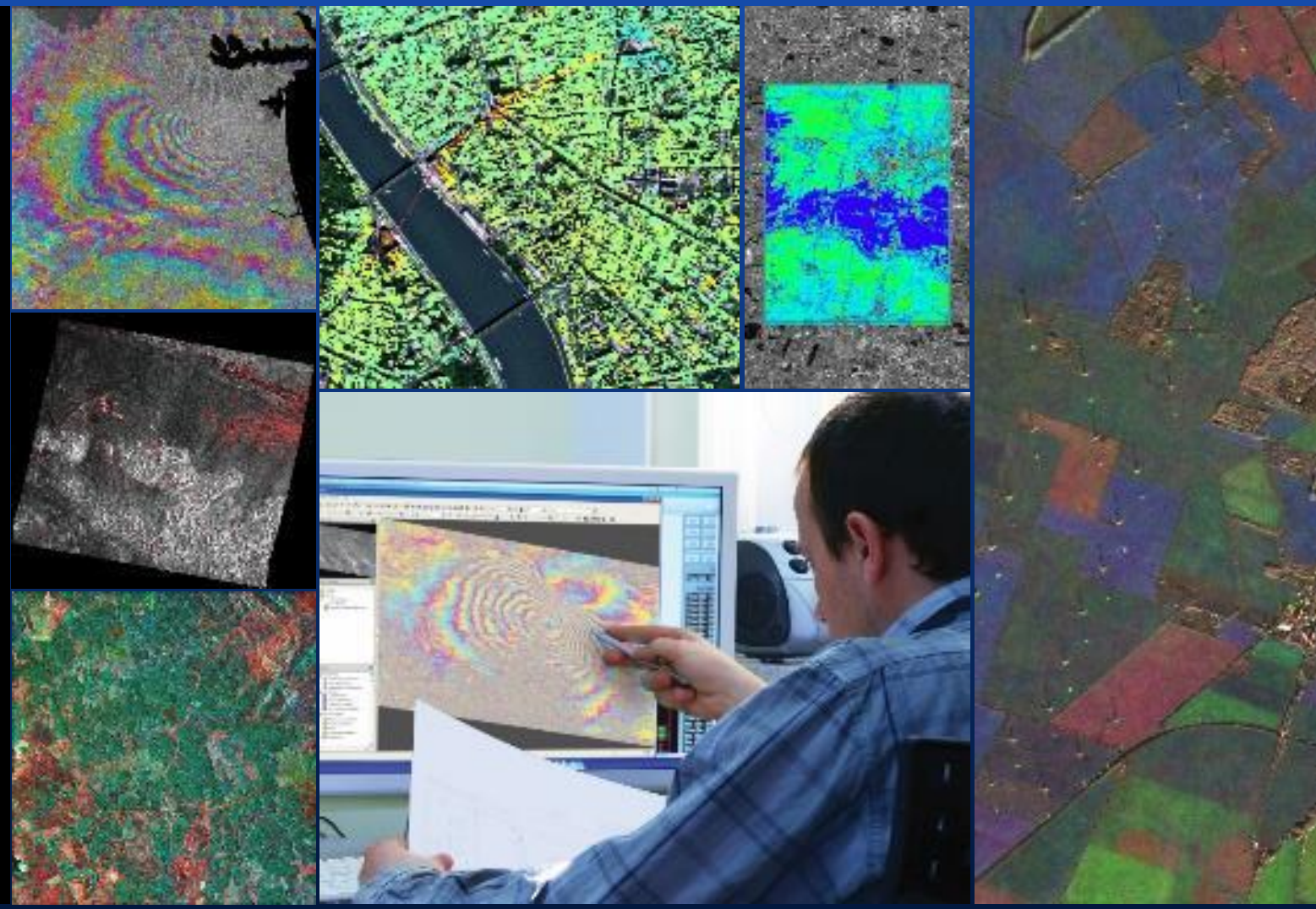
ENVI SARscape

Easily process and analyze SAR data

ENVI integration brings advanced image processing and analysis together with SAR processing in one package

Generate products (like DEMs or surface deformation maps) that can be integrated with other geospatial products

Built-in workflows and modules simplify processing and can be customized



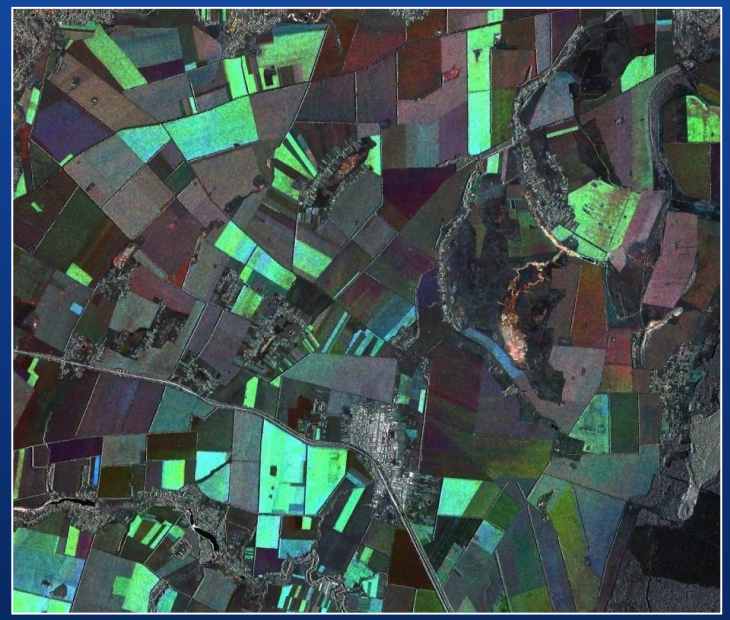
What is SARScape?

SARscape is a modular set of functions dedicated to the generation of products based on the following spaceborne Synthetic Aperture Radar (SAR) sensors:

ERS SAR 1 and 2
JERS-1 SAR
RADARSAT-1 and 2
ENVISAT ASAR
ALOS PALSAR
TerraSAR X-1
COSMO SkyMed-1
RISAT-1 and many others

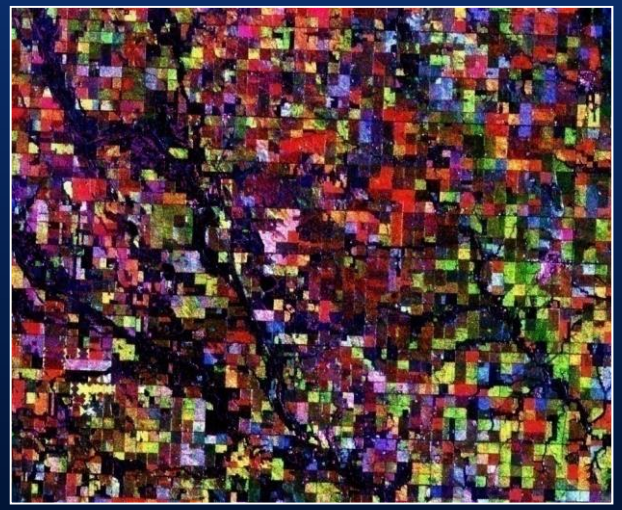
and following airborne SAR systems:

OrbiSAR-1 (X- and P-band)
TELAER
E-SAR
F-SAR
Astrium airborne SAR



SAR – Cosmo-SkyMed (3m)

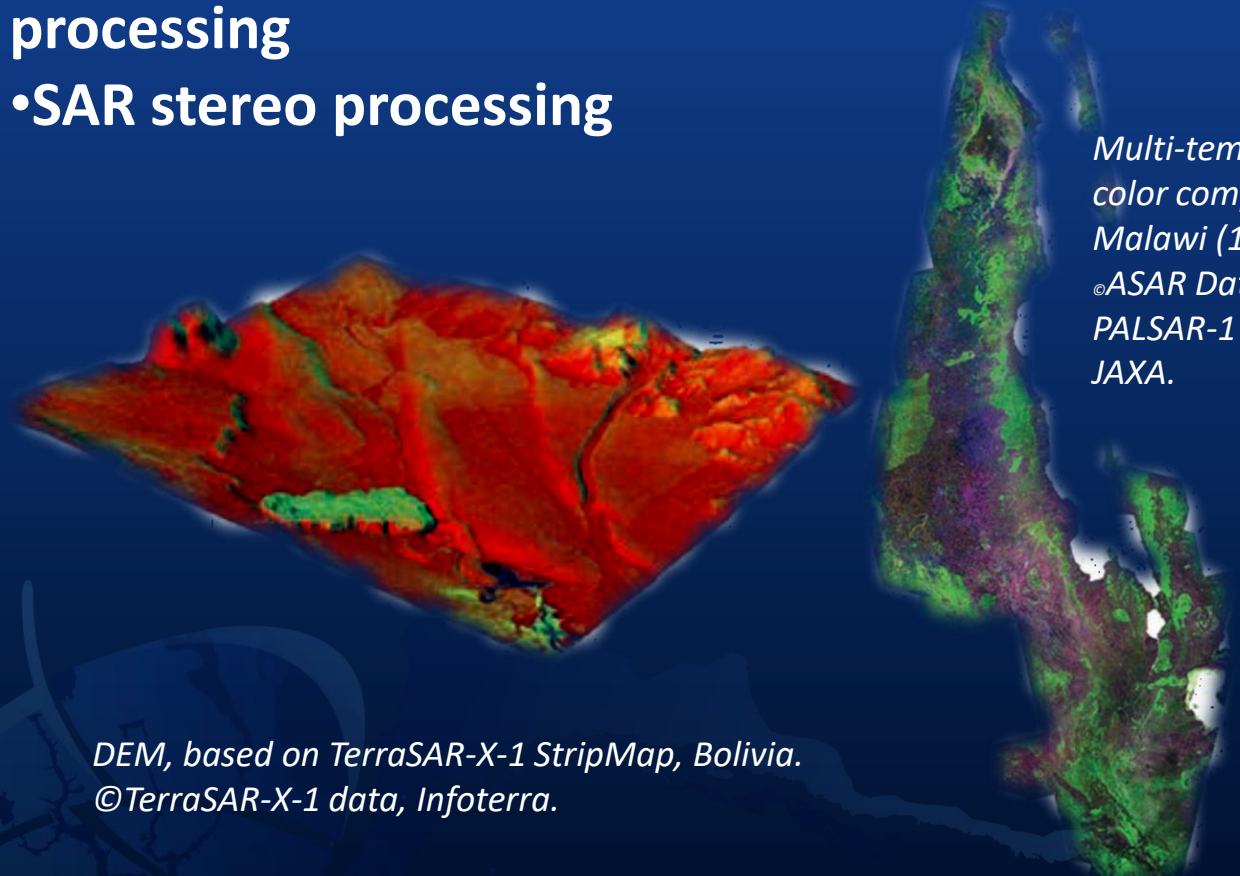
SAR – TerraSAR X



SAR – ENVISAT ASAR (15m)

Why SARscape?

- Processing of SAR Intensity
- Interferometric SAR (InSAR) processing
- Polarimetric SAR (PolSAR) processing
- Polarimetric-Interferometric SAR (PolInSAR) processing
- SAR stereo processing



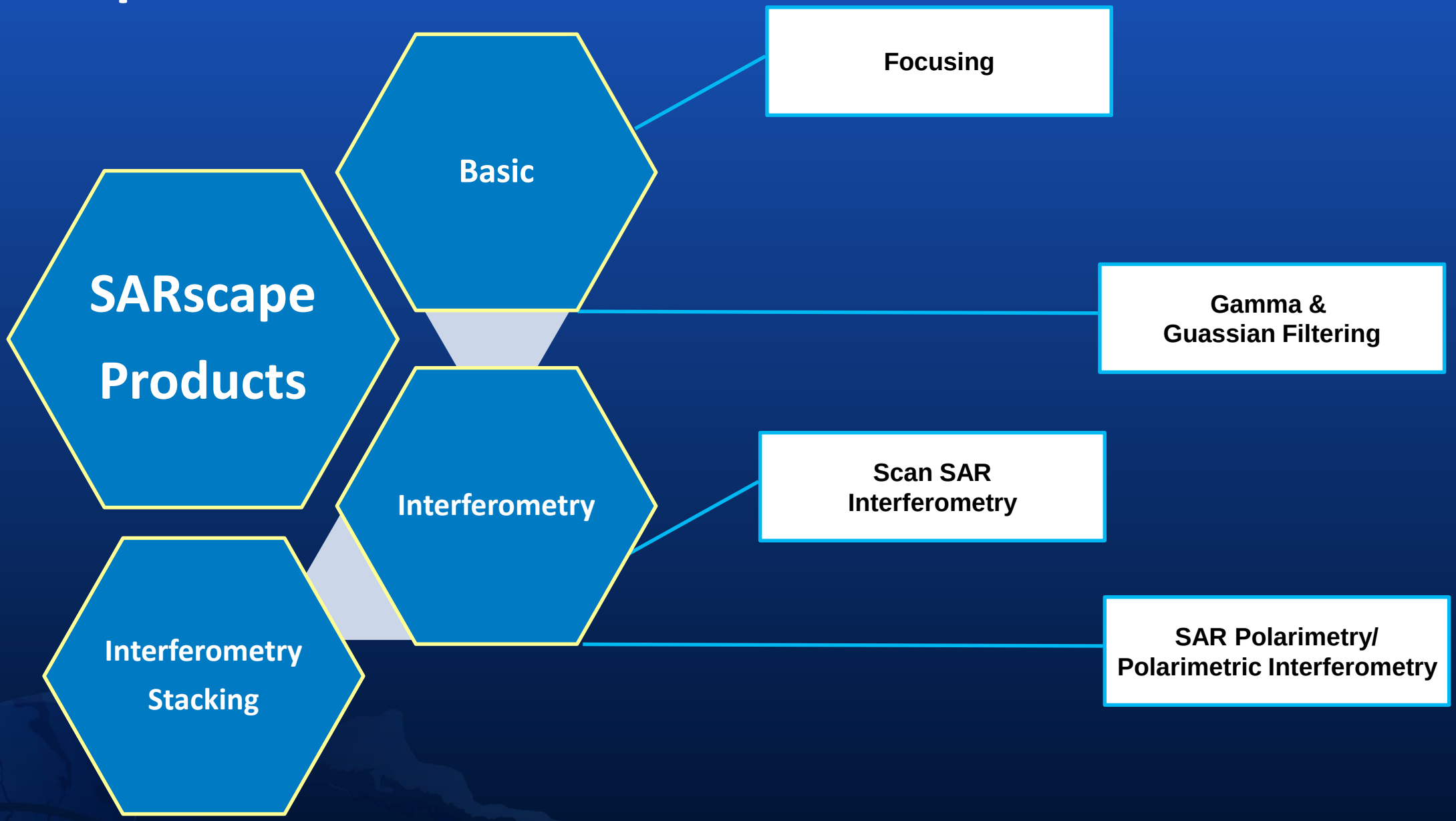
Multi-temporal SAR color composite of Malawi (160 images). ©ASAR Data: ESA; PALSAR-1 Data: METI - JAXA.

DEM, based on TerraSAR-X-1 StripMap, Bolivia. ©TerraSAR-X-1 data, Infoterra.

ENVI SARscape Capabilities

- Multilooking
- Coregistration
- Despeckling
- Geocoding and radiometric calibration
- Mosaicking
- Segmentation
- Classification

SARscape Products



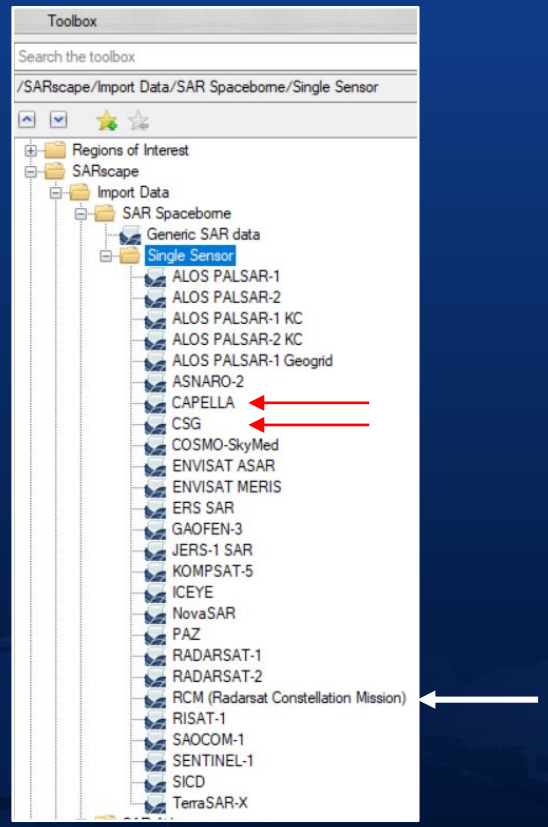
What's New in SARscape 5.6

Import Data

- **Drag and drop interface**.

The graphical user interface now enables to select one or more files via the OS file system explorer or the ENVI Layer Manager, and to drop them in a panel.

- **SAR Spaceborne/Single Sensor**



3 new sensors

- CAPELLA
- RCM (Radarsat Constellation Mission)
- CSG

1 new format

- SICD-Polar Format support

CAPELLA – X-band

Supported products**:**

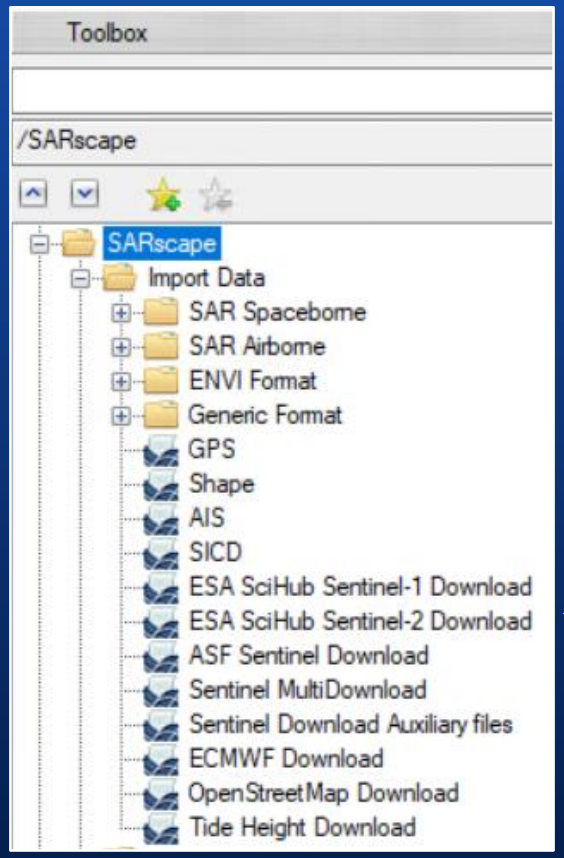
- GEO: Geocoded and Terrain Corrected using a Digital Elevation Model.
- SLC: Single Look Complex (only for image geometry type slant-plane).

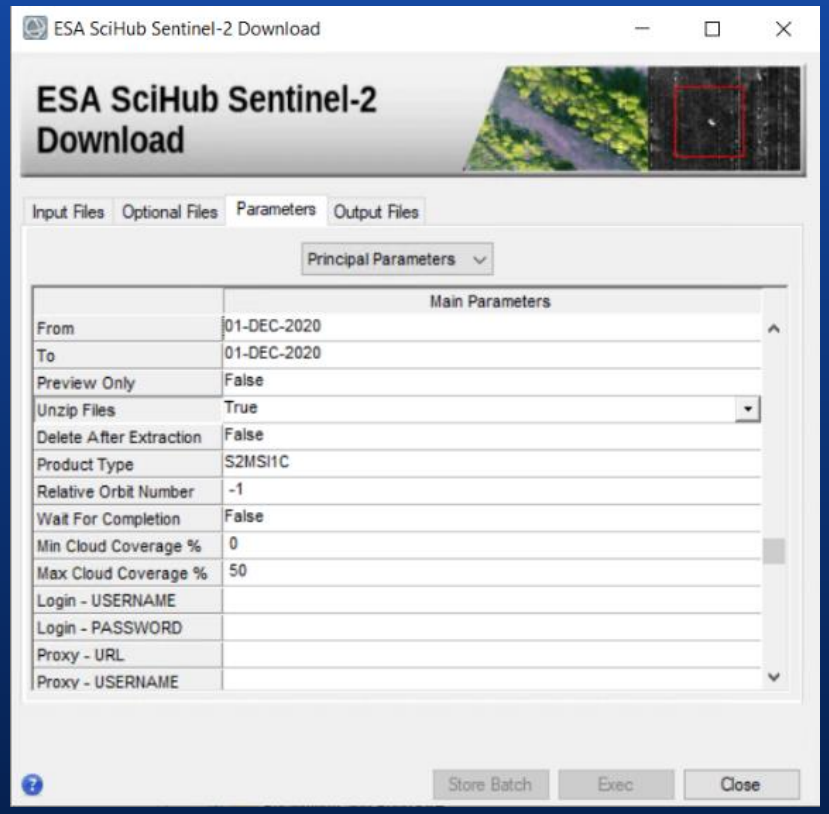
Courtesy: Capella Space

- **Very High resolution** data
- **Revisiting time 3-6 h (once the 40 satellites will be in orbit)**

Sentinel-2 Download

Query and download Sentinel-2 data from the ESA scientific Hub



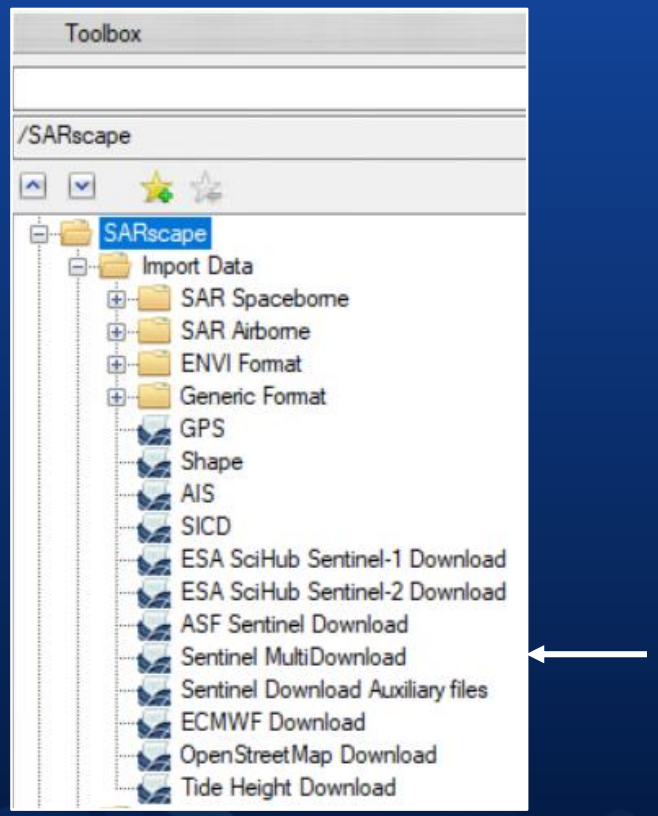


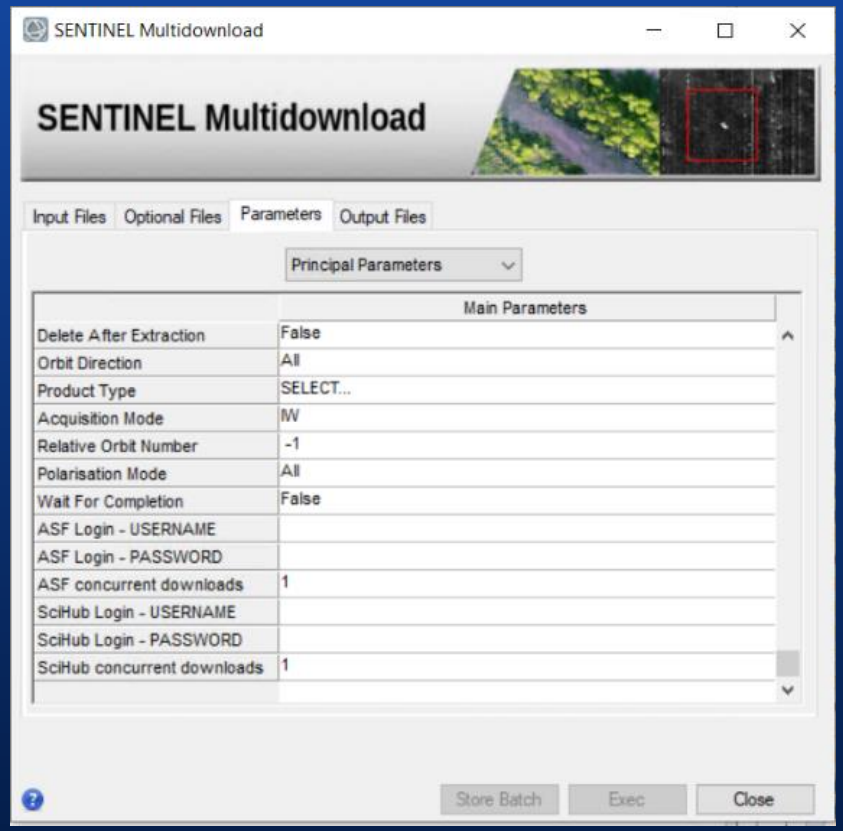
- Visually compare SAR and optical data

Sentinel MultiDownload

Query and download Sentinel data provided by

- **Alaska SAR Facility** ASF
- **ESA** scientific Hub



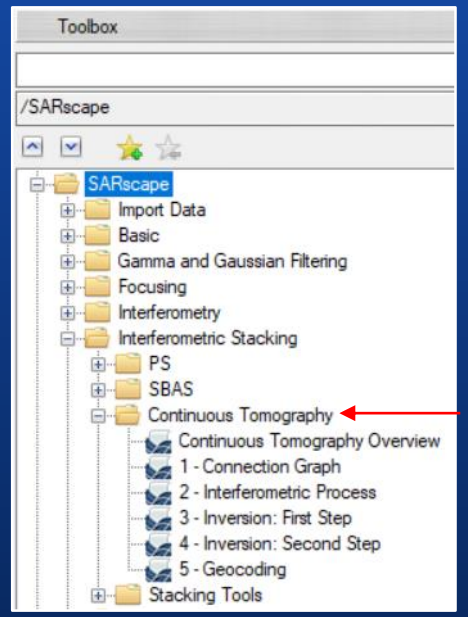


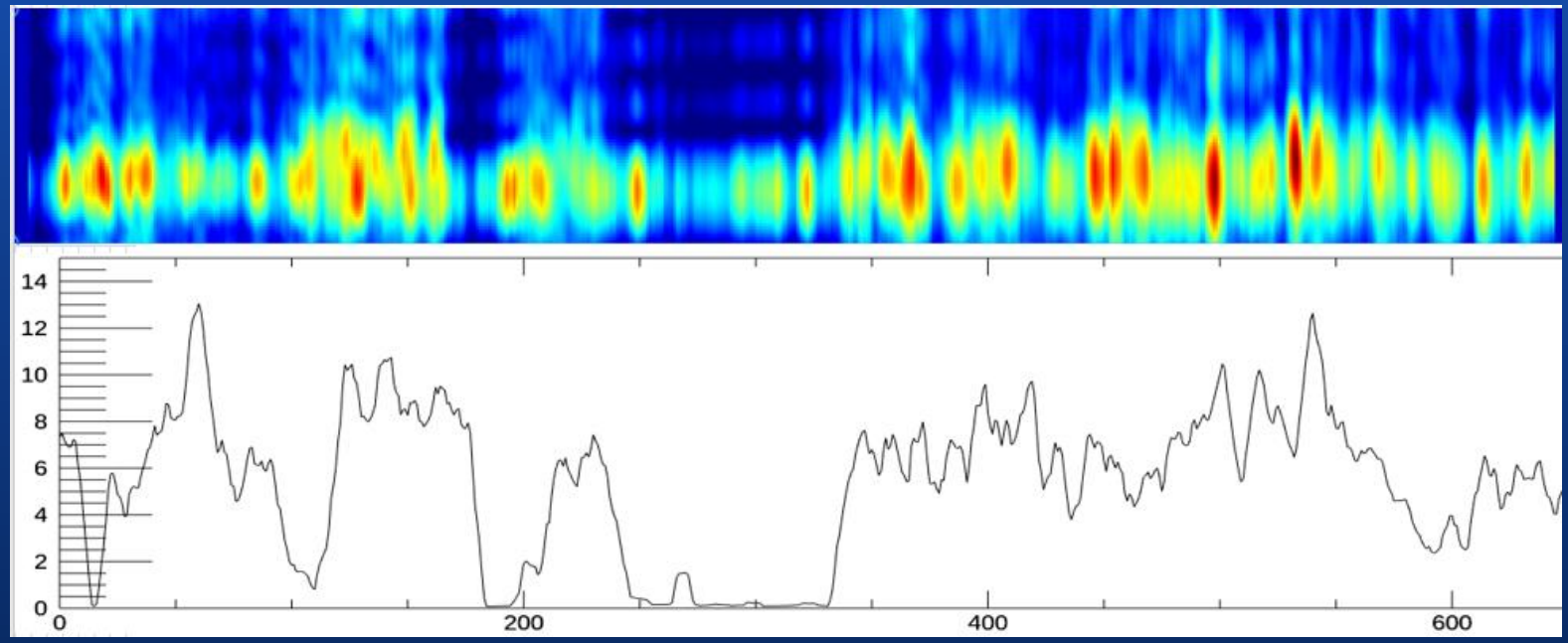
- It reduces the downloading time thanks to the two provider (ESA query for the most recent online data)
- It takes advantage of the online data available in the ASF (ASF query for the oldest data)

Continuous Tomography 1/2

Interferometric Stacking

A complete set of tools to process Continuous Tomography is now available.





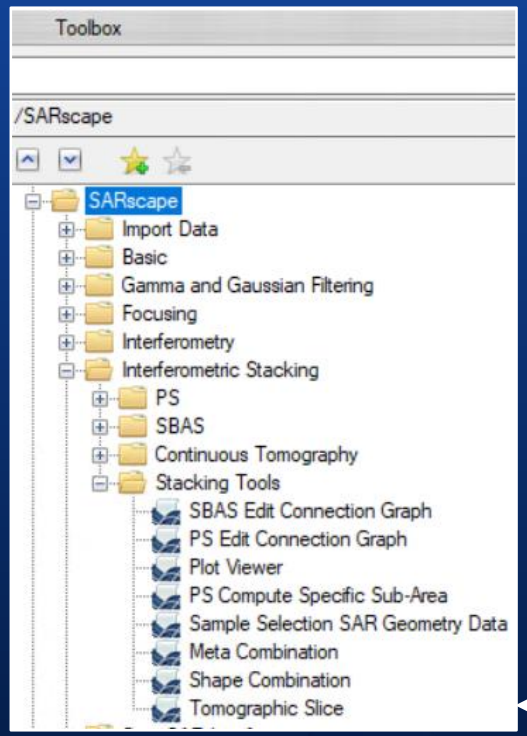
LIDAR h above ground

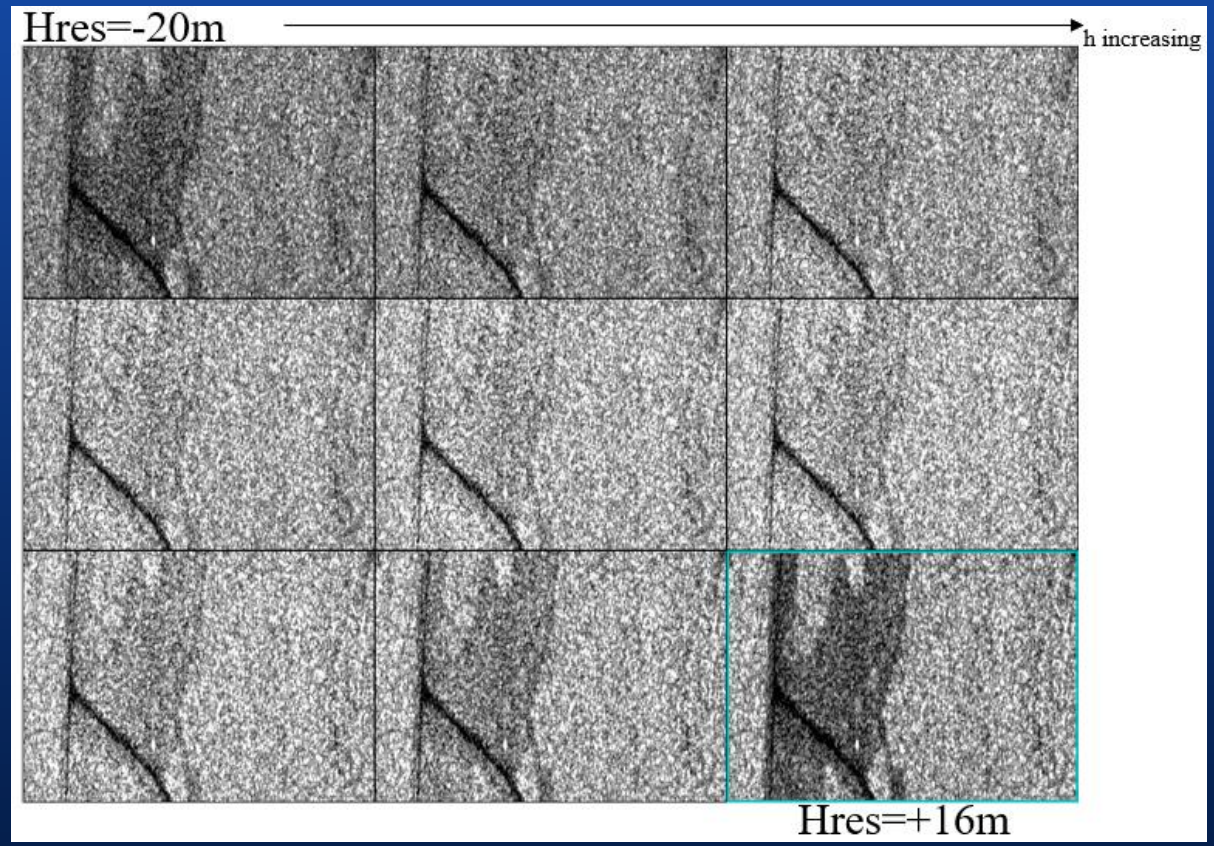
Interferometric Stacking /Continuous Tomography/TOMOGRAPHY

- 3D SAR radiometric and geometry reconstruction
- Results depends on the band sensor, it is particularly suitable for L-band and P-band
- To test the continuous tomography technique, airborne data are supported
- Ready tool to support future satellite mission –BIOMASS ESA for foresty purposes
- UAV SAR JPL data (airborne) that analysed the US forest condition will be supported soon
- Urban application

Continuous Tomography 2/2

Tomographic Slice





- The tomographic technique provides elevation slices

TDM 90 (World DEM Tandem-X)

The Digital Surface Model (DSM) tiles of the WorldDEM Tandem-X (90 m resolution) are downloaded from the DLR service

- The TDM DEM is the most recent and available for free

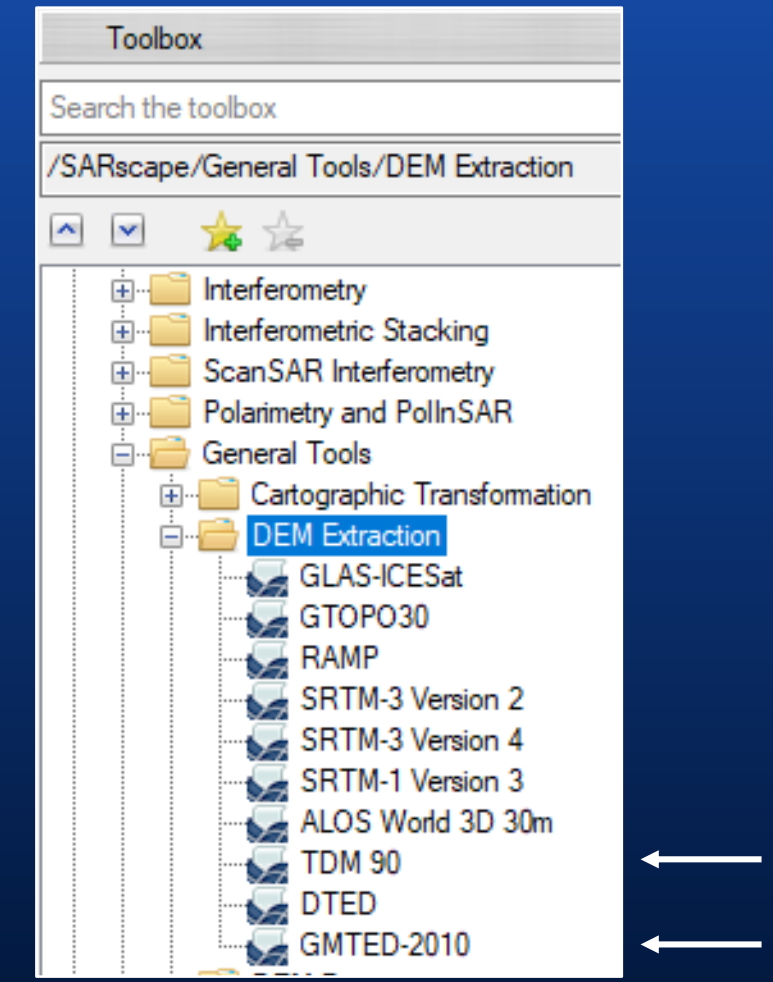
General Tools/DEM Extraction/TDM 90 (World DEM Tandem-X)

GMTED-2010

The enhanced global elevation model Global Multi-resolution Terrain Elevation (GMTED-2010) is included in the SARscape installer (off-line use)

- GMTED-2010 replaces the GTOPO30

General Tools/DEM Extraction/GMTED-2010



Improvements

Workflows

Workflows

- Integrated Import data
- sample selection
- DEM download

} in a SINGLE STEP

Generic SAR data

Automatic sample selection if }

- vector file (.shp),
- Google Earth file (.kml or .kmz)

The _**cut** suffix is not included in the output filename

Import Data/SAR Spaceborne/Generic SAR data

Import

SENTINEL-1 Auxiliary: Import S1 - Generic SAR data - Focusing S1

- If the auxiliary are not included in the repository, the auxiliary files are downloaded during the processing
- The downloaded auxiliary files are stored in the SARcape working directory
- The downloaded auxiliary files are used during the processing, after that orbit files are deleted

Import Data/SAR Spaceborne/Single Sensor/SENTINEL-1 (and in Generic SAR data, Focusing)

Basic

Multilooking

New multilooking methods:

- Time domain
- Frequency domain

Basic/Intensity Processing/Multilooking

Interferometric Stacking

PS

- Speedup improvement in wide areas
- New meta raster file for decomposition purposes

Interferometric Stacking/PS/PS

SBAS

- new folder structure
- **automatic** discharge of bad quality interferogram (Edith Connection Graph)
- new linear periodic model (1st & 2nd inversion)
- use of different model 1st & 2nd inversion
- opportunity to reject outliers for displacement and height
- opportunity to set the minimum number of connections per acquisition to reduce redundancy
- displacement time series is reported to zero, if the interpolation is performed in the Second Step/Parameters

Interferometric Stacking/SBAS/

General Tools

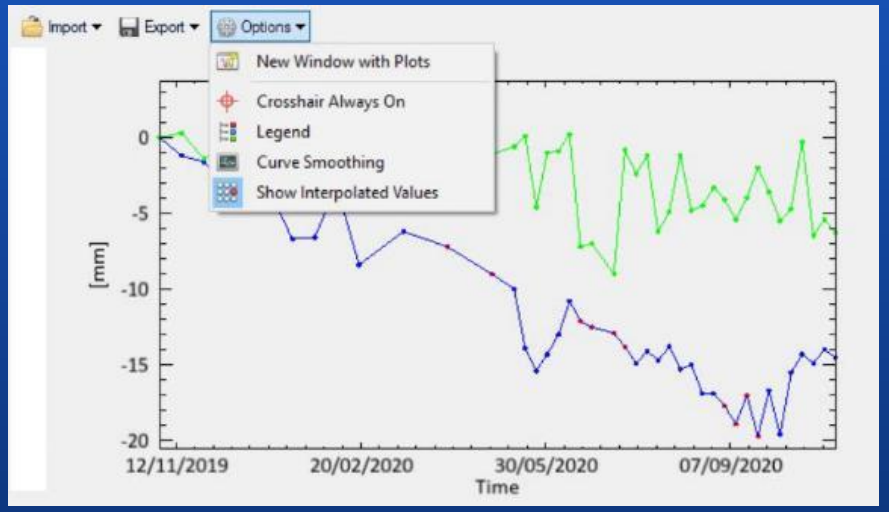
Time Series Analyzer Plot

Temporal Interpolation Code In Time Series set to True in geocoding results (Other Parameters)

the interpolation options are displayed

The red point shows temporal interpolated values to quickly identify the Disconnected Blocks (disconnected time series).
If all the points are displayed in red, all the corresponding dates have been spatially interpolated.

Plot information dedicated to interpolation option

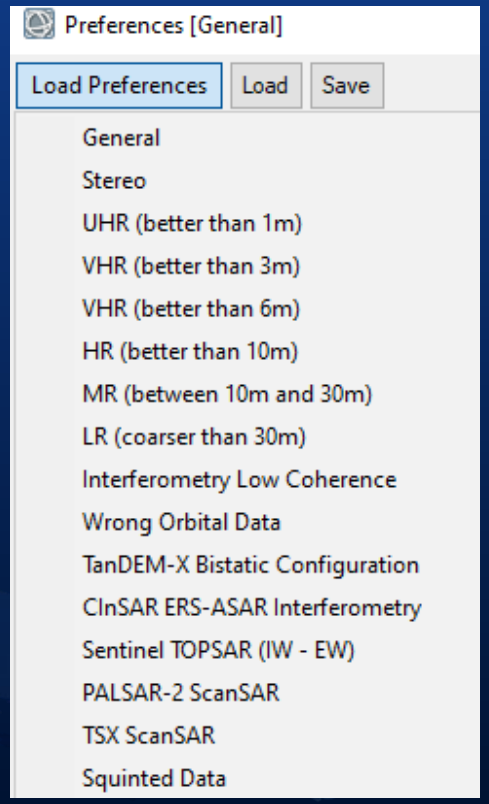


Preferences

Preferences Specific

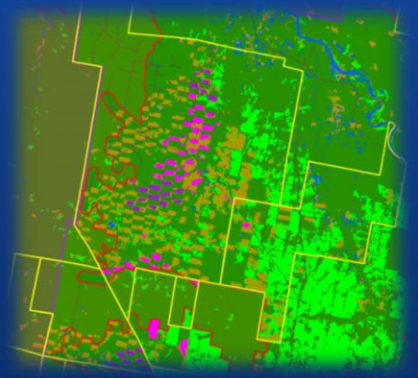
New resolution specifications

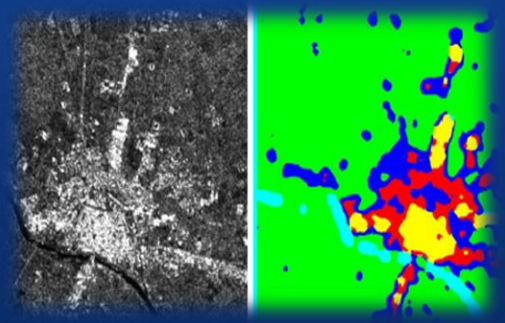
- Ultra High Resolution (UHR)
- Very High Resolution (VHR), 2 options
- High Resolution (HR)
- Medium Resolution (ML)
- Low Resolution (LR)



SARscape Applications

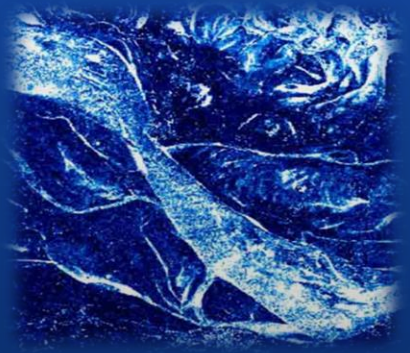
Forest Mapping

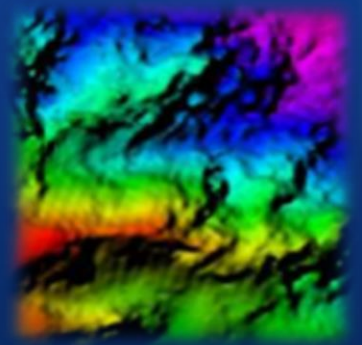




Urban Density Mapping

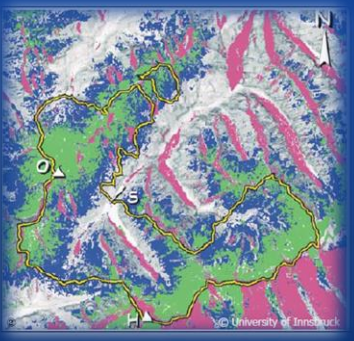
Flood Mapping



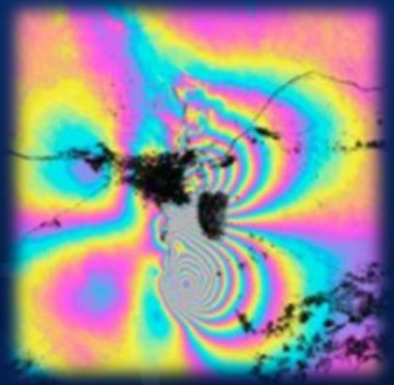


Geomorphology

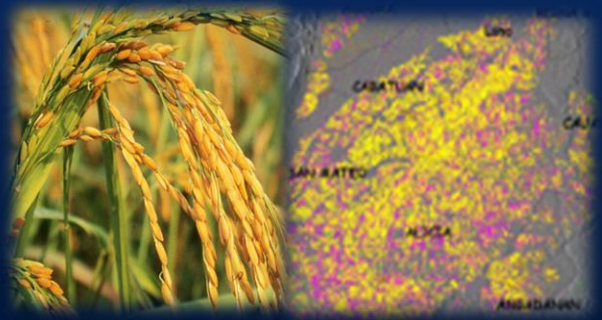
Snow Mapping



Agriculture Monitoring



Land Subsidence



Rice Mapping

DEMO

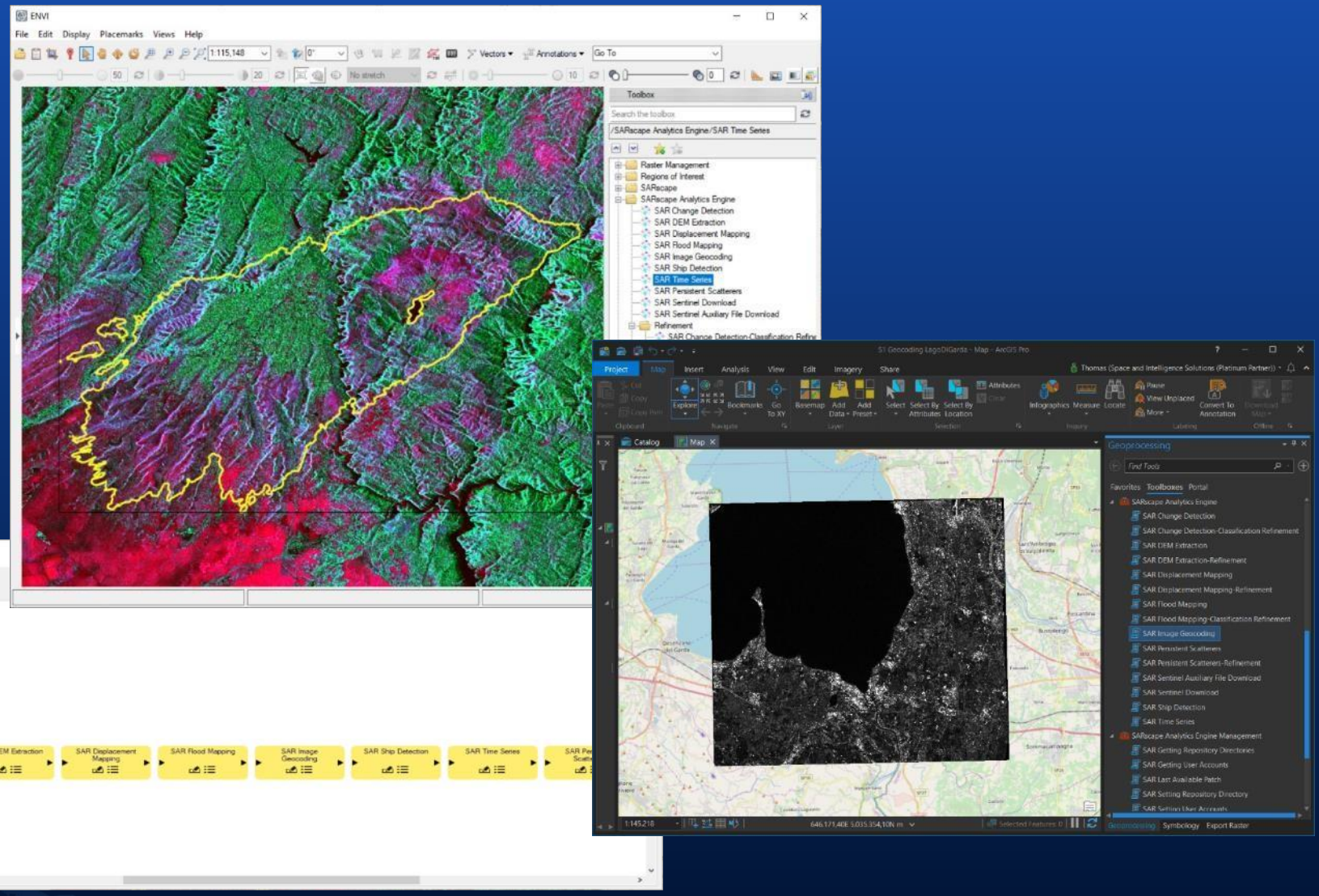
Introduction to SARscape Analytics Toobox

Introducing SARscape Analytics Toolbox

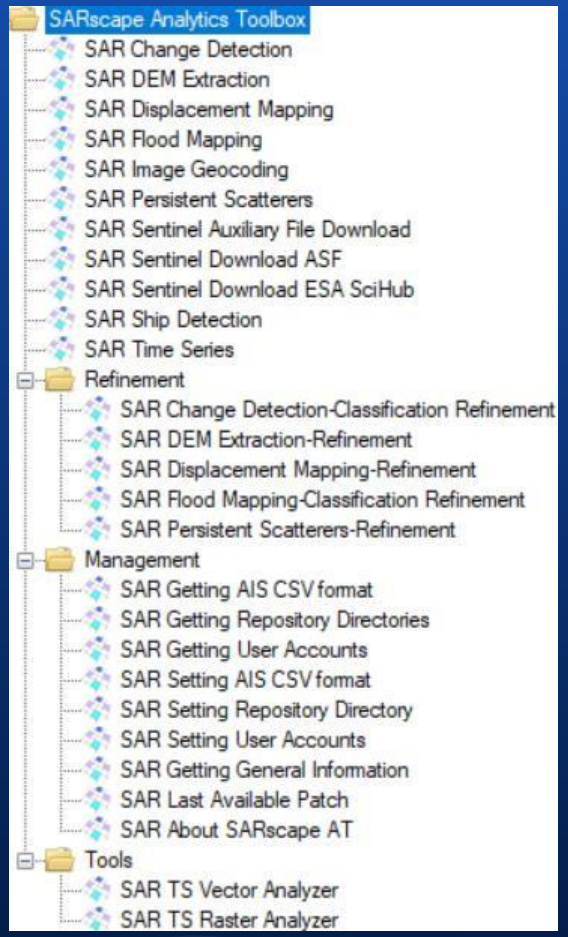
L3Harris Geospatial and sarmap SA, the leaders in image science and SAR analytics, have created easy-to-use tools for some of the most common SAR processing applications.

SARscape Analytics Toolbox can now be accessed in

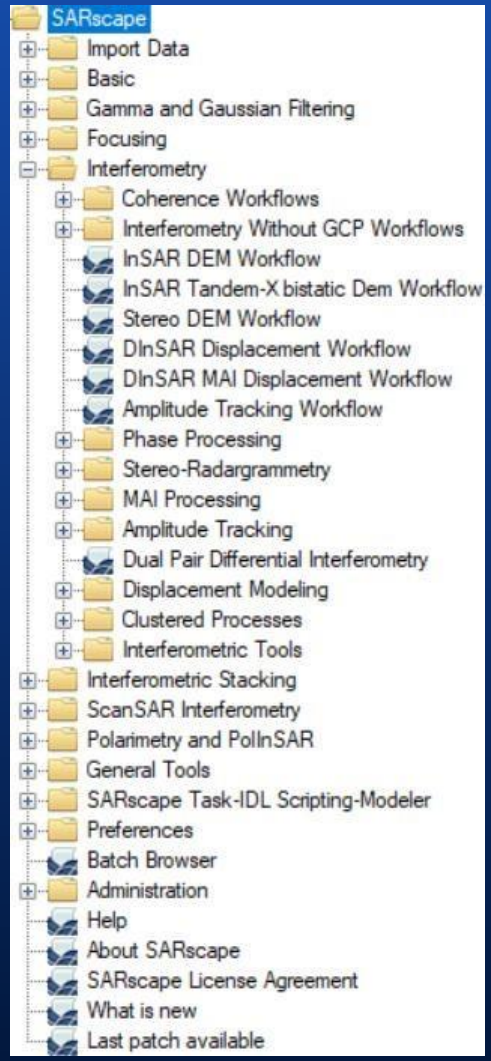
- **ENVI Desktop,**
- **ENVI Modeler, and**
- **ArcGIS Pro.**



Introducing SARscape Analytics Toolbox



SARscape Analytics Toolbox	SARscape
• User-friendly	• Complete and exhaustive
• All-in-one workflows • Includes world-leading SARscape algorithms	• Modules • Workflows • Parameter auto-completion • Automated processing
• Basic knowledge on SAR system and techniques	• Good knowledge on SAR system and techniques
	• **SARscape Batch** to run stored processing sequences
	• **IDL script** to generate customized procedures
	• **ENVI Modeler** to create workflows without coding
	• **SARscape Cluster** to run CPU-intensive tasks on a series of processing nodes



Introducing SARscape Analytics Toolbox

Benefits and applications

- **User-friendly**
- **All-in-one workflows**
- **Basic SAR knowledge**

- **Low user supervision**
- **Data input validation**
- **Output:**
  thematic map (raster) or point information (shape)

#	Workflow	Applications
03	SAR Image Geocoding	• Image analysis
04	SAR Time Series	• Land use analysis (crop / forest monitoring) • Natural disaster monitoring • Change detection (illegal movements)
05	SAR Flood Mapping	• Agriculture (irrigated areas mapping) • Natural disaster management
06	SAR Ship Detection (incl. AIS Tracking)	• Military • Civil authorities (illegal movements, piracy)
07	SAR Change Detection	• Agriculture (crop / forest classification) • Natural disaster management (damage assessment) • Military (vehicle tracks detection)
08	SAR DEM Extraction	• Topographic analysis
09	SAR Displacement Mapping	• Natural disasters (earthquakes, landslides, tailing dams collapsing)
10	SAR Persistent Scatterers	• Natural monitoring (ground surface deformation) • Monitoring of civil infrastructures

Introducing SARscape Analytics Toolbox

Supported sensors

All workflows of the SARscape Analytics Toolbox ingest original SAR data files or imported SARscape raster format.

To save processing time, most inputs are in SARscape raster format (_slc /_slc_list /_cut_slc /_cut_slc_list), generated during SAR data import by the SARscape software.

Sensor	Format		Sensor	Format
ALOS PALSAR-1	img*; *.dat		ICEYE	*.h5; *.H5 (preliminary)
ALOS PALSAR-2	IMG*; *.dat		RADARSAT-1	*.xml
ASNARO-2	IMG-*1.1_*; IMG-		RADARSAT-2	DAT*; dat*; *.D; *.d
COSMO-SkyMed	*.h5; *.H5		RISAT-1	product.xml; *.ntf
ENVISAT ASAR	*.N1		Sentinel-1	*manifest.safe
ERS SAR	*.E1; *.E2		SICD	*.nitf; *ntf
GAOFEN-3	*.meta.xml		TerraSAR-X and Tandem-X	*.xml
KOMPSAT 5	*.h5; *.H5		PAZ-1	*.xml

Introducing SARscape Analytics Toolbox

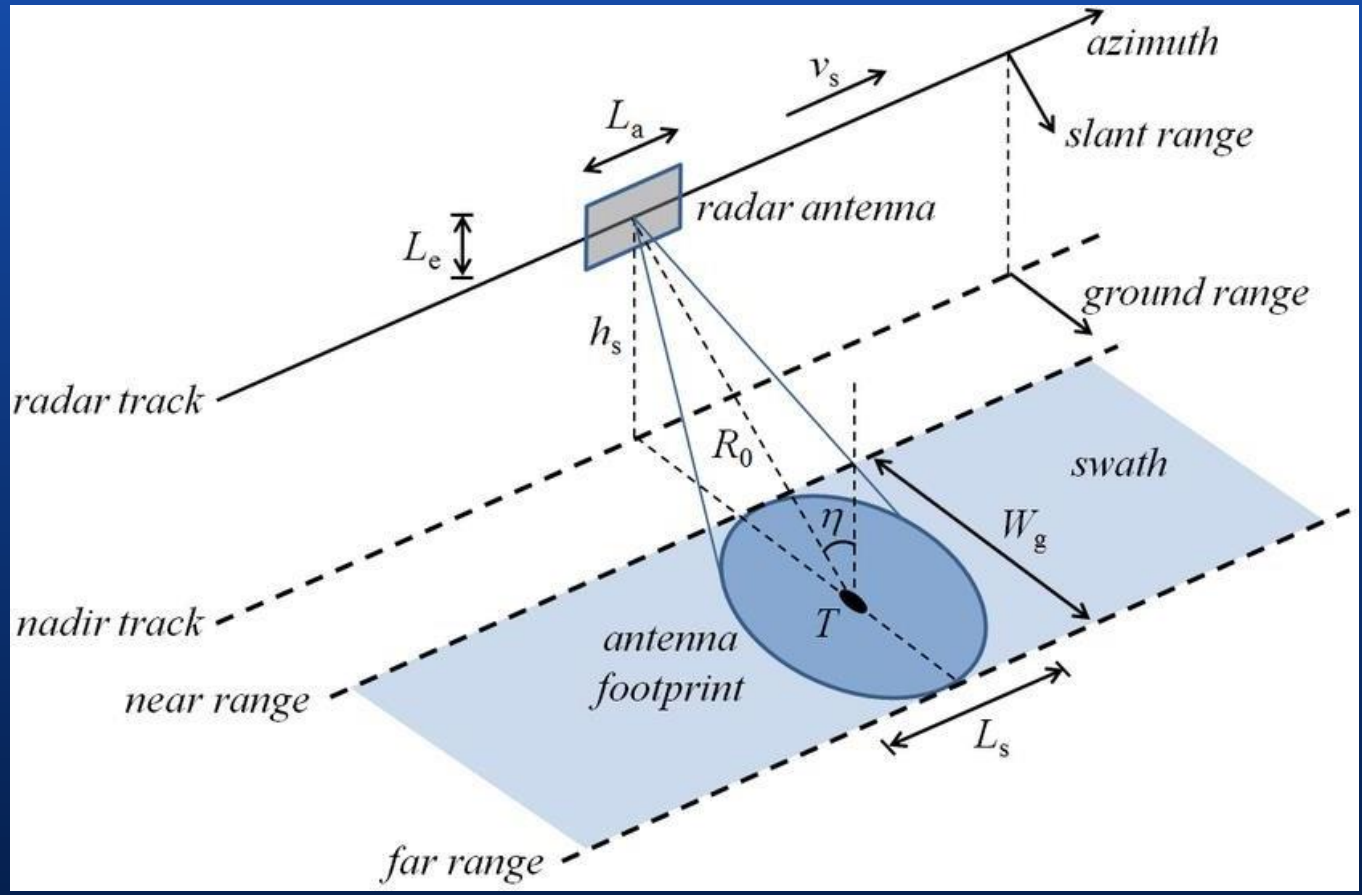
An important note on sensor data input

All input datasets of the workflows

- **Time Series,**
- **Flood Mapping,**
- **Change Detection,**
- **DEM Extraction,**
- **Displacement Mapping,**
- **Persistent Scatterers,**

require the following properties:

- **same sensor,**
- **same acquisition geometry (Ascending or Descending),**
- **same incidence angle,**
- **same data type,**
- **same polarization.**



*Martone, Michele. (2019). Onboard Quantization for Interferometric and Multichannel Synthetic Aperture Radar (SAR) Systems.

Introducing SARscape Analytics Toolbox

Supported coordinate systems

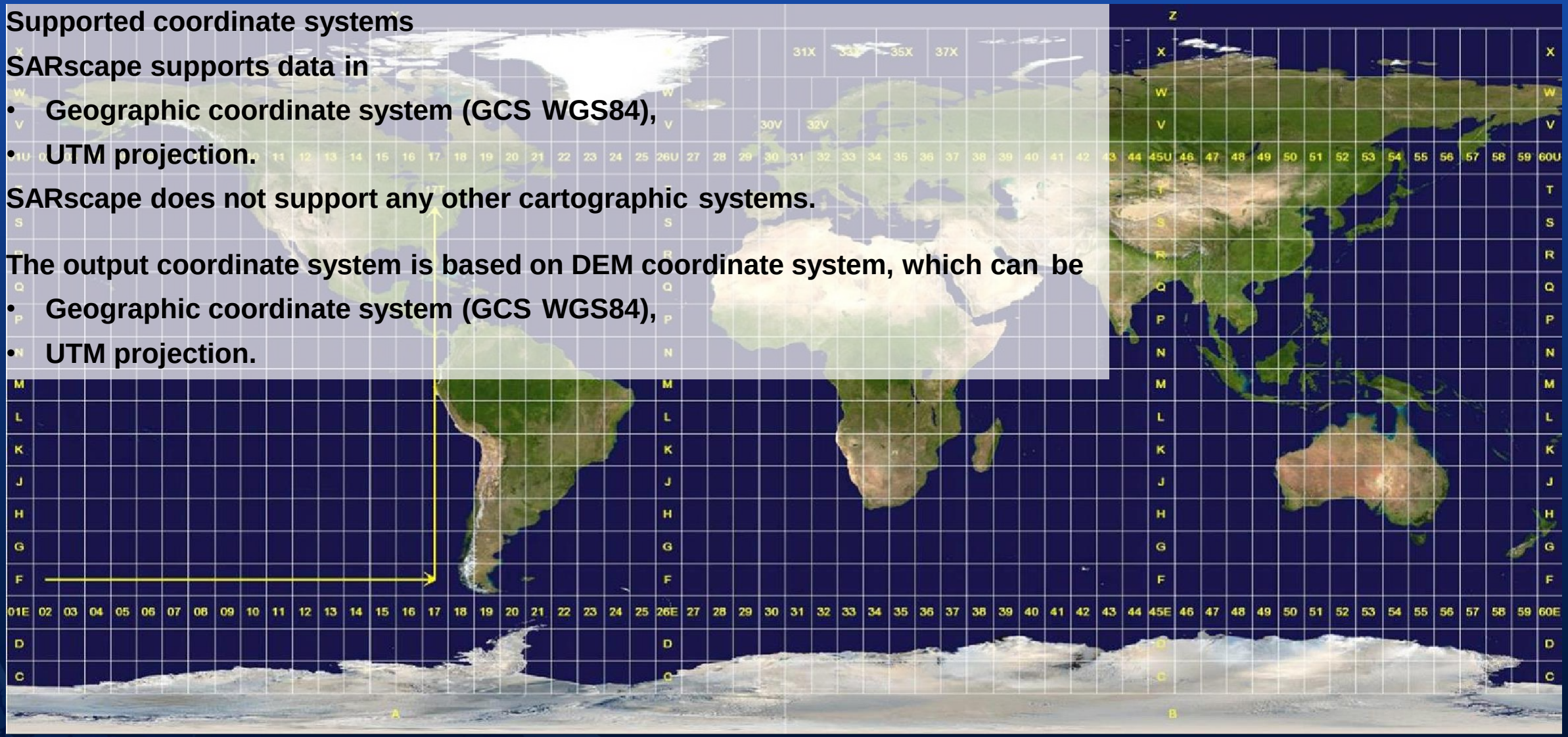
SARscape supports data in

- **Geographic coordinate system (GCS WGS84),**
- **UTM projection.**

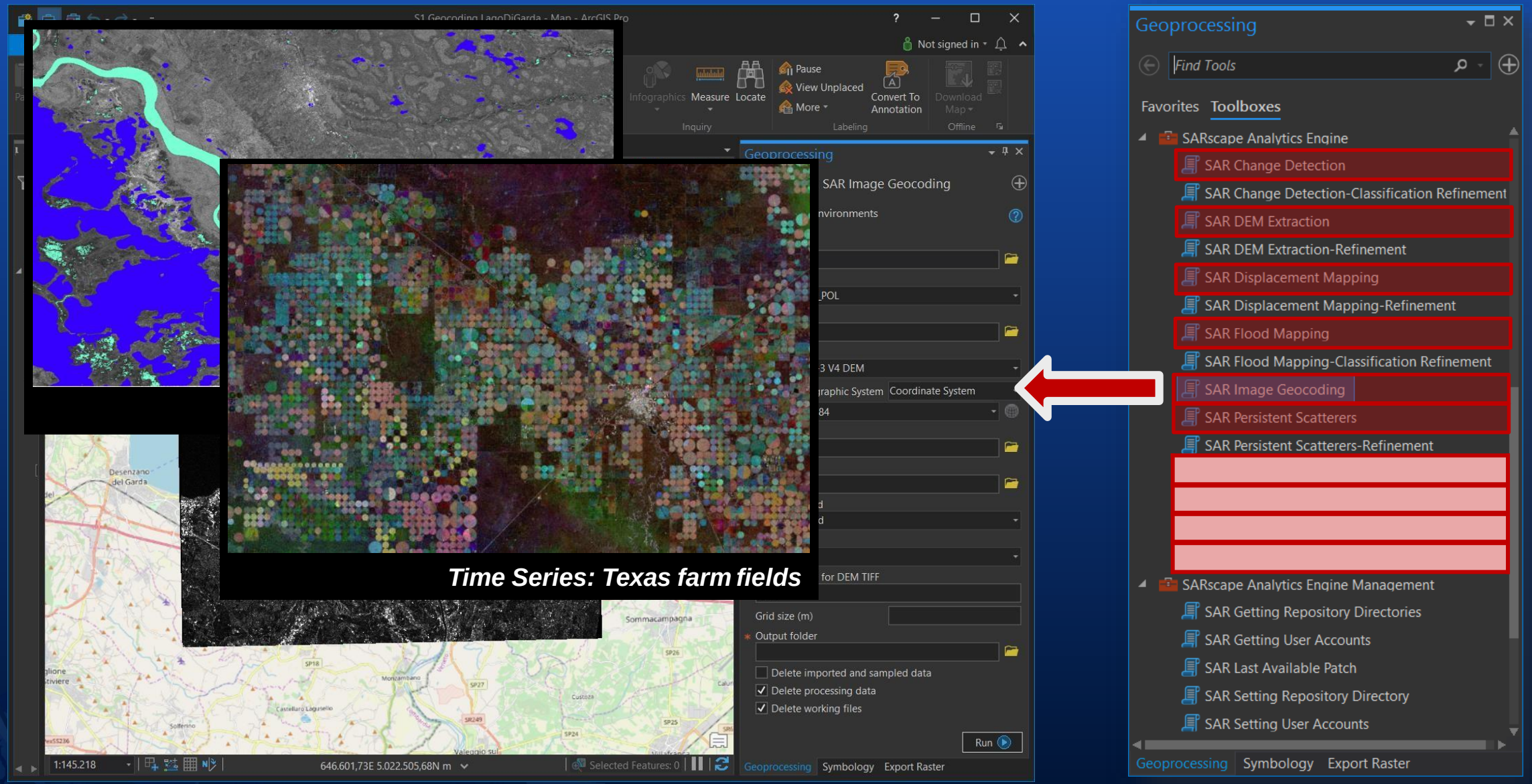
SARscape does not support any other cartographic systems.

The output coordinate system is based on DEM coordinate system, which can be

- **Geographic coordinate system (GCS WGS84),**
- **UTM projection.**



ENVI SARscape Analytics in ArcGIS Pro



DEMO

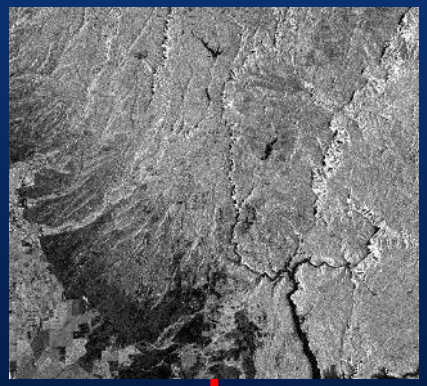
SAR Change Detection
SAR Change Detection Classification Refinement

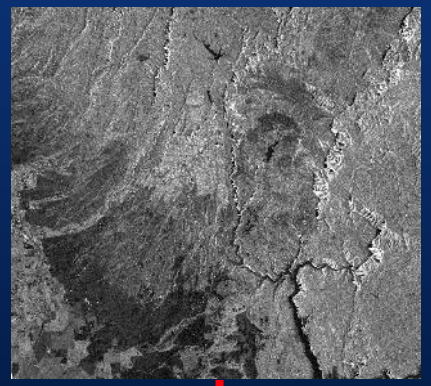
This tool creates a classification raster that identifies changes between two images.
It performs amplitude and phase analysis.

Amplitude analysis uses the intensity of the SAR images to track changes over time.

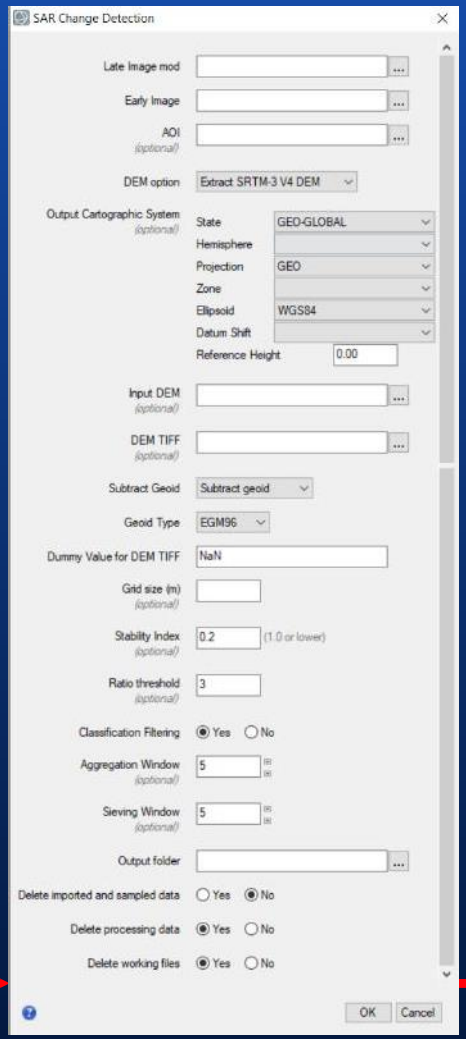
Phase analysis uses the coherence, or stability index, between the scenes input to track changes.
This workflow can detect subtle changes in the structure of the scene viewed.

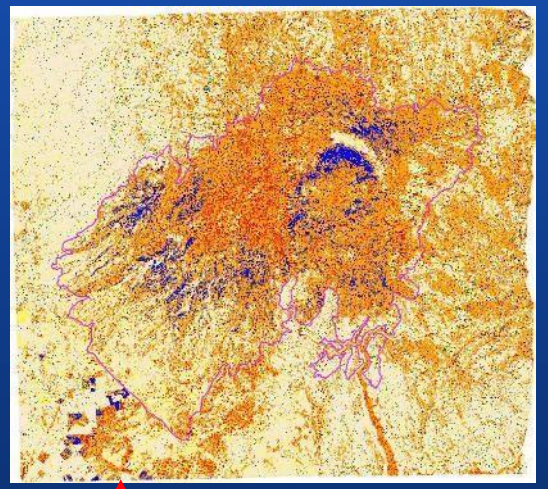
Data courtesy esa

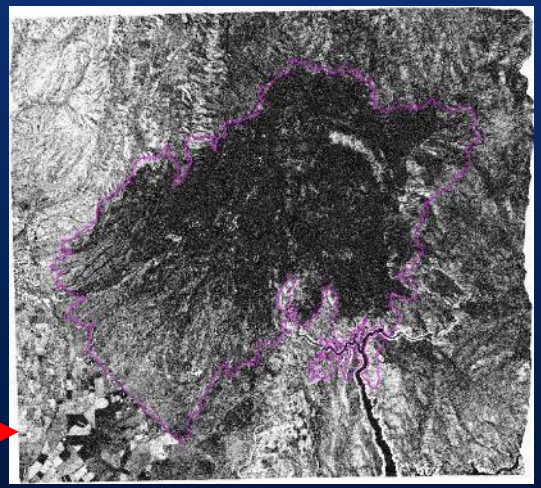




Sentinel-1 pre-fire and co-fire images, California, U.S.







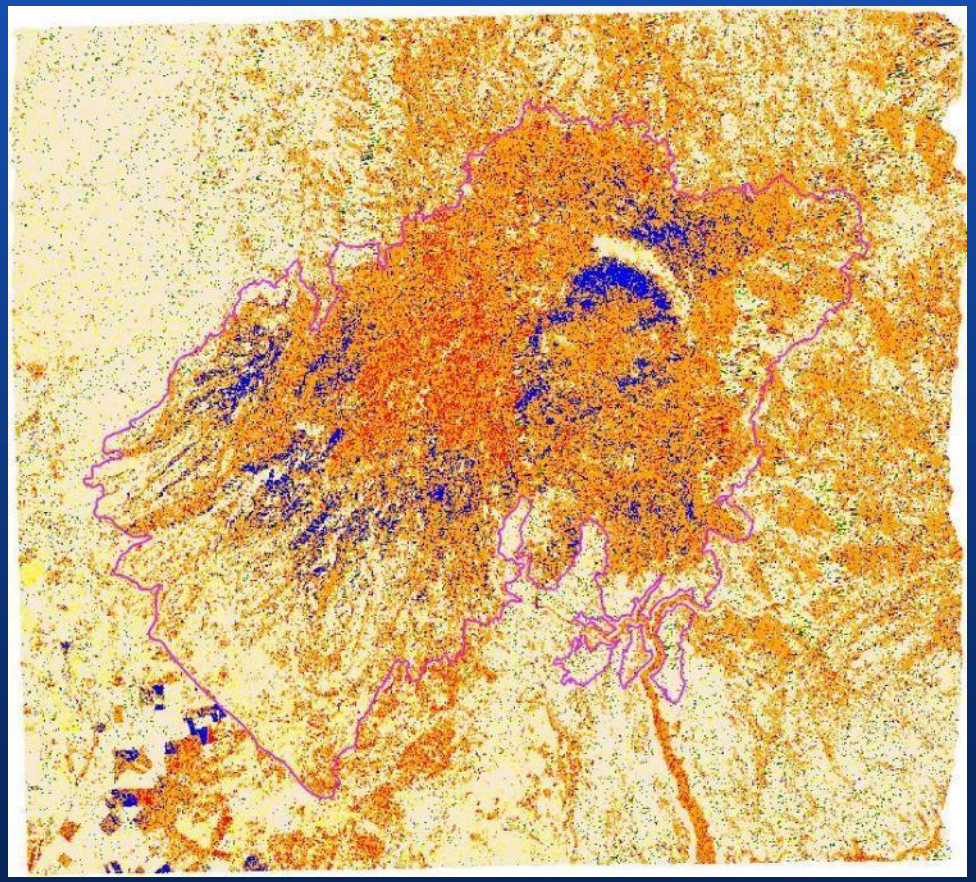
Filtered change detection map (top)
and stability index (coherence) image (bottom)

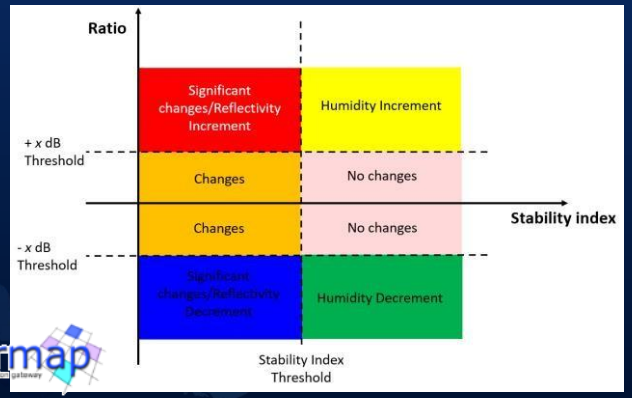
SAR Change Detection – Result Evaluation

Explore the resulting Change Detection Map

Display the Change Detection Map and evaluate it using the classification key:

- Changes (i.e. forest, dense canopy)
- No changes
- Significant changes/Reflectivity increment (i.e. water, farming)
- Significant changes/Reflectivity decrement (i.e. water, farming)
- Humidity increment (i.e. moisture increase)
- Humidity decrement (i.e. freezing, drying)





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