



DInSAR to Map Land Deformation after the Earthquake

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InSAR

Interferometry Synthetic Aperture Radar

What Is Interferometry ?

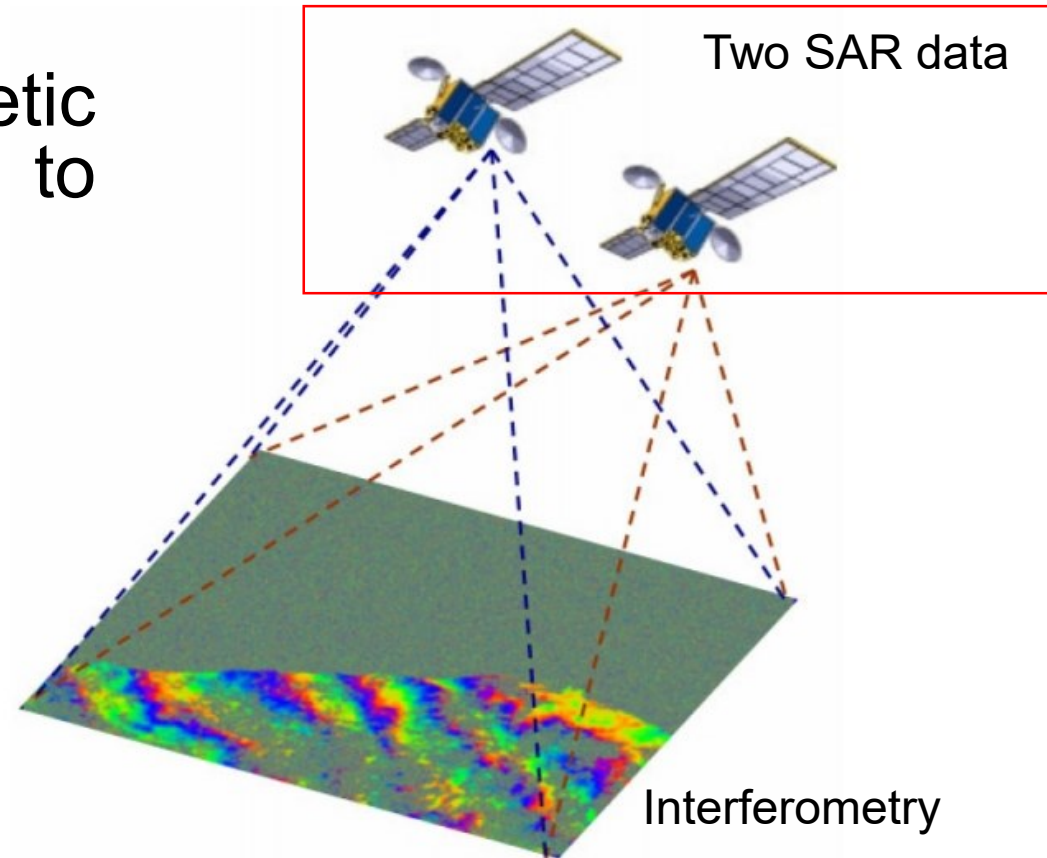
- Is a technique in which electromagnetic waves are superimposed in order to extract information about waves.
- During InSAR process, minimum two SAR data are needed. It produce interferometry phase

$$\varphi_{\text{intf}} = \varphi_{\text{flat}} + \varphi_{\text{topo}} + \varphi_{\text{def}} + \varphi_{\text{atm}} + \varphi_{\text{noice}}$$

$$-\frac{4\pi}{\lambda} \frac{B_n s}{R \tan \theta}$$

$$-\frac{\Delta q}{\sin \theta} \cdot \frac{B_n}{R_0} \cdot \frac{4\pi}{\lambda}$$

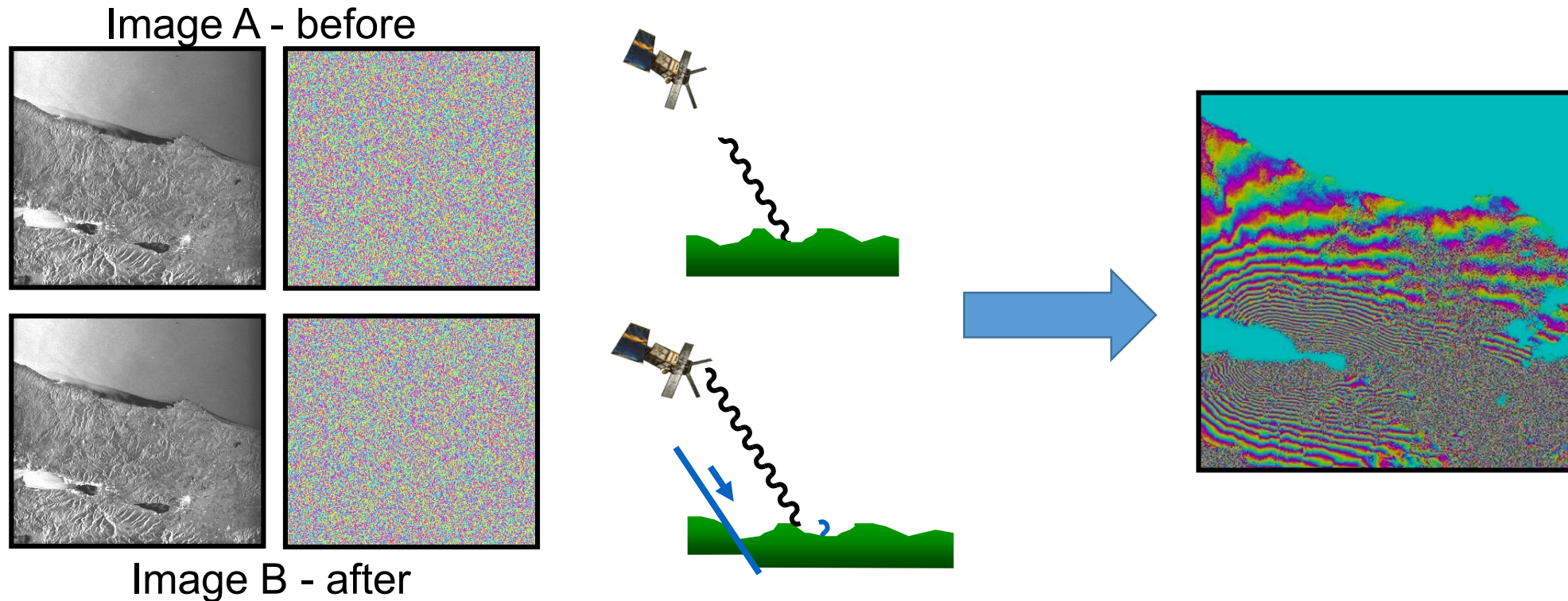
$$+\frac{4\pi}{\lambda} d$$



DInSAR

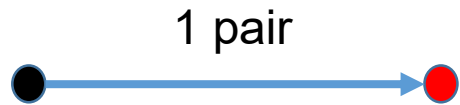
Differential Interferometry Synthetic Aperture Radar

- By comparing the difference of phase information between two SAR data that obtain at different observation date, the differential of wave interference can be measured.

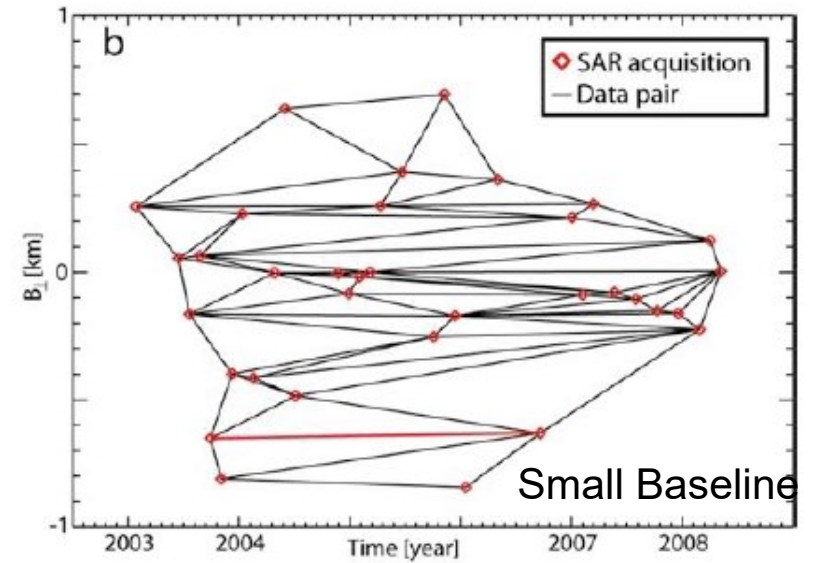
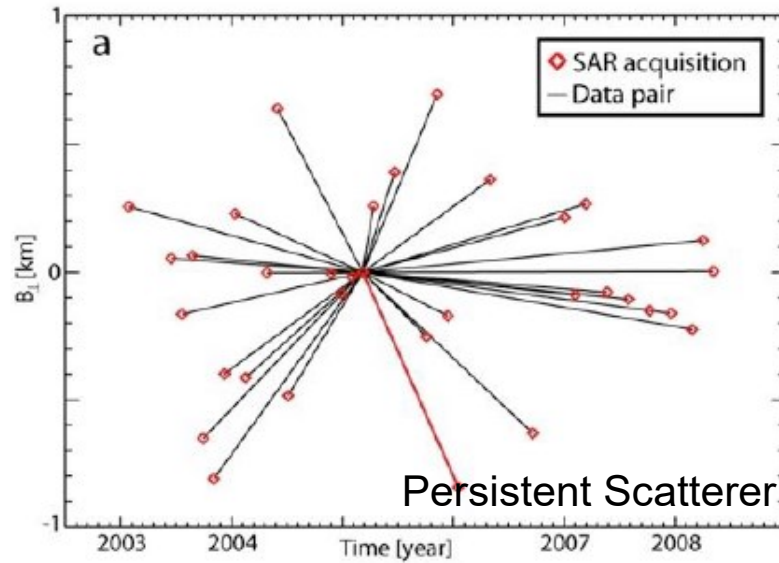


Method of DInSAR

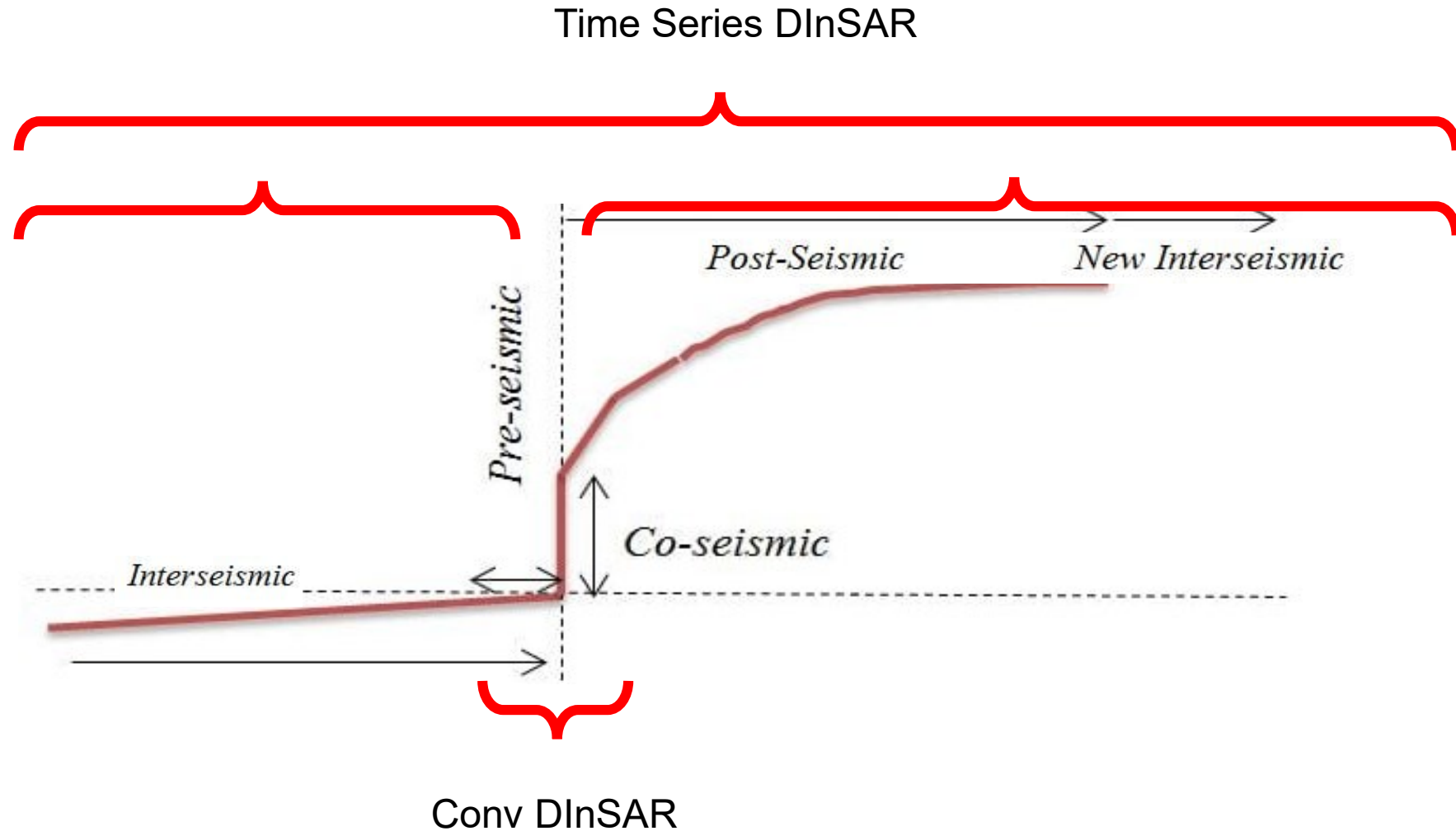
Conventional DInSAR



Timeseries DInSAR

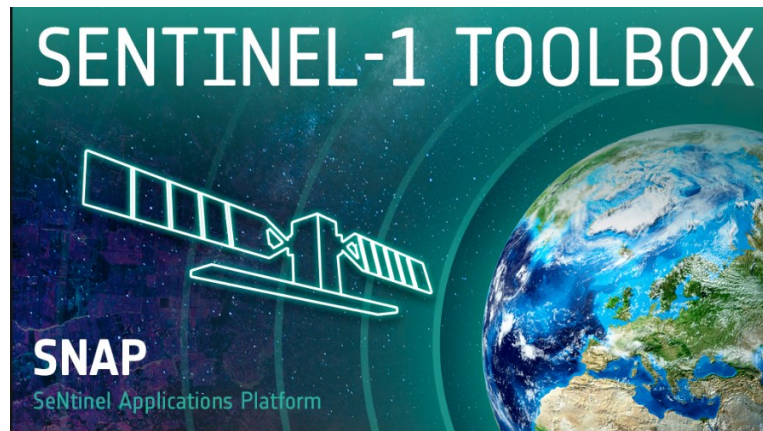


Method of DInSAR related to earthquake seismic cycle



How to Process

Local Processing



SNAP



GMTSAR

Cloud Processing



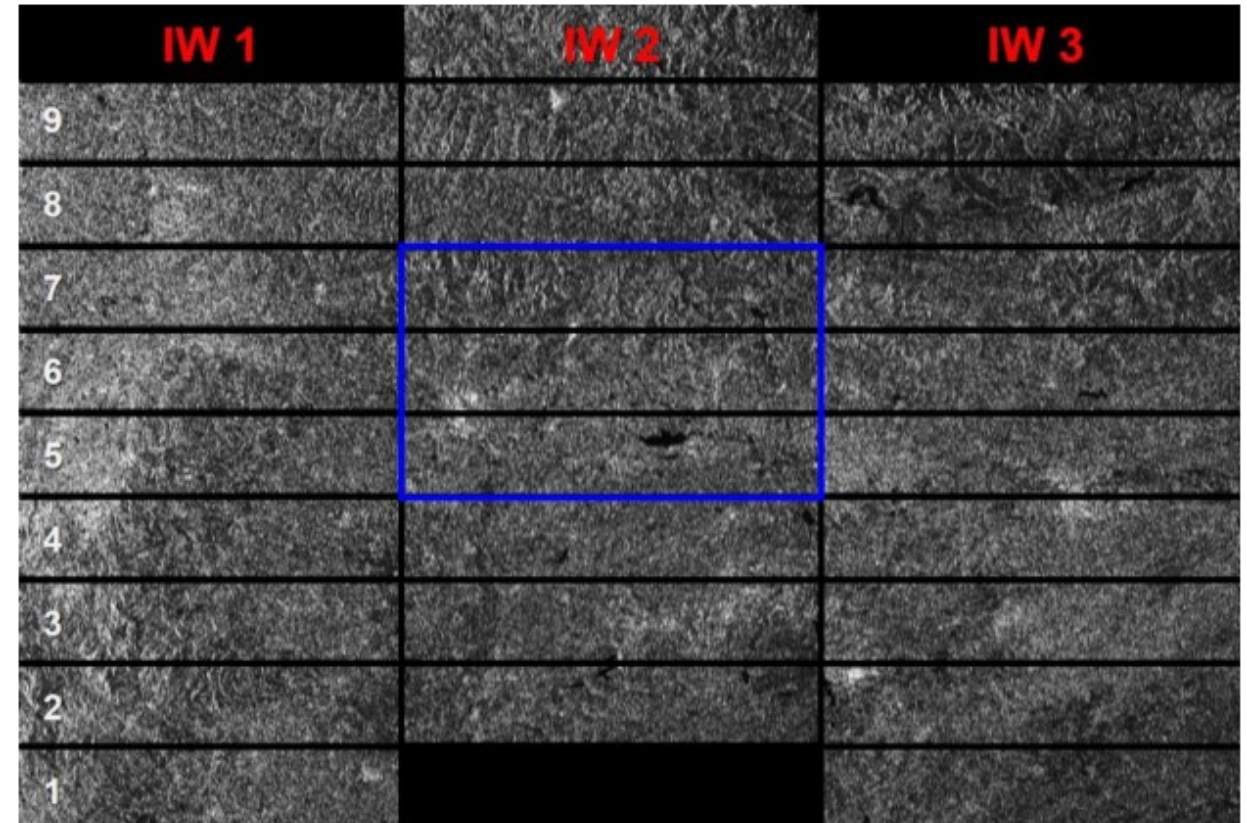
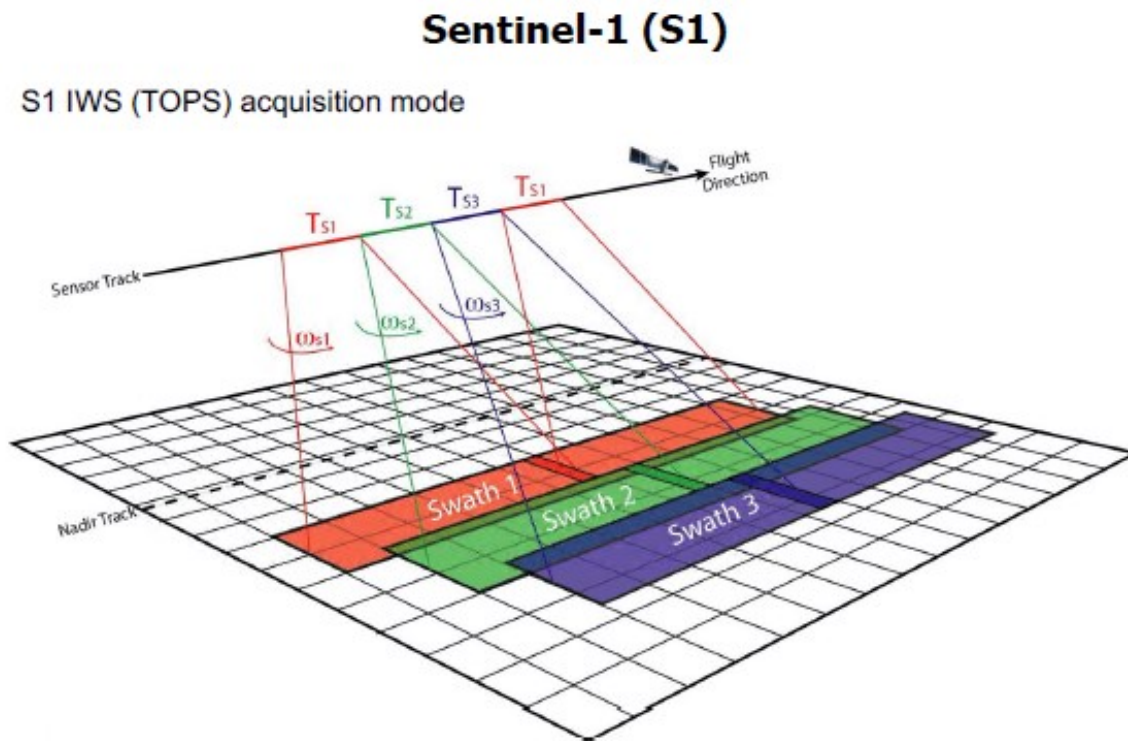
ASF platform



Geohazards Exploitation Platform

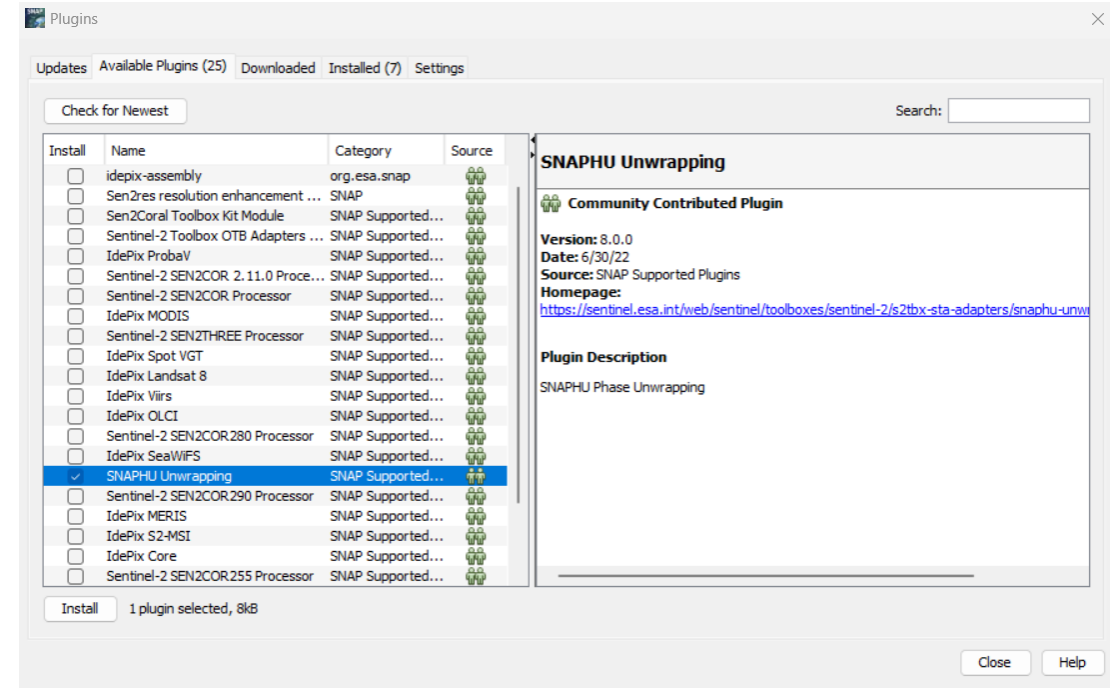
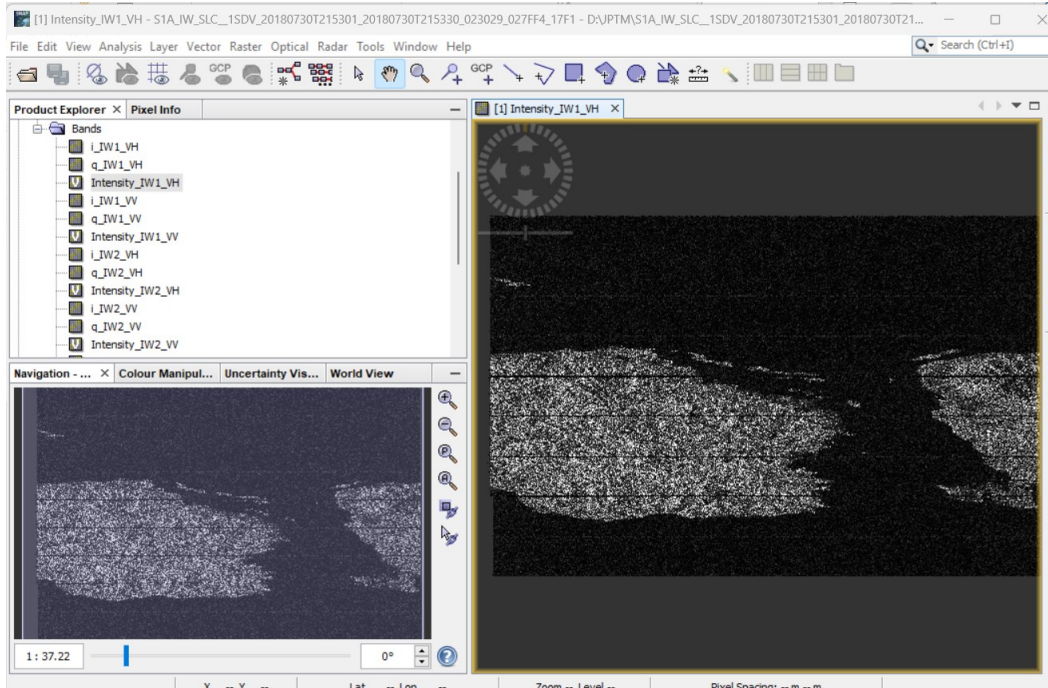
Sentinel-1 Data

- Sentinel-1 Interferometric Wide (IW) Swath Product



Preparation

1. Install SNAP (<https://step.esa.int/main/download/snap-download/>)
2. Install SNAPHU plugin
3. Download the Data (<https://scihub.copernicus.eu/dhus/#/home>)

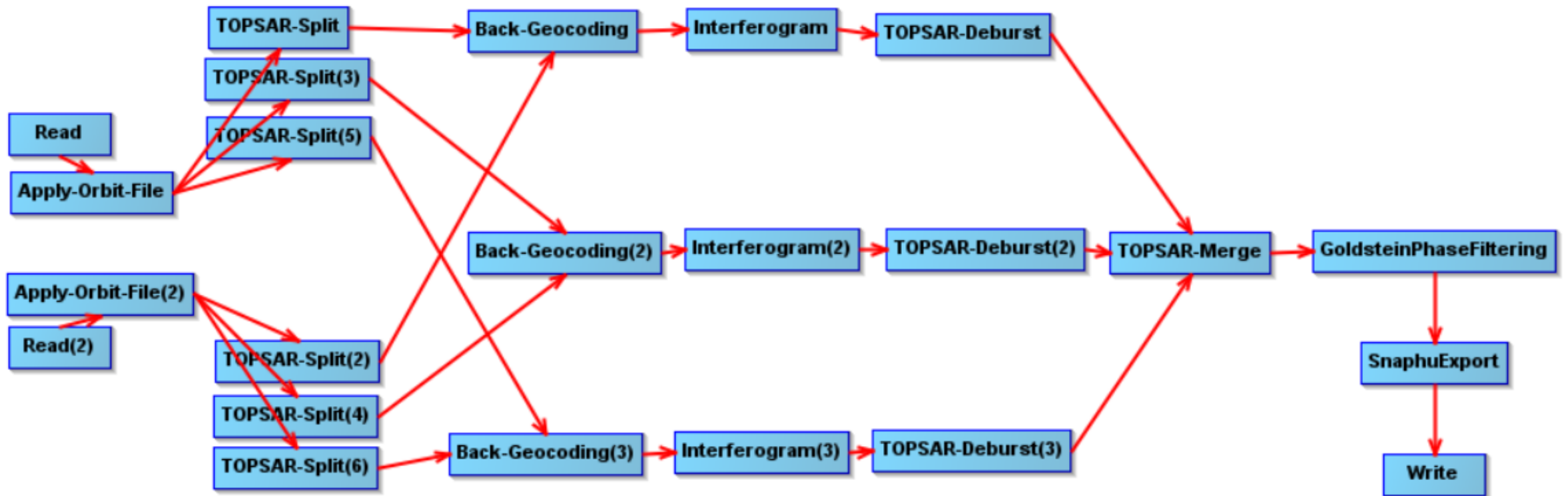


Processing DInSAR

1. Inteferometry (SNAP)
2. Unwrapping Interferogram (SNAPHU)
3. Unwrapped phase to Dissplacement (SNAP)

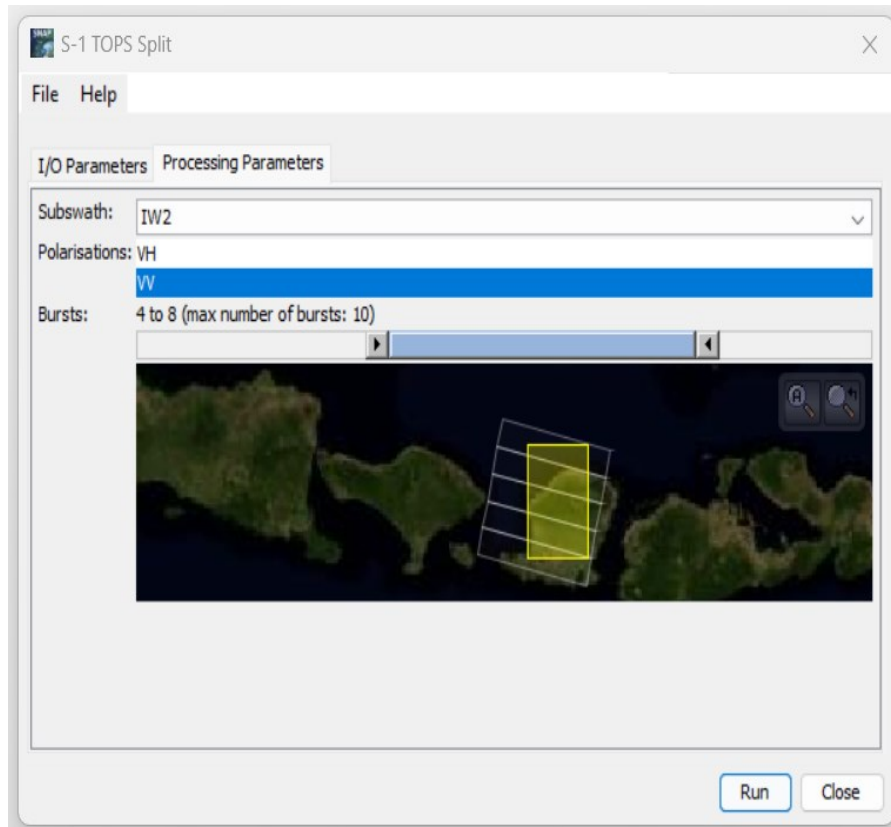
Processing DInSAR

- Interferometry (SNAP)

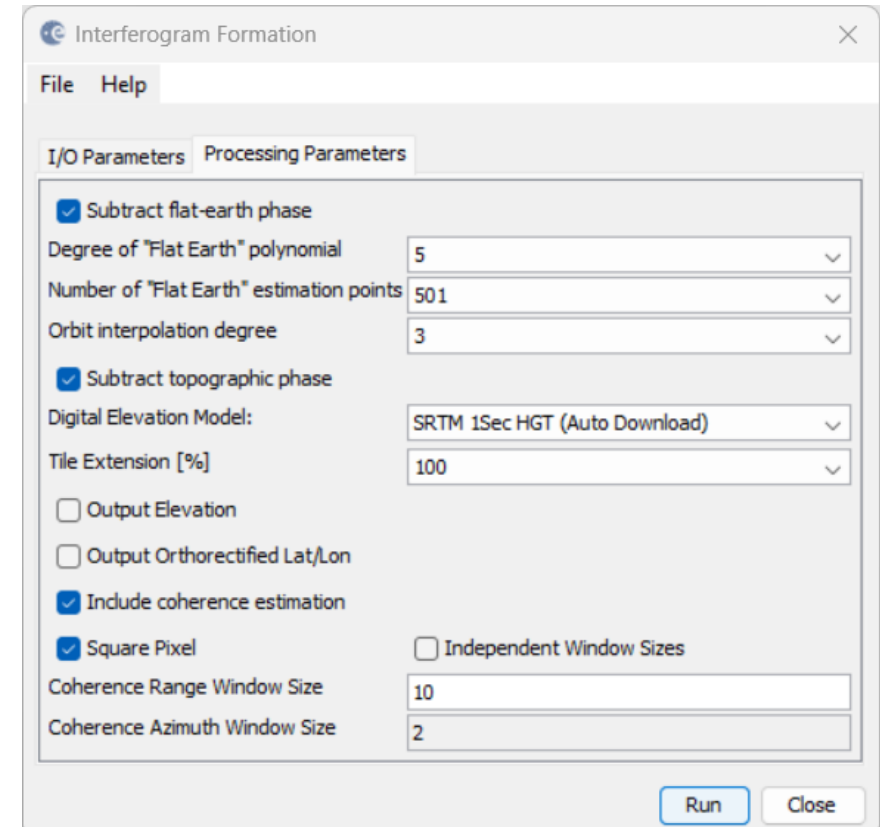


Produce wrapped Interferogram

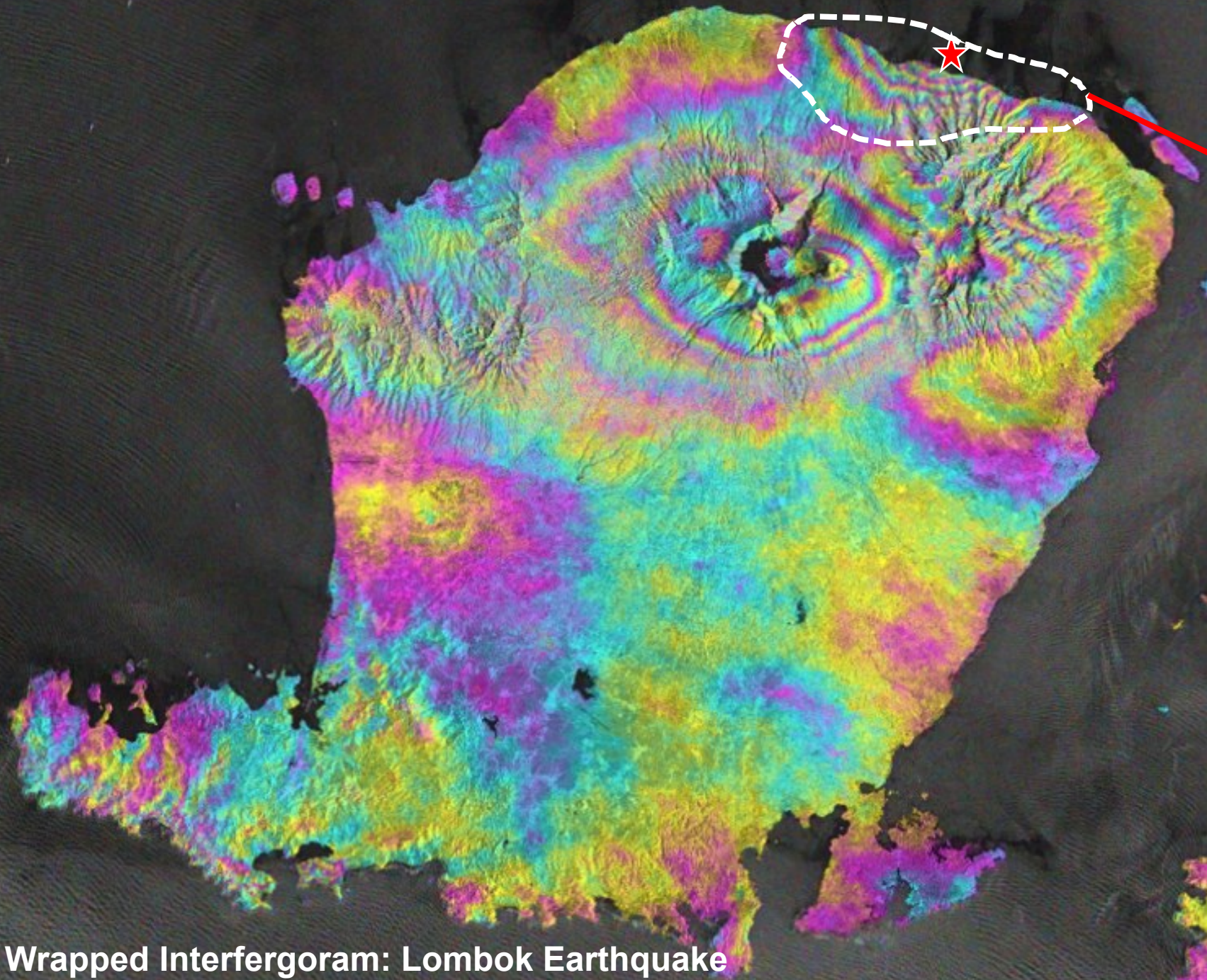
Some Important part



- Select subswath and burst. Each subswath pair is processed separately. If use 1 pair subswath, it doesn't need TOPSAR merge



- Check subtract flat-earth phase and topographic phase



Fringe : Repeating color patterns represent phase repetition

★ Earthquake : July 29th 2018

Pair :

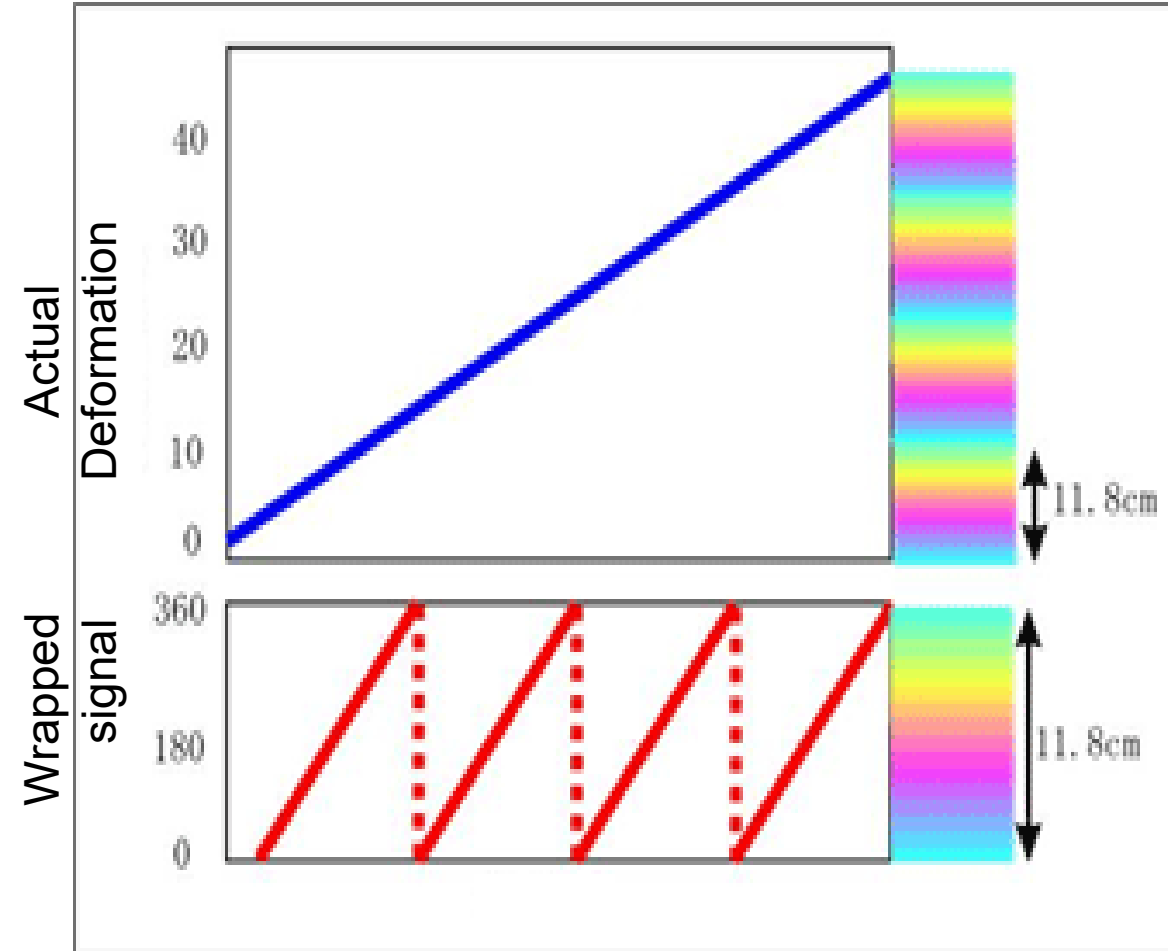
July 25th 2018 – July 31th 2018

Descending direction

Wrapped Interferogram: Lombok Earthquake

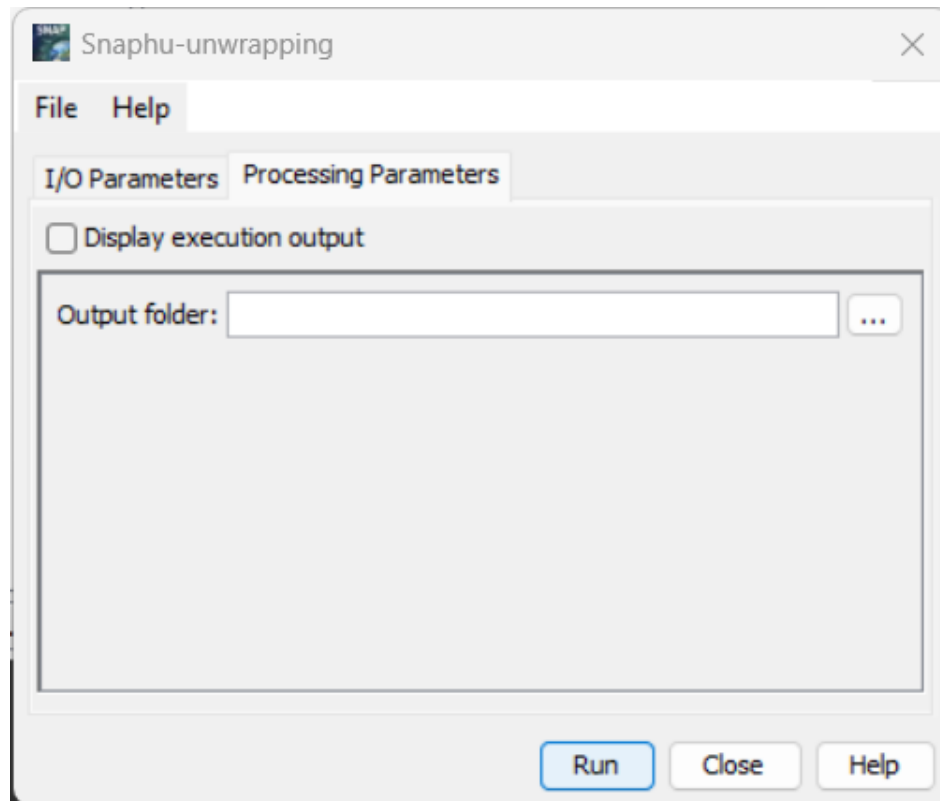
Why wrapped inteferogram need to unwrap

- InSAR doesn't produce absolute distance
- one cycle pattern = half of the wavelength
- If the deformation bigger than half of the wavelength, the cycle will repeated and creating wrapped deformation cycle. Usually the cycle displayed in color.

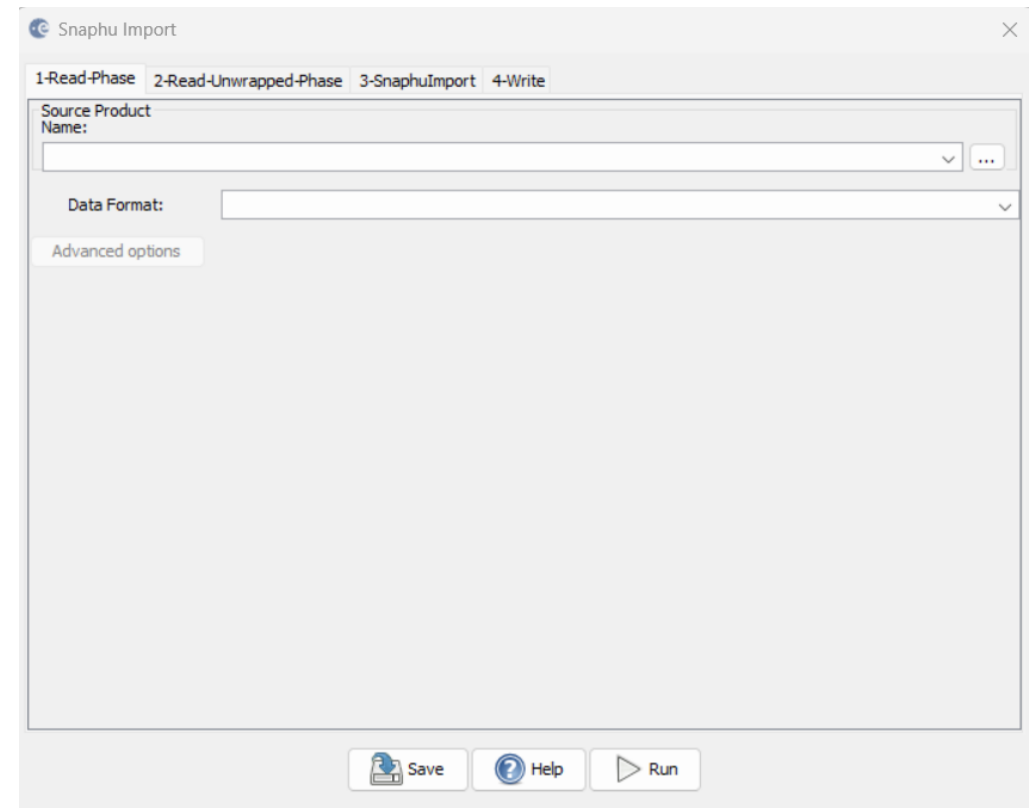


Processing DInSAR

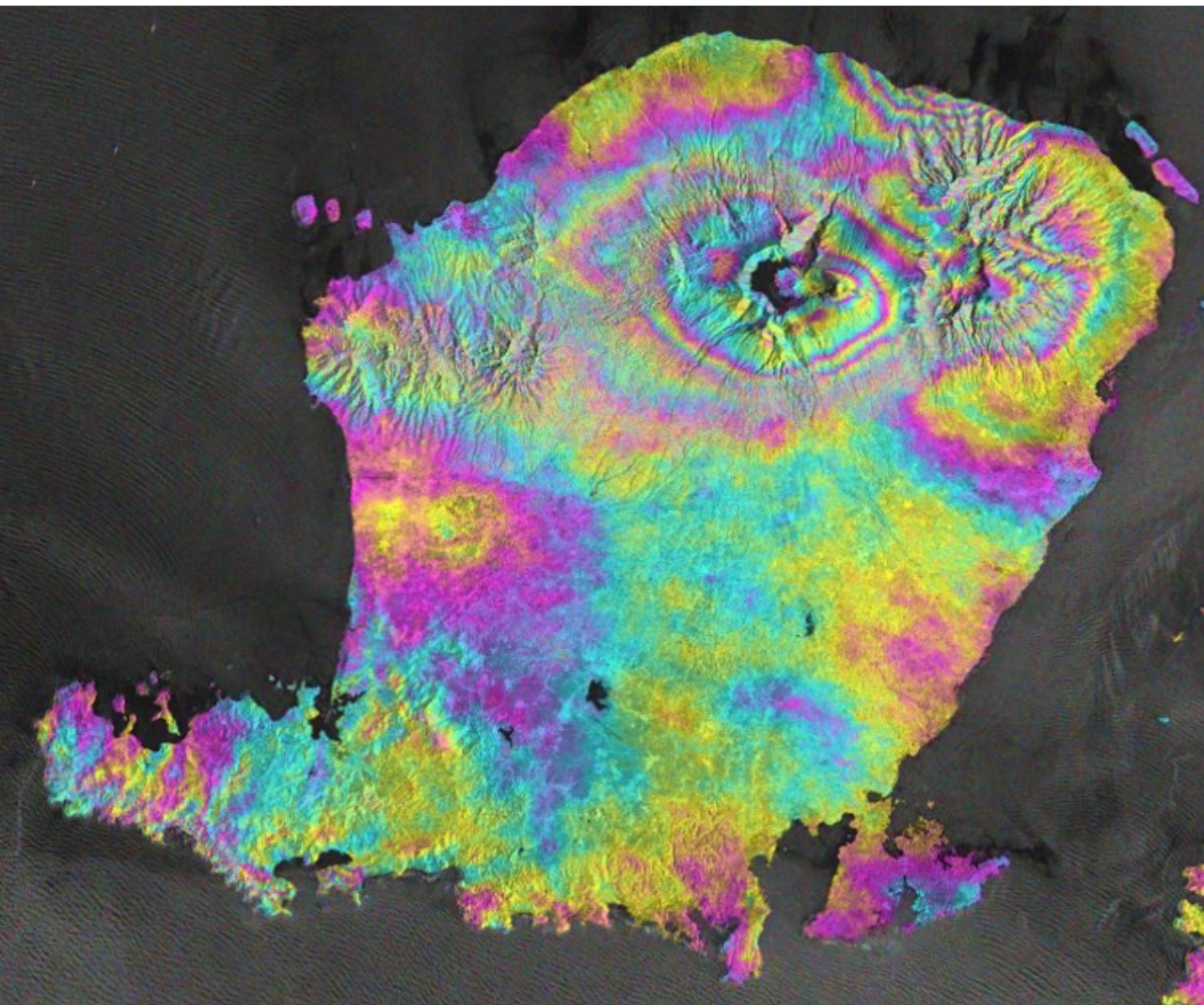
Unwrapping interferogram (SNAPHU tool)



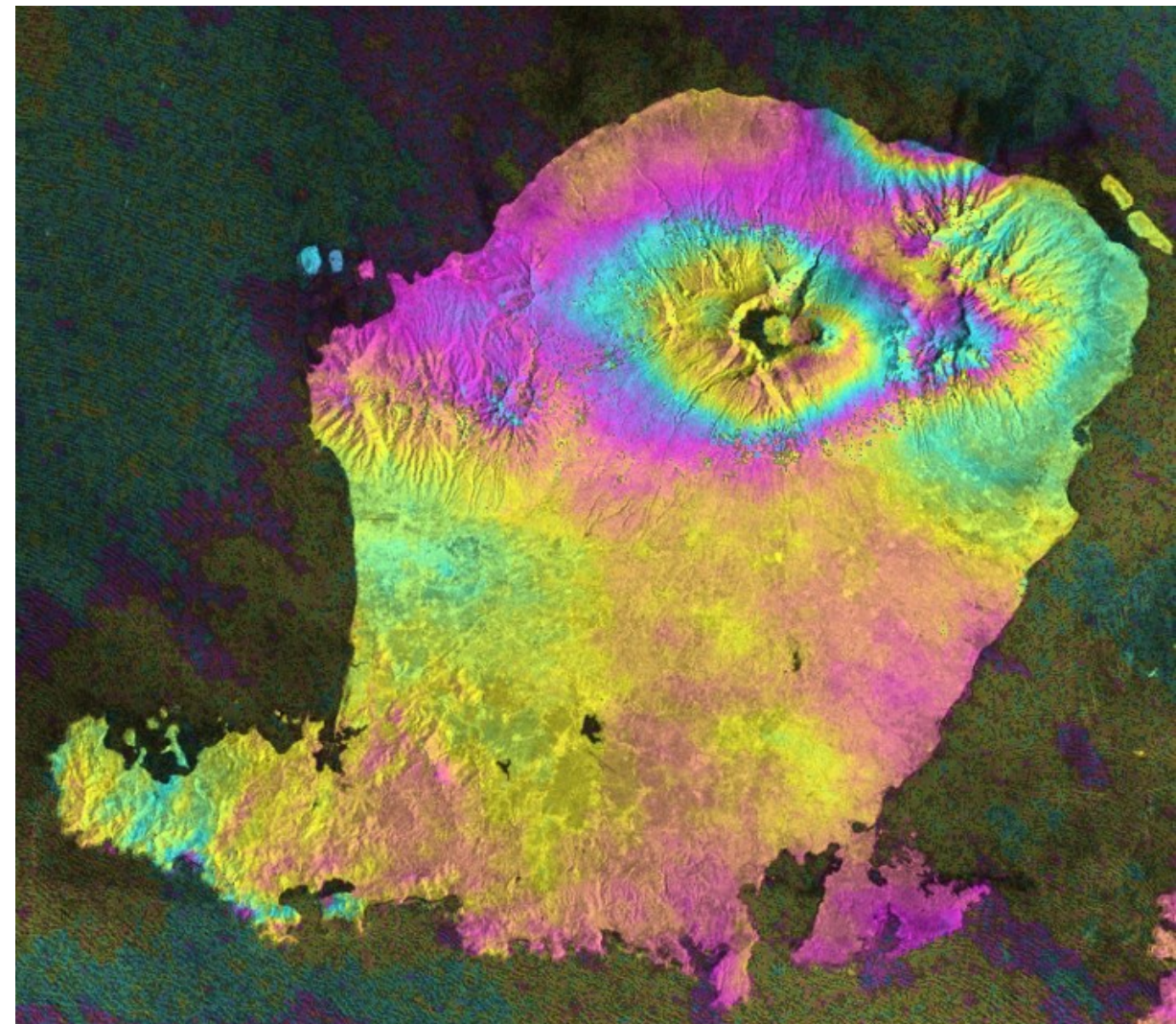
Unwrapping process on SNAPHU



Import unwrapped interferogram to SNAP



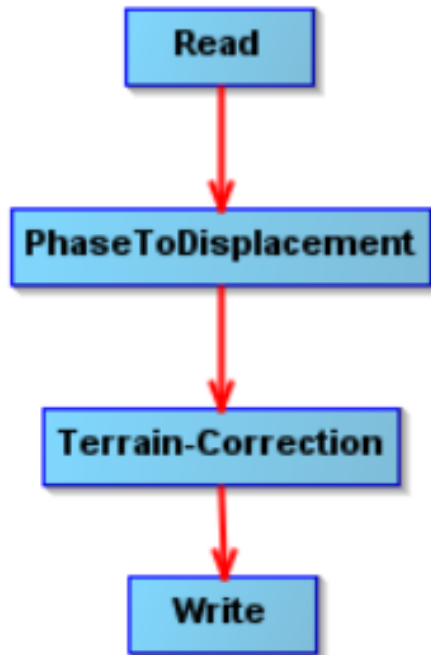
Wrapped Interferogram



Unwrapped Interferogram

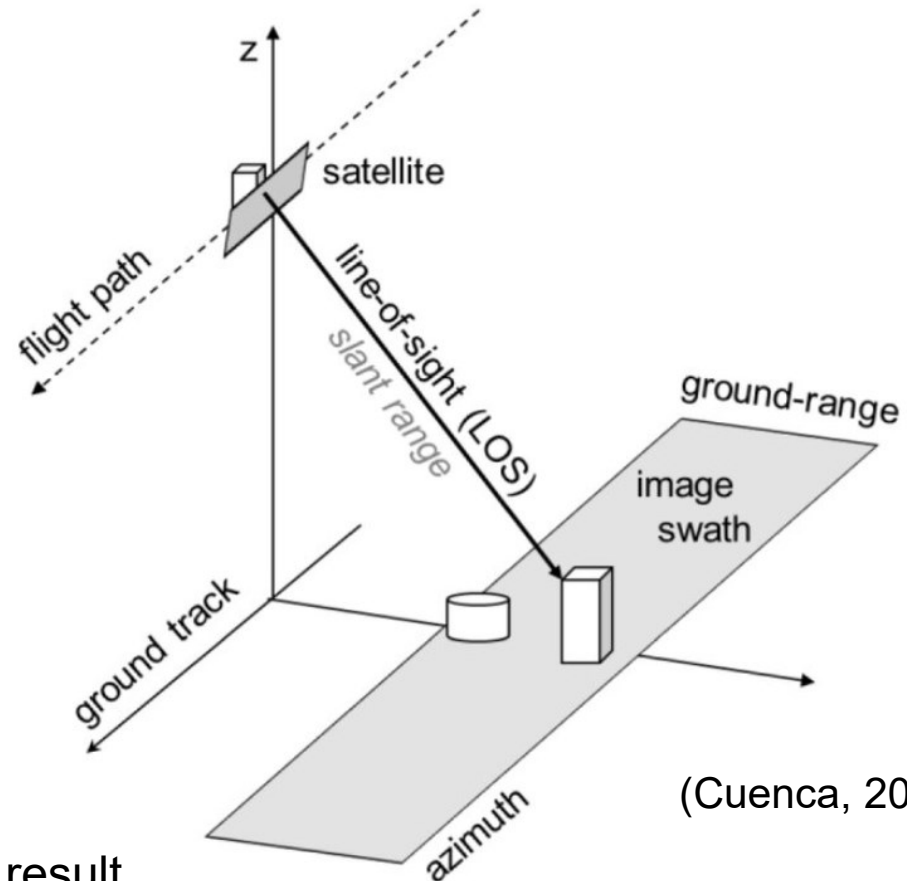
Processing DInSAR

- Phase to Displacement / Deformation



Produce LoS deformation

Need to coherence masking to mask out bad result



(Cuenca, 2013)

$$dv = \frac{d_{Los}}{\cos \theta}$$

DInSAR Cloud Processing

- It doesn't need download the data
- Doesn't need high spec workstation
- Faster than local processing (depend on workstation)
- Free platform (Alaska Satellite Facility (ASF) Vertex)
- Paid platform (Geohazard Exploitation Platform)



ASF Vertex

- Searching - Filtering

The screenshot displays the ASF Vertex web interface. At the top, the header includes 'EARTHDATA', 'Other DAACs', and 'Feedback'. The main search area features a search bar with the following parameters: Search Type: Geographic Search, Dataset: Sentinel-1, Area of Interest: POLYGON((115.8858 -8.9. Filters: 250 of 100 Files. A 'SEARCH' button is present. Below the search bar, the search criteria are summarized: Start: Jun 30 2018, End: Aug 31 2018, Flight Dir: Descending. The interface includes a map view with a search bar 'Search all ASF' and a microphone icon. The map shows a satellite view of Indonesia with a red polygon indicating the search area. A zoomed-in view of the search area is shown in the center, with a yellow box highlighting a specific location. The map includes labels for various locations: Krakarta, Kediri, Probolinggo, Bima, Labuan Bajo, Ruteng, Bajawa, Ende, Maumere, Plampang, Komodo National Park, Waikabubak, Kota Waingapu, and Savu Sea. The bottom section shows a list of 17 scenes (100 of 100 Files) with columns for scene details, actions, and file size. The selected scene is 'S1B_IW_GRDH_1SDV_20180829T215227_20180829T215300_01 2483_01705C_AA11' with a file size of 4.87 GB. The scene details include: Start Time: 08/29/2018, 21:52:27Z; Stop Time: 08/29/2018, 21:53:00Z; Beam Mode: IW; Path: 32; Frame: 620; Flight Direction: DESCENDING; Polarization: VV+VH; Absolute Orbit: 12483; PGE Version: 2.91; Data courtesy of ESA; Citation. The bottom right corner contains the footer: © 2023 ASF | Contact | Non-Discrimination | © Mapbox | © OpenStreetMap contributors | Improve this map.

ASF Vertex

- Pair selection base on event date and/or baseline. Possible more than 1 pair

The screenshot displays the ASF Data Search Vertex interface. At the top, the search type is 'SBAS Search' and the scene ID is 'S1B_IW_SLC__1SDV_20180829T215225_20180829T215225'. The search parameters are 'Start: Jun 30 2018', 'End: Aug 31 2018', 'Temporal: 1 to 12', and 'Perpendicular: 300'. The map shows the Indonesian archipelago with a red box highlighting an 'Approximate Placement Only' area. Below the map, a list of 19 pairs is shown, with the first pair selected. The selected pair details are:

Jun 30 2018 to Jul 06 2018	105m 6d	S1B_IW_SLC__1SDV_20180630T215222_20180630T215257_011608_015571_03BF
Sentinel-1 • C-Band		
Perpendicular • 0	Frame • 620	
Temporal • 0	Flight Direction • DESCENDING	
Start Time • 06/30/2018, 21:52:22Z	Polarization • VV+VH	
Stop Time • 06/30/2018, 21:52:57Z	Absolute Orbit • 11608	
Beam Mode • IW	PGE Version • 2.91	
Path • 32	Data courtesy of ESA	
	Citation	

The second pair in the list is:


Jul 12 2018 to Jul 24 2018	93m 12d	S1A_IW_SLC__1SDV_20180706T215259_20180706T215328_022679_027513_D789
Sentinel-1 • C-Band		

On the right, a 'Perp. Baseline' plot shows the baseline distance in meters over time. The x-axis is 'Date' from 0 days to 60 days, and the y-axis is 'Perp. Baseline' from -40 to 180 meters. A red vertical line is drawn at approximately 24 days, and a blue line connects the data points at this time, showing a sharp dip to about -20 meters.

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ASF Vertex

- InSAR on demand batch processing.

 **On Demand**
Powered by HyP3

[Docs](#) [Feedback](#)

InSAR GAMMA (4)

Interferometric Synthetic Aperture Radar (InSAR) processing uses two SAR images collected over the same area to determine geometric properties of the surface. The phase measurements of the two images acquired at different times are differenced to detect and quantify surface changes. [\[MORE\]](#)

Processing Options

LOOKS
10X2


Apply

Water Mask

Include

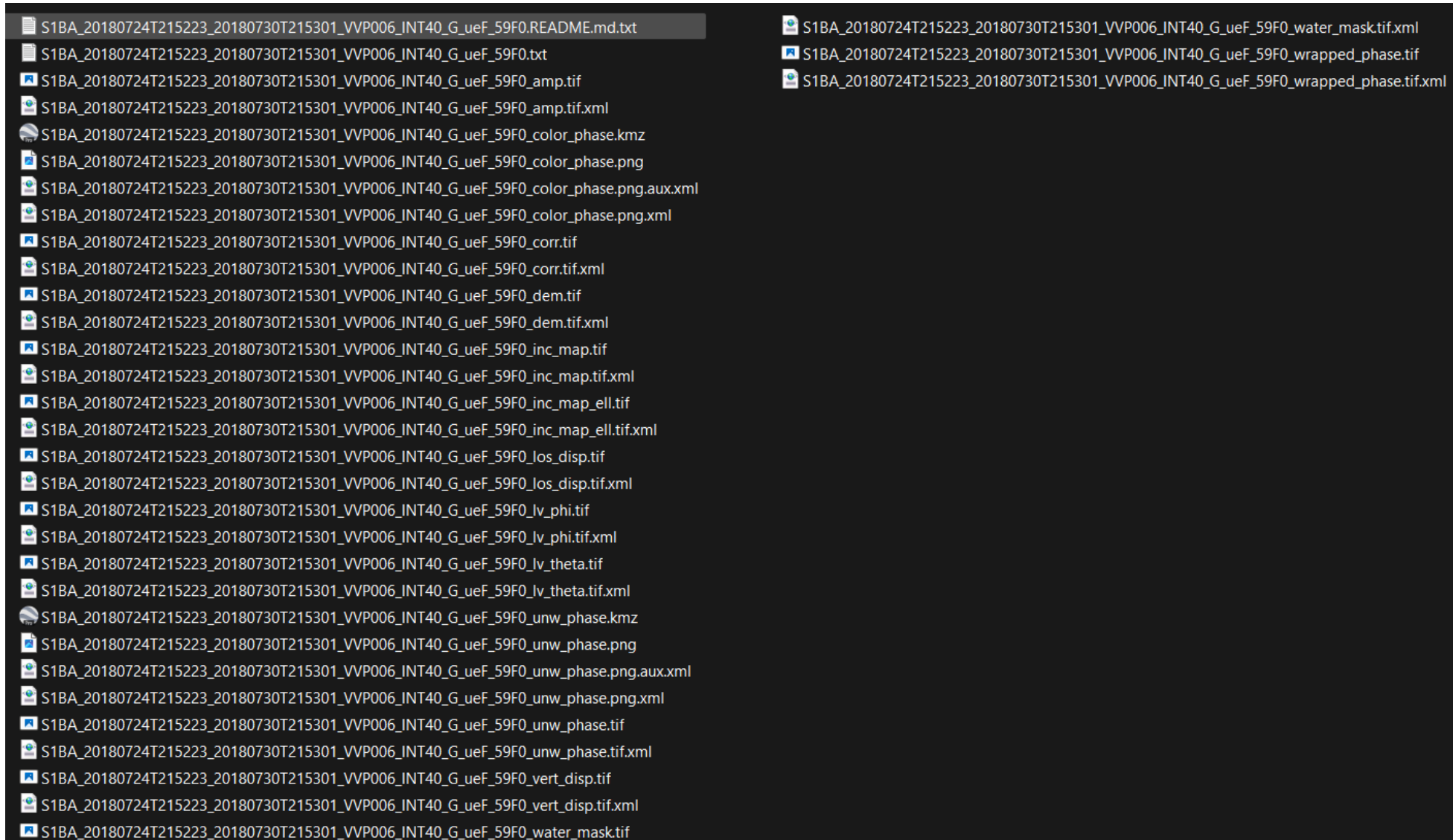
- DEM
- Incidence Angle Maps
- Look Vectors
- Displacement Maps
- Wrapped Phase

[Set MintPy Options](#)

 Clear 997 jobs left this month [Submit 4 jobs](#)

ASF Vertex

- List of result



THANK YOU

