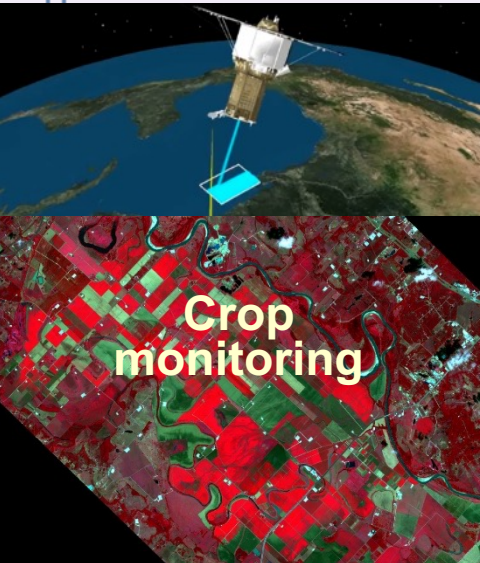


Using Freely Available Satellite Imagery and Software for Creating Prescription Maps

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Research Agricultural Engineer

USDA-ARS
Aerial Application Technology
Research Unit
College Station, TX





Landsat 8/9, NASA&USGS

115 miles, 30 m, 8d

<https://earthexplorer.usgs.gov>



**College
Station, TX**

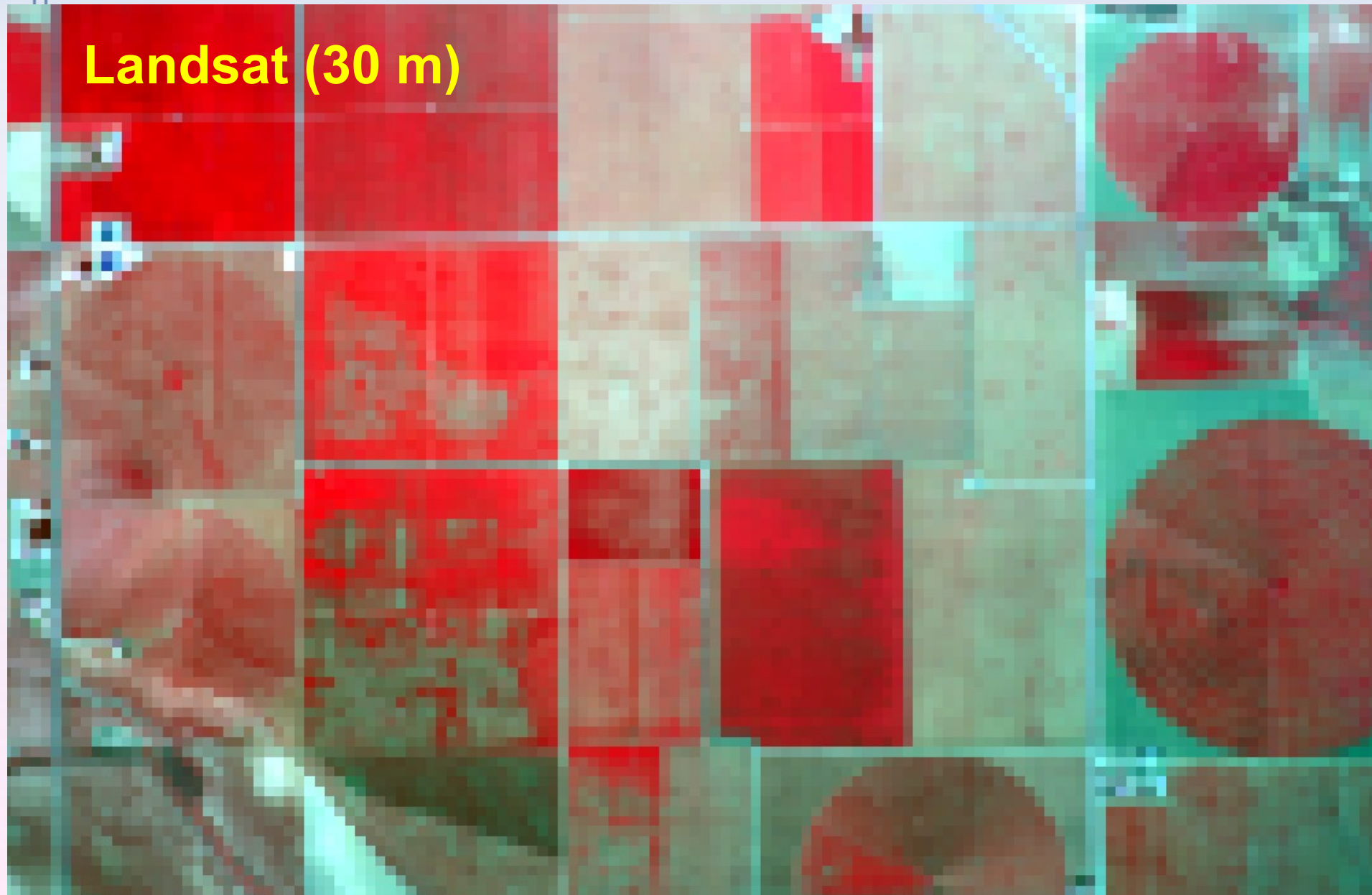
Sentinel-2A&2B, ESA

68 miles, 10 m, 5d

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

Airborne, Sentinel-2 and Landsat Images

Landsat (30 m)

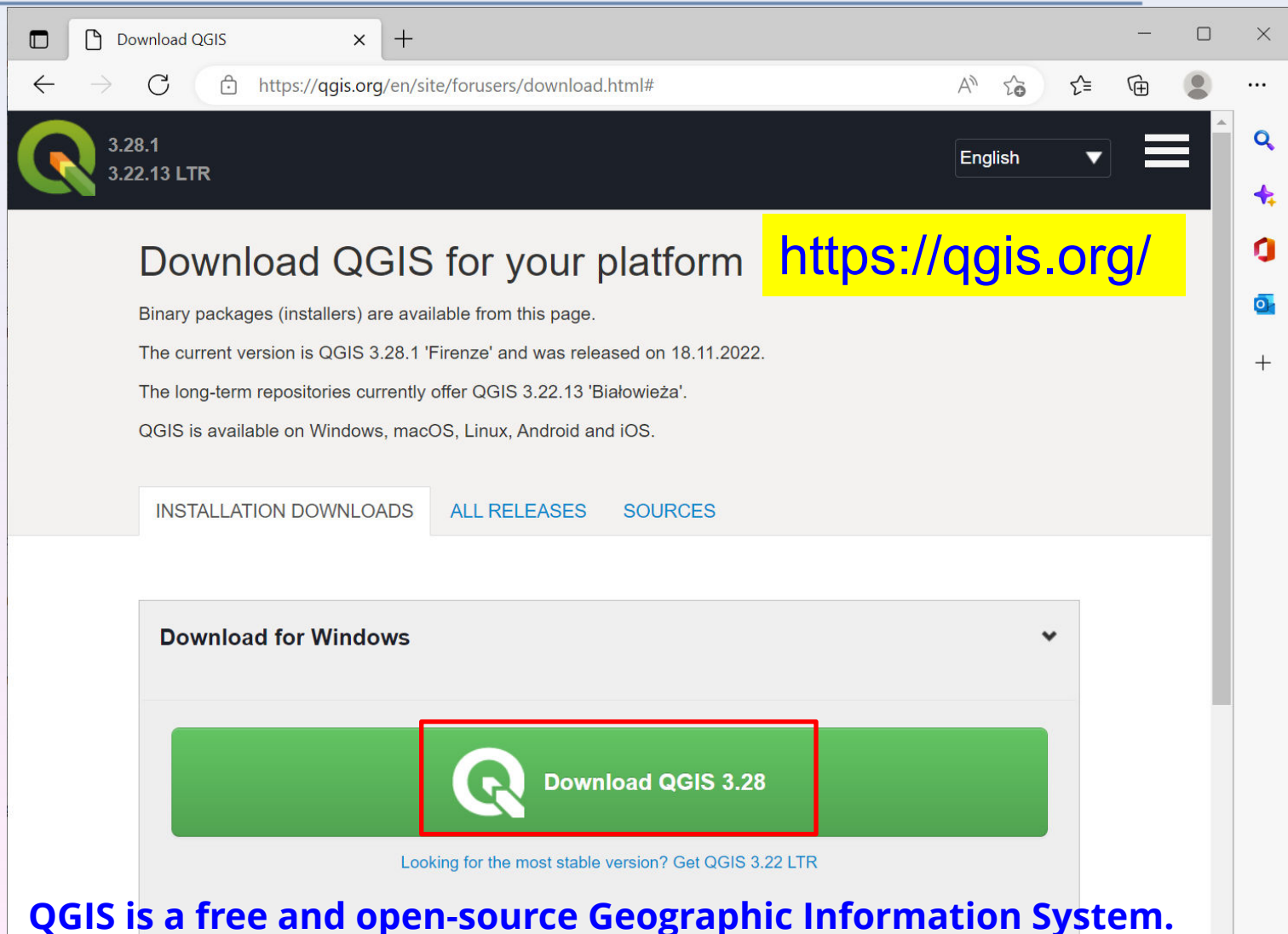


Sentinel-2 Specifications

Sentinel-2 band	Wavelength (nm)	Spatial resolution (m)
Band 1 - Coastal aerosol	443±10	60
Band 2 - Blue	490±32.5	10
Band 3 - Green	560±17.5	10
Band 4 - Red	665±15	10
Band 5 - Vegetation red edge	705±7.5	20
Band 6 - Vegetation red edge	740±7.5	20
Band 7 - Vegetation red edge	783±10	20
Band 8 - Near-infrared (NIR)	842±57.5	10
Band 8A - Vegetation red edge	865±10	20
Band 9 - Water vapor	945±10	60
Band 10 – SWIR2-Cirrus	1375±15	60
Band 11 - SWIR	1610±15	20
Band 12 – SWIR	2190±90	20

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

Download QGIS at QGIS.org

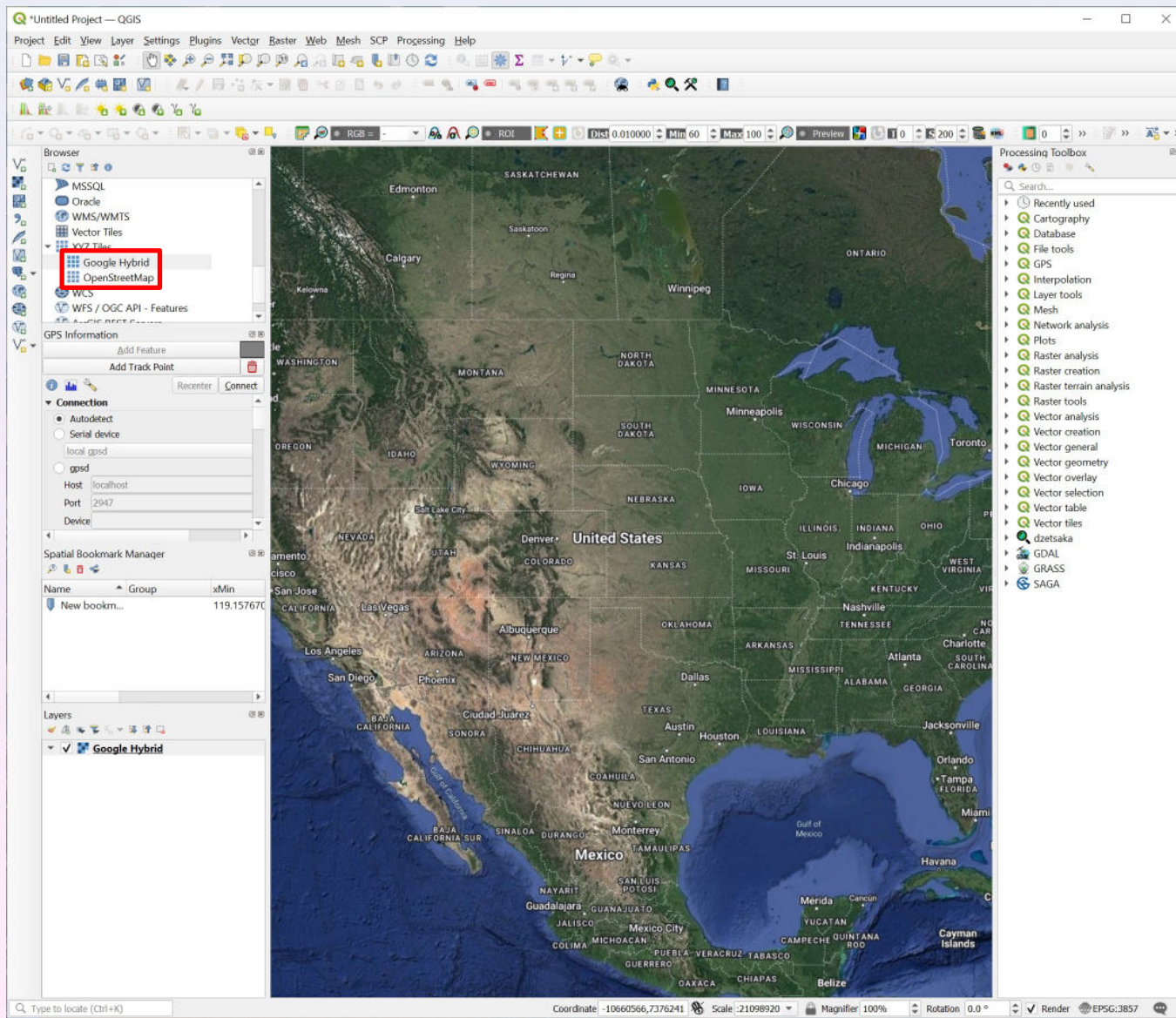


The screenshot shows the QGIS.org website's download page. The browser address bar displays <https://qgis.org/en/site/forusers/download.html#>. The page header includes the QGIS logo, version numbers (3.28.1 and 3.22.13 LTR), a language dropdown set to 'English', and a menu icon. The main heading is 'Download QGIS for your platform', with the URL <https://qgis.org/> highlighted in yellow. Below this, text states: 'Binary packages (installers) are available from this page. The current version is QGIS 3.28.1 'Firenze' and was released on 18.11.2022. The long-term repositories currently offer QGIS 3.22.13 'Białowieża'. QGIS is available on Windows, macOS, Linux, Android and iOS.' A navigation bar contains 'INSTALLATION DOWNLOADS', 'ALL RELEASES', and 'SOURCES'. The 'Download for Windows' section features a green button with the QGIS logo and the text 'Download QGIS 3.28', which is highlighted with a red border. Below the button, a link reads 'Looking for the most stable version? Get QGIS 3.22 LTR'.

QGIS is a free and open-source Geographic Information System.

QGIS is maintained by volunteer developers with support by users.

Open QGIS and Google Maps



Install Semi-Automatic Classification Plugin

The screenshot shows the QGIS interface with the Plugins dialog box open. The search bar contains the text "Semi-automatic classification". The results list the "Semi-Automatic Classification Plugin" as installed. The details for this plugin are displayed on the right, including its description, category, tags, author, and version history. The "Reinstall Plugin" button is highlighted with a red box.

Plugins **SCP**

Search "Semi-automatic classification"

Semi-Automatic Classification Plugin

The Semi-Automatic Classification Plugin (SCP) allows for the supervised classification of remote sensing images, providing tools for the download, the preprocessing and postprocessing of images.

Developed by Luca Congedo, the Semi-Automatic Classification Plugin (SCP) allows for the supervised classification of remote sensing images, providing tools for the download, the preprocessing and postprocessing of images. Search and download is available for ASTER, COCS, Landsat, MODIS, Sentinel-1, Sentinel-2, and Sentinel-3 images. Several algorithms are available for the land cover classification. This plugin requires the installation of GDAL, OGR, Numpy, ScPy, and Matplotlib. Some tools require also the installation of SNAP (ESA Sentinel Application Platform). For more information please visit <https://fromgis.com>.

★★★★★ 485 rating vote(s), 1305021 downloads

Category Raster

Tags raster, classification, land cover, remote sensing, analysis, aster, gis, landsat, sentinel, supervised classification, spectral signature, mask, clip, accuracy, landscape, copernicus, random forest, snap, processing

More Info [homepage](#) [bug tracker](#) [code repository](#)

Author Luca Congedo

Installed version 7.10.10

Available version (stable) 7.10.10 updated at Sat Nov 12 00:57:45 2022

Changelog

- 7.10.10
 - fixed issue with file name in Clip multiple raster
 - fixed French translation issue
- 7.10.9
 - fixed issue with ROI transparency
- 7.10.8
 - fixed issue with raster creation
- 7.10.7
 - preprocessing of Landsat and Sentinel-2 bands are now converted to Float32 to prevent issues related to postprocessing
 - changed the option GDAL_NUM_THREADS to avoid triggering Georeferencer plugin issue
 - other bug fixes
- 7.10.6
 - updated the Landsat tool for preprocessing Landsat 9 data
 - fixed issue for TOA conversion of Landsat 5 and 7 data

Upgrade All **Uninstall Plugin** **Reinstall Plugin** **Close** **Help**



Download Sentinel-2 Imagery

Click SCP and select Download products

Filter

Band set

Basic tools

Download products

Preprocessing

Band processing

Postprocessing

Band calc

Batch

Settings

User manual

Help

About

Support the SCP

Login data Search Download options

Search parameters

UL -96.50399746578 30.591426859208 LR -96.3971720318 30.497850874305 Show Max cloud cover (%) 100

Products Sentinel-2 Date from 2022-06-01 to 2022-06-15

Results 20 Advanced search

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

Product list

Product	ProductID	AcquisitionDate	CloudCover	Zone/Path	Row/
---------	-----------	-----------------	------------	-----------	------

Filter

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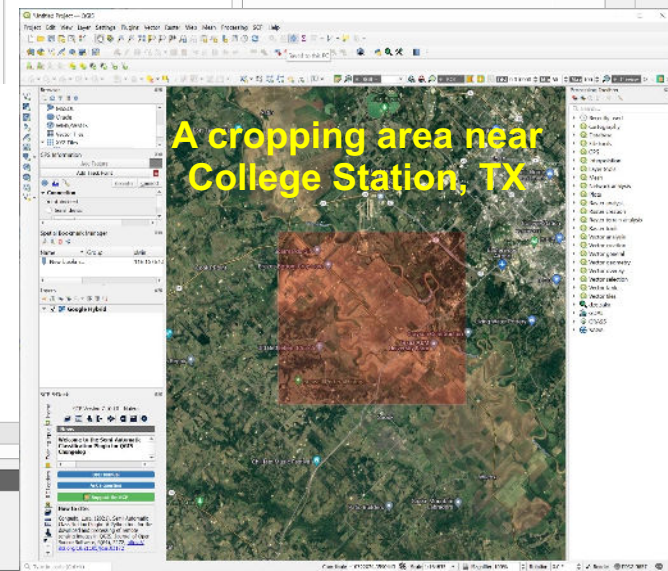
Sentinel-2 bands

Blue Green Red

Near-infrared

- Click **SCP** on QGIS menu to open **Download products** window
- **No login** is needed for Sentinel-2
- Select **Sentinel-2** as Products
- Click **Download options** to only check bands 2,3,4 and 8
- Specify the **date range**
- Define an **area of interest** using a box on Google map
- Click **Find** to search all available images

Only if preview in Layers Preprocess images Load bands in QGIS Virtual download



Download Sentinel-2 Imagery

Semi-Automatic Classification Plugin

Filter

- Band set
- Basic tools
- Download products
- Preprocessing
- Band processing
- Postprocessing
- Band calc
- Batch
- Settings
- User manual
- Help
- About
- Support the SCP

Login data Search Download options

Search parameters

UL -96.50399746578 30.591426859208 LR -96.3971720318 30.497850874305 Show +

Products Sentinel-2 Date from 2022-06-01 to 2022-06-15 Max cloud cover (%) 100

Results 20 Advanced search Find

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

Product list

Product	ProductID	AcquisitionDate	CloudCover	Zone/Path	Row
1 Sentinel-2	L2A_T14RQU_A027551_20220615T170540	2022-06-15T16:...	95.3831	14RQU	
2 Sentinel-2	L1C_T14RQU_A027551_20220615T170540	2022-06-15T16:...	97.7717	14RQU	
3 Sentinel-2	L2A_T14RQU_A036388_20220610T170344	2022-06-10T16:...	8.34802	14RQU	
4 Sentinel-2	L1C_T14RQU_A036388_20220610T170344	2022-06-10T16:...	4.39753	14RQU	
5 Sentinel-2	L2A_T14RQU_A027408_20220605T171001	2022-06-05T16:...	72.8686	14RQU	
6 Sentinel-2	L1C_T14RQU_A027408_20220605T171001	2022-06-05T16:...	92.5201	14RQU	

Filter

Download

Only if preview in Layers Preprocess images Load bands in QGIS Virtual download

Run

- Six images were found
- Check acquisition date and cloud cover
- Select L2A images, which are calibrated to surface reflectance
- Display preview of highlighted image in Google map
- Uncheck Preprocess images
- Click Run and select a folder to download the images
- Four black-and-white band images will be loaded to QGIS

Merge Band images as Composites

The screenshot displays the QGIS desktop environment with the Semi-Automatic Classification Plugin (SCP) active. The main map window shows a satellite image of a coastal area. The 'Layers' panel on the left lists several satellite bands, with the four selected bands highlighted by a red box:

- ✓ T14RQU_A036388_20220610T170344_B08
- ✓ T14RQU_A036388_20220610T170344_B04
- ✓ T14RQU_A036388_20220610T170344_B03
- ✓ T14RQU_A036388_20220610T170344_B02

The 'Semi-Automatic Classification Plugin' window is open, showing the 'Band set' tab. The 'Multiband Image list' contains the same four bands. Below it, the 'Band set definition' table is visible:

Band name	Center wavelength	Multiplicative Factor	Additive Factor	Wavelength unit	Image name	Date
1 T14RQU_A036388_20220610T170344_B02	1.0	1	0	band number		
2 T14RQU_A036388_20220610T170344_B03	2.0	1	0	band number		
3 T14RQU_A036388_20220610T170344_B04	3.0	1	0	band number		
4 T14RQU_A036388_20220610T170344_B08	4.0	1	0	band number		

The 'RUN' button is highlighted in green, indicating the process is ready to be executed. The bottom status bar shows the coordinate system as EPSG:3857 and a scale of 1:585952.

Visualize Normal Color Images

Project: 2022NAAA - QGIS

Set RGB = 3-2-1

Browser

- WMS/WMF
- Vector Tiles
- XYZ Tiles
- Google Hybrid
- OpenStreetMap
- WCS

GPS Information

Add Line

Add Track Point

Connection

- Autodetect
- Serial device
- local qpsd

Spatial Bookmark Manager

Name: Group

New bookmark...

Layers

- Virtual Band Set 1
 - Band 3
 - Band 2
 - Band 1
- T14RQU_A036388_20220610T170344_B08
- T14RQU_A036388_20220610T170344_B04
- T14RQU_A036388_20220610T170344_B03
- T14RQU_A036388_20220610T170344_B02
- Google Hybrid
- OpenStreetMap

SCP & Dock

SCP Version: 7.10.10 - Matias

News

Issue <https://trac.osgeo.org/qgis/ticket/715>, a possible solution is to uninstall completely QGIS and install the latest QGIS version, although this didn't solve the issue for some users.

Preprocessing of Landsat 8 and 9 of Collection 2 Level 2 is affected by an issue causing incorrect values of temperature. Please exclude the temperature bands from the preprocessing until this issue is solved.

User manual

Ask a question

Support the NSP

How to cite:

Congedo, Lucas, (2021). Semi Automatic Classification Plugin: A Python tool for the download and processing of remote sensing images in QGIS. Journal of Open Source Software, 6(64), 3172, <https://doi.org/10.21105/joss.03172>

Coordinate: 10712789,3606123 Scale: 1:511443 Monitor: 100% Rotation: 0.5 Render: EPSG:3857

Visualize Color-infrared Image

The screenshot shows the QGIS interface with a color-infrared image loaded. The main map area displays a dense forest with a color palette where red represents near-infrared, green represents the red band, and blue represents the blue band. A red box in the top toolbar highlights the 'Set RGB = 4-3-2' option, indicating the band configuration used for the visualization. In the Layers panel on the left, a red box highlights the 'Virtual Band Set 1' layer, which is composed of 'Band 4', 'Band 3', and 'Band 2'. The Processing toolbox on the right shows various tools available for the current project.

Clip Image to Your Area of Interest

The screenshot displays the QGIS desktop environment. The main map window shows a satellite image with a red polygon outlining a specific area of interest. The interface includes several panels:

- Browser:** Shows various map services like Google Hybrid and OpenStreetMap, and a list of layers including 'Clipped (extent)' and 'Merged'.
- Layers:** A list of layers with checkboxes, including 'Clipped (extent)', 'Merged', and several 'T14RQU_A036388_20220610T170344_B02' files.
- Processing Toolbox:** A list of processing tools, with 'Clip' and 'Clip raster by extent' highlighted.
- SCP & Dock:** A sidebar containing a news feed and a 'Support the SCP' button.

The status bar at the bottom shows the coordinate '10742947,572592', scale '1:77227', and other system information.

Classify the image to Crop Types

The screenshot displays the QGIS desktop environment. The main window shows a satellite image of a rural area, overlaid with a classification map. A yellow rectangular box highlights a specific region of the map. A legend in the top right corner of the map area provides the key for the crop types:

- Cotton (Green)
- Corn (Yellow)
- Sorghum (Blue)
- Soybean (Pink)
- Watermelon (Red)
- Sunflower (Purple)
- Fallow (Brown)

The QGIS interface includes a menu bar at the top with options like Project, Edit, View, Layer, Settings, Plugins, Vector, raster, Web, Mesh, SCP, Processing, and Help. Below the menu bar is a toolbar with various icons for map navigation and processing. On the left side, there are several panels: Browser (showing Vector Tiles, XYZ Tiles, Google Hybrid, OpenStreetMap, WCS, and WFS/OGC API - Features), GPS Information (with Add Track Point), Connection (with autodetect, Serial device, and local gisml), Spatial Bookmark Manager, and Layers (showing a 'Clipped (extent)' layer and a 'Merged' layer with bands 4, 3, and 2). On the right side, there is a Processing Toolbox with a search bar and a list of tools, including 'Clip raster by extent', 'Clip raster by mask layer', 'Vector overlay', 'Clip', 'Extract/clip by extent', 'GDAL', 'Raster extraction', 'Clip raster by extent', 'Clip raster by mask layer', 'Vector geospatial processing', 'Clip vector by extent', 'Clip vector by mask layer', 'SAGA', 'Features - Features-Basic Tools', 'Clip Raster with Polygon', 'Features - Points', 'Clip Points with Polygons', 'Features - Polygons', 'Polygon Clipping', 'Import/Export - Rasters', 'Import, Clip and Rename...', and 'Raster - Tools', 'Clip Rasters'. At the bottom, there is a status bar showing the coordinate (10742947, 5720592), scale (1:77227), magnifier (100%), rotation (0.0°), and render (EPSG:3857).

Calculate Normalized Difference Vegetation Index (NDVI)

The screenshot displays the QGIS desktop environment. The main map area shows a satellite image with a grayscale NDVI overlay. The overlay uses light gray to represent healthy vegetation and dark gray to represent stressed/sparse vegetation, bare soil, roads, and water. The interface includes a Browser panel on the left, a Processing Toolbox on the right, and a central map area. The Processing Toolbox shows a list of tools, with 'Clip' and 'Raster extraction' tools visible. The Layers panel on the left shows the current project layers, including 'Clipped (extent)@4', 'Clipped (extent)', and 'Merged' (with sub-layers for Band 4, Band 3, and Band 2). The Status Bar at the bottom shows the current coordinates, scale, and other project information.

Light gray represents healthy vegetation, while dark gray indicates stressed/sparse vegetation, bare soil, roads and water.

A Root Rot-infested Cotton Growing Area

The screenshot displays the QGIS interface with a multi-band satellite image of a cotton field. The image is composed of several layers, with a blue box highlighting a specific area of interest. The interface includes a top menu bar, a toolbar, and several docked panels on the left and right.

Browser Panel: Shows the project structure with Vector Tiles, XYZ Tiles (Google Hybrid, OpenStreetMap), WCS, and WFS / OGC API - Features.

GPS Information Panel: Includes fields for Add Feature, Add Track Point, Recenter, and Connect.

Connection Panel: Offers options for Autodetect, Serial device, and local gpsd.

Spatial Bookmark Manager: Contains a table with columns for Name, Group, xMin, and yMin.

Layers Panel: Lists the following layers:

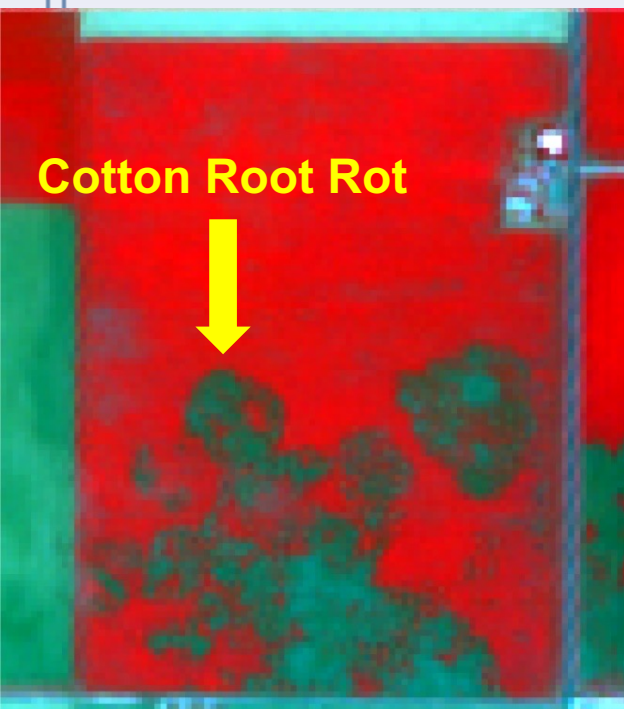
- "Clipped (extent)@4" - "Clipped (extent)"
- Clipped (extent)
- S711
 - Band 4: Layer_4
 - Band 3: Layer_3
 - Band 2: Layer_2
- S711crop
 - Band 4
 - Band 3
 - Band 2
- Merged
 - Band 4
 - Band 3
 - Band 2

Processing Toolbox: Lists various processing tools, including Raster extraction, Vector geoprocessing, and SAGA.

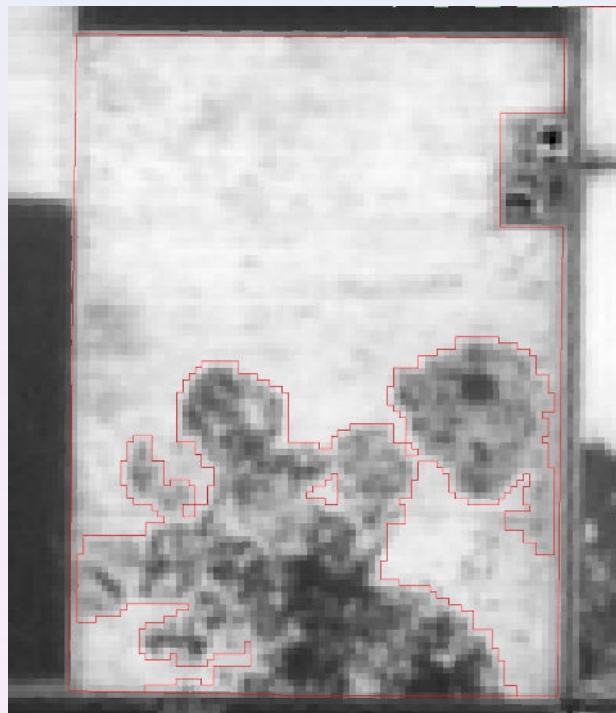
SCP & Dock Panel: Displays SCP Version 7.10.10 - Matera, a News section with a link to a GitHub issue, and a How to cite section with a citation for Congedo, Luca, (2021).

Status Bar: Shows the current coordinate (-10871877,3250592), scale (1:62247), magnifier (100%), rotation (0.0°), and render status (EP5G:3857).

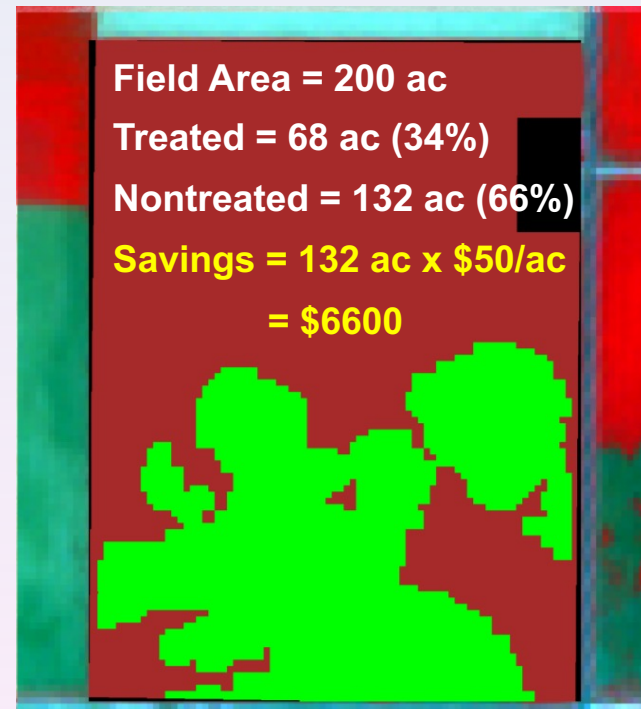
Create Prescription Map from NDVI Image for Site-specific Fungicide Application



Color-infrared image



NDVI map



Prescription map

Summary

- The free QGIS software can be used for downloading and processing free Sentinel-2 satellite imagery.
- Sentinel-2 imagery can be used to create prescription maps for site-specific management of crop problems and many other agricultural applications.
- This presentation serves as a first step to get you started. It will take some hands-on experience for you to feel comfortable to complete the process.

Questions?

Thank You!

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