

Course 09: RADAR IMAGING TECHNOLOGY

Practice : Deformation map based on
Sentinel 1 data (DInSAR)

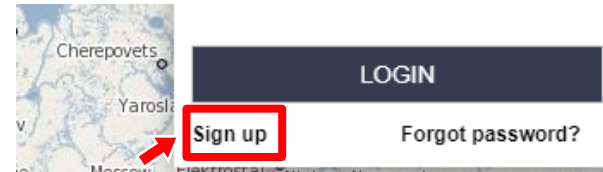
Cand. Sc., Associate Professor
Yurii Medvedskyi

I. PREPARATION

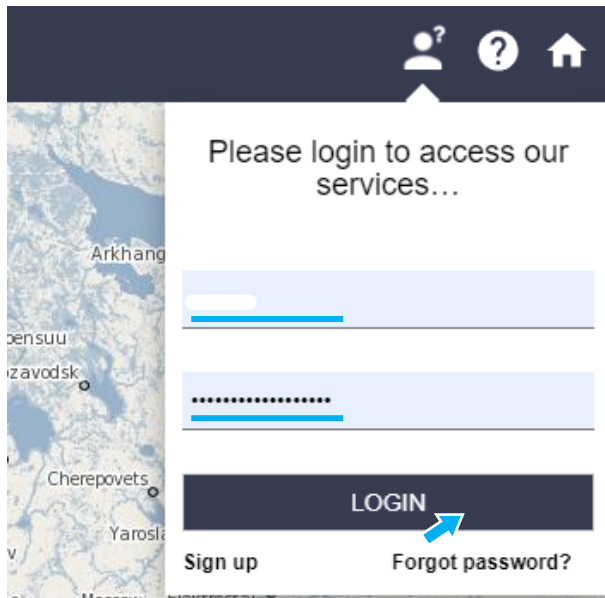
Step 1. Download data

Variant 1. Copernicus Open Access Hub

1. Open link <https://scihub.copernicus.eu/dhus/#/home> and login or register



[Register new account](#)



Sentinel data access is free and open to all.

On completion of the registration form below you will receive an e-mail with a link to validate your e-mail address. Following this you can start to download the data.

Username field accepts only lowercase alphanumeric characters plus ".", "-" and "_"

Password field accepts only alphanumeric characters plus "!", "@", "#", "\$", "%", "&", "*", "+", "=", "~", "_", "-".

Password fields minimum length is 8 characters.

Firstname	Lastname
Username	
Password	Confirm Password
E-mail	Confirm E-mail
Select Domain	
Select Usage	
Select your country	

By registering in this website you are deemed to have accepted the [T&C for Sentinel data use](#).



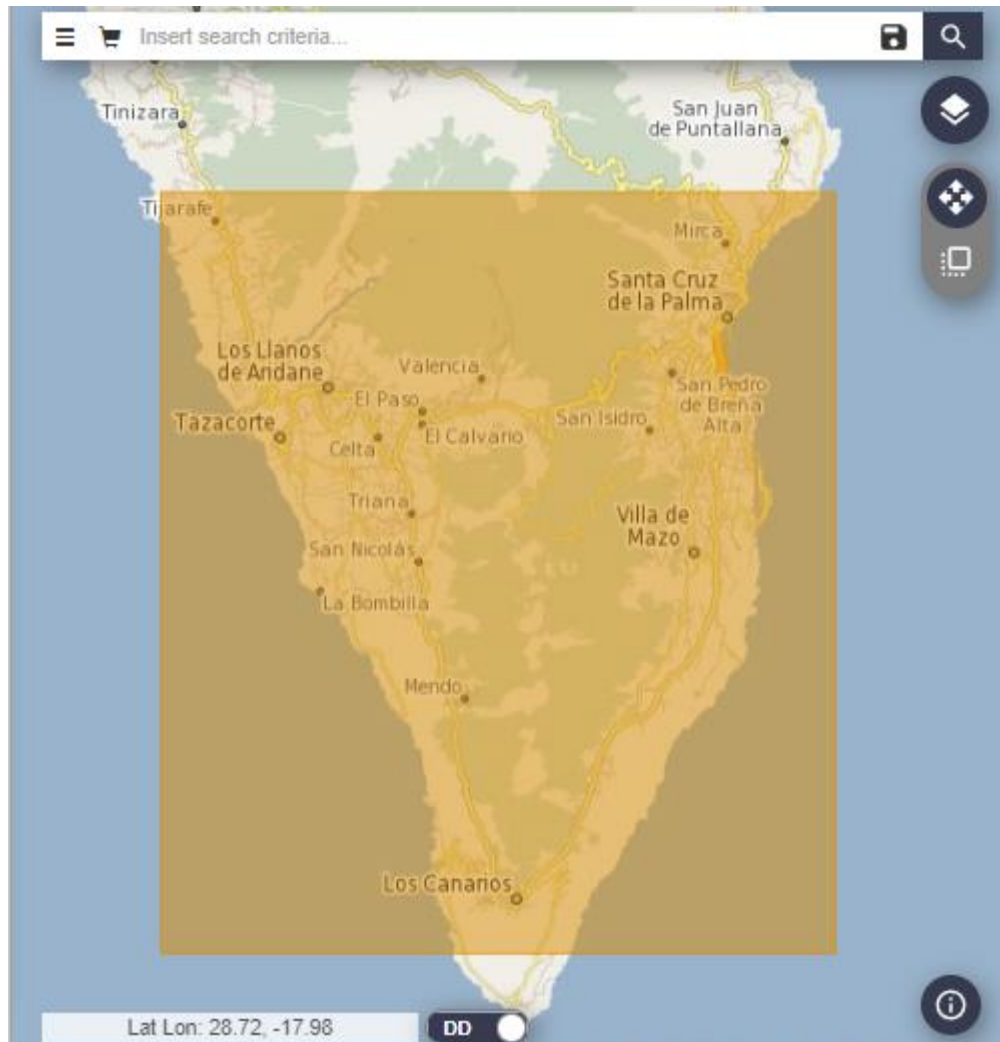
I. PREPARATION

Step 1. Download data

Variant 1. Copernicus Open Access Hub

2. Find the necessary territory on the map and select it by holding down the right button of the manipulator.

*Right click again to remove the selection area.



The 2021 Cumbre Vieja eruption began in September 2021

[28°36'54"N 17°52'07"W](#)

- From September 9, seismic activity began to be recorded on the island.
- Eruptions on the Cumbre Vieja volcanic ridge began on September 19, 2021.
- On the night of September 29, lava reached the ocean and formed a ledge.
- On September 30, frozen lava formed a peninsula in the ocean with an area of more than 20 hectares.



I. PREPARATION

Step 1. Download data

Variant 1. Copernicus Open Access Hub

3. Configuring search parameters

The screenshot shows the 'Advanced Search' panel on the left of the Copernicus Open Access Hub interface. Blue arrows highlight the following elements:

- The search bar at the top left.
- The 'Sort By' dropdown menu set to 'Ingestion Date'.
- The 'Order By' dropdown menu set to 'Ascending'.
- The 'Sensing period' date range (2021/09/01 to 2021/10/05).
- The 'Ingestion period' date range.
- The 'Mission: Sentinel-1' radio button.
- The 'Satellite Platform' dropdown menu set to 'S1A_*'.
- The 'Polarisation' dropdown menu set to 'VV'.
- The 'Product Type' dropdown menu set to 'SLC'.
- The 'Sensor Mode' dropdown menu set to 'IW'.

3.1 You can chose 1 variant orbit

» Order By:

Ascending
Descending
Ascending

3.2 Select the date interval with a margin

2021/09/01

September 2021

01	02	03	04	05	06	07
08	09	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	01	02	03	04	05
06	07	08	09	10	11	12

Today Clear Close

3.3 Select one and satellites or leave the field blank

Satellite Platform

S1A_*
S1B_*

3.4 Select SLC product

Product Type

SLC
SLC
GRD
OCN
RAW

3.5 Select VV or VV+VH polarization

VV

HH
VV
HV
VH
HH+HV
VV+VH

3.6 Select IW sensor mode

Sensor Mode

IW
SM
IW
EW
WV

Step 1. Download data

Variant 1. Copernicus Open Access Hub

4. Chose images

The screenshot displays the Copernicus Open Access Hub interface. On the left, a sidebar shows a list of 6 products, with 3 selected. The products are sorted by Ingestion Date. Each product entry includes a thumbnail, a status icon (checkmark or X), and a download URL. The selected products are highlighted with a blue checkmark icon. On the right, a map shows the geographical area covered by the selected products, with red polygons indicating the image footprints. The map includes labels for various locations such as Los Barrios de Andar, Santa Cruz de la Palma, Los Canales, Buzo de la Palma, Real Alto, and Valverde. At the bottom of the sidebar, there is a 'Products per page' dropdown set to 25, a 'page: 1 of 1' indicator, and a shopping cart icon. A button labeled 'Add selected products to cart' is located at the bottom right of the sidebar.

Insert search criteria...

Display 1 to 6 of 6 products.
Order By: Ingestion Date ↑ 3 products selected

Request Done: (footprint:"Intersects(POLYGON((-17.97599226592832 28.55024511938751,-17.79156974745752 28.55024511938751,-17.79156974745752 28.696462770610083,-17.97599226592832 28.696462770610083,-17.97599226592832 28.55024511938751,-17.97599226592832 28.55024511938751)))")

S1A SAR-C S1A_IW_SLC__1SDV_20210902T191349_20210902T191419_039507_04AB1F_...
Download URL: [https://scihub.copernicus.eu/dhus/odata/v1/Products\(74ec8562-b275-4b5-](https://scihub.copernicus.eu/dhus/odata/v1/Products(74ec8562-b275-4b5-)
Mission: Sentinel-1 Instrument: SAR-C Sensing Date: 2021-09-02T19:13:49.741Z Size: 7

S1A SAR-C S1A_IW_SLC__1SDV_20210910T071102_20210910T071129_039616_04AEE...
Download URL: [https://scihub.copernicus.eu/dhus/odata/v1/Products\(7cbe9bef-749-4d54-](https://scihub.copernicus.eu/dhus/odata/v1/Products(7cbe9bef-749-4d54-)
Mission: Sentinel-1 Instrument: SAR-C Sensing Date: 2021-09-10T07:11:02.097Z Size: 7

S1A SAR-C S1A_IW_SLC__1SDV_20210914T191350_20210914T191420_039682_04B134_...
Download URL: [https://scihub.copernicus.eu/dhus/odata/v1/Products\(90ee3b1e-a5d1-40e-](https://scihub.copernicus.eu/dhus/odata/v1/Products(90ee3b1e-a5d1-40e-)
Mission: Sentinel-1 Instrument: SAR-C Sensing Date: 2021-09-14T19:13:50.359Z Size: 7

S1A SAR-C S1A_IW_SLC__1SDV_20210922T071102_20210922T071129_039791_04B4D6_...
Download URL: [https://scihub.copernicus.eu/dhus/odata/v1/Products\(2239c780-7d3-462-](https://scihub.copernicus.eu/dhus/odata/v1/Products(2239c780-7d3-462-)
Mission: Sentinel-1 Instrument: SAR-C Sensing Date: 2021-09-22T07:11:02.483Z Size: 7

S1A SAR-C S1A_IW_SLC__1SDV_20210926T191350_20210926T191420_039857_04B716_...
Download URL: [https://scihub.copernicus.eu/dhus/odata/v1/Products\(8649a3a2-58e0-430-](https://scihub.copernicus.eu/dhus/odata/v1/Products(8649a3a2-58e0-430-)
Mission: Sentinel-1 Instrument: SAR-C Sensing Date: 2021-09-26T19:13:50.775Z Size: 7

S1A SAR-C S1A_IW_SLC__1SDV_20211004T071102_20211004T071129_039966_04BAEE...
Download URL: [https://scihub.copernicus.eu/dhus/odata/v1/Products\(b116a7ed-7d3-4716-](https://scihub.copernicus.eu/dhus/odata/v1/Products(b116a7ed-7d3-4716-)
Mission: Sentinel-1 Instrument: SAR-C Sensing Date: 2021-10-04T07:11:02.801Z Size: 7

Products per page: 25 << < page: 1 of 1 > >>

Add selected products to cart

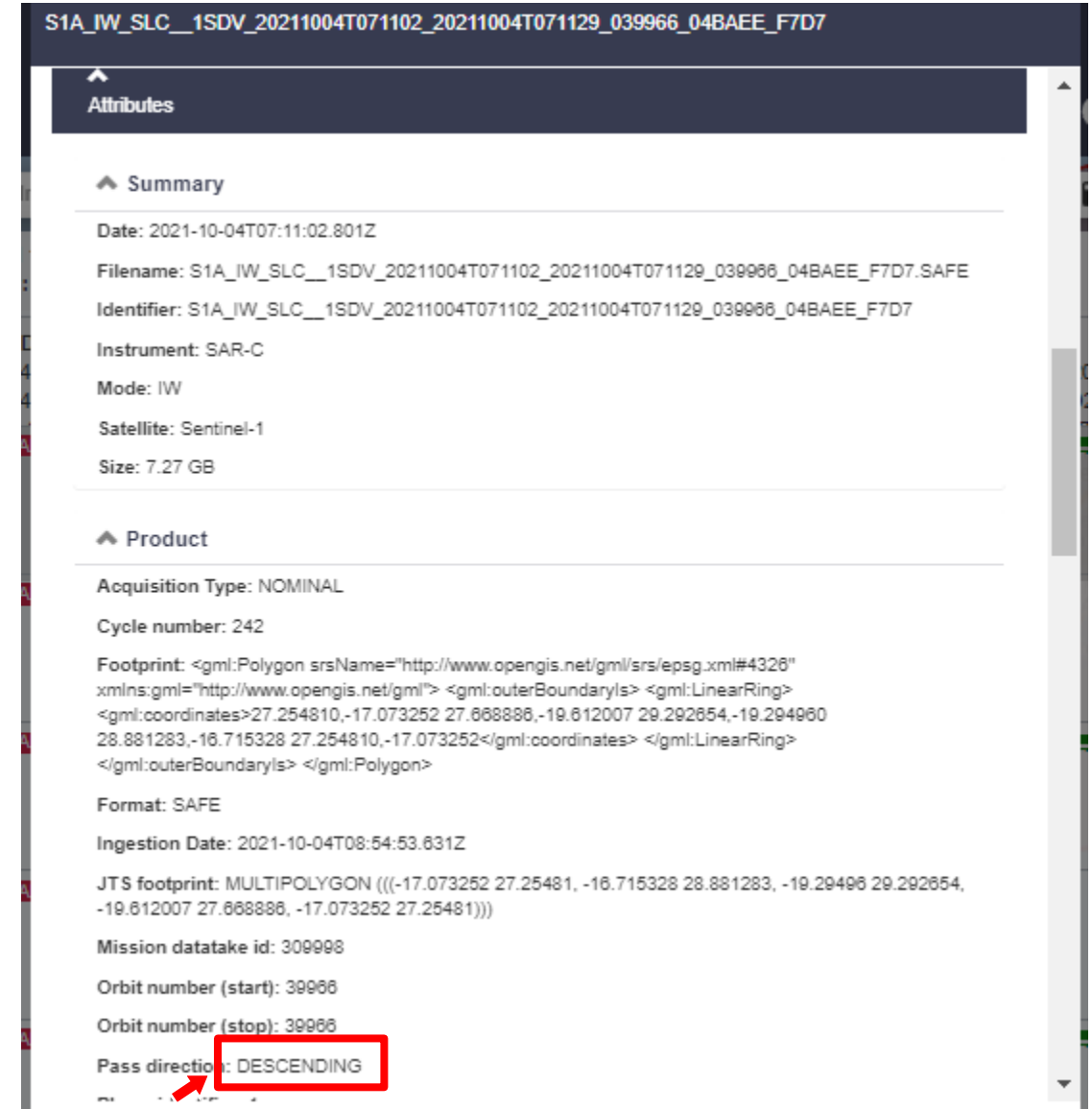
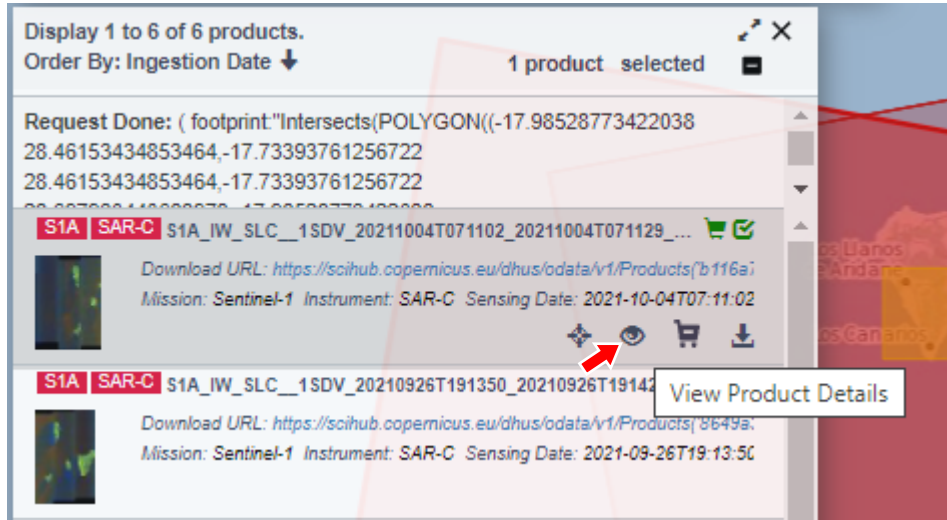
When you select an image, it is highlighted in the map area. Pay attention to the choice of images related to one orbit

I. PREPARATION

Step 1. Download data

Variant 1. Copernicus Open Access Hub

4. Chose images



It is advisable to check the parameters of the selected image by clicking on the eye sign. This is necessary because filtering often does not work well for the orbit.

We chose an ascending orbit, and the selected image has a descending orbit. It is important that a pair of images have the same orbit, no matter which one.

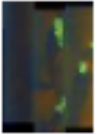
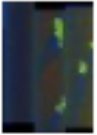
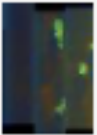
Step 1. Download data

Variant 1. Copernicus Open Access Hub

5. Download images

(footprint:"Intersects(POLYGON((-17.963164488367457 28.502386530290323,-17.79212747691669 28.502386530290323,-17.79212747691669 28.502386530290323,-17.963164488367457 28.502386530290323,-17.963164488367457 28.502386530290323))")

Your cart contains 3 products.
Display 1 to 3 of 3 products.

	S1A SAR-C S1A_IW_SLC__1SDV_20210910T071102_20210910T071129_039616_04AEEC_3EAF	☐
Download URL: https://scihub.copernicus.eu/dhus/odata/v1/Products('7cbe9bef-7949-4d54-be9b-3a5b12cbe96e')/ Mission: Sentinel-1 Instrument: SAR-C Sensing Date: 2021-09-10T07:11:02.097Z Size: 7.27 GB		
	S1A SAR-C S1A_IW_SLC__1SDV_20210922T071102_20210922T071129_039791_04B4D6_984F	☐
Download URL: https://scihub.copernicus.eu/dhus/odata/v1/Products('2239c780-b457-4626-9427-12c6c6afe8c6')/ Mission: Sentinel-1 Instrument: SAR-C Sensing Date: 2021-09-22T07:11:02.483Z Size: 7.27 GB		
	S1A SAR-C S1A_IW_SLC__1SDV_20211004T071102_20211004T071129_039966_04BAEE_F7D7	☐
Download URL: https://scihub.copernicus.eu/dhus/odata/v1/Products('b116a7ed-090f-4716-8f11-b5de25947911')/ Mission: Sentinel-1 Instrument: SAR-C Sensing Date: 2021-10-04T07:11:02.801Z Size: 7.27 GB		

Products per page: 25 << < page: 1 of 1 > >>

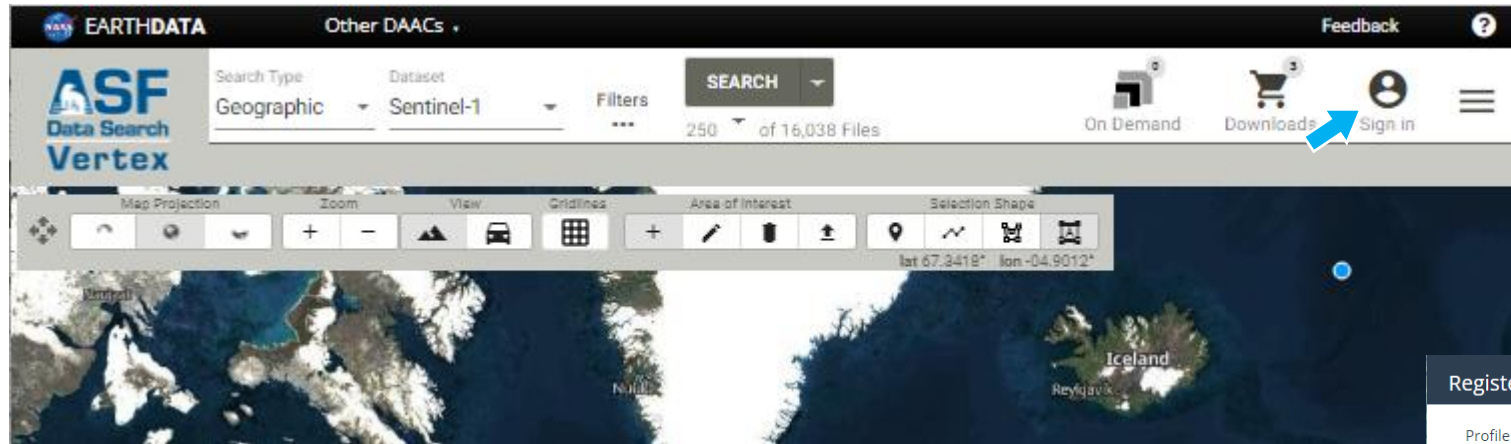
Download Product

I. PREPARATION

Step 1. Download data

Variant 2. ASF Data Search Vertex

1. Open link <https://search.asf.alaska.edu/#/> and login or register

This image shows a login and registration form. It has a 'Password' field at the top. Below it, there's a checkbox labeled 'Stay signed in (this is a private workstation)'. At the bottom, there are two buttons: 'LOG IN' (green) and 'REGISTER' (blue). A red box is drawn around the 'REGISTER' button, and a red arrow points to it.This image shows the Earthdata Login page. It has a header with the NASA Earthdata logo. Below the header, there's a section titled 'Alaska Satellite Facility: making remote-sensing data accessible'. There are two input fields for 'Username' and 'Password'. Below these fields, there's a checkbox labeled 'Stay signed in (this is a private workstation)'. At the bottom, there are two buttons: 'LOG IN' (green) and 'REGISTER' (blue). A blue arrow points to the 'LOG IN' button.This image shows the 'Register for an Earthdata Login Profile' page. It has a section titled 'Profile Information' with input fields for 'Username' and 'Password'. Below the 'Password' field, there's a 'Password Confirmation' field. To the right of these fields, there's a list of requirements for the password. At the bottom, there's a checkbox labeled 'Yes, I'm interested in Meris and ESA Sentinel-3 Data.' Below this, there's a section titled 'By clicking the REGISTER FOR EARTHDATA LOGIN button below, you are acknowledging that all Earthdata Login applications running in DAACs will have access to my profile information. Information in user profiles complies with NASA's Web Privacy Policy'. Below this section, there's a 'By accessing and using this information system, you acknowledge and consent to the following:' section. At the bottom, there's a checkbox labeled 'I agree' and a 'REGISTER FOR EARTHDATA LOGIN' button. A red arrow points to the 'REGISTER FOR EARTHDATA LOGIN' button.

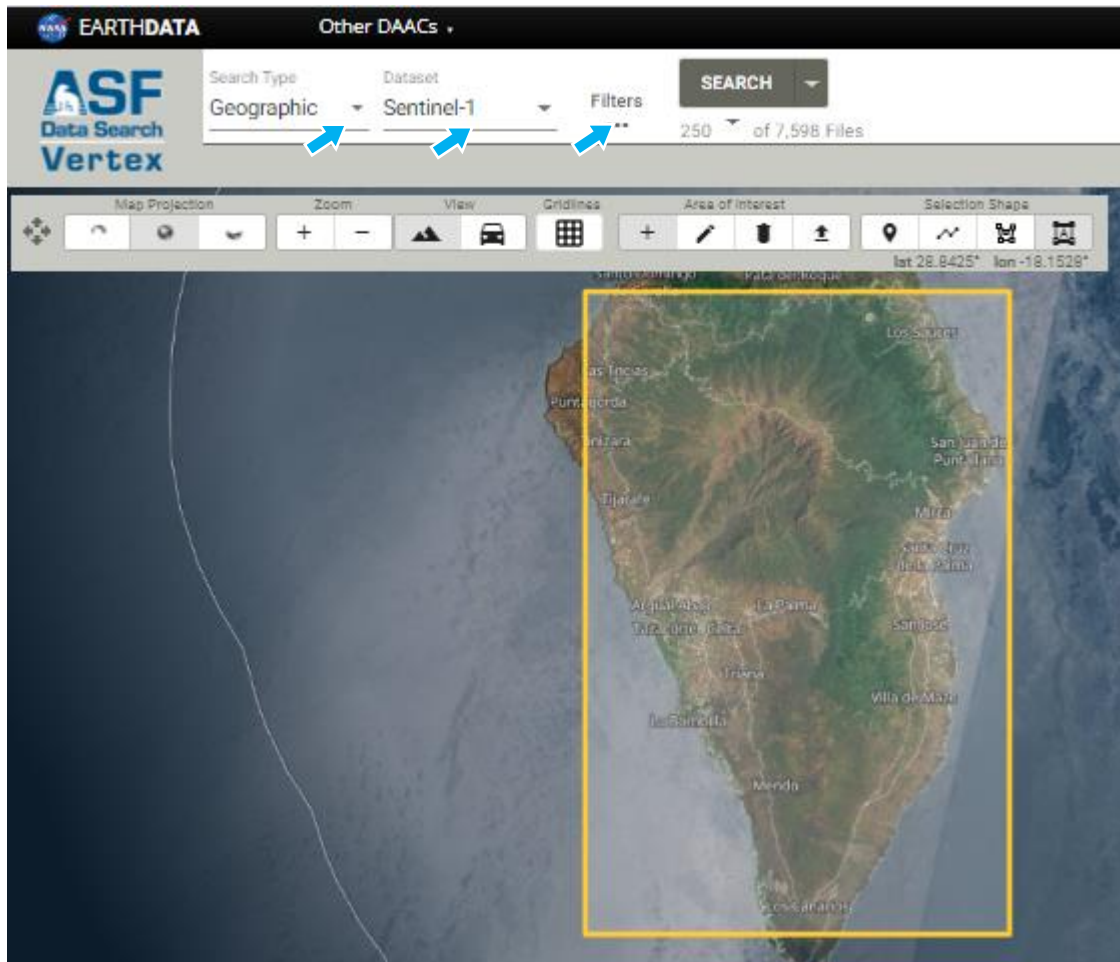
I. PREPARATION

Step 1. Download data

Variant 2. ASF Data Search Vertex

2. Select Search type “Geographic” find Sentinel-1 data

3. Find the necessary territory on the map and select it by holding down the right button of the manipulator.



4. Select “Filters” for configuring search parameters

The screenshot shows the 'Filters' panel in the ASF Data Search Vertex interface. It is divided into three main sections: 'Date Filters', 'Additional Filters', and 'Path and Frame Filters'.
1. 'Date Filters': Includes 'Start Date' (9/1/2021) and 'End Date' (10/5/2021) with calendar icons. There is a 'Seasonal Search' toggle switch.
2. 'Additional Filters': Includes dropdowns for 'File Type' (L1 Single Look Comp...), 'Beam Mode' (IW), 'Polarization' (VV+VH, WV), and 'Direction' (Descending). Below these are counts for each selection: '1/14 file types selected', '1/9 beam modes selected', '2/8 polarizations selected', and '1/2 flight directions selected'. There is also a 'Subtype' dropdown set to 'SA' with a count of '1/2 subtypes selected'.
3. 'Path and Frame Filters': Includes input fields for 'Path Start', 'Path End', 'Frame Start', and 'Frame End', along with 'Clear' and 'Clear Search Area' buttons.
At the bottom of the panel, there's a status bar showing '250 of 3 Files' and buttons for 'Cancel' and 'SEARCH'.

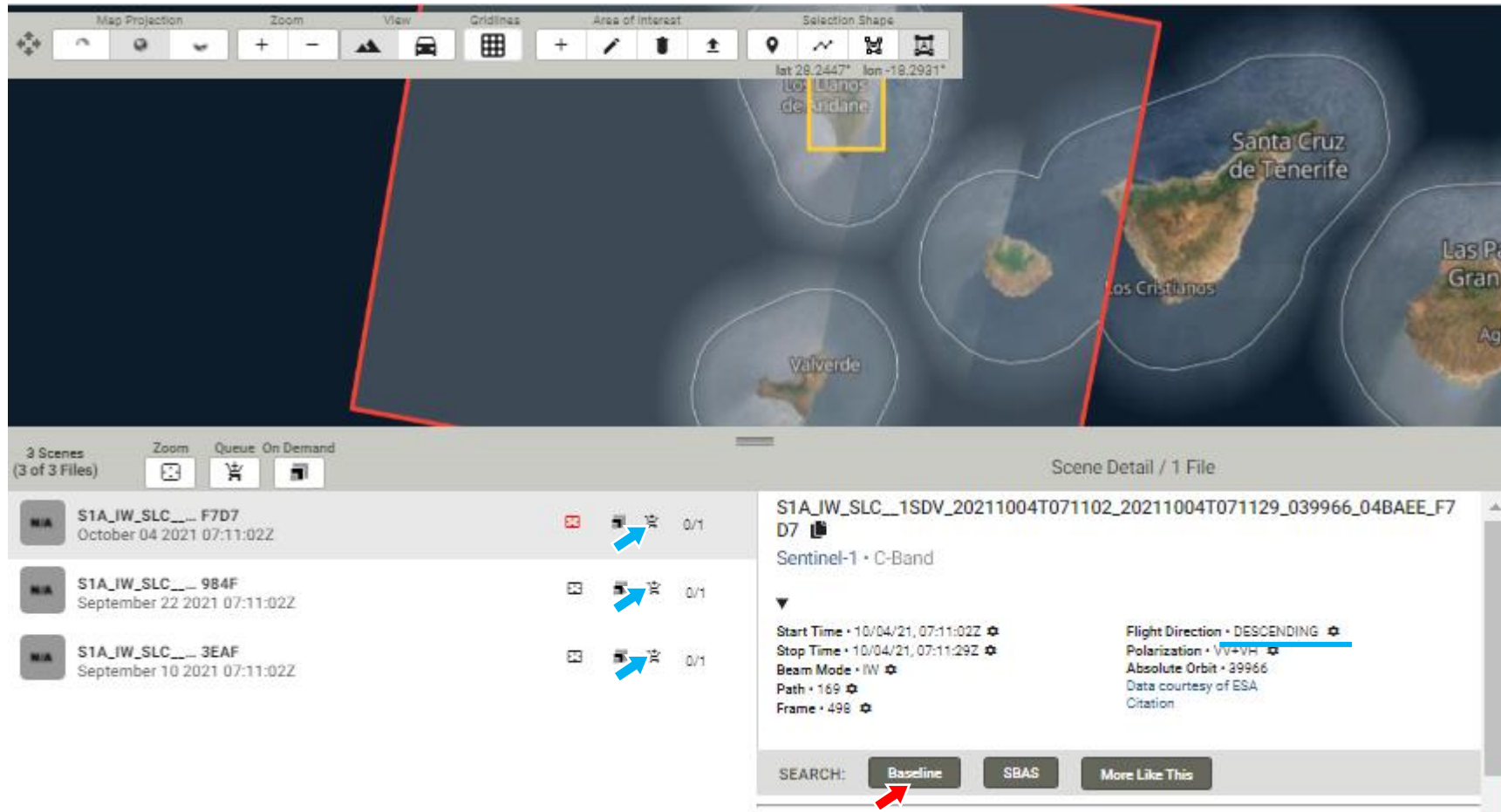
* use similar Copernicus Open Access Hub options

I. PREPARATION

Step 1. Download data

Variant 2. ASF Data Search Vertex

5. Add images to the basket, check the orbit parameters in the right window.



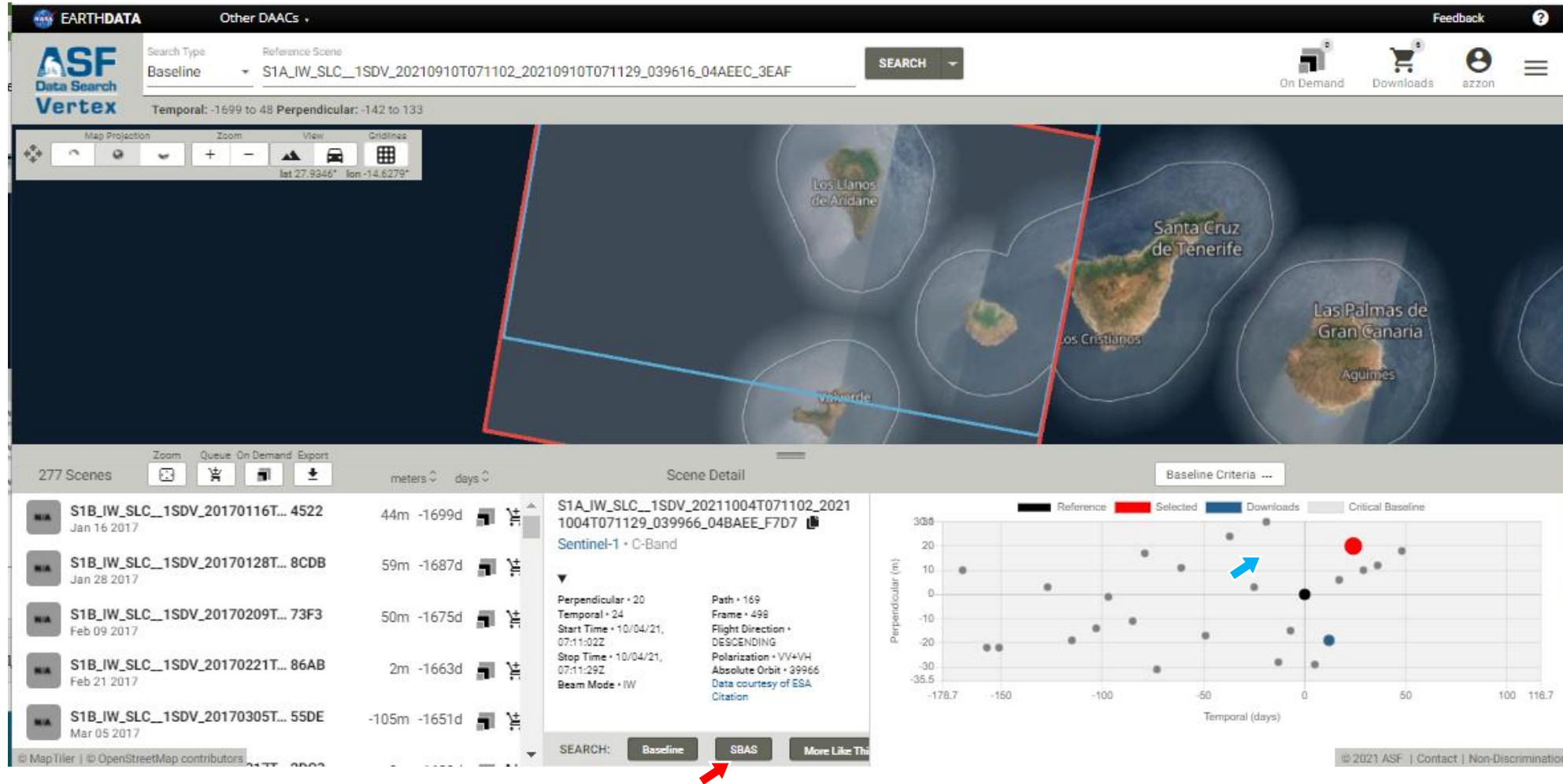
By clicking on the Baseline item, you can go to the selection of images by the distance between them in meters and days.

I. PREPARATION

Step 1. Download data

Variant 2. ASF Data Search Vertex

6. Baseline search type



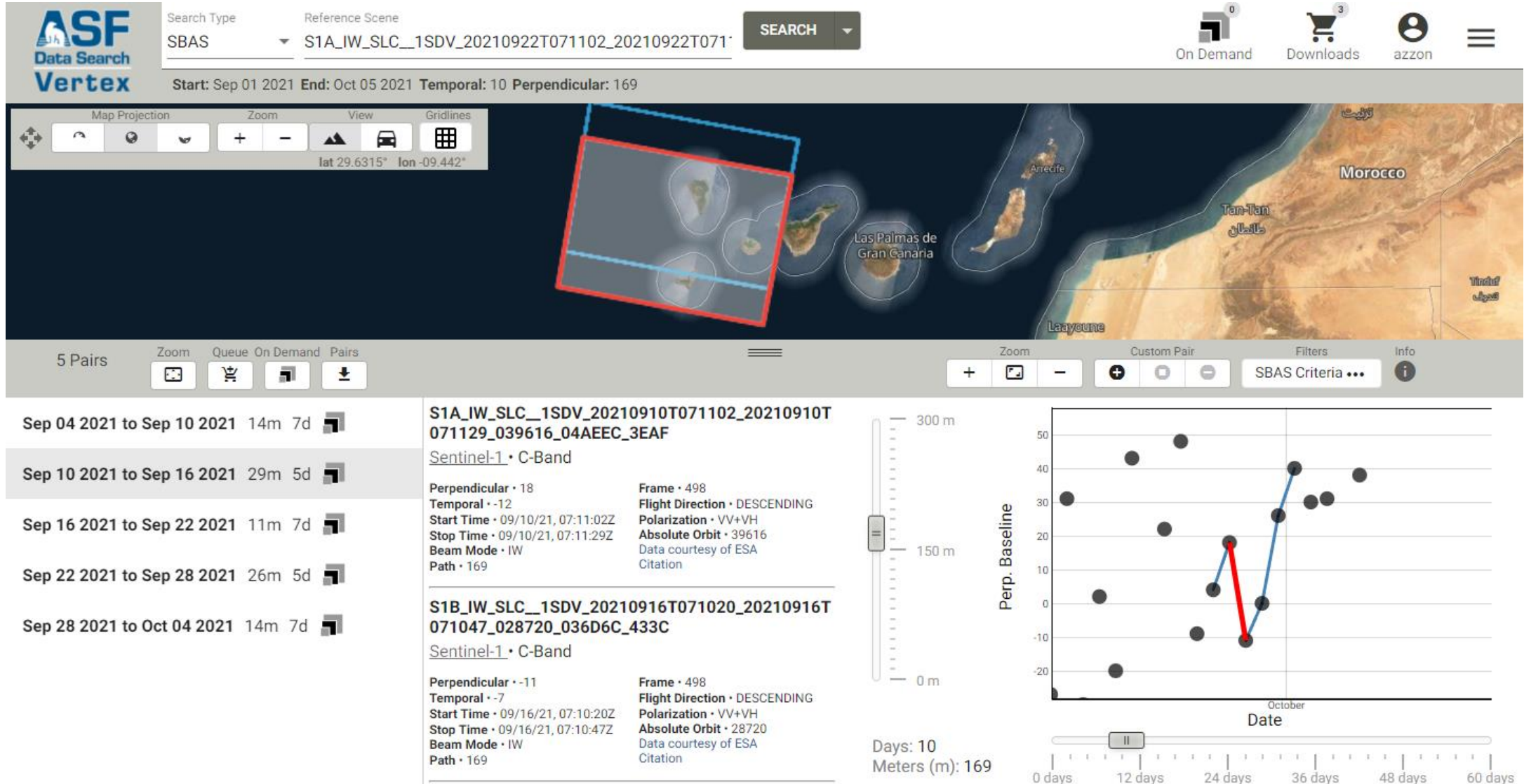
You can go to SBAS, in this option of image search, you can build a chain of images with minimum distance and time requirements for the selected area.

I. PREPARATION

Step 1. Download data

Variant 2. ASF Data Search Vertex

7. SBAS search type

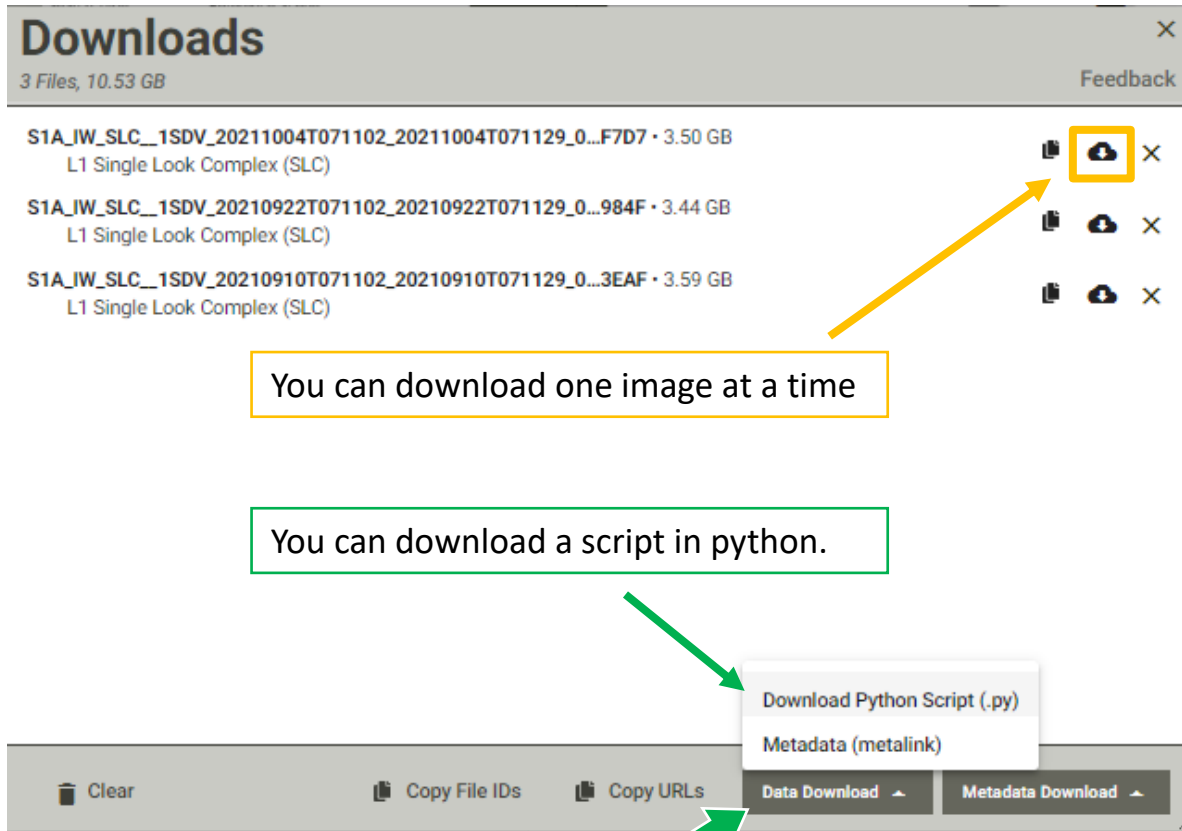
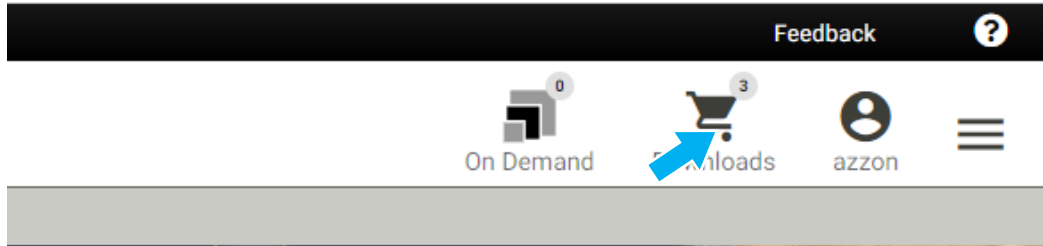


I. PREPARATION

Step 1. Download data

Variant 2. ASF Data Search Vertex

8. After adding images, go to the cart.



After launching it, you must specify the login and password from ASF Data Search Vertex.

```
C:\Windows\py.exe
> attempting to download https://urs.earthdata.nasa.gov/profile
> Could not validate old cookie Jar
No existing URS cookie found, please enter Earthdata username & password:
(Credentials will not be stored, saved or logged anywhere)
> attempting to download https://urs.earthdata.nasa.gov/profile
Username: Azzon
Password (will not be displayed):
> attempting to download https://urs.earthdata.nasa.gov/profile
> 'Temporary' Redirect download @ Remote archive:
> https://dy4owt9f80bz7.cloudfront.net/s3-06b3213905ebfa9144871d6c7f9306f0/asf
-ngap2w-p-s1-slc-7b420b89.s3.us-west-2.amazonaws.com/S1A_IW_SLC__1SDV_20211004T
071102_20211004T071129_039966_04BAEE_F7D7.zip?A-userid=azzon&X-Amz-Algorithm=AW
S4-HMAC-SHA256&X-Amz-Credential=ASIA5MAGUDN3KMJSVIXB%252F20211101%252Fus-west-2
%252Fs3%252Faws4_request&X-Amz-Date=20211101T181844Z&X-Amz-Expires=3600&X-Amz-S
ecurity-Token=FwoGZXIvYXdzEIT%252F%252F%252F%252F%252F%252F%252F%252F%252F
wEaDOvOXAEuP1g%252FXJXbHiK0AZhrwyl23x70V3tpcWSJnYJvRX07Lpj7ie0ReYTHs3mZbX63eknT
slv%252BtZgAM0zMi%252FyWYDoC03F1h1Cf1Q8D7gJLUDEb9snjYjHKH5Qx0oobGdZryIk%252FLPd
u91zF2V%252Fuiig4U0ke%252ByYfn28%252ByudqZGvMk9j5rj5LqRFQE90sHyJP7scNXv4%252Bm2
FO2oMc1LUVpxOngg9sN%252B5eqPLbvkfGye%252FhnWD3Kq5iEOz%252Fu4McT%252FnatirDxSiE3
4CMBjityg4K7IFTJHdbQmd0aI0%252F%252Fj0J%252FDjdQxY%252FSKHwbpMUyGJmH0jEyqFnsPmM
qpc2&X-Amz-SignedHeaders=host&X-Amz-Signature=ca677267f126d468be9322ce1b73fbefb
1c597c34b8f3a544d3457da8c9b02c7
(1/3) Downloading https://datapool.asf.alaska.edu/SLC/SA/S1A_IW_SLC__1SDV_20211
004T071102_20211004T071129_039966_04BAEE_F7D7.zip
> Downloaded 235749376 of 3674372095 bytes (6.42%)
```

**This method allows you to upload a large number of images and guarantees the integrity of the uploaded files.*

I. PREPARATION

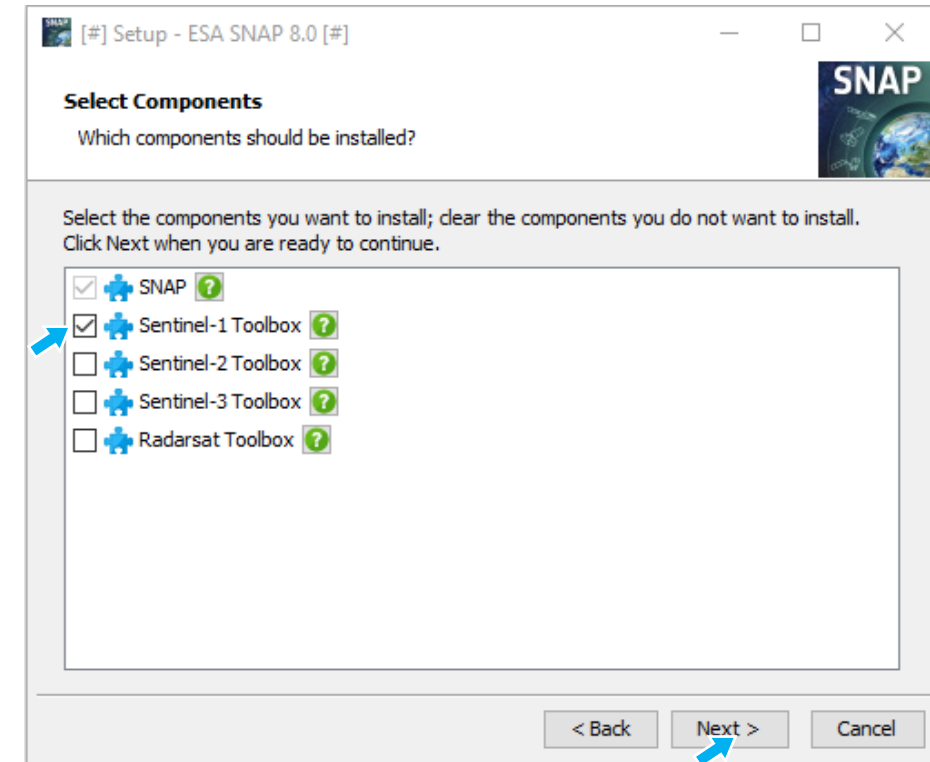
Step 2. Install program

Program 1. SNAP

1. Open link <https://step.esa.int/main/download/snap-download/>
2. Choose the one from the following table which suits your needs.

	Windows 64-Bit	Windows 32-Bit	Mac OS X	Unix 64-bit
	These installers contain the Sentinel-1, Sentinel-2, Sentinel-3 Toolboxes, download size is close to 900MB.			
Sentinel Toolboxes	Main Download	Main Download	Main Download	Main Download
	Mirror Download	Mirror Download	Mirror Download	Mirror Download
	These installers contain only the SMOS Toolbox , download size is close to 500MB. Download also the Format Conversion Tool (Earth Explorer to NetCDF) and the user manual .			
SMOS Toolbox	Main Download	Main Download	Main Download	Main Download
	Mirror Download	Mirror Download	Mirror Download	Mirror Download
	These installers contain the Sentinel-1, Sentinel-2, Sentinel-3 Toolboxes, SMOS and PROBA-V Toolbox, download size is close to 1GB.			
All Toolboxes	Main Download	Main Download	Main Download	Main Download
	Mirror Download	Mirror Download	Mirror Download	Mirror Download

3. Select the required components

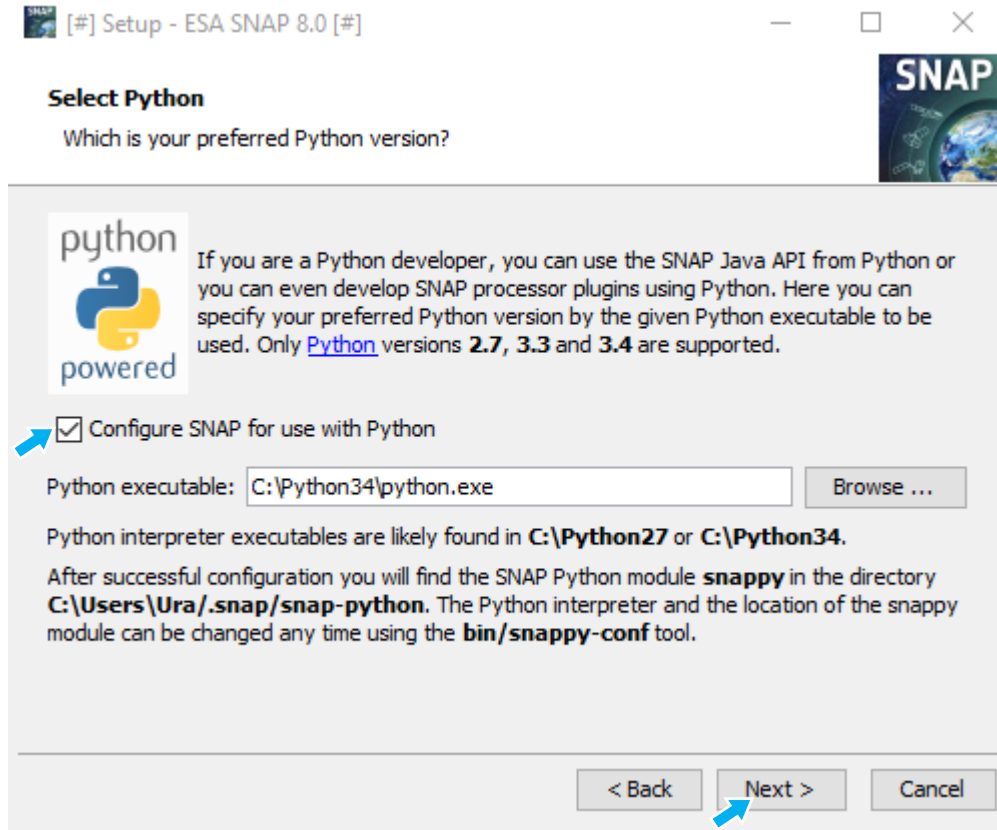


I. PREPARATION

Step 2. Install program

Program 1. SNAP

4. If you have installed python, select "Configure SNAP ..." Otherwise, you can skip this item by clicking Next



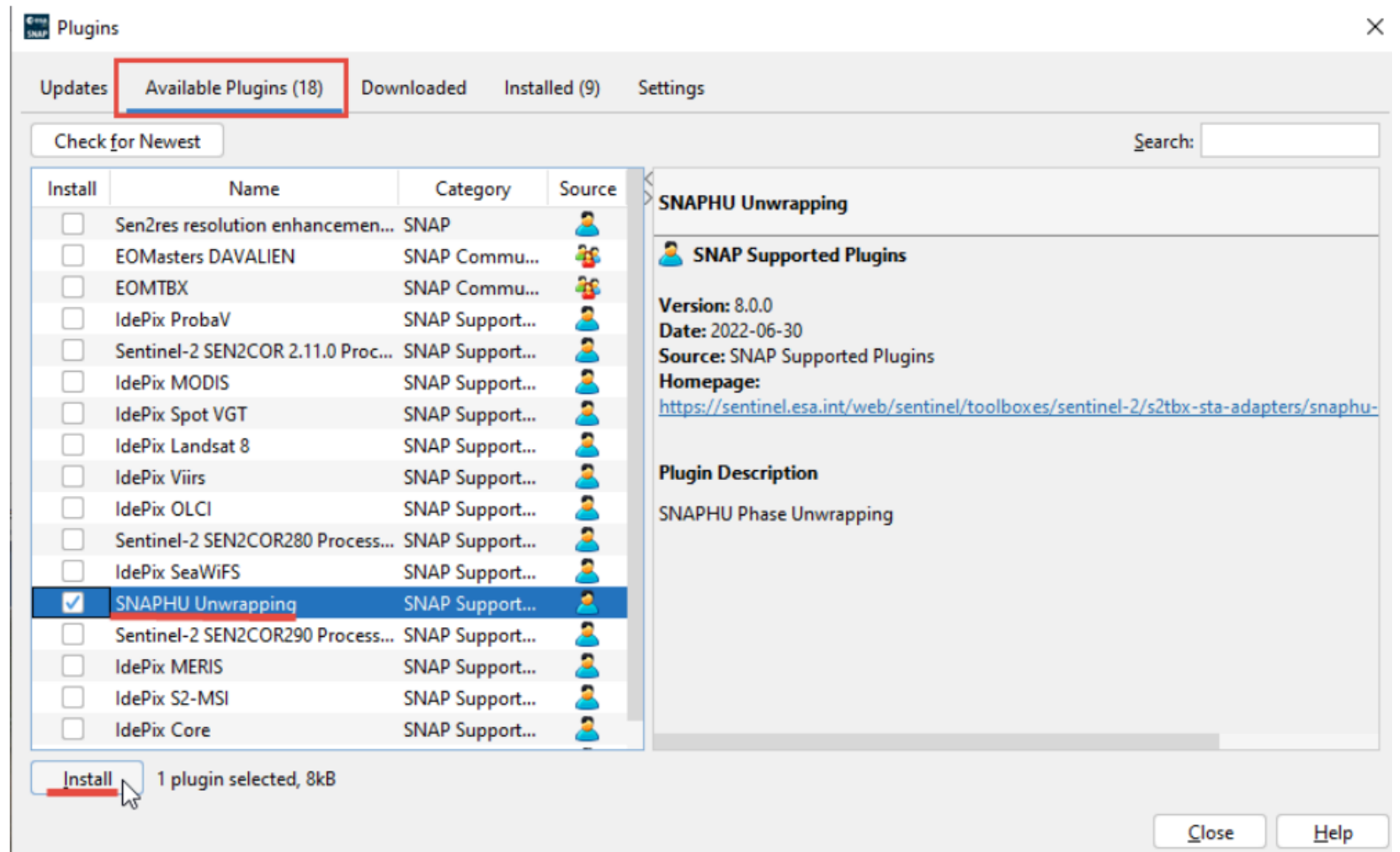
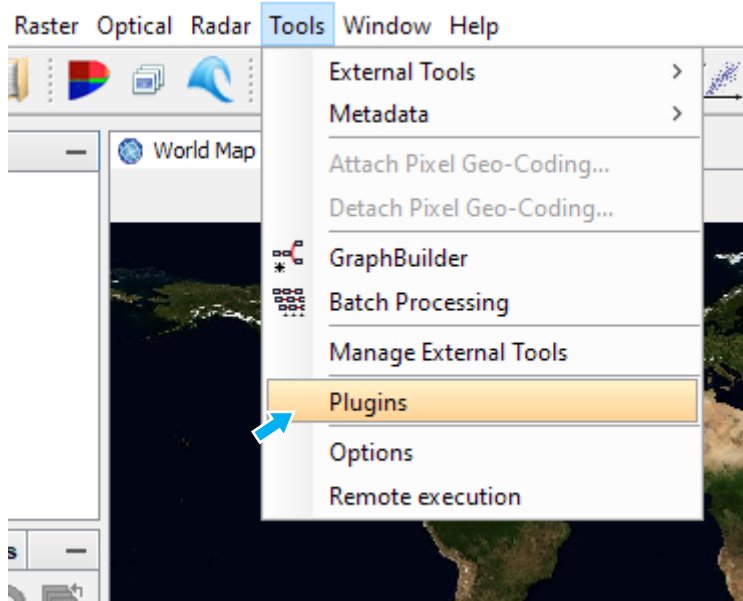
I. PREPARATION

Step 2. Install program

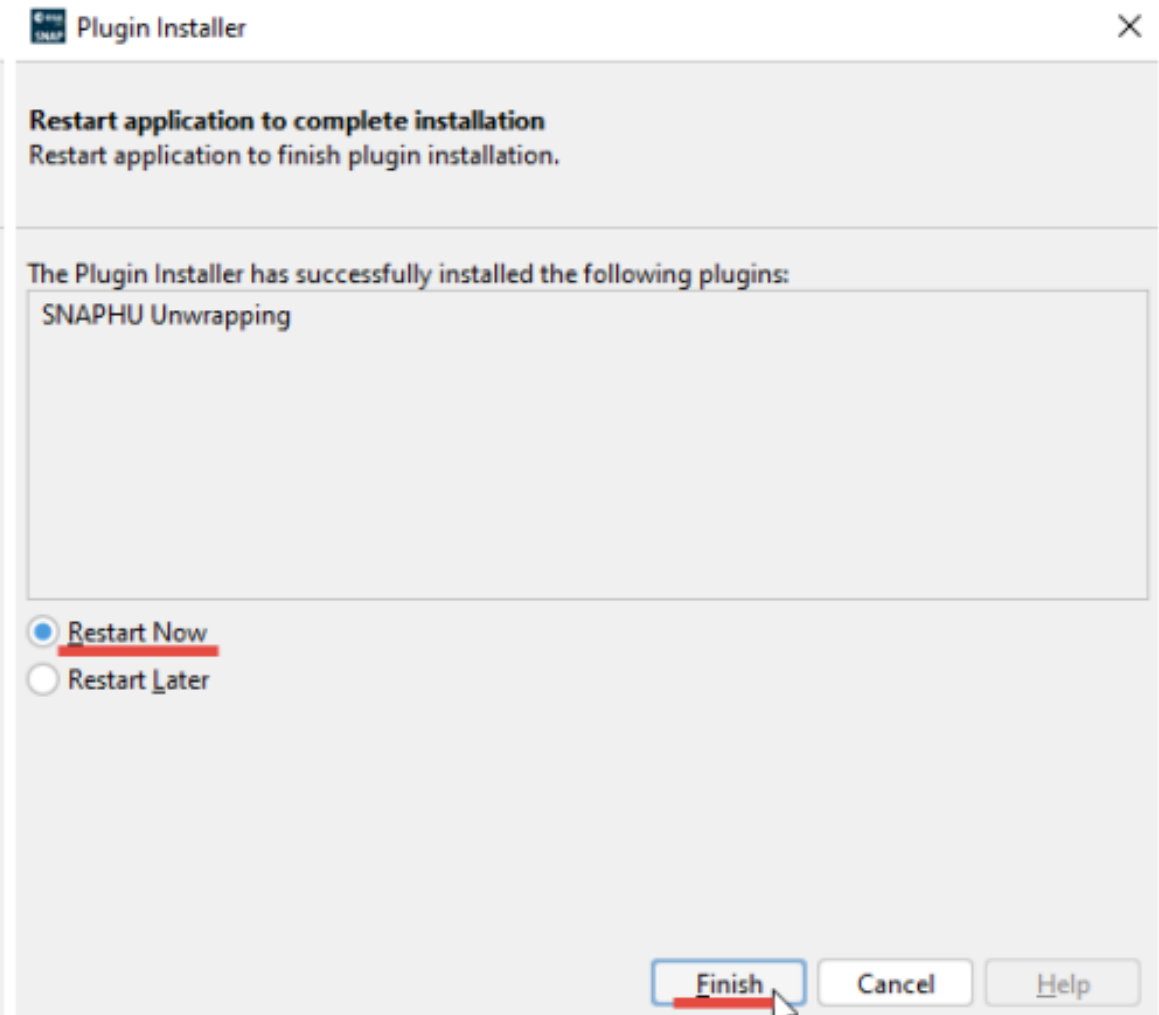
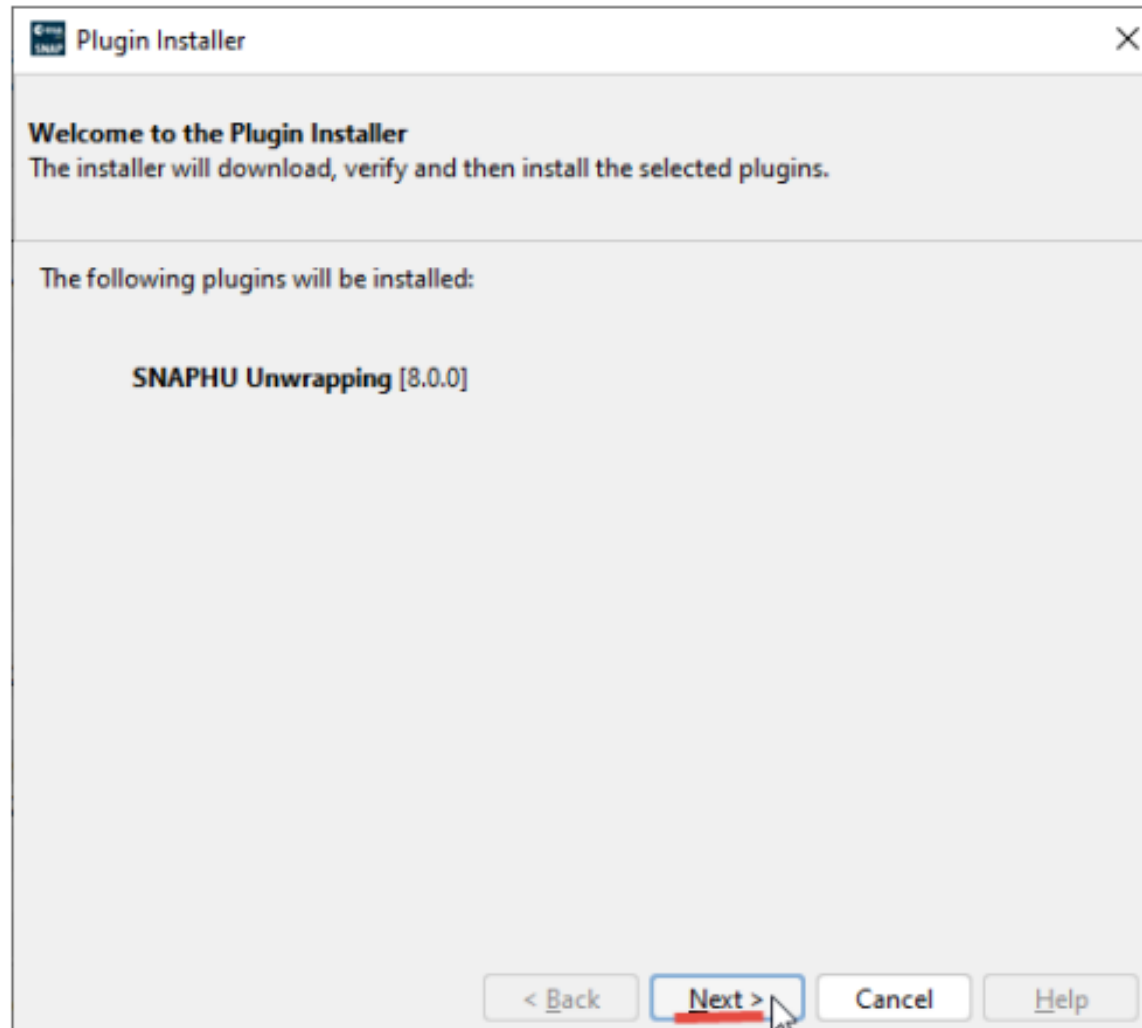
Program 1. SNAP

5. Install module SNAPHU

After starting SNAP



5. Install module SNAPHU



5. Install module SNAPHU

The screenshot displays the SNAP software interface with the 'Tools' menu open. The 'Manage External Tools' option is highlighted. The 'External Tools' window is open, showing a table of installed tools. The 'Snaphu-unwrapping' tool is selected, and its configuration window is open. The 'Bundled Binaries' tab is active, showing the 'Type' as 'Zip archive', 'Location' as 'REMOTE', and 'URL' as 'http://step.esa.int/thirdparties/snaphu/2.0.4/snaphu-v2.0.4_win64.zip'. The 'Target Folder' is set to '\$USERPROFILE/.snap/auxdata'. The 'Reflect in Variable' is set to 'SNAPHU_TOOL_EXE'. The 'Download and Install Now' button is highlighted.

Tools Window Help

- External Tools >
- Metadata >
- Attach Pixel Geo-Coding...
- Detach Pixel Geo-Coding...
- GraphBuilder
- Batch Processing
- Manage External Tools**
- Plugins
- Options
- Remote execution

External Tools

Status	Alias	Description
✓	Snaphu-unwrapping	SNAPHU Phase Unwrapping

Snaphu-unwrapping

Operator Descriptor

Configuration Parameters

Preprocessing

Operator Parameters

System Variables

Bundled Binaries

Bundled Binaries

Windows Bundle Linux Bundle MacOSX Bundle

Type: Zip archive

Location: ☐ LOCAL ☒ REMOTE

Source File: ...

URL: http://step.esa.int/thirdparties/snaphu/2.0.4/snaphu-v2.0.4_win64.zip

Arguments: ...

Target Folder: \$USERPROFILE/.snap/auxdata

Reflect in Variable: SNAPHU_TOOL_EXE

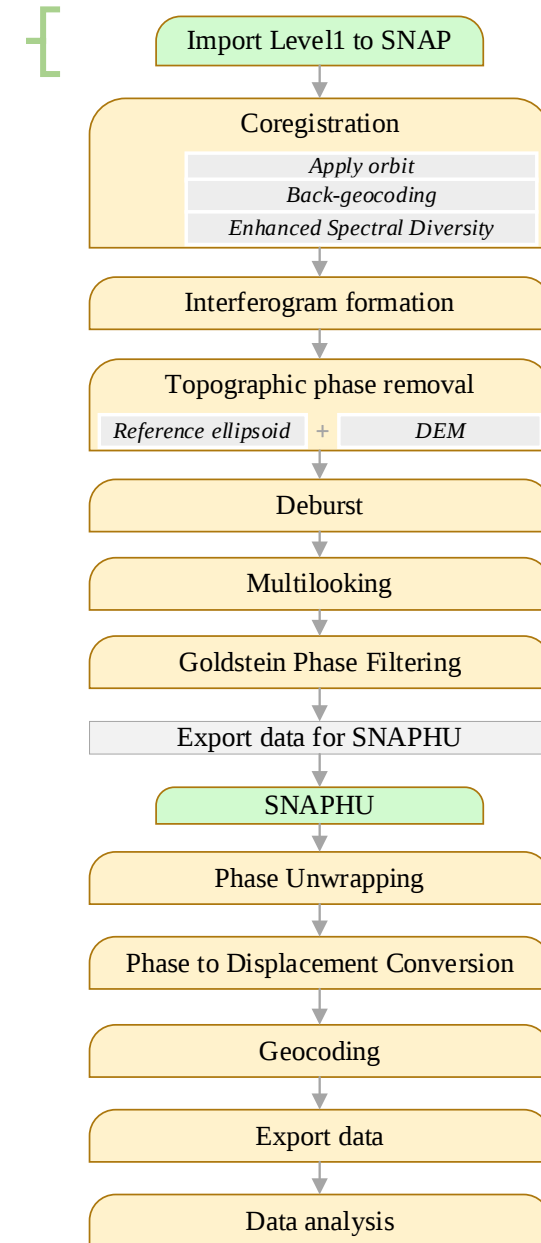
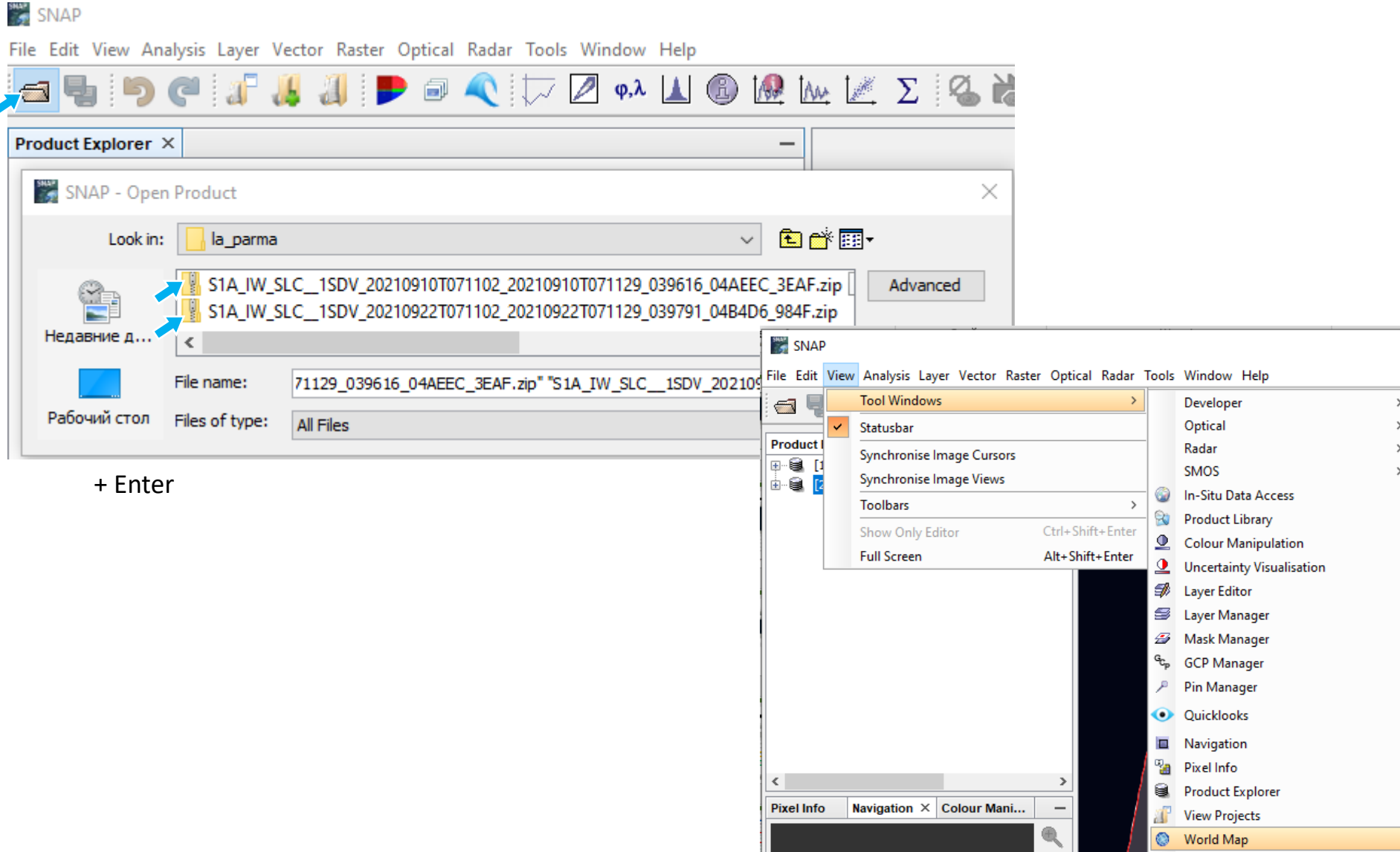
Download and Install Now

Export as Module OK Cancel Help

II. Displacement (DInSAR) 2 images

Stage 1. Import Level1 to SNAP

1. Open images

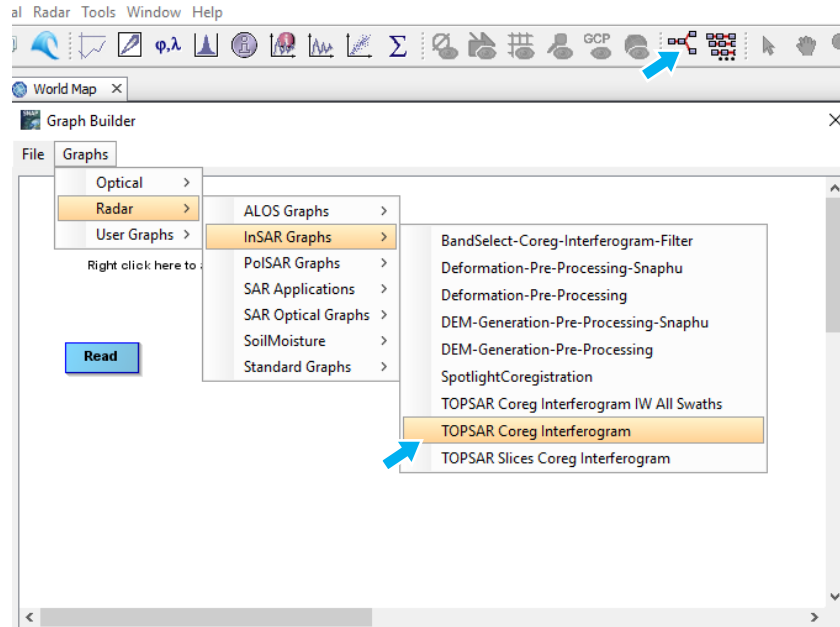


II. Displacement (DInSAR) 2 images

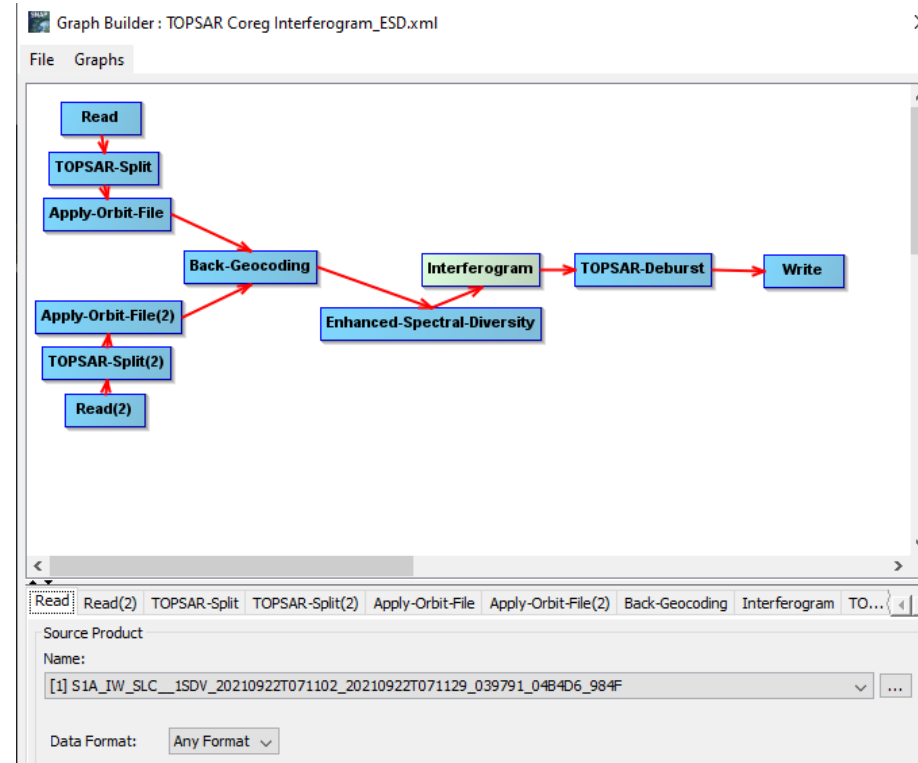
Stage 2. Coregistration and more

Variant 1. Load graph

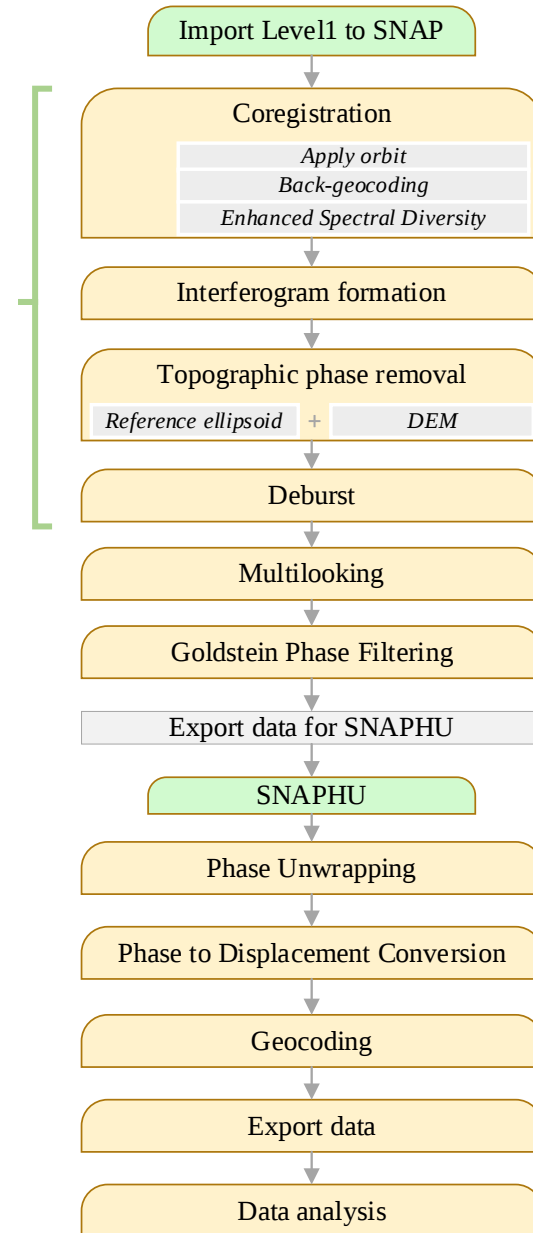
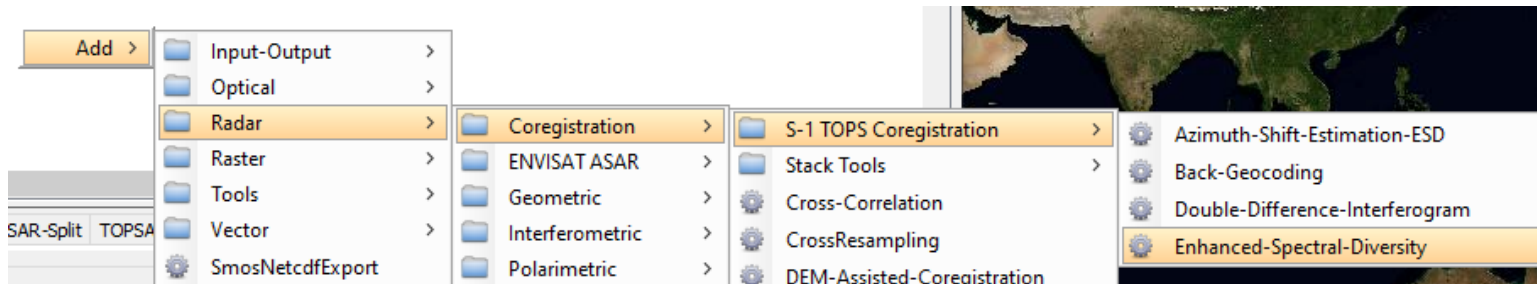
1. Load graph



2. Correction graph and make settings



You can use prepared graph or create new (right click)



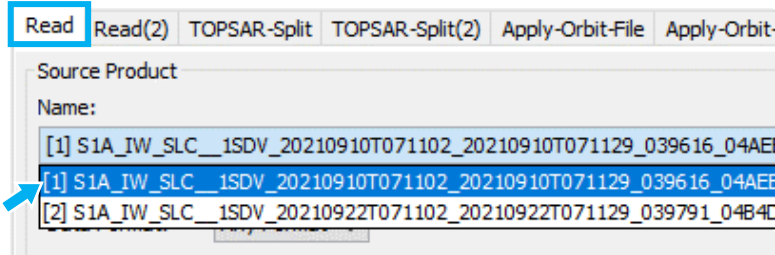
II. Displacement (DInSAR) 2 images

Stage 2. Coregistration

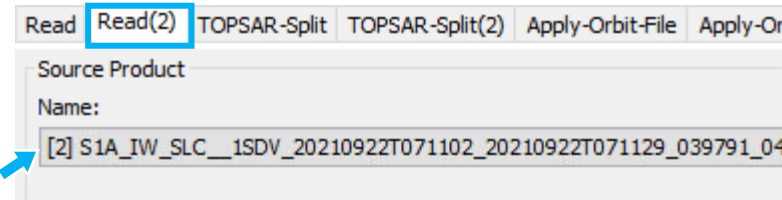
Variant 2. Menu SNAP

1. Radar > Coregistration > S1 TOPS Coregistration > S-1 TOPS Coregistration with ESD

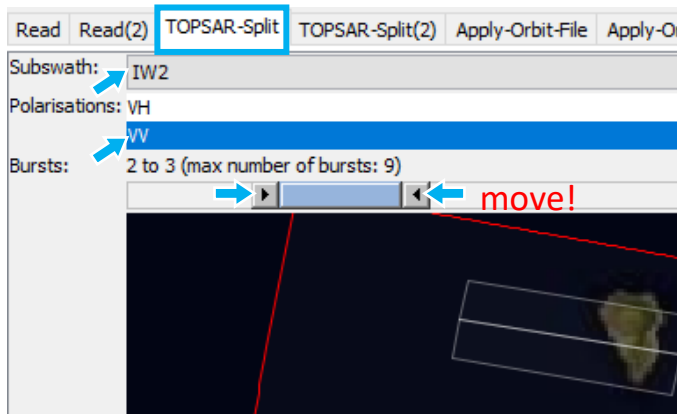
2. Select first (master) image (date earlier)



3. Select second (slave) image

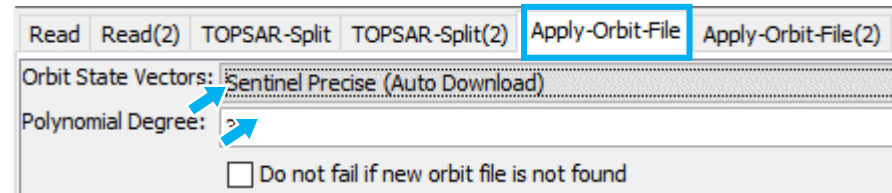


4. Select sub swath and 2 burst above territory for first img.



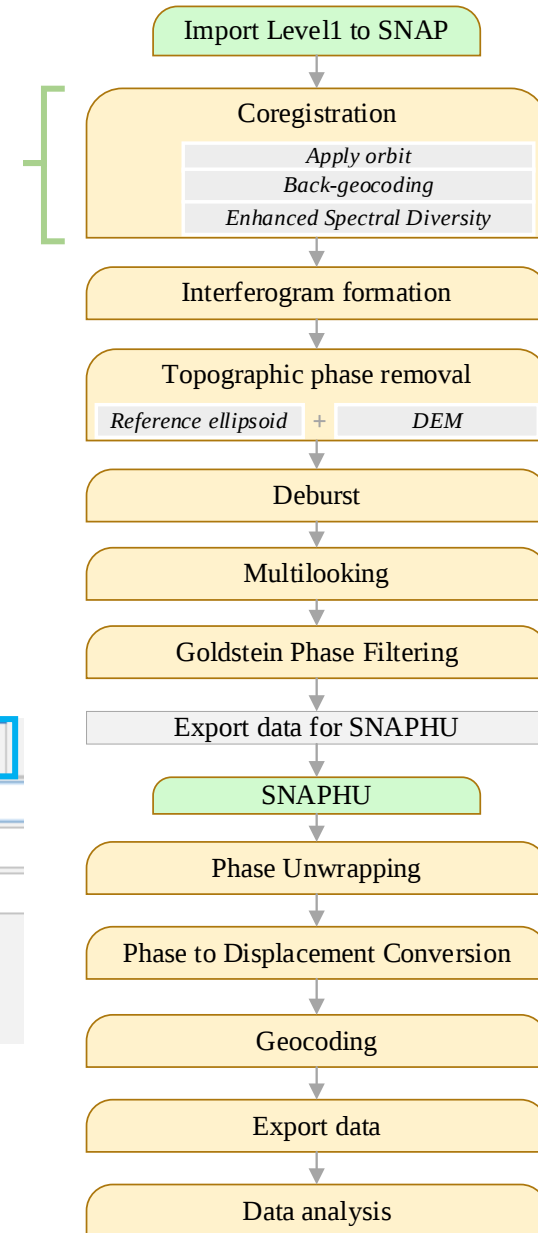
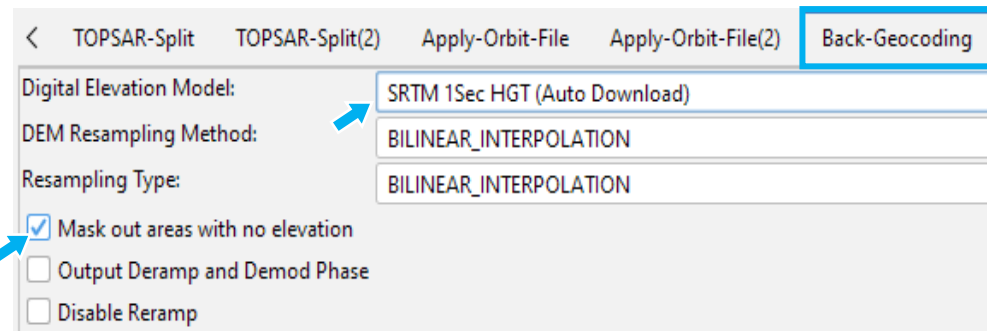
5. Similarly select sub swath and 2 burst above territory for second img.

6. Select precise orbit for first img.

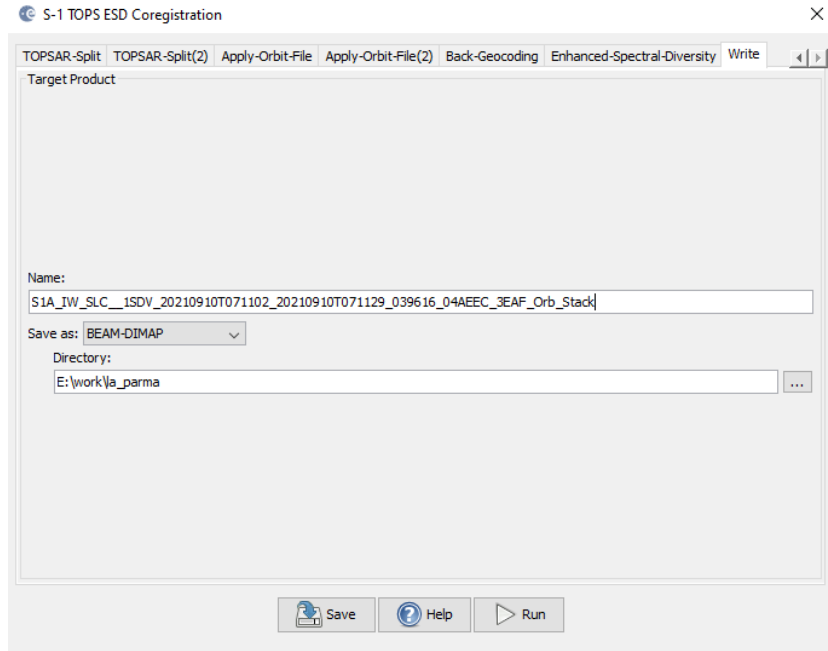


7. Similarly select precise orbit for second img.

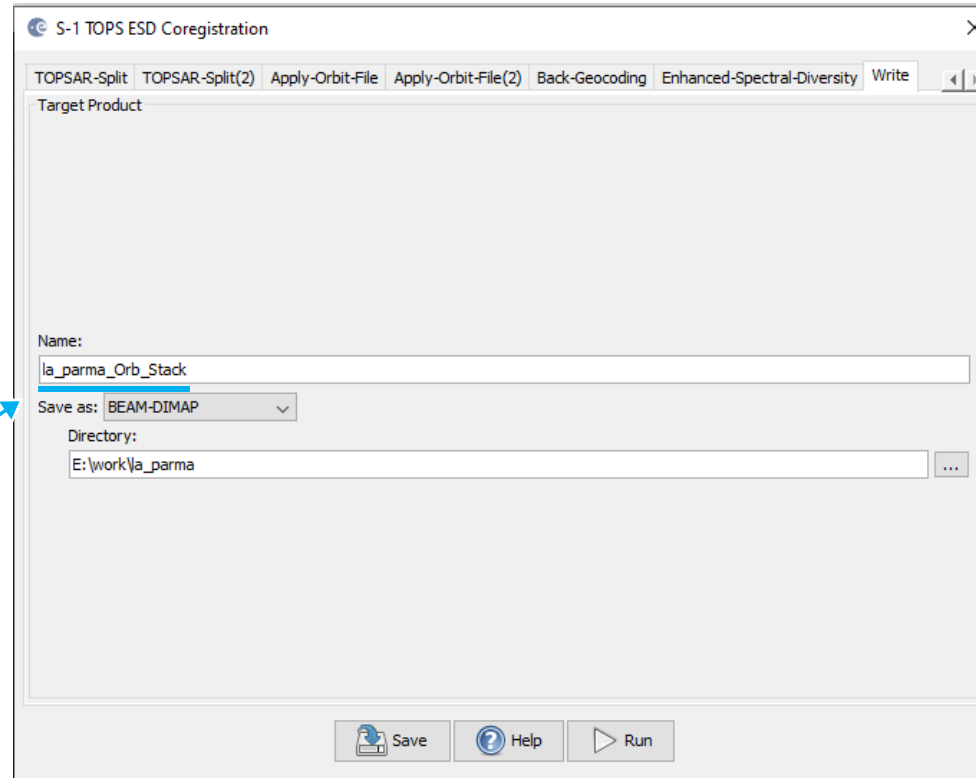
8. Select DEM



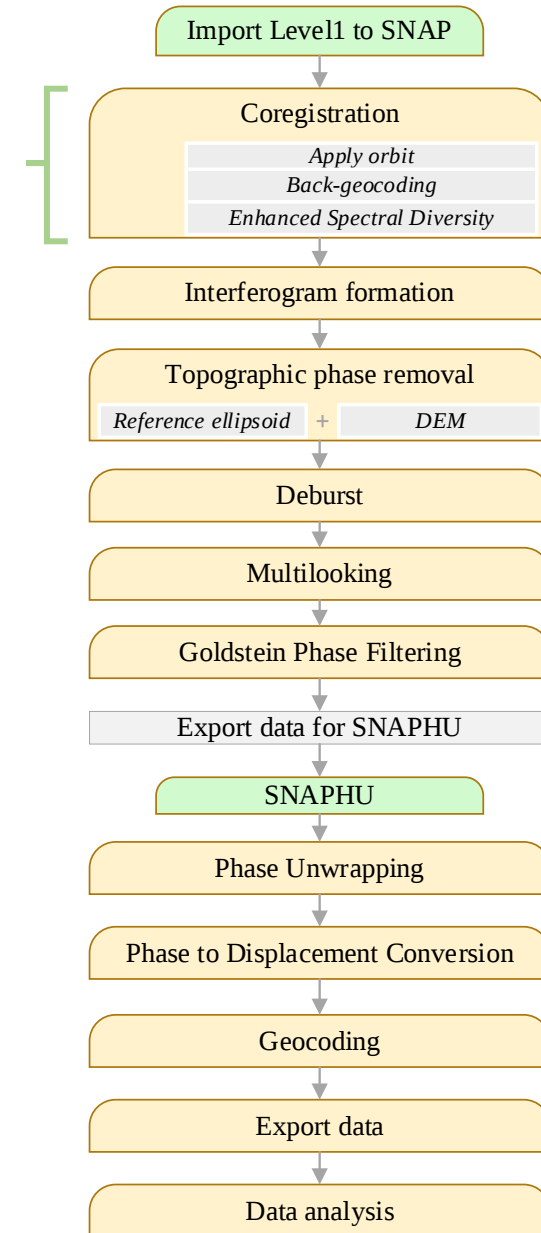
9. Write image



**settings Extended spectral diversity leave by default*



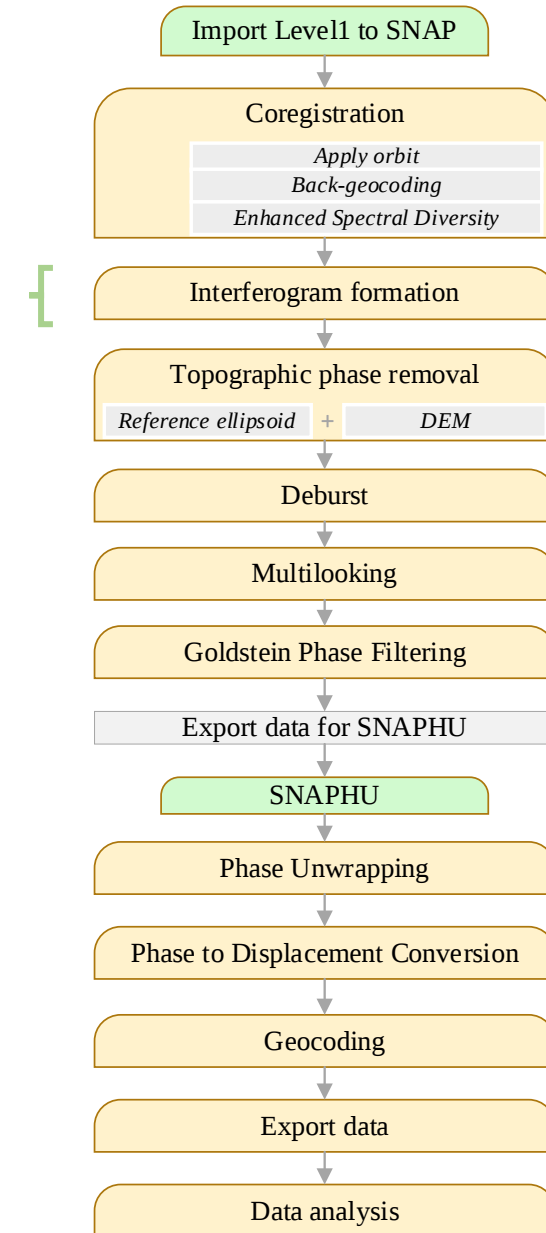
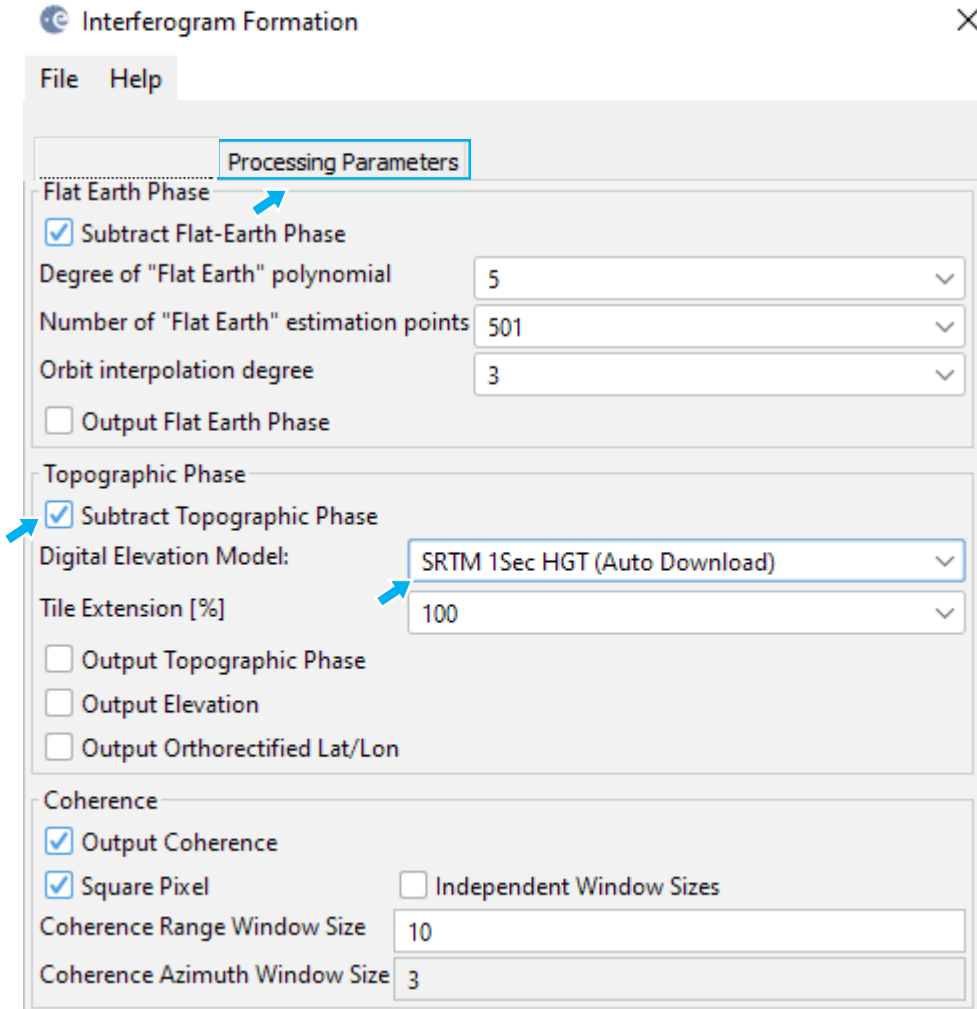
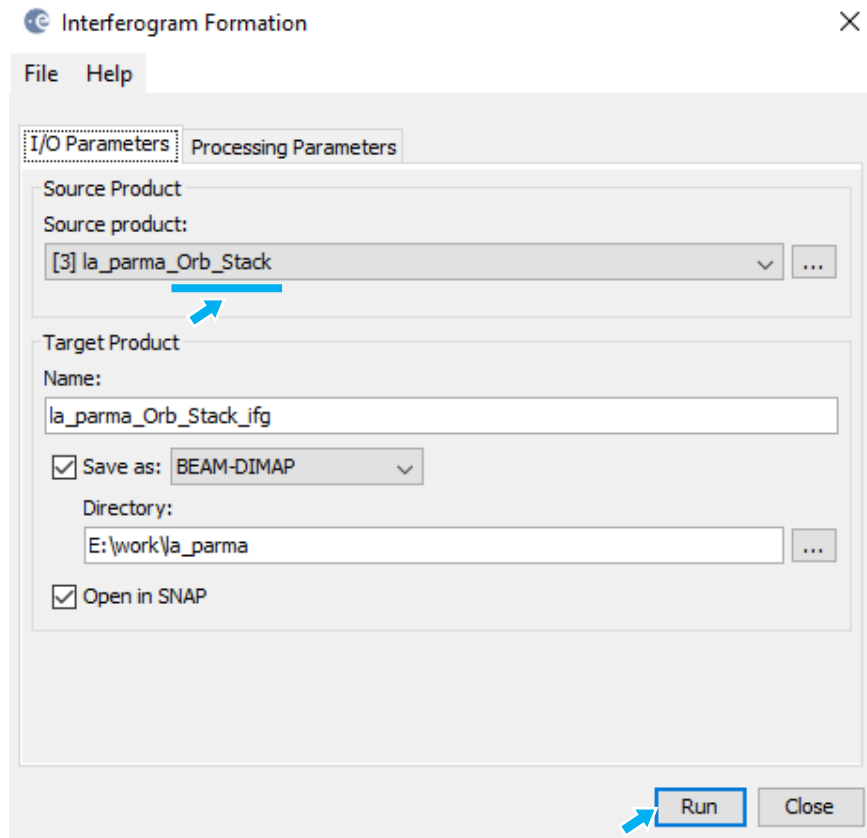
For convenience, the name can be abbreviated



Stage 3. Create Interferogram + Topophase remove

Variant 2. Menu SNAP

1. Radar > Interferometric > Products > Interferogram Formation



1. Radar > Sentinel-1 TOPS > S-1 Deburst

S-1 TOPS Deburst

File Help

I/O Parameters Processing Parameters

Source Product

source:

[4] la_parma_Orb_Stack_ifg ...

Target Product

Name:

la_parma_Orb_Stack_ifg_deb_dinsar

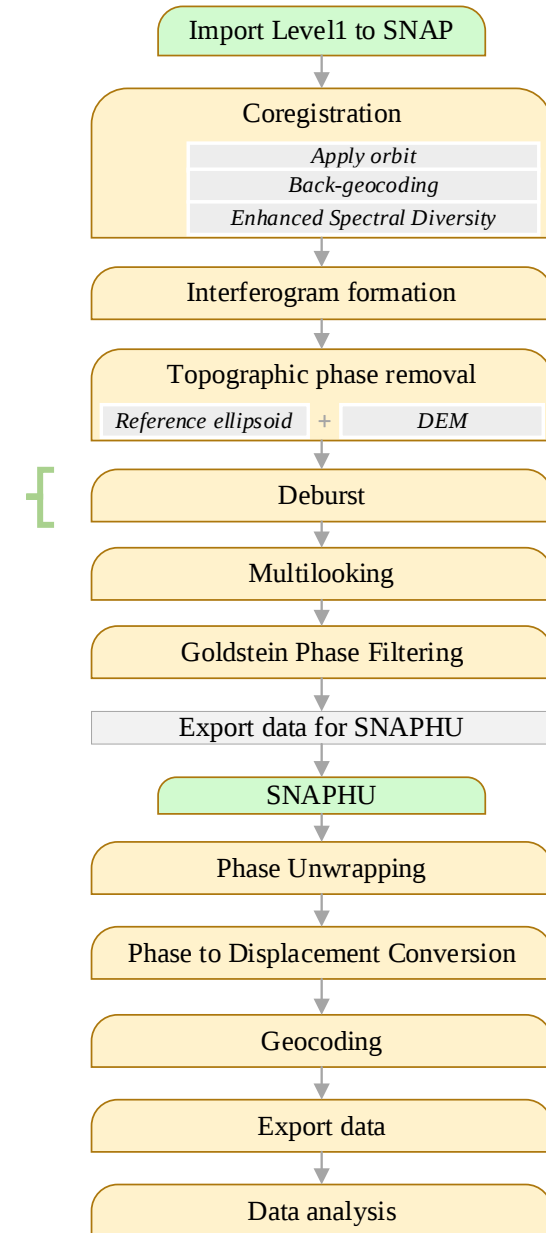
☒ Save as: BEAM-DIMAP

Directory:

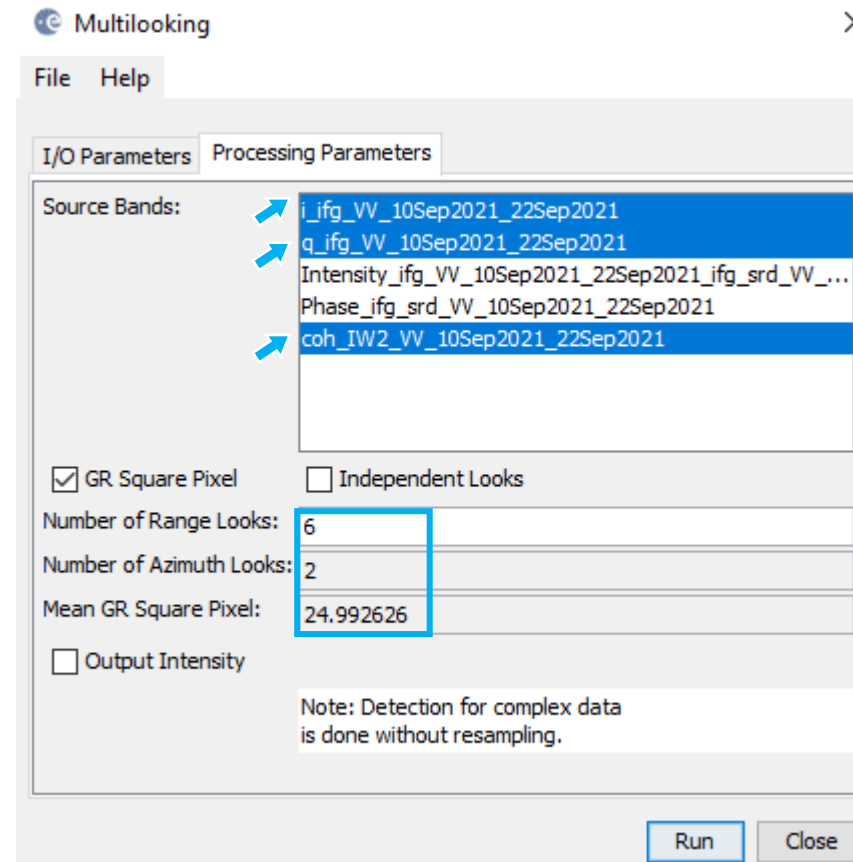
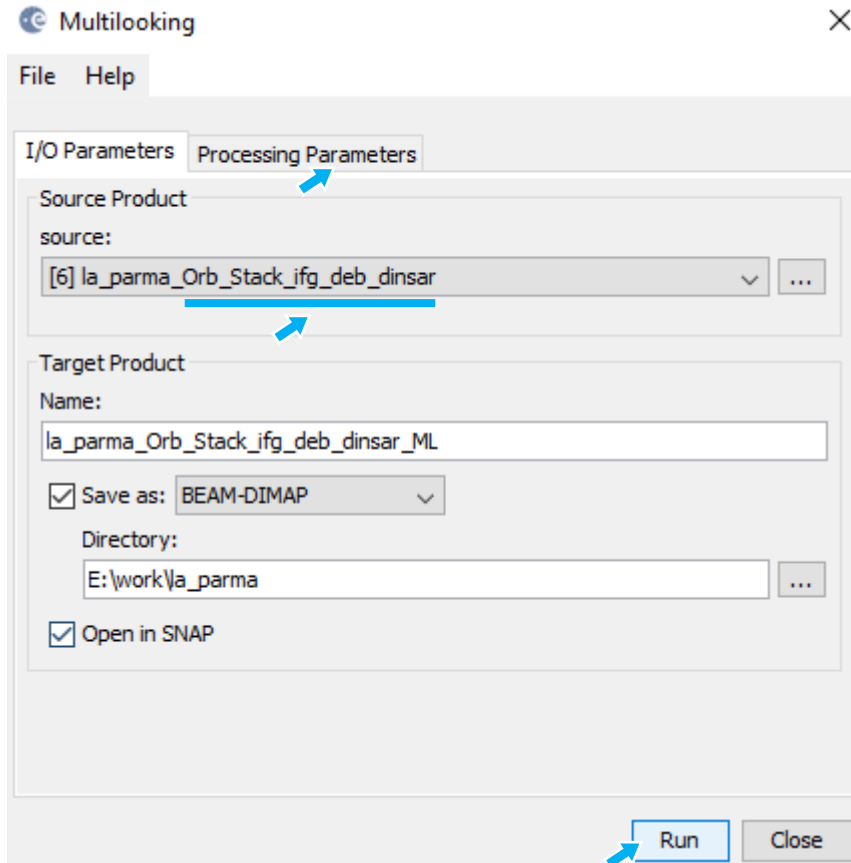
E:\work\la_parma ...

☒ Open in SNAP

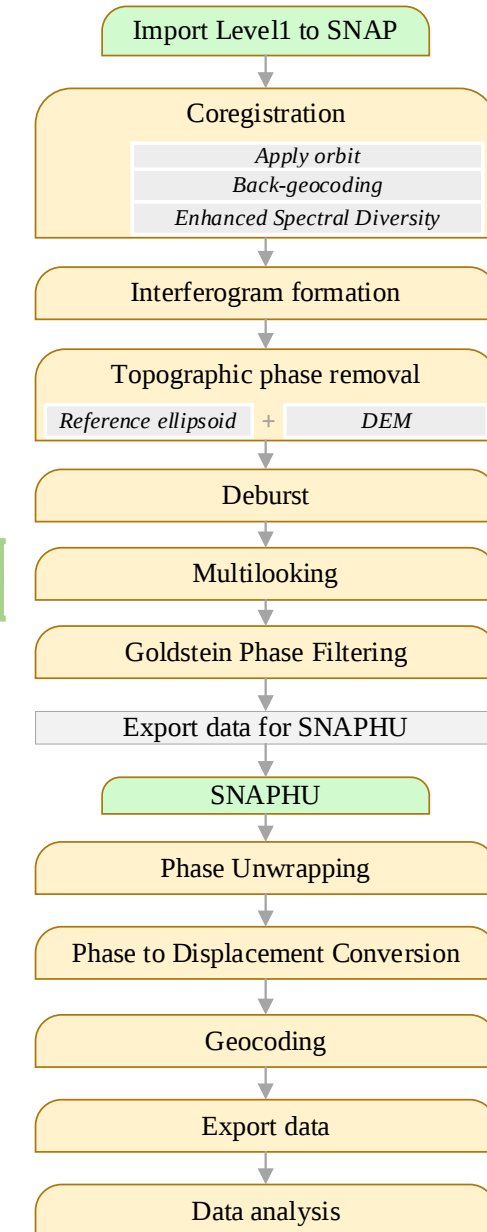
Run Close



1. Radar > Sar utilities > Multilooking



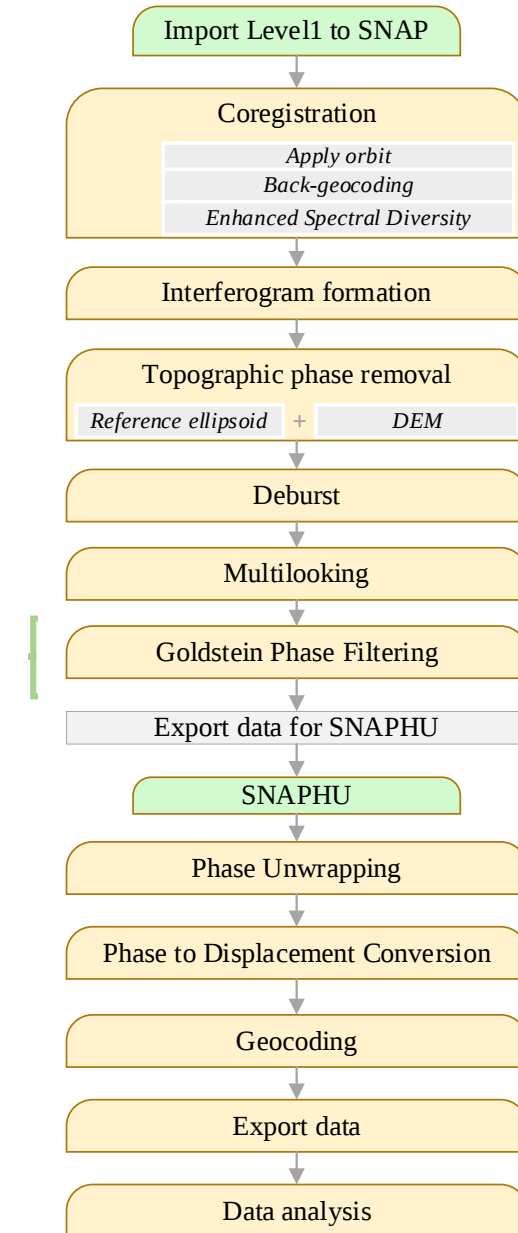
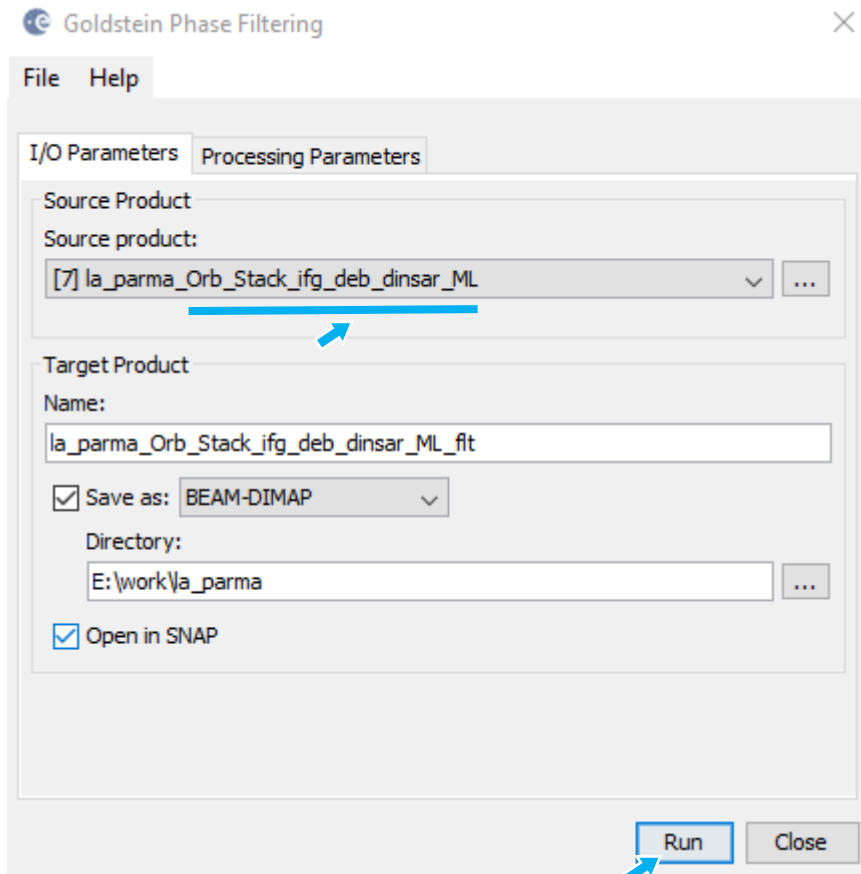
In the Number of Range Looks field, enter 6, which will result in a pixel size of about 26.5 meters. In essence, multi-looking performs a spatial average of a number of neighboring pixels (in our case, 6x2 pixels) to suppress noise and proportion the image correctly. This process comes at the expense of spatial resolution



Stage 6. Goldstein Phase Filtering

Variant 2. Menu SNAP

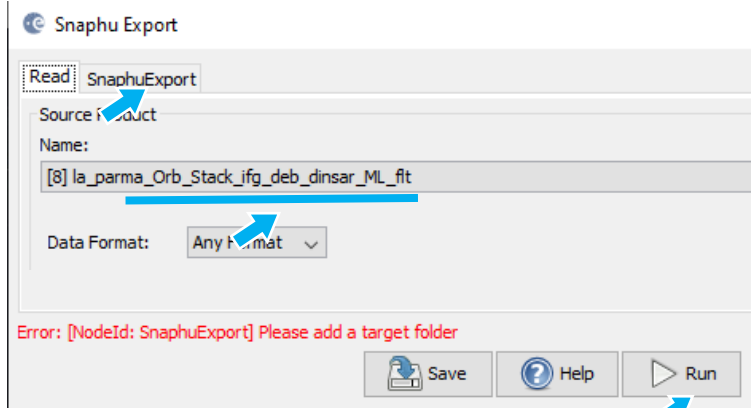
1. Radar > Interferometric > Filtering > Goldstein Phase Filtering



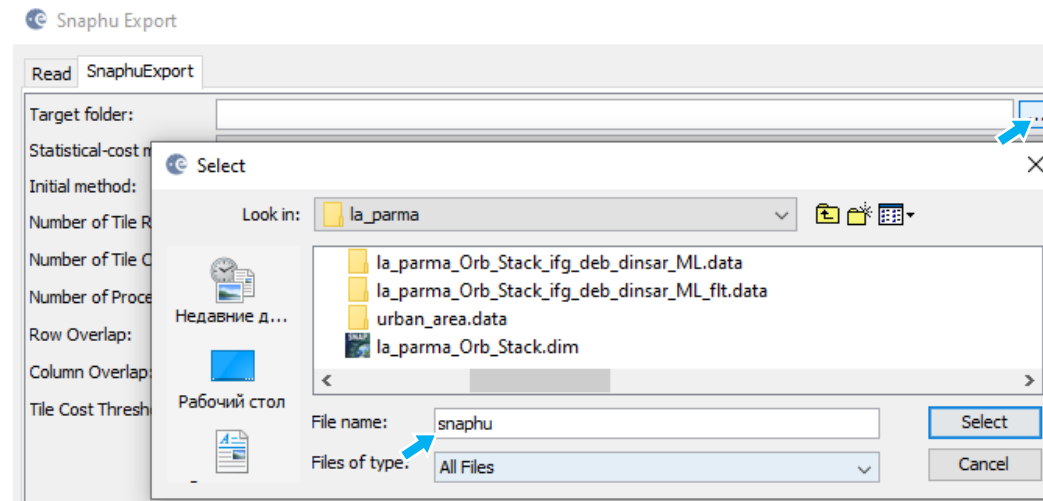
Stage 7. Snapu Export

Variant 2. Menu SNAP

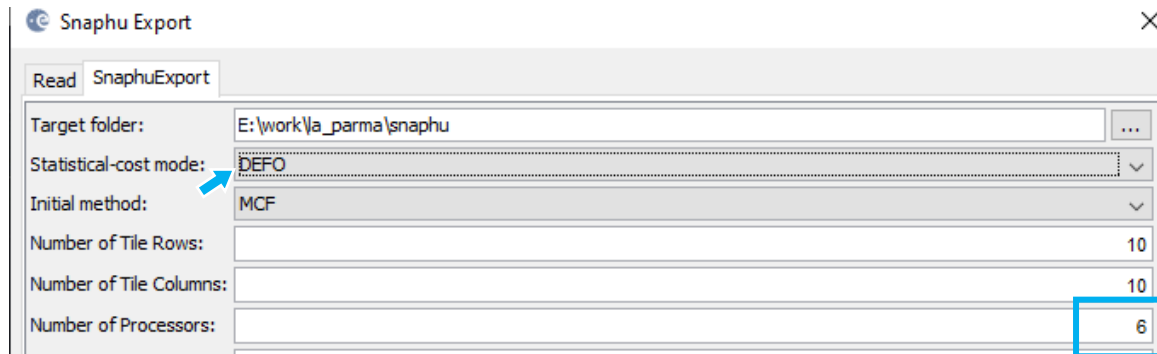
1. Radar > Interferometric > Unwrapping > Snapu Export



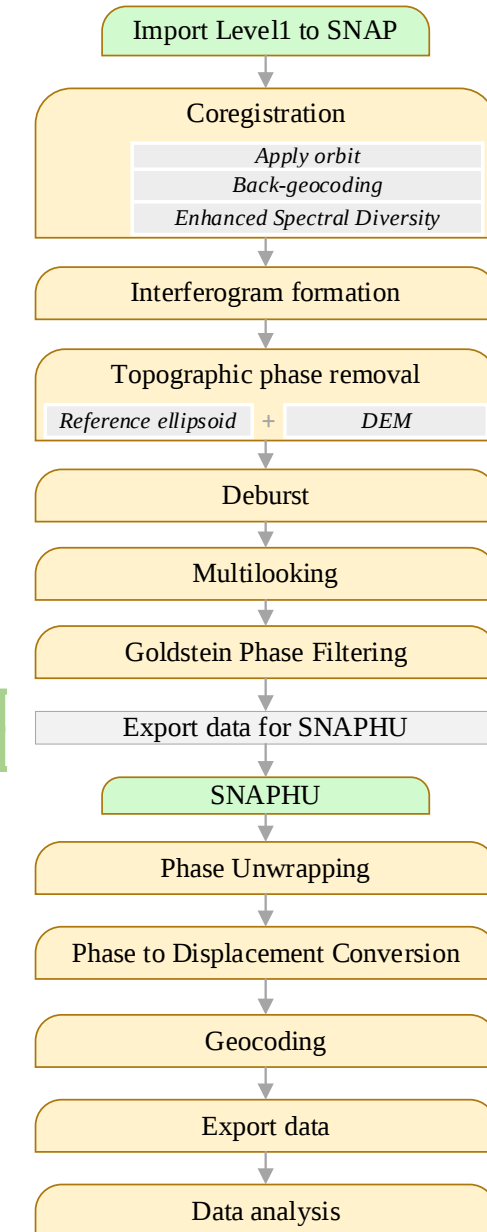
2. Open target folder and write name "snapu"



3. Select DEFO for deformation mapping



this depends on the CPU you have

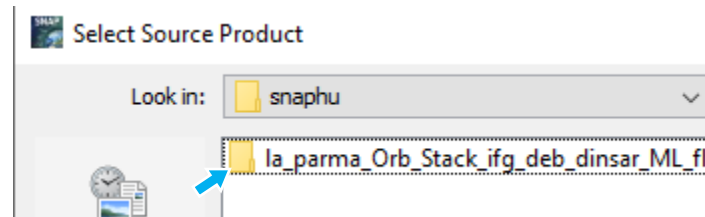
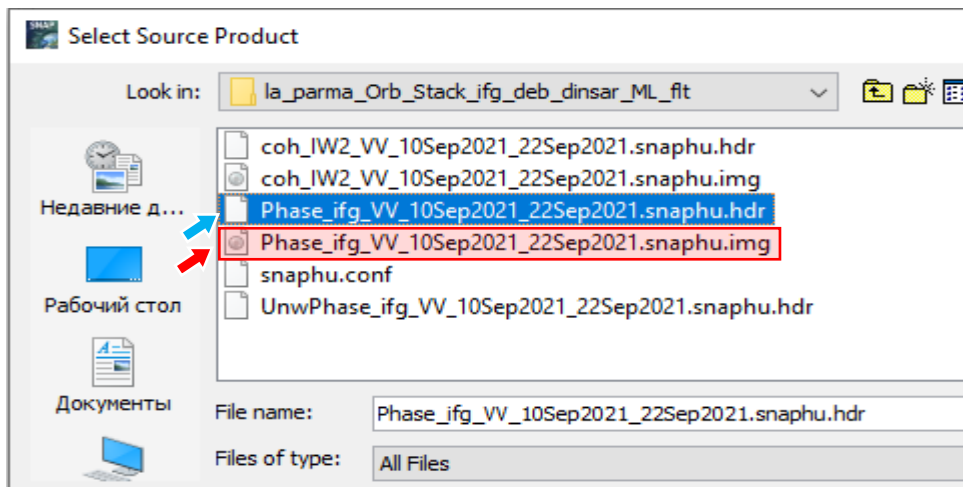
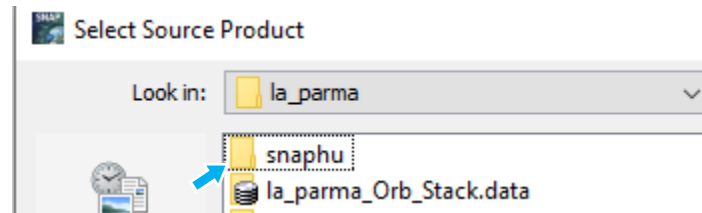
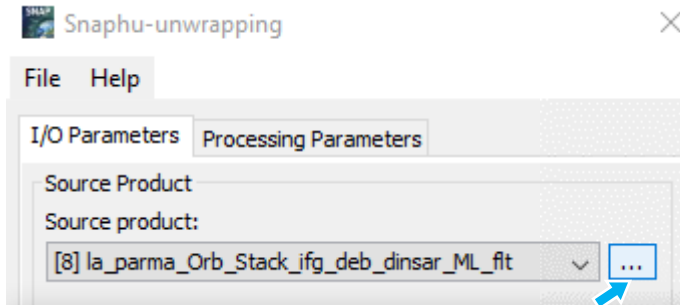


Stage 8. Snapu Unwrapping phase

Variant 2. Menu SNAP

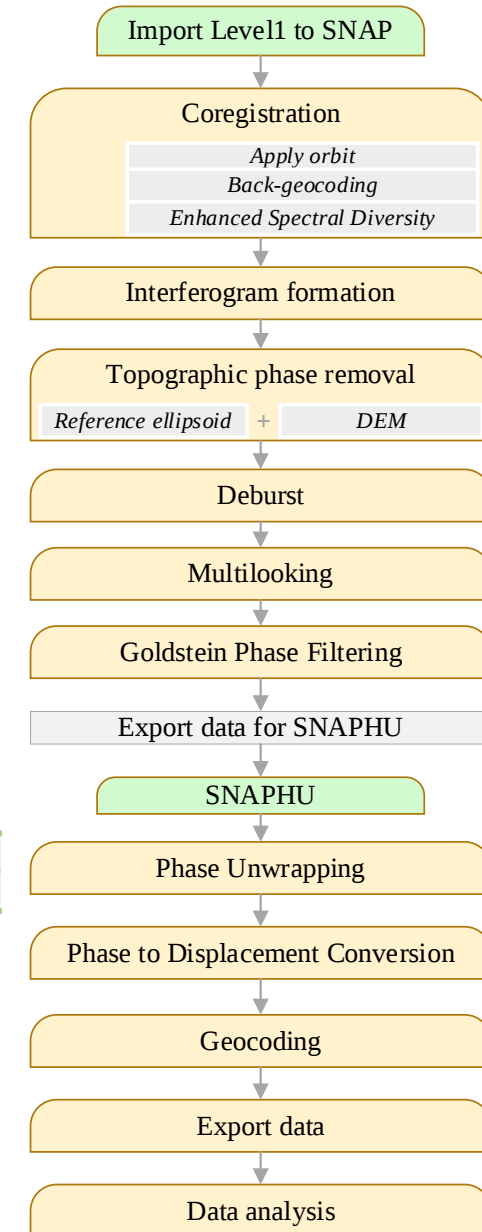
1. Radar > Interferometric > Unwrapping > Snapu-unwrapping

2. Select phase source



*select file "Phase_ifg_.....snapu.hdr" for SNAP before version 9

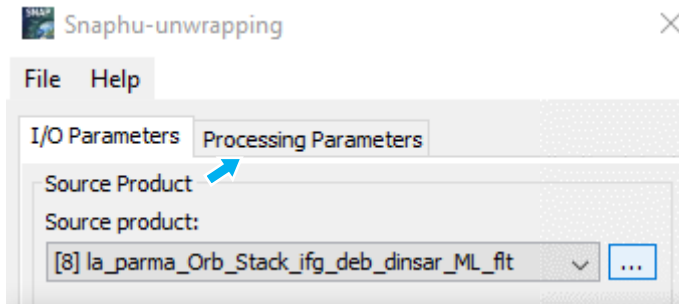
*select file "Phase_ifg_.....snapu.img" for SNAP after version 10



Stage 8. Snaphu Unwrapping phase

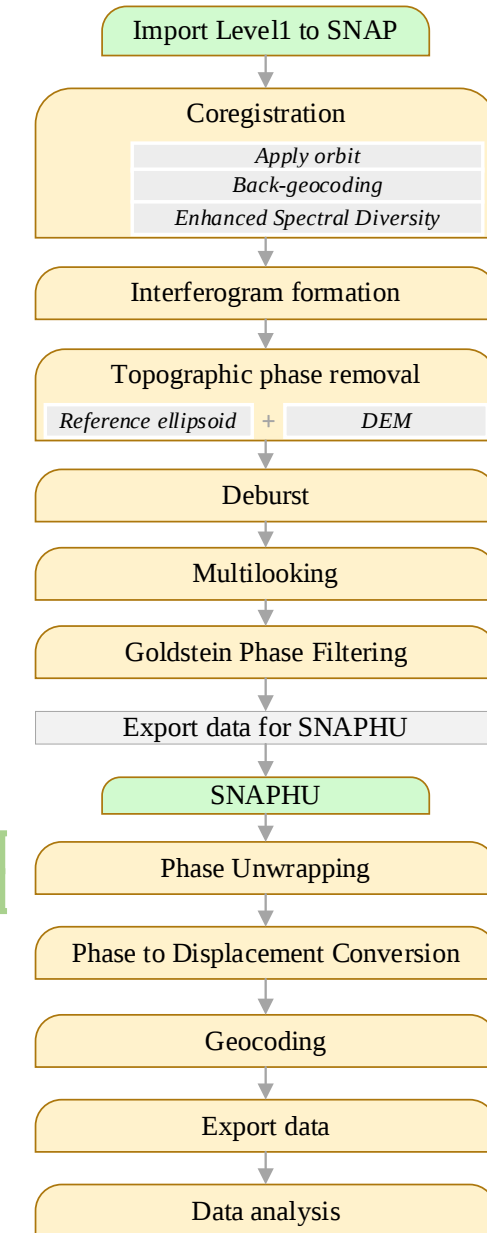
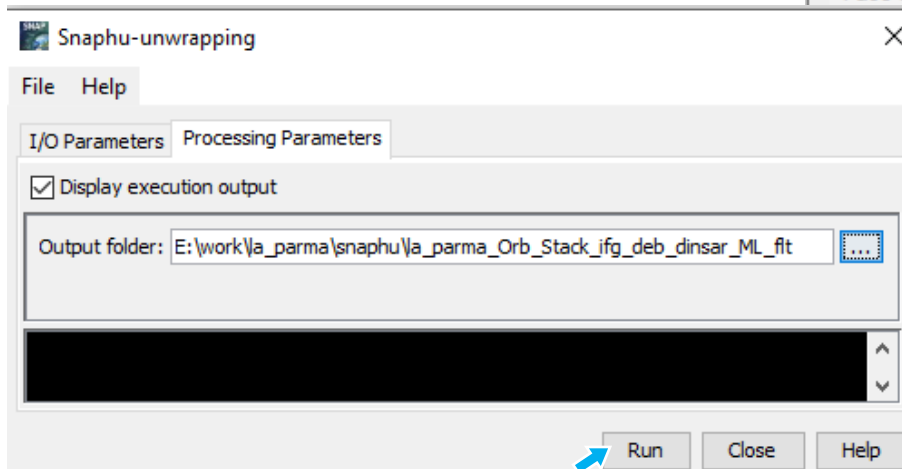
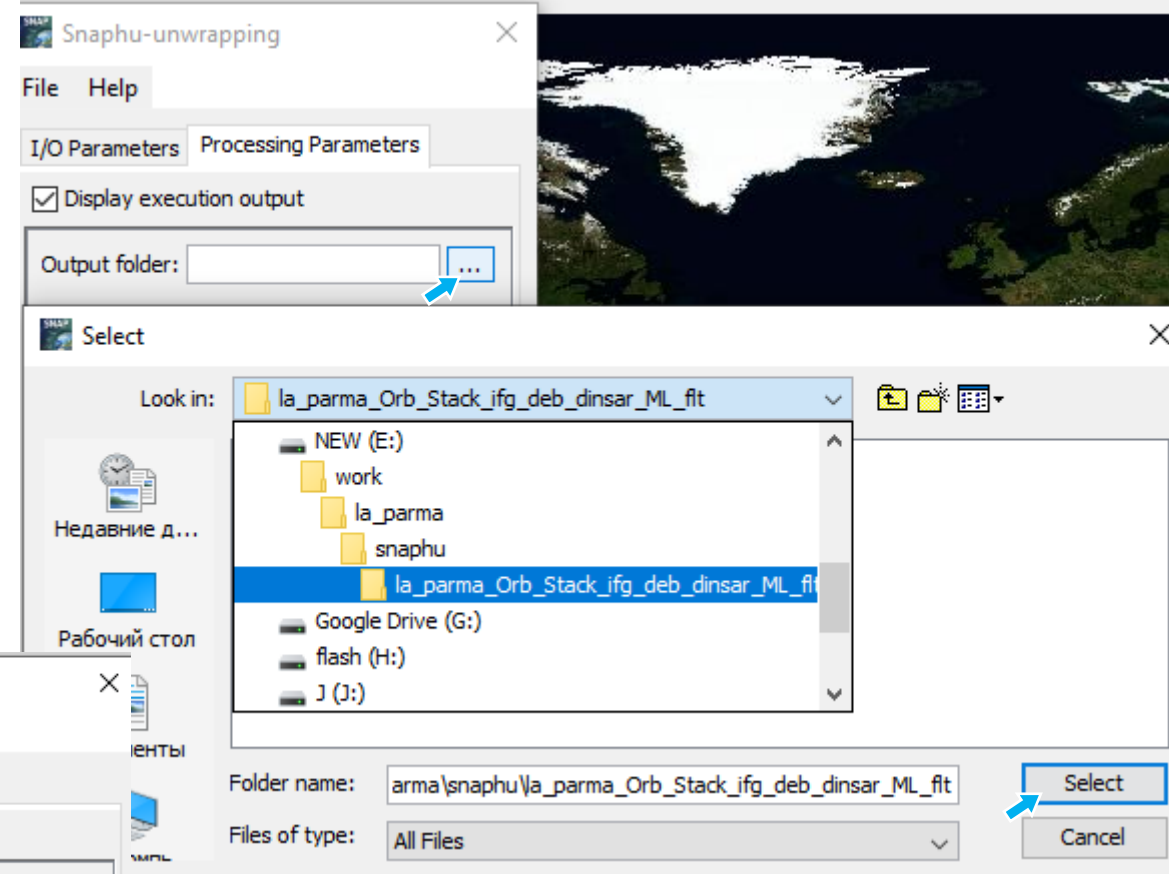
Variant 2. Menu SNAP

3. Select processing parameters



Folder were you selected file
"Phase_ifg_.....snaphu.hdr" and had file
"UnwPhase_ifg_...snaphu.img"

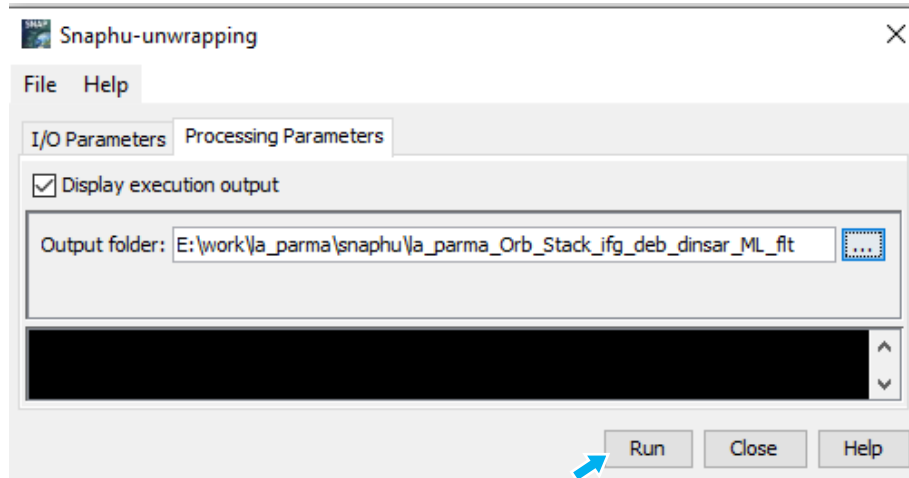
4. Select folder for unwrapped phase



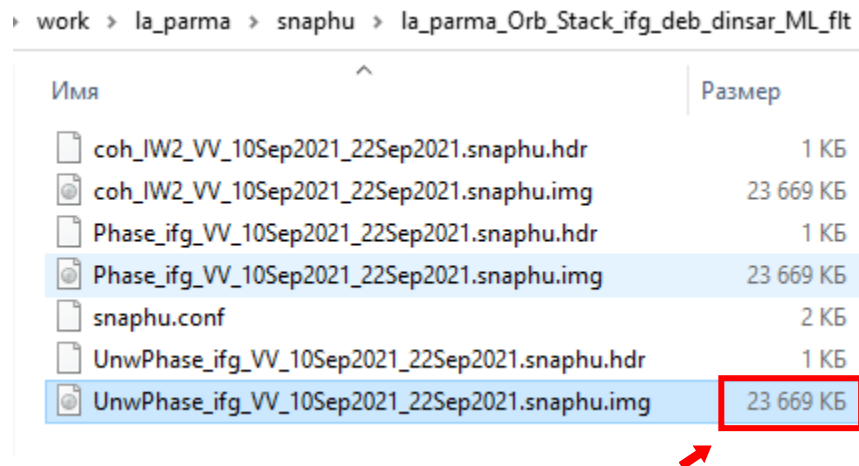
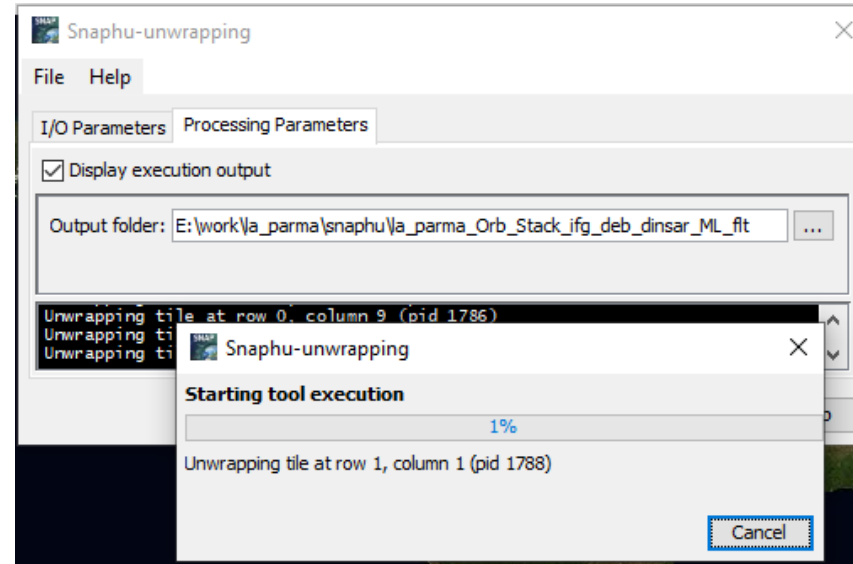
Stage 8. Snapu Unwrapping phase

Variant 2. Menu SNAP

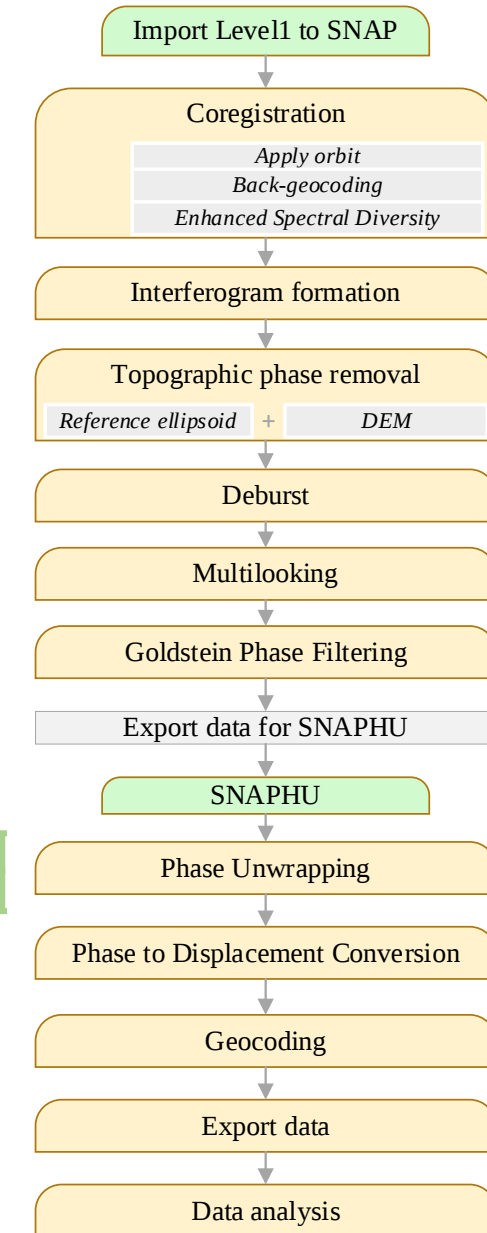
5. Run unwrapped phase



6. Normal view process



after process you get file
UnwPhase_ifg_....snaphu.img
size >>1kb



II. Displacement (DInSAR) 2 images

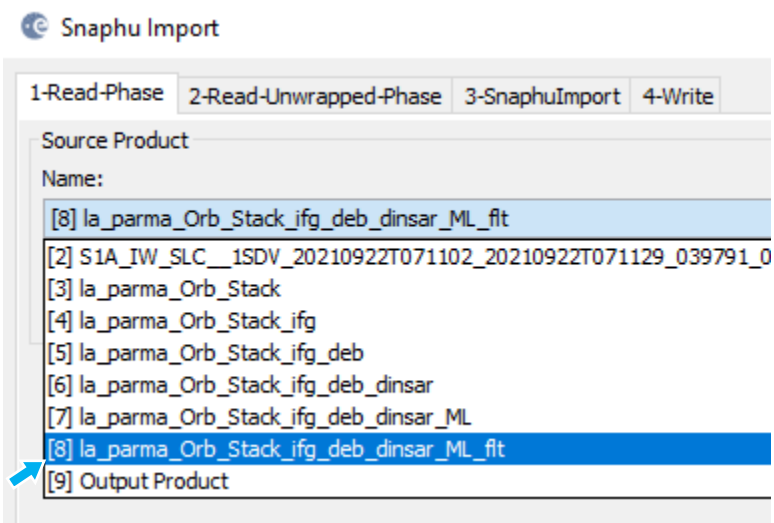
Stage 9. Snaphu import

Variant 2. Menu SNAP

1. Radar > Interferometric > Unwrapping > Snaphu import

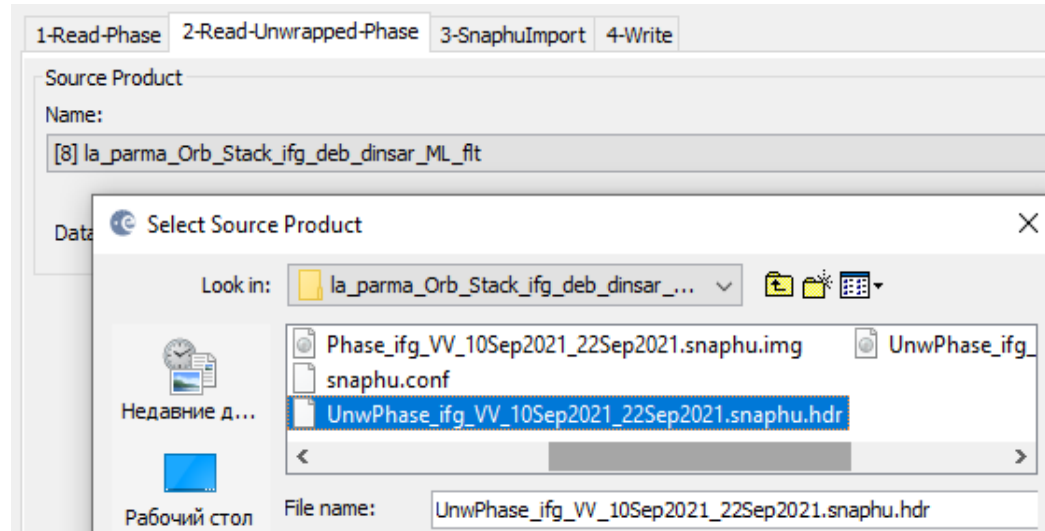
2. Select image before unwrapping

1-Read-Phase > select file "name_ML_Flt"

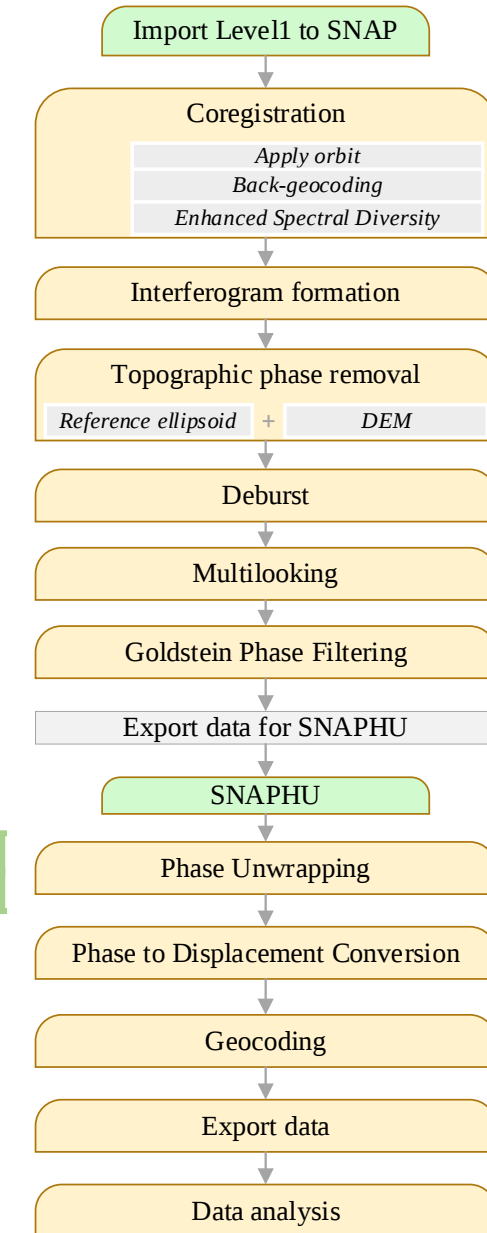
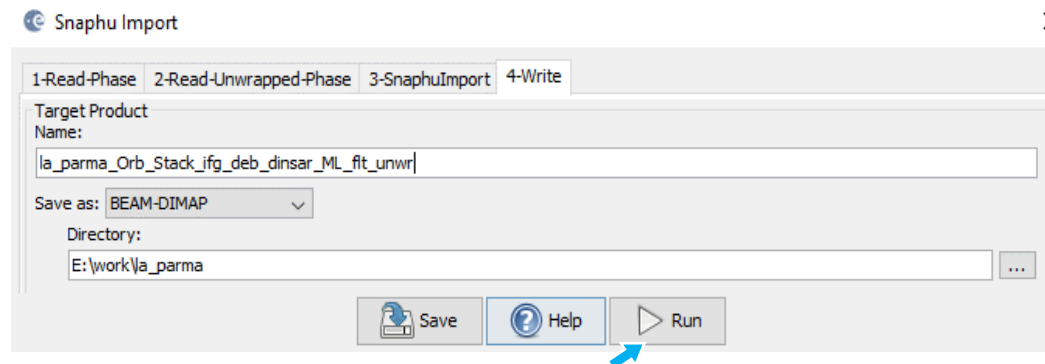


3. Select file unwrapped phase

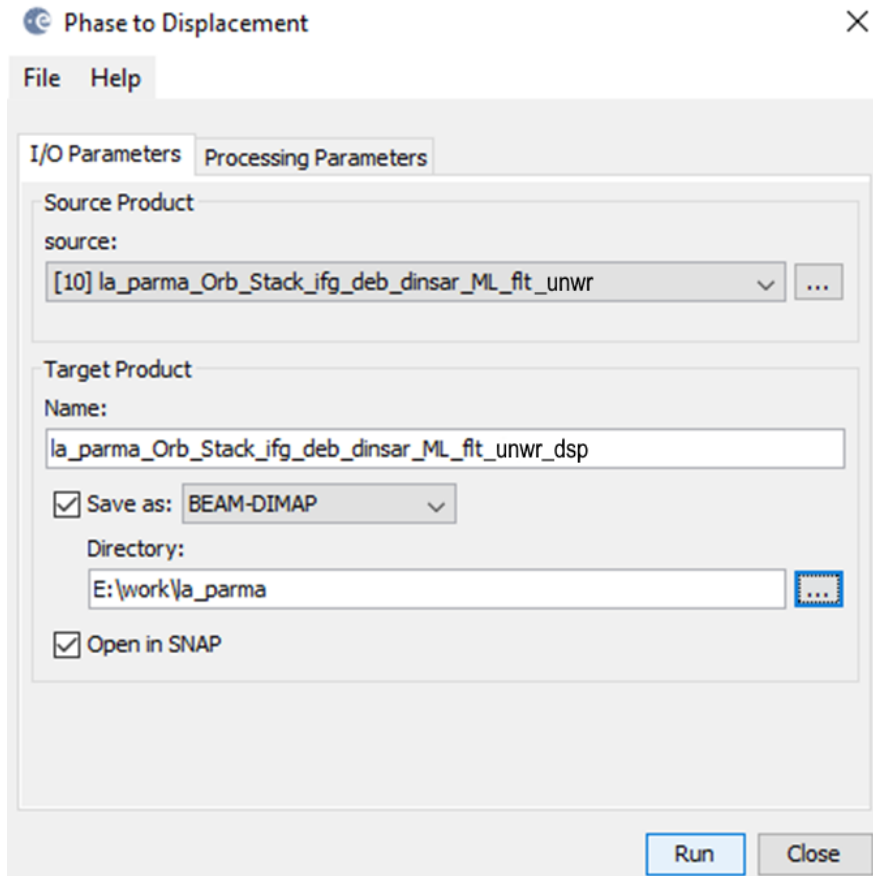
2-Read-Unwrapped-Phase > select file "UnwPhase_ifg_....snaphu.hdr"



3-SnaphuImport -> not use bottom
(use custom option)



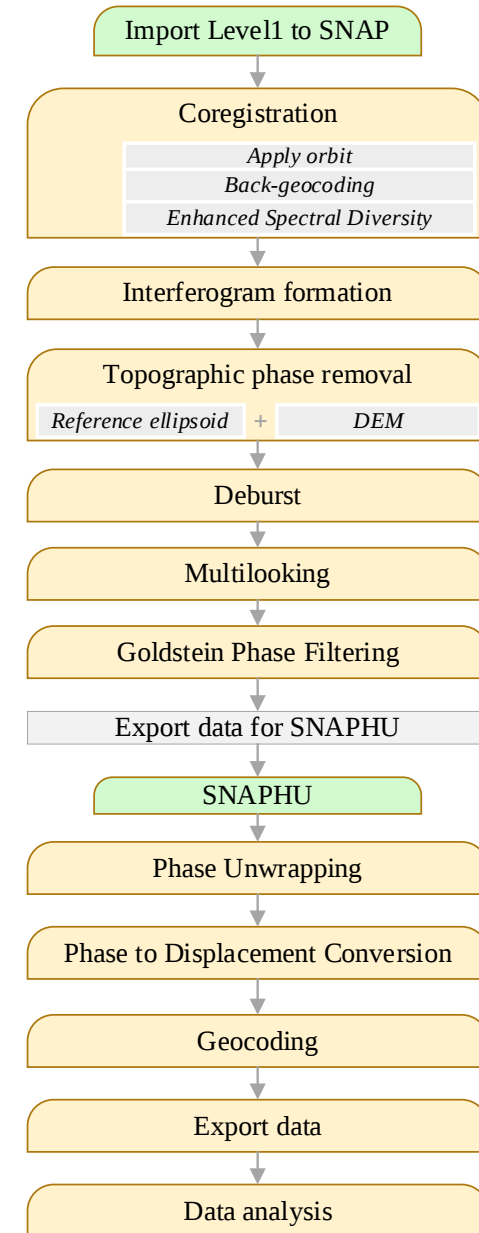
1. Radar > Interferometric > Products > Phase to Displacement.



Absolute vertical displacement in a setting with no horizontal movement can be calculated with the following expression, where the number 0.056 is the approximate value of Sentinel-1's wavelength in meters:

$$(0.056 * Unw_Phase_ifg_08Apr2016_20Apr2016) / (-4 * \pi * \cos(\text{rad}(\text{incident_angle})))$$

1. In the **Product Explorer**, right click the unwrapped interferogram product and select **Band Maths**.
2. In the **Band Maths** window (Figure 8), set the **Name** to something appropriate, such as *Vertical_Displacement*.
 - a. Enter *meters* in the **Unit** field.
 - b. Uncheck **Virtual**.
 - c. In the **Band maths expression** field, paste the expression listed above.
3. Click <OK>. The new band will appear in the bands directory and when viewed, should look very similar to Figure 5.

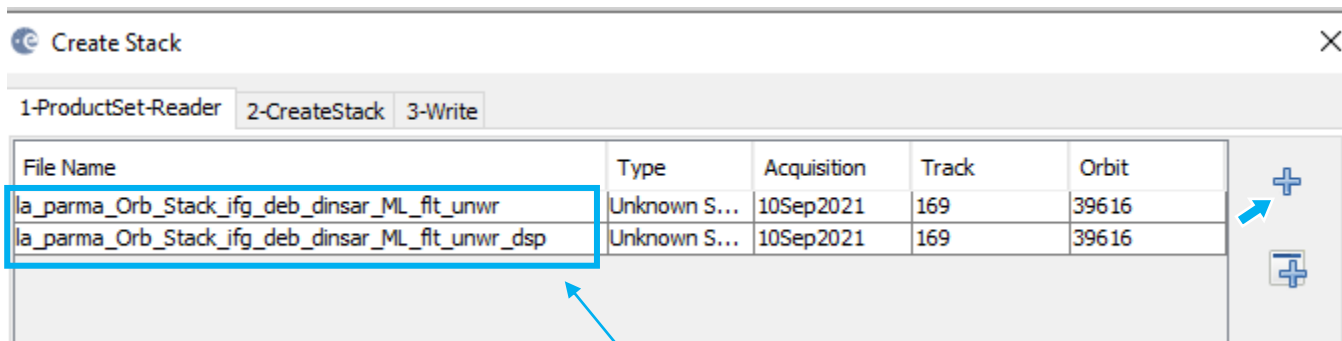


Stage 11. Geocoding.

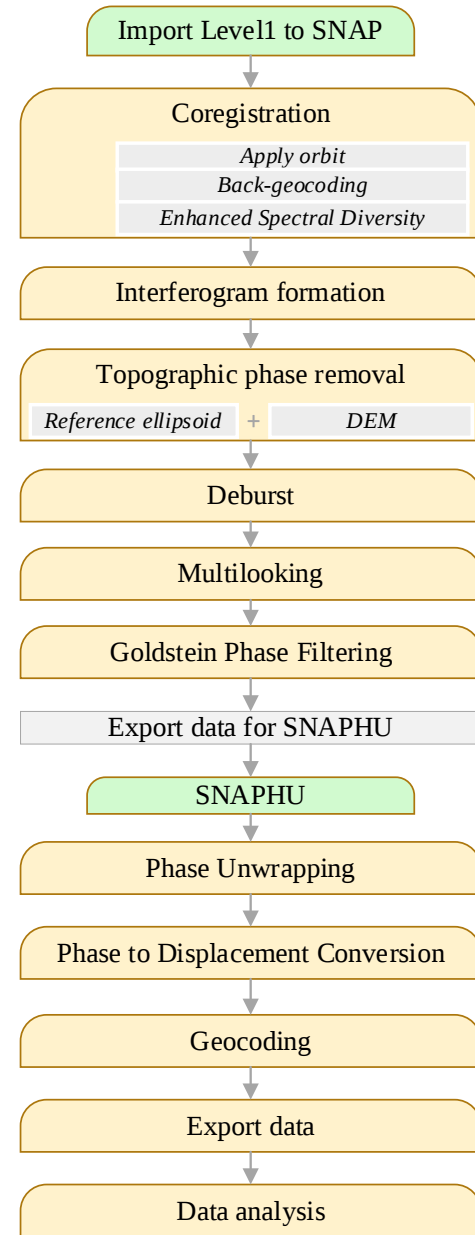
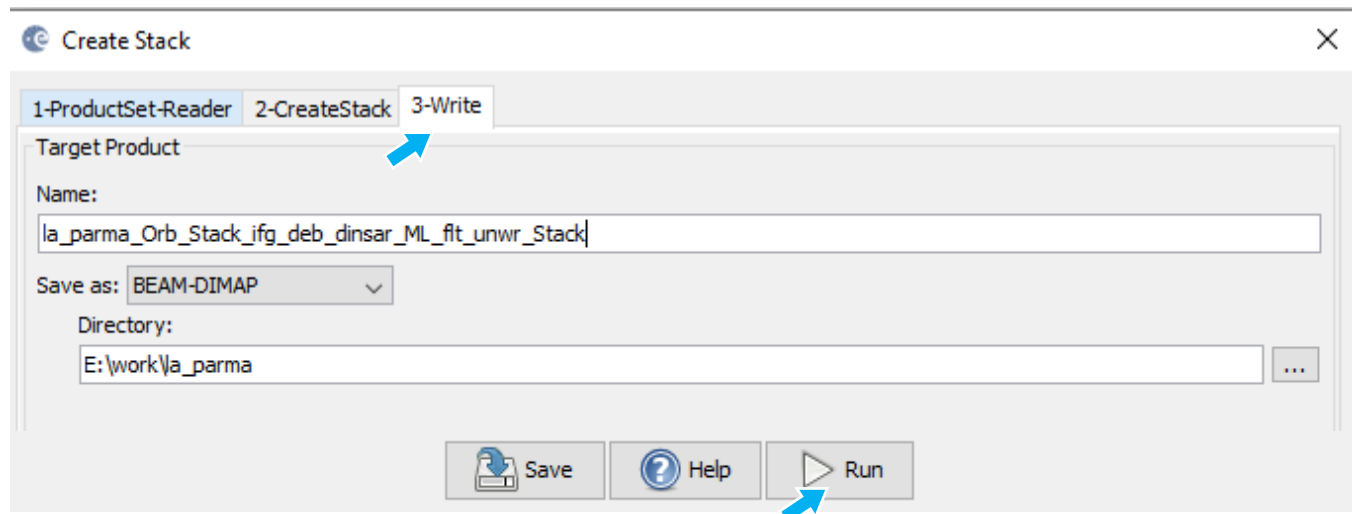
Variant 2. Menu SNAP

1. Create Stack.

Radar > Coregistration > Stack Tools > Create Stack.



Add "name_disp"+"name_unwrapped"

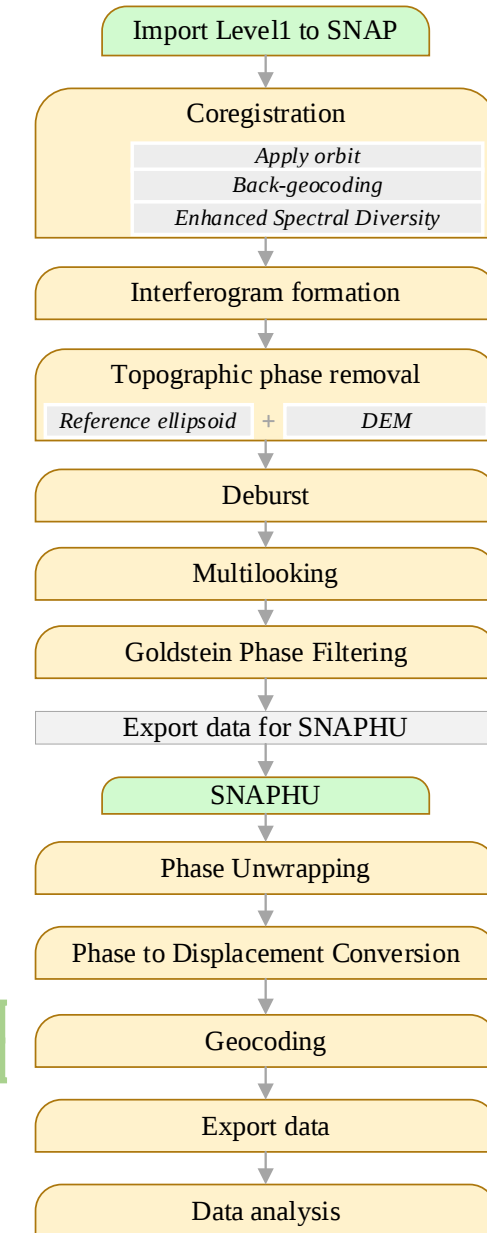
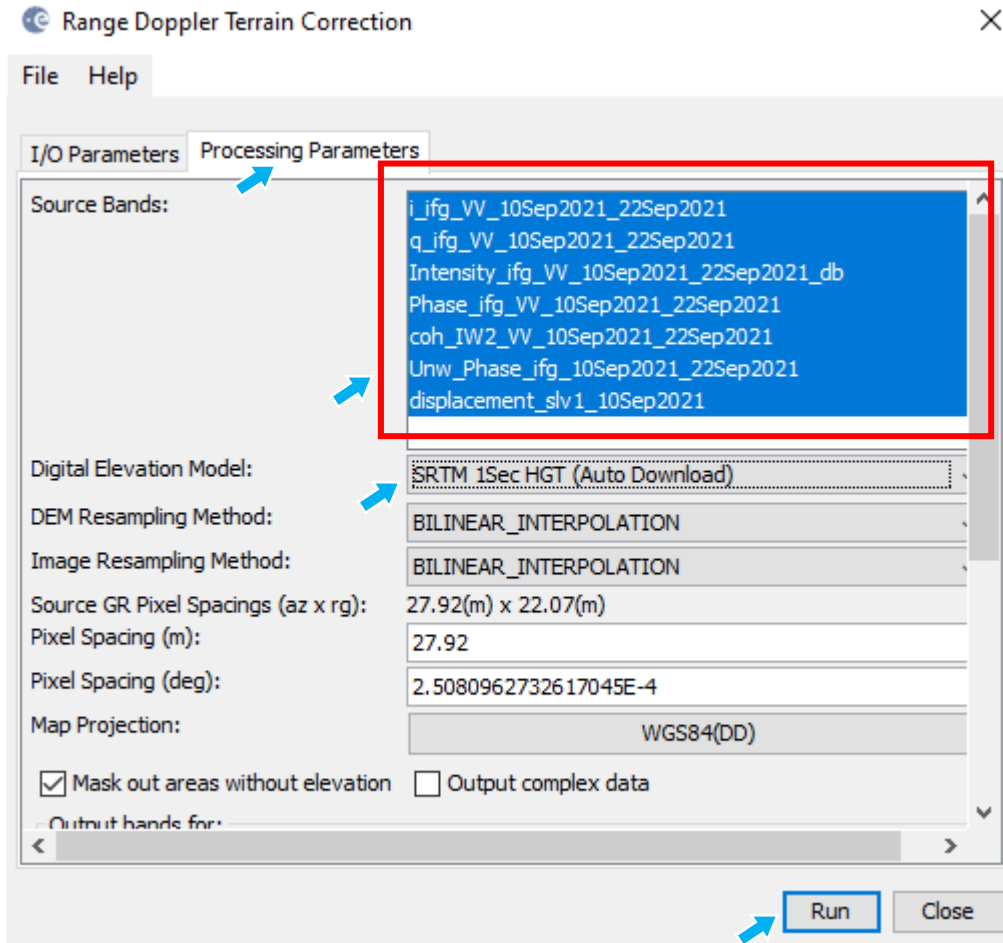


Stage 11. Geocoding.

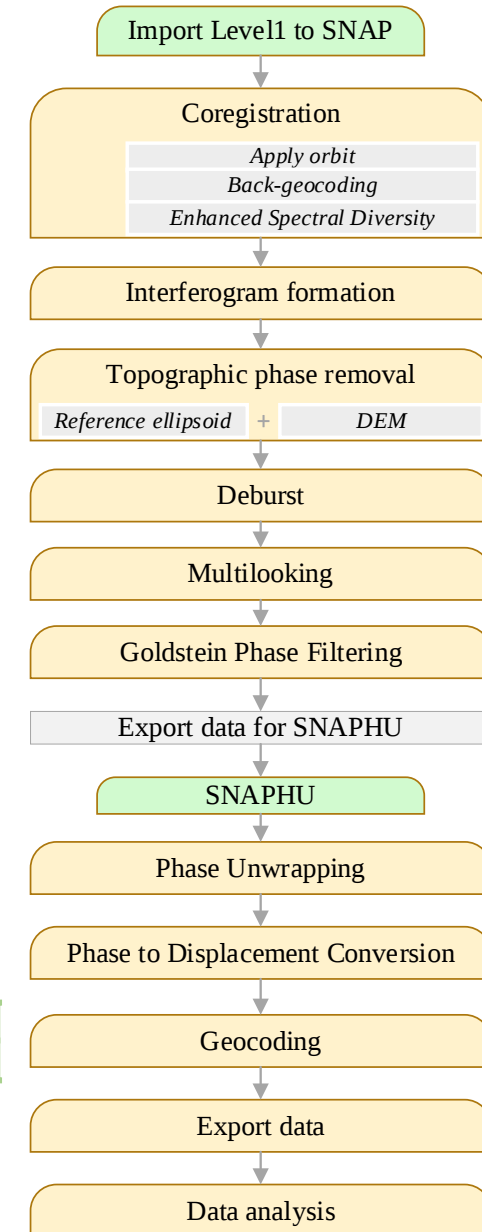
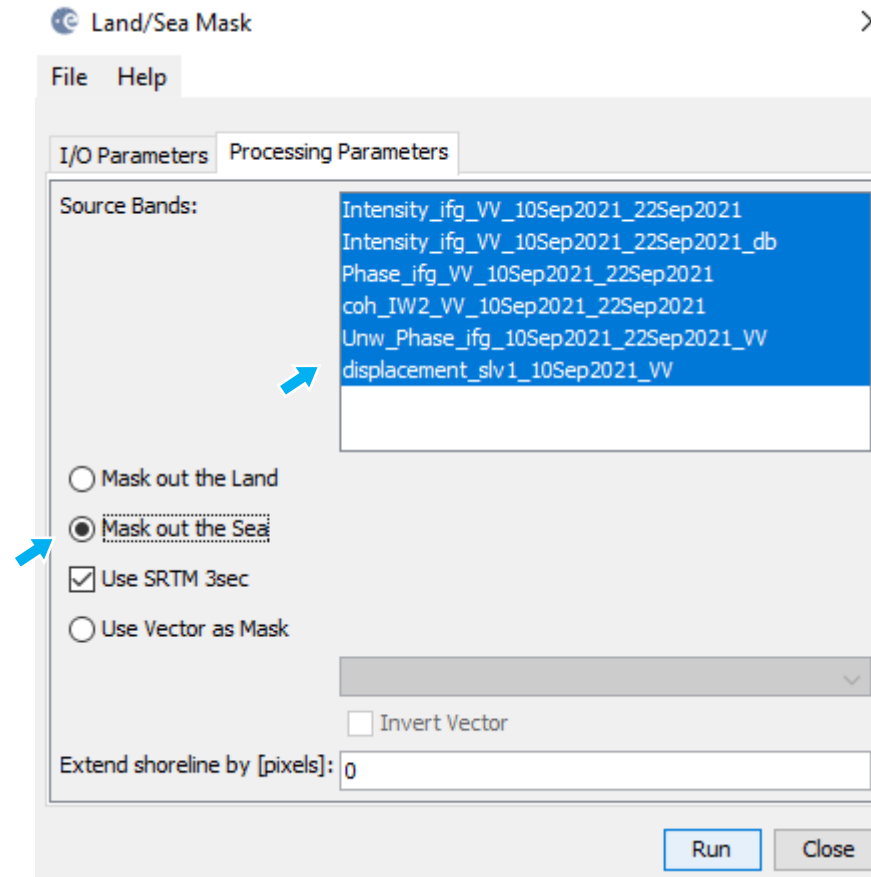
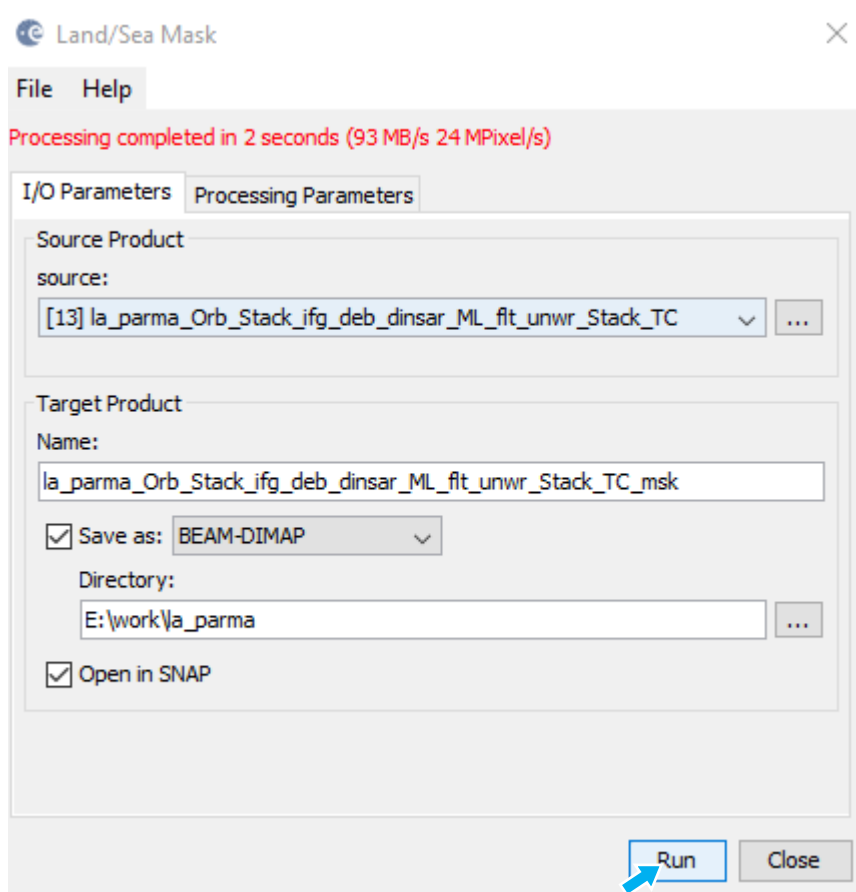
Variant 2. Menu SNAP

2. Range-Doppler Terrain Correction

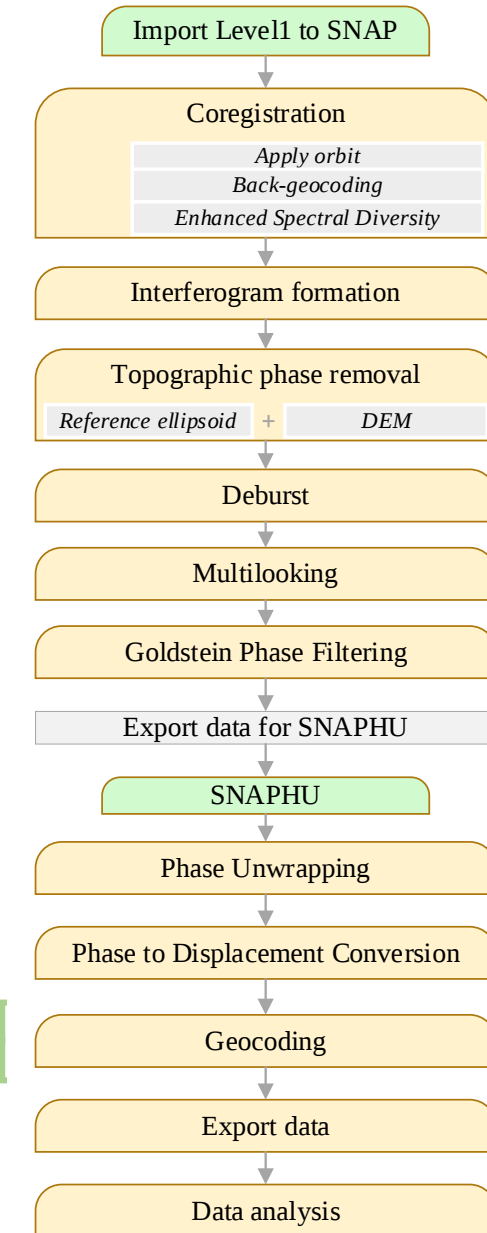
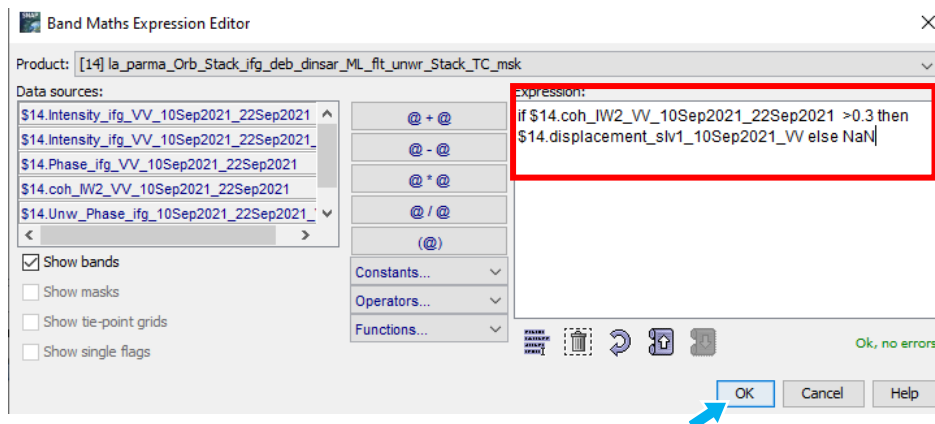
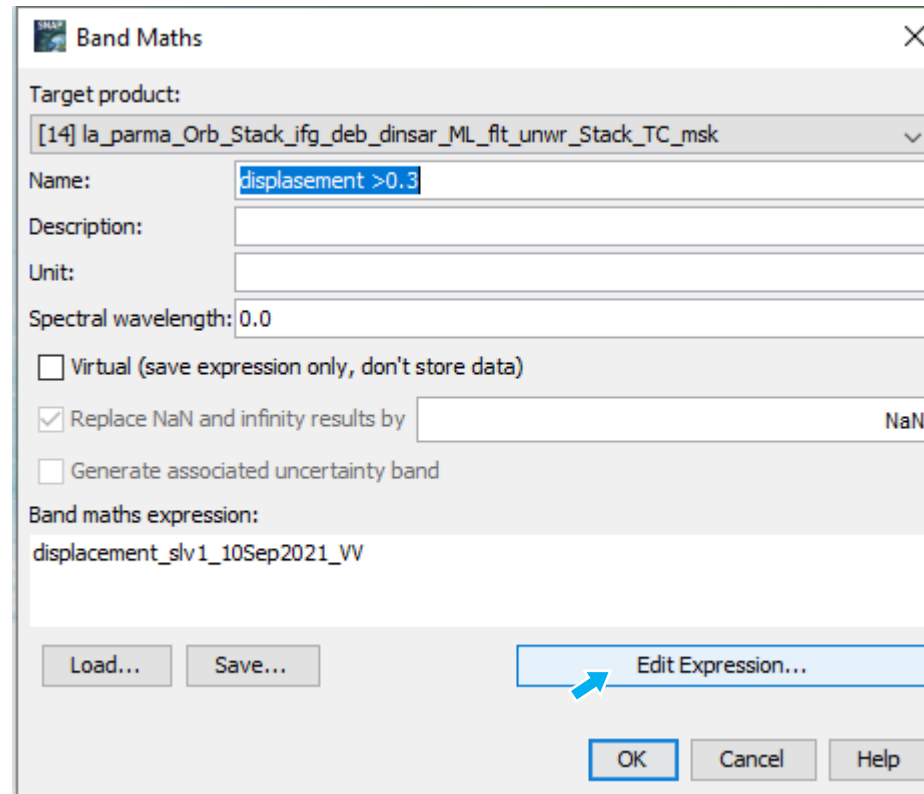
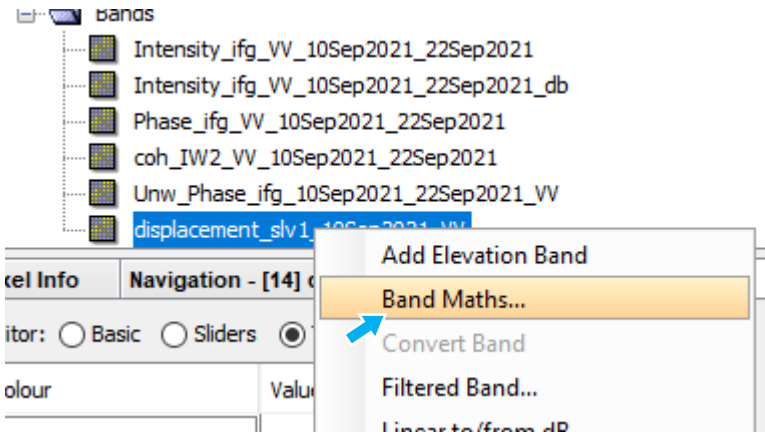
Radar > Geometric > Terrain Correction > Range-Doppler Terrain Correction.



3. Mask Out Areas of Water



4. Mask Out Areas of Low Coherence

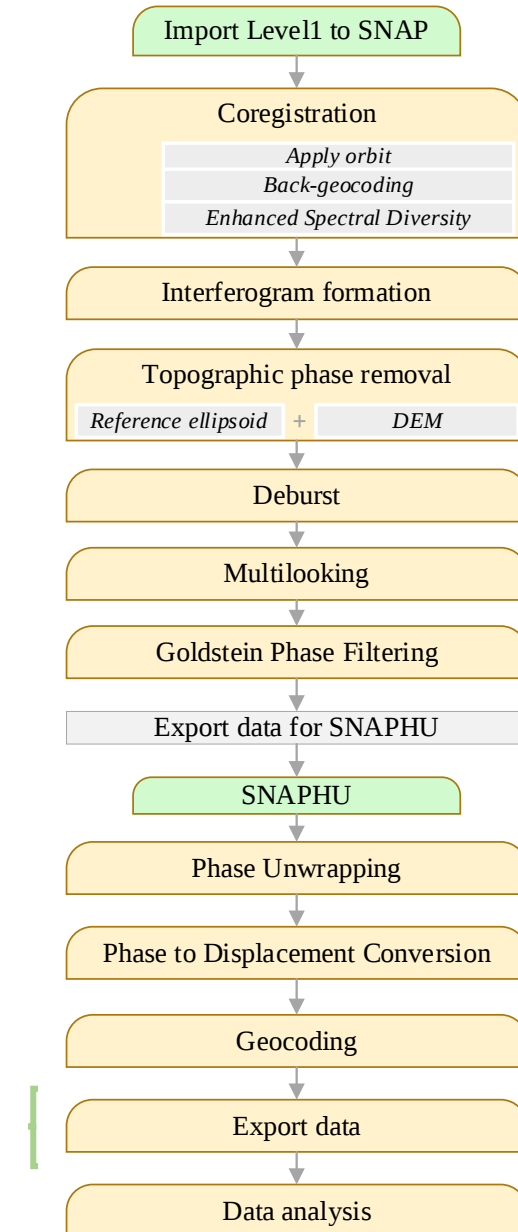
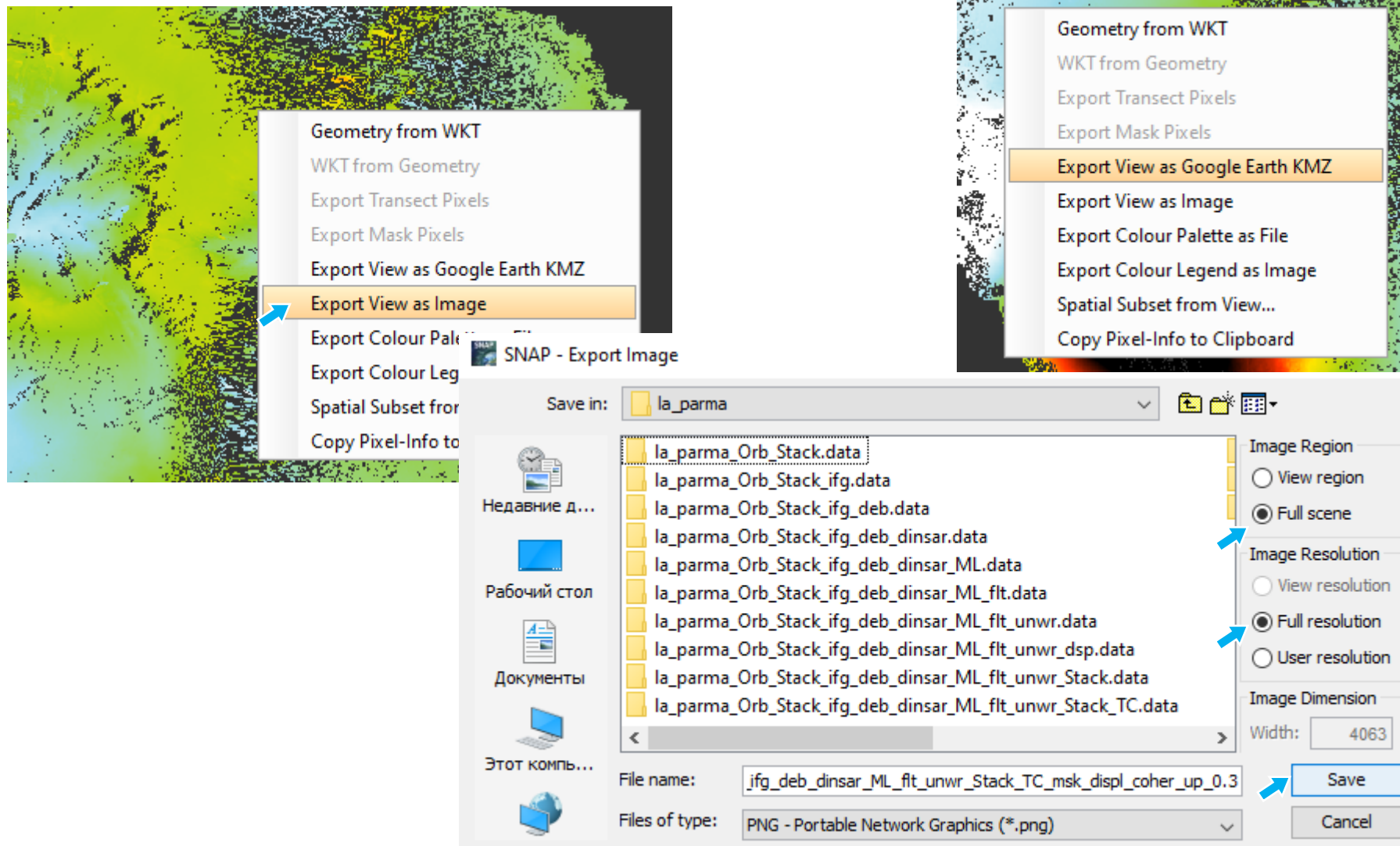


II. Displacement (DInSAR) 2 images

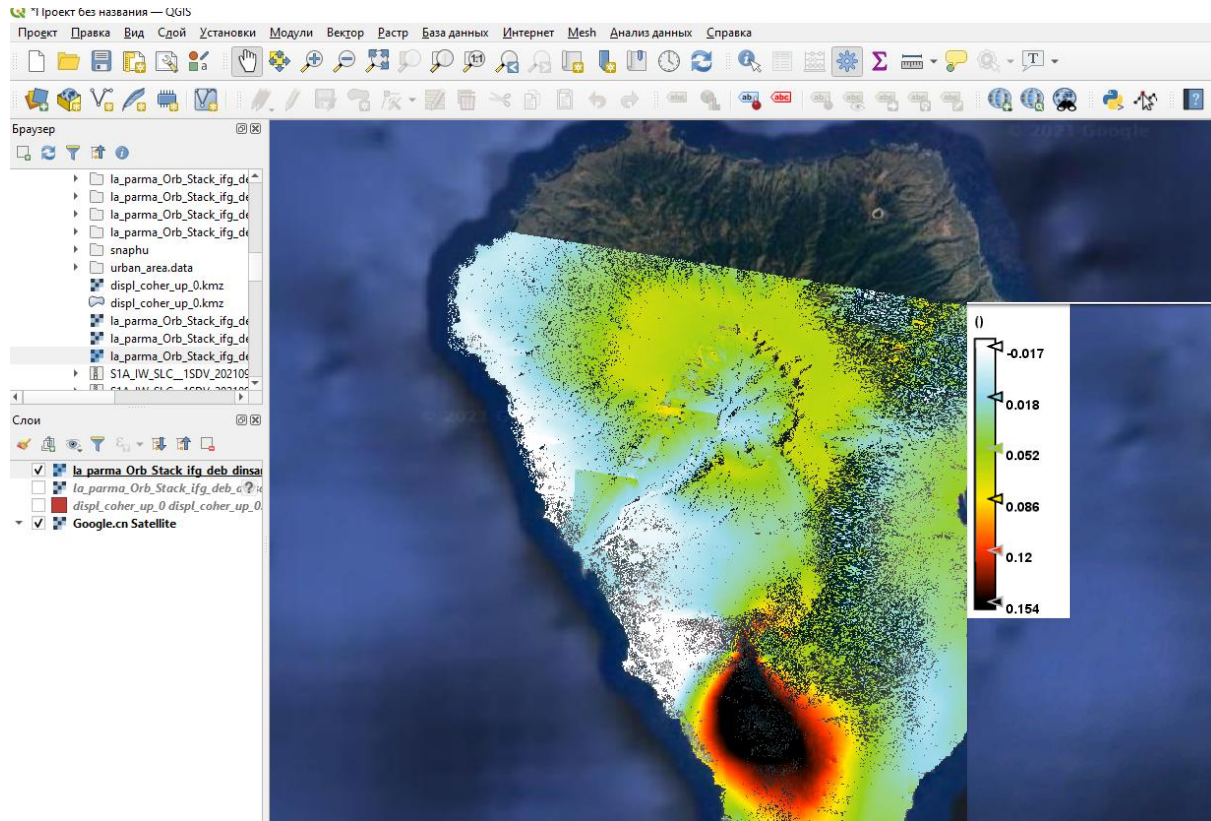
Stage 12. Export data

Variant 2. Menu SNAP

1. Right-click in the view area on your masked and re-colored displacement map



1. Qgis



2. Google Earth

