





Common borders. Common solutions.

Assessment on dynamics of coastline changes - Theory and hands-on experience

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Introduction to coastal erosion







Introduction to Coastal Erosion



- Coastal erosion is one of the highly growing environmental concerns faced by coastal communities
- It is aggravated by the prospect of accelerated sea level rise due to climate change and accumulated negative effects of mismanagement practices
- Over the past 100 years about 70% of the world's sandy shorelines have been retreating due to coastal erosion, while currently around 20% of EU coastline is eroding



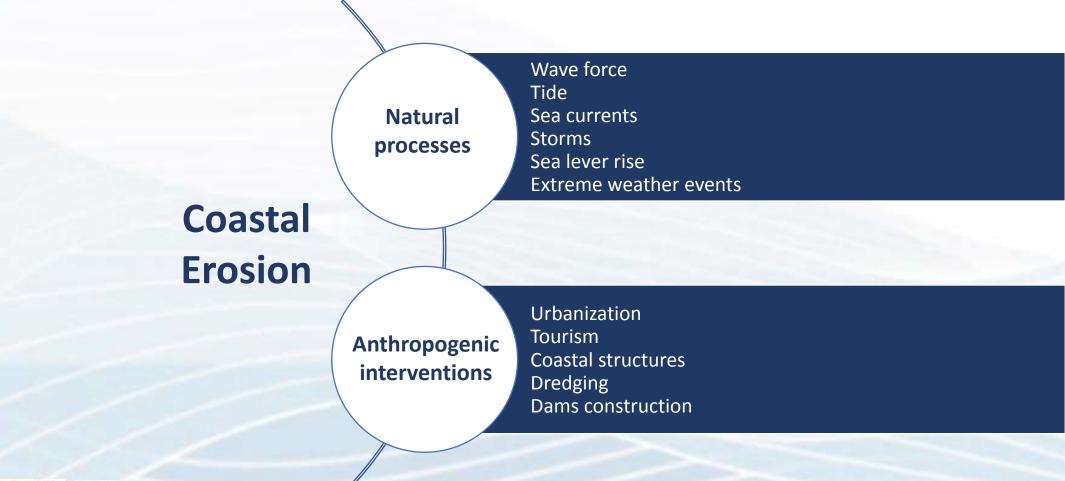






Indicative factors affecting coastal erosion











Coastal Erosion/Deposition



Historical images from Google Earth Pro







2003 2013 2019







Coastal Erosion/Deposition













How do we study erosion?

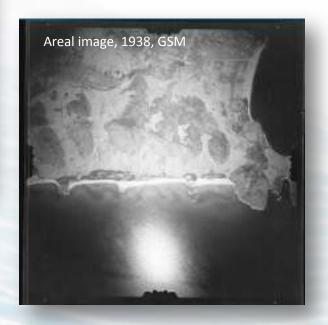


By processing, analyzing and comparing historical data such as:

- ✔ Areal Images
- **✔** Topographic maps
- ✓ Other historical maps
- ✓ In-situ measurements

















Introduction to Remote Sensing







Satellite sensors characteristics



Spatial Resolution

The spatial resolution specifies the pixel size of satellite images covering the Earth surface.

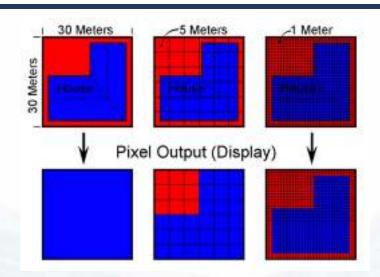
Temporal Resolution

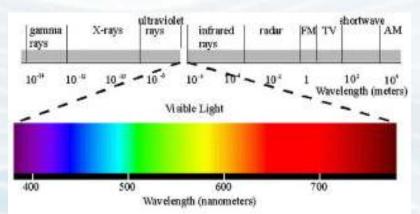
The temporal resolution specifies the revisiting frequency of a satellite sensor for a specific location.

Spectral Resolution

The number of spectral bands in which the sensor can collect reflected radiance.

But also the position of bands in the electromagnetic spectrum.











Satellite image characteristics



| Cloud percentage | Percentage of the image covered by clouds | | | |
|--|--|--|--|--|
| Ground sample distance | The distance in meters between pixel centers measured on the ground | | | |
| Pixel Resolution Pixel resolution of the image in meters | | | | |
| Off-nadir angle | Spacecraft across-track off-nadir viewing angle used for imaging, in degrees ("+" being East and "-" being West) | | | |
| Sun elevation Elevation angle of the sun in degrees (0-90) | | | | |
| Sun azimuth | Angle from the true North to the sun vector projected on the horizontal plane in degrees (0-360) | | | |

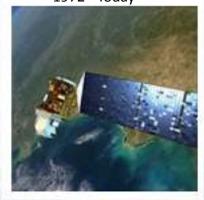




Satellites used in Remote Sensing



Landsat (30 - 15m) 1972 - Today



PlanetScope (3.6m) 2016 – Today



Sentinel 2 (10m)



Kompsat (0.55m) 1999 – Today



RapidEye (5m)

2009 – 2020



WorldView (0.31m) 2007 – Today











Open source databases for satellite images

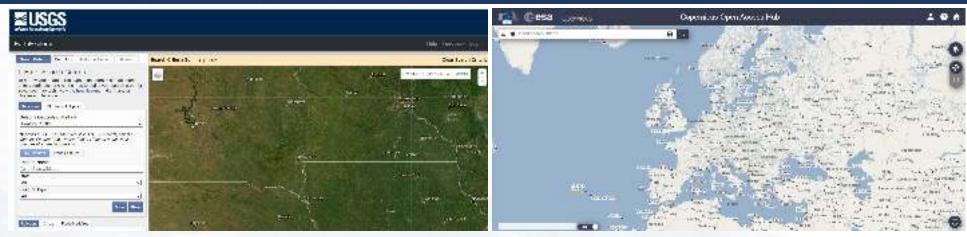












https://earthexplorer.usgs.gov/

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











Open source products

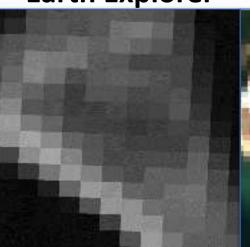


Earth Explorer

Copernicus Hub

Planet Explorer

Planet Explorer









Landsat 5 ETM

- Spatial Res.: 30m
- 1984 2013
- Number of Bands: 7

Landsat 8

- Spatial Res.: 30m
- 2013 Still active
- Number of Bands: 8

Sentinel 2A & 2B

- Spatial Res.: 10, 20, 60m
- 2015 Still active
- Number of Bands: 13
- Number of Sat.: 2

RapidEye

- Spatial Res.: 5 m
- 2009 March 2020
- Number of Bands: 5
- Number of Sat.: 5

PlanetScope

- Spatial Res.: 3.6 m
- 2016 Still active
- Number of Bands: 4
- Number of Sat.: more than 120 optical satellites









Methodology applied in a coastal erosion assessment

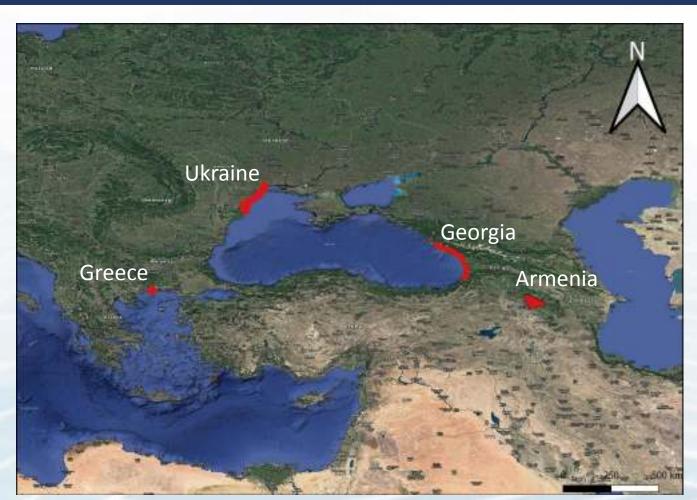






Study sites





- 1. Armenian Study site
- 2. Georgian Study site
- 3. Greek Study site
- 4. Ukrainian Study site







Workflow





- Data list of coastal zone
- List of available satellite images
- In-Situ data

Satellite image selection

(Earth Explorer, Sentinel Hub, Planet Explorer)

- Create an account
- Filter images
- Download historical images

Shoreline extraction

- NDWI, mNDWI Indices
- Image Classification
- Shoreline Extraction
- Historical shorelines extraction

Evaluation of shoreline movement in DSAS

- Transects creation
- Statistics of shoreline movement

- - Very high resolution Satellite image

Validation

• Comparison of the two methods







Data collection



Bathymetry, GEBCO



Seabed slope, GEBCO



River discharge and physicochemical data, E-Hype



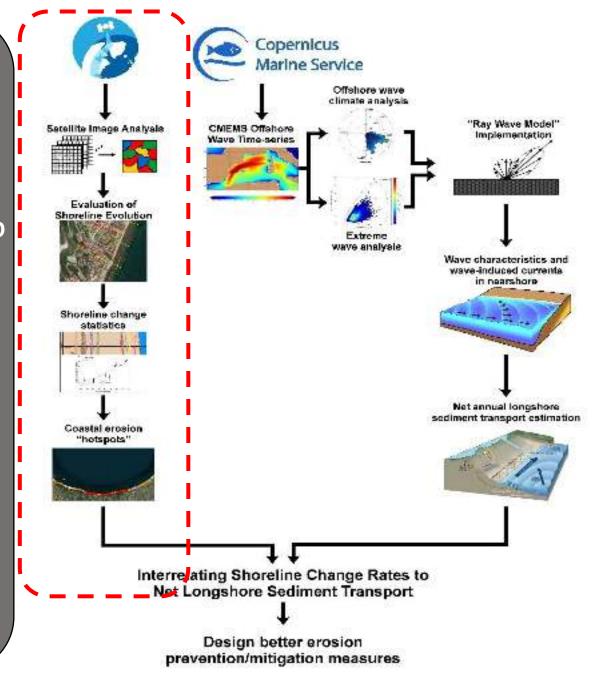
Land use, CORINE 2018



Sea surface currents, CMEMS



Suspended matter, CMEMS



Data list



| No | Data Products | Description | Number of items | Resolution | Period cover | Type of file / Format | Source | Link |
|----|------------------|--|-----------------|---------------------------|-----------------|--------------------------|------------------------------------|---|
| 1 | Landsat 4-5 TM | Historical Satellite images | 5 | 30 m | 1985 to 2015 | Raster (geotiff) | Earth Explorer | https://earthexplorer.usgs.gov/ |
| 2 | Landsat 8 OLI | Historical Satellite image | 1 | 30 m | 2015 | Raster (geotiff) | Earth Explorer | https://earthexplorer.usgs.gov/ |
| 3 | Sentinel 2 | Historical Satellite images | 6 | 10 m | 2015 to 2020 | Raster (.jp2) | Copernicus Open Access | https://scihub.copernicus.eu/ |
| 4 | Bathymetry | Bathymetry | 1 | 0.0625 degrees | | Raster (.png) | EMODnet | https://www.emodnet-bathymetry. eu/ |
| 5 | Seabed Slope | Seabed Slope | 1 | 0.0625 degrees | | Raster (.png) | EMODnet | https://www.emodnet-bathymetry.eu/ |
| 6 | River Discharge | River Discharge data | 3 | Hourly step - time series | 1981 to 2010 | ASCII (.csv) | SMHI HYPEWeb | https://hypeweb.smhi.se |
| 7 | Land Cover | Corine 2018 | 1 | | 2018 | Vector (.shp) | Copernicus Land Monitoring Service | https://land.copernicus.eu/pan-eur opean/corine-land-cover/clc2018 |
| 8 | Seabed Substrate | Seabed Substrate | 1 | 1:1M | - | Vector (.shp) | EMODnet | http://drive.emodnet-geology.eu/g eoserver/gtk/wms |
| 9 | Geology | GISEurope Bedrock and Structural geology | 1 | 1:1.5M | - | Raster (.png) | OneGeology | http://www.onegeology.org/ |









Satellite image selection







Satellite image selection



Image selection should be based on:

- Clarity from cloud cover
- The correct **geo-reference & Orthorectification**
- The seasonality (all images retrieved in the summer months)
- Sea surface height (CMEMS data) / Tidal phase







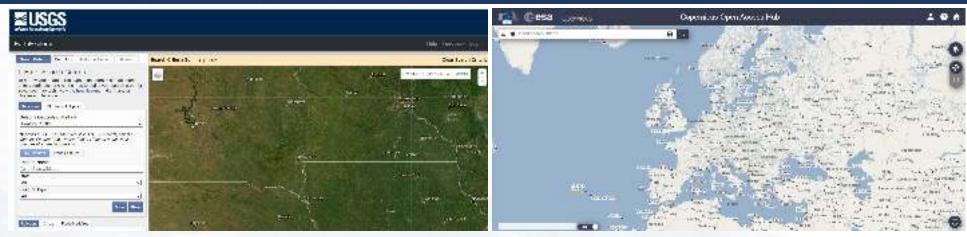




| | | No | Date | Data Products | Resolution | Dataset | Type of file / Format | Index |
|-----------------|----------|----|----------|----------------|------------|-------------------------|-----------------------|-------|
| | | 1 | 23-08-85 | Landsat 4-5 TM | 30 m | TM Collection 2 Level-1 | .TIF | NDWI |
| | | 2 | 19-08-90 | Landsat 4-5 TM | 30 m | TM Collection 2 Level-1 | .TIF | NDWI |
| | | 3 | 31-07-95 | Landsat 4-5 TM | 30 m | TM Collection 2 Level-1 | .TIF | NDWI |
| 1985 - 2015 | \dashv | 4 | 16-08-00 | Landsat 4-5 TM | 30 m | TM Collection 2 Level-1 | .TIF | NDWI |
| | | 5 | 29-07-05 | Landsat 4-5 TM | 30 m | TM Collection 2 Level-1 | .TIF | NDWI |
| | | 6 | 12-08-10 | Landsat 4-5 TM | 30 m | TM Collection 2 Level-1 | .TIF | NDWI |
| | | 7 | 09-07-15 | Landsat 8 OLI | 30 m | OLI collection Level-1 | .TIF | NDWI |
| | | 9 | 25-08-15 | Sentinel 2B | 10 m | Sentinel-2 mission | .JP2 | NDWI |
| | | 10 | 10-07-16 | Sentinel 2B | 10 m | Sentinel-2 mission | .JP2 | NDWI |
| 2015 - 2020 | | 11 | 30-07-17 | Sentinel 2B | 10 m | Sentinel-2 mission | .JP2 | NDWI |
| 2013 - 2020 | | 12 | 14-08-18 | Sentinel 2B | 10 m | Sentinel-2 mission | .JP2 | NDWI |
| | | 13 | 14-08-19 | Sentinel 2B | 10 m | Sentinel-2 mission | .JP2 | NDWI |
| Black 200 | L | 14 | 28-08-20 | Sentinel 2B | 10 m | Sentinel-2 mission | .JP2 | NDWI |
| tiges to the be | | | | | | | | |







https://earthexplorer.usgs.gov/

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















https://sentinel.esa.int/web/sentinel/sentinel-data-access











Practical Session 1 Earth Explorer, Planet Explorer, Copernicus Open Access Hub







Browse Earth Explorer



Create an Account





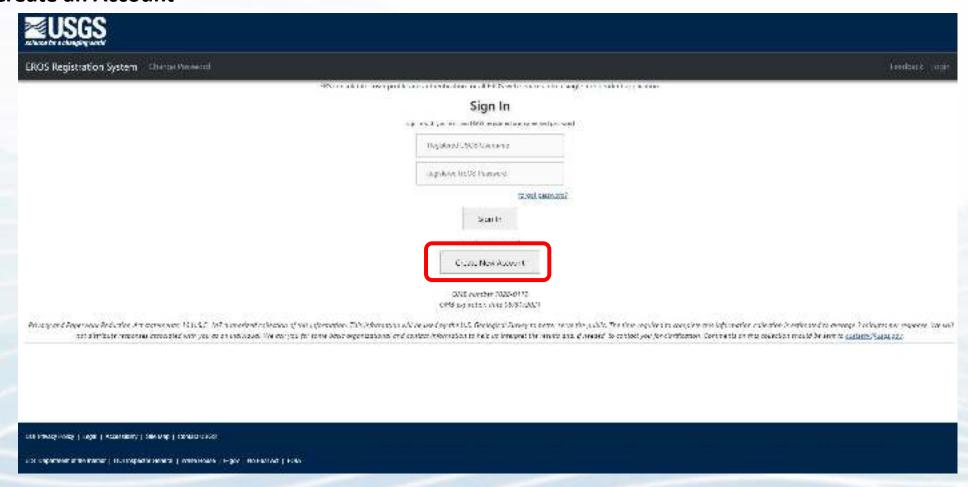






Browse Earth Explorer

Create an Account





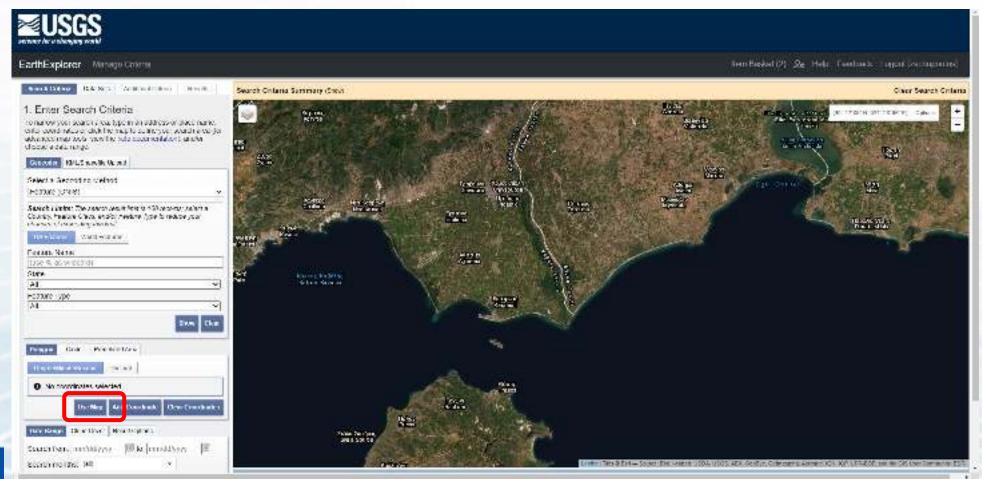








Select Area of Interest













Define the time period





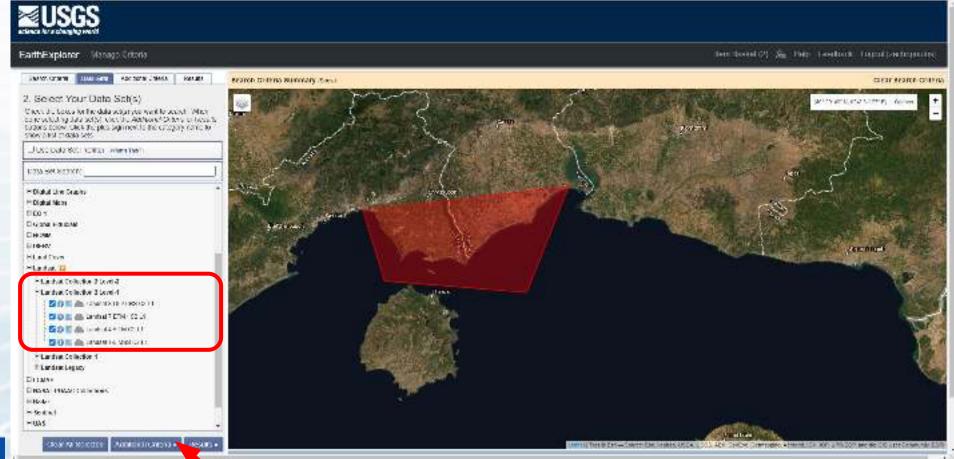








Select Landsat Data Set





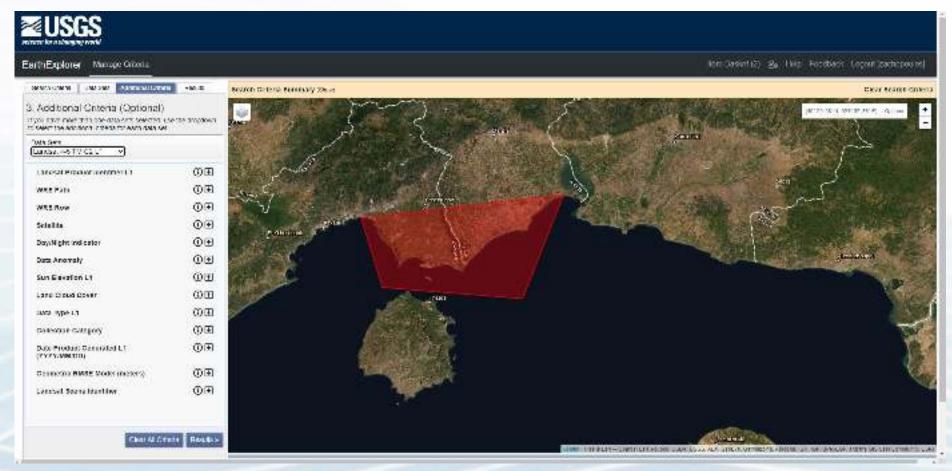








Additional criteria





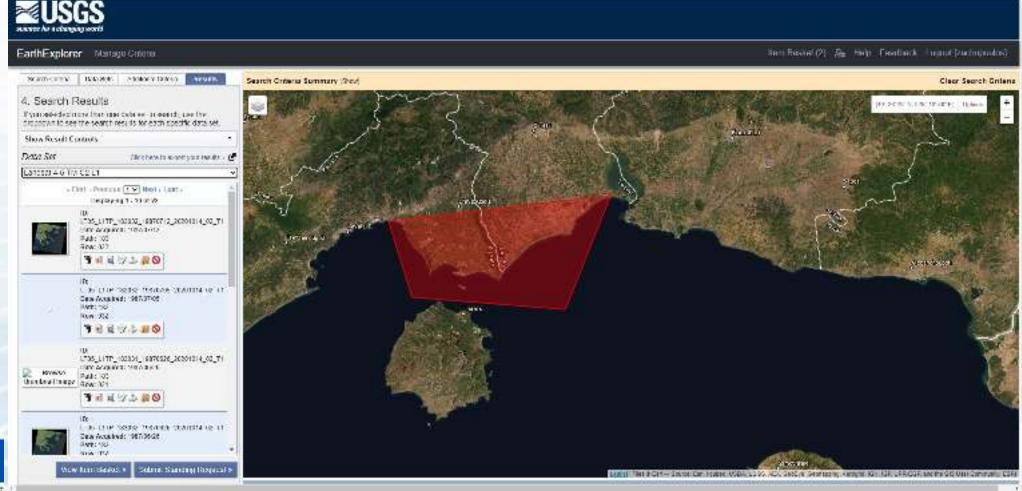




Landsat Historical images selection



Choose Landsat Data Set





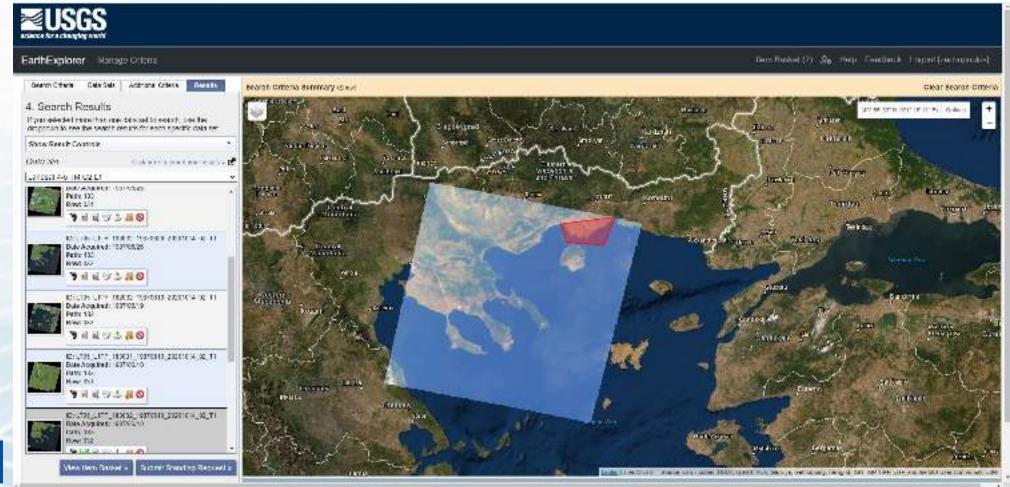




Download Satellite Image



image selection





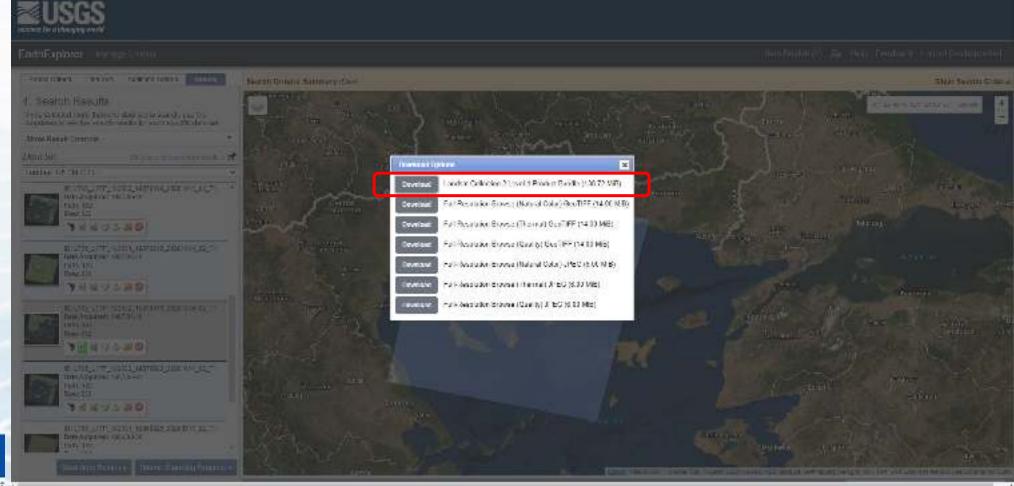




Download Satellite Image



Download image









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ET05_L1TP_183032_19870610_20170212_01_T1.zip

15-Oct-18 12:49 PM

WinRAR ZIP archive

4,530 KB



LT05_L1TP_183032_19870610_20170212_01_T1

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100212-01-11

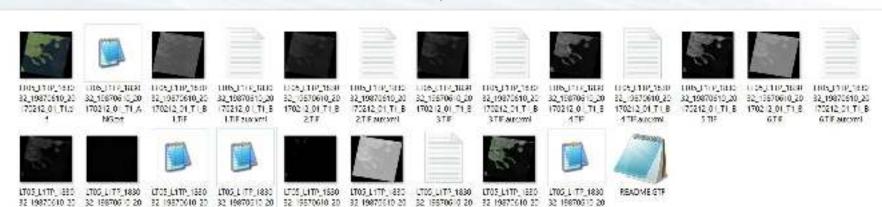
170212-01-11-1

15-Oct-18 1:13 PM

180202 00: 11 32

File folder













Copernicus Open Access Hub







Copernicus Open Access Hub



https://scihub.copernicus.eu/



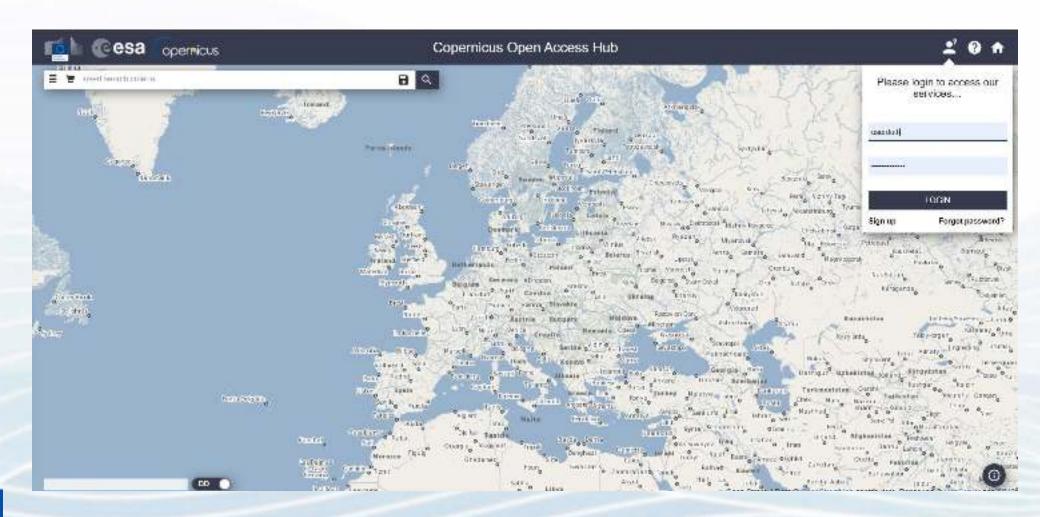






Register in Copernicus Open Access Hub











Region of interest





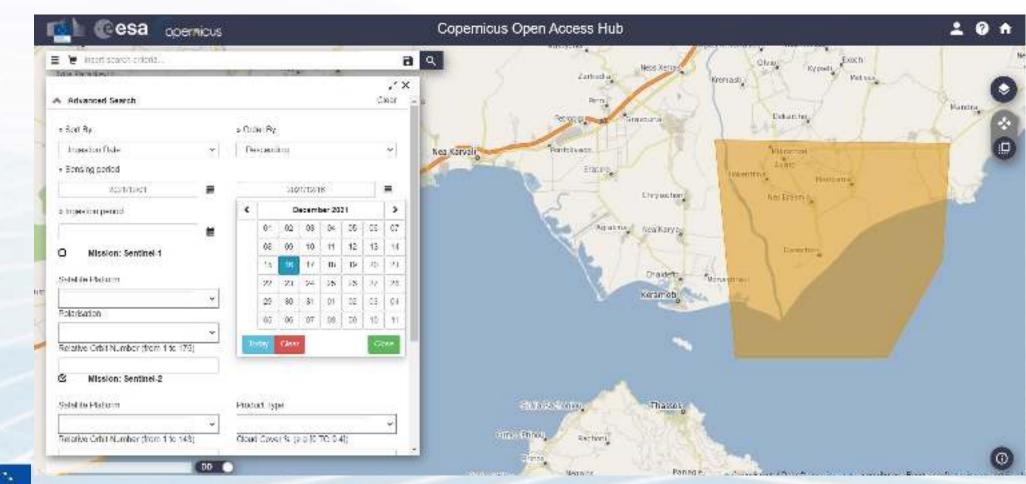












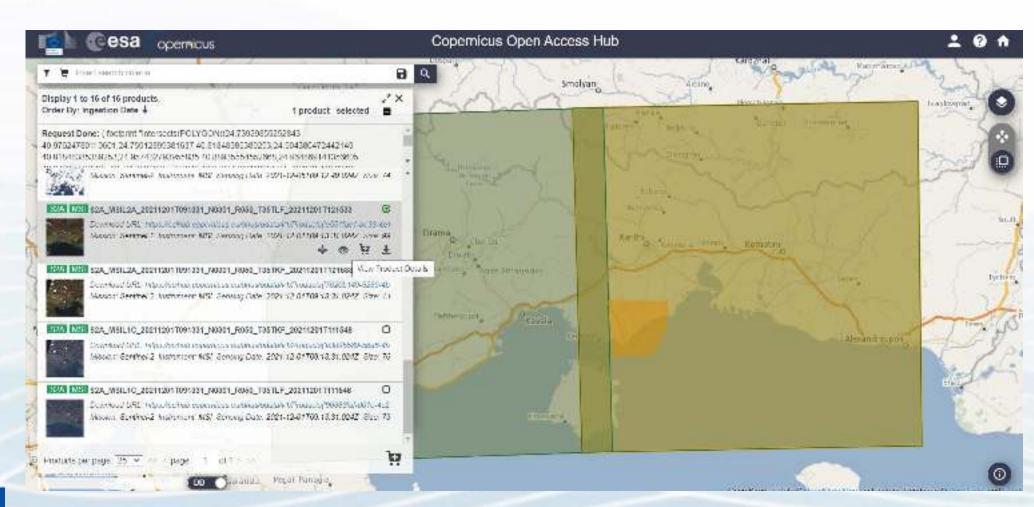






Satellite image selection





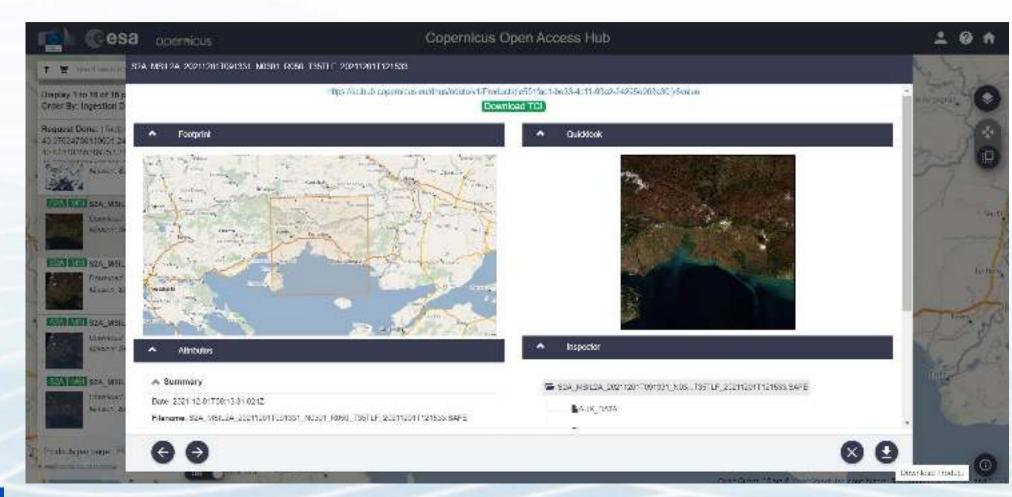






Download Satellite Image





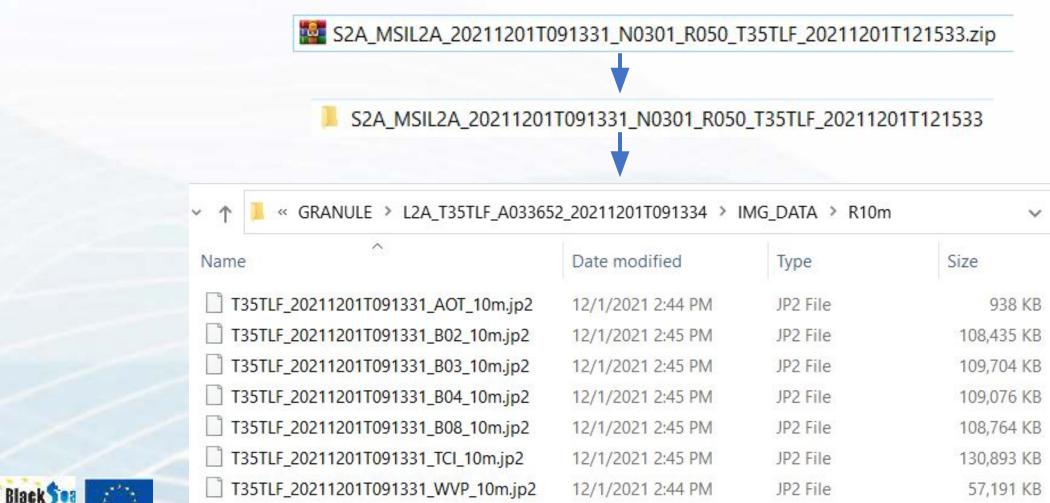






Downloaded file













QGIS Download







QGIS Download



https://www.qgis.org/en/site/











Semi Automatic Classification plug-in



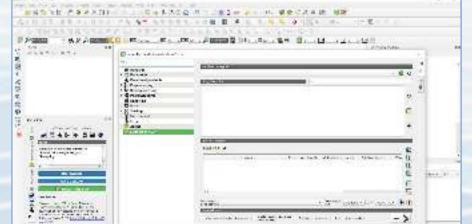




SCP tool in QGIS







the same Real areas, a larger on the course of the constraint &







Supervised Classification



Semi-automatic classification (Supervised Classification) is an image processing technique that identifies the pixels of an image according to their spectral identity (spectral ID).

Training Areas - Regions of Interest (ROIs)

