



GEE Time Series Explorer

**Planetary-scale visualization
and temporal profile sampling of
EO imagery from the
Earth Engine Data Catalog in
QGIS and the EnMAP-Box**

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GEE (*Google Earth Engine*) Time Series Explorer

- user-friendly, GUI-based integration of GEE into QGIS / EnMAP-Box
- access to multi-petabytes of EO imagery like Sentinel, Landsat and MODIS collections
- no programming skills required

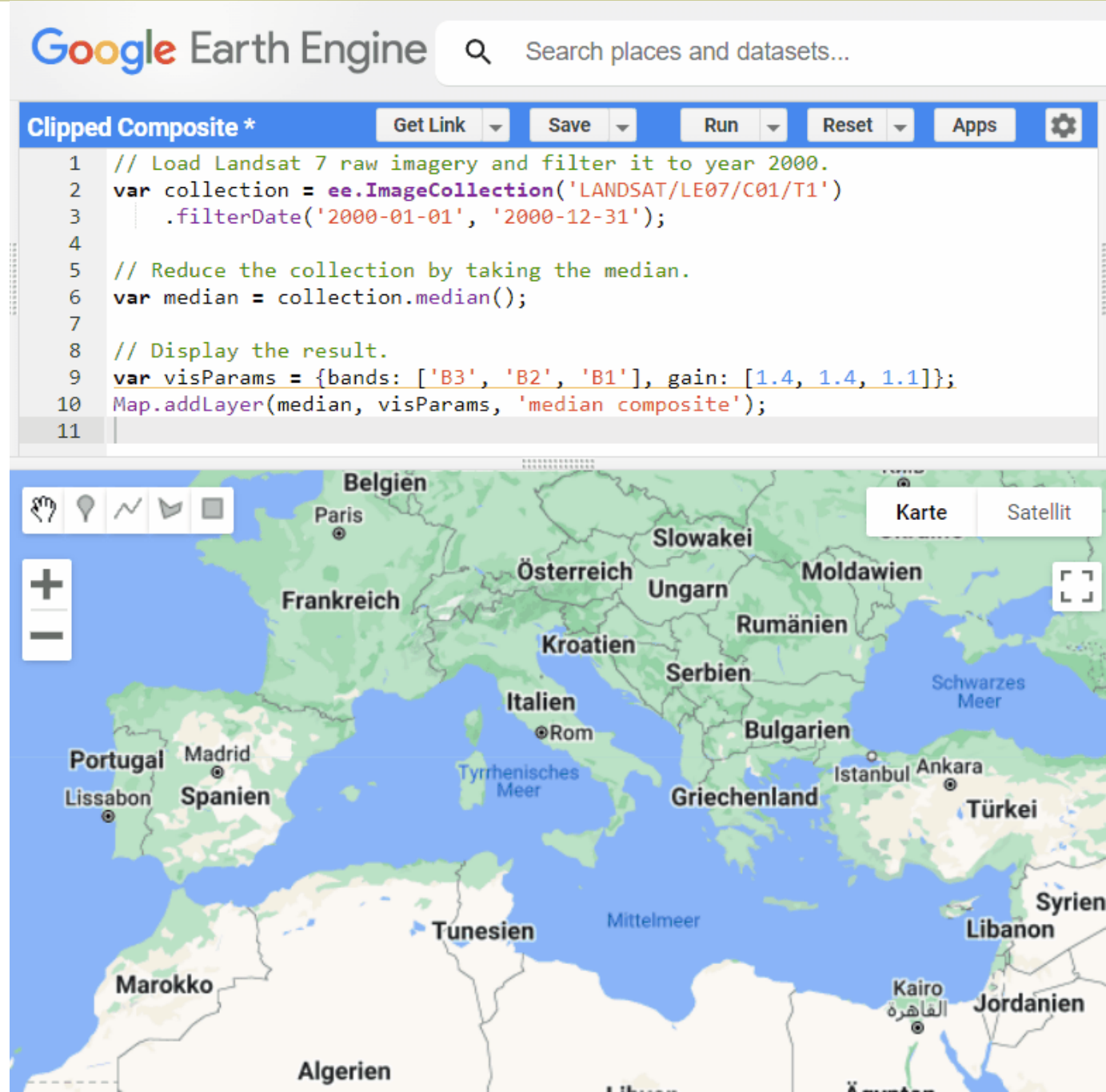


Google Earth Engine



Google Earth Engine

- web-based code editor
- interactive exploration of raw images and derived products
- easy to learn API
- but it takes some time to really learn all aspects of the API
- programming skills required



The screenshot displays the Google Earth Engine web interface. At the top, the Google Earth Engine logo is visible next to a search bar labeled "Search places and datasets...". Below the search bar, there is a blue header bar with the text "Clipped Composite *" and several buttons: "Get Link", "Save", "Run", "Reset", "Apps", and a settings gear icon.

```
1 // Load Landsat 7 raw imagery and filter it to year 2000.
2 var collection = ee.ImageCollection('LANDSAT/LE07/C01/T1')
3   .filterDate('2000-01-01', '2000-12-31');
4
5 // Reduce the collection by taking the median.
6 var median = collection.median();
7
8 // Display the result.
9 var visParams = {bands: ['B3', 'B2', 'B1'], gain: [1.4, 1.4, 1.1]};
10 Map.addLayer(median, visParams, 'median composite');
11
```

Below the code editor, a map of Europe and the Mediterranean region is shown. The map is labeled with various countries and cities in German, including Belgien, Frankreich, Italien, Griechenland, Türkei, and others. The map is displayed in a "Karte" (Map) view, with a "Satellit" (Satellite) view option also visible. The map shows a greenish tint, likely due to the Landsat 7 imagery being processed.

Google Earth Engine

- composite from >87k Landsat 7 scenes for the year 2000



Browsing

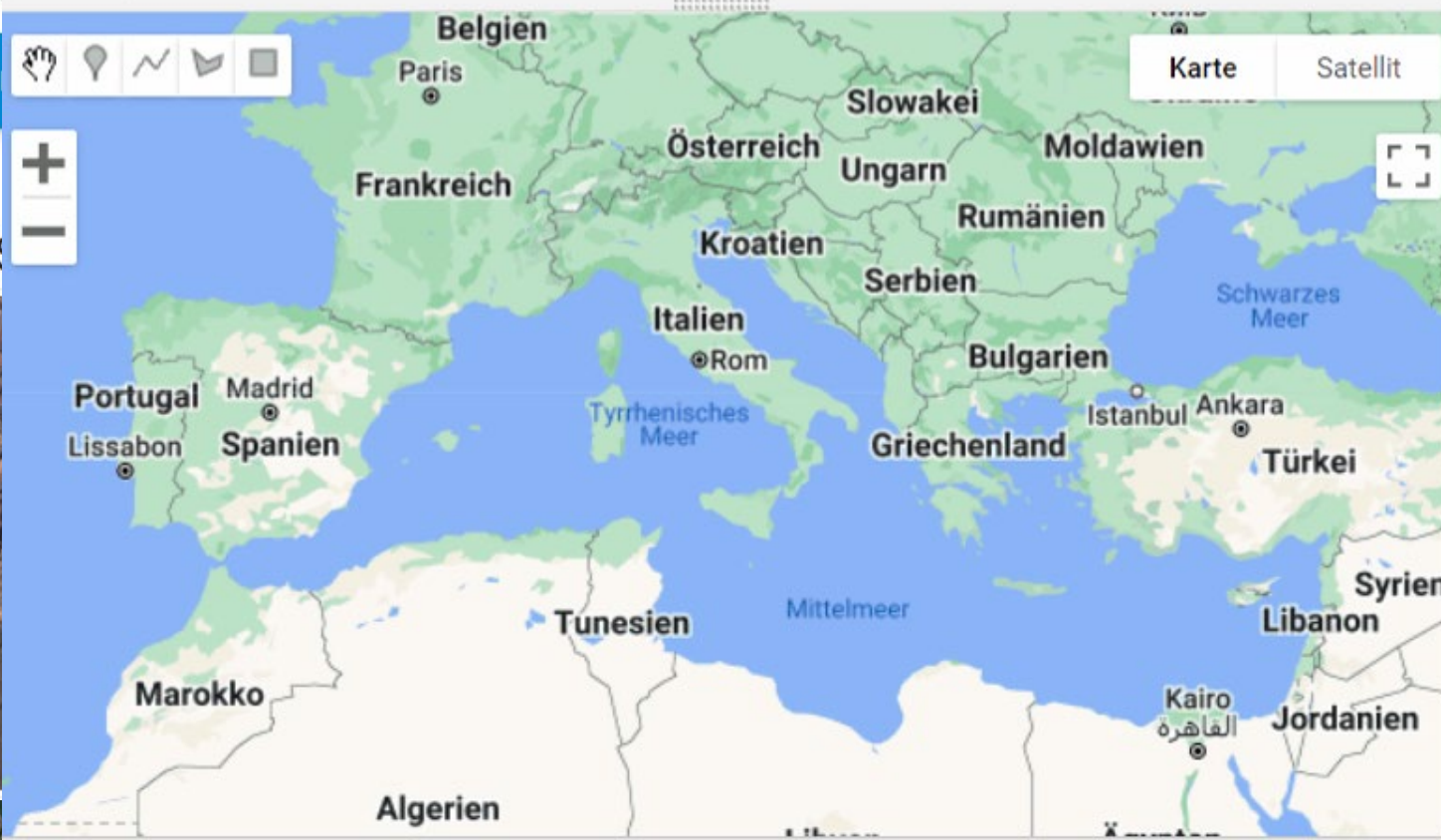
➤ a typical workflow

```

Clipped Composite *
Get Link Save Run Reset Apps

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10 Map.addLayer(median, visParams, 'median composite');
11

```



g
or

USGS Lands



distance algorithm.
 erature algorithm.
 not calculated.
 00), -1 = not calculated.

Browsing the *Earth Engine Data Catalog*



➤ using the GEE Time Series Explorer in QGIS

The screenshot shows the QGIS interface with the GEE Time Series Explorer plugin. The main map displays a satellite image of the Arctic region. The 'Layers' panel on the left shows 'GEE Image' and 'Google Maps' layers. The 'GEE Time Series Explorer' panel on the right is open, showing a 'Composite Viewer' with settings for 'Date range' (2021-06-01 to 2021-07-01), 'Season' (01-01 to 12-31), 'Extent' (planetary), and 'Reducer' (Band-wise, Mean).

Main Features of the GEE Time Series Explorer

- browsing the EE Data Catalog (already shown)

The screenshot shows the GEE Time Series Explorer interface. On the left is a map of Central Europe with a red bounding box around a region including Hamburg, Rostock, and Berlin. On the right is the 'Image Viewer' panel, which includes a 'Limit number of images' dropdown set to 1000 and a 'List Images' button. Below this is a table of available images:

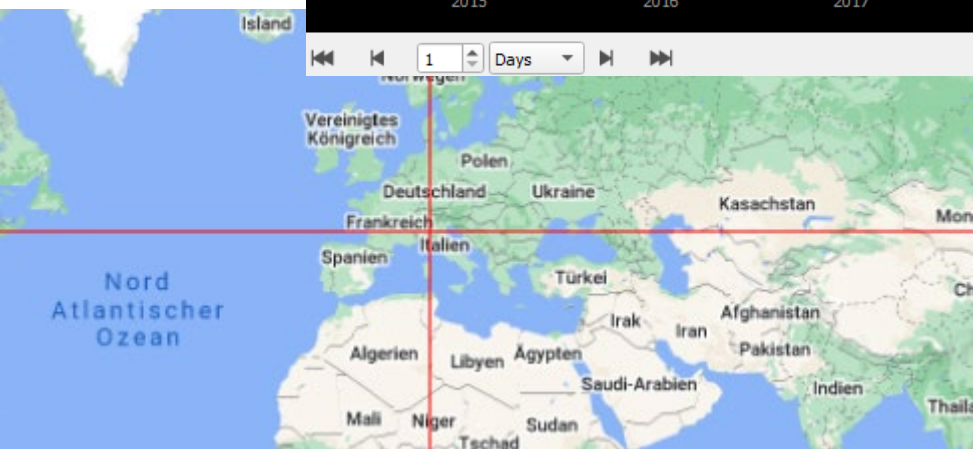
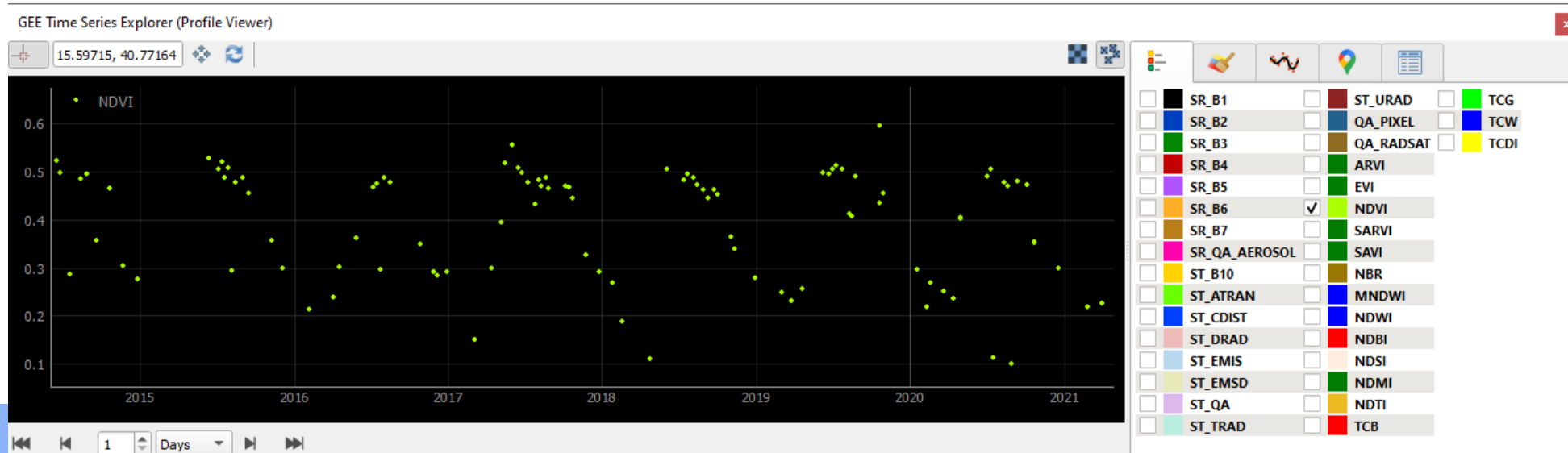
	Available Images	Acquisition Time	CLOUD_COVER	AL
1	LC09_194023_20220122	2022-01-22T10:09:00	84.87	LaSR
2	LC09_194023_20220207	2022-02-07T10:08:59	32.76	LaSR
3	LC09_194023_20220223	2022-02-23T10:08:50	46.47	LaSR
4	LC09_194023_20220311	2022-03-11T10:08:46	0.01	LaSR
5	LC09_194023_20220327	2022-03-27T11:08:40	10.37	LaSR
6	LC09_194023_20220412	2022-04-12T11:08:37	70.81	LaSR
7	LC09_194023_20220428	2022-04-28T11:08:29	26.77	LaSR

The screenshot shows the GEE Time Series Explorer interface with a composite image of the Arctic region on the left. On the right is the 'Composite Viewer' panel, which includes the following settings:

- Date range: 2021-06-01 to 2021-07-01
- Season: 01-01 to 12-31
- Extent: planetary
- Reducer: Uniform (selected), Band-wise
- Mean (selected)

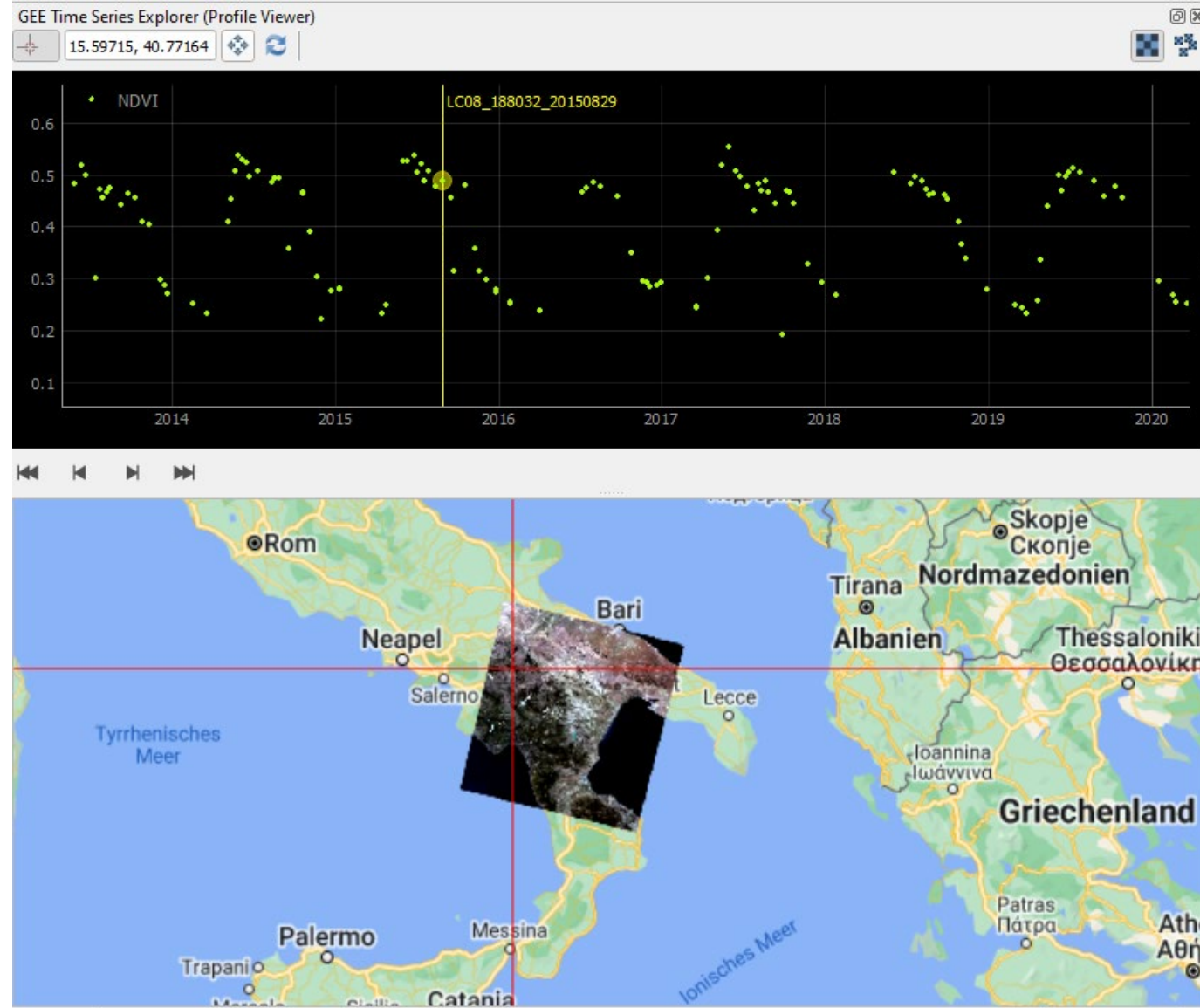
Main Features of the GEE Time Series Explorer

➤ temporal profile plotting



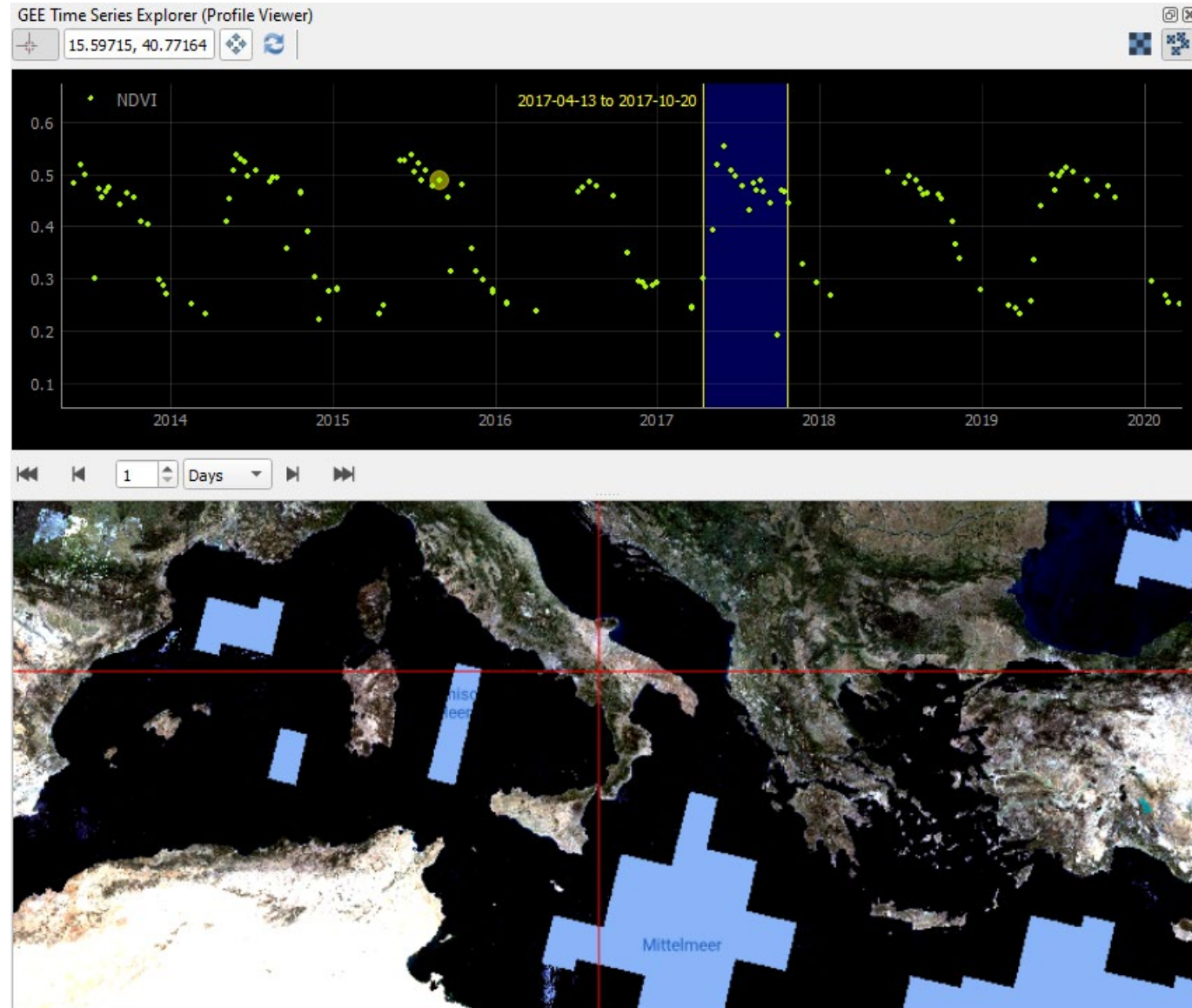
Main Features of the GEE Time Series Explorer

- temporal profile plotting



Main Features of the GEE Time Series Explorer

- temporal profile plotting





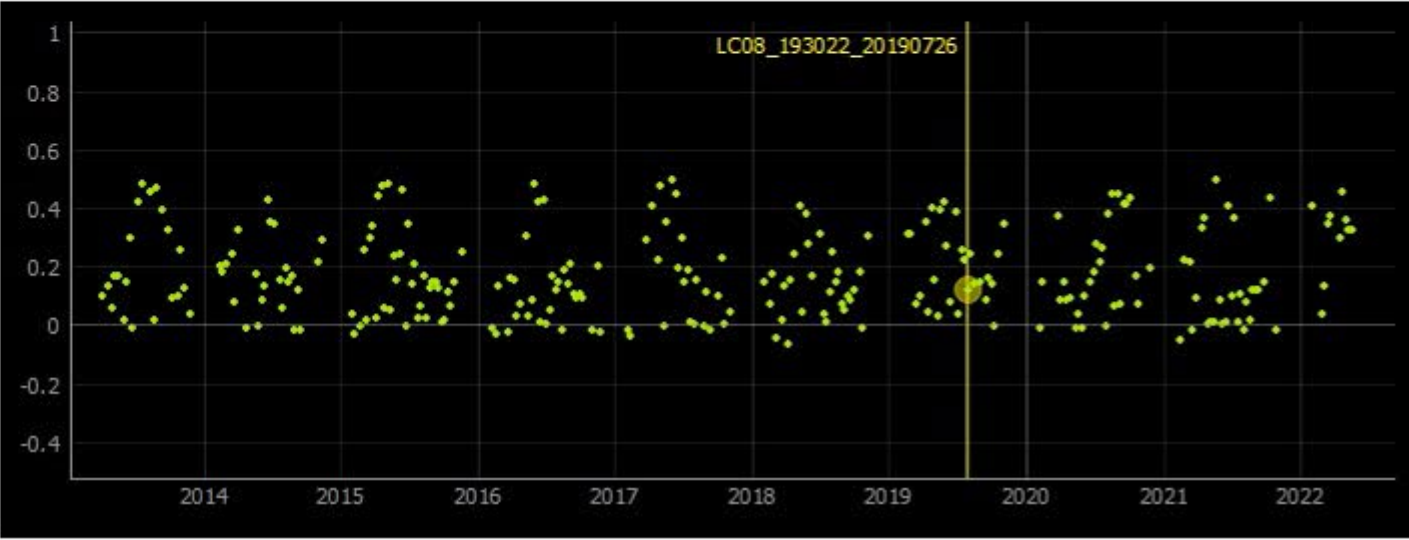
GEE Time Series Explorer (Profile Viewer)

» 12.84352, 54.18896

GEE Time Series Explorer



GEE Image
Google Maps

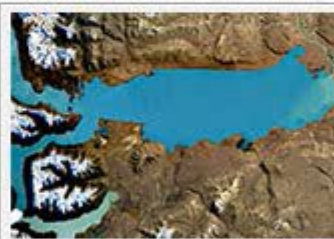


Landsat MODIS Sentinel HSI Custom



Landsat 9
Surface Reflectance

2021 - Present



Landsat 8
Surface Reflectance

2013 - Present



Landsat 7
Surface Reflectance

1999 - Present



Landsat 5
Surface Reflectance

1984 - 2012



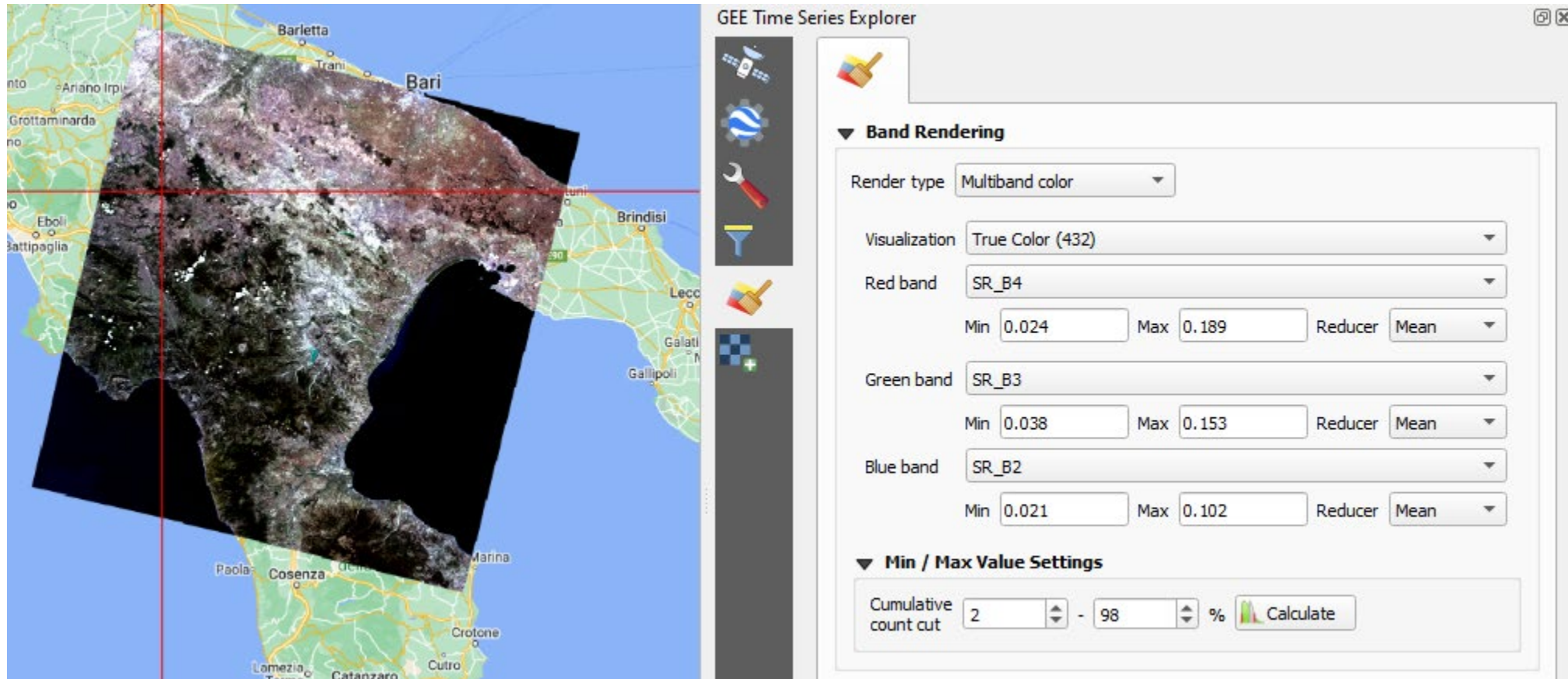
GEE Image ID Date Bands

Layer Name GEE Image

Collection USGS Landsat 8 Level 2, Collection 2, Tier 1

Main Features of the GEE Time Series Explorer

- QGIS-like styling of GEE WMS layer



The screenshot displays the GEE Time Series Explorer interface. On the left, a map of Italy is shown with a red crosshair indicating a selected location. The map is overlaid with a satellite-style image. On the right, the 'GEE Time Series Explorer' panel is visible, featuring a toolbar with icons for map navigation and styling. The main panel is divided into two sections: 'Band Rendering' and 'Min / Max Value Settings'.

Band Rendering

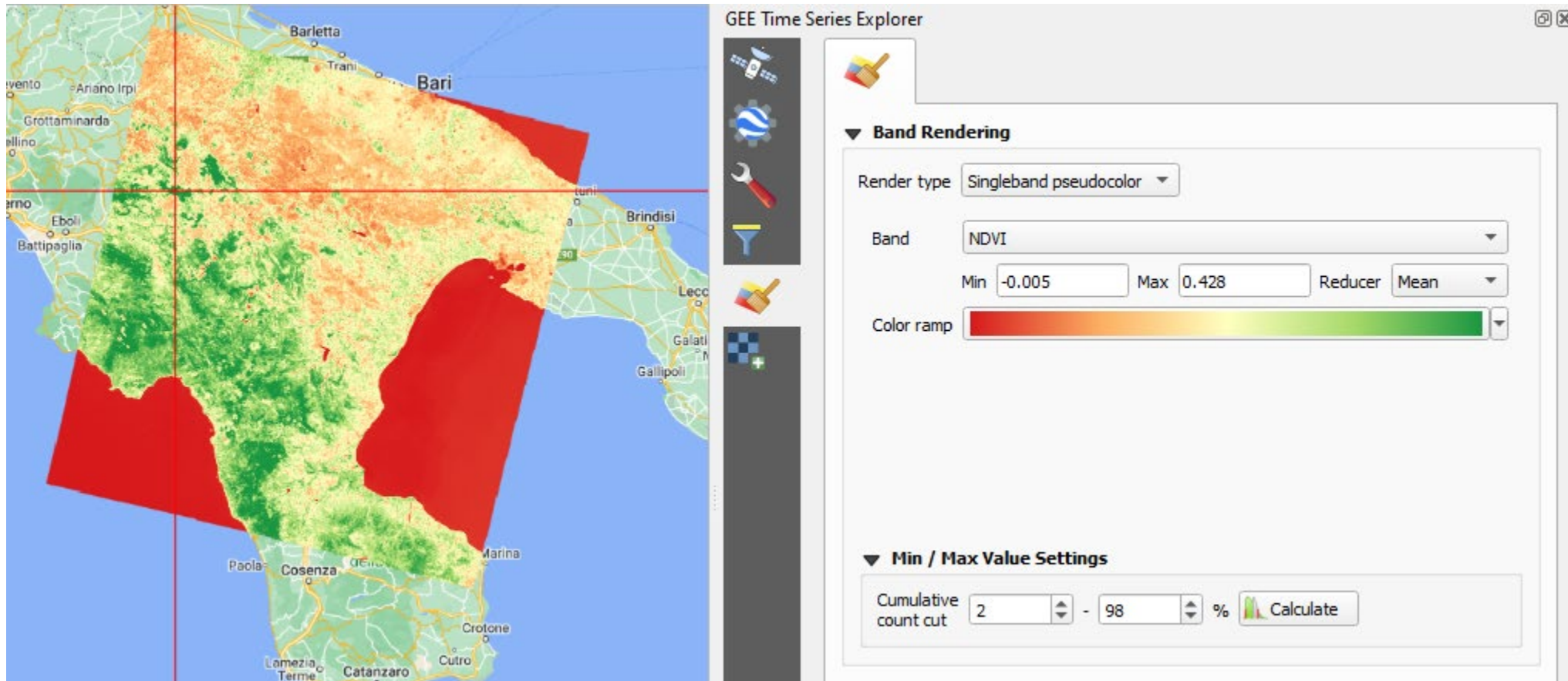
- Render type: Multiband color
- Visualization: True Color (432)
- Red band: SR_B4
Min: 0.024, Max: 0.189, Reducer: Mean
- Green band: SR_B3
Min: 0.038, Max: 0.153, Reducer: Mean
- Blue band: SR_B2
Min: 0.021, Max: 0.102, Reducer: Mean

Min / Max Value Settings

- Cumulative count cut: 2 - 98 %
- Calculate button

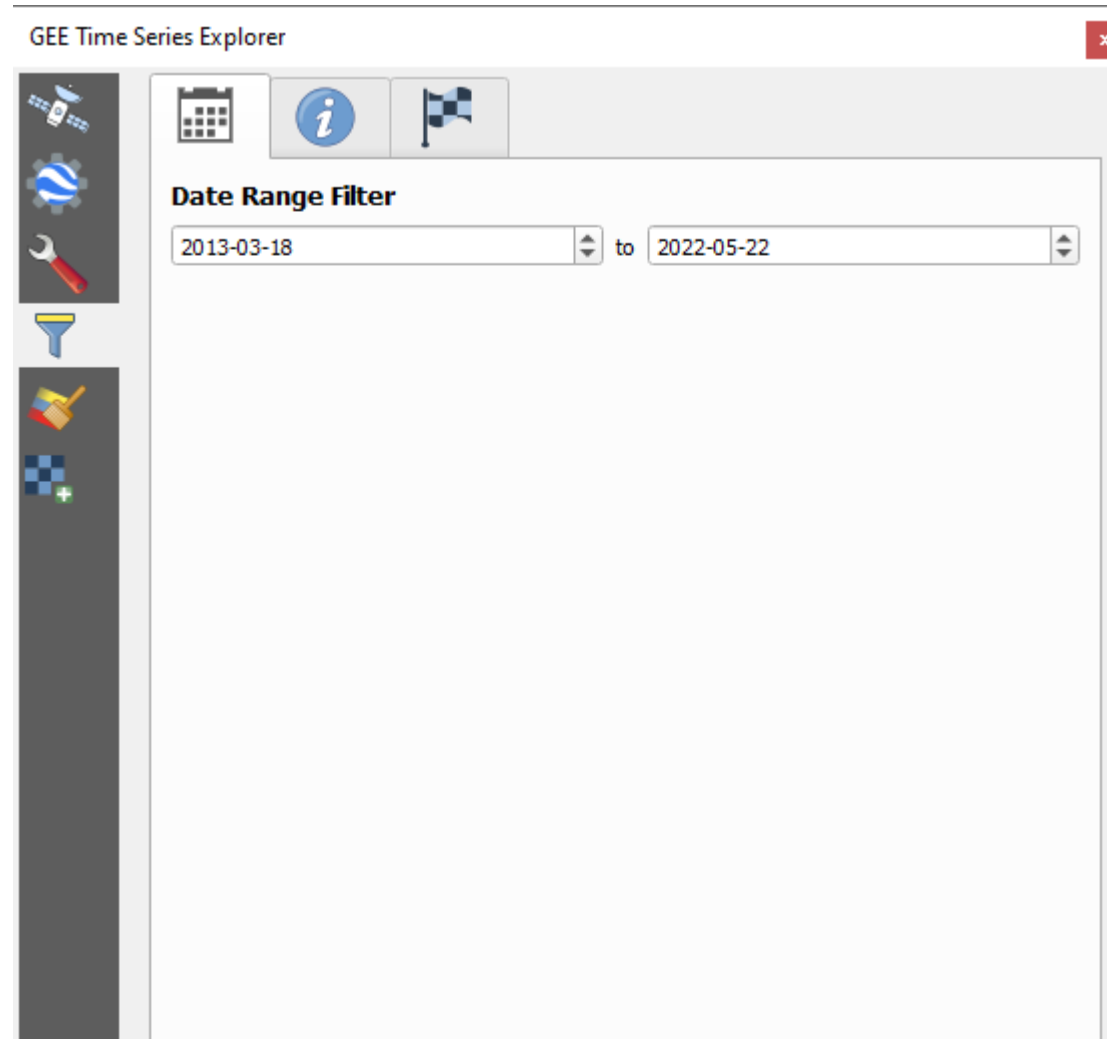
Main Features of the GEE Time Series Explorer

- QGIS-like styling of GEE WMS layer



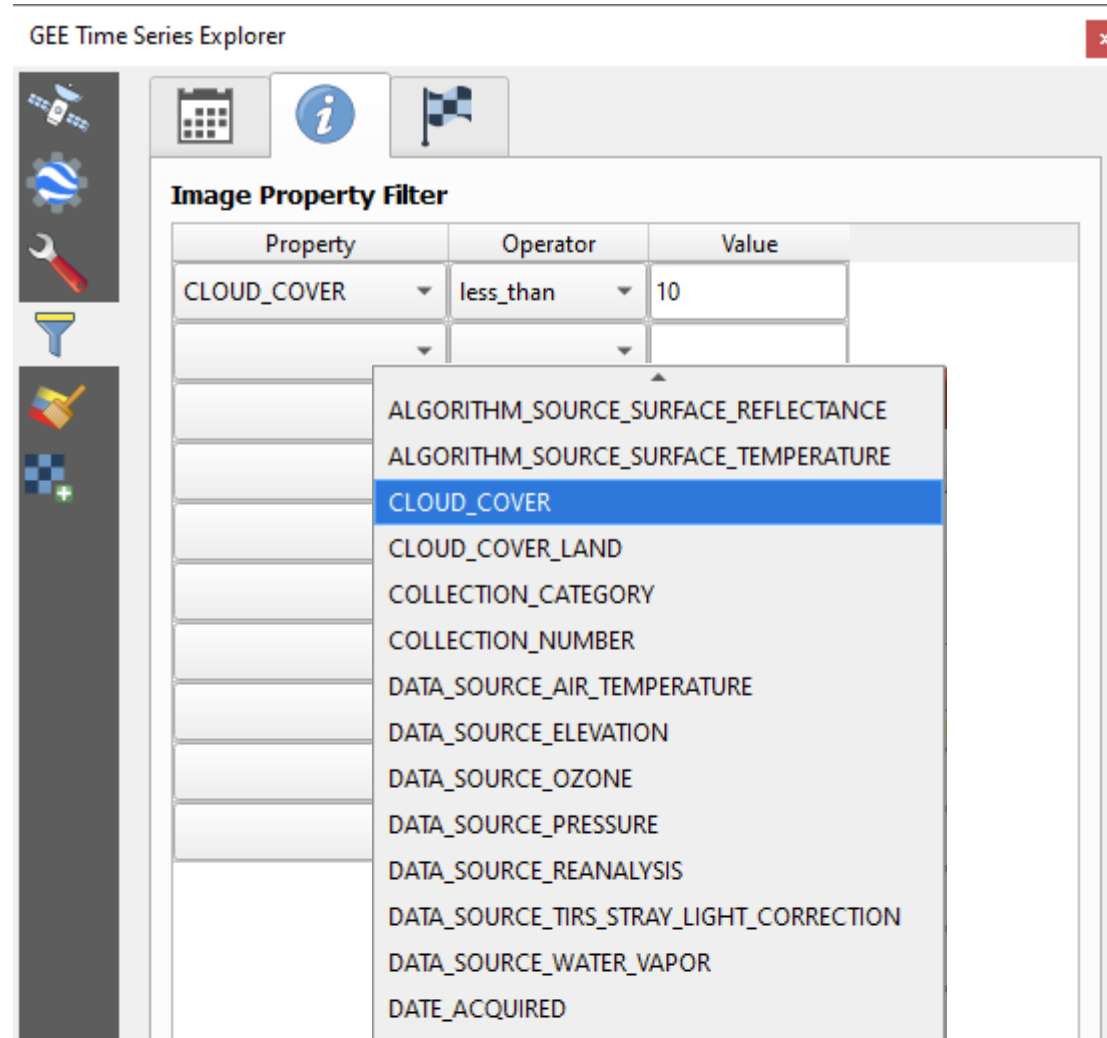
Main Features of the GEE Time Series Explorer

- image collection and pixel quality filtering



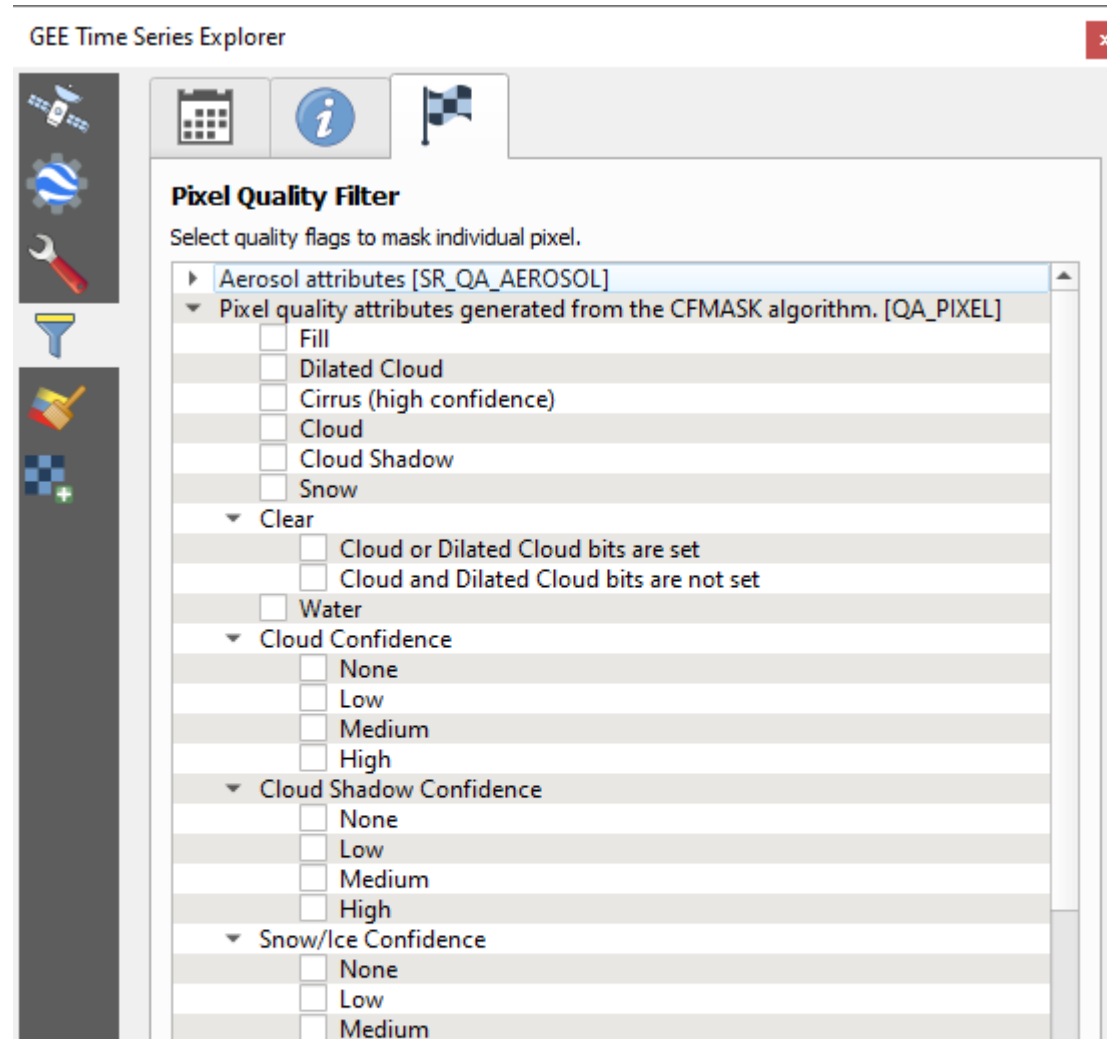
Main Features of the GEE Time Series Explorer

- image collection and pixel quality filtering



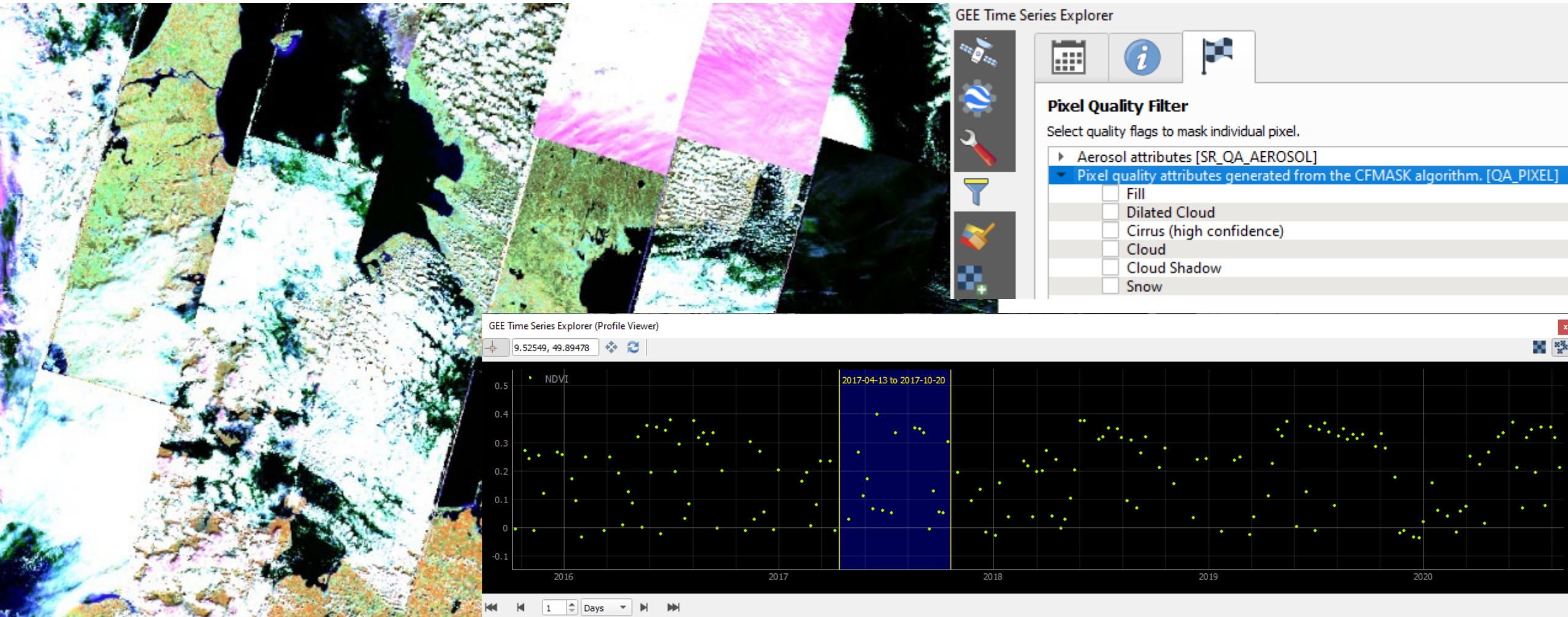
Main Features of the GEE Time Series Explorer

- image collection and pixel quality filtering



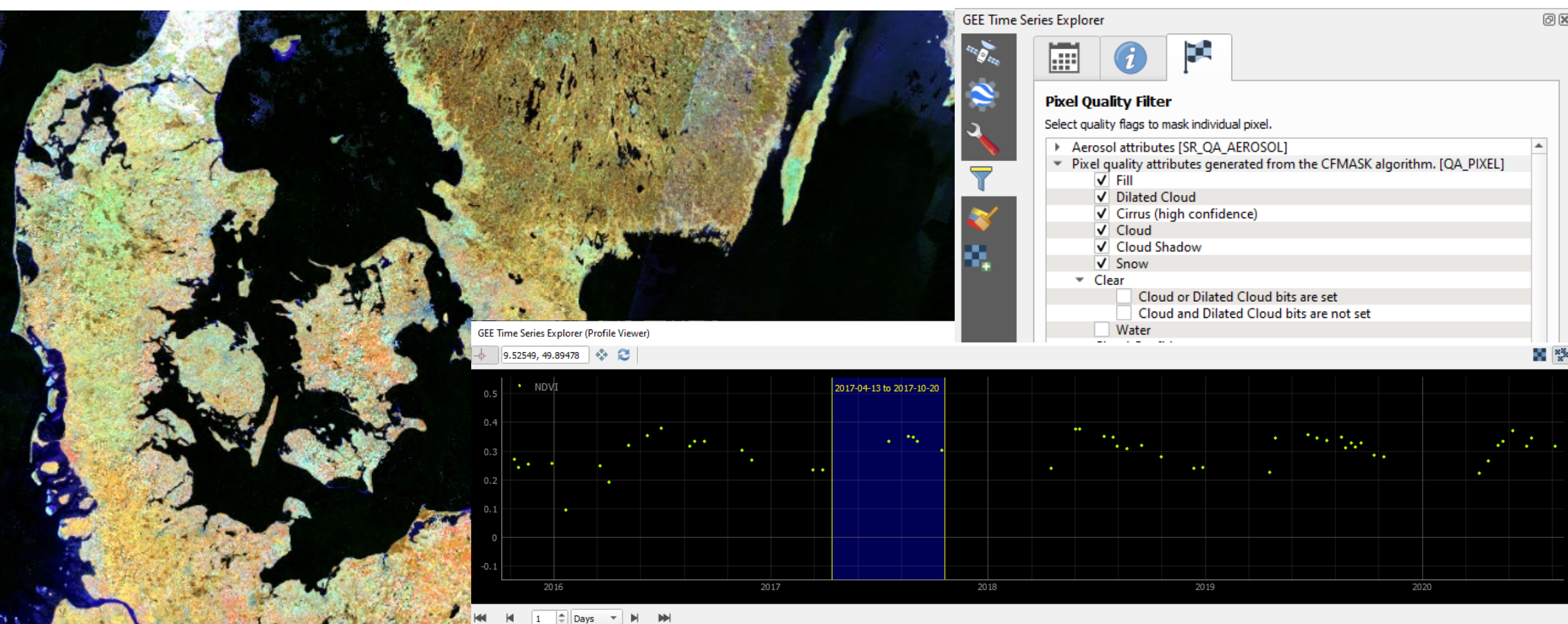
Main Features of the GEE Time Series Explorer

➤ pixel quality screening



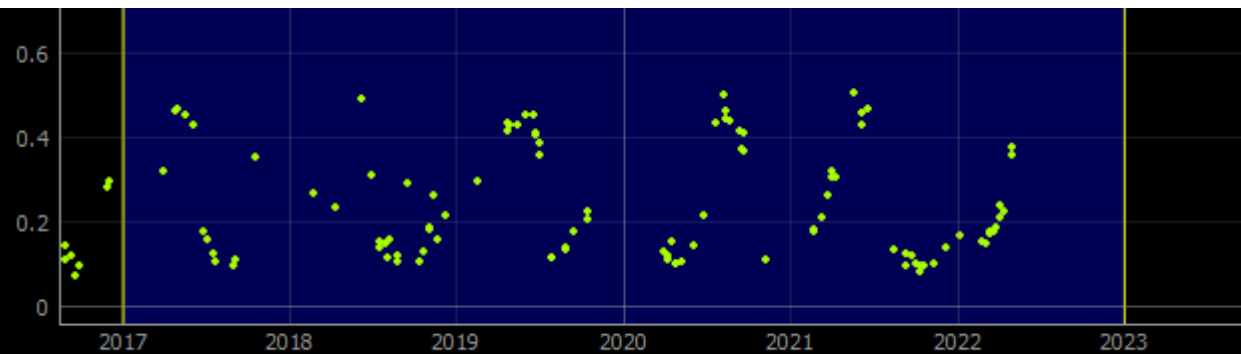
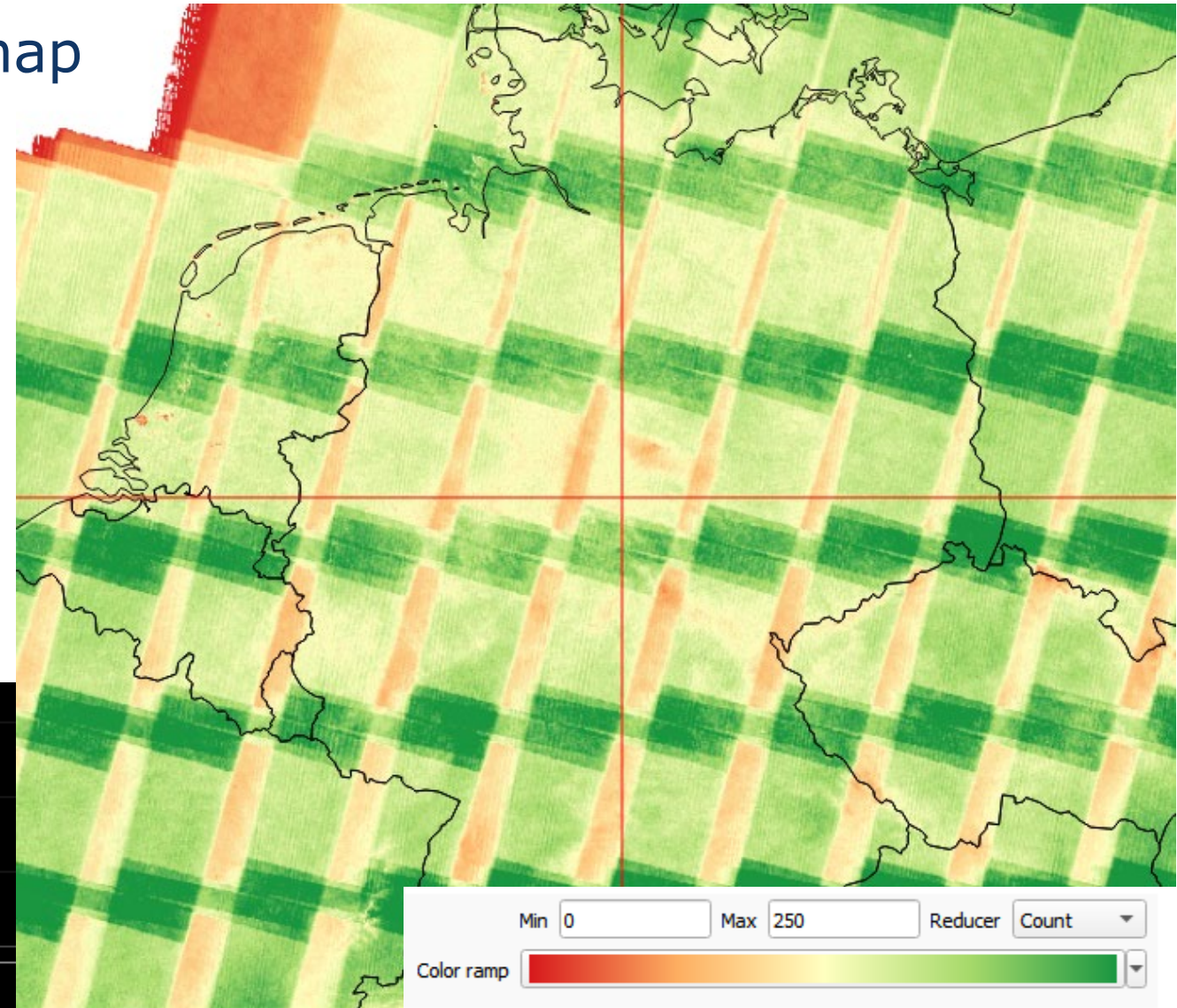
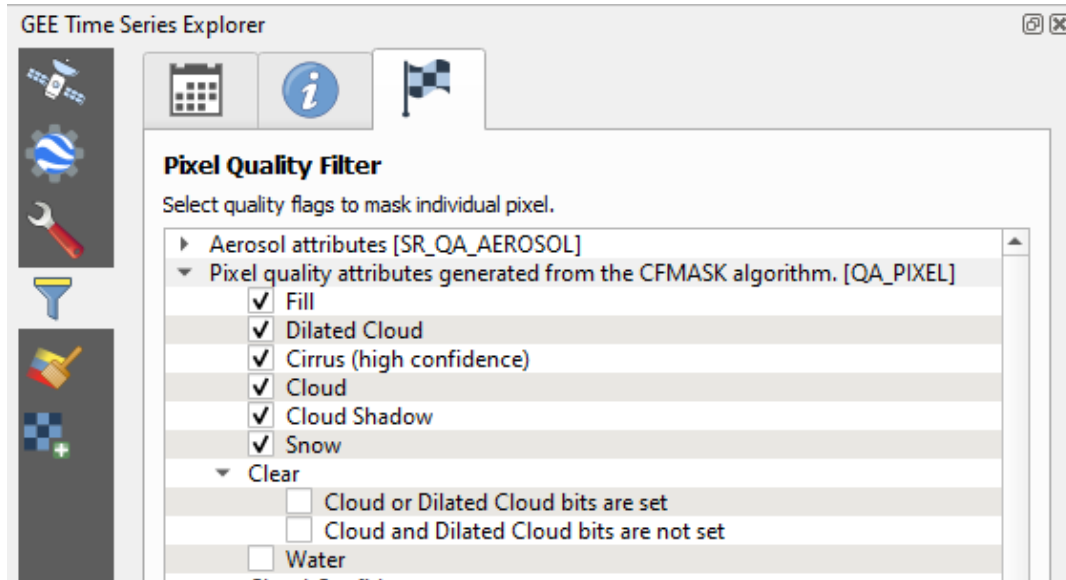
Main Features of the GEE Time Series Explorer

- pixel quality screening



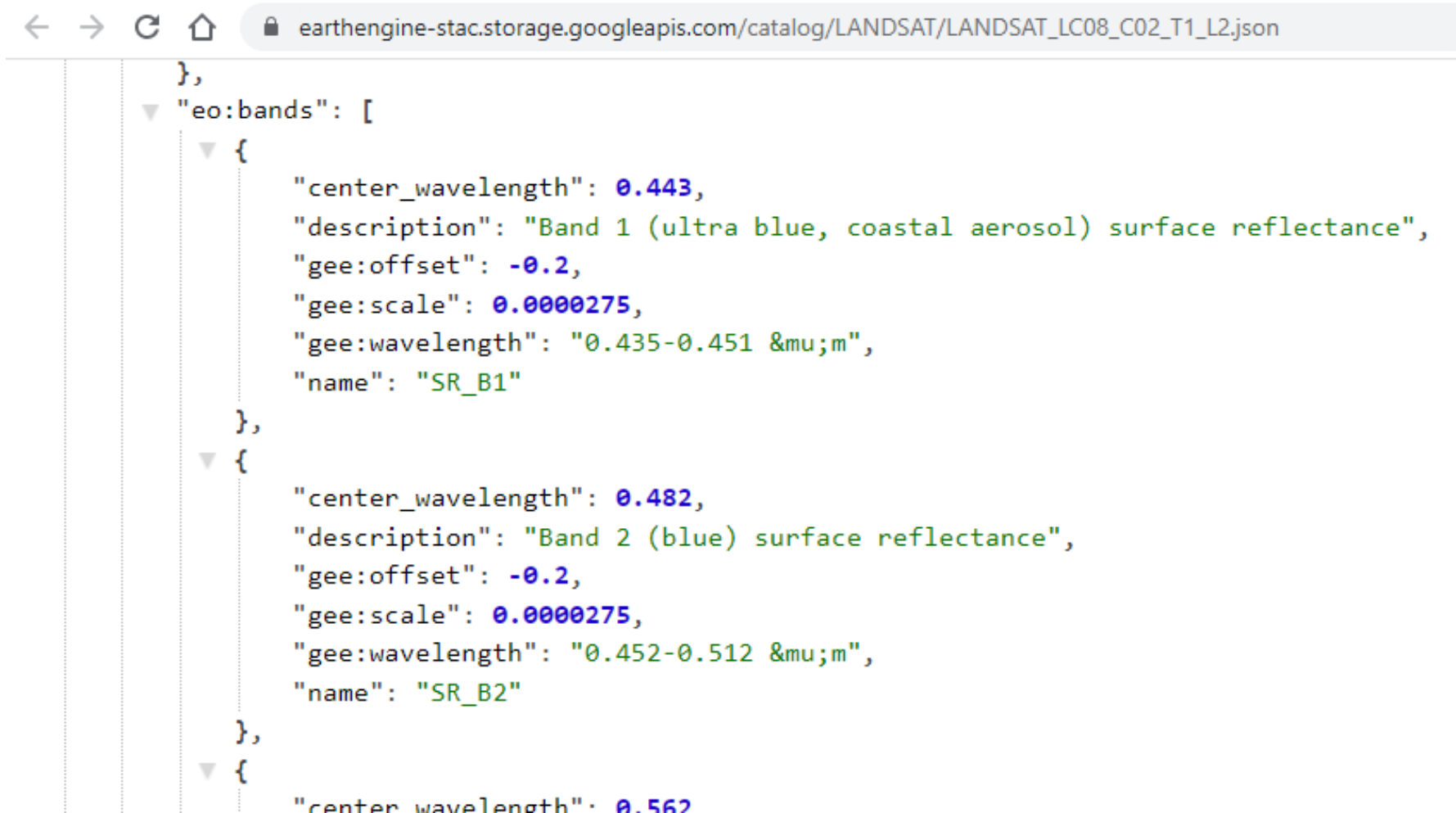
Main Features of the GEE Time Series Explorer

➤ clear-observation-counts heatmap



Main Features of the GEE Time Series Explorer

- capitalise on provided metadata



```
← → ↻ 🏠 🔒 earthengine-stac.storage.googleapis.com/catalog/LANDSAT/LANDSAT_LC08_C02_T1_L2.json
},
  "eo:bands": [
    {
      "center_wavelength": 0.443,
      "description": "Band 1 (ultra blue, coastal aerosol) surface reflectance",
      "gee:offset": -0.2,
      "gee:scale": 0.0000275,
      "gee:wavelength": "0.435-0.451 &mu;m",
      "name": "SR_B1"
    },
    {
      "center_wavelength": 0.482,
      "description": "Band 2 (blue) surface reflectance",
      "gee:offset": -0.2,
      "gee:scale": 0.0000275,
      "gee:wavelength": "0.452-0.512 &mu;m",
      "name": "SR_B2"
    },
    {
      "center_wavelength": 0.562
```

Main Features of the GEE Time Series Explorer

- capitalise on provided metadata: present information

GEE Time Series Explorer

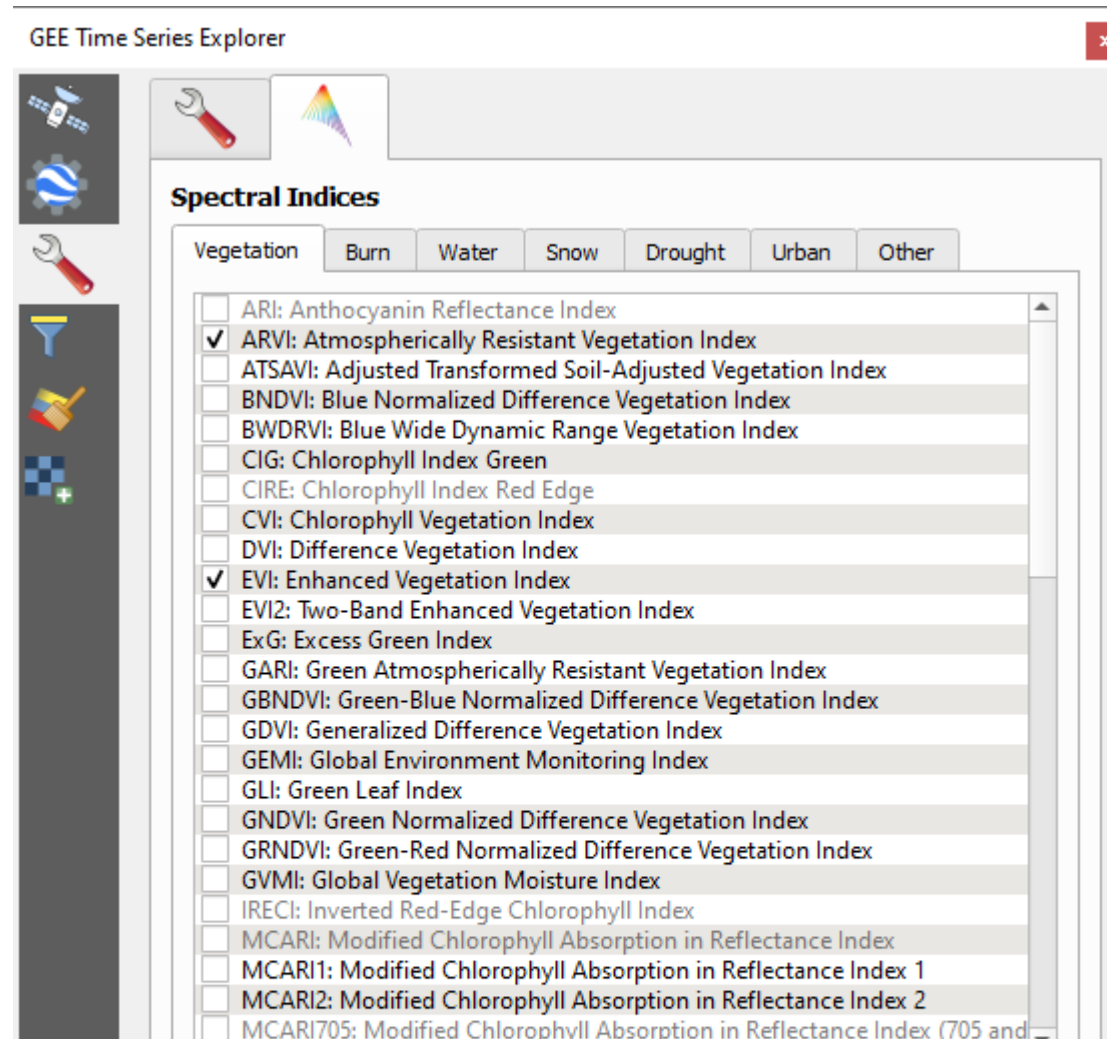
Band Properties

Apply data offset and scale

	Band name	Wavelength	Offset	Scale	Show in Z-Profile	Description
1	SR_B1	443.0	-0.2	2.75e-05	<input checked="" type="checkbox"/>	Band 1 (ultra blue, coastal aerosol) surface reflectance
2	SR_B2	482.0	-0.2	2.75e-05	<input checked="" type="checkbox"/>	Band 2 (blue) surface reflectance
3	SR_B3	562.0	-0.2	2.75e-05	<input checked="" type="checkbox"/>	Band 3 (green) surface reflectance
4	SR_B4	655.0	-0.2	2.75e-05	<input checked="" type="checkbox"/>	Band 4 (red) surface reflectance
5	SR_B5	865.0	-0.2	2.75e-05	<input checked="" type="checkbox"/>	Band 5 (near infrared) surface reflectance
6	SR_B6	1609.0	-0.2	2.75e-05	<input checked="" type="checkbox"/>	Band 6 (shortwave infrared 1) surface reflectance
7	SR_B7	2201.0	-0.2	2.75e-05	<input checked="" type="checkbox"/>	Band 7 (shortwave infrared 2) surface reflectance
8	SR_QA_AEROSOL				<input checked="" type="checkbox"/>	Aerosol attributes
9	ST_B10		149	0.00341802	<input checked="" type="checkbox"/>	Band 10 surface temperature. If 'PROCESSING_LEVEL' is set to 'L2SR', this band is fully masked out.
10	ST_ATRAN			0.0001	<input checked="" type="checkbox"/>	Atmospheric Transmittance. If 'PROCESSING_LEVEL' is set to 'L2SR', this band is fully masked out.
11	ST_CDIST			0.01	<input checked="" type="checkbox"/>	Pixel distance to cloud. If 'PROCESSING_LEVEL' is set to 'L2SR', this band is fully masked out.
12	ST_DRAD			0.001	<input checked="" type="checkbox"/>	Downwelled Radiance. If 'PROCESSING_LEVEL' is set to 'L2SR', this band is fully masked out. Emissivity of Band 10 estimated from ASTER GED.

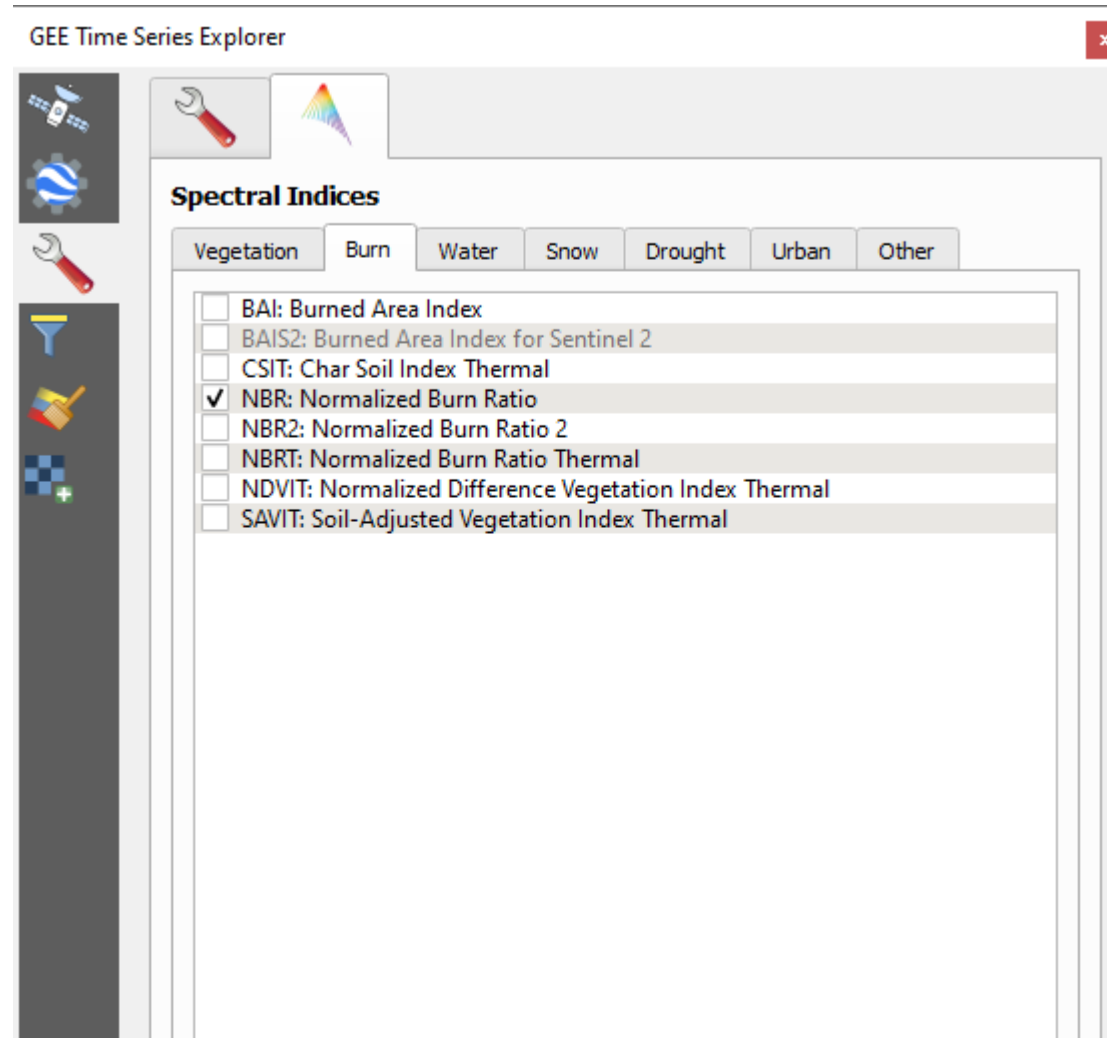
Main Features of the GEE Time Series Explorer

- capitalise on provided metadata: prepare spectral indices



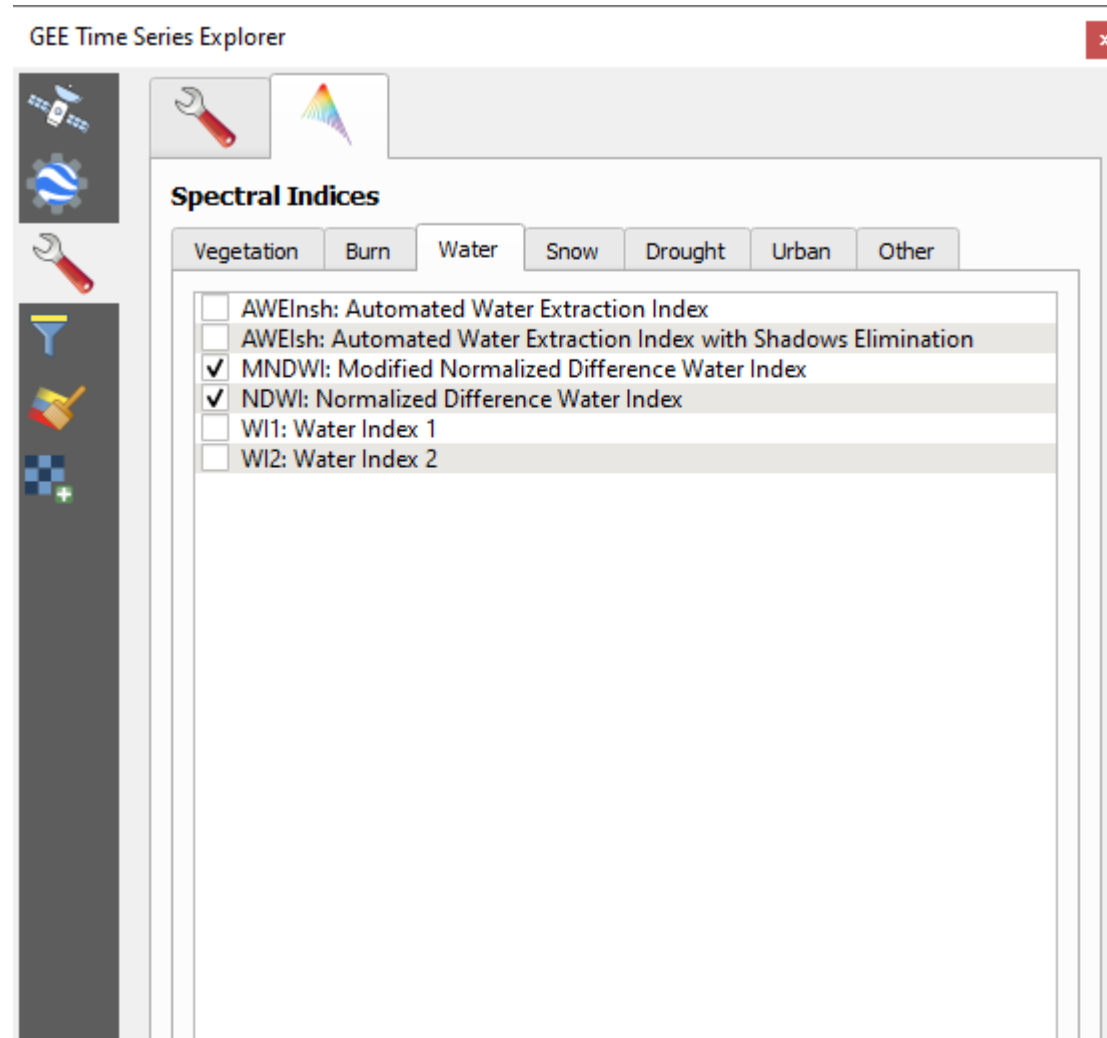
Main Features of the GEE Time Series Explorer

- capitalise on provided metadata: prepare spectral indices



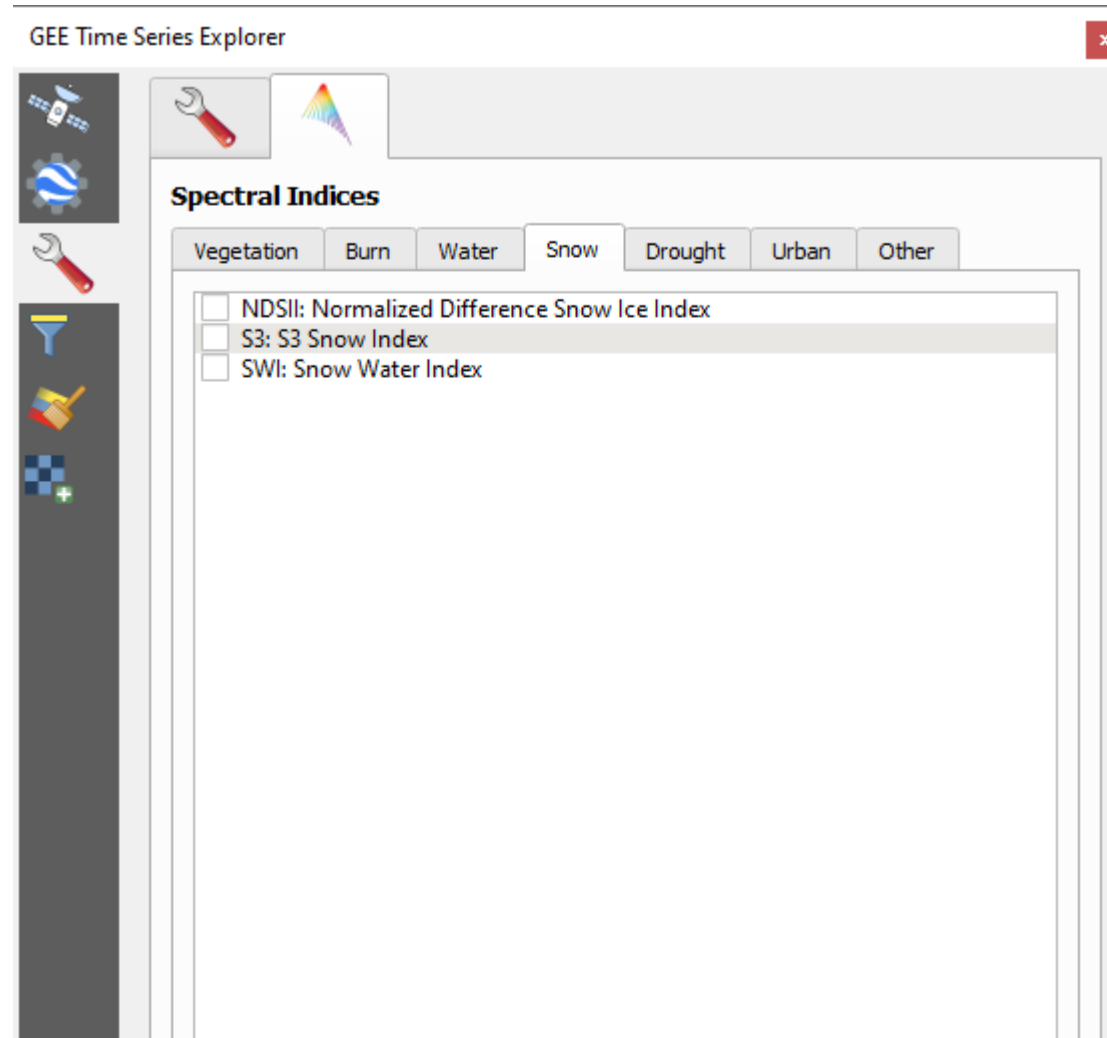
Main Features of the GEE Time Series Explorer

- capitalise on provided metadata: prepare spectral indices



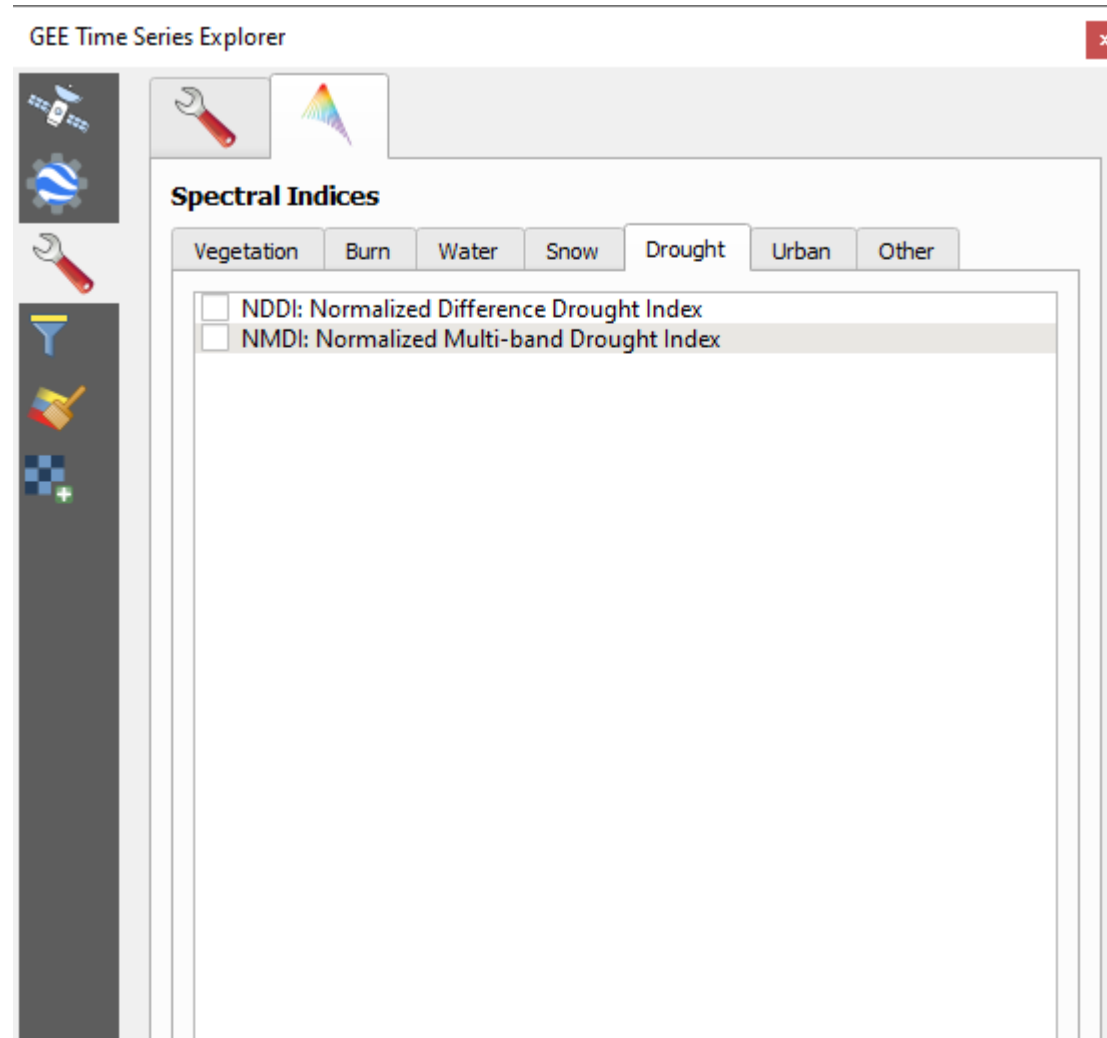
Main Features of the GEE Time Series Explorer

- capitalise on provided metadata: prepare spectral indices



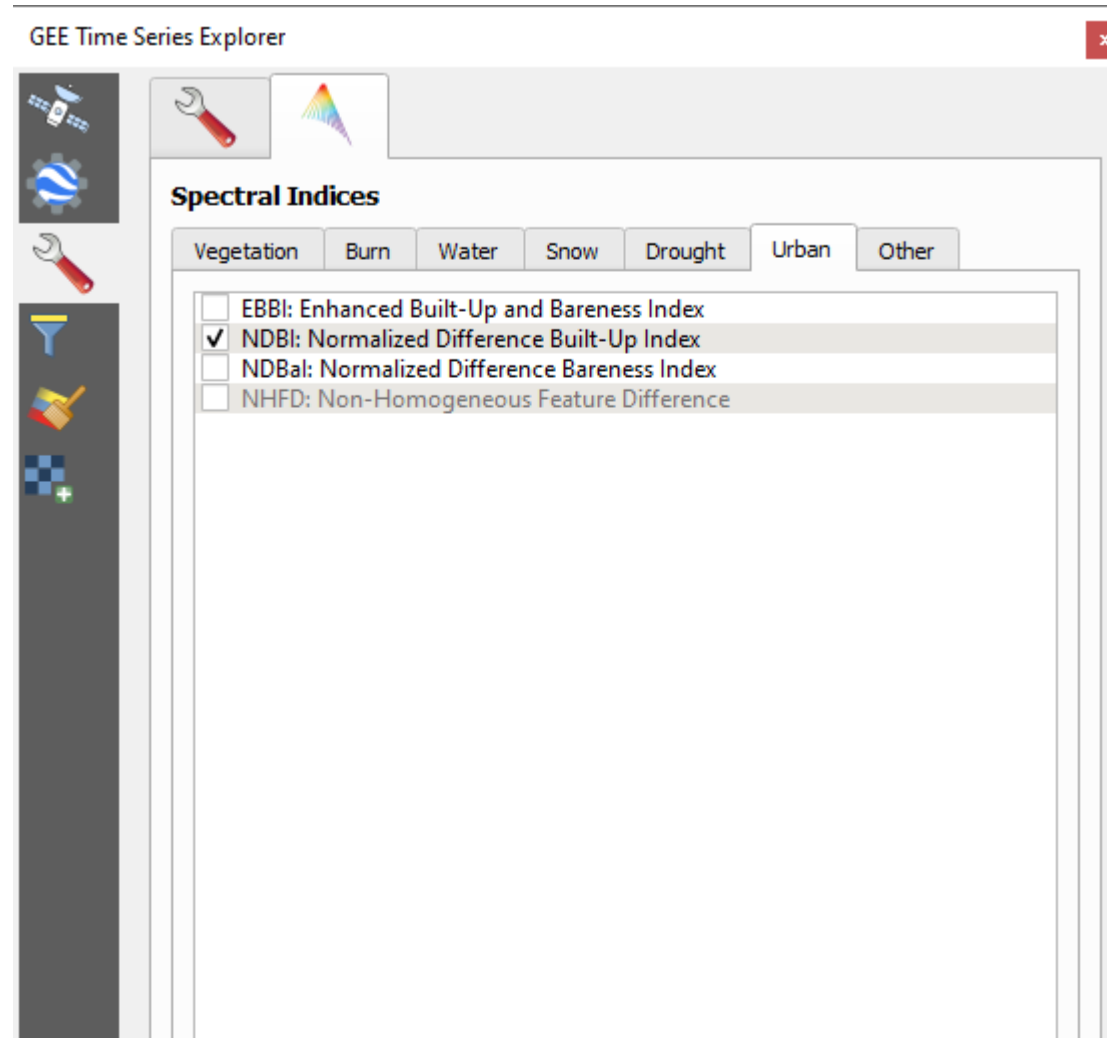
Main Features of the GEE Time Series Explorer

- capitalise on provided metadata: prepare spectral indices



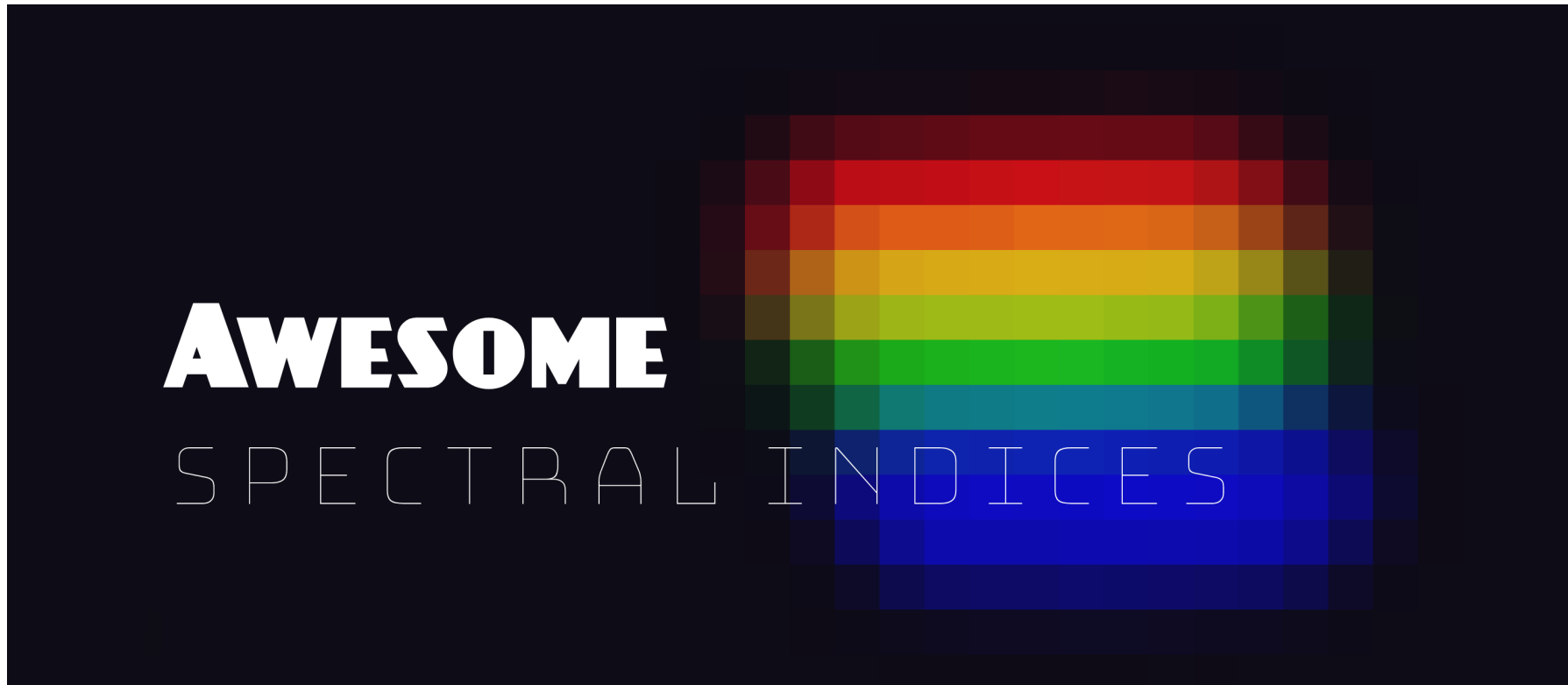
Main Features of the GEE Time Series Explorer

- capitalise on provided metadata: prepare spectral indices



Main Features of the GEE Time Series Explorer

- capitalise on provided metadata: prepare spectral indices
<https://awesome-ee-spectral-indices.readthedocs.io>



Main Features of the GEE Time Series Explorer

- capitalise on provided metadata: sort images by properties

GEE Time Series Explorer

Image Viewer

Limit number of images 1000 List Images

	Available Images	Acquisition Time	CLOUD_COVER	CLOUD_COVER_LAND	ALGORITHM_SOURCE_SURFACE_REFLECTANCE	ALGORITHM_SOURCE_SURFACE_TEMPERATURE	COLLECTION_CATEGORY	COLLECTION_NUMBER	DATA_SOURCE_AIR_TEMPERAT
1	LC08_195025_20220513	2022-05-13T11:15:37	45.39	45.39	LaSRC_1.5.0	st_1.3.0	T1	2	MODIS
2	LC08_195025_20220427	2022-04-27T11:15:28	17.75	17.75	LaSRC_1.5.0	st_1.3.0	T1	2	MODIS
3	LC08_195025_20220411	2022-04-11T11:15:32	0.97	0.97	LaSRC_1.5.0	st_1.3.0	T1	2	MODIS
4	LC08_195025_20220326	2022-03-26T10:15:30	0.03	0.03	LaSRC_1.5.0	st_1.3.0	T1	2	MODIS
5	LC08_195025_20220310	2022-03-10T10:15:41	0.22	0.22	LaSRC_1.5.0	st_1.3.0	T1	2	MODIS
6	LC08_195025_20220222	2022-02-22T10:15:44	93.20	93.20	LaSRC_1.5.0	st_1.3.0	T1	2	MODIS
7	LC08_195025_20220105	2022-01-05T10:15:57	78.40	78.40	LaSRC_1.5.0	st_1.3.0	T1	2	MODIS
8	LC08_195025_20211220	2021-12-20T10:16:02	3.19	3.19	LaSRC_1.5.0	st_1.3.0	T1	2	MODIS
9	LC08_195025_20211118	2021-11-18T10:16:02	100.00	100.00	LaSRC_1.5.0	st_1.3.0	T1	2	MODIS
10	LC08_195025_20211102	2021-11-02T10:16:08	86.20	86.20	LaSRC_1.5.0	st_1.3.0	T1	2	MODIS
11	LC08_195025_20211017	2021-10-17T11:16:08	75.29	75.29	LaSRC_1.5.0	st_1.3.0	T1	2	MODIS
12	LC08_195025_20211001	2021-10-01T11:16:01	6.01	6.01	LaSRC_1.5.0	st_1.3.0	T1	2	MODIS

Image LC08_194025_20130401

GEE Image ID Date Bands

Layer Name GEE Image

Collection USGS Landsat 8 Level 2, Collection 2, Tier 1

Main Features of the GEE Time Series Explorer

- capitalise on provided metadata: sort images by properties

GEE Time Series Explorer

Image Viewer

Limit number of images List Images

	Available Images	Acquisition Time	CLOUD_COVER	CLOUD_COVER_LAND	ALGORITHM_SOURCE_SURFACE_REFLECTANCE	ALGORITHM_SOURCE_SURFACE_TEMPERATURE	COLLECTION_CATEGORY	COLLECTION_NUMBER	DATA_SOURCE_AIR_TEMPERAT
1	LC08_194025_20140313	2014-03-13T10:10:03	0.01	0.01	LaSRC_1.5.0	st_1.3.0	T1	2	MODIS
2	LC08_194025_20160825	2016-08-25T11:09:40	0.01	0.01	LaSRC_1.5.0	st_1.3.0	T1	2	MODIS
3	LC08_195025_20150424	2015-04-24T11:15:02	0.01	0.01	LaSRC_1.5.0	st_1.3.0	T1	2	MODIS
4	LC08_195025_20170328	2017-03-28T11:15:18	0.01	0.01	LaSRC_1.5.0	st_1.3.0	T1	2	MODIS
5	LC08_195025_20190419	2019-04-19T11:15:08	0.01	0.01	LaSRC_1.5.0	st_1.3.0	T1	2	MODIS
6	LC08_195025_20200405	2020-04-05T11:15:22	0.01	0.01	LaSRC_1.5.0	st_1.3.0	T1	2	MODIS
7	LC08_195025_20200421	2020-04-21T11:15:15	0.01	0.01	LaSRC_1.5.0	st_1.3.0	T1	2	MODIS
8	LC08_195025_20200507	2020-05-07T11:15:06	0.01	0.01	LaSRC_1.5.0	st_1.3.0	T1	2	MODIS
9	LC08_194025_20200921	2020-09-21T11:09:48	0.02	0.02	LaSRC_1.5.0	st_1.3.0	T1	2	MODIS
10	LC08_195025_20151001	2015-10-01T11:15:43	0.02	0.02	LaSRC_1.5.0	st_1.3.0	T1	2	MODIS
11	LC08_195025_20190724	2019-07-24T11:15:42	0.02	0.02	LaSRC_1.5.0	st_1.3.0	T1	2	MODIS
12	LC08_195025_20200306	2020-03-06T11:15:00	0.02	0.02	LaSRC_1.5.0	st_1.3.0	T1	2	MODIS

Image

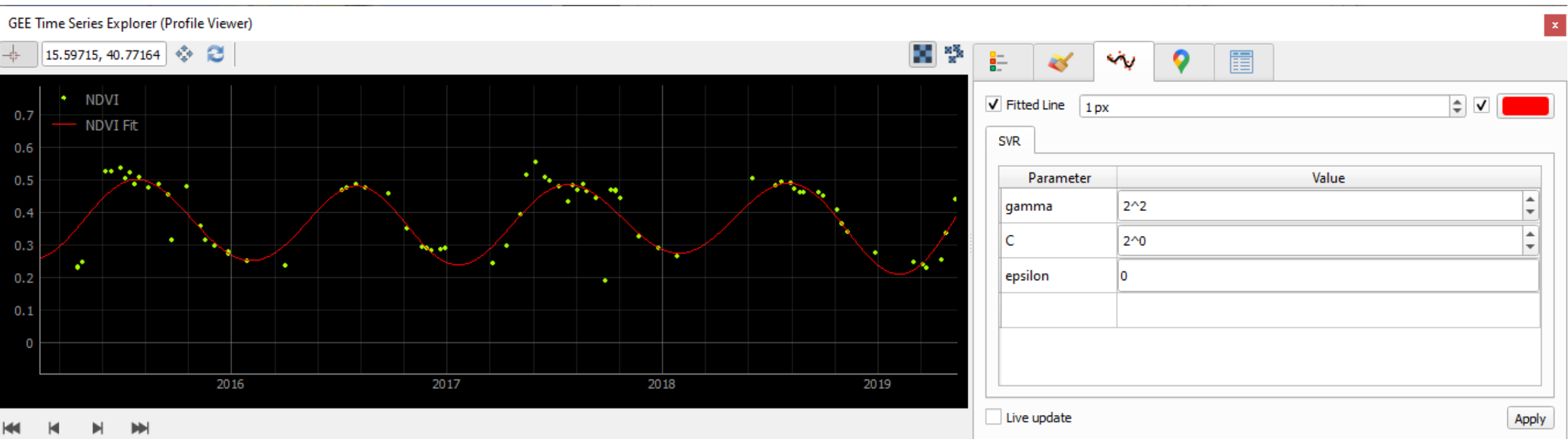
GEE Image ID Date Bands

Layer Name GEE Image

Collection USGS Landsat 8 Level 2, Collection 2, Tier 1

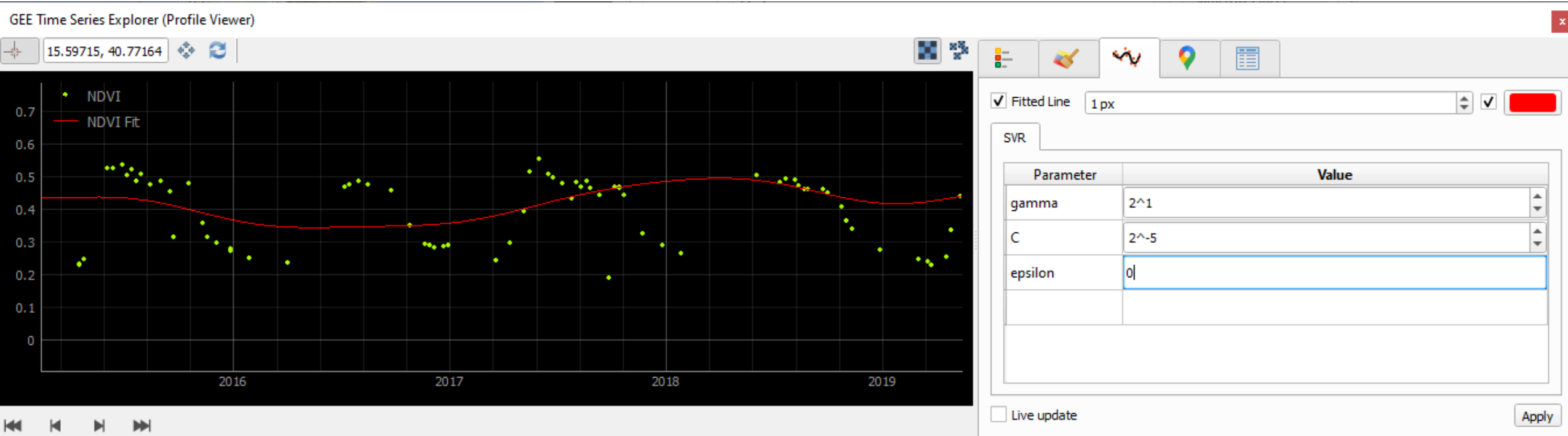
Main Features of the GEE Time Series Explorer

- profile fitting



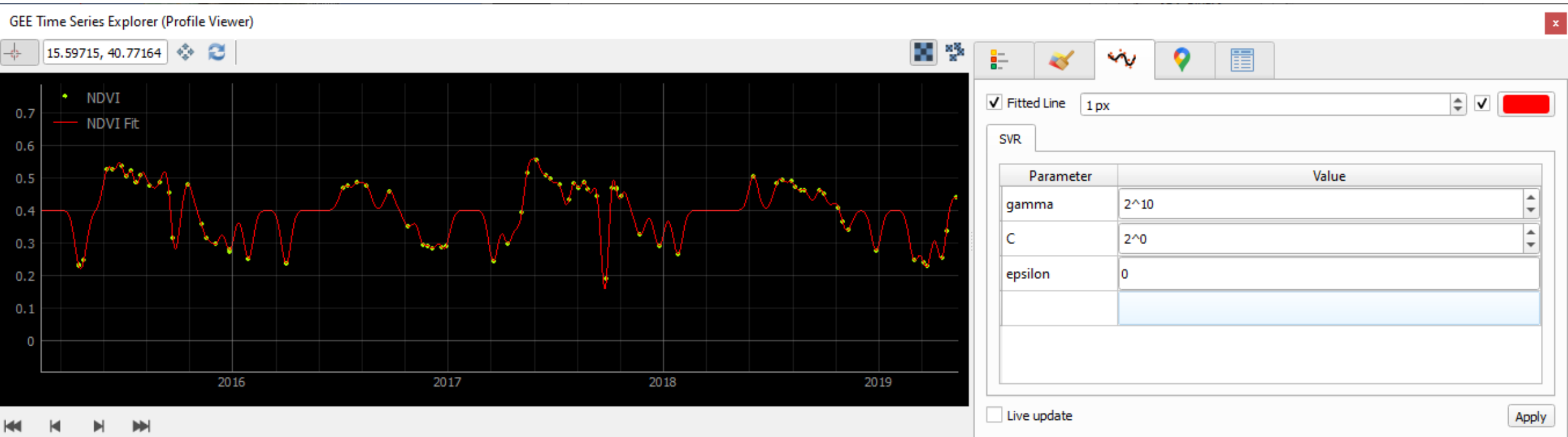
Main Features of the GEE Time Series Explorer

- profile fitting



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- profile fitting



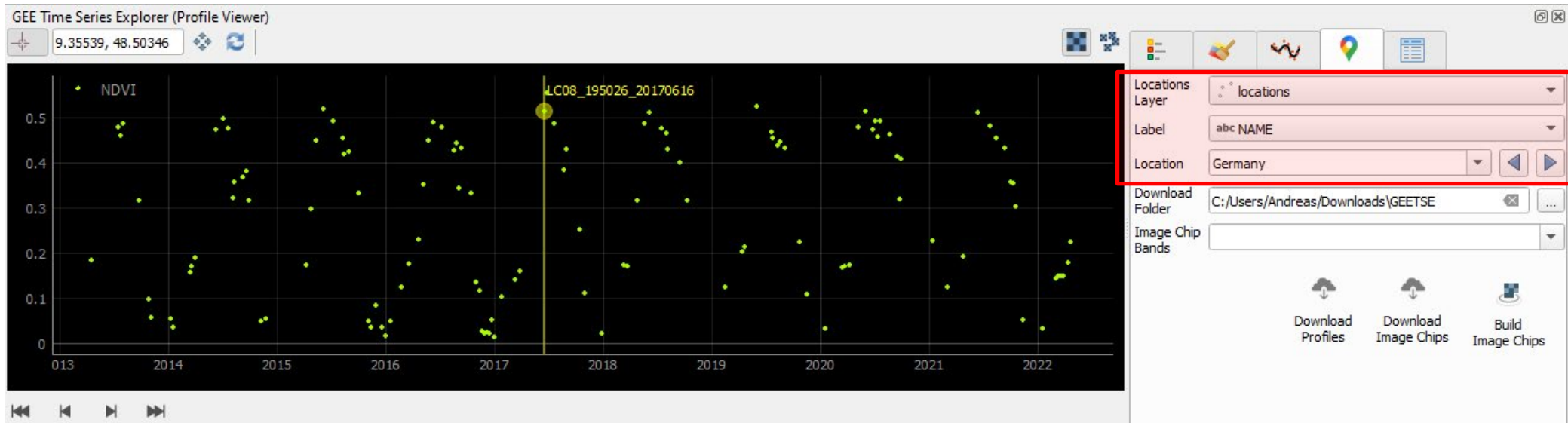
Main Features of the GEE Time Series Explorer

- sample-based analysis via the location browser



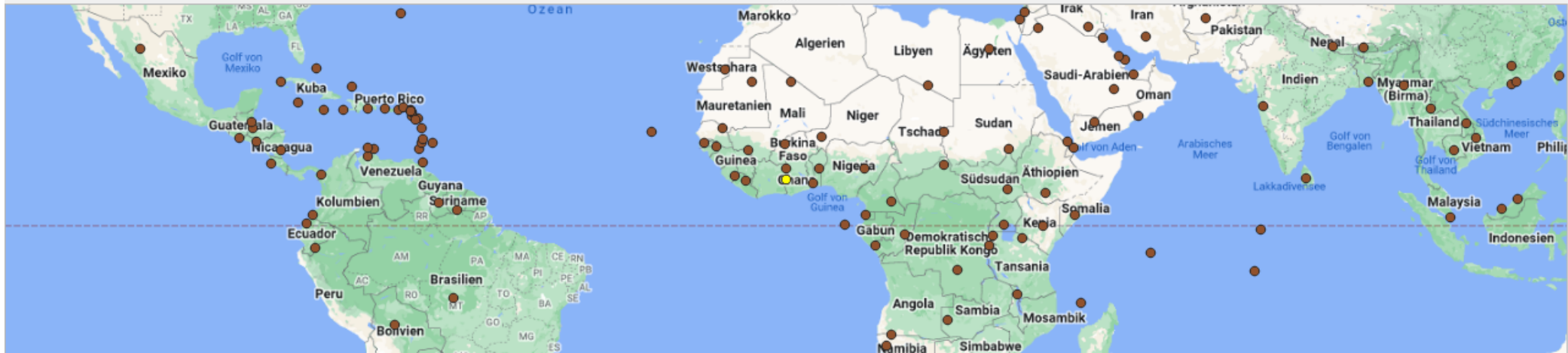
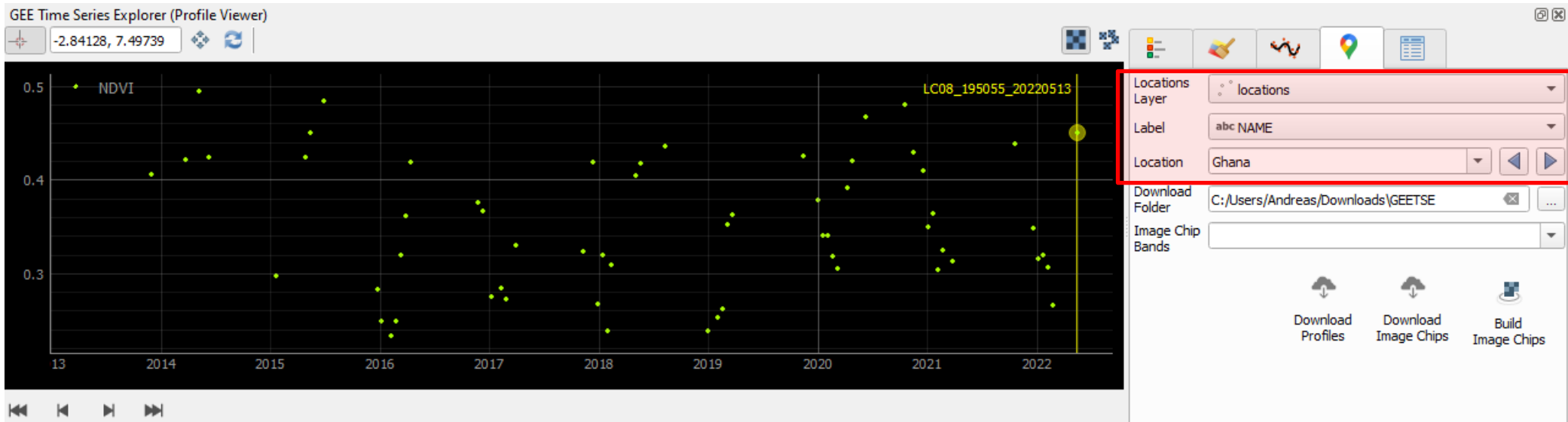
Main Features of the GEE Time Series Explorer

➤ sample-based analysis via the location browser



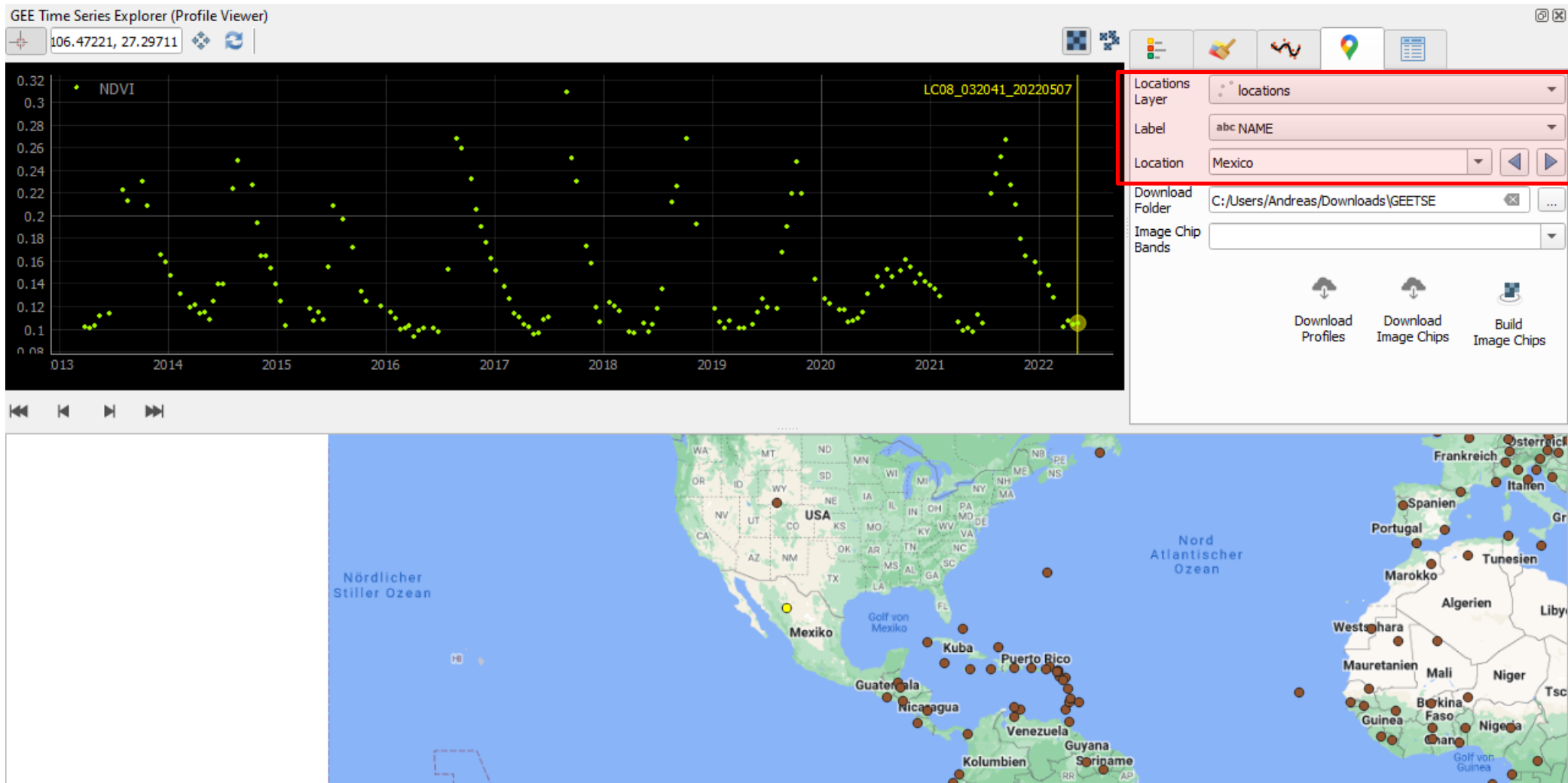
Main Features of the GEE Time Series Explorer

- sample-based analysis via the location browser



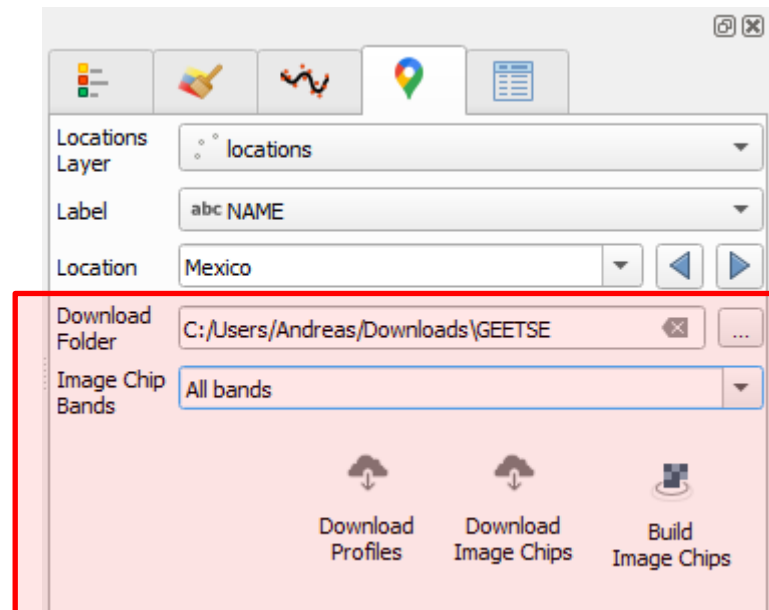
Main Features of the GEE Time Series Explorer

- sample-based analysis via the location browser

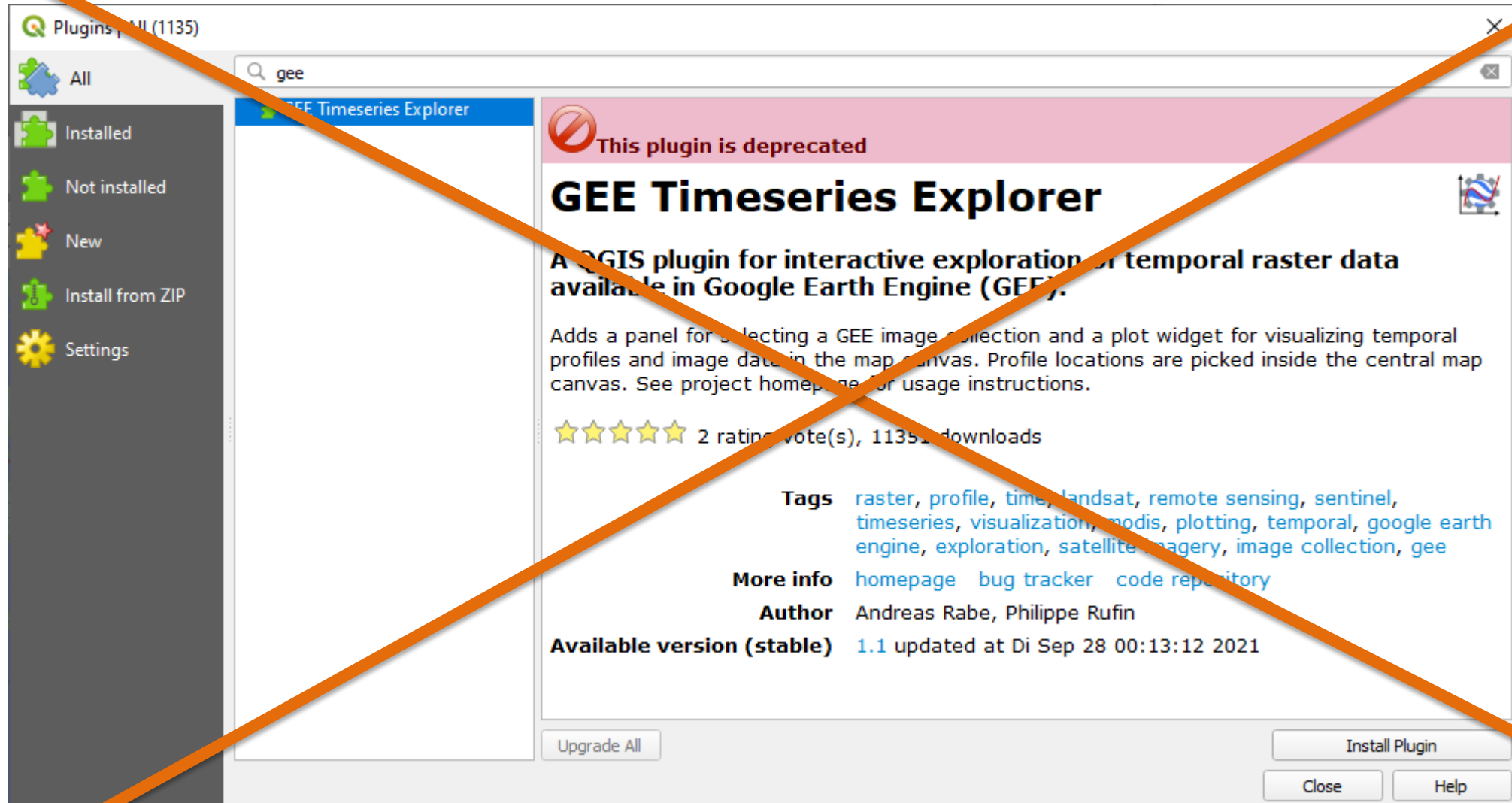


Main Features of the GEE Time Series Explorer

- sample-based analysis via the location browser
 - ❖ download profiles for each location
 - ❖ download image chips (500x500 px) for each data point



Installation



Installation

Plugins | All (1125)

EnMAP-Box

EnMAP-Box 3

This plugin has an experimental version available

EnMAP-Box 3

Imaging Spectroscopy and Remote Sensing for QGIS

The EnMAP-Box is a QGIS plug-in to visualize and process remote sensing data, and particularly developed to handle EnMAP products. It was particularly developed to handle imaging spectroscopy data from the upcoming EnMAP sensor

Project Website
<https://enmap-box.readthedocs.io>

Licensed under the GNU General Public Licence
<http://www.gnu.org/licenses/>

Environmental Mapping and Analysis Program (EnMAP)
<http://www.enmap.org>

The EnMAP-Box is developed at Humboldt-Universität zu Berlin under contract by the Helmholtz Centre Potsdam GFZ and is part of the EnMAP Core Science Team activities. It is funded by the German Aerospace Centre (DLR) - Project Management Agency, granted by the Federal Ministry of Economic Affairs and Energy (BMWi; grant no. 50EE1529).

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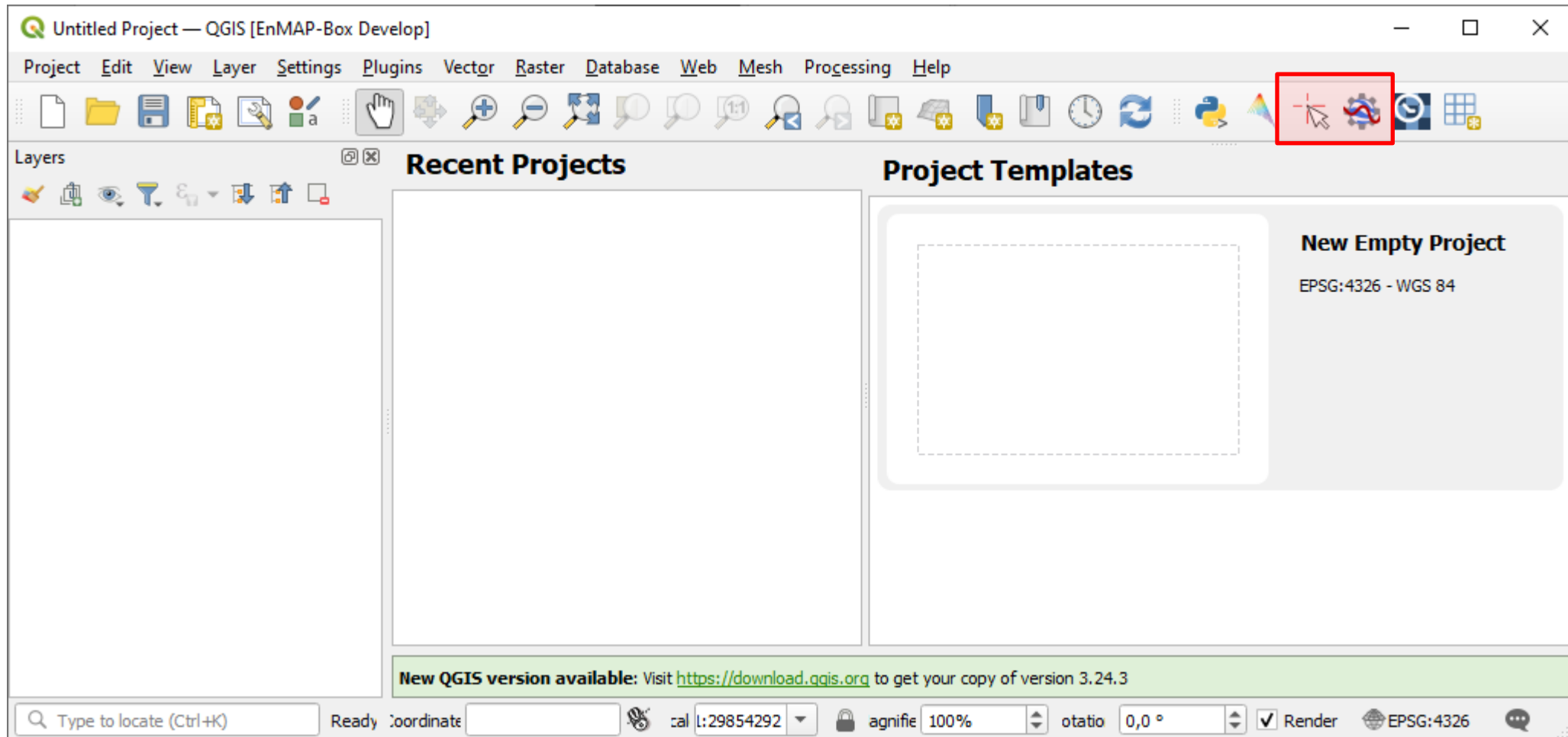
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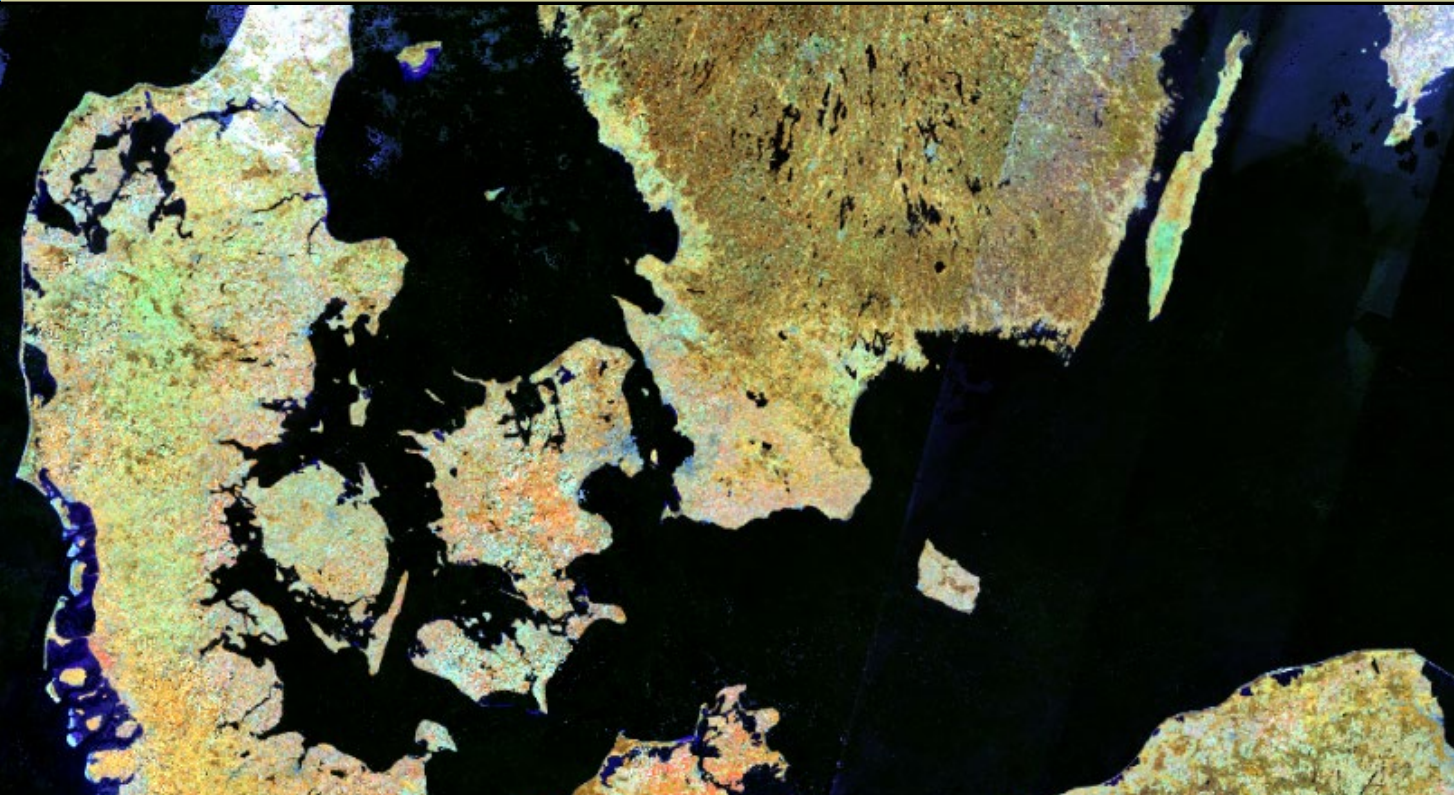
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