LAND & SEA APPLICATIONS USING SAR

sarmap
your information gateway

HARRIS® TECHNOLOGY TO CONNECT, INFORM AND PROTECT™

Meet the Presenters

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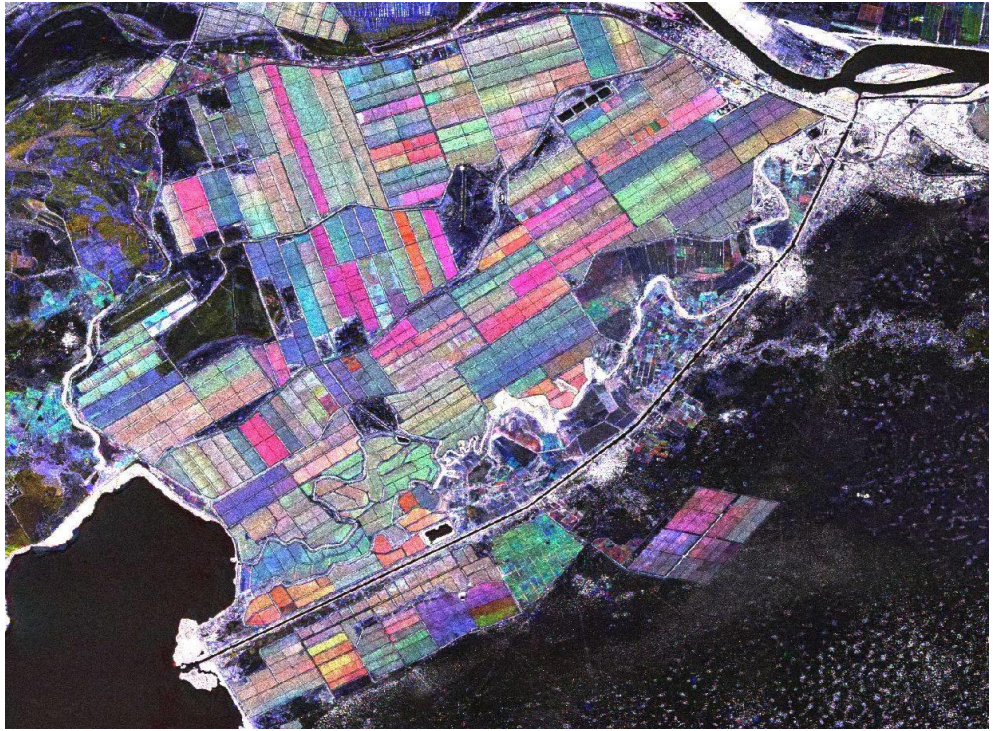
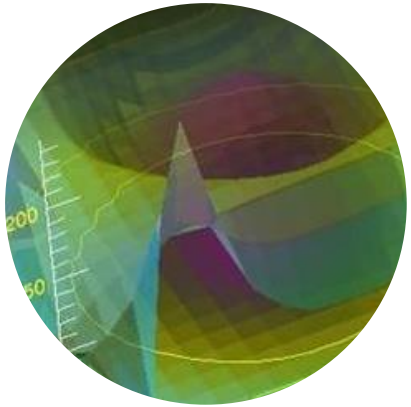
Overview

- **Introductions**
- **Background on SAR**
- **Ocean Applications**
  - Ship Detection
  - Oil Spills
- **Land Applications**
  - Burn Area Analysis
  - Land Surface Deformation



Poll Question #1

Harris Geospatial Solutions – SW Portfolio



IDL

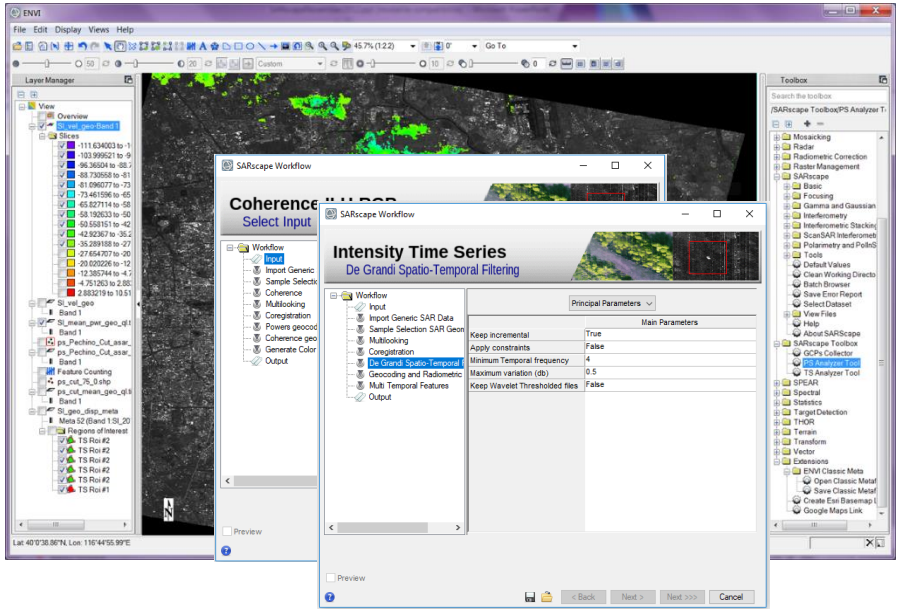
ENVI

Geospatial Services Framework

SARscape

sarmap
your information gateway

An integrated software platform for operational processing of SAR data



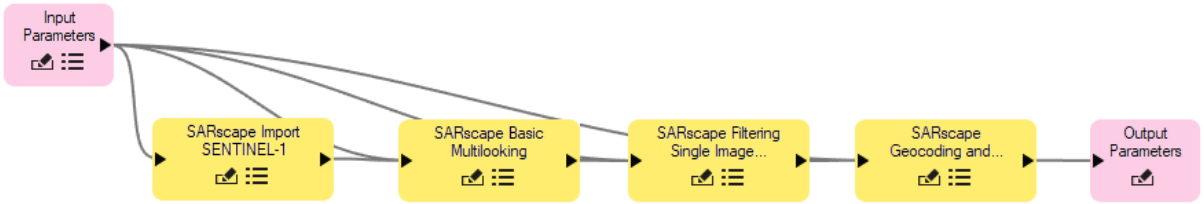
ENVI UI

ENVI Workflows

ENVI Modeler

ArcGIS Pro

Desktop-Enterprise-Cloud



Run SARscape where you are most comfortable.

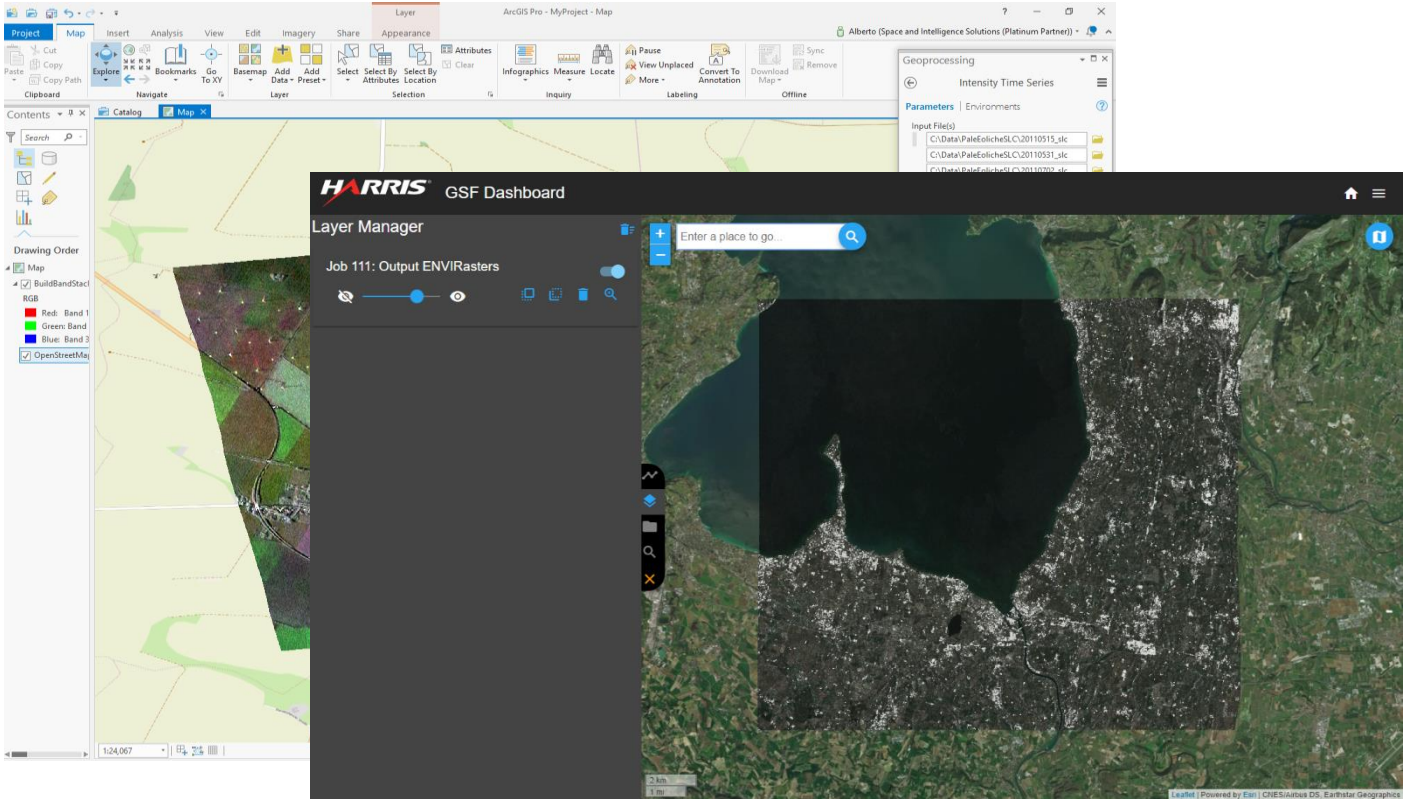
ENVI UI

ENVI Workflows

ENVI Modeler

ArcGIS Pro

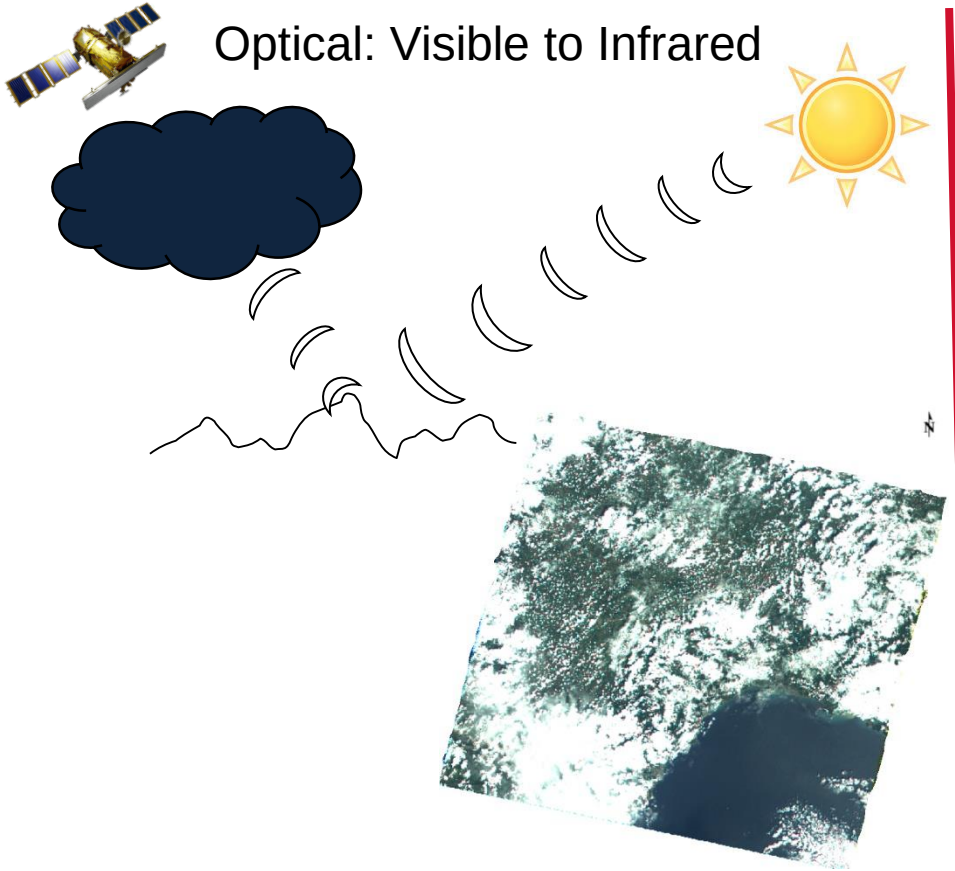
Desktop-Enterprise-Cloud



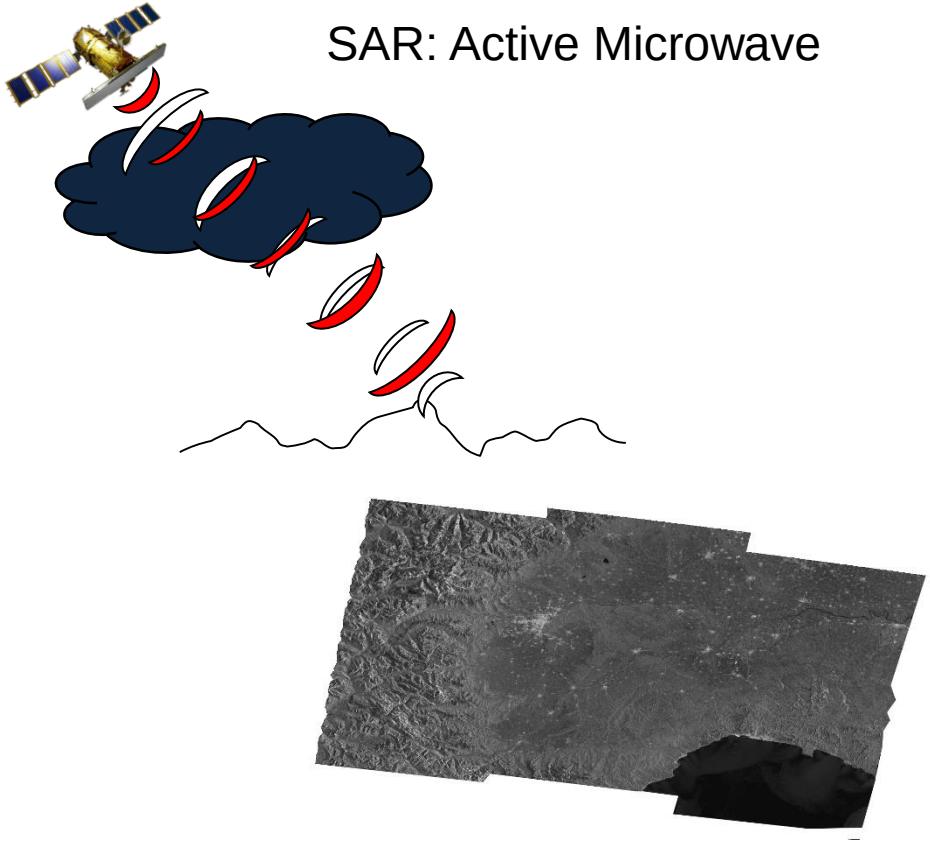
Poll Question #2

Why SAR?

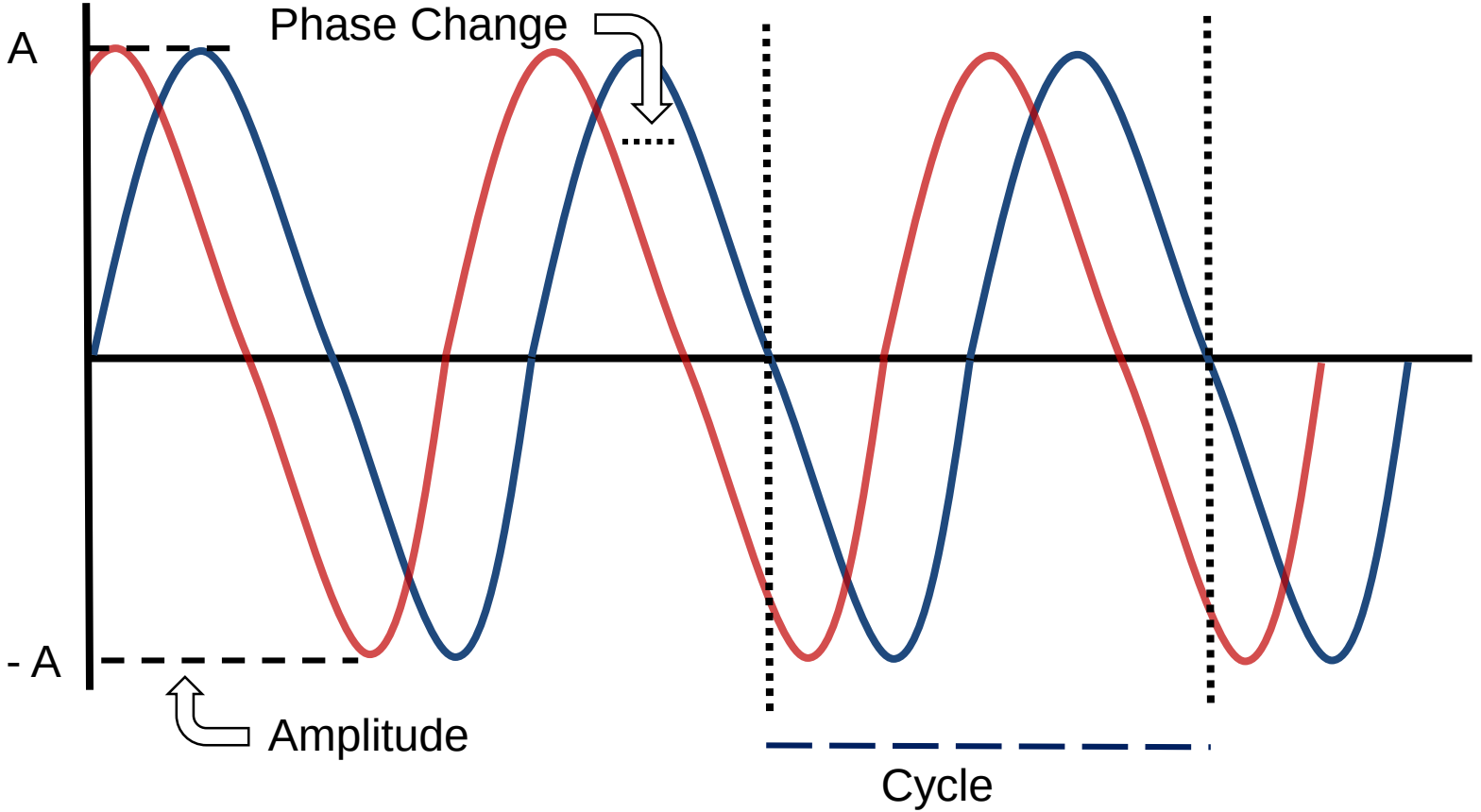
Optical: Visible to Infrared



SAR: Active Microwave



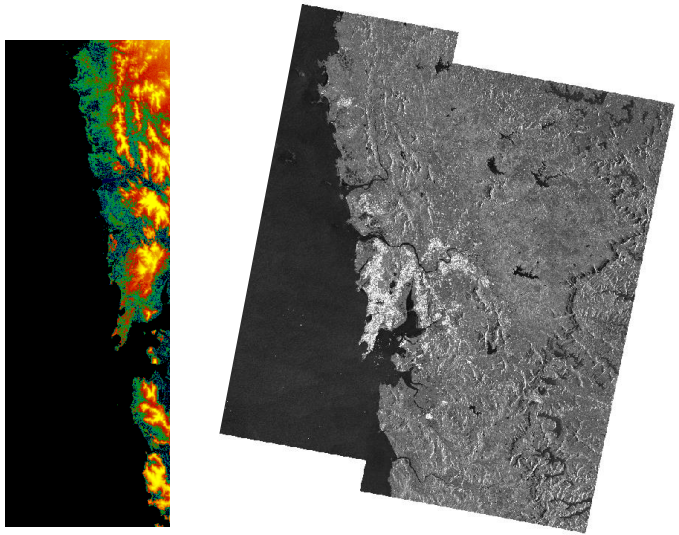
Backscatter Results: Amplitude and Phase



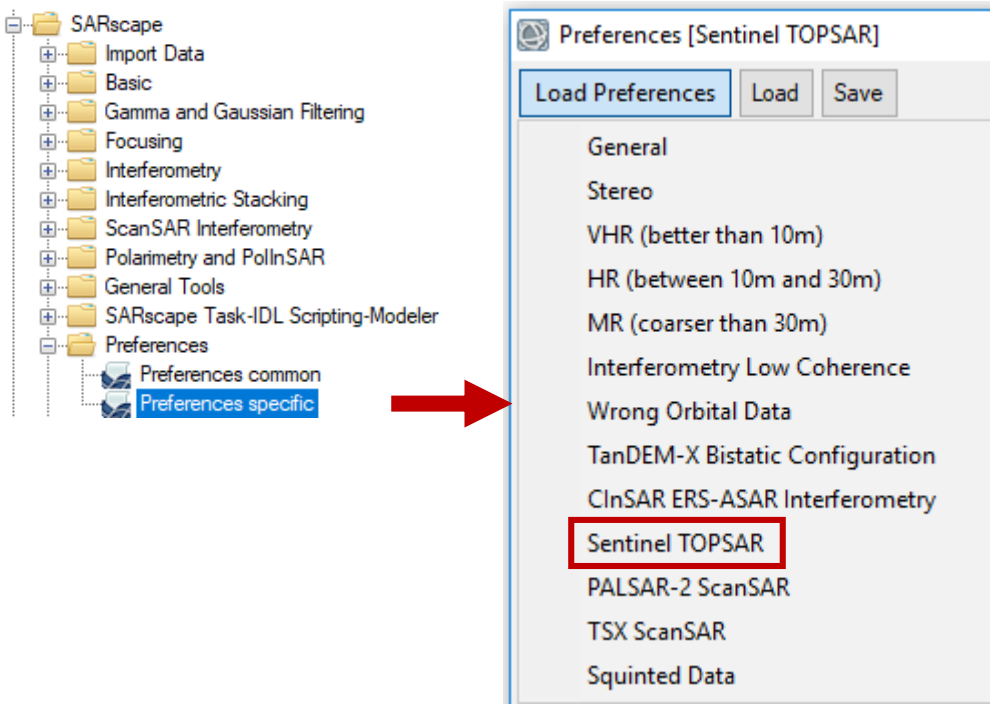
Before you get started

SAR data

DEM



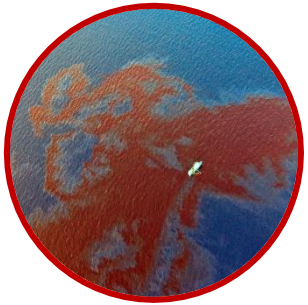
Set format-specific preferences



Synthetic Aperture Radar Applications

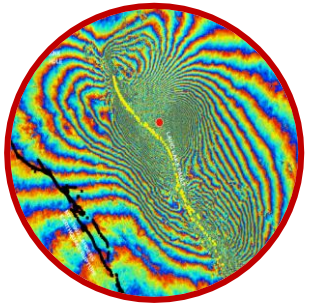
Landslides

Glaciers and permafrost



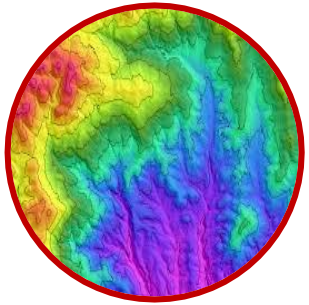
Oil spills

Subsidence



Earthquakes

Shipping



DEM generation

Burn Area Analysis

Deforestation

Flooding

Volcano monitoring

Activity monitoring

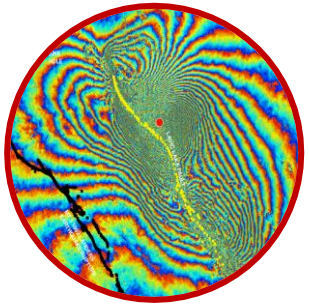
Synthetic Aperture Radar Applications

Landslides

Glaciers and permafrost

Oil spills

Subsidence



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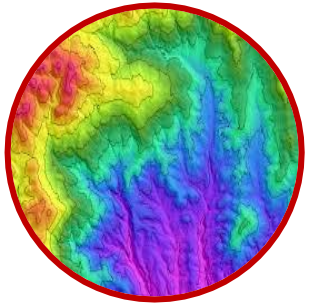


DEM generation

Burn Area Analysis

Deforestation

Flooding

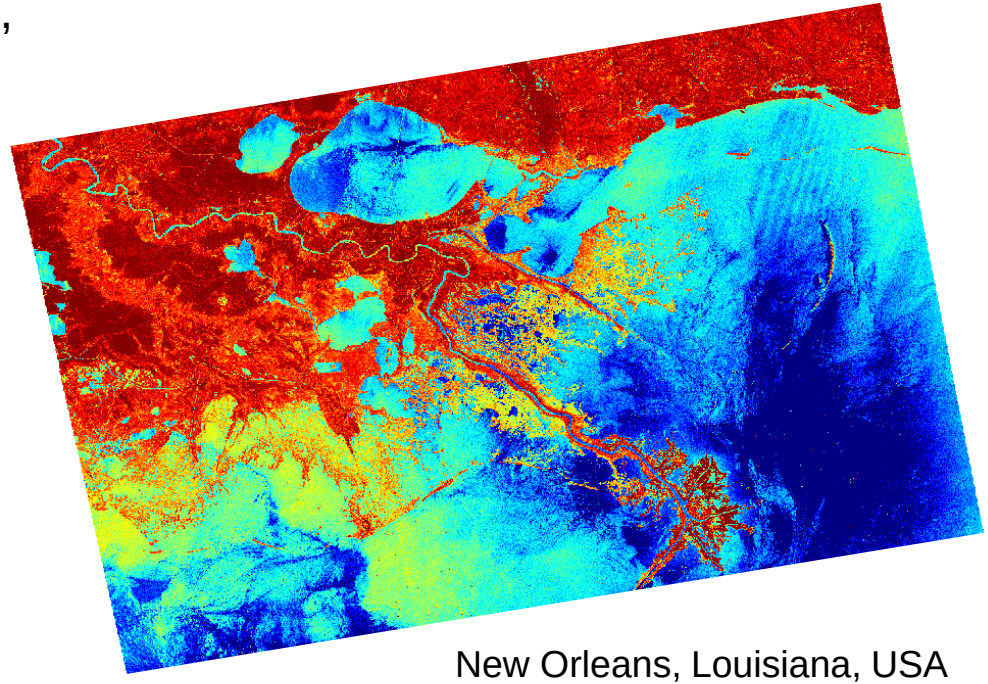
Volcano monitoring

Activity monitoring

Ocean Applications:

SAR views the surface water conditions, allowing us to view important features such as:

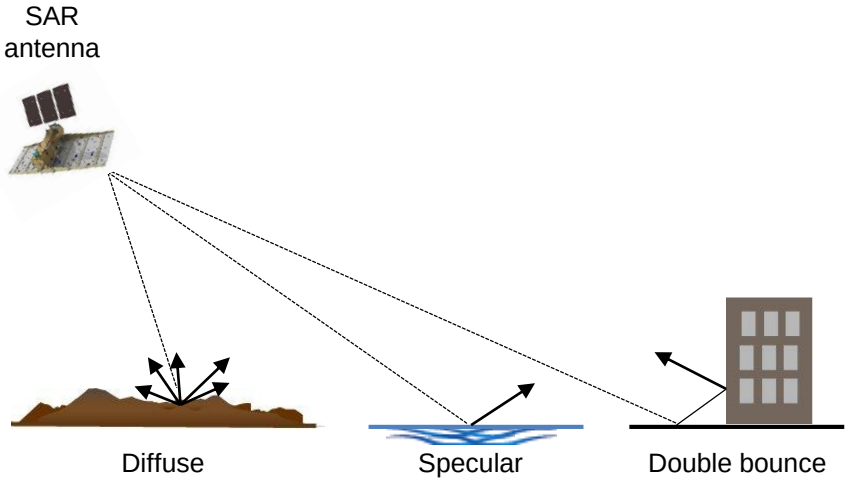
- Waves
- Tides and Currents
- Shallow Bathymetry
- Wind effects
- Oils or other surface coverings

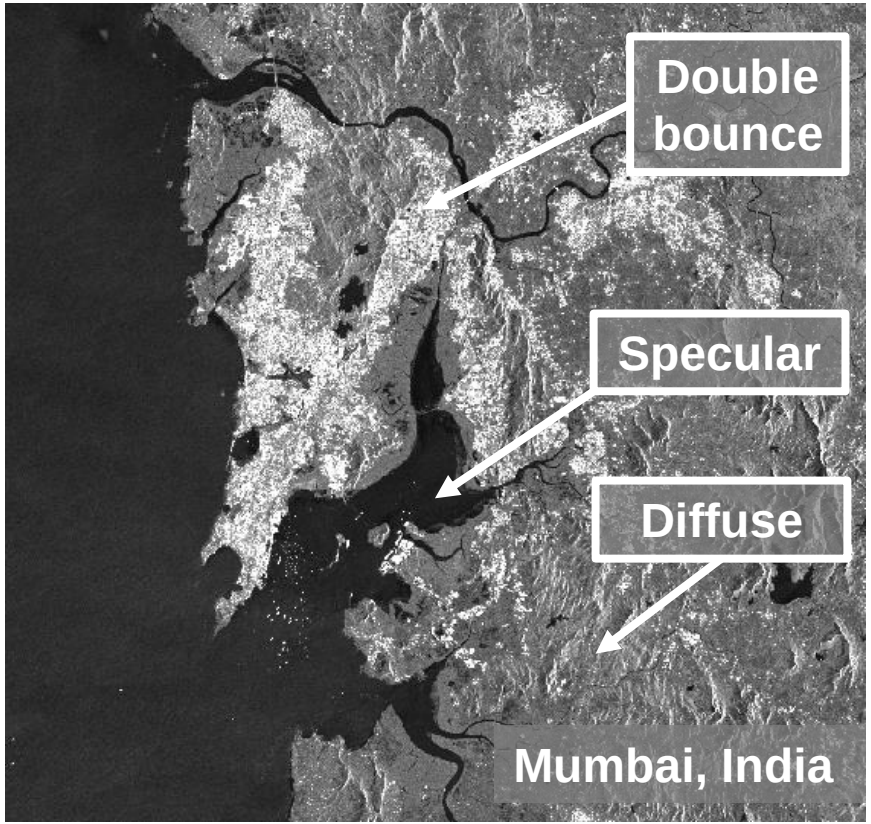


New Orleans, Louisiana, USA
and the Gulf of Mexico
May 15, 2016 – Sentinel-1

Ship Detection

Differences in radar backscatter highlight ships against water





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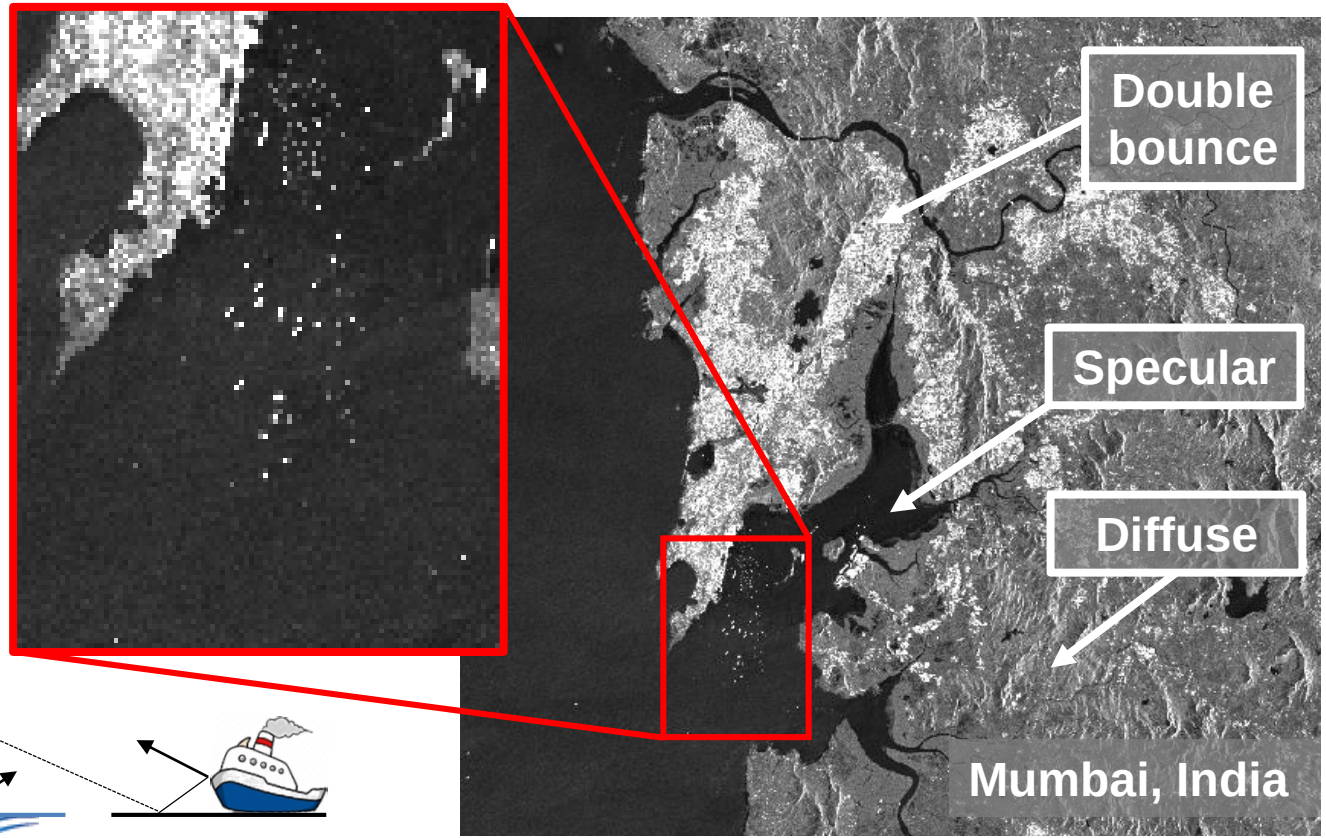
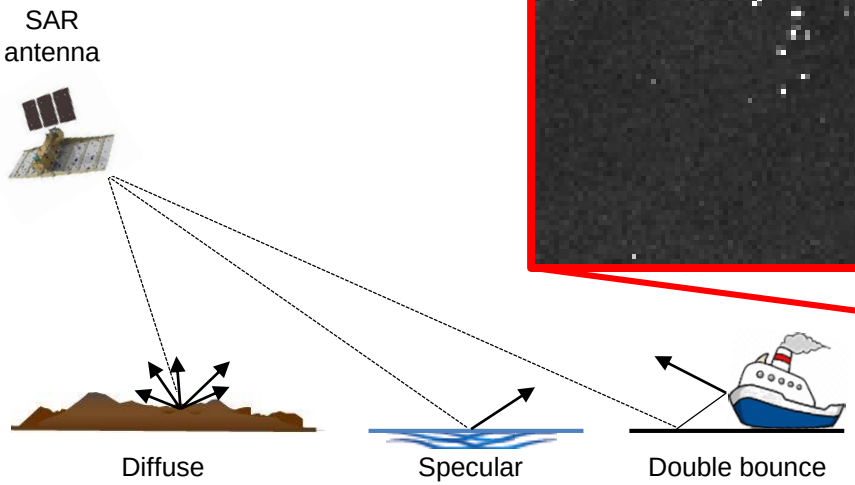
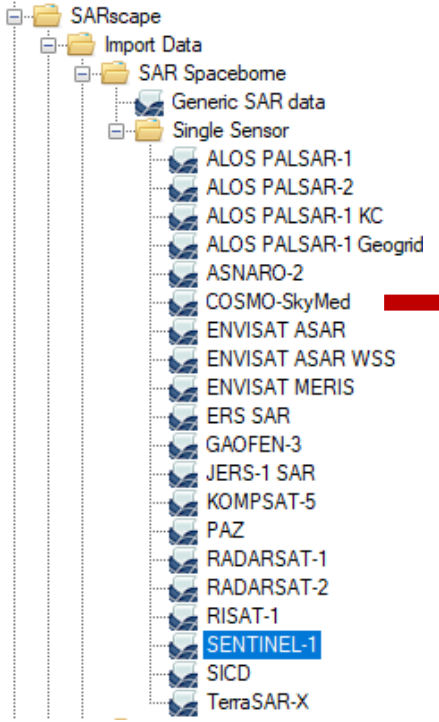
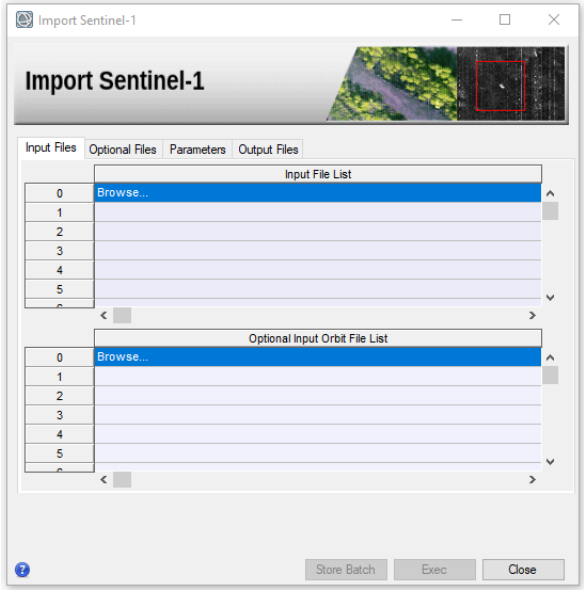


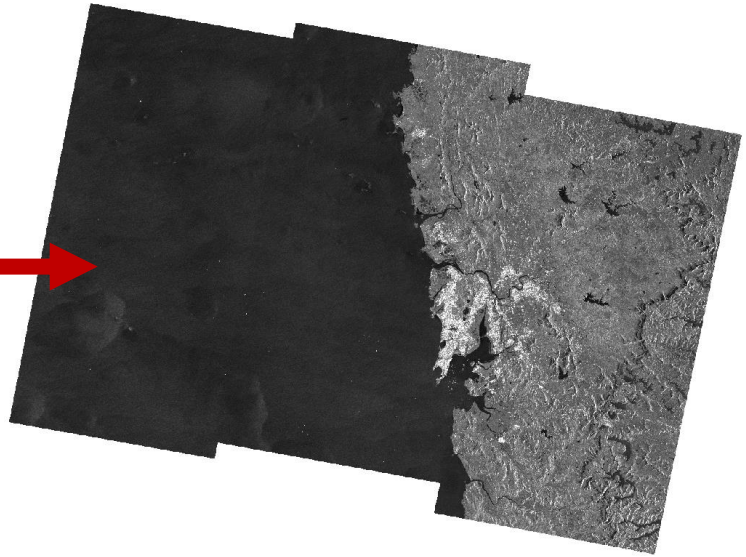


Ship Detection – Step 1: Data Import

Import Sentinel-1 GRD Data



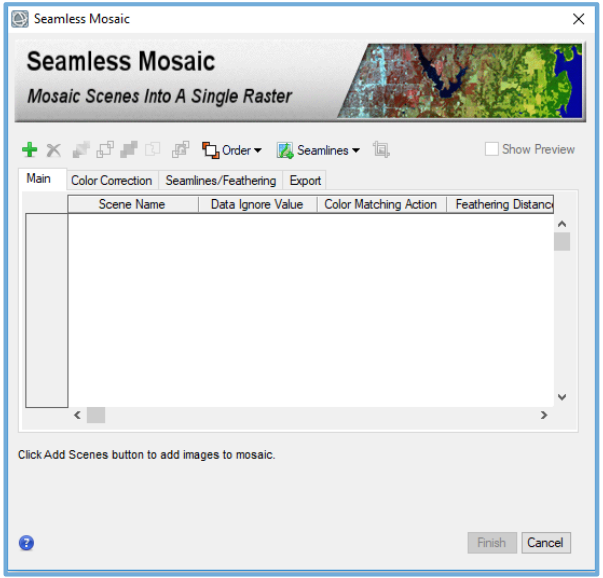




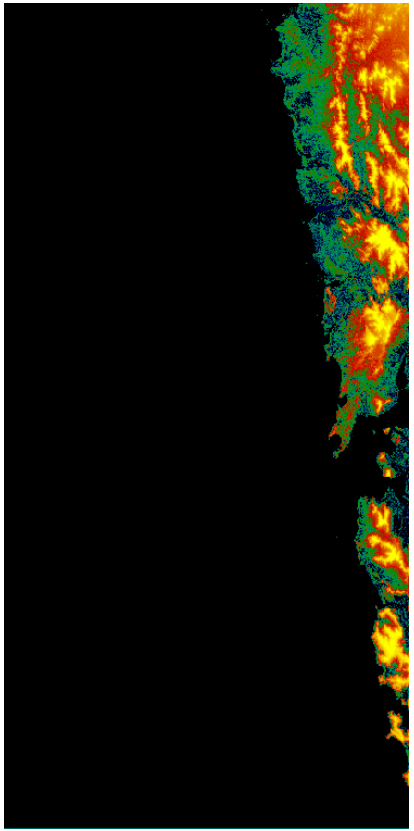
GRD data is already converted to ground range

Ship Detection – Step 2: DEM Import

ASTER DEM: allows for simple land mask creation



Mosaic DEM tiles
(if needed)



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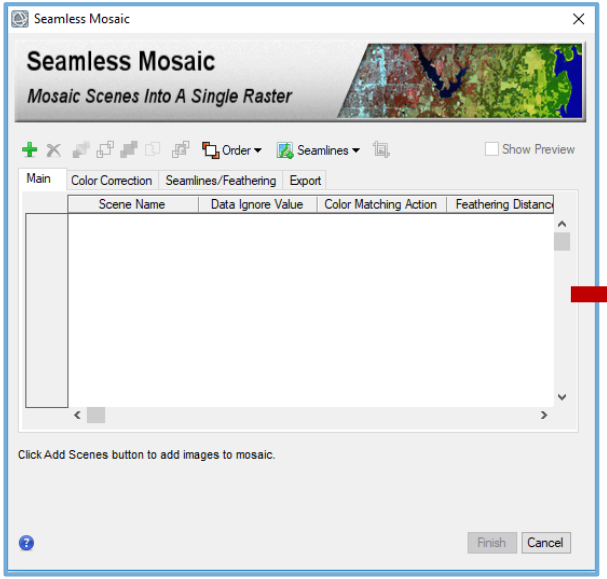
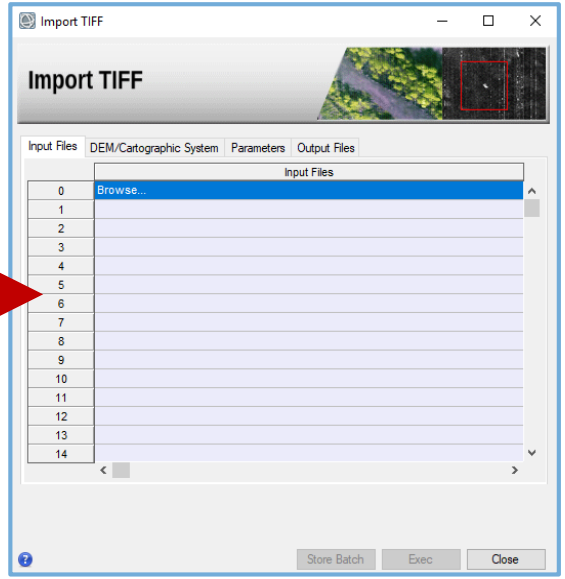
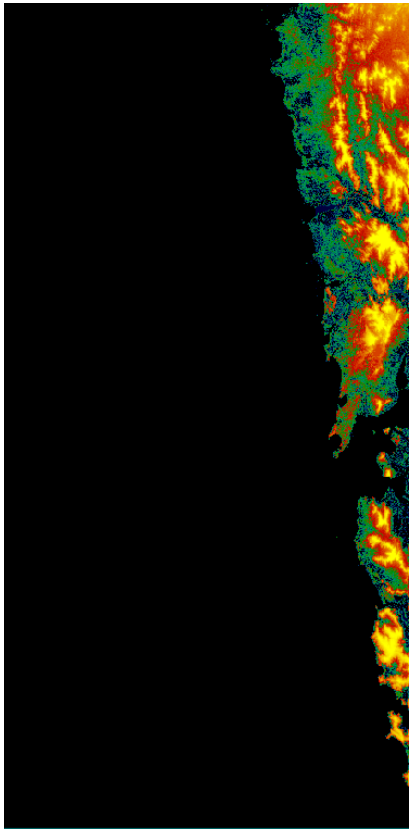


Mosaic DEM tiles
(if needed)



SARscape import Generic tiff



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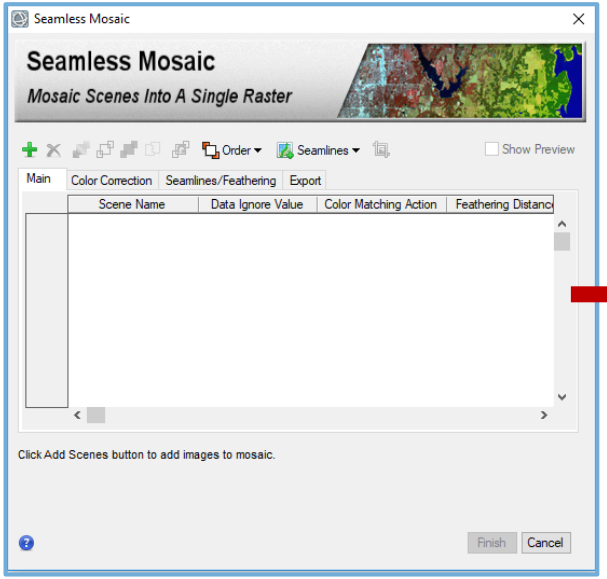
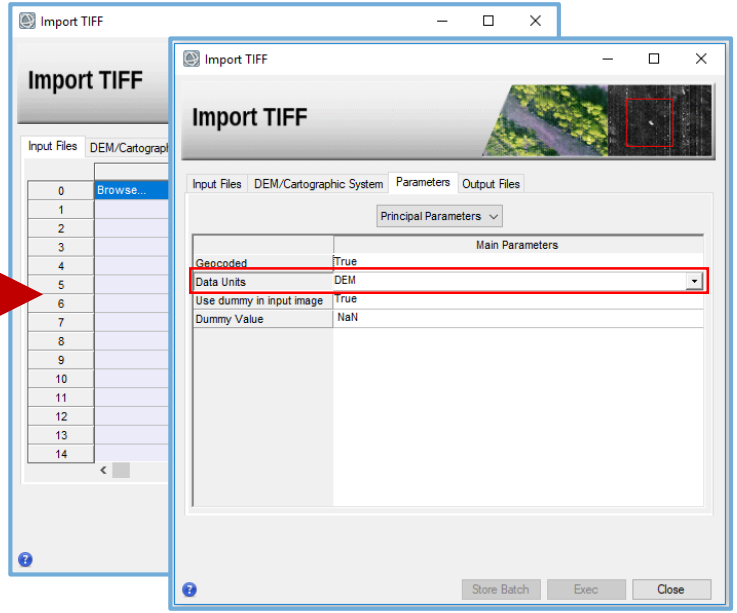
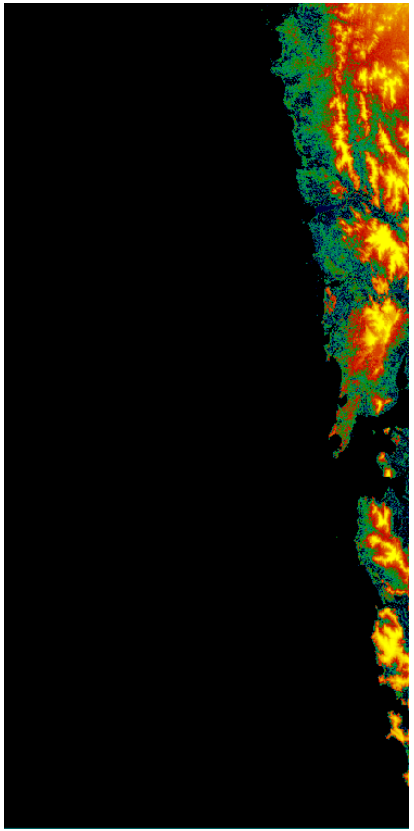


Mosaic ASTER DEM tiles (if needed)

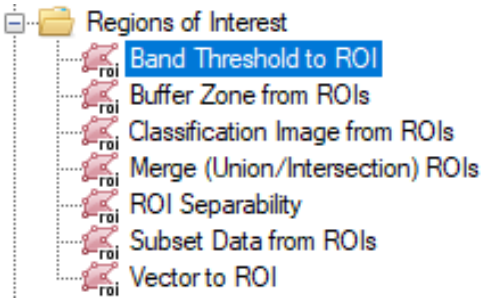


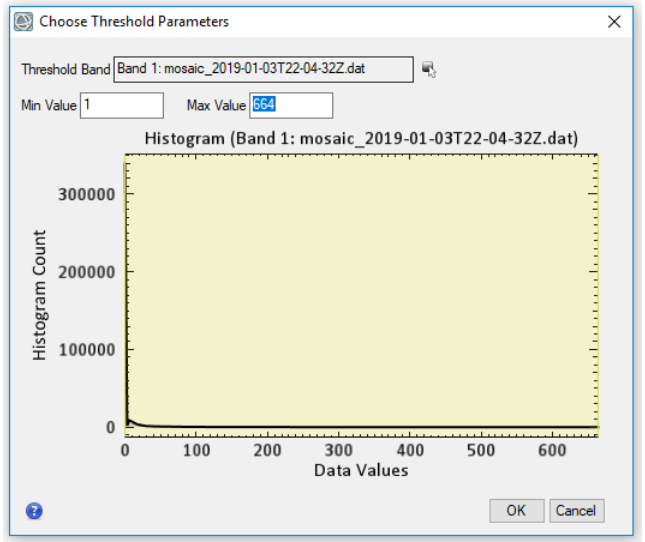
SARscape import Generic tiff



Ship Detection – Step 3: Land Mask

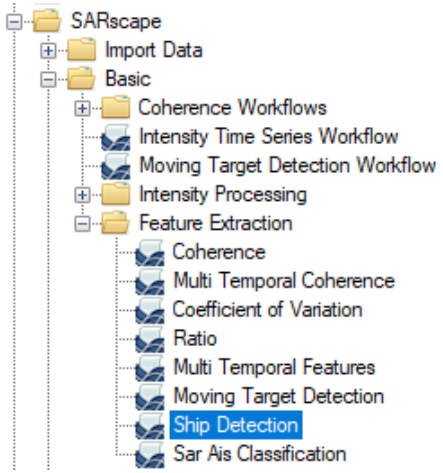
Threshold DEM to ROI

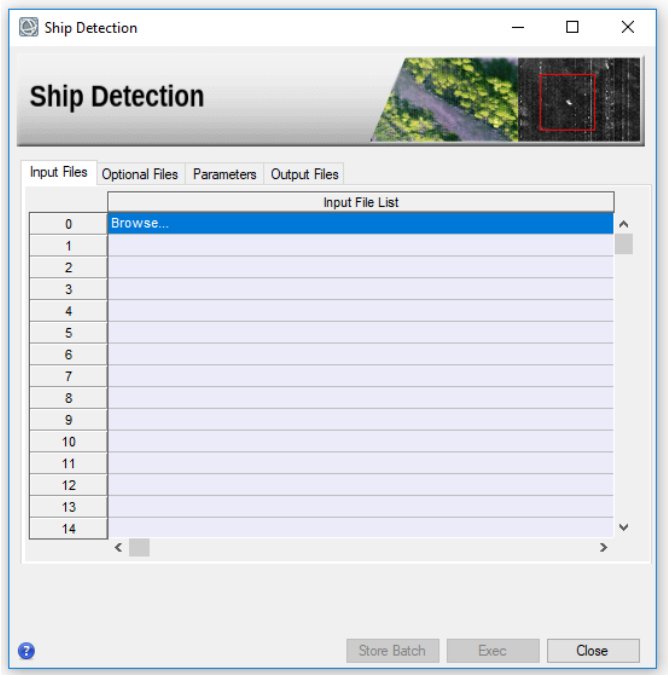




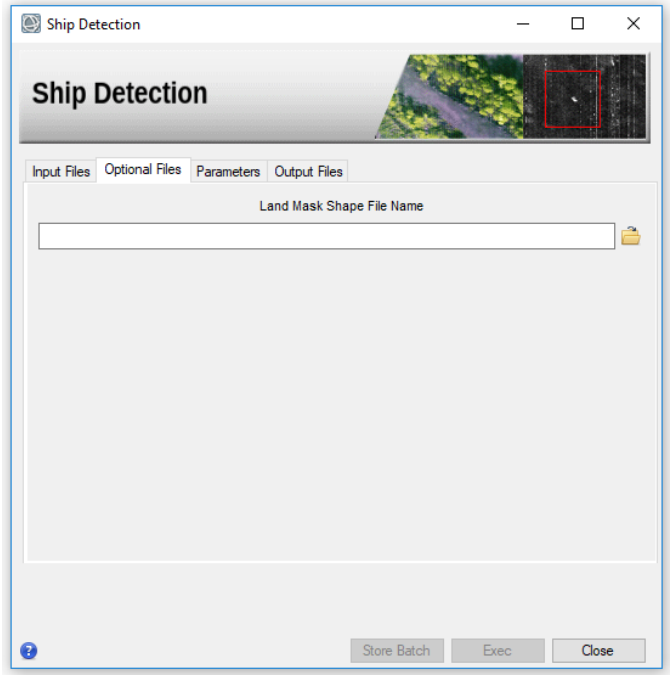
Min value = 1

Ship Detection – Step 4: Ship Detection Tool





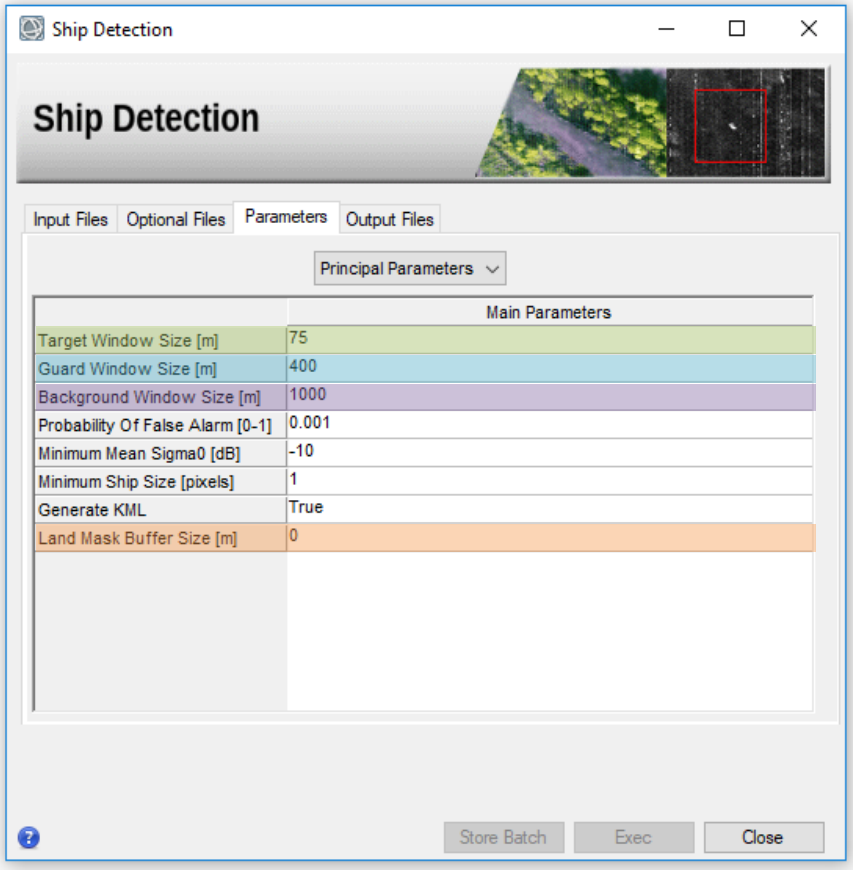
SAR Data input



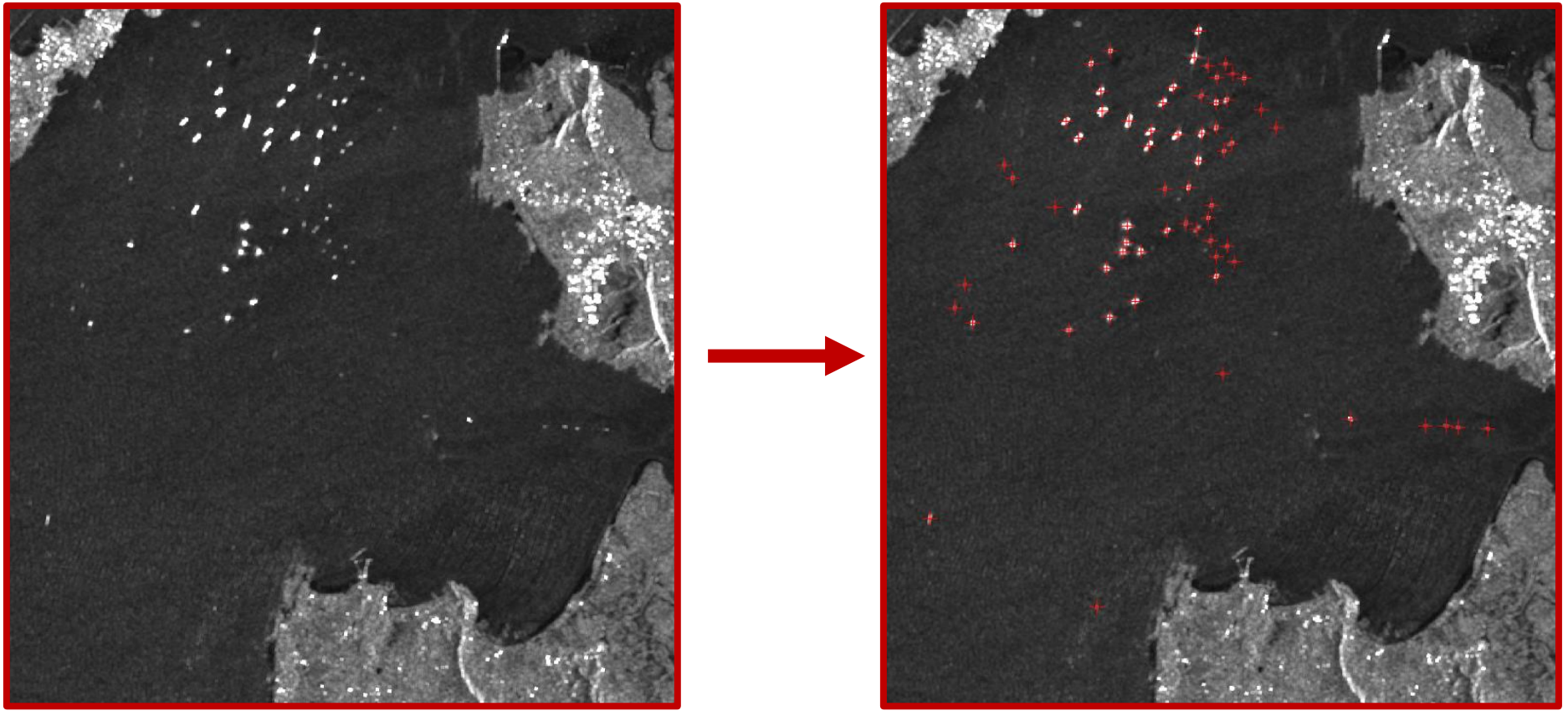
Mask from DEM

Ship Detection – Step 4: Ship Detection Tool

Parameter	Significance
Target window	Size of target
Guard window size	Buffer around target
Background window size	Background value calculation
Land mask buffer size	Buffer around land mask to reduce noise

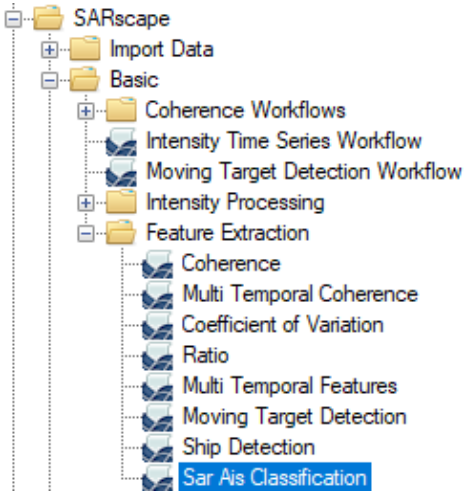


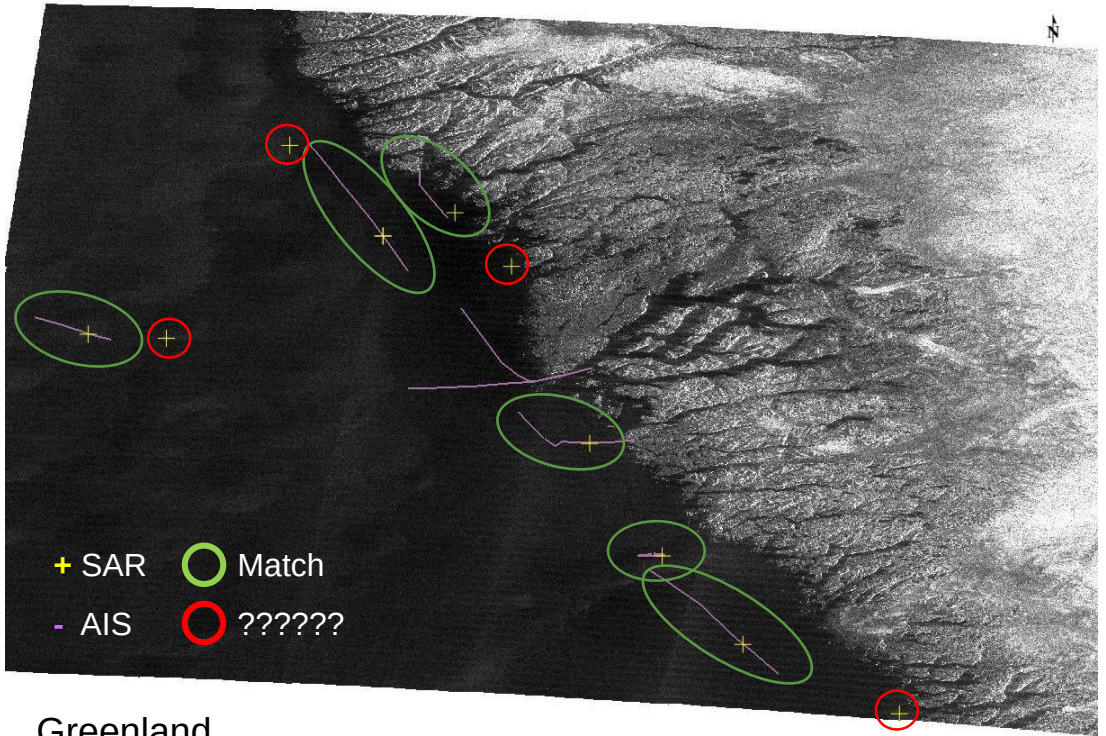
Ship Detection: Output



Ship Detection with AIS

AIS (Automatic Identification Systems) documentation for ships can be used with the ship detection tool

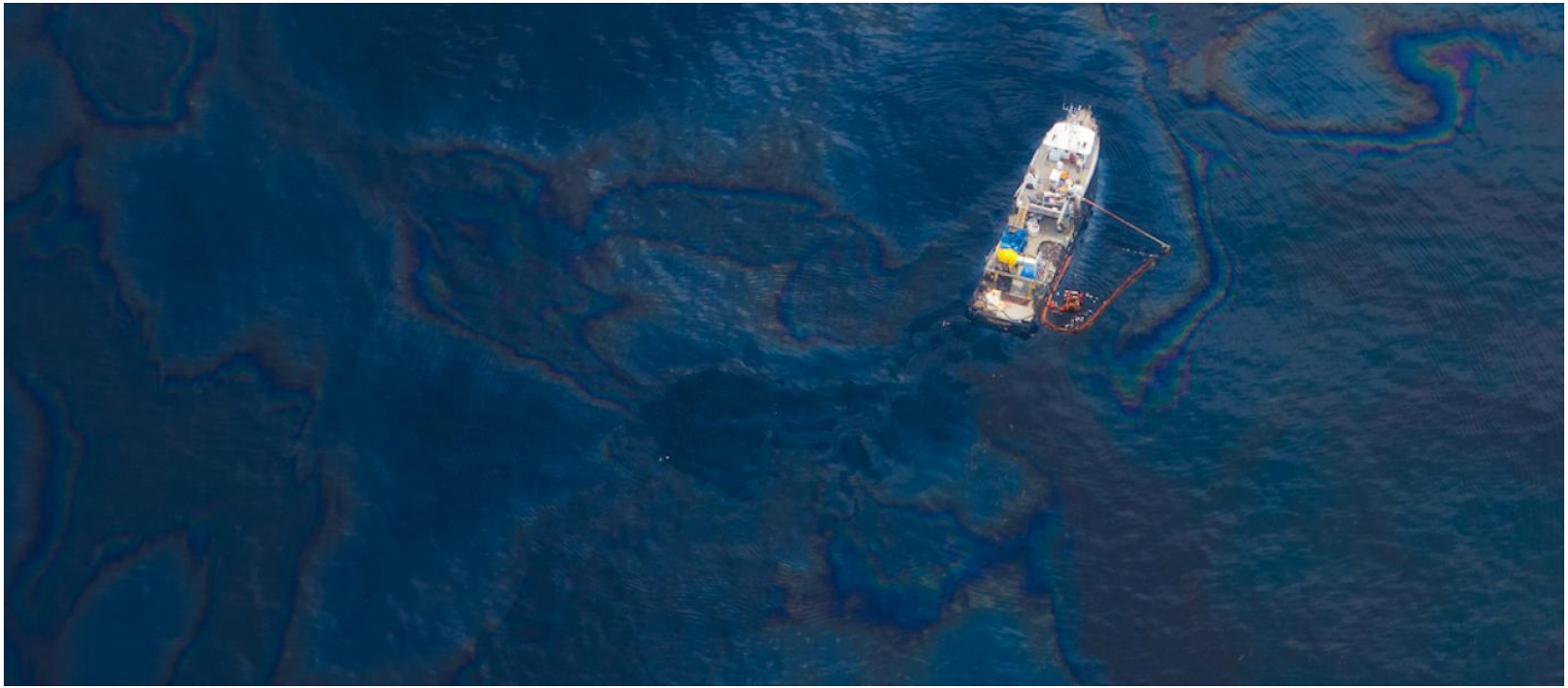




Greenland
Radarsat-2 data
SAR & AIS matching

Oil Spills

Oil creates a heavy sheen on the water surface, differentiating it from surrounding water.



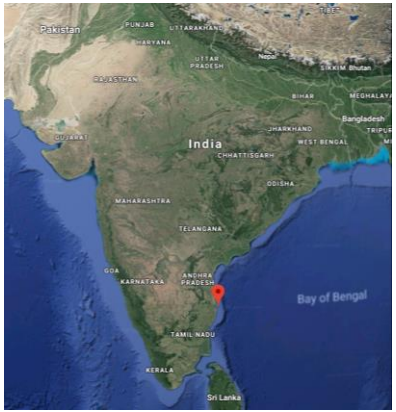
Background – Ennore and Gotland Island

Ennore Oil Spill

Date: 28 January 2017

Cause: BW Maple collided with Dawn Kanchipuram

Where: Kamarajar Port, Ennore India



Gotland Island

Date: May 2005

Cause: Unknown

Where: Gotland Island, Sweden

Oil Spills

Data:

Sentinel-1 SLC

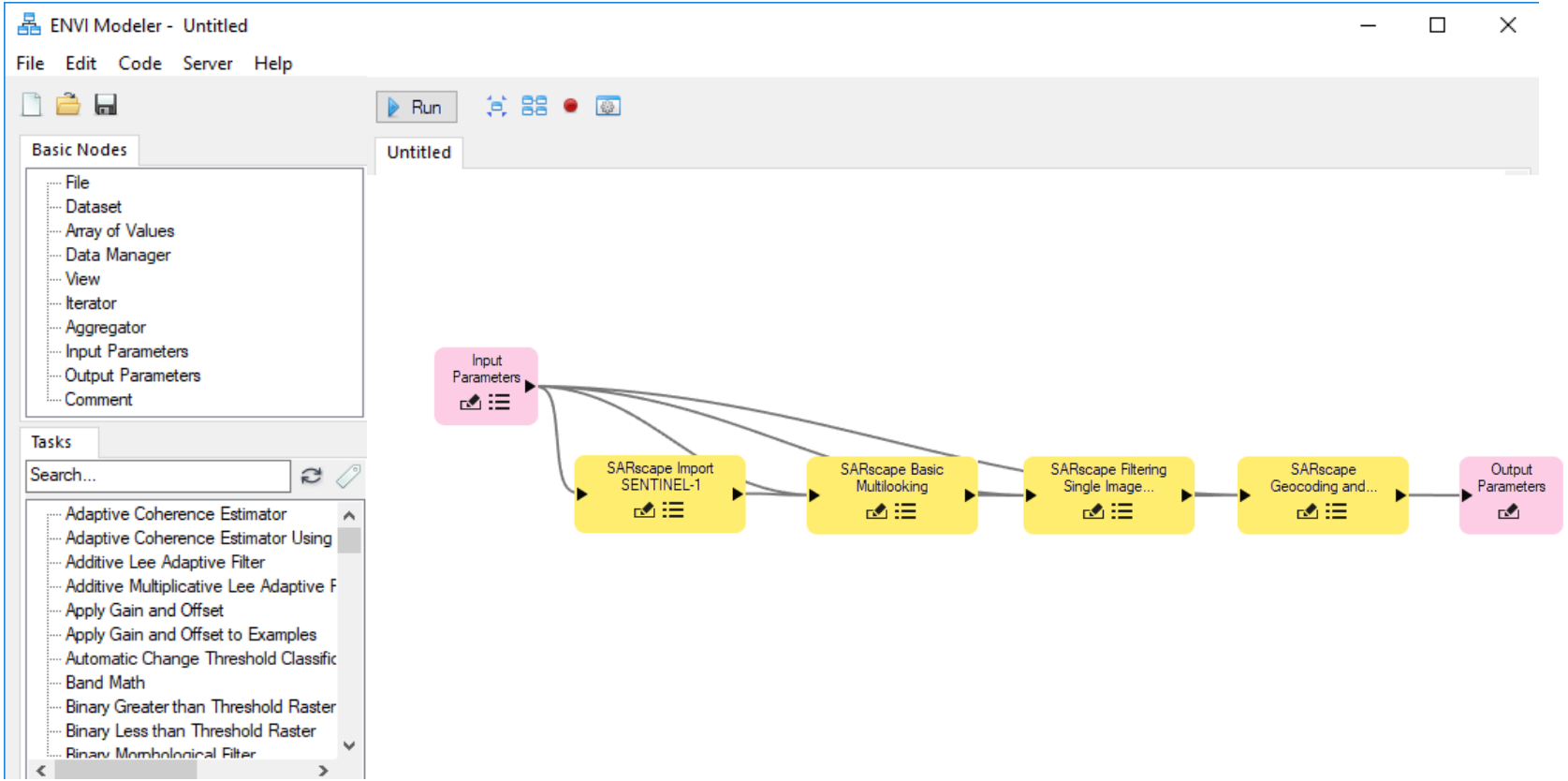
Process:

Import Sentinel-1 SLC

Preprocess

Create ROI

Oil Spills Workflow

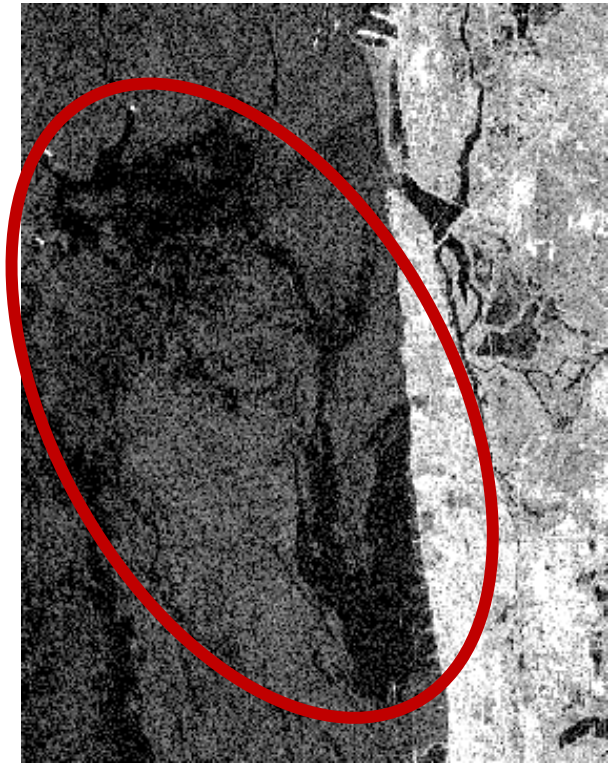


SLC Processing

Multilook

Filter

Geocode



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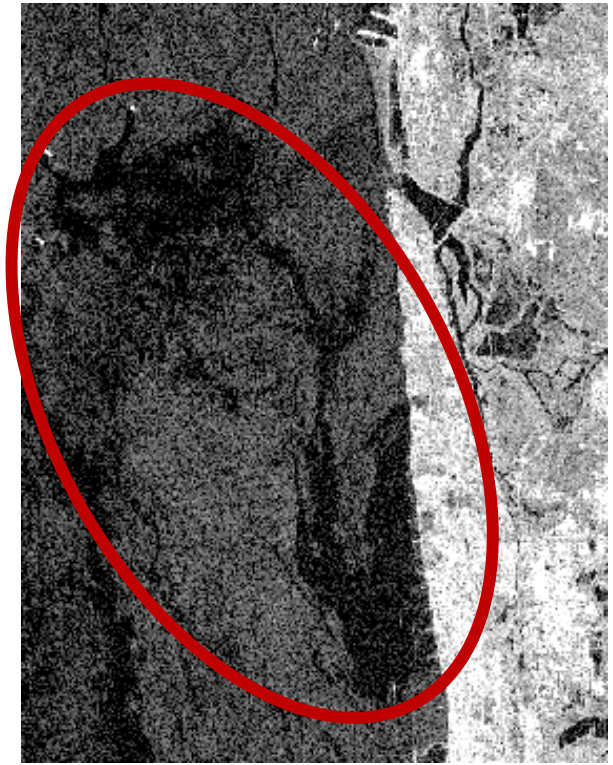


SLC Processing

Multilook

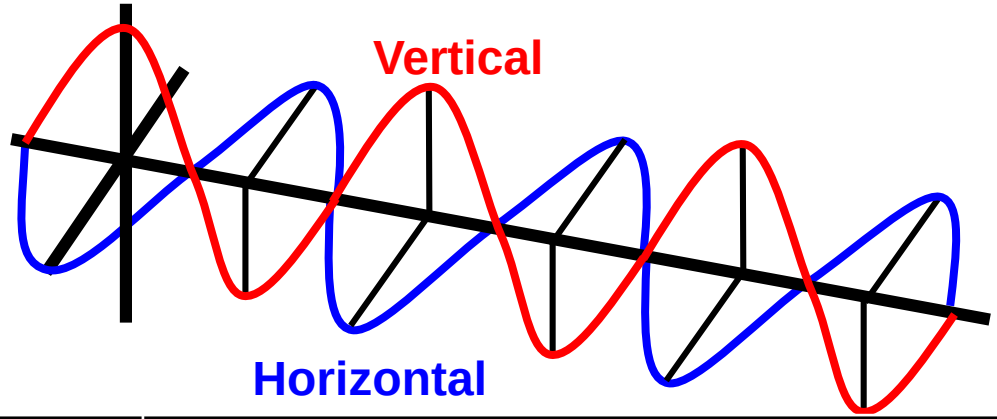
Filter

Geocode

Polarization Choices

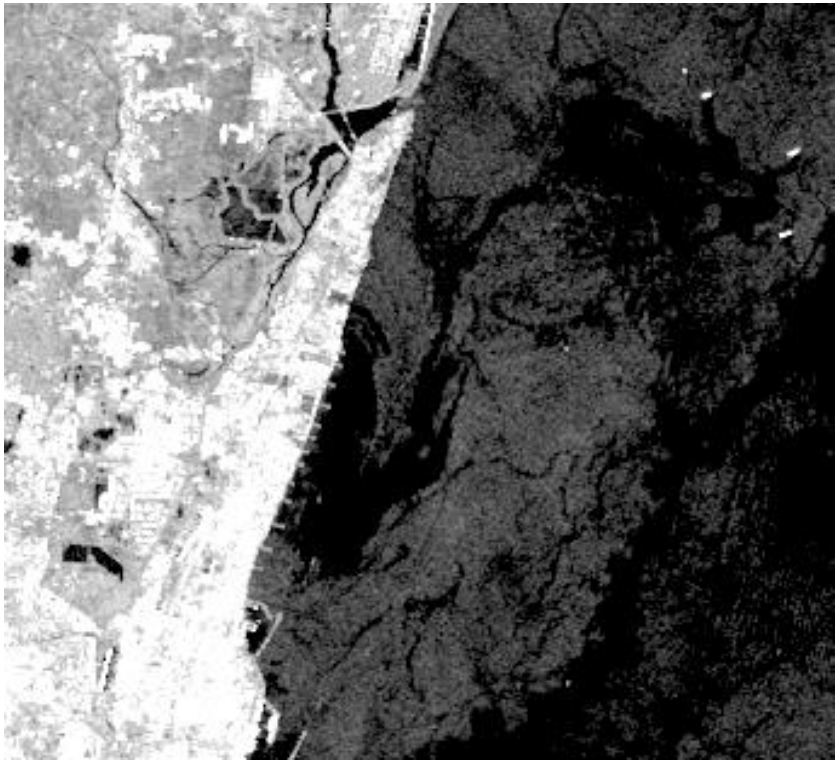
SAR satellites have multiple polarizations, from single pole (such as only VV or VH) to quad-pole (which returns all variations)

Each polarization interacts differently with the surface it hits, adding information to the scene



Polarization	Physical Meaning
VV	Vertical wave, outgoing and incoming
HH	Horizontal wave, outgoing and incoming
VH	Vertical Wave outgoing, Horizontal Wave incoming
HV	Horizontal Wave outgoing, Vertical Wave incoming

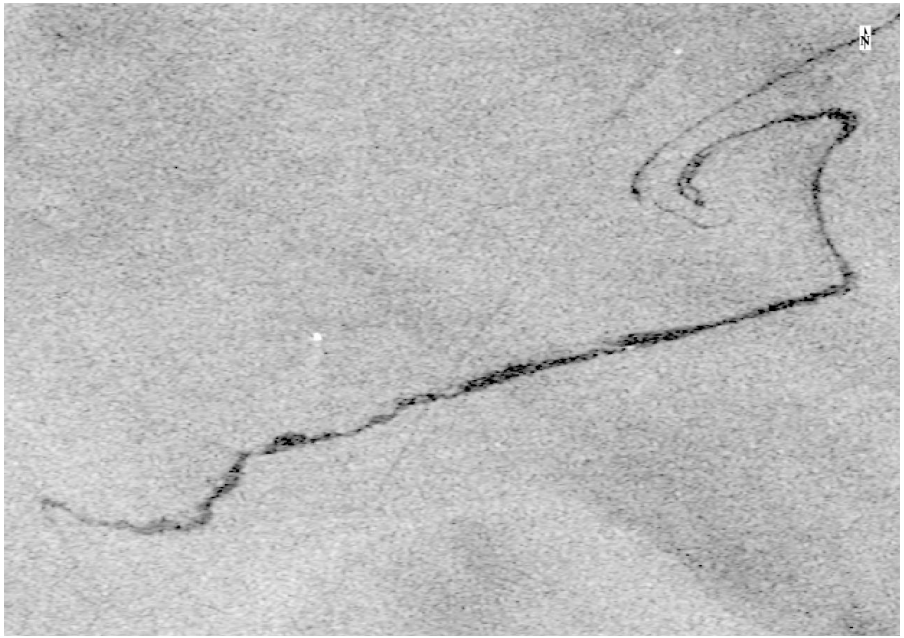
Oil Spill – Why Polarization is Important

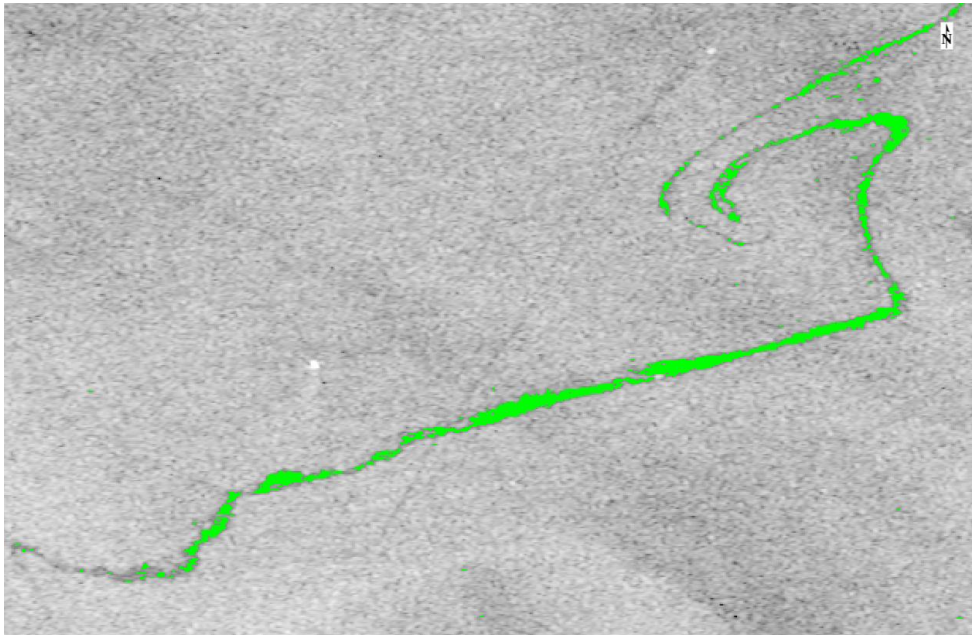


VV

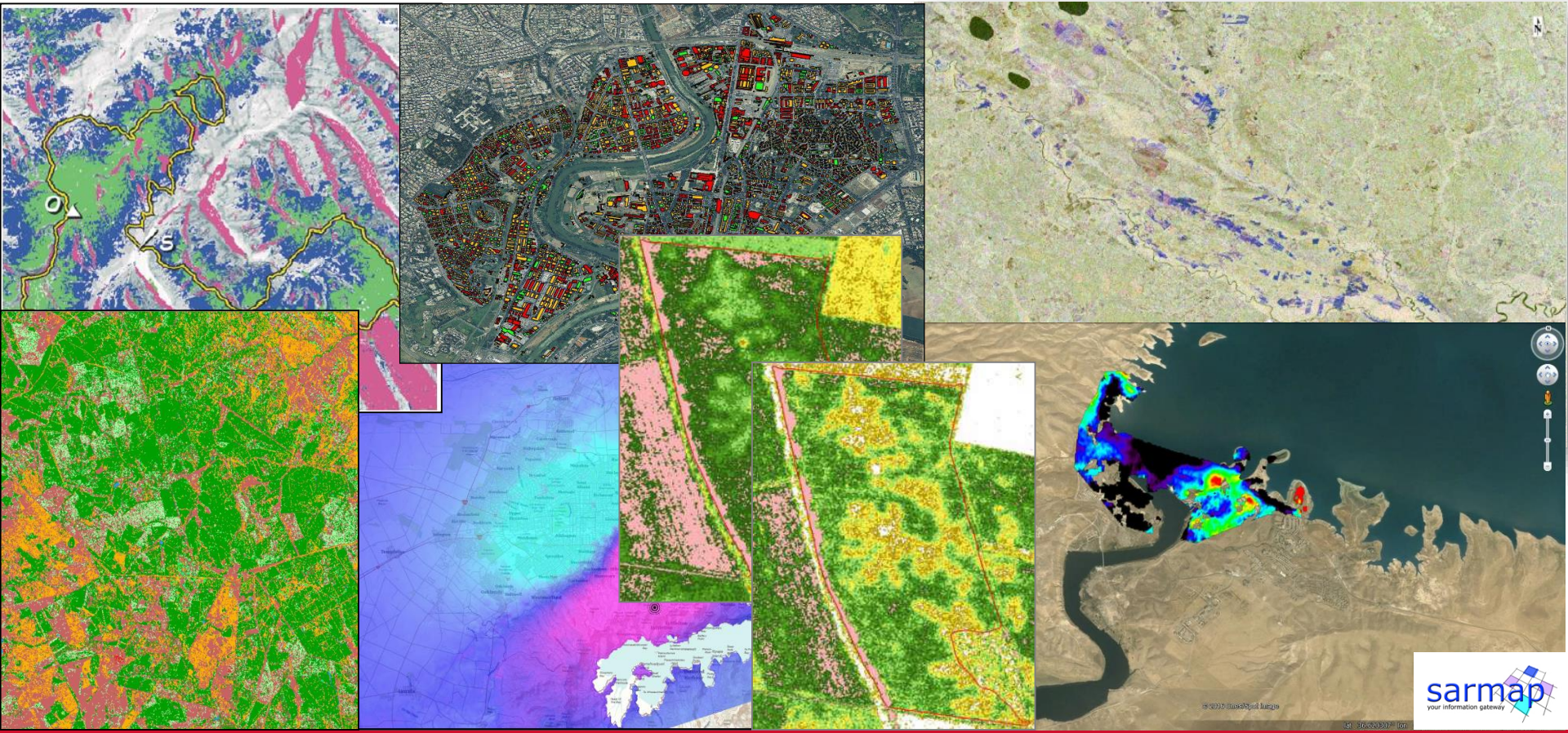
VH

Oil Spills – Area with ROI/Classification





Land Applications

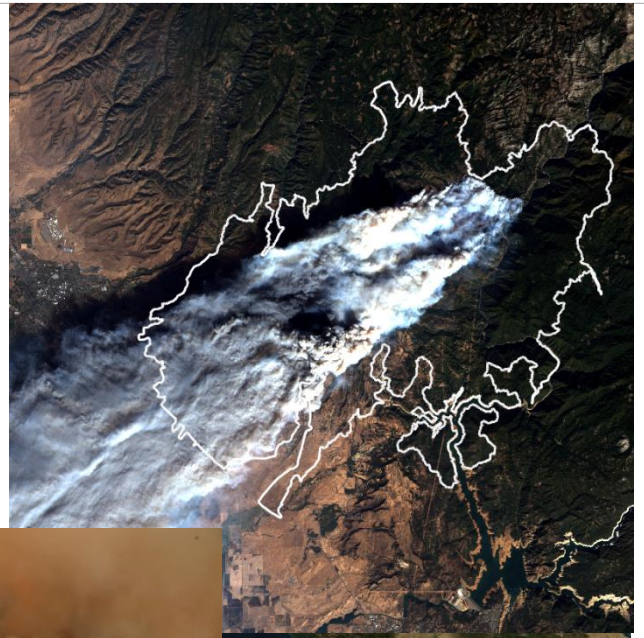


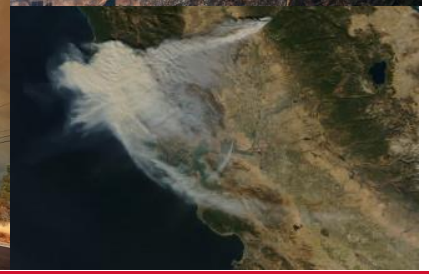
Burn Area Analysis – Camp Fire

Camp Fire, Butte County California USA
November 8th – November 25th

The Camp fire is the deadliest wildfire that has ever occurred in California, with 88 people were killed, and 18,000 buildings were destroyed.

The smoke of the Camp Fire inundated the Bay Area of California, causing the worst air pollution globally for days.





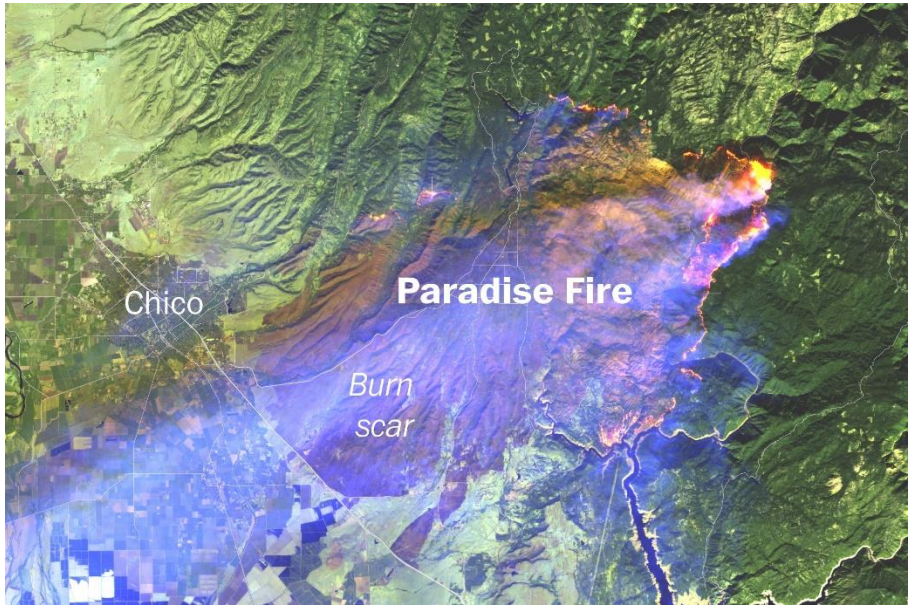
Burn Area Analysis

Data:

Sentinel-1 SLC scenes

DEM GTOPO 30

Camp Fire Shapefile

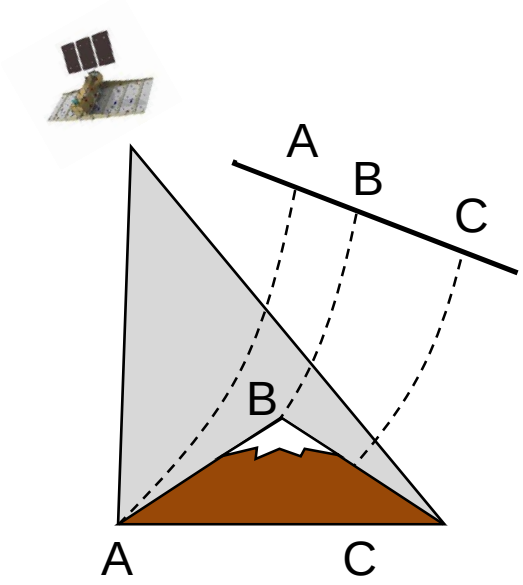


Process:

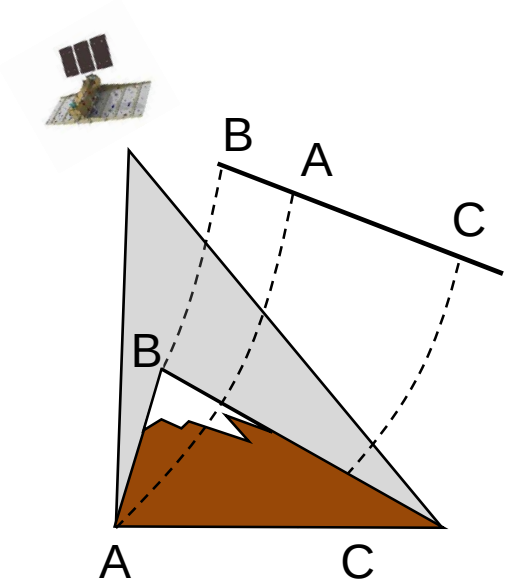
Import SAR SLC data

Run Coherent Change Detection Timeline Workflow

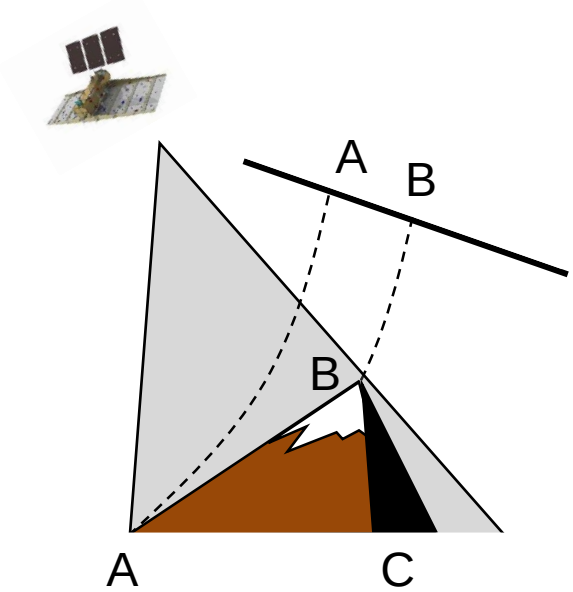
Geometric Effects in SAR Imagery



Foreshortening:
When an area is “squished” caused by change in vertical and horizontal placement emphasized by imaging angle

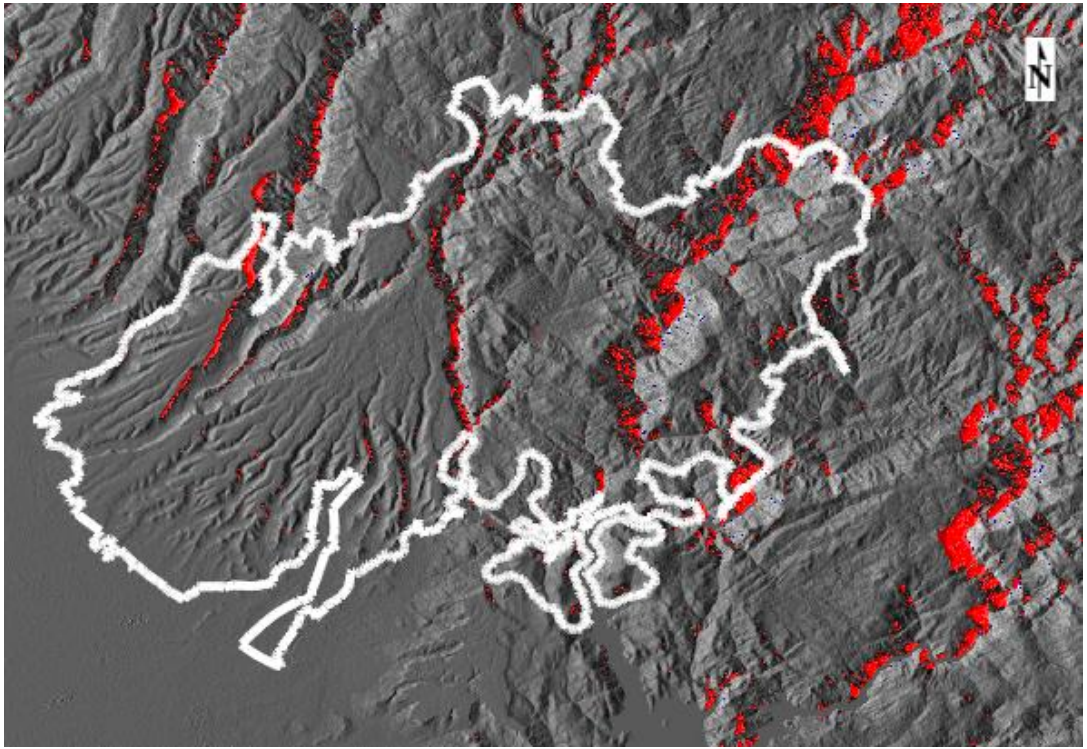


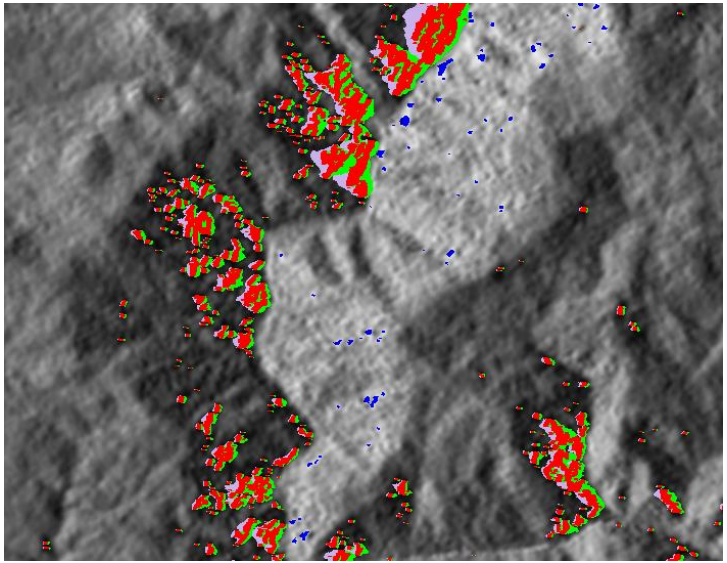
Layover:
Extreme foreshortening, when a point is seen as occurring before another point



Shadowing:
When an area is covered by other areas

Layover and Shadow



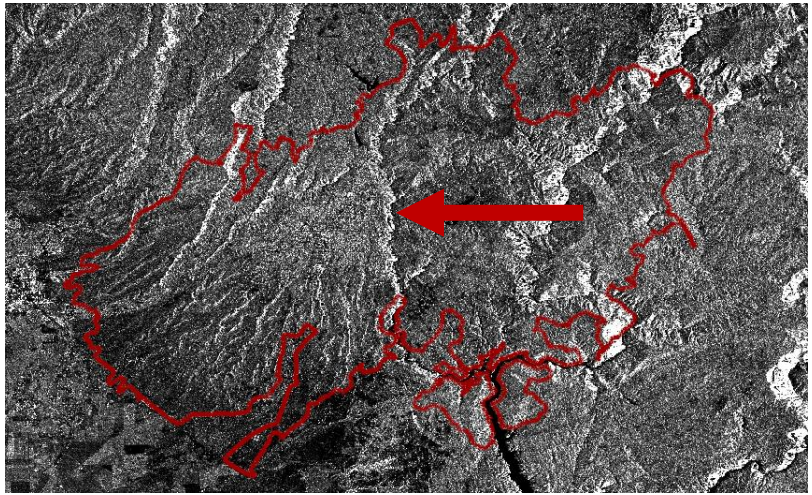


- Layover Active
- Layover Near Passive
- Layover Far Passive
- Shadow Active
- Shadow Passive
- Layover Shadow

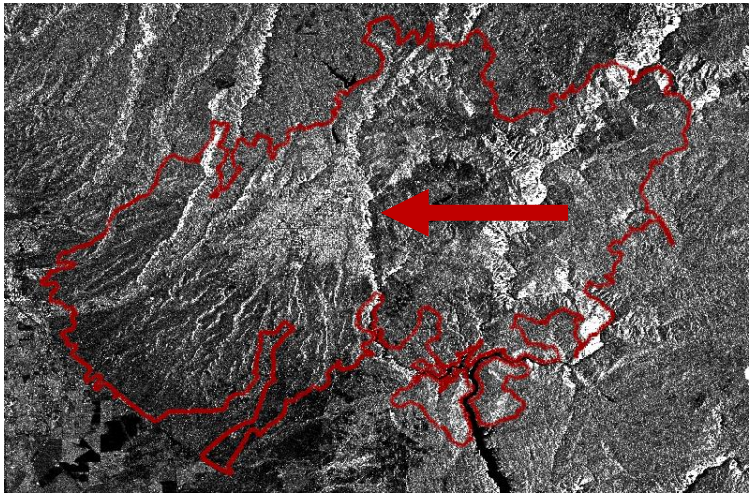
Burn Area Analysis- CCD

Coherence Change Detection uses the similarities between the phase responses of multiple images.

The phase is influenced greatly by surface roughness and changes in surface features.

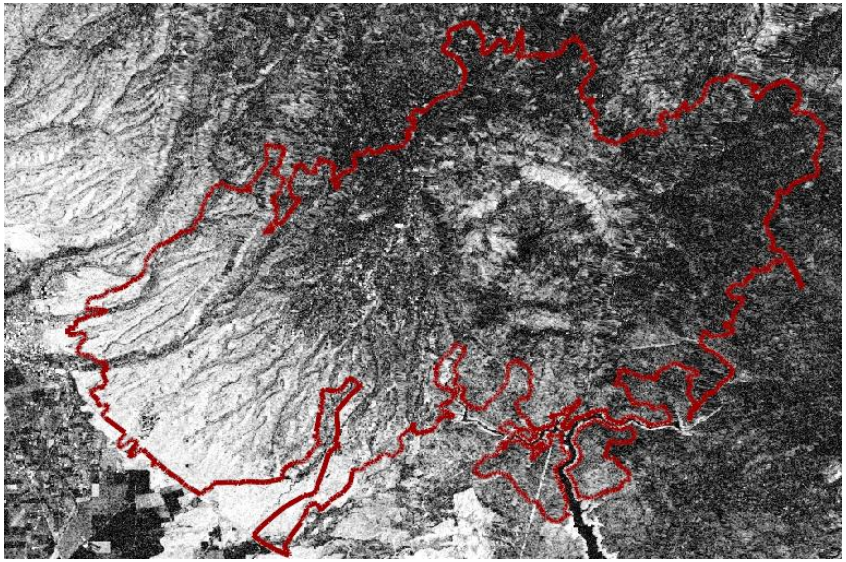


Pre-Fire Intensity

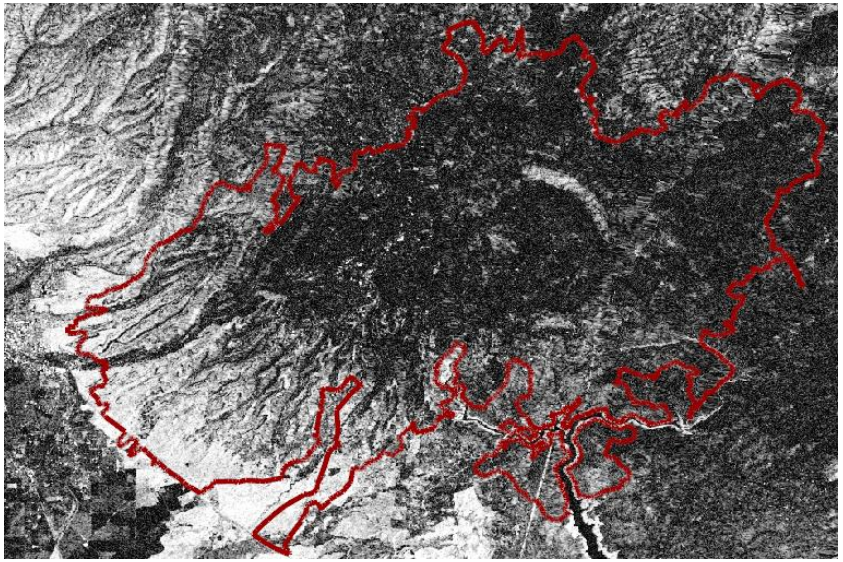


Co-Fire Intensity

Burn Area Analysis- CCD



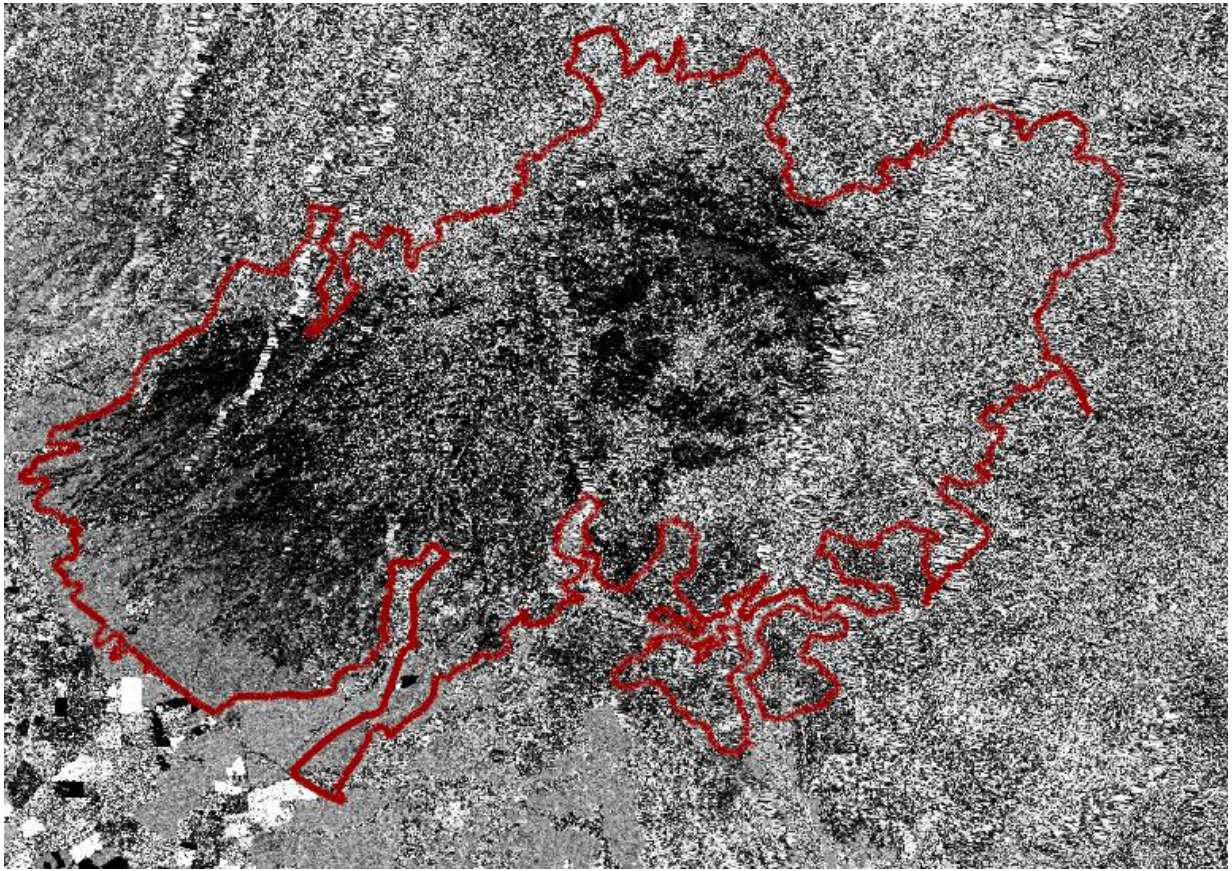
Pre-Fire Coherence:
October 16th and 28th



Co-Fire Coherence:
October 28th and November 9th

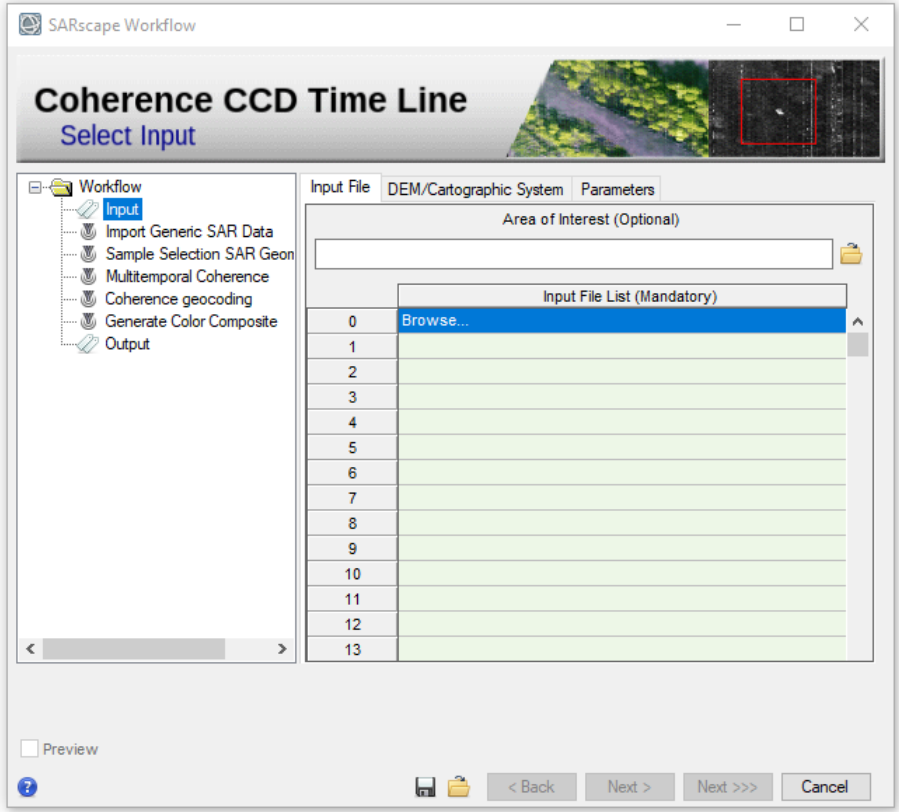
Burn Area Analysis- CCD

Coherence change between pre- and co-fire pairs

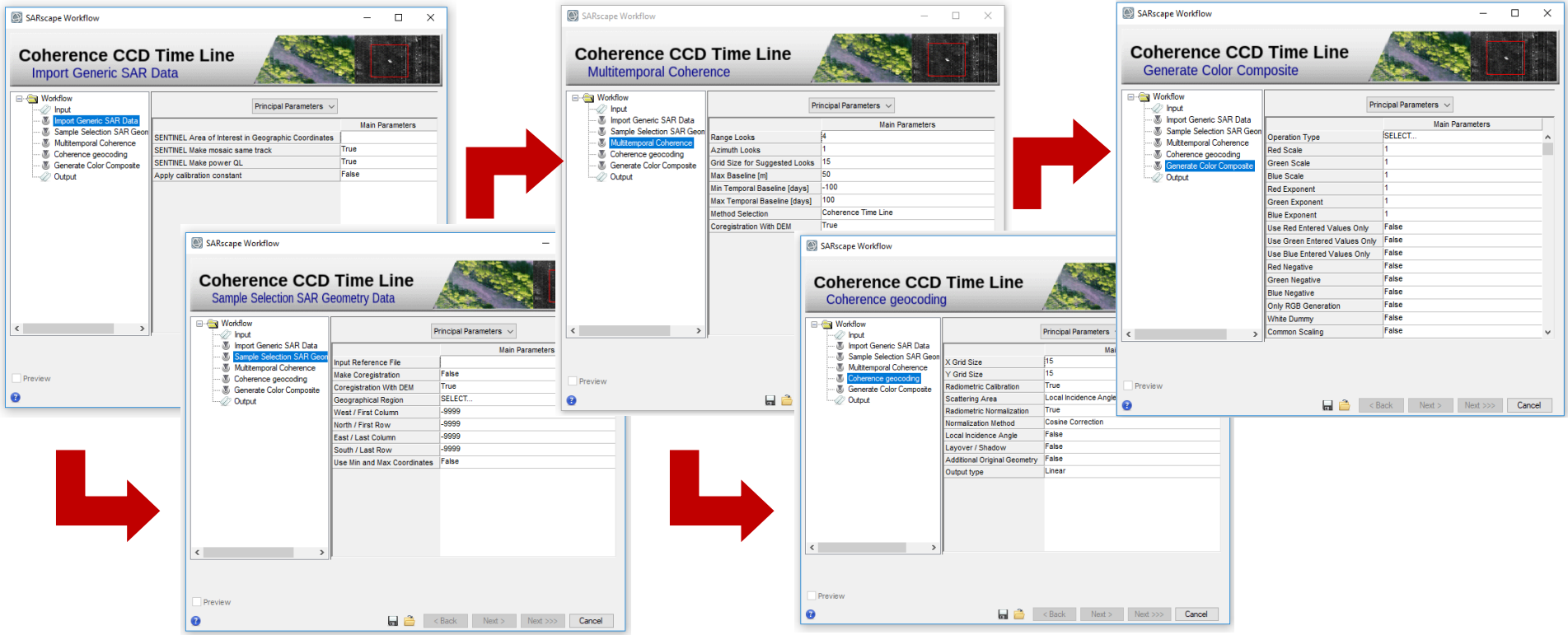


Burn Area Analysis Workflow

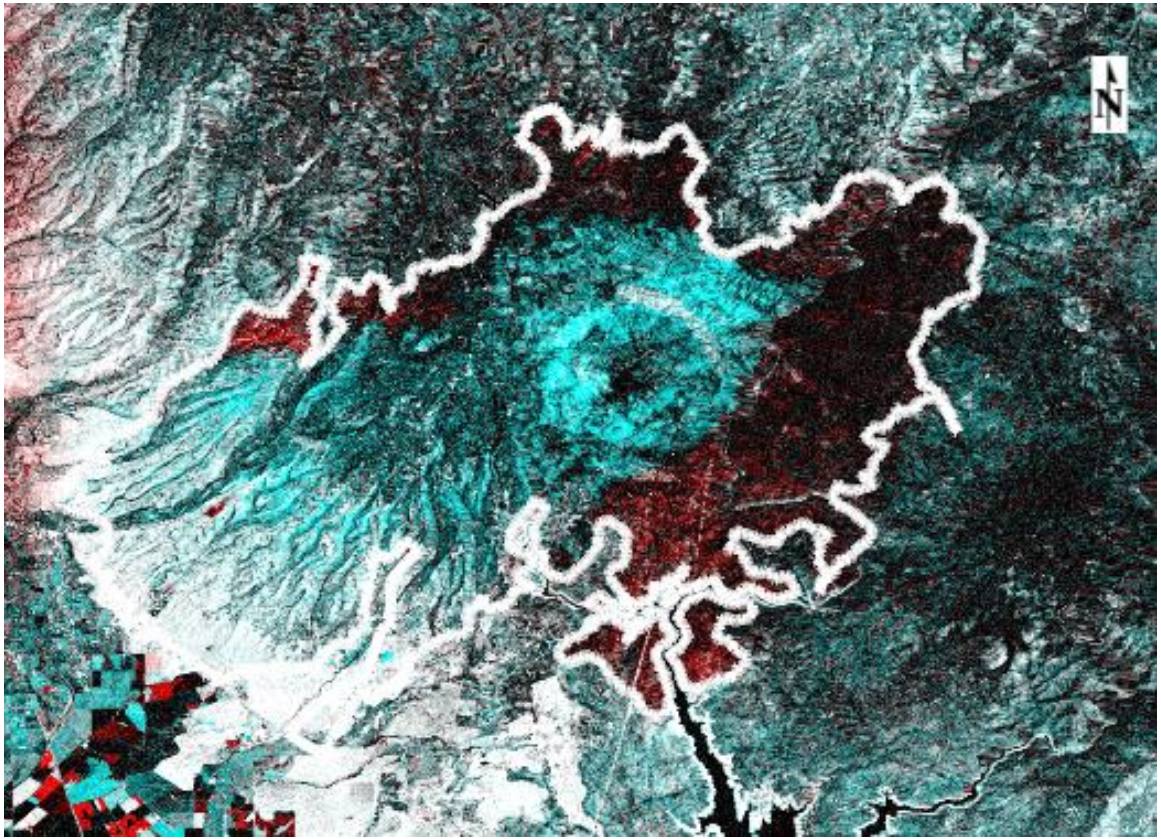
ILU	Coherence Map Average Backscatter Absolute Value of the Difference
MTC	Master Backscatter Slave Backscatter Coherence
MICCD	First Coherence Second Coherence Second Coherence
COV-PWR-CC	Spatial-Coefficient of Variation of average backscatter Average Backscatter of Master/Slave Coherence



Burn Area Analysis Workflow



Camp Fire, California, USA



3 Sentinel-1 scenes

Blue/Green is large change between October 28 and November 9

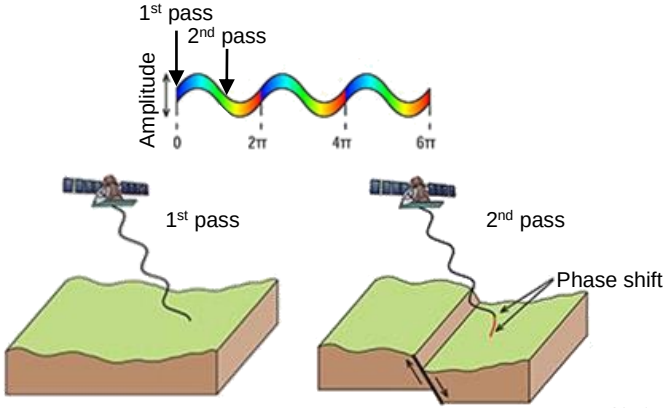
Red is change between November 9 and November 21

Land surface deformation

DInSAR Displacement

- Detect mm displacement
- Volcanoes & Earthquakes
- Ongoing subsidence

Change in phase from T1 to T2

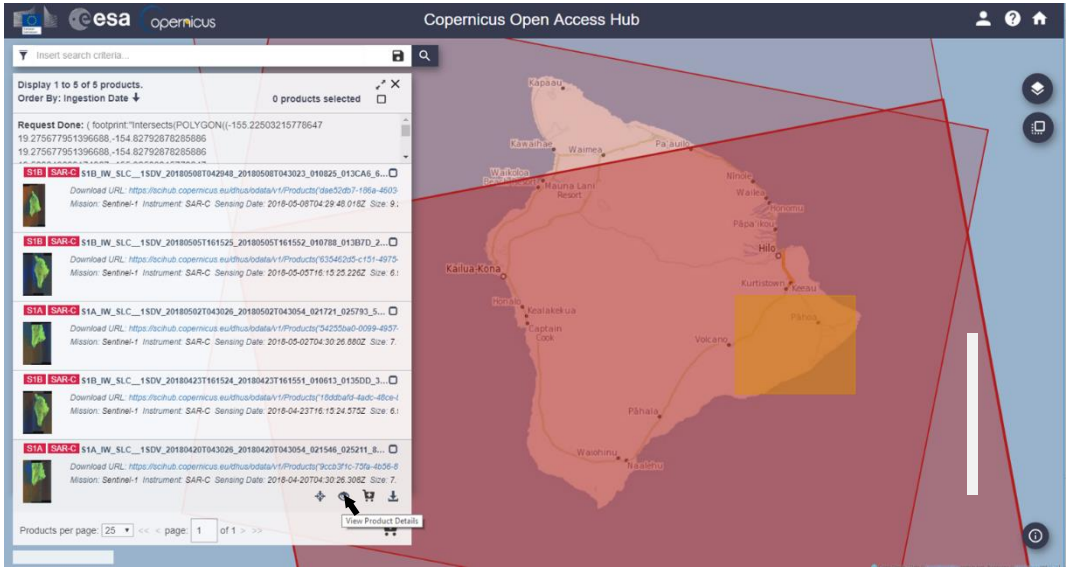


Hawaii, USA – 2018

Interferometry rules

Important things to consider when preparing your data:

- Don’t mix
  - satellites
  - relative orbit numbers
  - acquisition geometries
- Only use co-polarized data for interferometry
- Low coherence = trouble



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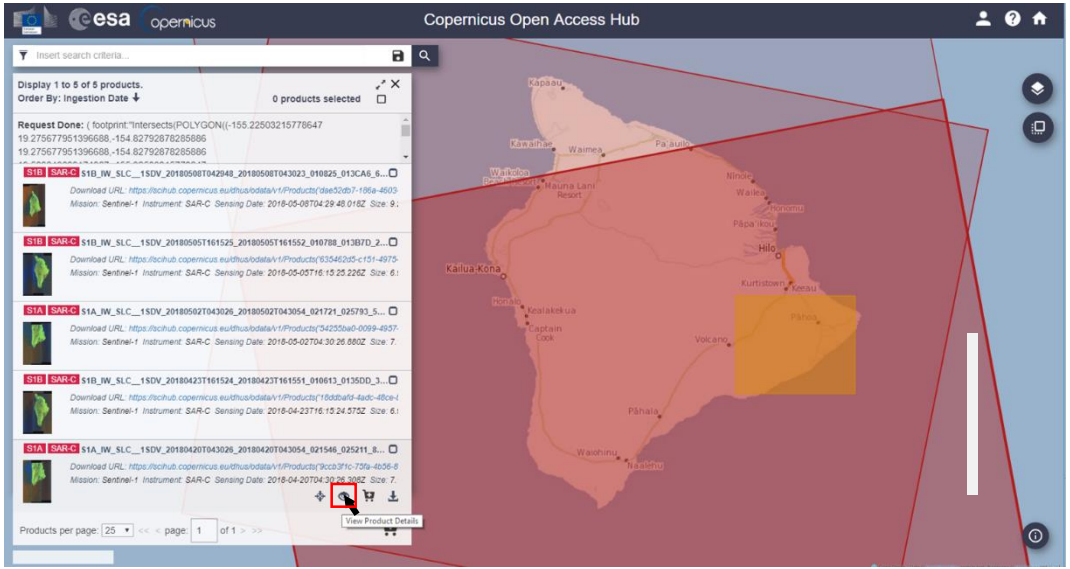

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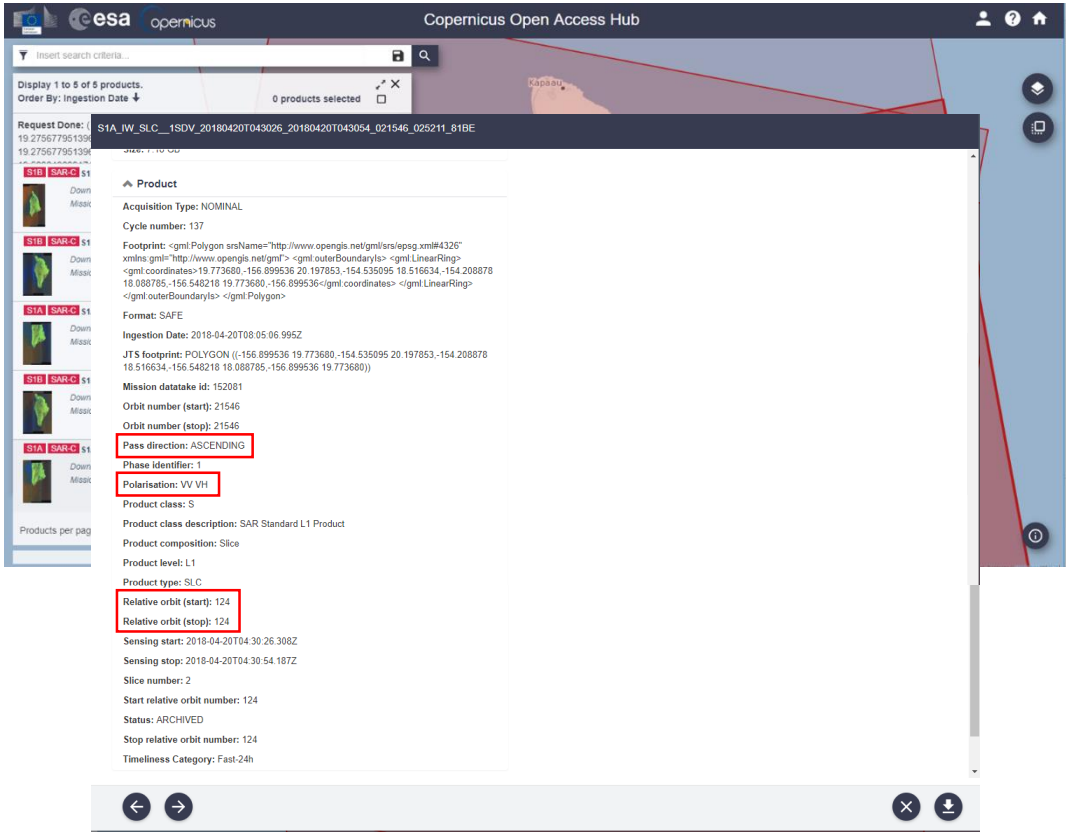
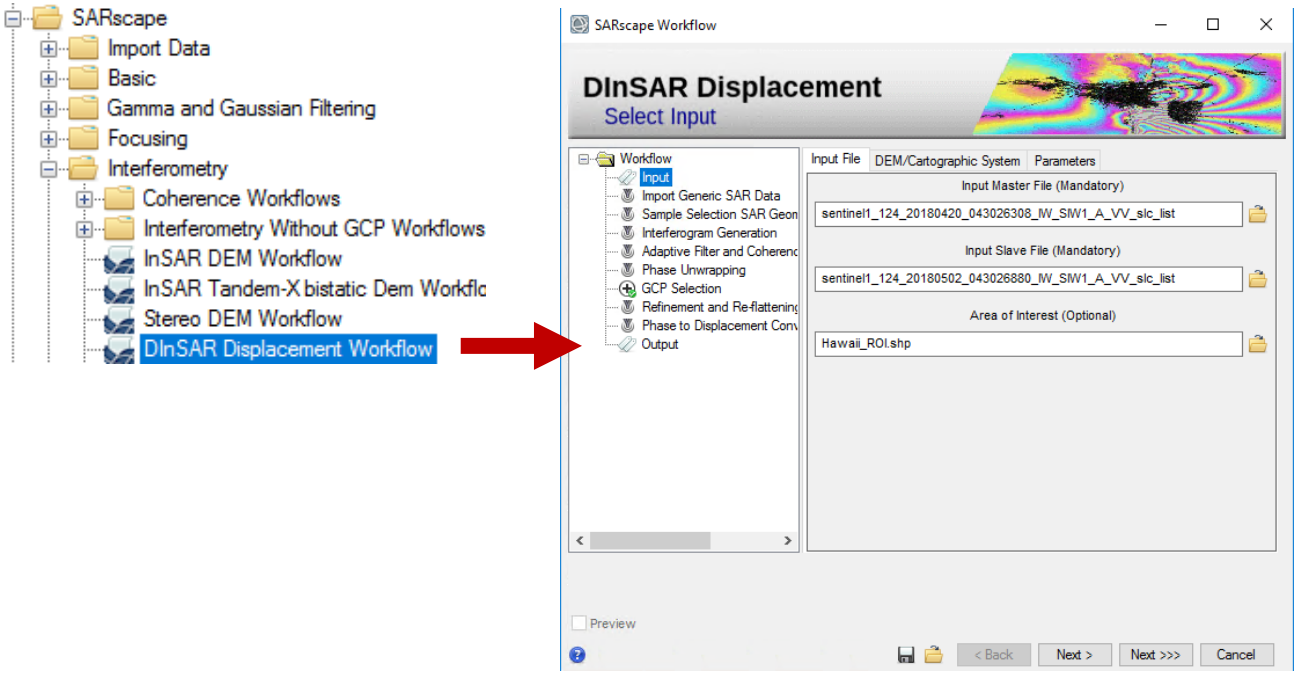
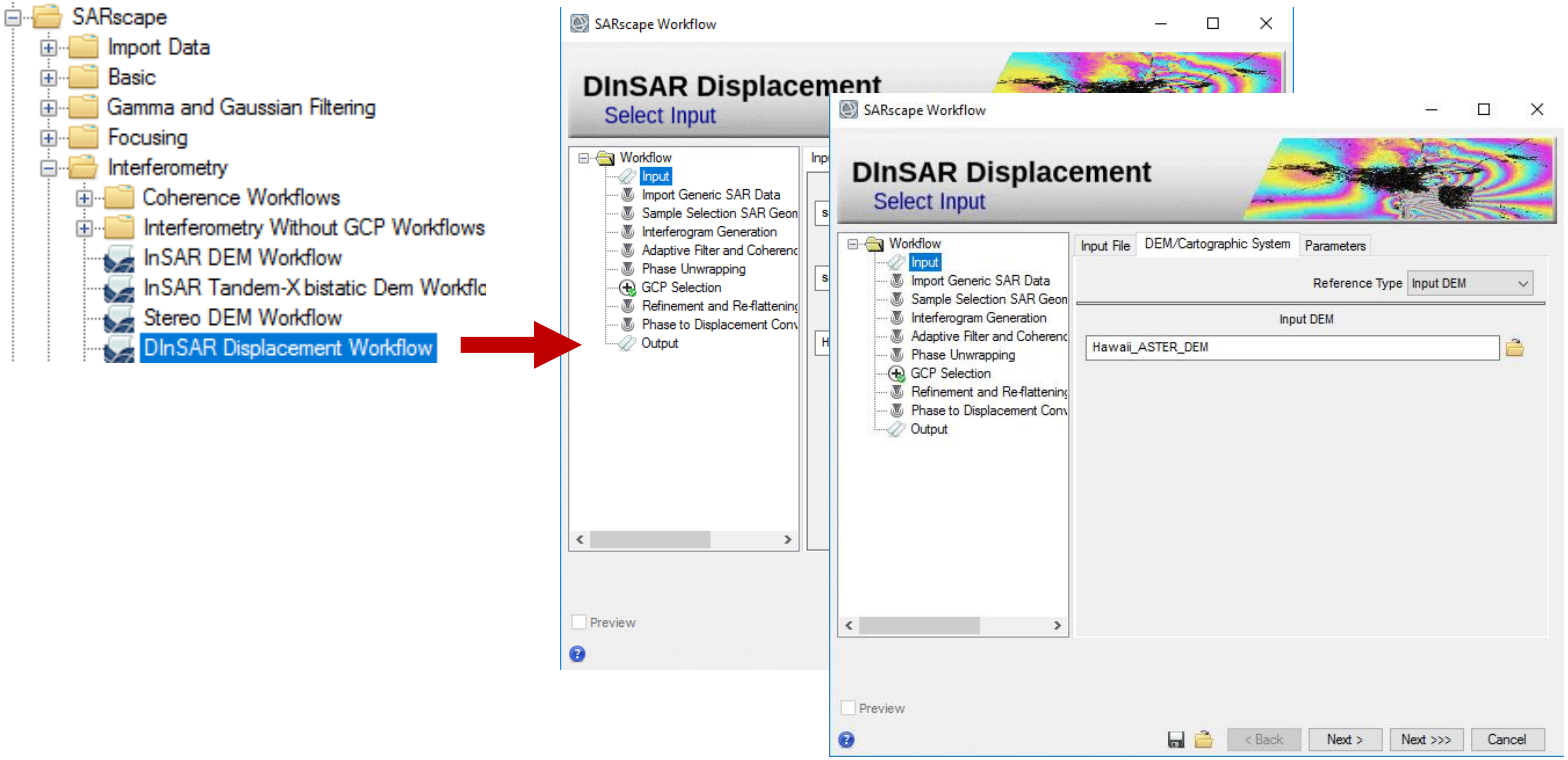


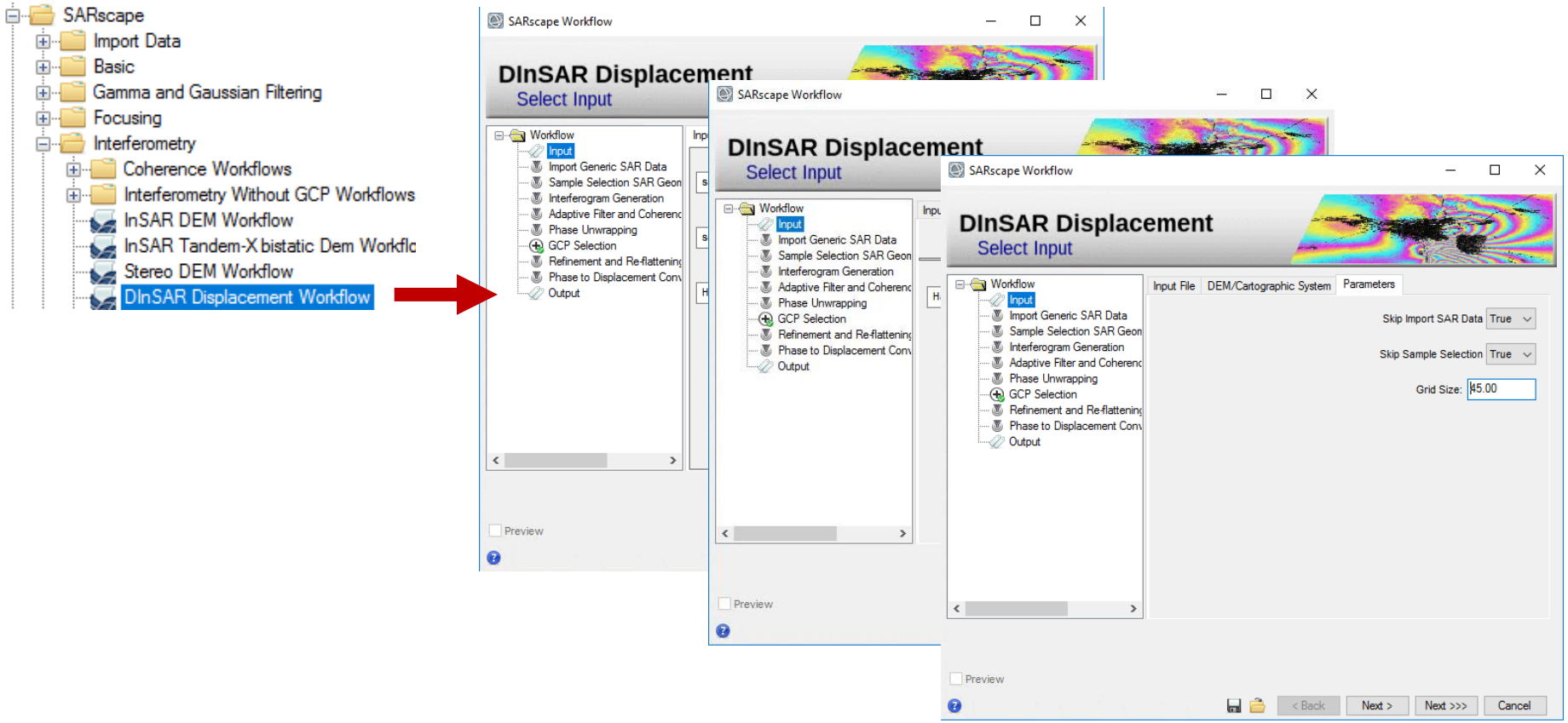
DInSAR Displacement Workflow



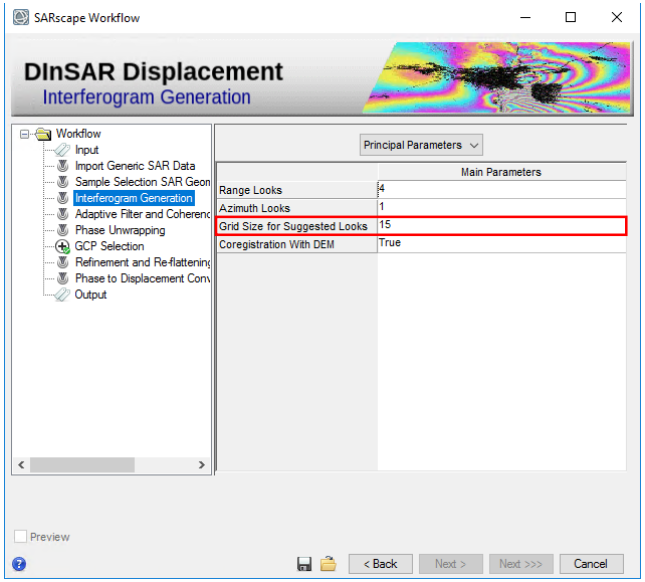
DInSAR Displacement Workflow



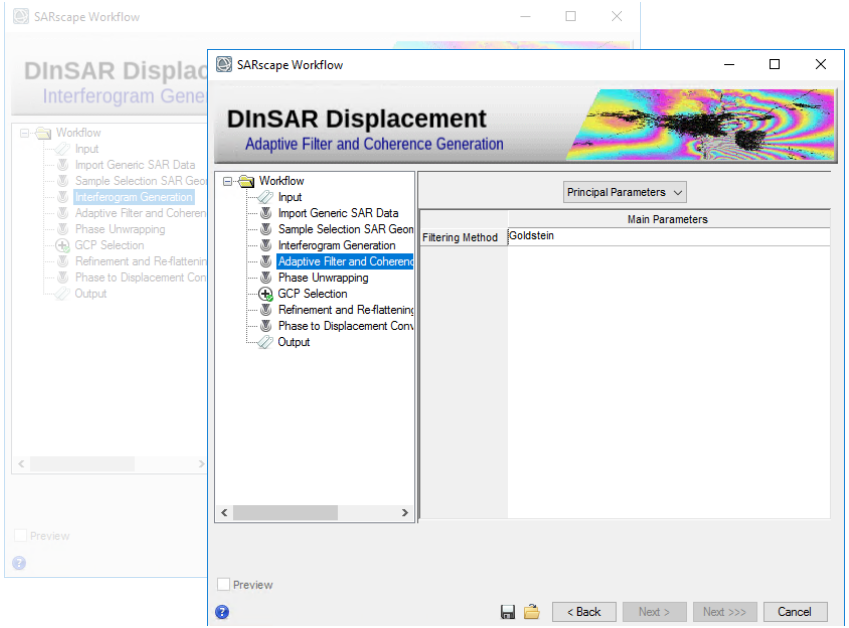
DInSAR Displacement Workflow



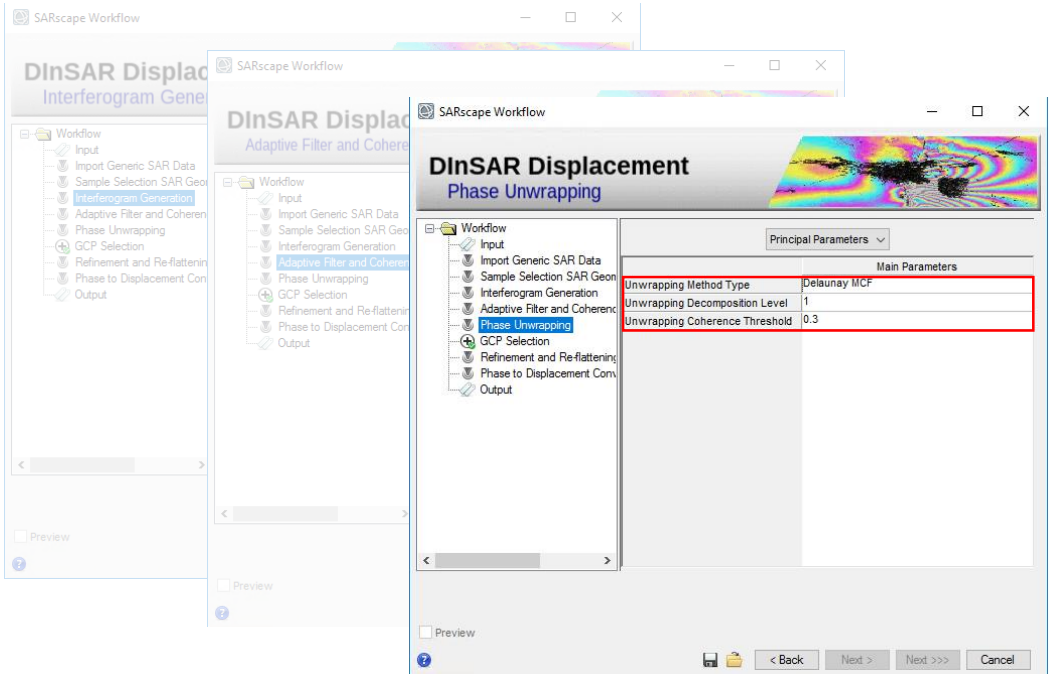
DInSAR Displacement Workflow



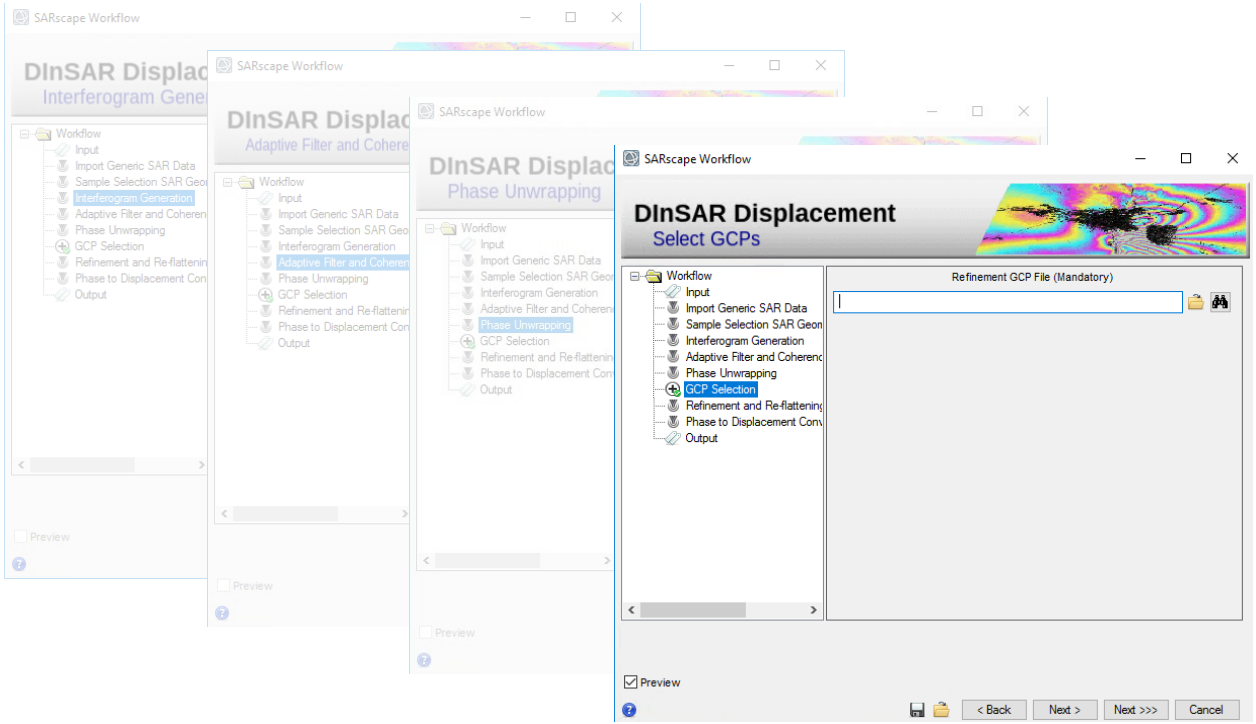
DInSAR Displacement Workflow



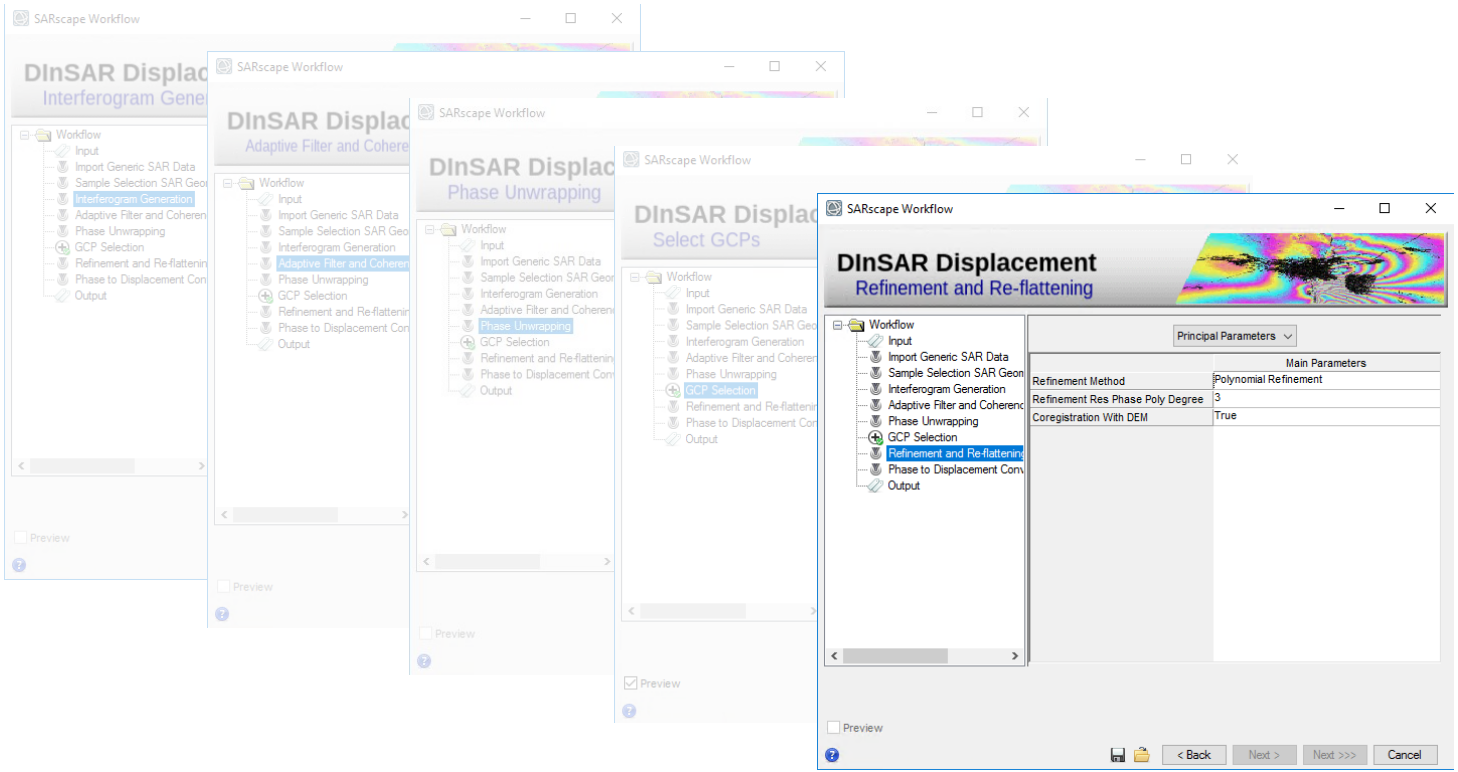
DInSAR Displacement Workflow



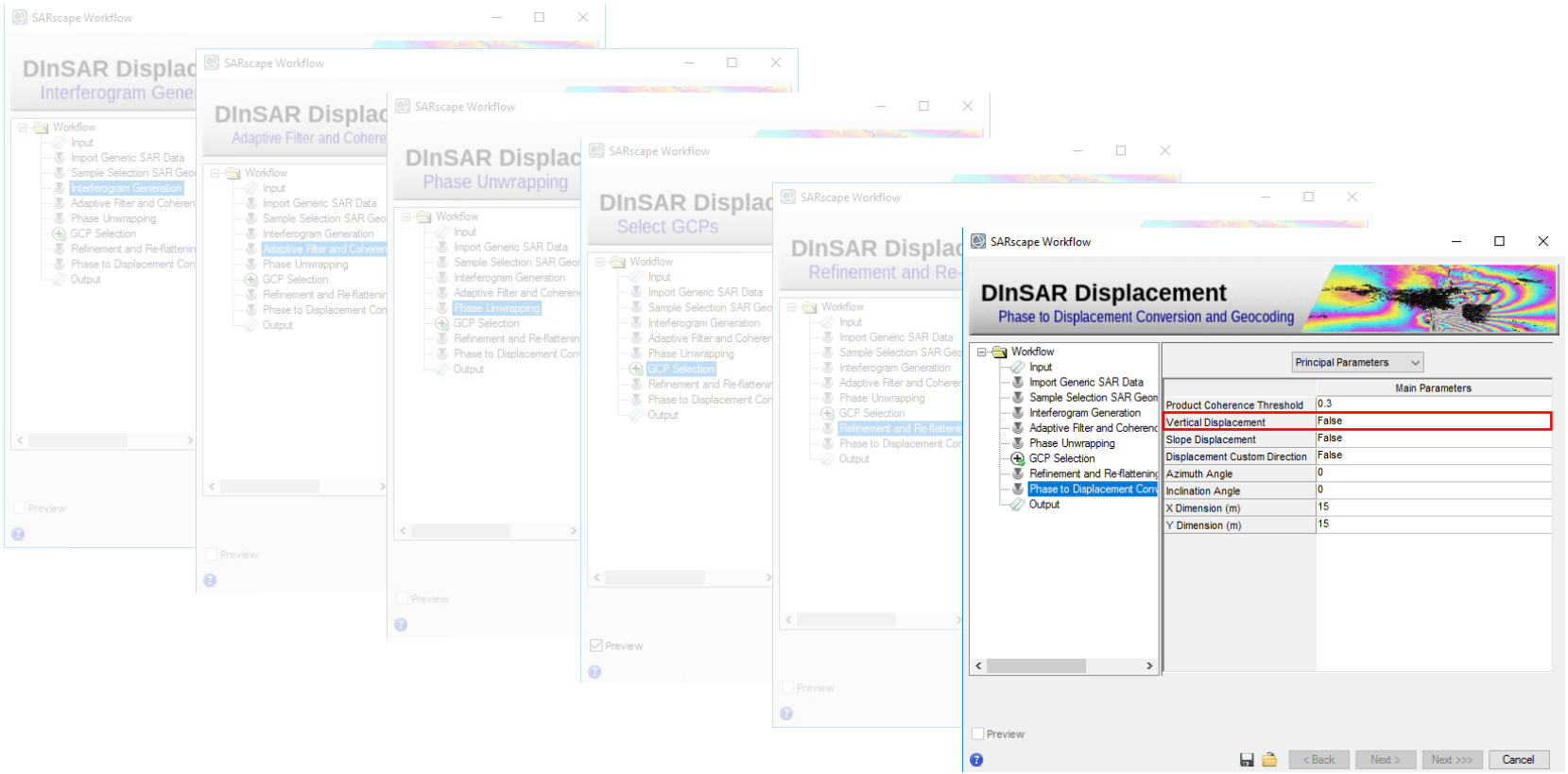
DInSAR Displacement Workflow



DInSAR Displacement Workflow

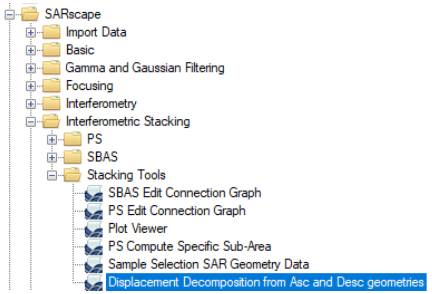


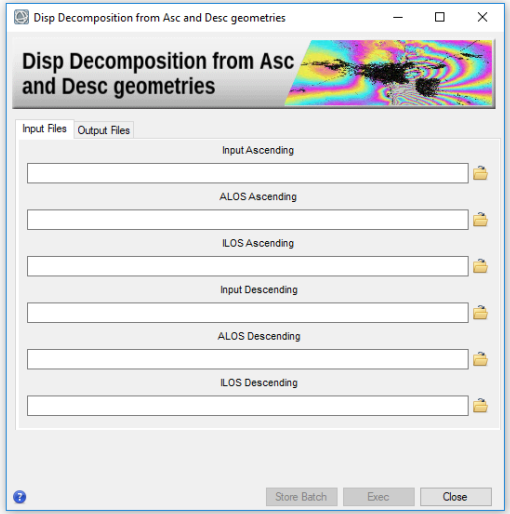
DInSAR Displacement Workflow

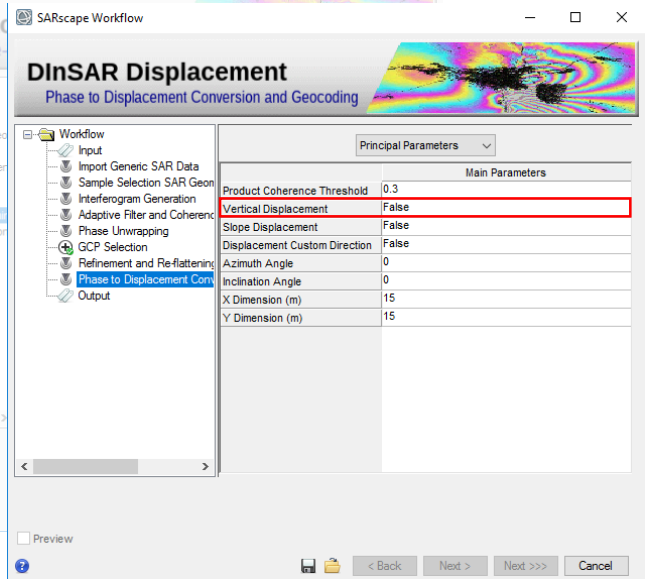


DInSAR Displacement Workflow

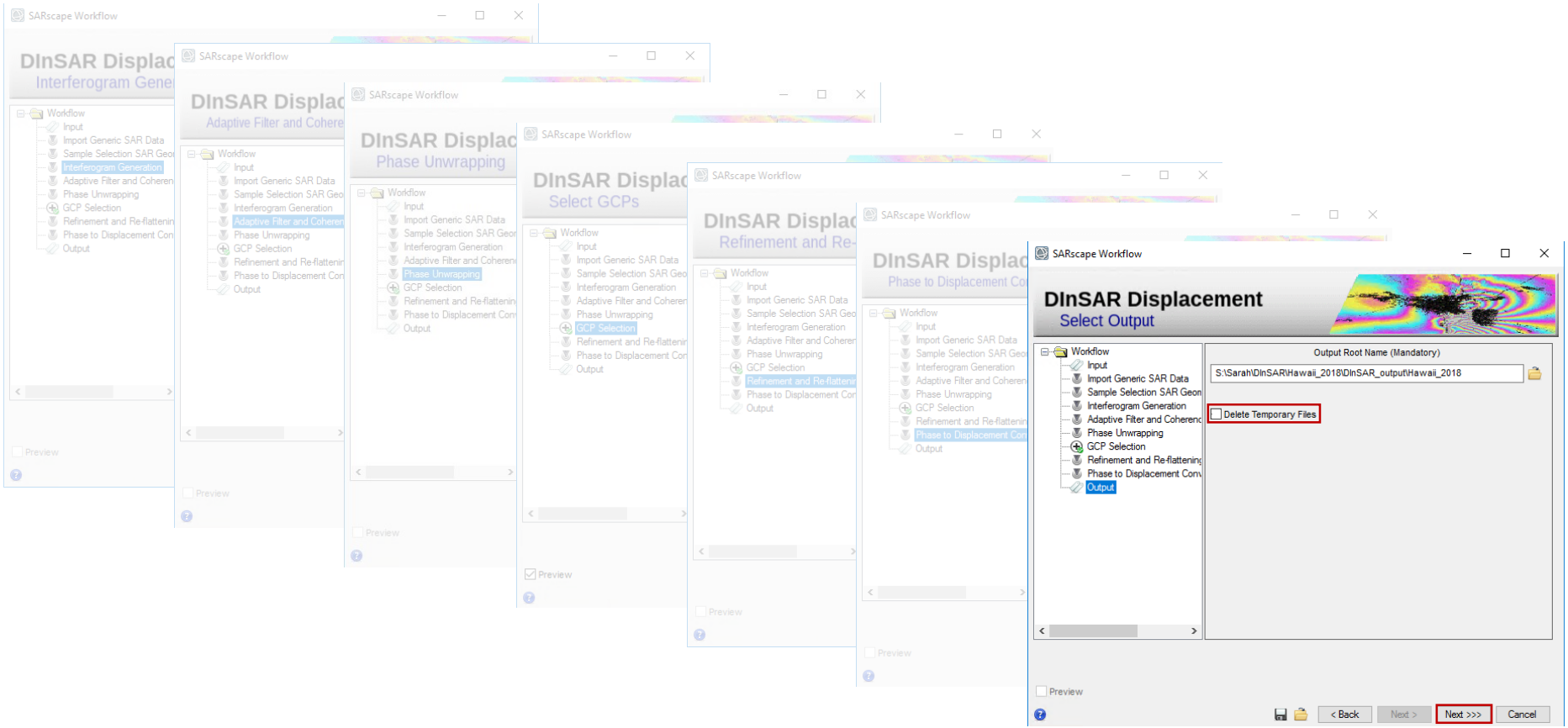
Vertical displacement



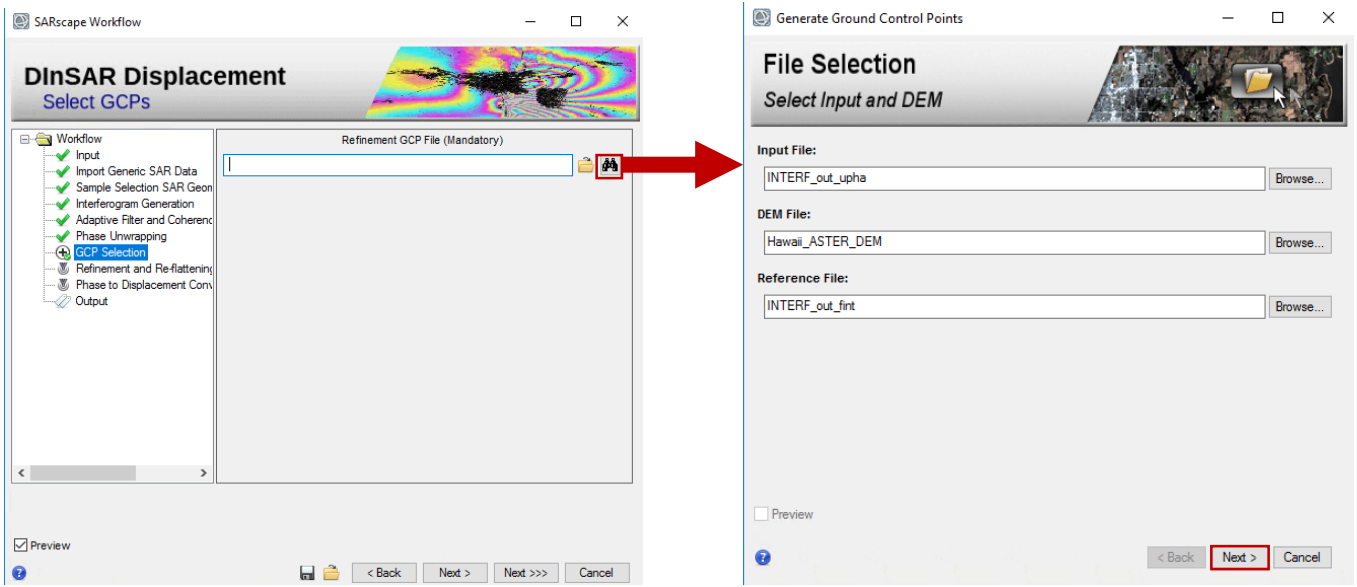




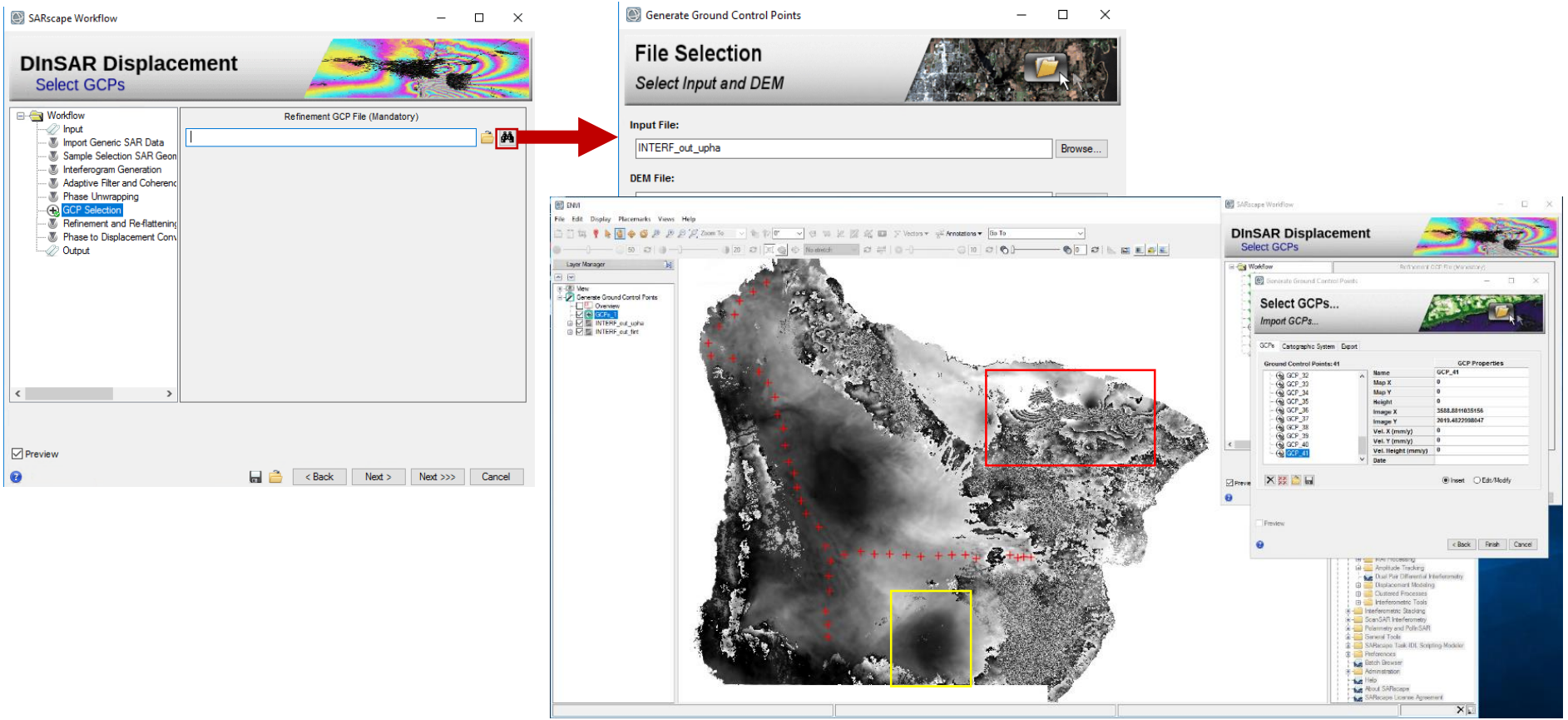
DInSAR Displacement Workflow



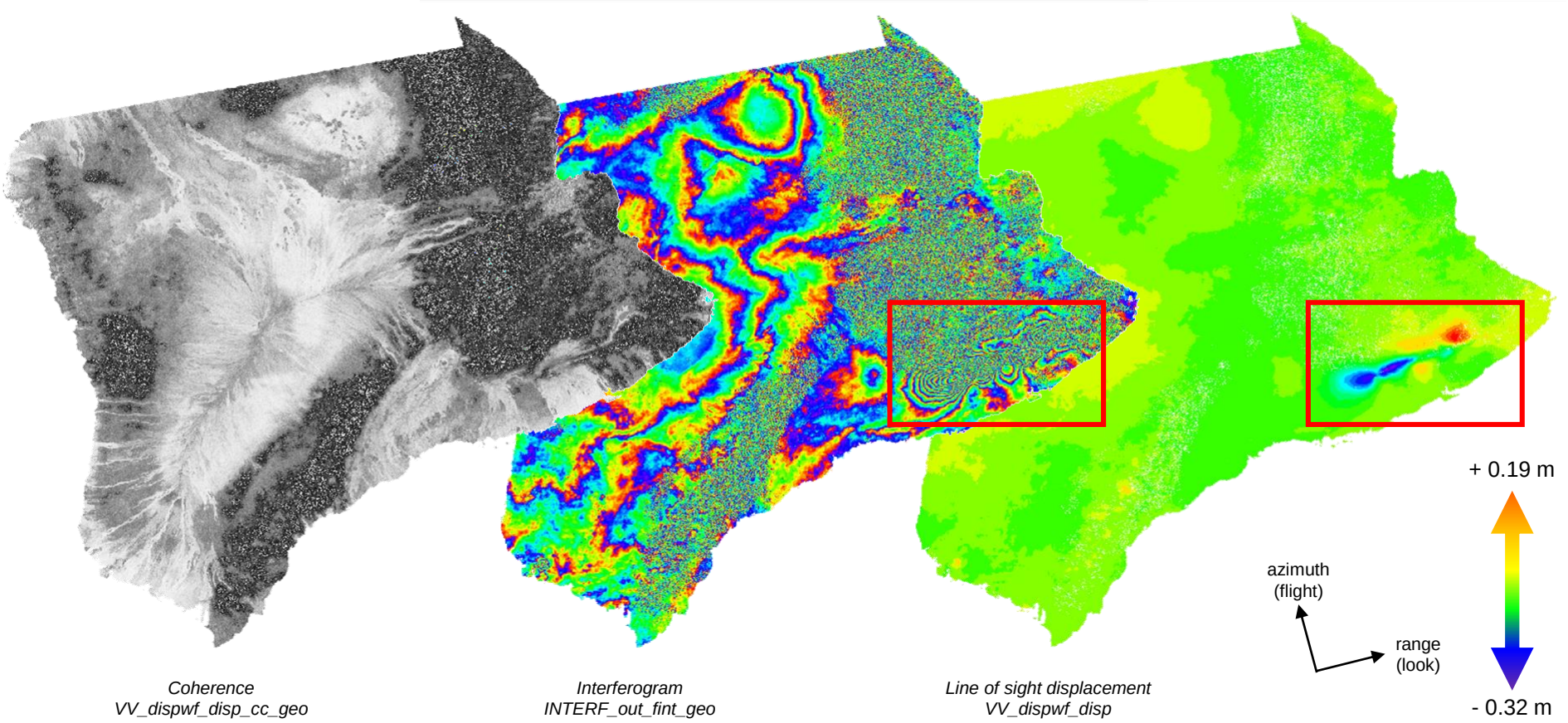
DInSAR Displacement Workflow



DInSAR Displacement Workflow



DInSAR: Products

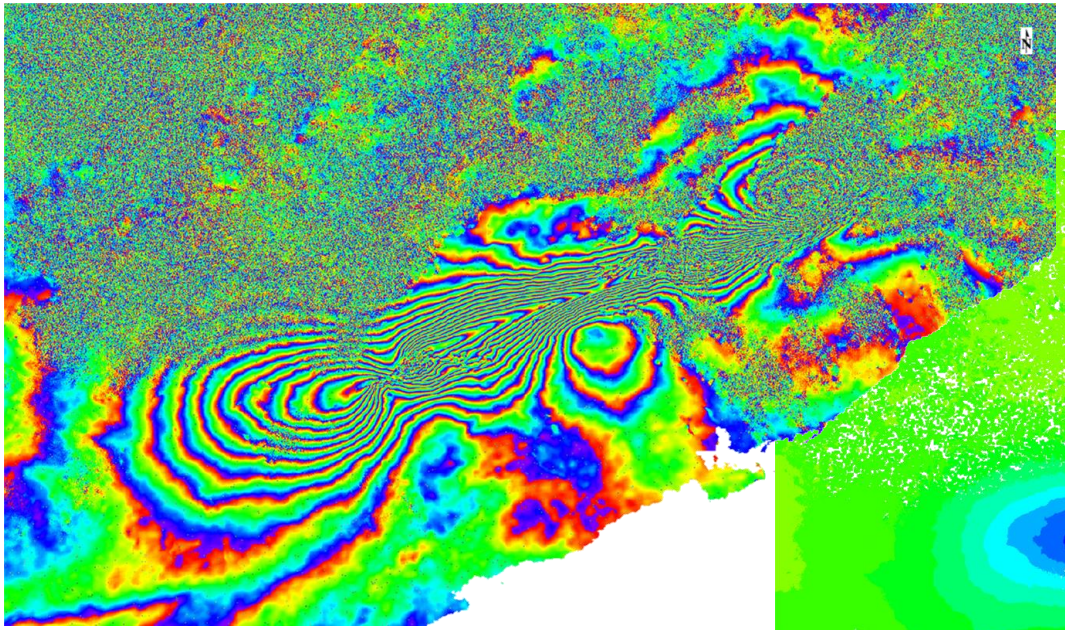


Coherence
VV_dispwf_disp_cc_geo

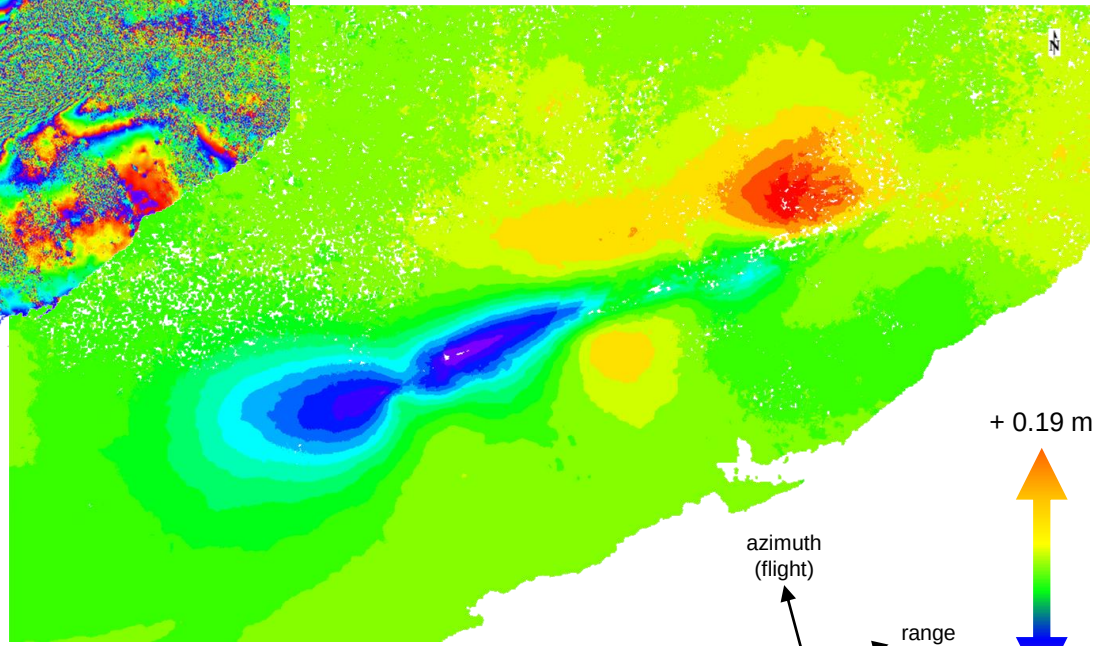
Interferogram
INTERF_out_fint_geo

Line of sight displacement
VV_dispwf_disp

DInSAR: Products



Interferogram
INTERF_out_fint_geo



Line of sight displacement
VV_dispwf_disp

Poll Question #3

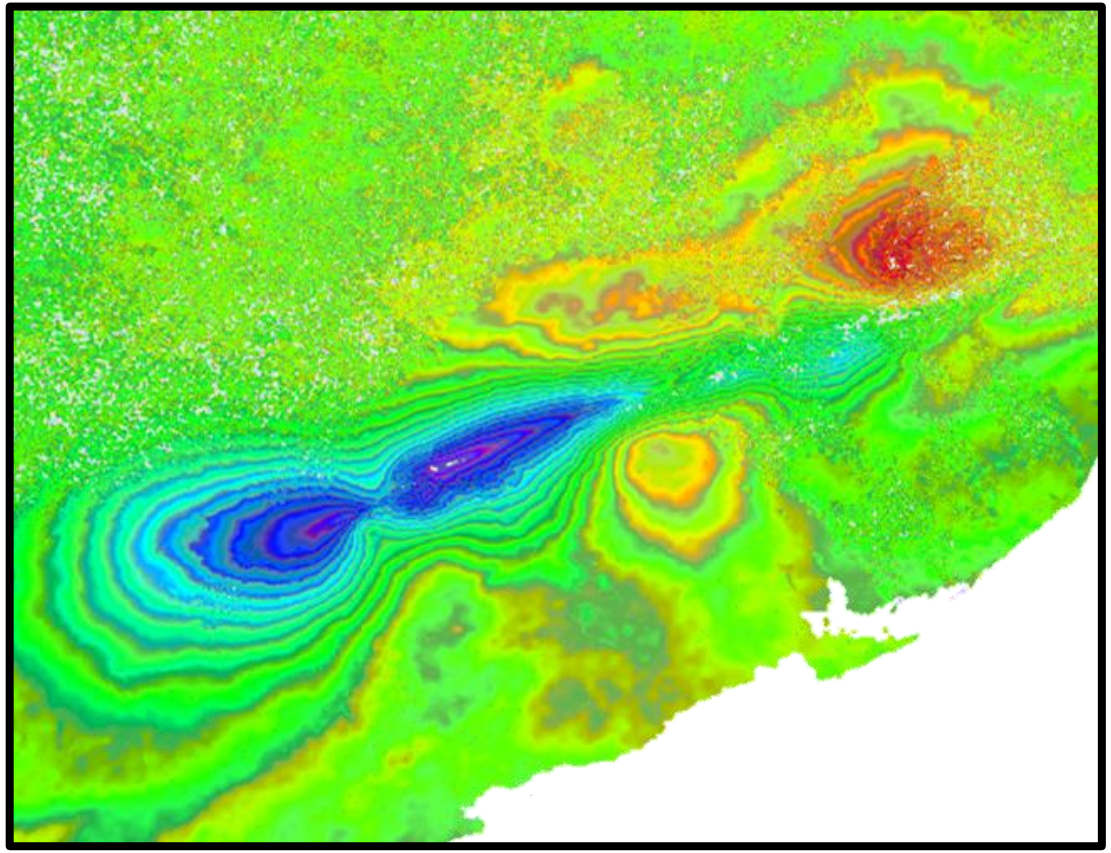
Upcoming events

January 28-30

Visit Harris Geospatial at the International LiDAR Mapping Forum (ILMF) in Denver, Colorado! Booth #213

April 3, 2019

Part 3 of our SAR Webinar Series



Questions?

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