



Common borders. Common solutions.

PONTOS VIRTUAL TRAINING MODULES

December 2022

[PONTOS-EU.AUA.AM](https://pontos-eu.aua.am)

AUA ACOPIAN CENTER
for the ENVIRONMENT



CERTH
CENTRE FOR
RESEARCH & TECHNOLOGY
HELLAS



ΔΗΜΟΚΡΙΤΕΙΟ
ΑΝΕΡΓΙΣΤΗΜΙΟ
ΘΡΑΚΗΣ | DEMOCRITI
UNIVERSITY
OF THRACE



**GREEN
ALTERNATIVE**





Common borders. Common solutions.

Module 6

The Application of Earth Observation: Agricultural Water Balance, Water Productivity & Water Stress Indices with the Example of Assessments via PONTOS Platform



Common borders. Common solutions.

Responsible Partner - Democritus University of Thrace

Supporting Partner - Centre for Research and Technology, Hellas

Slides and scripts prepared by - PhD Ioannis D. Tsakmakis, Dr Nikolaos T. Kokkos, Prof Georgios K. Sylaios

Contact Information - itsakmak@env.duth.gr

This module is developed in the frames of the BSB 889 PONTOS Project



Project funded by
EUROPEAN UNION



Common borders. Common solutions.

LEARNING OBJECTIVES OF MODULE 6

Familiarize with satellite images characteristics

Introduction to vegetation indices - Normalized Difference Vegetation Index (NDVI)

Brief to NDVI calculation tools based on Sentinel 2 imagery

NDVI utilization as a crop model calibration/validation index

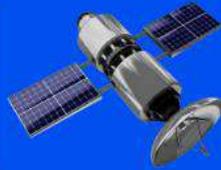


Project funded by
EUROPEAN UNION

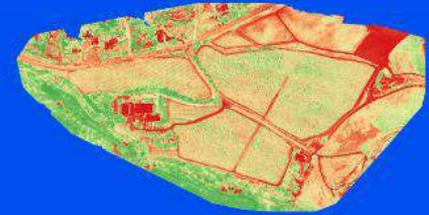


Common borders. Common solutions.

MODULE STRUCTURE



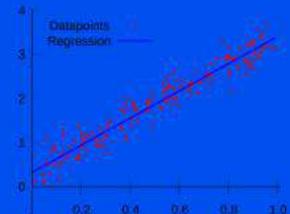
Part 1: Introduction to satellite images characteristics and vegetation indices



Part 2: NDVI calculation via QGIS geographic information system application



Part 3: NDVI as a crop model calibration/validation index





Project funded by
EUROPEAN UNION



Common borders. Common solutions.

PART 1

Common borders. Common solutions.

Introduction to satellite images characteristics

Spatial Resolution

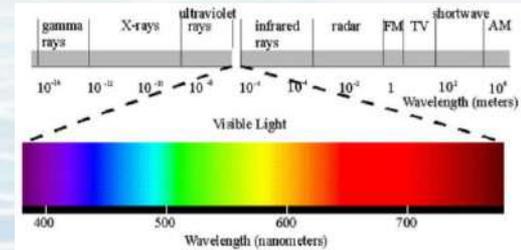
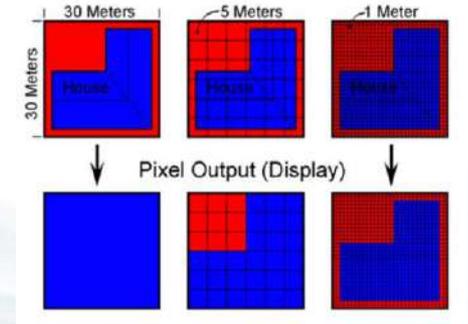
The spatial resolution specifies a satellite's image pixel size on the ground.

Temporal Resolution

The amount of time needed by a satellite to revisit and acquire data for the exact same location.

Spectral Bands

The number of spectral bands that the satellite mounted sensor(s) can capture.



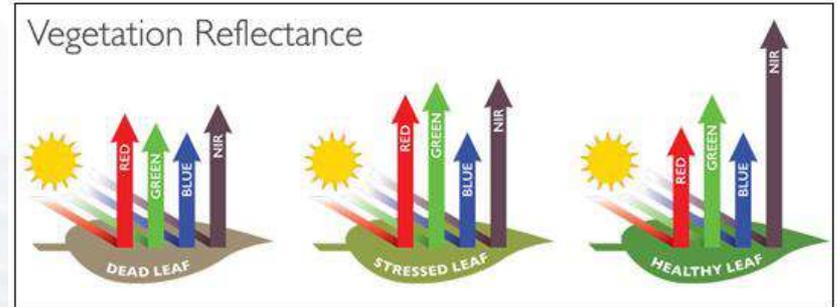


Project funded by
EUROPEAN UNION



Common borders. Common solutions. Introduction to Vegetation Indices

- o Healthy plants absorb strongly **red** and **blue** wavelengths during photosynthesis to create chlorophyll.
- o A healthy plant reflects the largest portion of the incident near infrared radiation.
- o **Vegetation Index (VI)** is a single value derived by the transformation of two or more spectral bands.
- o VIs are designed to allow the remote assessment of plants photosynthetic activity and canopy structural variations.





Project funded by
EUROPEAN UNION

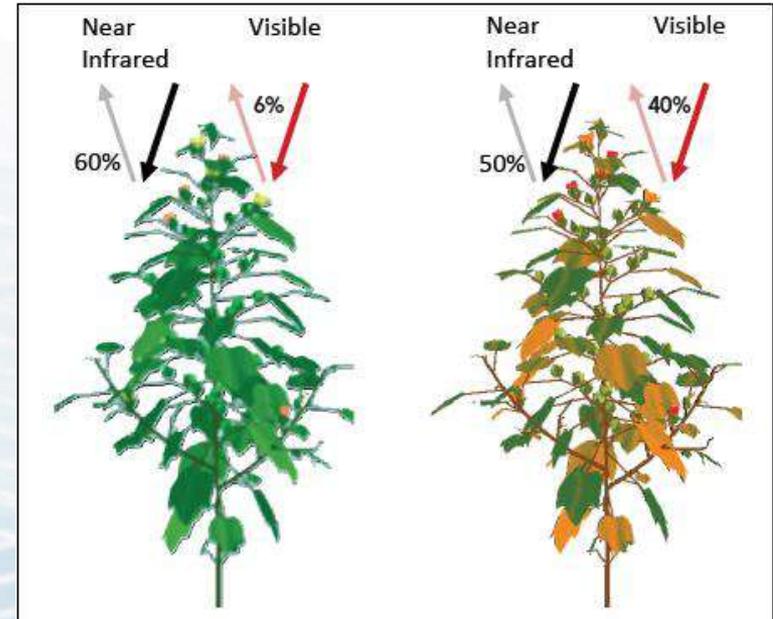


Common borders. Common solutions.

Introduction to Normalized Difference Vegetation Index (NDVI)

- o **Normalized Difference Vegetation Index (NDVI)** is a single graphical indicator that can be used to assess the plants health status and the development of their canopy cover.
- o It is defined as the ratio between the difference of the reflectance in near infrared and red against the sum of the reflectance in near infrared and red.

$$NDVI = \frac{NIR - RED}{NIR + RED}$$





Project funded by
EUROPEAN UNION



Common borders. Common solutions.

PART 2



Project funded by
EUROPEAN UNION



Common borders. Common solutions.

Installing QGIS geographical information software

- o Open the following url in a browser:

<https://www.qgis.org/en/site/forusers/download.html>

- o Choose the installation file that corresponds to your operating system (it is highly recommended to choose the long term release).
- o Once the download is completed install the QGIS in your system by double clicking on the downloaded executable file.

INSTALLATION DOWNLOADS ALL RELEASES SOURCES

Download for Windows

QGIS in OSGeo4W (recommended for regular users):

 [OSGeo4W Network installer](#) if

In the installer choose **Express Install** and select **QGIS** to install the latest release or **QGIS LTR** to install the long term release. The express installations have several optional packages including non-free software. To avoid those you have to use the **Advanced Install** and choose **qgis** and/or **qgis-ltr** in the desktop section.

CAUTION: Upgrades of old setups from OSGeo4W v11 using this repository are not supported. You need to do a fresh install or use a different directory.
CAUTION: 32 bit binaries are not produced anymore. Also Windows 7 no longer works as we are now using Python 3.5, which dropped support for it.

Standalone installers (MSI) from OSGeo4W packages (recommended for new users)

Latest release (nearest on features):

 [QGIS Standalone Installer Version 3.24](#) if

 [QGIS Standalone Installer Version 3.22](#) if

Long term release (most stable):

 [QGIS Standalone Installer Version 3.22](#) if

Note that the MSI installers are much bigger than the previous installers. This is because they include significant larger packages (eg PROJ 8). The main reason for the switch to MSI were the size limits previously used NSIS has, which was blocking updates of dependencies.

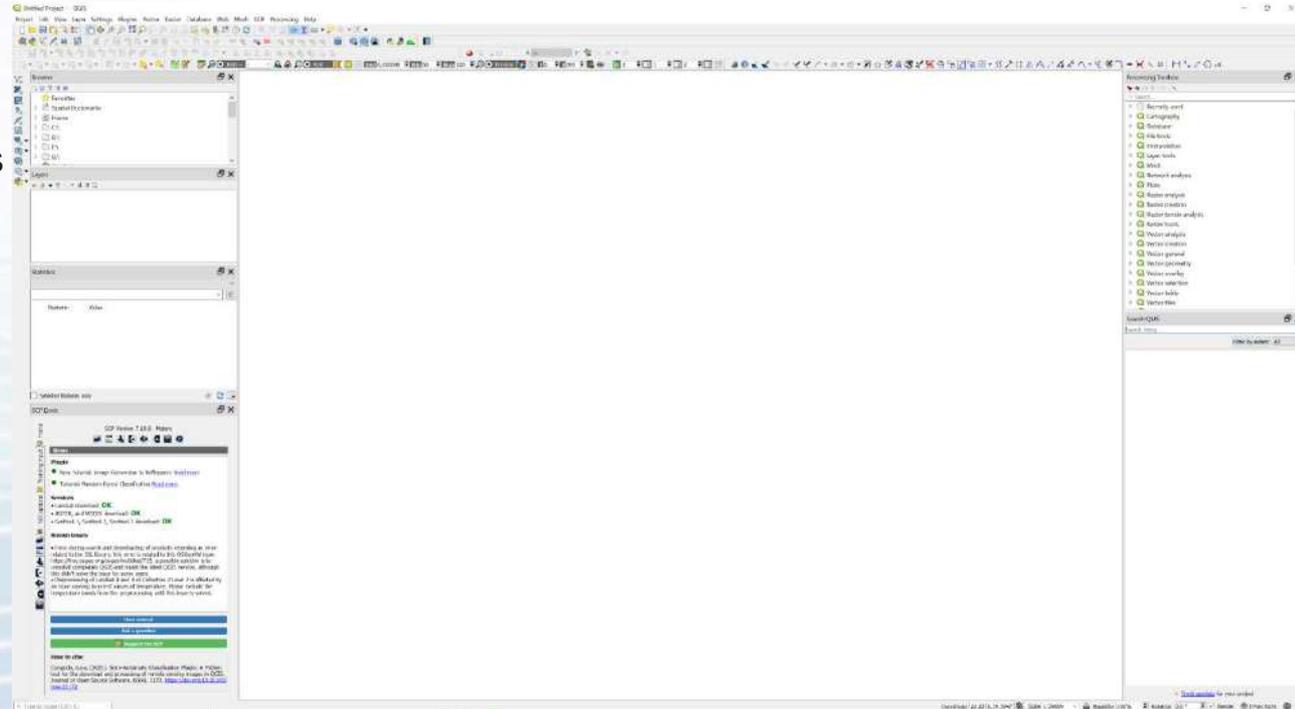


Project funded by
EUROPEAN UNION



Common borders. Common solutions. Getting started ...

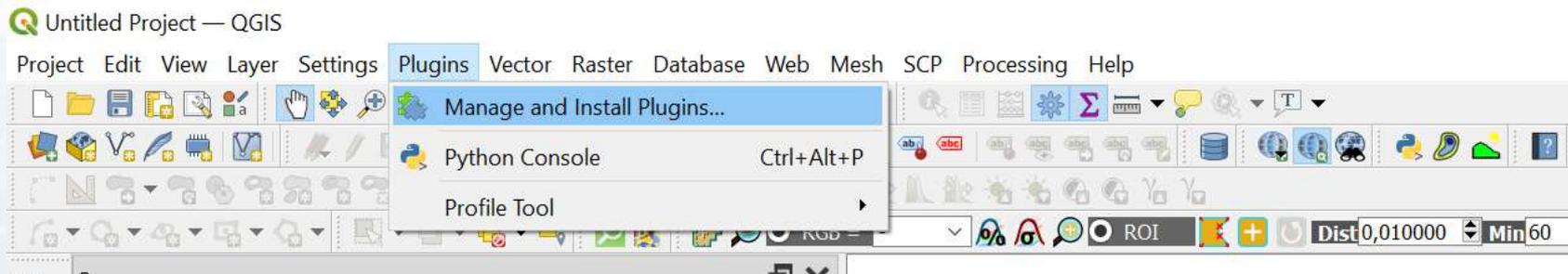
- Open QGIS by:
 - pressing the windows key, typing *qgis* and press the Enter button
 - or double clicking on QGIS desktop shortcut.
- The QGIS user interface is initialized with zero layers loaded by default.



Common borders. Common solutions.

Installation of Semi-Automatic Classification Plugin (SCP)

- o From *Plugins* dropdown menu select *Manage and Install Plugins...*





Project funded by
EUROPEAN UNION



Common borders. Common solutions.

Installation of Semi-Automatic Classification Plugin (SCP)

- o From the pop up window select *All* and successively type *Semi-Automatic Classification Plugin* in the search bar and hit Enter button.
- o In the results menu appears the plugin latest release. By clicking on it, the latest version number and general info about the plugin appear.
- o Click on the *Install Plugin* button

The screenshot shows the QGIS Plugins Manager interface. On the left, the 'All' filter is selected, and the search results list the 'Semi-Automatic Classification Plugin' with version 7.10.6. The right pane displays the plugin's details, including its description, category (Raster), tags, author (Luca Congeddu), and a detailed changelog. The 'Uninstall Plugin' button is highlighted in red at the bottom right of the plugin details pane.



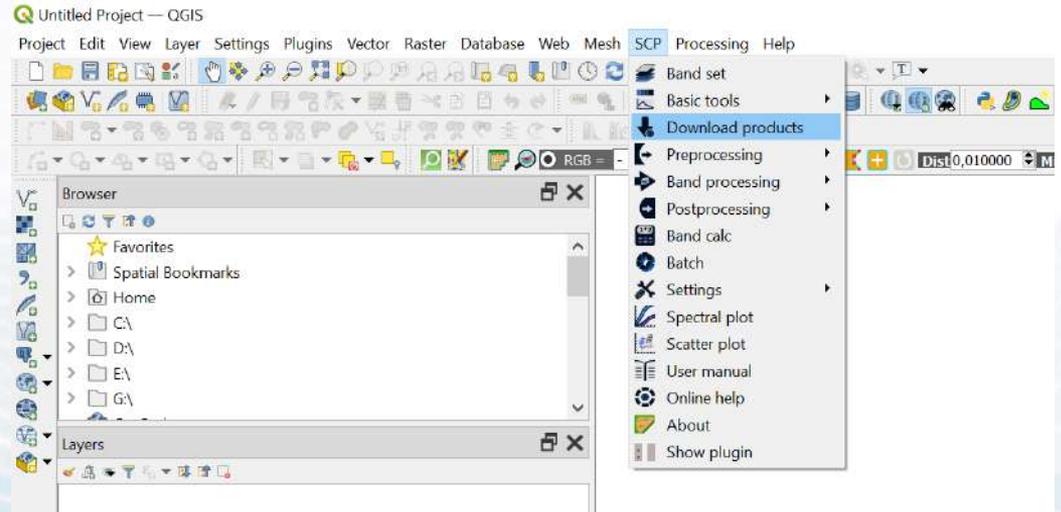
Project funded by
EUROPEAN UNION



Common borders. Common solutions.

Using SCP to acquire Sentinel 2 imagery for NDVI calculation

- o On a successful installation of the Semi-Automatic Classification Plugin a new menu named *SCP* will appear in the main menu bar.
- o Click on *SCP* and from the dropdown menu select *Download products*





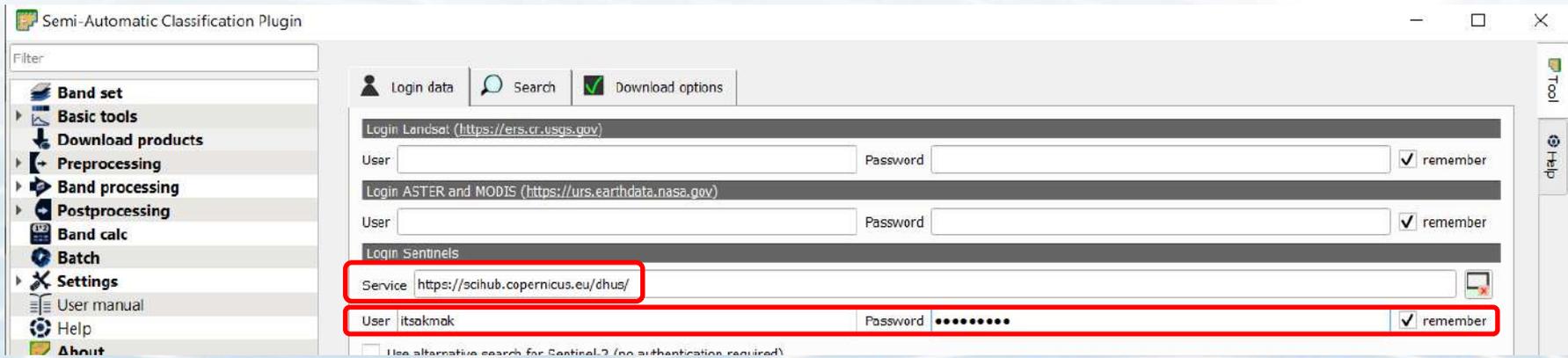
Project funded by
EUROPEAN UNION



Common borders. Common solutions.

Using SCP to acquire Sentinel 2 imagery for NDVI calculation

- From the Semi-Automatic Classification Plugin pop up window select the *Login data* tab and successively, in the *Login Sentinels* category:
 - fill in the *Service* box with the following url <https://scihub.copernicus.eu/dhus/>
 - in ***User*** and ***Password*** boxes insert your Copernicus Open Access Hub username and password, respectively.





Project funded by
EUROPEAN UNION



Common borders. Common solutions.

Using SCP to acquire Sentinel 2 imagery for NDVI calculation

- Switch to Download options tab. By default, the plugin has selected all the available satellite missions and their corresponding bands.
- Deselect all the bands by clicking on the *select all* buttons located on the right side of the box

The screenshot shows the 'Semi-Automatic Classification Plugin' window. The 'Download options' tab is active, displaying a grid of satellite bands with checkboxes. The bands are grouped into Landsat, Sentinel-2, Sentinel-3, and GOES categories. On the right side of each band group, there is a 'select all' button (a small icon with a list symbol) which is highlighted with a red box in the original image. The 'Support the SCP' button is highlighted in green in the left sidebar.

Landsat bands												
<input checked="" type="checkbox"/> 1 (Landsat 4-8)	<input checked="" type="checkbox"/> 2 (Landsat 4-8)	<input checked="" type="checkbox"/> 3 (Landsat 4-8)	<input checked="" type="checkbox"/> 4 (Landsat 1-8)	<input checked="" type="checkbox"/> 5 (Landsat 1-8)	<input checked="" type="checkbox"/> 6 (Landsat 1-8)	<input checked="" type="checkbox"/> 7 (Landsat 1-8)	<input checked="" type="checkbox"/> 8 (Landsat 7, 8)	<input checked="" type="checkbox"/> 9 (Landsat 8)	<input checked="" type="checkbox"/> 10 (Landsat 8)	<input checked="" type="checkbox"/> 11 (Landsat 8)	<input checked="" type="checkbox"/> Ancillary data	

Sentinel-2 bands														
<input checked="" type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input checked="" type="checkbox"/> 3	<input checked="" type="checkbox"/> 4	<input checked="" type="checkbox"/> 5	<input checked="" type="checkbox"/> 6	<input checked="" type="checkbox"/> 7	<input checked="" type="checkbox"/> 8	<input checked="" type="checkbox"/> 8A	<input checked="" type="checkbox"/> 9	<input checked="" type="checkbox"/> 10	<input checked="" type="checkbox"/> 11	<input checked="" type="checkbox"/> 12	<input checked="" type="checkbox"/> Ancillary data	

Sentinel-3 bands											
<input checked="" type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input checked="" type="checkbox"/> 3	<input checked="" type="checkbox"/> 4	<input checked="" type="checkbox"/> 5	<input checked="" type="checkbox"/> 6	<input checked="" type="checkbox"/> 7	<input checked="" type="checkbox"/> 8	<input checked="" type="checkbox"/> 9	<input checked="" type="checkbox"/> 10	<input checked="" type="checkbox"/> 11	
<input checked="" type="checkbox"/> 12	<input checked="" type="checkbox"/> 13	<input checked="" type="checkbox"/> 14	<input checked="" type="checkbox"/> 15	<input checked="" type="checkbox"/> 16	<input checked="" type="checkbox"/> 17	<input checked="" type="checkbox"/> 18	<input checked="" type="checkbox"/> 19	<input checked="" type="checkbox"/> 20	<input checked="" type="checkbox"/> 21	<input checked="" type="checkbox"/> Ancillary data	

GOES bands						
<input checked="" type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input checked="" type="checkbox"/> 3	<input checked="" type="checkbox"/> 4	<input checked="" type="checkbox"/> 5	<input checked="" type="checkbox"/> 6	

Common borders. Common solutions.

Using SCP to acquire Sentinel 2 imagery for NDVI calculation

- Then in the *Sentinel-2-bands* category select bands 4 and 8, which correspond to the wavelengths of Red and Near Infrared respectively.



The screenshot displays the SCP interface with the following components:

- Filter:** A search bar at the top left.
- Left Panel:** A navigation menu with categories: Band set, Basic tools, Download products, Preprocessing, Band processing, Postprocessing, Band calc, Batch, Settings, User manual, Help, About, and Support the SCP (highlighted in green).
- Top Bar:** Includes 'Login data', 'Search', and 'Download options' (checked).
- Main Content Area:** A grid of band selection options:
 - Landsat bands:** 1 (Landsat 4-8), 2 (Landsat 4-8), 3 (Landsat 4-8), 4 (Landsat 1-8), 5 (Landsat 1-8), 6 (Landsat 1-8), 7 (Landsat 1-8), 8 (Landsat 7, 8), 9 (Landsat 8), 10 (Landsat 8), 11 (Landsat 8), and Ancillary data.
 - Sentinel-2 bands:** 1, 2, 3, **4** (checked), 5, 6, 7, **8** (checked), 8A, 9, 10, 11, 12, and Ancillary data.
 - Sentinel-3 bands:** 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, and Ancillary data.
 - GOES bands:** 1, 2, 3, 4, 5, 6 (all checked).

Common borders. Common solutions.

Using SCP to acquire Sentinel 2 imagery for NDVI calculation

- Click on *Search* tab and define the co-ordinates of the study area by:
 - (a) inserting the maximum and minimum longitude and latitude (bbox coordinates) in the corresponding boxes using your keyboard



The screenshot shows the SCP search interface. The search parameters section is highlighted with a red box and contains the following values:

UL	LR
24.629863167205	40.984395422967
40.847893867132	24.821586002629

Below the search parameters, the date range is set from 2021-05-11 to 2022-05-11. The product list table is shown below:

Product	ProductID	AcquisitionDate	CloudCover	Zone/Path	Row/Day/Night	min_lat	min_lon	max_lat	max_lon	Collection/Size	Preview	Collection/ID	Collection/Im
---------	-----------	-----------------	------------	-----------	---------------	---------	---------	---------	---------	-----------------	---------	---------------	---------------



Project funded by
EUROPEAN UNION



Common borders. Common solutions.

Using SCP to acquire Sentinel 2 imagery for NDVI calculation

- or (b) clicking the (+) button in the window upper right corner and then switching to the area map (main QGIS interface) and click initially to define the first point that approximately corresponds to the minimum longitude and maximum latitude of the study area and then click to define the second point that corresponds to the maximum longitude and minimum latitude of the study area. A rectangle with red fill should cover your study area, while the min/max longitude and latitude boxes were filled in automatically.

Login data Search Download options

Search parameters

UL 24.629863167205 40.984395422967 LR 24.821586002629 -40.847893867132 Show +

Products Sentinel-2 Date from 2021-05-11 to 2022-05-11 Max cloud cover (%) 100 Find

Results 20 Advanced search

Add OpenStreetMap to the map (© OpenStreetMap contributors. The cartography is licensed as CC BY-SA. [Tile Usage Policy](#))

Product list Filter

Product	ProductID	AcquisitionDate	CloudCover	Zone/Path	Row/Day/Night	min_lat	min_lon	max_lat	max_lon	Collection/Size	Preview	Collection/ID	Collection/Ima
---------	-----------	-----------------	------------	-----------	---------------	---------	---------	---------	---------	-----------------	---------	---------------	----------------



Project funded by
EUROPEAN UNION



Common borders. Common solutions.

Using SCP to acquire Sentinel 2 imagery for NDVI calculation

The screenshot displays the SCP Desktop software interface. The main window shows a satellite image of a coastal region. A red bounding box labeled "bbox" is overlaid on the image. Two blue dots are placed at the corners of the bounding box: one at the top-left corner and one at the bottom-right corner. Text labels are overlaid on the image: "First point: Min Longitude Max Latitude" is positioned near the top-left dot, and "Second point: Max Longitude Min Latitude" is positioned near the bottom-right dot. The software interface includes a menu bar at the top, a toolbar, and several panels on the left side, including a "Layers" panel and a "SCP Desktop" panel.

Common borders. Common solutions.

Using SCP to acquire Sentinel 2 imagery for NDVI calculation

- Once the study area is selected, check if the *Sentinel 2* product is selected in the *Products* dropdown menu and
 - (a) define the time window that plugin will check for available products
 - (b) define the acceptable products cloud cover (as percentage of the total image area).



The screenshot shows the SCP web interface. At the top, there are navigation links for 'Login data', 'Search', and 'Download options'. Below this is a 'Search parameters' section with a search bar containing '40.984395422967'. To the right of the search bar, there are two date input fields: 'Date from' set to '2021-05-11' and 'to' set to '2022-05-31'. Further right, there is a 'Max cloud cover (%)' dropdown menu set to '100'. Below the search parameters is a 'Products' dropdown menu set to 'Sentinel-2'. Below the search parameters is a 'Results' section with a '20' results count and an 'Advanced search' button. Below the search parameters is a 'Product list' table with the following columns: Product, ProductID, AcquisitionDate, CloudCover, Zone/Path, Row/Day/Night, min_lat, min_lon, max_lat, max_lon, Collection/Size, Preview, Collection/ID, and Collection/Ima. The table is currently empty.



Project funded by
EUROPEAN UNION



Common borders. Common solutions.

Using SCP to acquire Sentinel 2 imagery for NDVI calculation

- When the search is completed the available products for the selected area and time period will appear in the *Product list* table.

The screenshot shows the 'Semi-Automatic Classification Plugin' interface. The search parameters are as follows:

- UL: 24.629863167205
- LR: 24.821596002529
- Products: Sentinel-2
- Date from: 2022-05-0 to 2022-05-0

The 'Product list' table is highlighted with a red box and contains the following data:

Product	ProductID	AcquisitionDate	CloudCover	Zone/Path	Row/Day/Night	min_lat	min_lon	max_lat	max_lon	Collection/Size	Preview	Collection/ID	Collection/
1 Sentinel-2	L2A_T35TKF_A026960_20220505T091048	2022-05-05T09...	18.0705	35TKF	40.5085	23.4336	41.5292	24.7538	1.03 GB	https://schub.c...	0b9fd7b7-6e83...	S2B_MSIL2	
2 Sentinel-2	L2A_T34TGL_A026960_20220505T091048	2022-05-05T09...	16.3794	34TGL	40.5049	23.3611	41.5214	24.7106	1.01 GB	https://schub.c...	9e9b6840-dcad...	S2B_MSIL2	
3 Sentinel-2	L2A_T35TLF_A026960_20220505T091048	2022-05-05T09...	28.2841	35TLF	40.5386	24.6028	41.5468	25.9346	1005.82 MB	https://schub.c...	569412a2-d671...	S2B_MSIL2	
4 Sentinel-2	L1C_T35TLF_A026960_20220505T091048	2022-05-05T09...	25.5123	35TLF	40.5386	24.6028	41.5468	25.9346	725.33 MB	https://schub.c...	19452023-9741...	S2B_MSIL1	
5 Sentinel-2	L1C_T35TKF_A026960_20220505T091048	2022-05-05T09...	15.3493	35TKF	40.5085	23.4336	41.5292	24.7538	745.63 MB	https://schub.c...	ba1d0e2f-d28e...	S2B_MSIL1	
6 Sentinel-2	L1C_T34TGL_A026960_20220505T091048	2022-05-05T09...	13.7274	34TGL	40.5049	23.3611	41.5214	24.7106	730.86 MB	https://schub.c...	890f7897-4c3-	S2B_MSIL1	



Project funded by
EUROPEAN UNION



Common borders. Common solutions.

Using SCP to acquire Sentinel 2 imagery for NDVI calculation

- Select a product by clicking on it and press the *RUN* button.
- Alternatively, hold SHIFT key to select multiple products in row
- or hold CTRL key to select multiple products scattered within product list.

The screenshot displays the SCP interface with a table of Sentinel-2 products. The table has the following columns: Product, ProductID, AcquisitionDate, CloudCover, ZonalPath, Row/DayNight, min_lon, min_lat, max_lon, max_lat, CollectionSize, Preview, CollectionID, and Collector. The 'RUN' button is located at the bottom right of the interface, highlighted with a red box.

Product	ProductID	AcquisitionDate	CloudCover	ZonalPath	Row/DayNight	min_lon	min_lat	max_lon	max_lat	CollectionSize	Preview	CollectionID	Collector
Sentinel-2	12A_135117_A020990_282205051001040	2022-05-03T06:25:28.841	3.511F	40_5380	24_6008	-41.5468	25.3548	105.02 MB	https://s3.amazonaws.com/sentinel2-public-us-east-1-135117-A020990_282205051001040	5084240-1071	528_M02_1A	SC2A_135117_A020990_282205051001040	
Sentinel-2	12A_135117_A020990_282205051001040	2022-05-03T06:25:31.125	3.511F	40_5380	24_6008	-41.5468	25.3548	723.33 MB	https://s3.amazonaws.com/sentinel2-public-us-east-1-135117-A020990_282205051001040	7982302-9341	528_M02_1A	SC2A_135117_A020990_282205051001040	
Sentinel-2	12A_135117_A020990_282205051001040	2022-05-03T06:25:32.849	3.511F	40_5380	24_6008	-41.5468	25.3548	745.84 MB	https://s3.amazonaws.com/sentinel2-public-us-east-1-135117-A020990_282205051001040	7982302-9341	528_M02_1A	SC2A_135117_A020990_282205051001040	



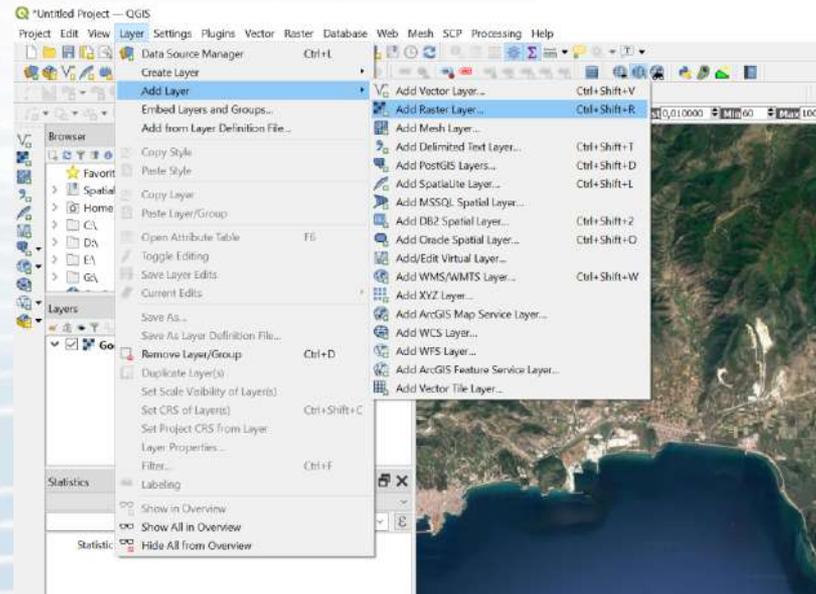
Project funded by
EUROPEAN UNION



Common borders. Common solutions.

Calculating NDVI from Sentinel 2 products

- From the main toolbar click on the *Layer* dropdown menu and then select *Add Layer* → *Add Raster Layer*



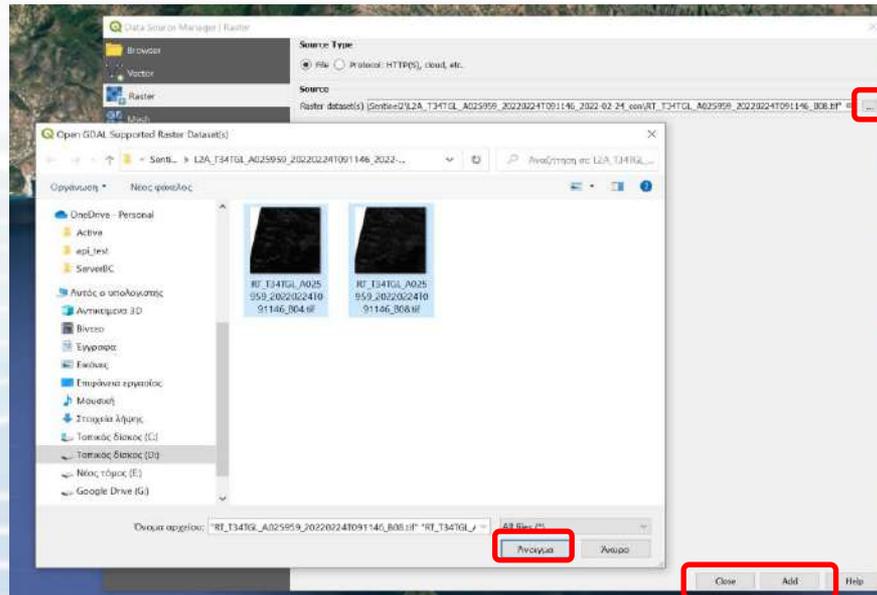


Project funded by
EUROPEAN UNION



Common borders. Common solutions. Calculating NDVI from Sentinel 2 products

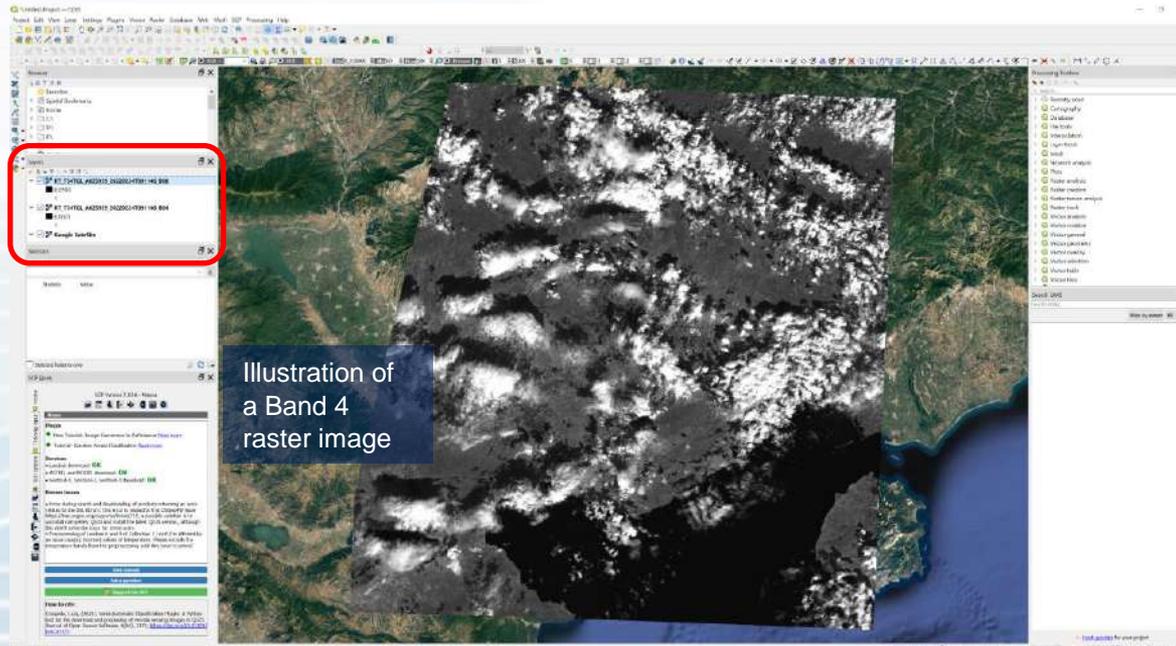
- In the pop up window click on *Raster Dataset(s)*, find the path that the downloaded raster (.tif) files are saved, select them and successively press open, add and close.



Common borders. Common solutions.

Calculating NDVI from Sentinel 2 products

- The images are loaded in the *Layers* panel and appear on the main map view





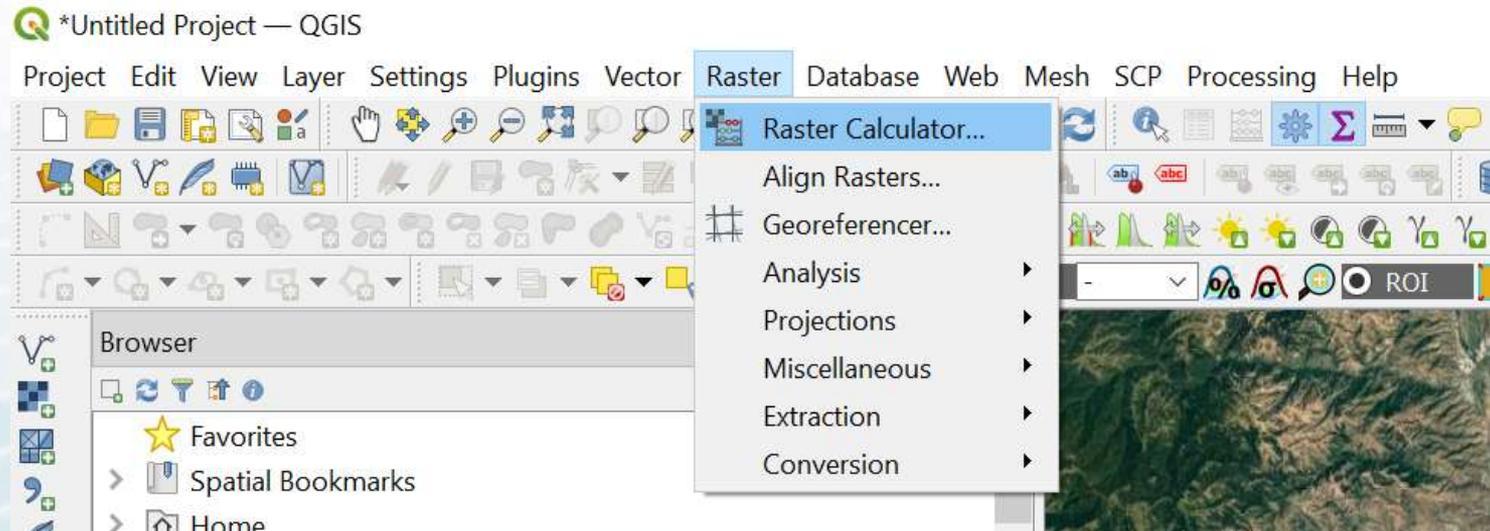
Project funded by
EUROPEAN UNION



Common borders. Common solutions.

Calculating NDVI from Sentinel 2 products

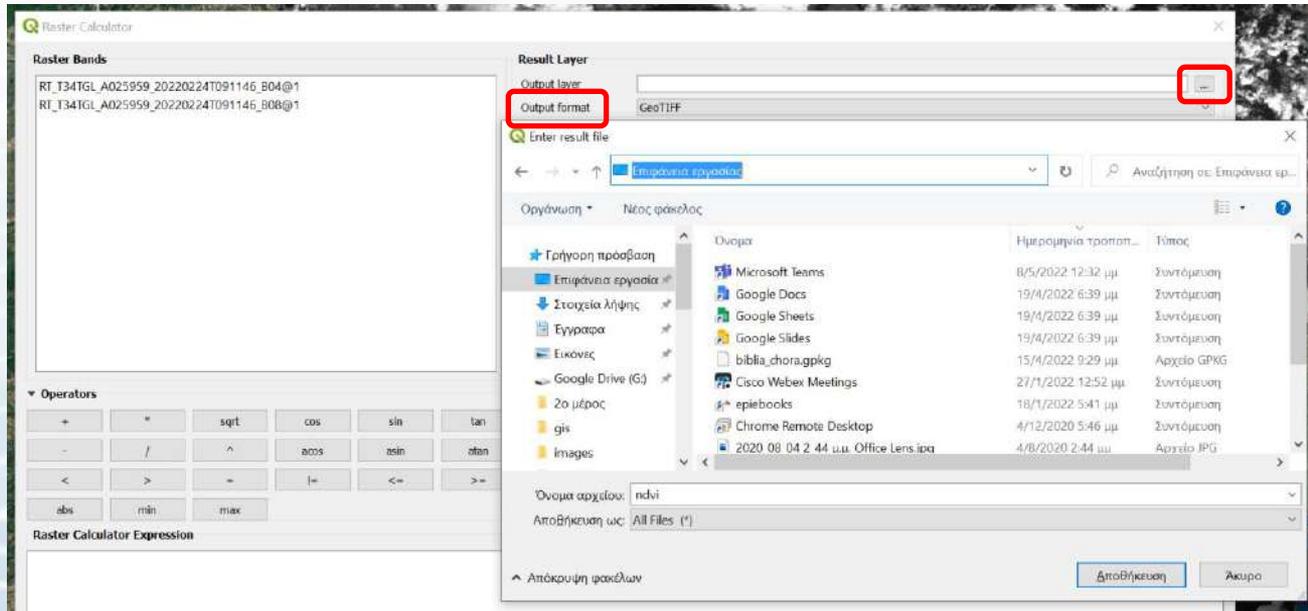
- From the main toolbar click on the *Raster* dropdown menu and then select the *Raster Calculator*



Common borders. Common solutions.

Calculating NDVI from Sentinel 2 products

- In the pop up window define the path that the derived NDVI map file will be saved and the desired format.

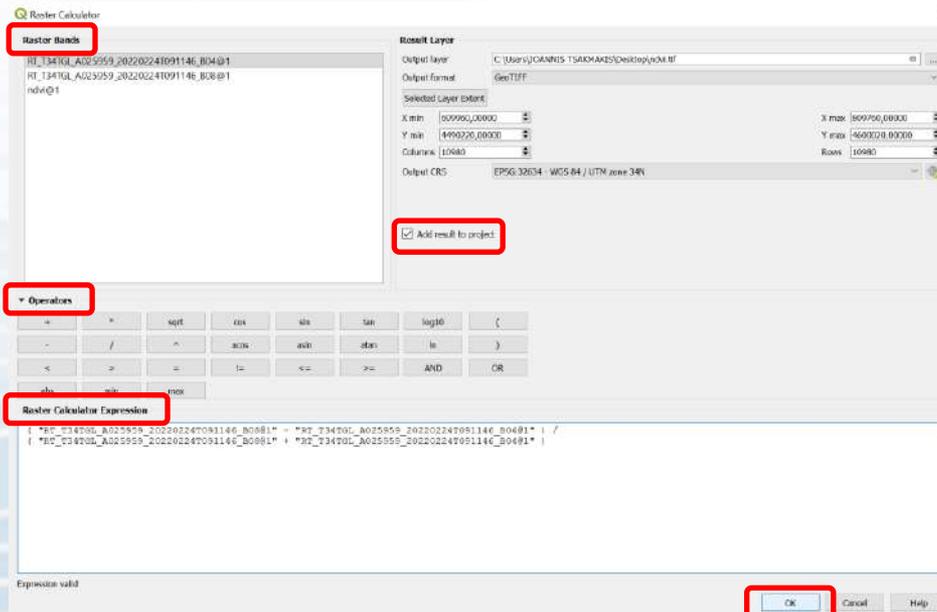


The screenshot shows the Raster Calculator dialog box in QGIS. The 'Output Layer' section is highlighted with a red box, showing 'GeoTIFF' as the selected output format. Below it, a file explorer window is open, showing the 'Επιφάνεια εργασίας' (Desktop) folder. The file explorer shows a list of files and folders, including 'Microsoft Teams', 'Google Docs', 'Google Sheets', 'Google Slides', 'biblia_chora.gpkg', 'Cisco Webex Meetings', 'epiebooks', 'Chrome Remote Desktop', and '2020 08 04 2 44 μμ. Office Lens.jpg'. The 'Όνομα αρχείου:' (File name) field is set to 'ndvi' and the 'Αποθήκευση ως:' (Save as type) is set to 'All Files (*.*)'.

Common borders. Common solutions.

Calculating NDVI from Sentinel 2 products

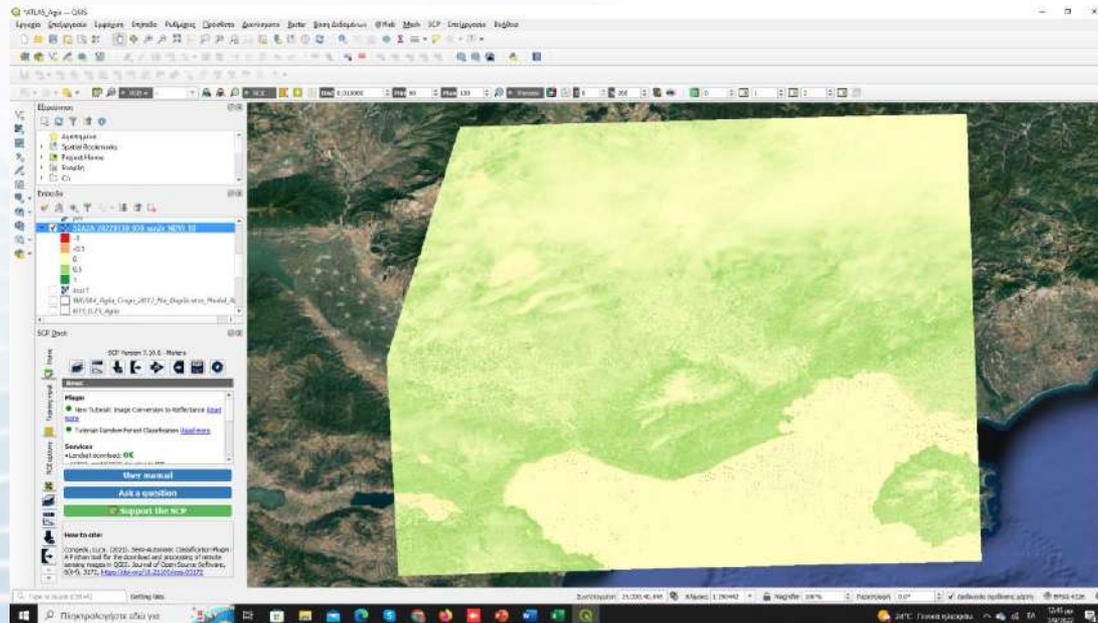
- Successively, insert the NDVI formula to the Raster Calculator Expression box using the band 4 and 8 raster images from Raster Bands panel and the available symbols from Operators panel and press OK button



Common borders. Common solutions.

Calculating NDVI from Sentinel 2 products

- If the *Add results to project* option is selected, the derived image is automatically loaded into the Layers panel and displayed in the main map view.





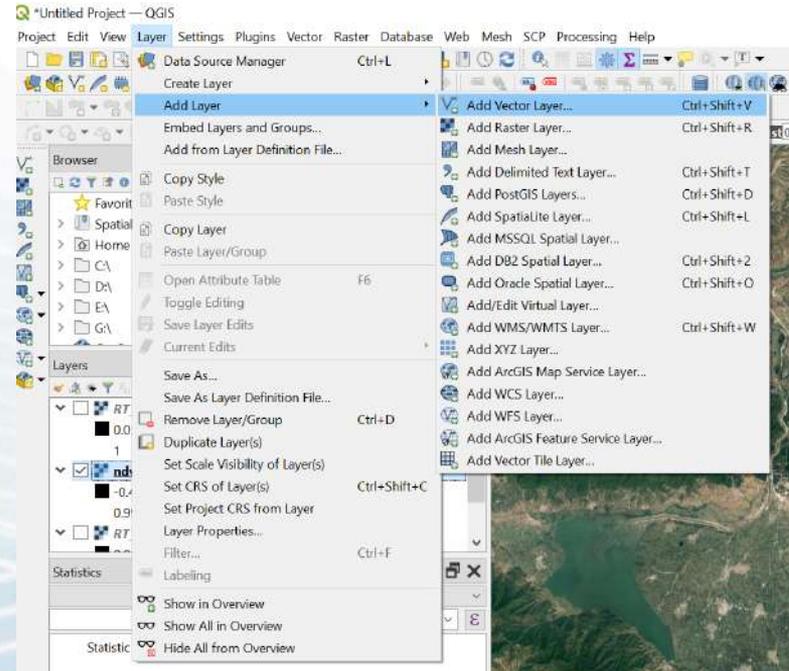
Project funded by
EUROPEAN UNION



Common borders. Common solutions.

Crop initial NDVI map to field boundaries

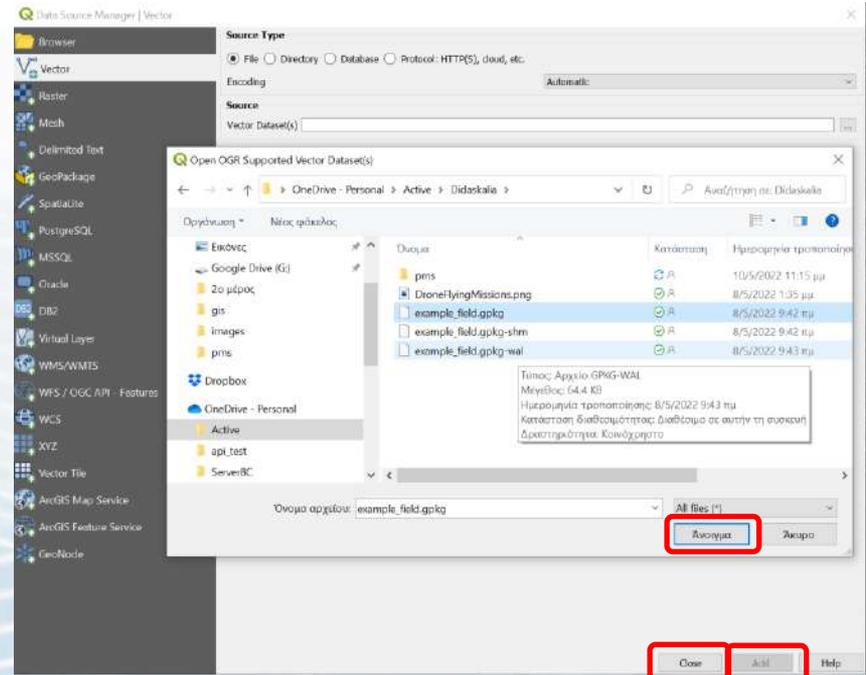
- The NDVI map calculated in the previous step corresponds to the boundaries of the downloaded products.
- In the case that the NDVI for a selected field is needed, the previous map is not that useful, so it has to be clipped to the field boundaries.
- In order to do that, from the main toolbar click on the *Layer* dropdown menu and then select *Add Layer* → *Add Vector Layer...*



Common borders. Common solutions.

Crop initial NDVI map to field boundaries

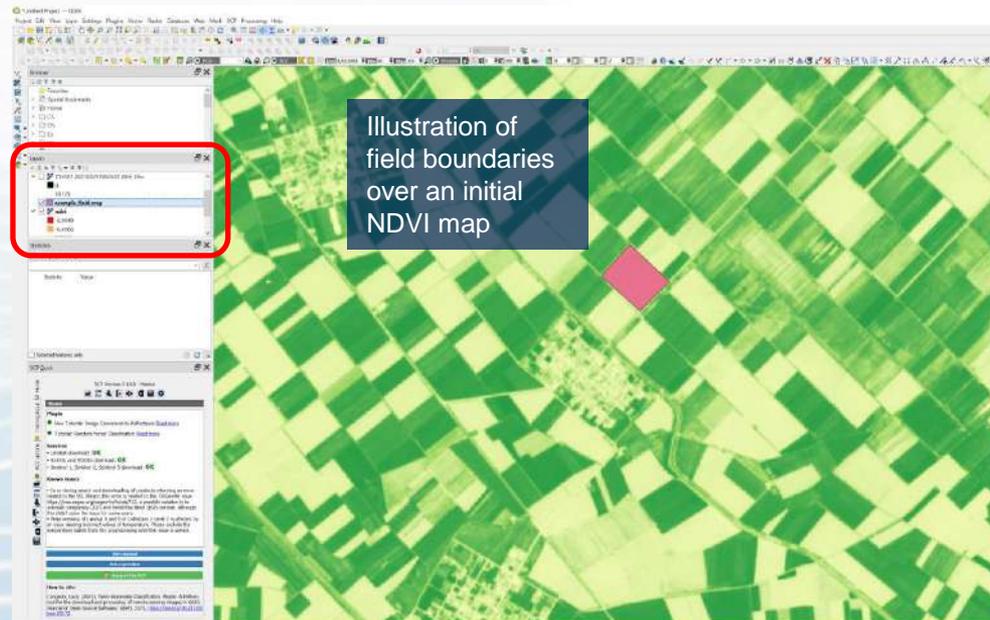
- In the pop up window click on *Vector Dataset(s)* and define the path where the field vector file is saved.
- Press successively the *Open*, *Add* and *Close* buttons.



Common borders. Common solutions.

Calculating NDVI from Sentinel 2 products

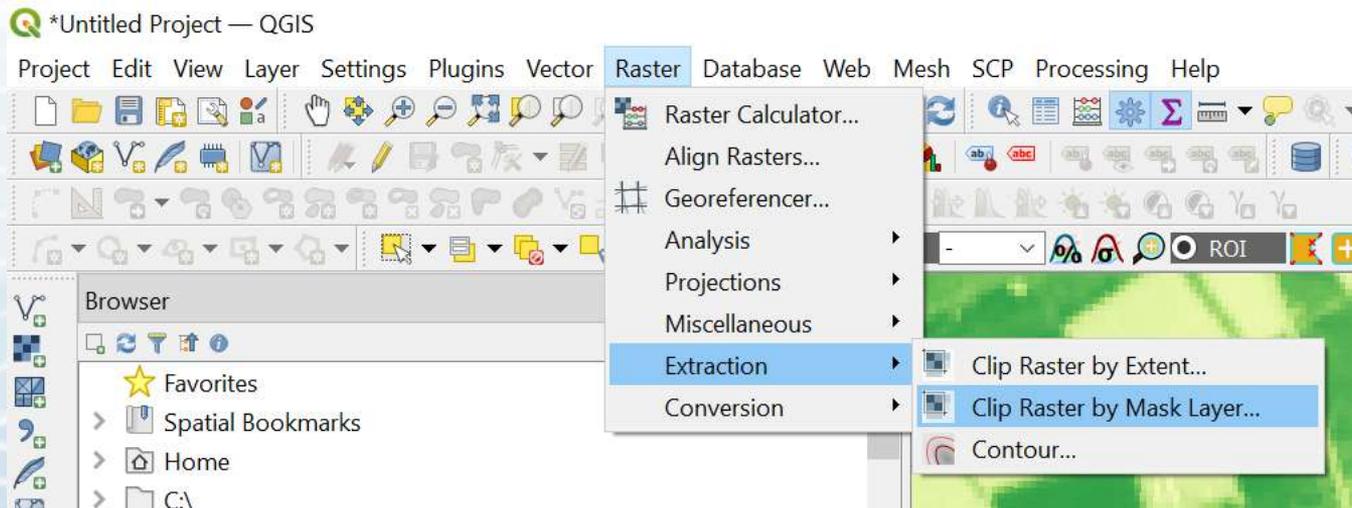
- The selected field polygon is loaded automatically into the Layers panel and displayed on the main map view.



Common borders. Common solutions.

Calculating NDVI from Sentinel 2 products

- Subsequently, click on the *Raster* dropdown menu then select *Extraction* → *Clip Raster by Mask Layer...*



Common borders. Common solutions.

Calculating NDVI from Sentinel 2 products

- In the pop up window we initially set the NDVI map that we created in the previous steps as the Input Layer and the field layer as a Mask layer.



Clip Raster by Mask Layer

Parameters Log

Input layer

- Google Satellite [EPSG:3857]
- ndvi [EPSG:32634]
- example_field crop [EPSG:4326]

Mask layer

- example_field crop [EPSG:4326]

Selected features only



Project funded by
EUROPEAN UNION



Common borders. Common solutions.

Calculating NDVI from Sentinel 2 products

- In the *Advanced Parameters* section set the path and the format of the derived masked NDVI file with field boundaries and press *Save* button.
- To initiate the mask process press *Run* button.
- Check the *Open output file after running algorithm*.

The screenshot displays the QGIS software interface. On the left, the 'Advanced Parameters' section is highlighted with a red box. Below it, the 'Open output file after running algorithm' checkbox is checked and also highlighted with a red box. The 'Save file' dialog is open, showing a file explorer view of a folder named 'Αυτός ο υπολογιστής > Επιφάνεια εργασίας >'. The 'Save as' field is set to 'ndvi_clipped' and the file type is 'GPKG files (*.gpkg)'. The 'Save' button is highlighted with a red box. At the bottom of the QGIS window, the 'Run' button is also highlighted with a red box.

Save file

Αυτός ο υπολογιστής > Επιφάνεια εργασίας >

Αναζήτηση ως: Επιφάνεια ερ...

Οργάνωση - Νέος φάκελος

Όνομα	Ημερομηνία τροποπ...	Τύπος
bibilis_chora.gpkg	15/4/2022 9:29 μμ	Αρχείο GPKG
1ο μέρος	26/6/2020 11:40 πμ	Φάκελος αρχείων
2ο μέρος	26/6/2020 11:40 πμ	Φάκελος αρχείων
SPSS	22/10/2018 8:54 πμ	Φάκελος αρχείων
missions	31/5/2018 11:26 πμ	Φάκελος αρχείων
ExtendOffice OfficeTab Enterprise (v.12.00)	17/9/2017 4:07 μμ	Φάκελος αρχείων

Όνομα αρχείου: ndvi_clipped

Αποθήκευση ως: GPKG files (*.gpkg)

Διορθώστε

Αποθήκευση

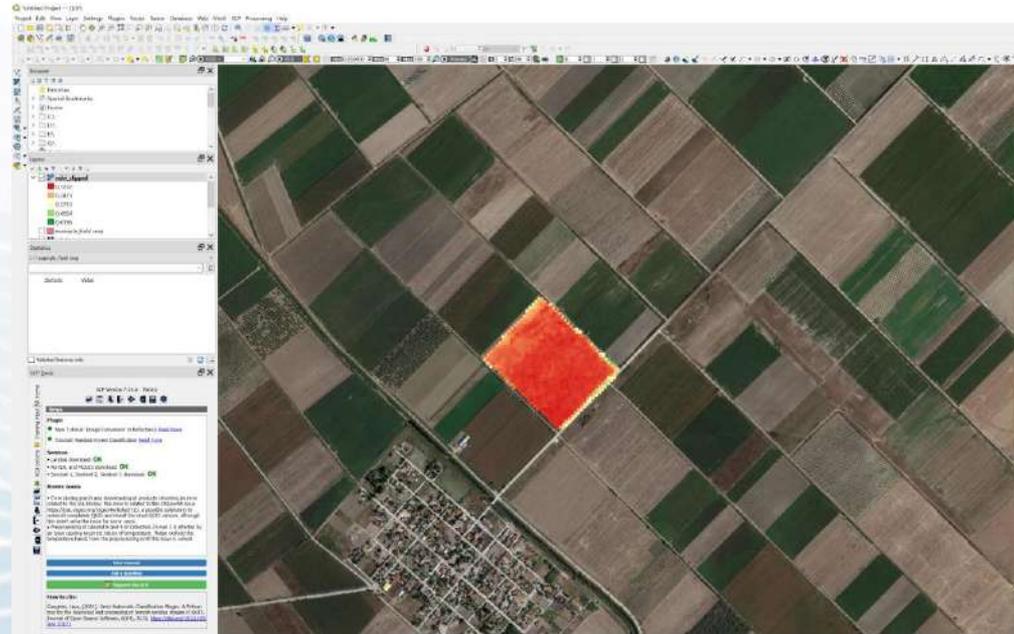
Run as Batch Process...

Run

Common borders. Common solutions.

Calculating NDVI from Sentinel 2 products

- To derived masked NDVI map is loaded automatically into *Layer* panel and displayed on the main map view.





Project funded by
EUROPEAN UNION



Common borders. Common solutions.

PART 3



Project funded by
EUROPEAN UNION



Common borders. Common solutions.

Plant canopy as crop model validation index

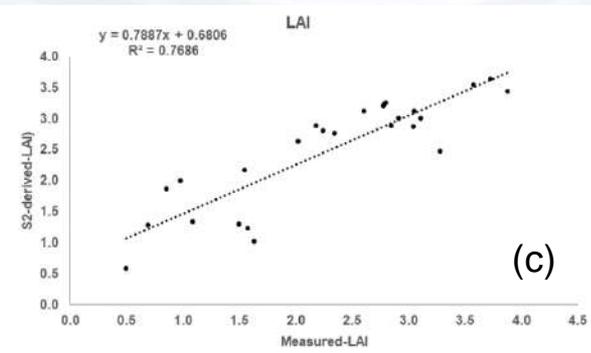
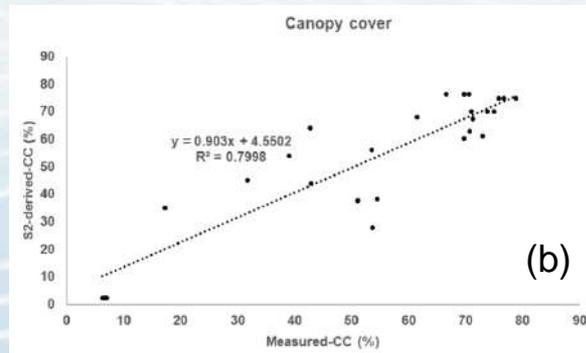
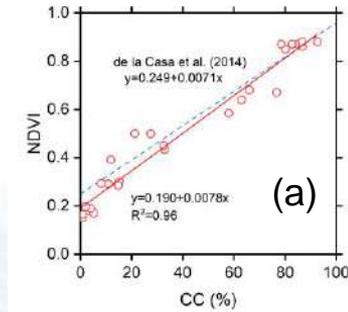
- One of the main parameters that is used as an evaluation criterion of crop model performance is the plants canopy.
- The traditional indices used as means to assess plants canopy are Leaf Area Index (LAI) or Green Canopy Cover (CC).
- Both require field measurements, scientific instruments and post-process of the measured data.



Common borders. Common solutions.

NDVI as an alternative plant canopy index

- A number of studies have shown a fair correlation between the NDVI and the CC and LAI.
- Figures show correlation results between measured CC and NDVI in the case of Corn (Figure a) and Wheat (Figure b) and LAI and NDVI in the case of Wheat (Figure c)





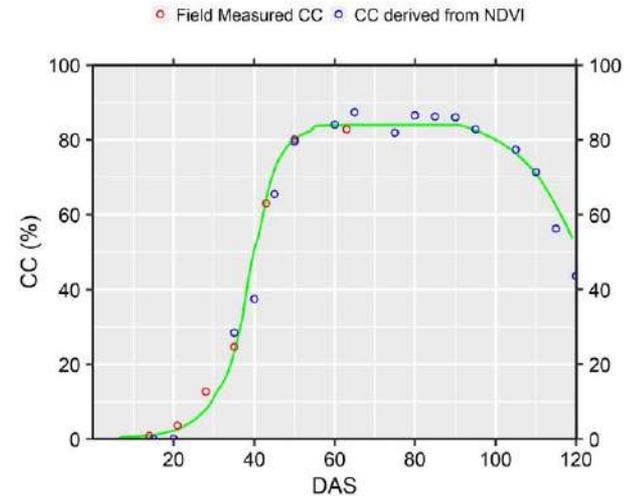
Project funded by
EUROPEAN UNION



Common borders. Common solutions.

NDVI as an alternative plant canopy index

- These empirical equations can be used to convert the NDVI map values derived from satellite images to CC or LAI.
- Successively, the derived CC or LAI timeseries can be used to validate crop models performance.
- Figure shows an example of AquaCrop crop model capability to simulate corn canopy cover development using in-situ CC measurements and NDVI derived CC.





Common borders. Common solutions.

Joint Operational Programme Black Sea Basin 2014-2020
Copernicus Assisted Environmental Monitoring across the Black Sea Basin - PONTOS
December 2022

Joint Operational Programme Black Sea Basin 2014-2020 is co-financed by the European Union through the European Neighbourhood Instrument and by the participating countries: Armenia, Bulgaria, Georgia, Greece, Republic of Moldova, Romania, Turkey, and Ukraine.

This publication has been produced with the financial assistance of the European Union. The contents of this publication are the sole responsibility of Copernicus assisted environmental monitoring across the Black Sea Basin - PONTOS and can in no way be taken to reflect the views of the European Union.

AUA ACOPIAN CENTER
for the ENVIRONMENT



CERTH
CENTRE FOR
RESEARCH & TECHNOLOGY
HELLAS



ΔΗΜΟΚΡΙΤΕΙΟ
ΑΝΕΡΓΙΣΤΗΜΙΟ
ΘΡΑΚΗΣ
DEMOCRITUS
UNIVERSITY
OF THRACE




GREEN
ALTERNATIVE

