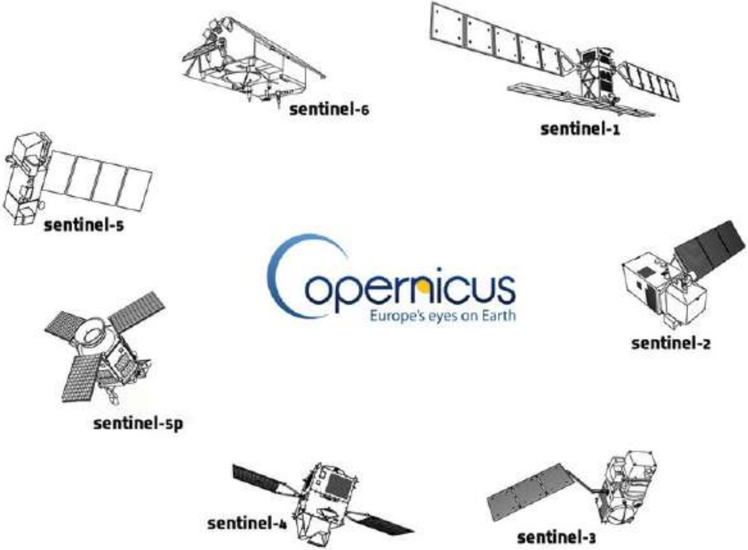
Remote Sensing: brief overview

Alessandro Sebastianelli

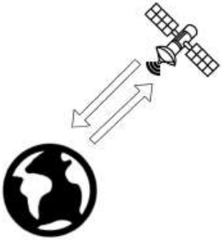
May 2022

Copernicus and its Sentinels



Active vs Passive Sensors

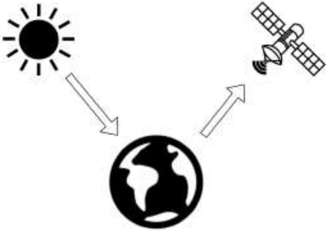
Active Sensor



Sentinel-1

Sentinel-3

Passive Sensor

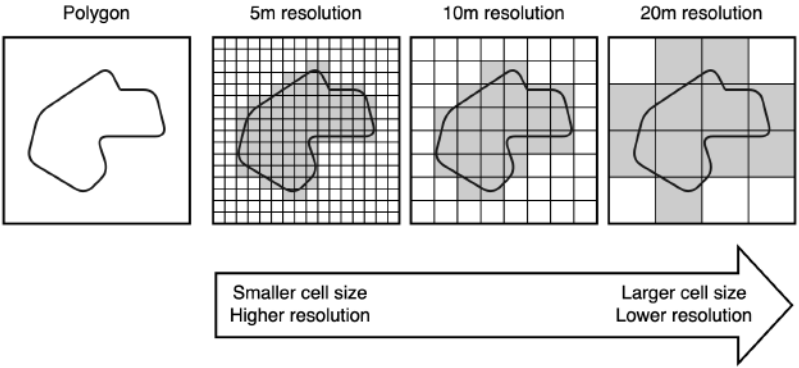


Sentinel-2

Sentinel-5p

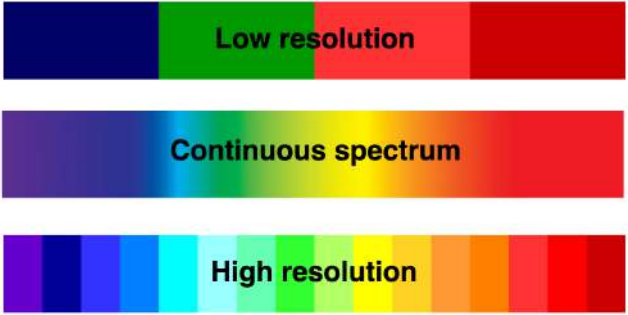
Resolutions (1)

Spatial Resolution: it represents the smallest possible feature thet can be detected. The spatial resolution quantifies the capability to separate two close targets. The pixel size is often considered as spatial resolution. It depends on the design of the sensor, while the pixel size depends on the digital sampling of the signal.



Resolutions (2)

Spectral Resolution: it represents the wavelenght of the different frequency bands recorded. Spectral resolution descbribes the ability of a sensor to define fine wavelenght intervals.



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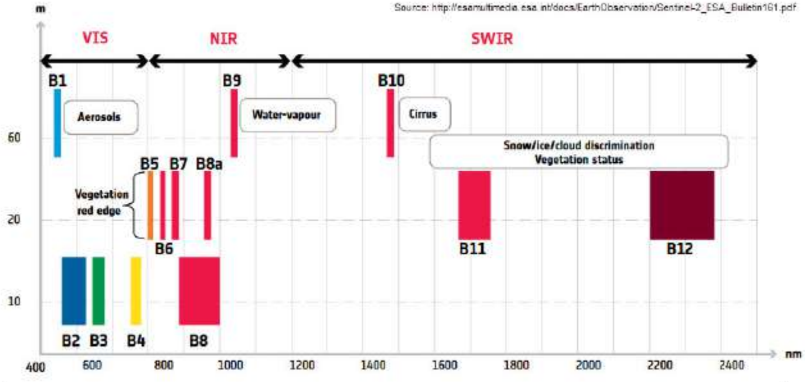
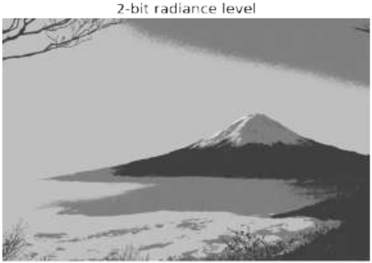


↑ Spatial resolution versus wavelength: Sentinel-2's span of 13 spectral bands, from the visible and the near-infrared to the shortwave infrared at different spatial resolutions ranging from 10 to 60 m on the ground, takes land monitoring to an unprecedented level

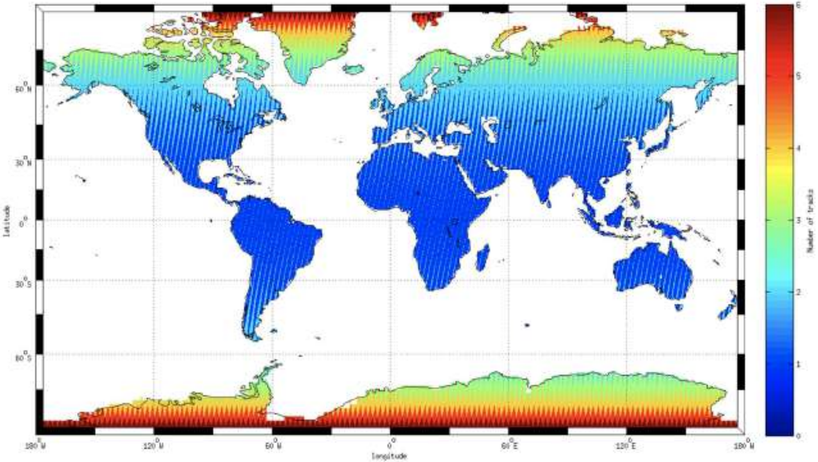
Resolutions (3)

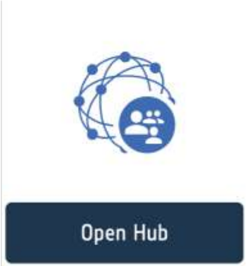
Radiometric Resolution: it refers to the number of different intensities of radiation the sensor is able to distinguish. The greater the radiometric resolution, the more accurate the sensed image will be.



Resolutions (4)

Temporal Resolution: is the frequency of flyovers by the satellite. This resolution can become relevant in time series studies or those requiring an averaged or mosaic image (e.g. change detection, deforestation monitoring)



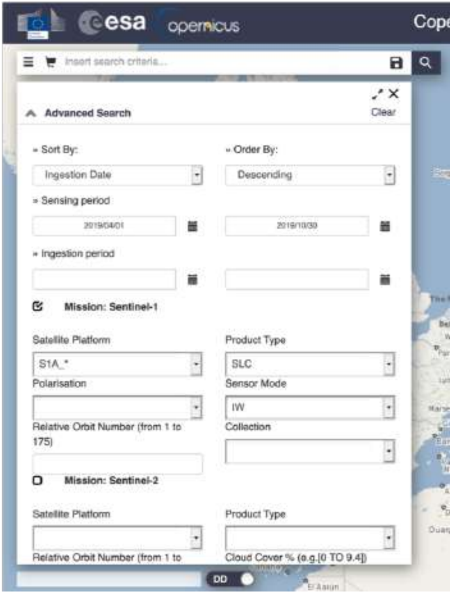


Copernicus Open Access Hub

https://scihub.copernicus.eu/dhus/#/home

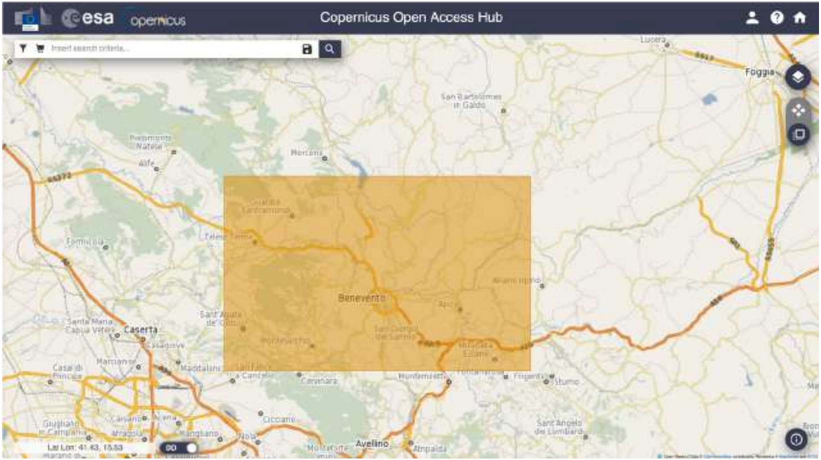
Main Page

Set parameters

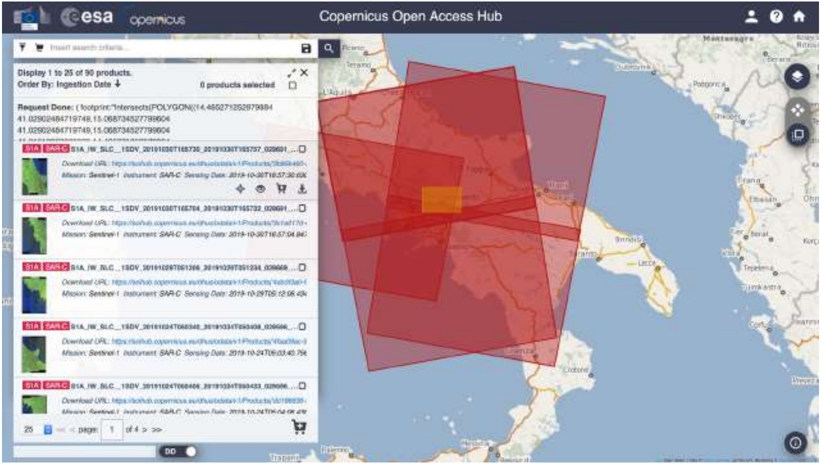


- Mission
- Platform
- Sensing Period (start and end date)
- Product type
- Acquisition mode

Select the AOI (Area Of Interest) (1)



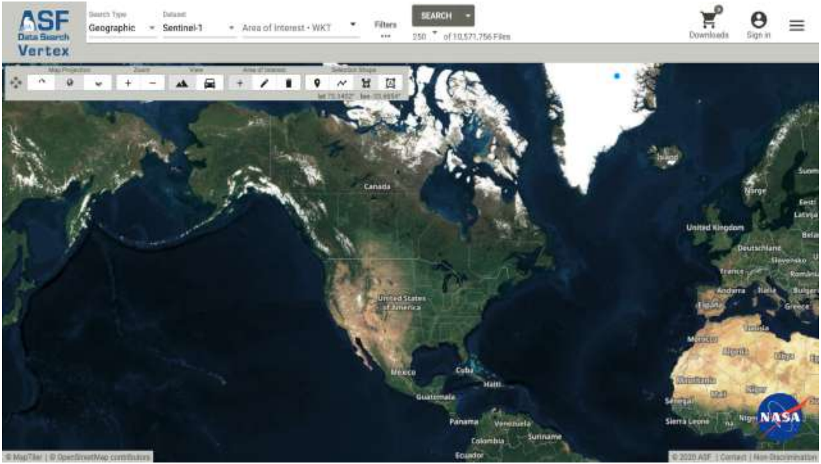
Select the AOI (Area Of Interest) (2)



Alaska Satellite Facility

https://search.asf.alaska.edu/#/

Main Page


ASF
Data Search
Vertex
Search Type
Geographic
Dataset
Sentinel-1
Area of Interest - WKT
Filters
SEARCH
250
of 10,571,756 Files
Downloads
Sign in
Canada
United States of America
Mexico
Cuba
Haiti
Guatemala
Panama
Venezuela
Colombia
Suriname
Ecuador
United Kingdom
Deutschland
France
España
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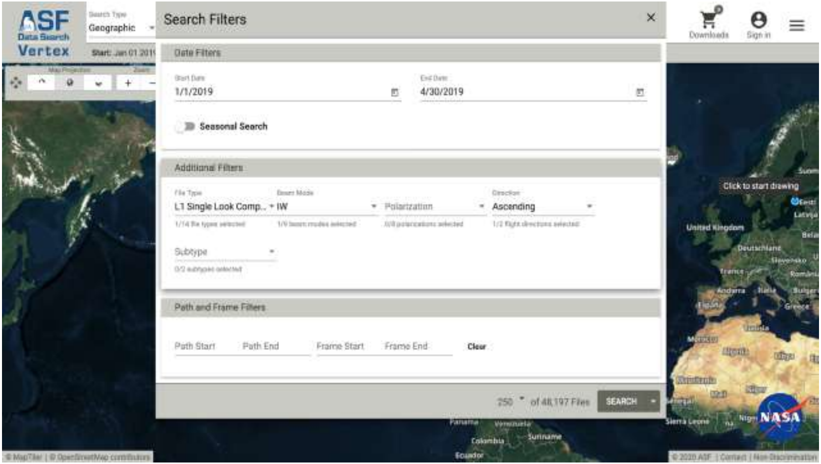
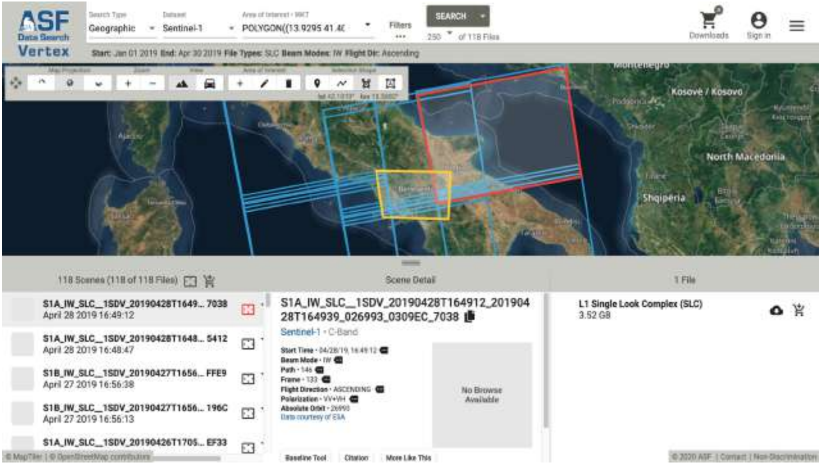
Set parameters



Select the AOI (Area Of Interest)

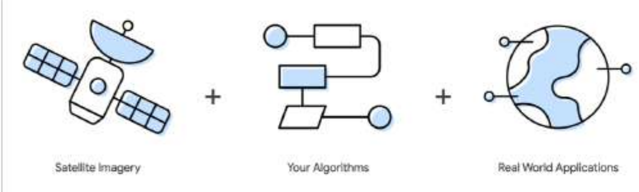


Google Earth Engine

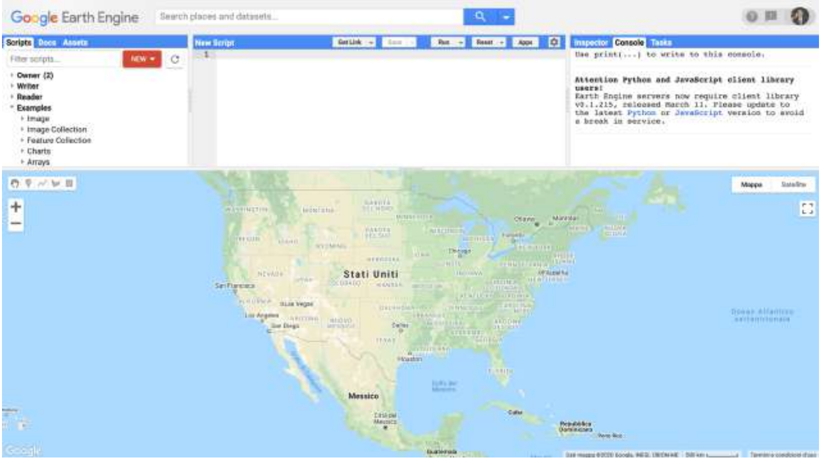
https://code.earthengine.google.com/

Google Earth Engine

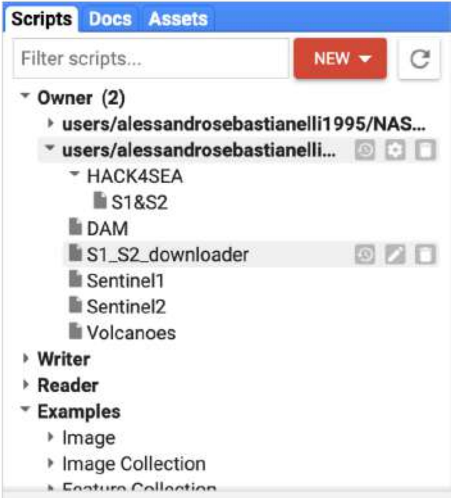
Google Earth Engine combines a multi-petabyte catalog of satellite imagery and geospatial datasets with planetary-scale analysis capabilities. Scientists, researchers, and developers use Earth Engine to detect changes, map trends, and quantify differences on the Earth's surface. Earth Engine is now available for commercial use, and remains free for academic and research use.



Main Page


Google Earth Engine
Search places and datasets...
Scripts Docs Assets
Filter scripts...
NEW
Owner (2)
Writer
Reader
Examples
Image
Image Collection
Feature Collection
Charts
Arrays
New Script
Get Link
Run
Reset
Apps
Inspector Console Tasks
Use print(...) to write to this console.
Attention Python and JavaScript client library users!
Earth Engine servers now require client library v0.1.215, released March 11. Please update to the latest Python or JavaScript version to avoid a break in service.
Mappa
Satellite
Stati Uniti
Messico

GEE Components (1)



Scripts

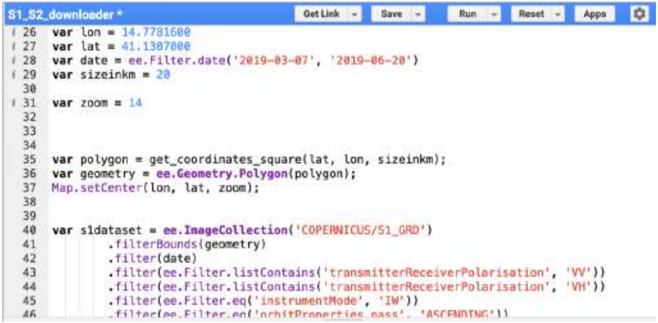
- Examples
- User code

Docs

- Code documentation

GEE Components (2)

The **code editor** allows to write and execute GEE code. GEE is based on Javascript, adpated properly to the platform. There exists also a Python API with the same functionalities, but it can be used olny outside the web app.



GEE Components (3)

Console

- Terminal used to monitor activities, to print variables and to debug code

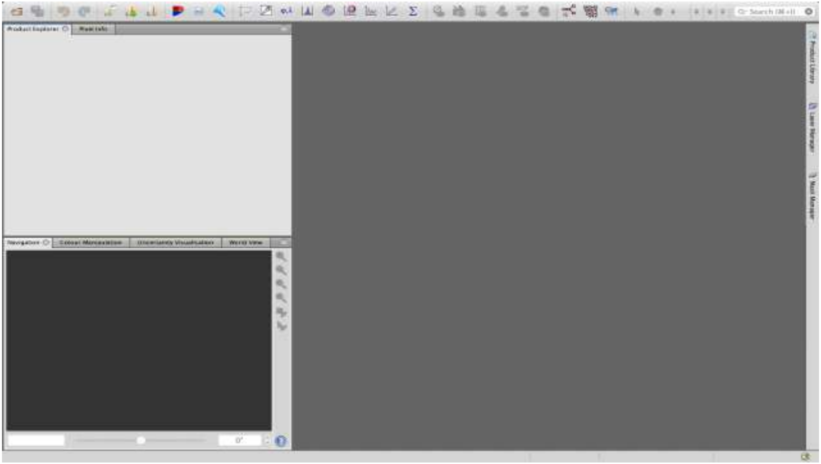
Tasks

- It allows to monitor or to start tasks (e.g. download data)

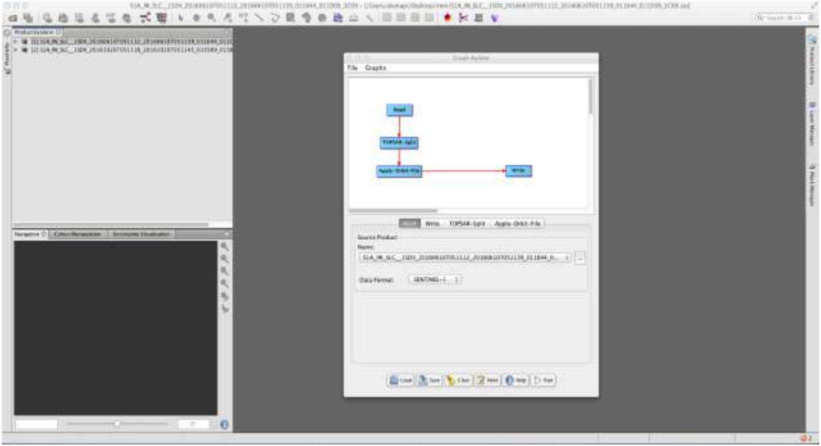
Sentinel Application Platform

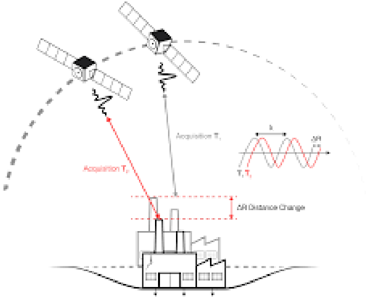
https://step.esa.int/main/download/

Main Page



Use functions

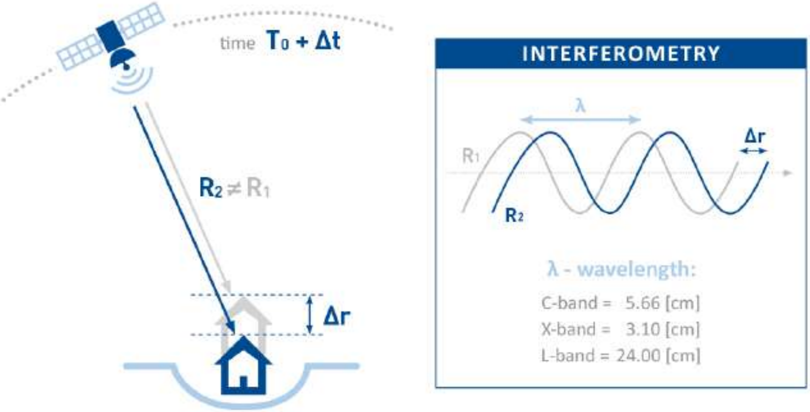




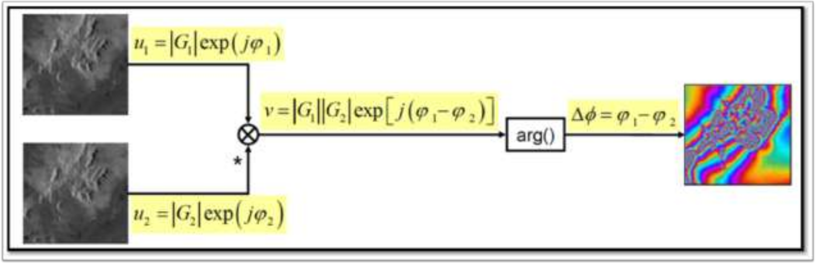
DInSAR: Differential Interferometric Synthetic Aperture Radar

SAR vs Optical

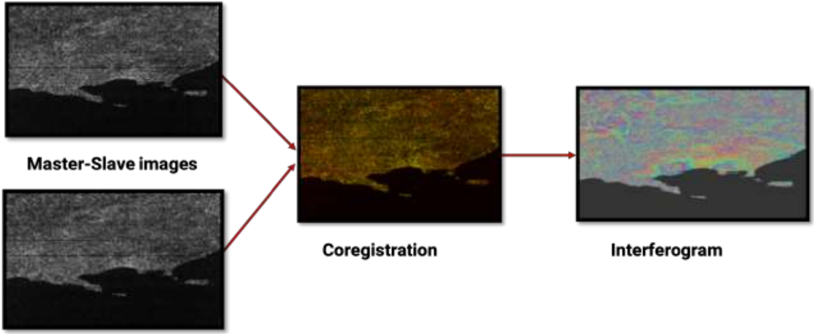
DInSAR (1)


time $T_0 + \Delta t$
$R_2 \neq R_1$
Δr
INTERFEROMETRY
λ
Δr
R_1
R_2
λ - wavelength:
C-band = 5.66 [cm]
X-band = 3.10 [cm]
L-band = 24.00 [cm]

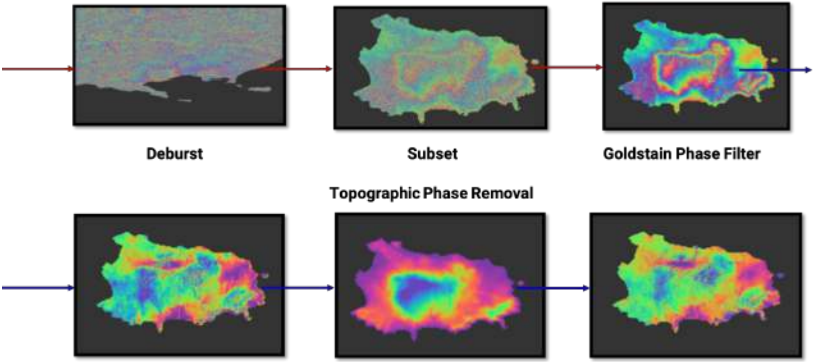
DInSAR (2)


$u_1 = |G_1| \exp(j\varphi_1)$
$u_2 = |G_2| \exp(j\varphi_2)$
*
$v = |G_1||G_2| \exp[j(\varphi_1 - \varphi_2)]$
arg()
$\Delta\phi = \varphi_1 - \varphi_2$

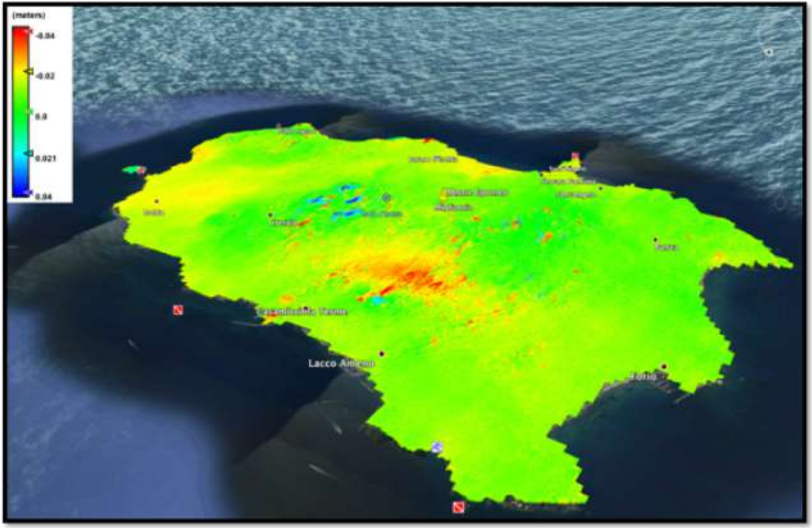
DInSAR (3)



DInSAR (4)


Deburst
Subset
Goldstain Phase Filter
Topographic Phase Removal

DInSAR (5)



Assignments

Assignment 1

- Register on Open Access Hub
- Donwload a Sentinel-2 image
- Open the image on SNAP or on QGIS

Assignment 2

- Register on Google Earth Engine
- Copy the code at `https://github.com/Sebbyraft/GoogleEarthEngine/blob/master/sentinel_1_and_2_downloader.js`
- Paste the code in a new script on GEE
- Save the script and run it
- Change size in Km to change the size of the image
- Chage the date
- Change lat and lon to change the geographical position
- Start the tasks for 1 Sentinel-1 and 1 Sentinel-2 image
- Download the date from Google Drive
- Open the images in SNAP or QGIS