

From NDVI to N application map (Precision Agriculture)

Lecture notes preparation - about conceptual framework

(Education purpose)

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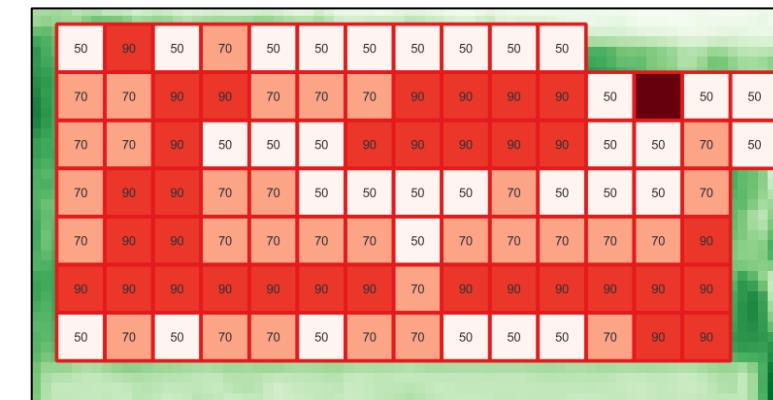
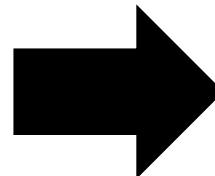
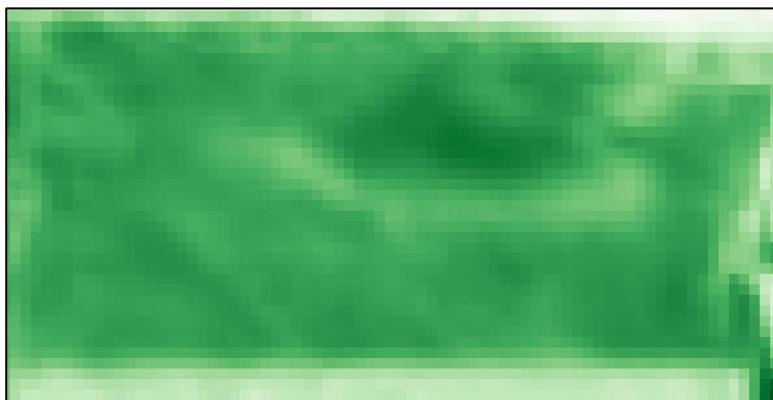
April 2024

Outline

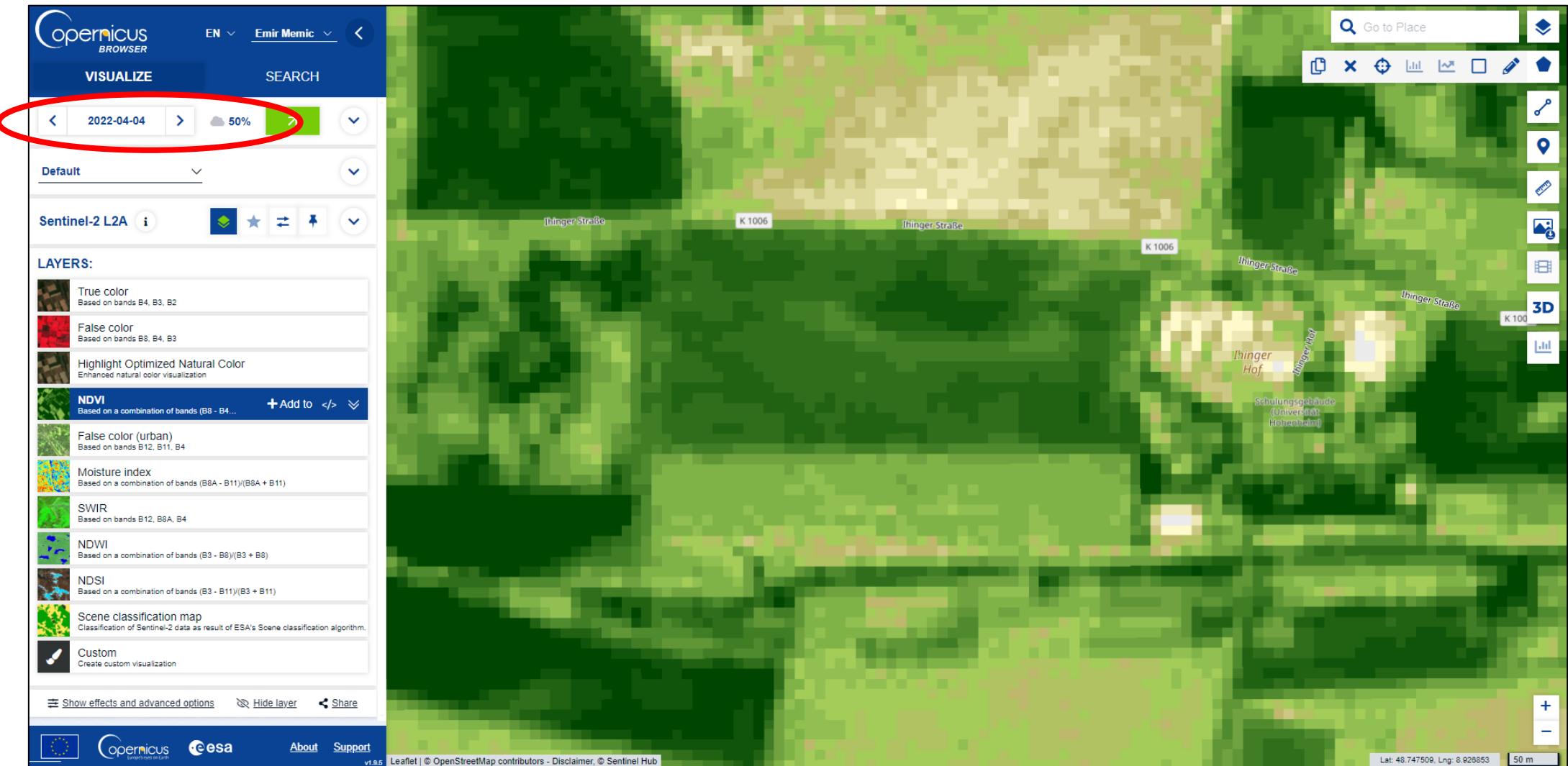
- Satellite images download – Copernicus Browser
 - Copernicus Data Space Ecosystem (CDSE), Modified Copernicus Sentinel data 2024 processed in Copernicus Browser. <https://browser.dataspace.copernicus.eu/>
- QGIS-based NDVI analysis and N prescription map processing
 - QGIS 2024. QGIS.org, Geographic Information System. QGIS Association. <http://www.qgis.org>
- Discussion

Objective:

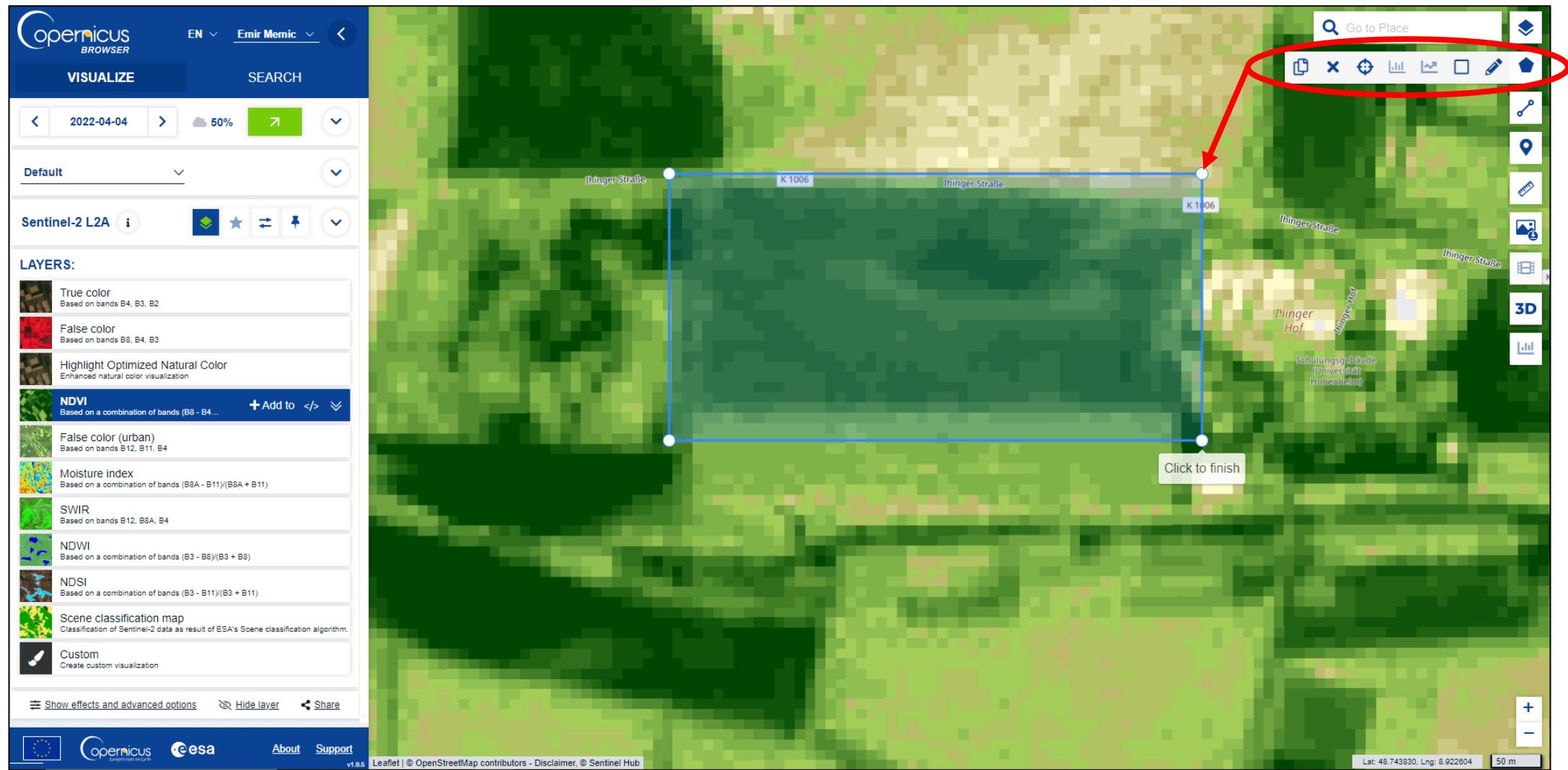
From NDVI to N application map



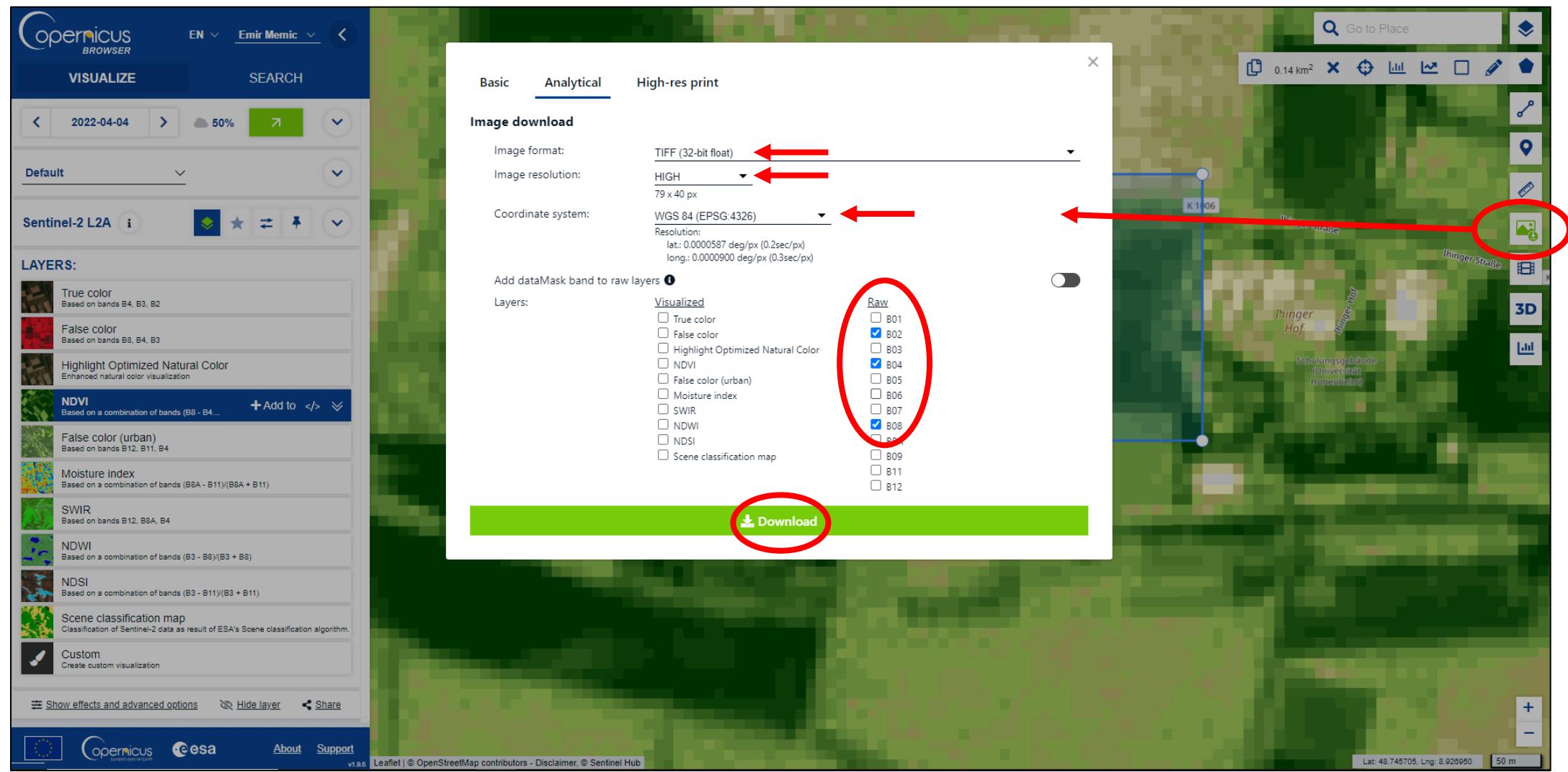
Acquiring satellite images via Copernicus Browser



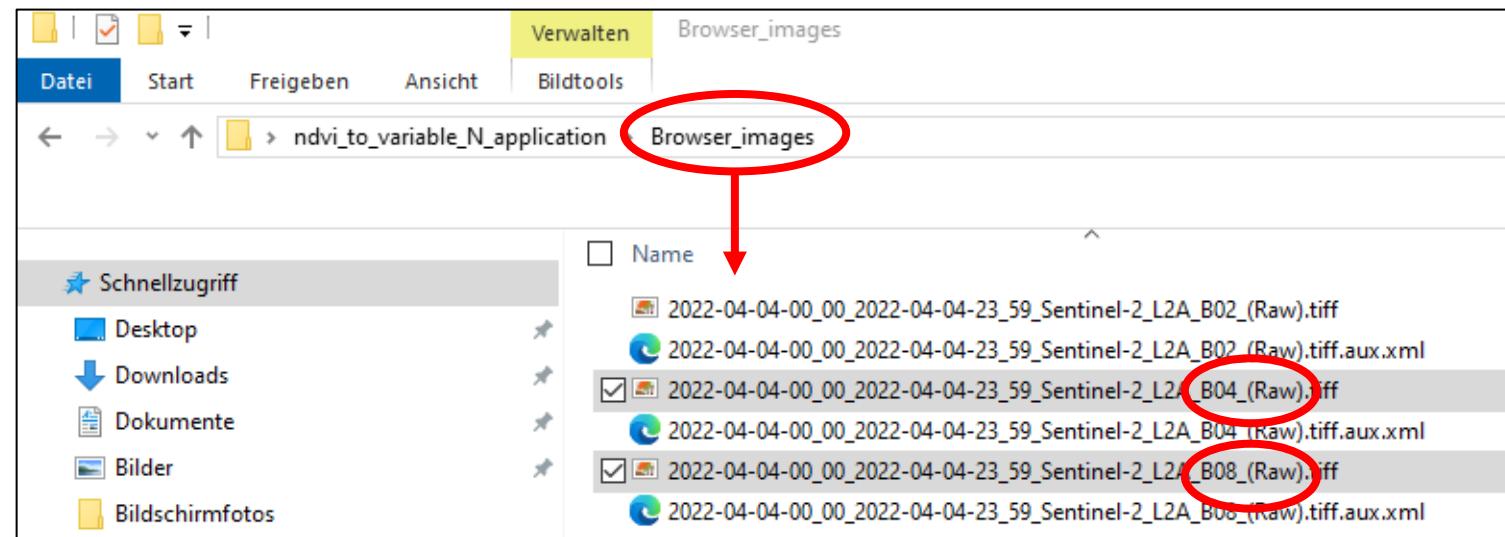
Delineating area of interest (polygon) for downloading



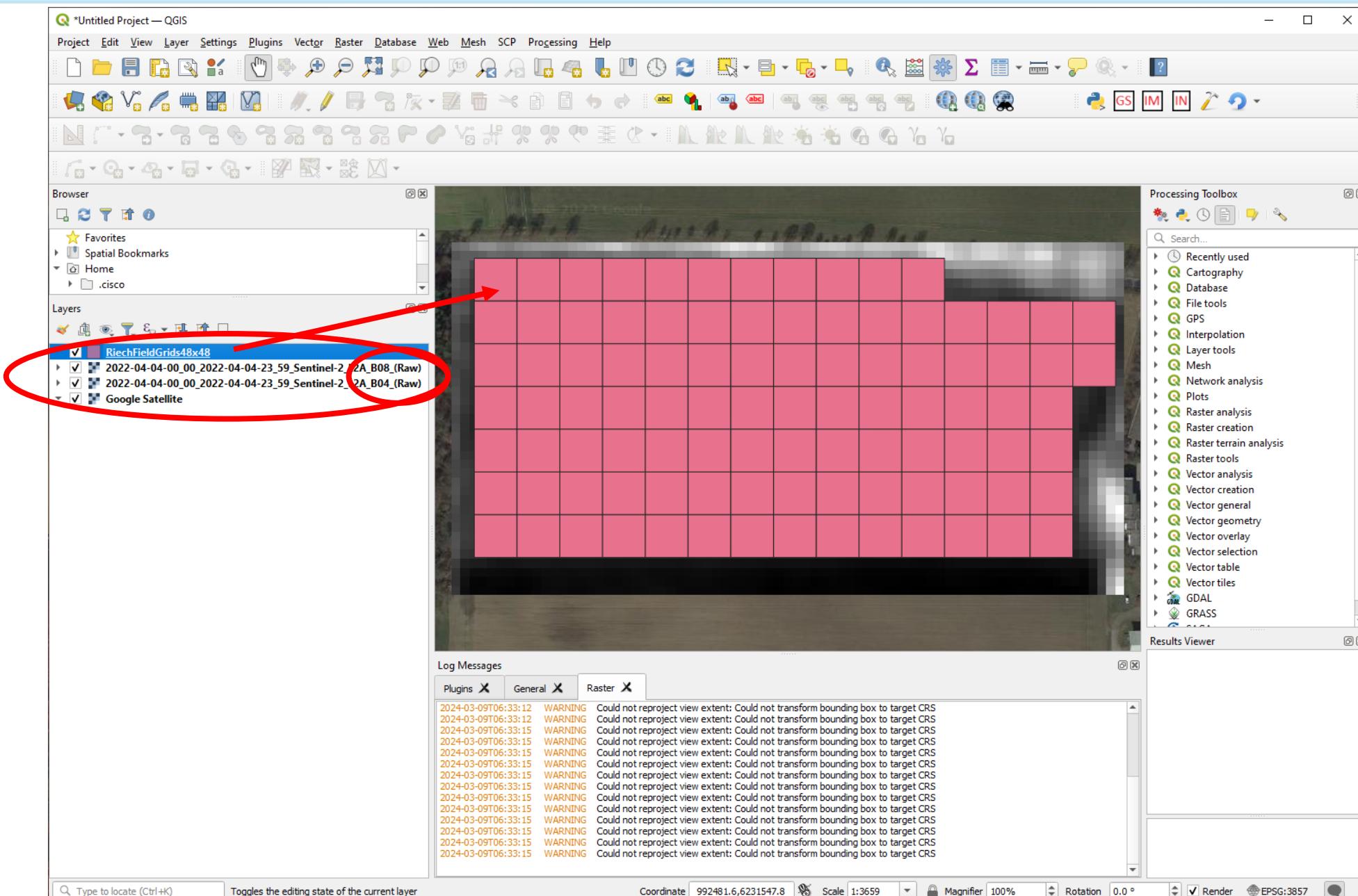
Downloading bands of interest – B02 (Blue), B04 (Red) and B08 (NIR)



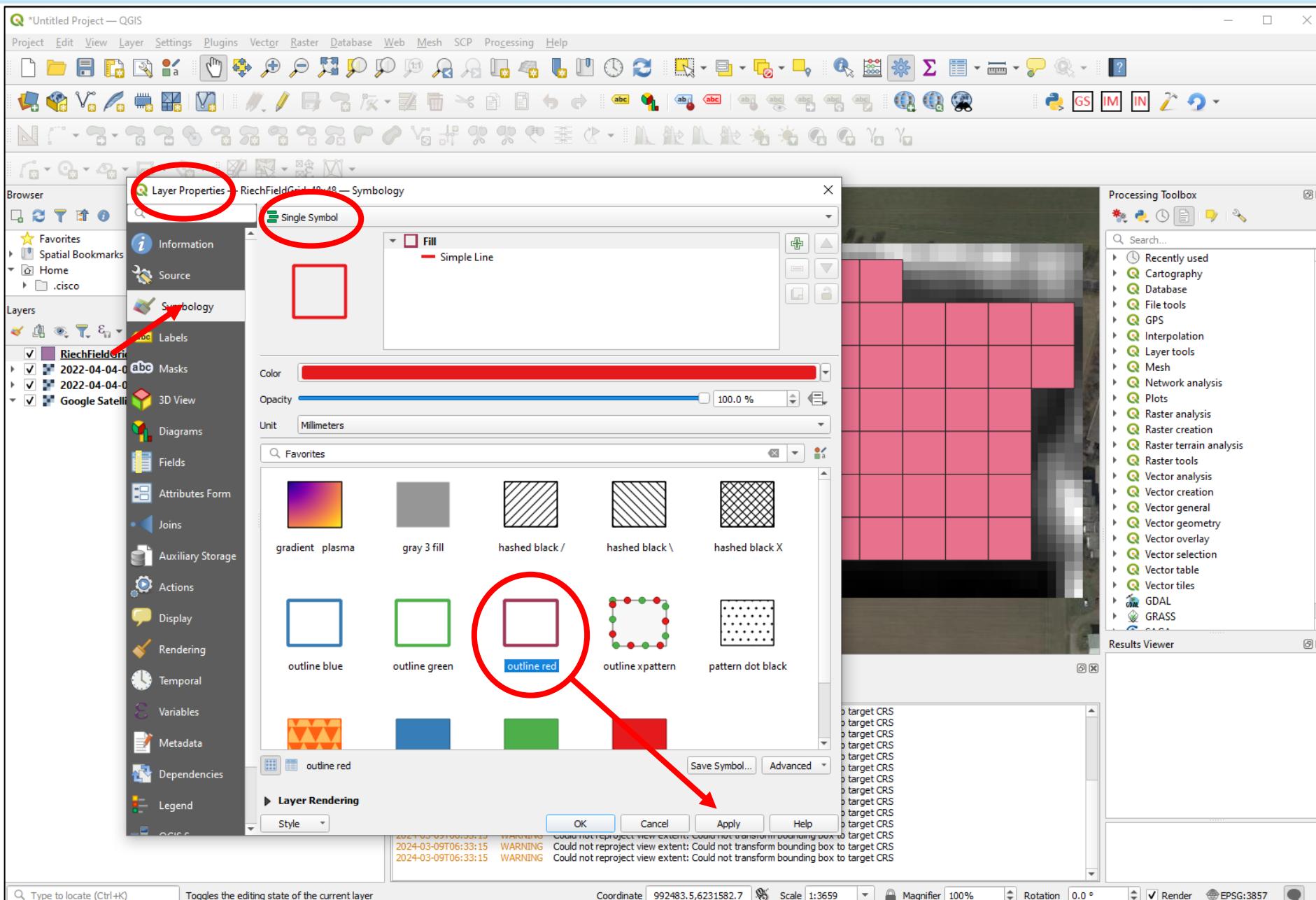
Downloaded and unzipped row data – for this example only B04 and B08 required for NDVI calculation



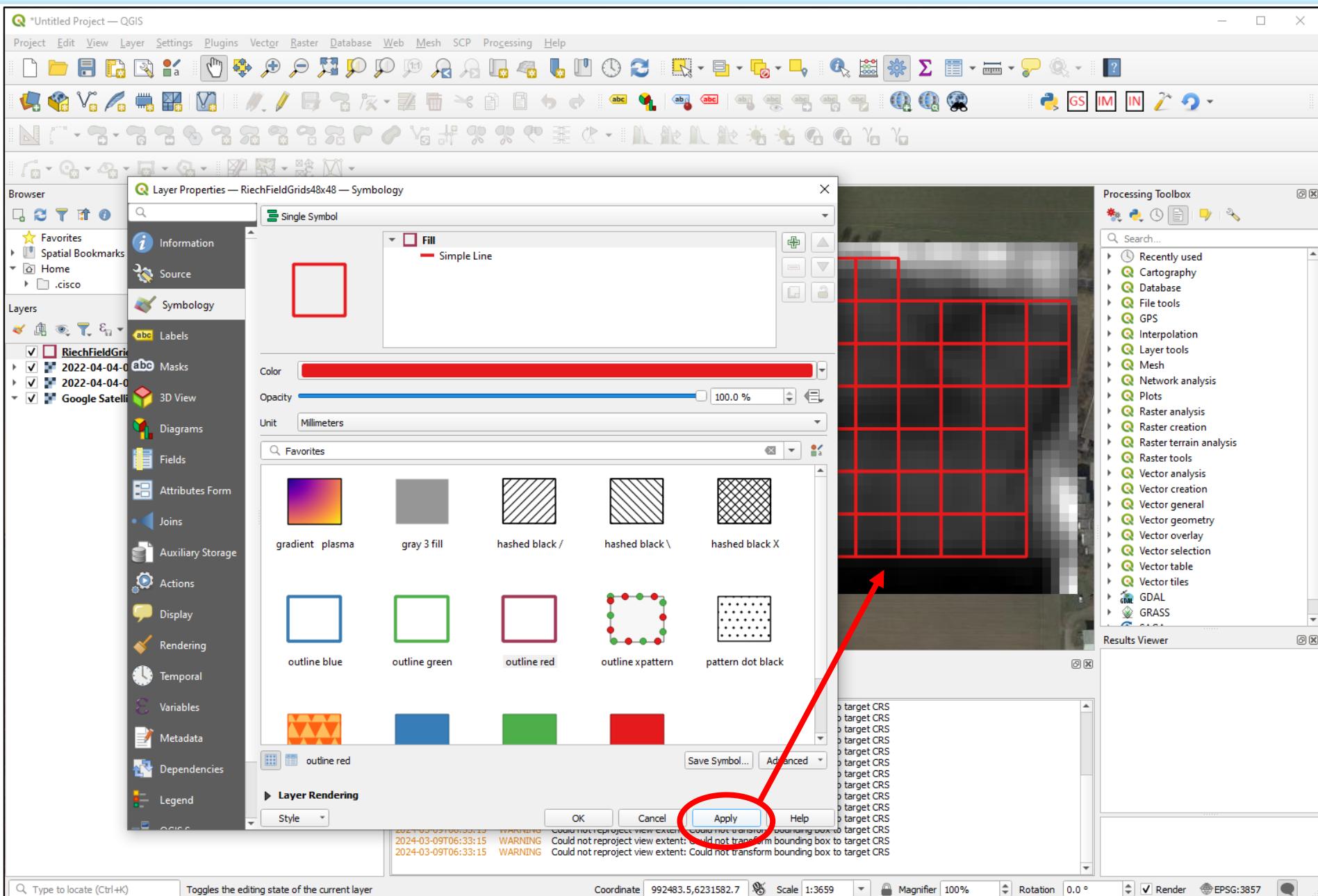
Uploading required data into QGIS (drag and drop): georeferenced images and raster grid of area of interest



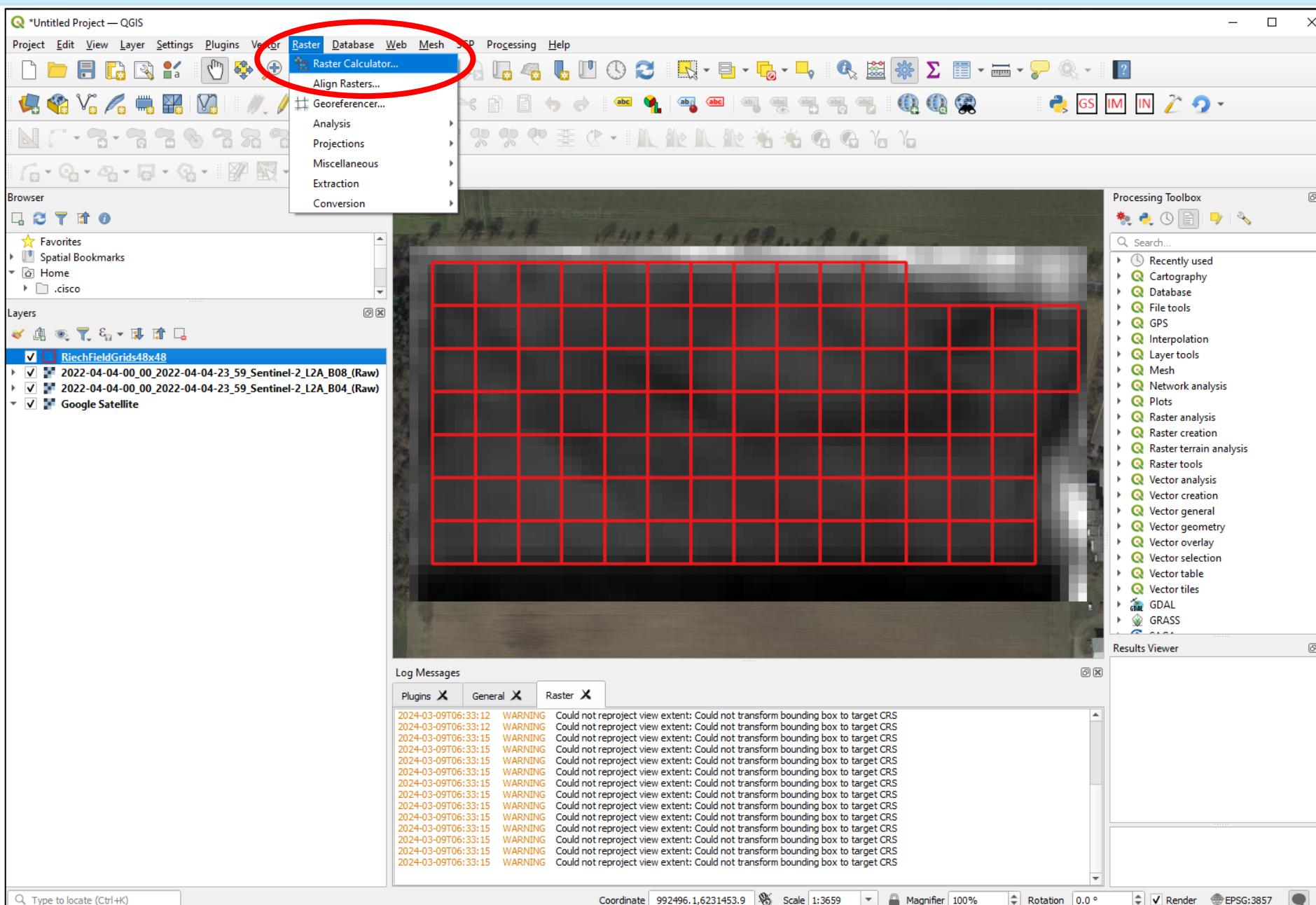
Modifying of the girds to get transparent background – Layer Properties -> Symbology -> Single Symbol



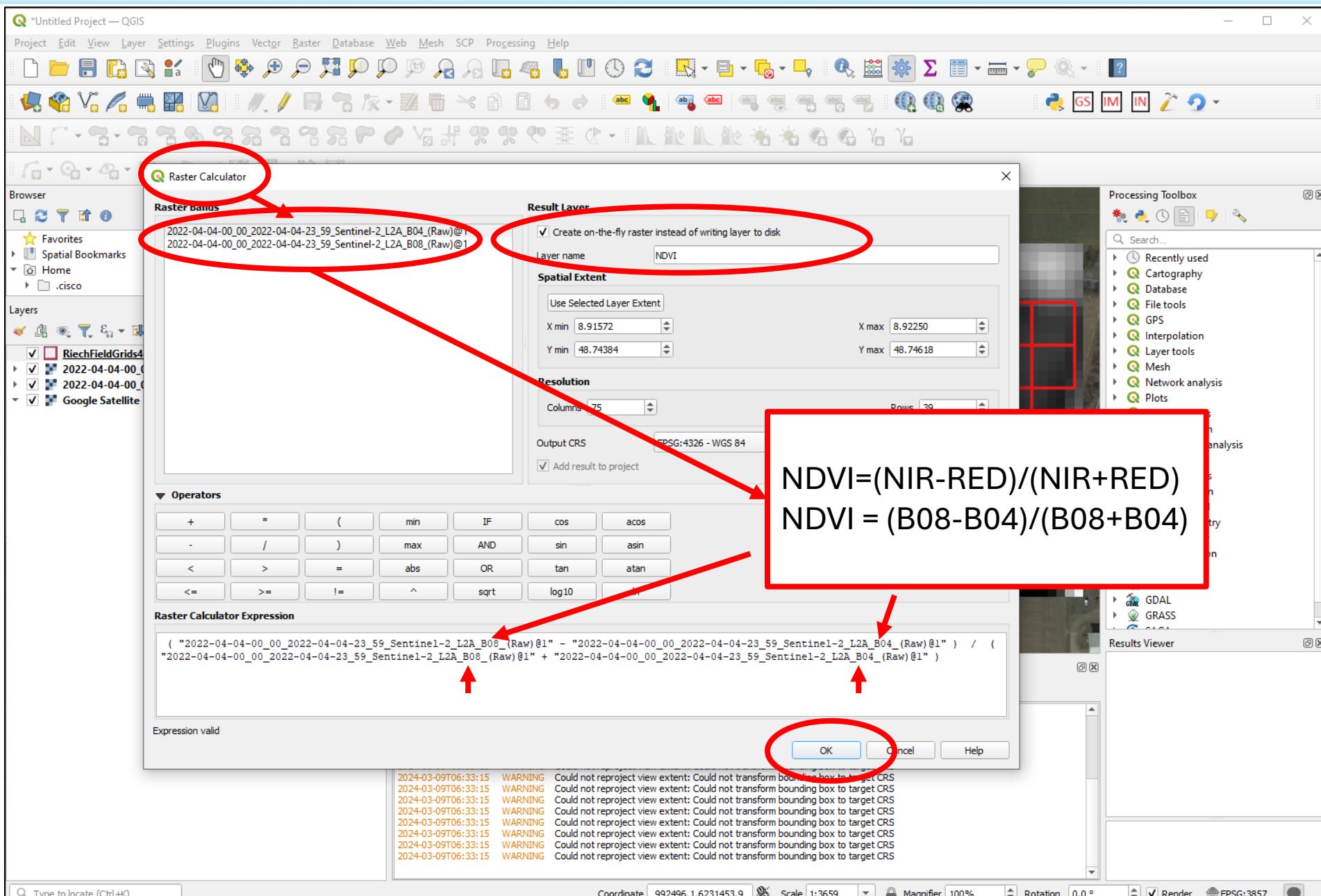
Modifying of the girds to get transparent background – when executed



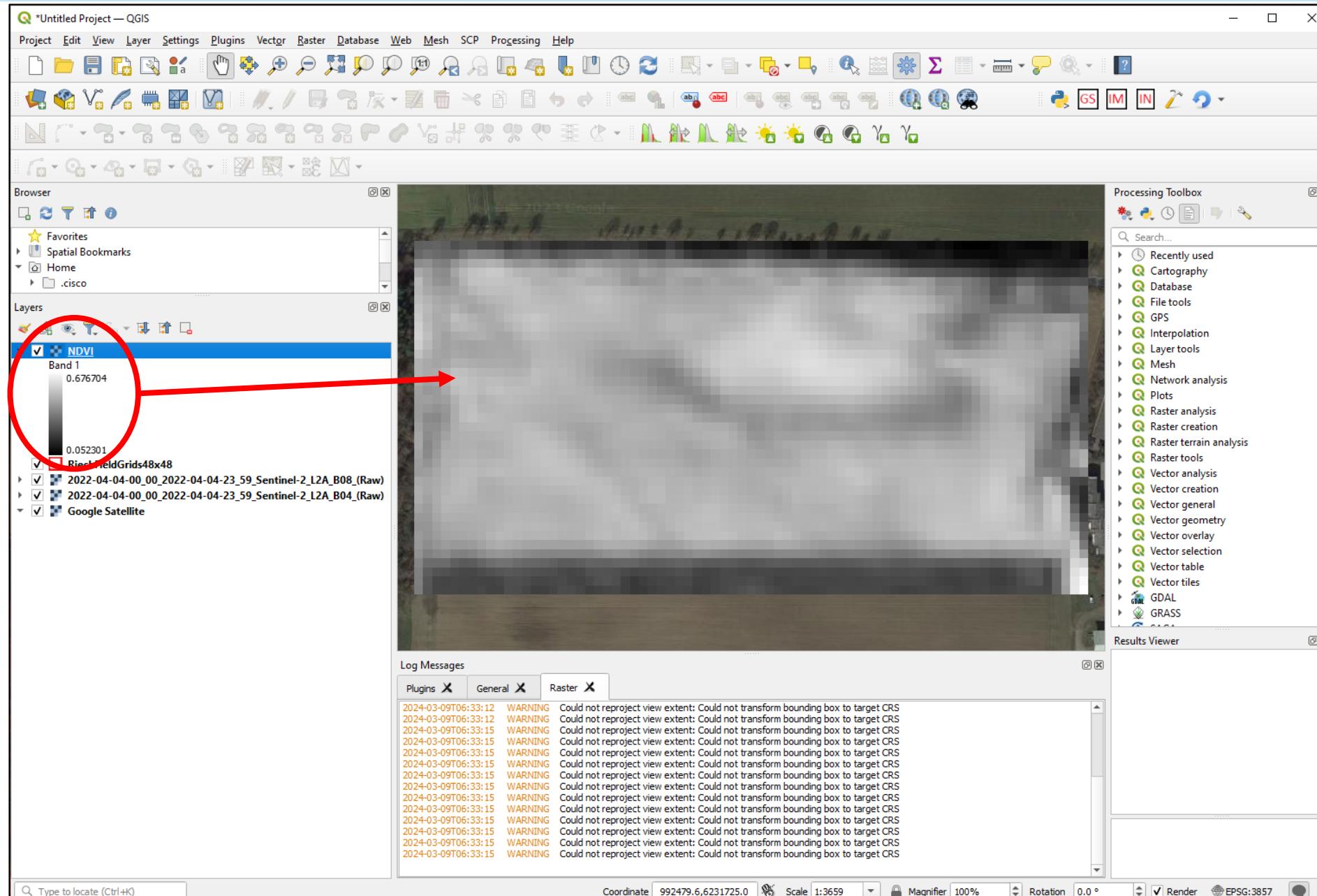
Calculating NDVI is conducted with Raster Calculator – Raster -> Raster Calculator



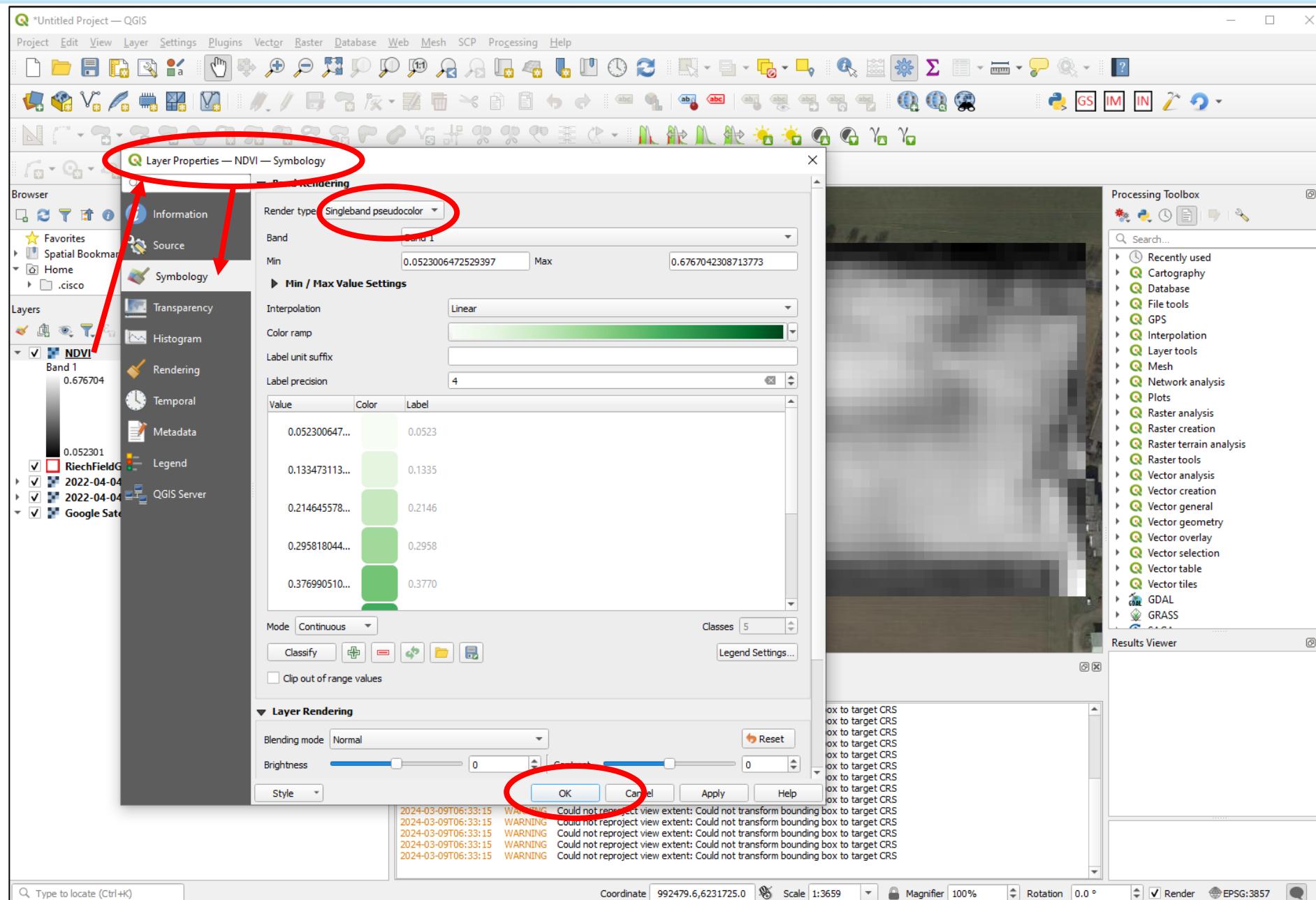
In Raster Calculator – minimum action required to calculate NDVI is indicated with red circles and arrows



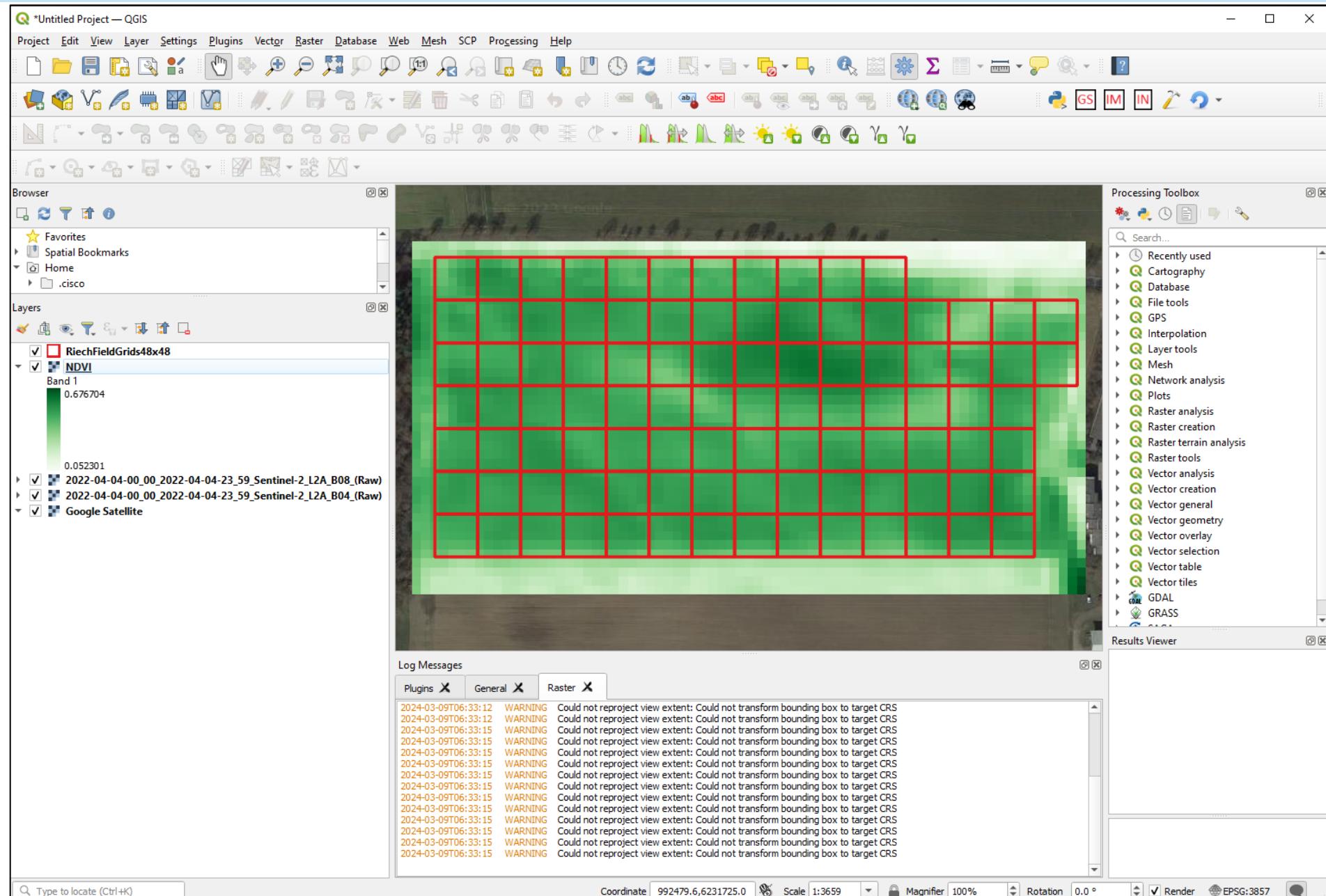
After Raster Calculator calculations are conducted a user gets NDVI layer in QGIS



NDVI layer (in gray by default) can be changed to green – Layer Properties -> Symbology -> Singleband Pseudocolor

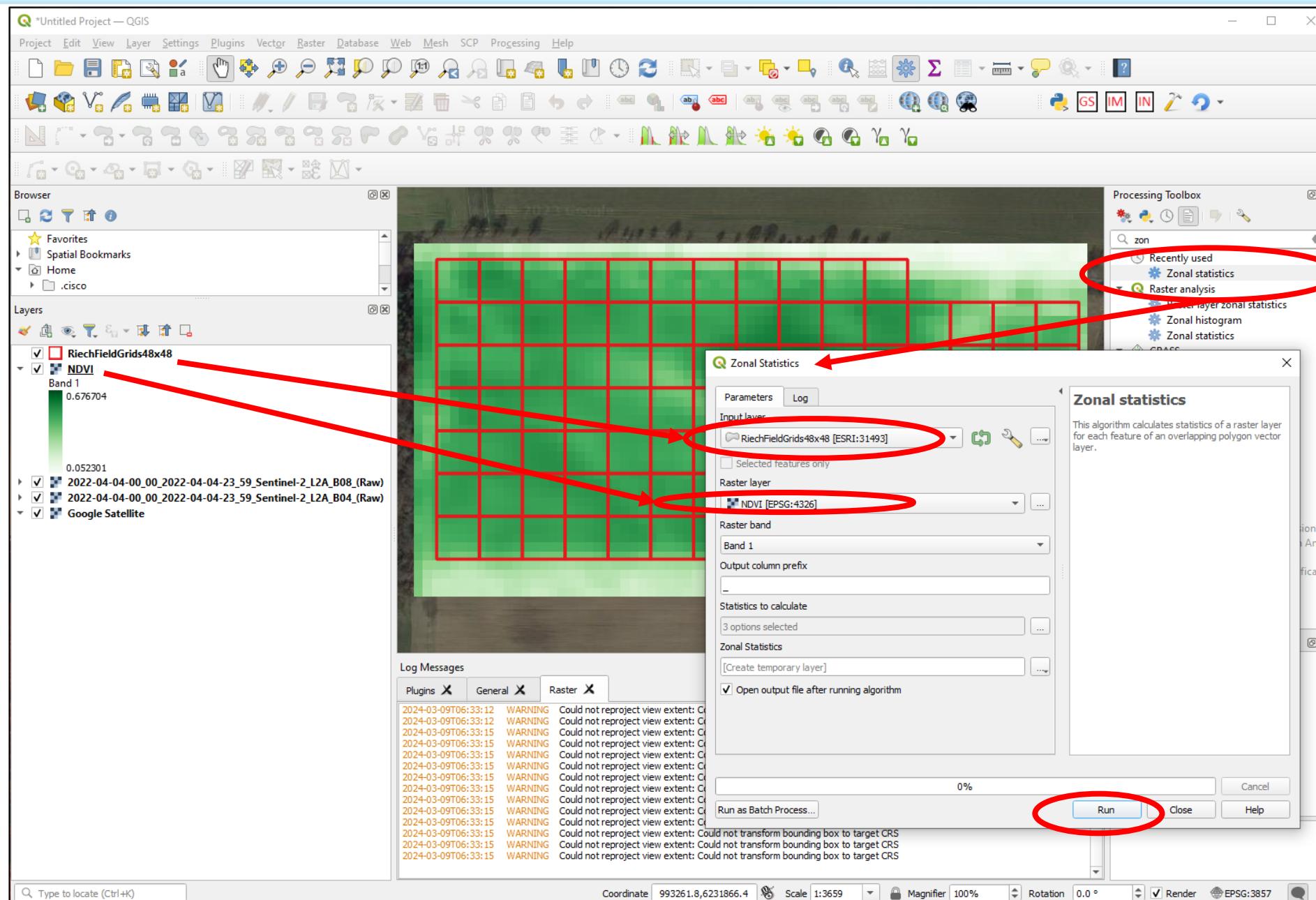


NDVI layer in green

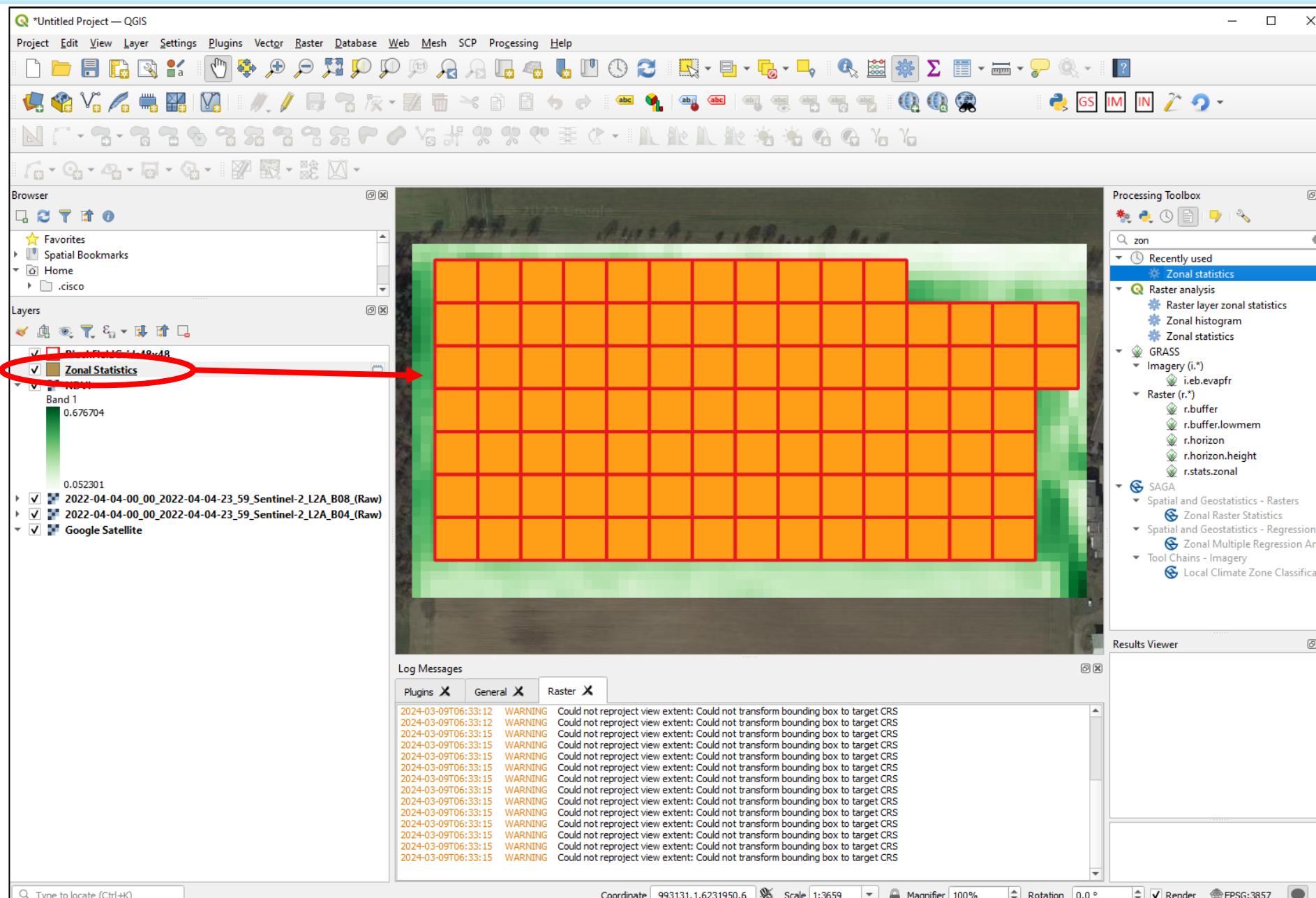


QGIS-based NDVI analysis

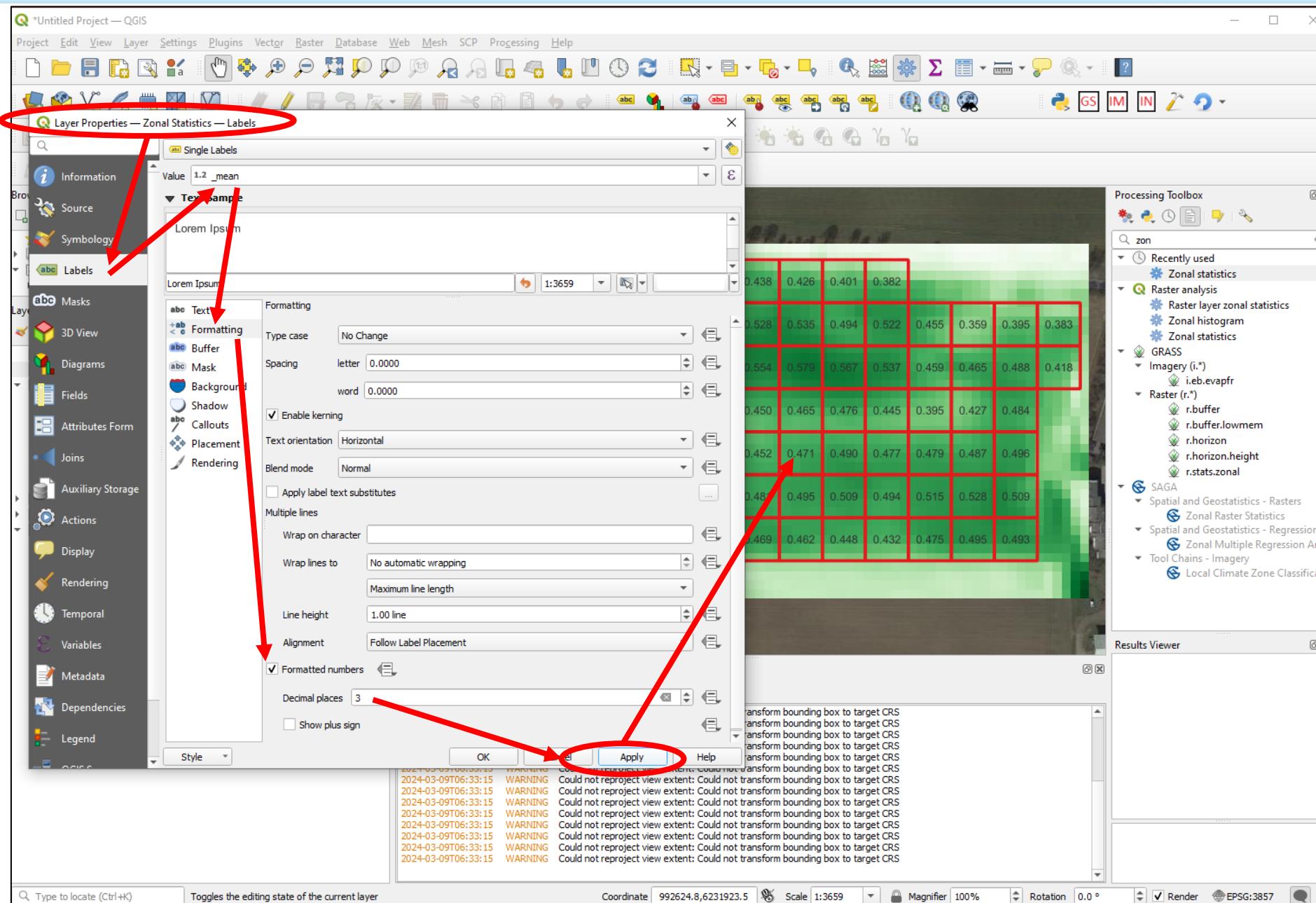
Calculating NDVI for each grid – based on Grid layer and NDVI layer with Zonal Statistics



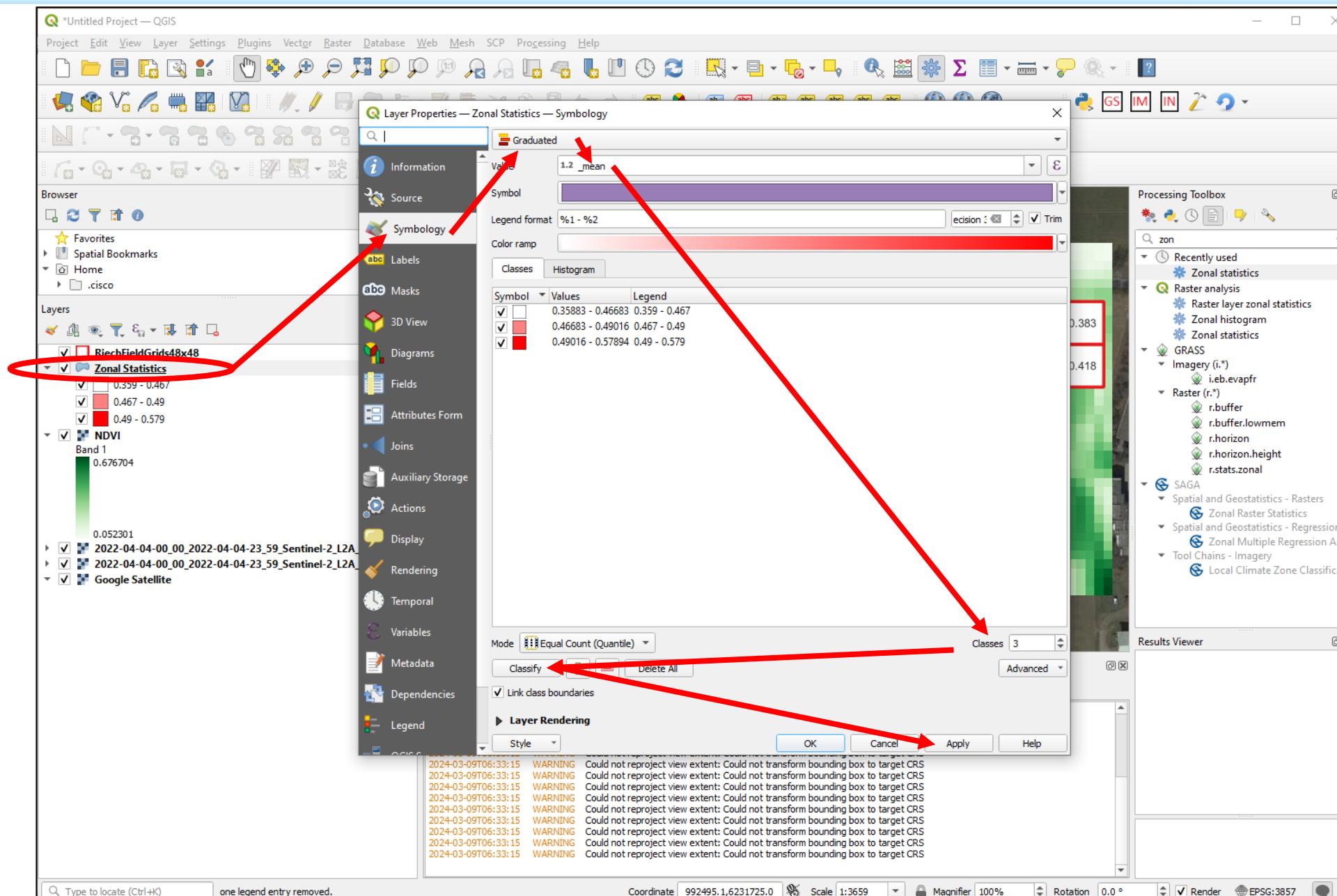
Zonal Statistics after execution produce Zonal Statistics (temporary layer)



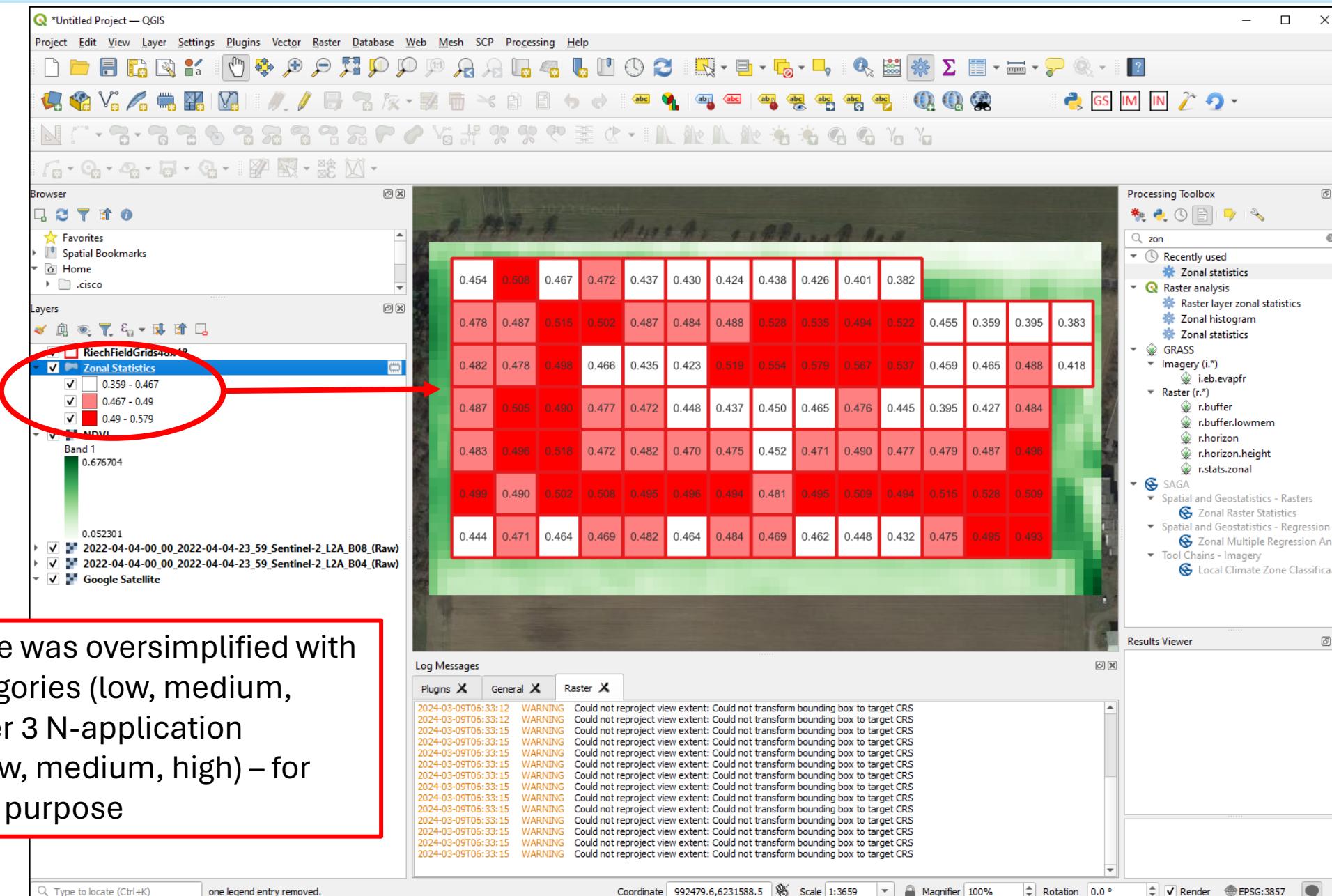
Zonal Statistics layer – to show NDVI for each grid – Layer Properties -> Labels -> Single Labels -> _mean (value select)



Zonal Statistics layer – create 3 NDVI categories – Symbology -> Graduated -> _mean -> Classes (3) -> Classify



Zonal Statistics layer – setup of previous slide when executed will produce heat map of index variability (3 categories)



QGIS-based NDVI analysis

Zonal Statistics layer – Properties -> Open Attribute Table (shows statistics for each grid, including number of pixels per grid – count)

The screenshot shows the QGIS interface with several panels:

- Project Bar:** Standard QGIS menu and toolbar.
- Browser Panel:** Shows layers: RiechfieldGrids40_10, Zonal Statistics, NDVI, Band 1, 0.676704, 0.052301, 2022-04-04_00_00_2022-04, 2022-04-04_00_00_2022-04, and Google Satellite.
- Processing Toolbox:** Contains categories like Recently used, Raster analysis, GRASS, and SAGA.
- Attribute Table:** Titled "Zonal Statistics — Features Total: 97, Filtered: 97, Selected: 0". It has columns: id, _count, _sum, and _mean. The data is as follows:

id	_count	_sum	_mean
1	16	7.26533224302356	0.454083265188...
2	20	9.561190362974...	0.478059518148...
3	20	9.64982833645304	0.482491416822...
4	20	9.7433026494669	0.487165132473...
5	16	7.729688096652...	0.483105506040...
6	20	9.987119150445...	0.499355957522...
7	20	8.885069083774...	0.444253454188...
8	20	10.16147149656...	0.508073574828...
9	25	12.18572898793...	0.487429159517...
10	25	11.96224975064...	0.478489990025...
11	25	12.63730946743...	0.505492378697...
12	20	9.914615602144...	0.495730780107...
13	25	12.25410090718...	0.490164036287...
14	25	11.77746172654...	0.471098469061...
15	20	9.336695751450...	0.466834787572...
16	25	12.86960526978...	0.514784210791...
17	25	12.45027138085...	0.498010855234...
18	25	12.25743391055...	0.490297356422...
19	20	10.36852047105...	0.518426023552...
20	25	12.53953562042...	0.501581424816...

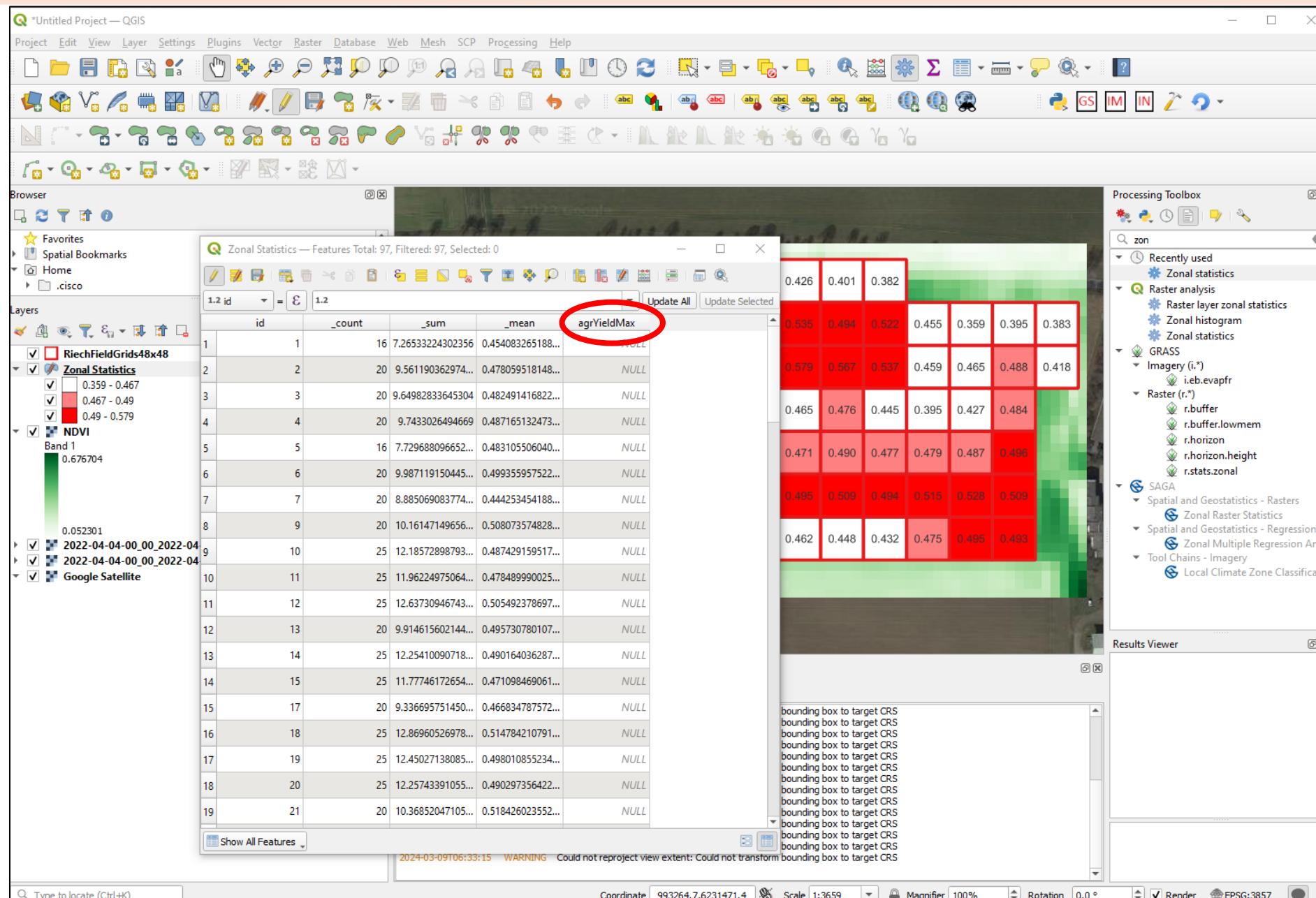
- Raster View:** A 10x10 grid of colored pixels (red, green, blue) representing the zonal statistics data.
- Message Bar:** Shows a warning message: "2024-03-09T06:33:15 WARNING Could not reproject view extent: Could not transform bounding box to target CRS".
- Coordinate Bar:** Shows coordinates: 993264.7, 6231471.4, Scale: 1:3659, Magnifier: 100%, Rotation: 0.0°, Render: EPSG:3857.

Zonal Statistics layer –Attribute Table tool -> Add Field (will create a place holder to populate later with corresponding N application kg)

The screenshot shows the QGIS interface with the following components:

- Toolbar:** Standard QGIS toolbar with various icons for selection, measurement, and analysis.
- Layers Panel:** Shows layers including "RiechFieldGrids48x48" (selected), "Zonal Statistics" (with three sub-categories: 0.359 - 0.467, 0.467 - 0.49, 0.49 - 0.579), and "NDVI".
- Processing Toolbox:** Opened to the "Raster analysis" section, specifically the "Raster layer zonal statistics" tool.
- Table View:** "Zonal Statistics" table showing results for 97 features. The columns include id, _count, _sum, and _mean.
- Add Field Dialog:** A modal dialog titled "Add Field" is open, with the "Name" field set to "agrYieldMax". This dialog is circled in red.
- Raster Preview:** A preview window showing a 48x48 pixel grid with values ranging from 0.359 to 0.579.
- Status Bar:** Shows the date and time (2024-03-09T06:33:15) and a warning message: "WARNING Could not reproject view extent: Could not transform bounding box to target CRS".

Zonal Statistics layer –Attribute Table – new field added: agrYieldMax



Zonal Statistics layer –Attribute Table – Field Calculator setup – based on the grid NDVI value the grid is allocated N application value (kg)

The screenshot shows the QGIS interface with several windows open:

- Top Bar:** Project, Edit, View, Layer, Settings, Plugins, Vector, Raster, Database, Web, Mesh, SCP, Processing, Help.
- Toolbar:** Various icons for selection, zoom, measurement, and analysis.
- Processing Toolbox:** Shows recent items like "zon", "Zonal statistics", "Raster analysis", "Raster layer zonal statistics", and "Zonal histogram".
- Layers Panel:** Shows layers "RiechFieldGrids48", "Zonal Statistics" (with items 0.359 - 0.467, 0.467 - 0.49, 0.49 - 0.579), and "NDVI Band 1" (value 0.676704).
- Attribute Table Window:** Shows columns: id, _count, _sum, _mean, and agrYieldMax. The agrYieldMax column contains NULL values.
- Field Calculator Window:**
 - Checkboxes: Only update 0 selected features, Create a new field (unchecked), Create virtual field (unchecked), Update existing field (checked).
 - Output field name: agrYieldMax (with a note "123 agrYieldMax").
 - Expression Editor:

```
CASE
WHEN "_mean" >= 0.359 and "_mean" < 0.467 THEN 50
WHEN "_mean" >= 0.467 and "_mean" < 0.490 THEN 70
WHEN "_mean" >= 0.490 and "_mean" <= 0.579 THEN 90
END
```
 - Function Editor: A dropdown menu listing various functions and operators.
 - Buttons: OK, Cancel, Help.

This code when added into Field Calculator consol to allocate N kg value: If NDVI is **bigger or equal to 0.359 and less than 0.467** in the field in Attribute Table agrYieldMax 50 value is added. 50 -> low N application rate etc.

CASE

WHEN "_mean" >= 0.359 and "_mean" < 0.467 THEN 50

WHEN "_mean" >= 0.467 and "_mean" < 0.490 THEN 70

WHEN "_mean" >= 0.490 and "_mean" <= 0.579 THEN 90

END

Zonal Statistics layer – based on grid NDVI values and categories the N-application values are allocated

Q *Untitled Project — QGIS

Project Edit View Layer Settings Plugins Vector Raster Database Web Mesh SCP Processing Help

Zonal Statistics — Features Total: 97, Filtered: 97, Selected: 0

id	_count	_sum	_mean	agrYieldMax
1	16	7.26533224302356	0.454083265188...	50
2	20	9.561190362974...	0.478059518148...	70
3	3	20	9.64982833645304	0.482491416822...
4	20	9.7433026494669	0.487165132473...	70
5	16	7.729688096652...	0.483105506040...	70
6	20	9.987119150445...	0.499355957522...	90
7	20	8.885069083774...	0.444253454188...	50
8	20	10.16147149656...	0.508073574828...	90
9	25	12.18572898793...	0.487429159517...	70
10	25	11.96224975064...	0.478489990025...	70
11	25	12.63730946743...	0.505492378697...	90
12	20	9.914615602144...	0.495730780107...	90
13	25	12.25410090718...	0.490164036287...	90
14	25	11.77746172654...	0.471098469061...	70
15	20	9.336695751450...	0.466834787572...	50
16	25	12.86960526978...	0.514784210791...	90
17	25	12.45027138085...	0.498010855234...	90
18	25	12.25743391055...	0.490297356422...	90
19	20	10.36852047105...	0.518426023552...	90

Show All Features

2024-03-09T06:33:12 WARNING Could not reproject view extent: Could not transform bounding box to target CRS
2024-03-09T06:33:15 WARNING Could not reproject view extent: Could not transform bounding box to target CRS
2024-03-09T06:33:15 WARNING Could not reproject view extent: Could not transform bounding box to target CRS
2024-03-09T06:33:15 WARNING Could not reproject view extent: Could not transform bounding box to target CRS
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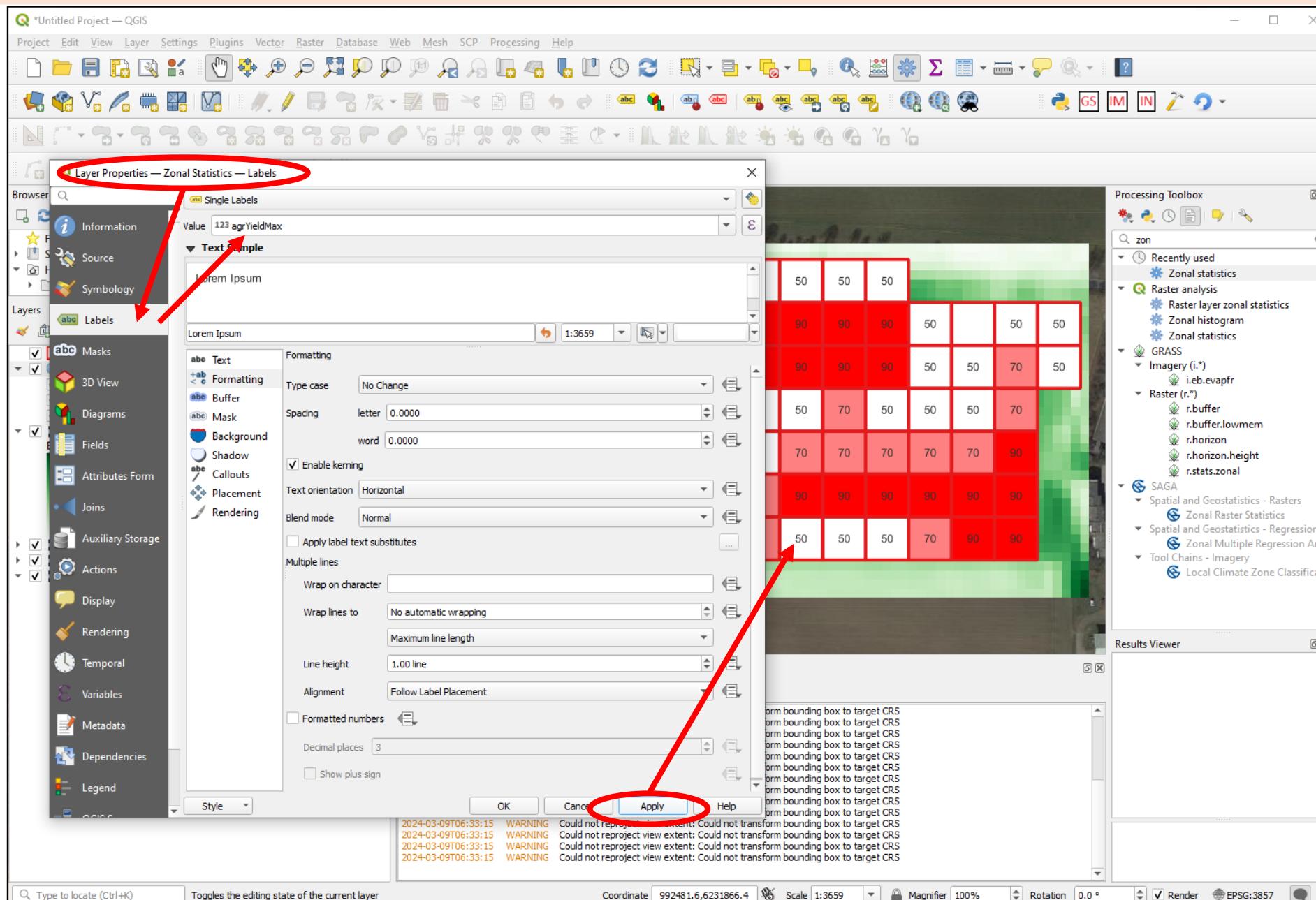
Coordinate 992596.8,6231915.7 Scale 1:3659 Magnifier 100% Rotation 0.0° Render EPSG:3857

Zonal Statistics layer – based on grid NDVI values and categories the N-application values are allocated – stop editing and save!

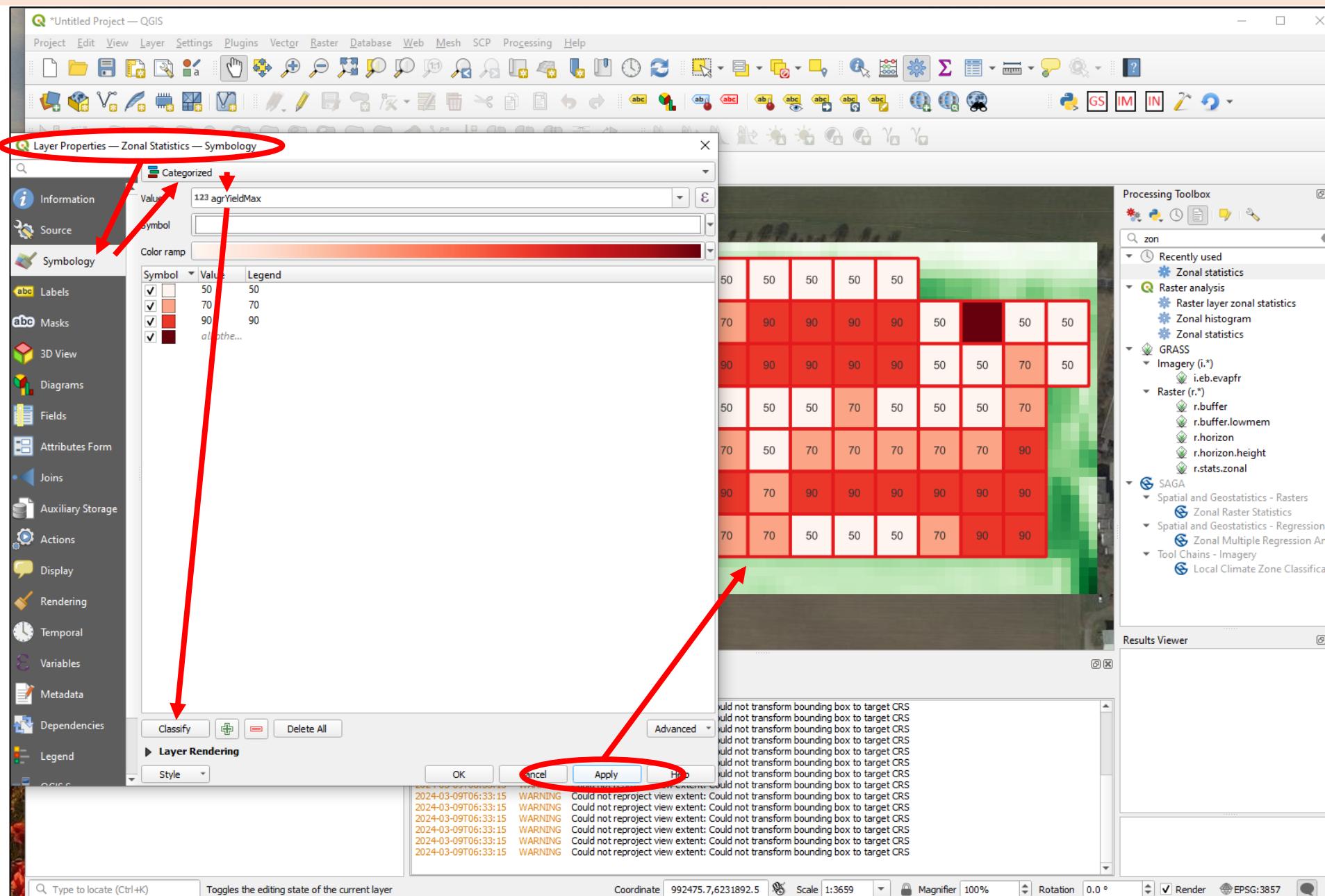
The screenshot shows the QGIS interface with the following elements:

- Toolbar:** Includes icons for project management, editing, selection, measurement, and various analysis tools.
- Map View:** Displays a raster map with a grid overlay. The grid cells contain numerical values ranging from 0.438 to 0.554.
- Processing Toolbox:** Shows the 'zon' search results, including 'Zonal statistics' under 'Raster analysis'.
- Layers Panel:** Shows the 'RiechFieldGrids48' vector layer and the 'Zonal Statistics' raster layer.
- Table View:** Shows a table with columns: id, _count, _sum, _mean, and agrYieldMax. The table includes rows for various categories and their corresponding statistics.
- Message Dialog:** A modal dialog titled 'Stop Editing' asks 'Do you want to save the changes to layer Zonal Statistics?'. It has 'Save', 'Discard', and 'Cancel' buttons. The 'Save' button is highlighted with a red circle.
- Log Panel:** At the bottom, a log window displays multiple 'WARNING' messages about failed reprojection attempts.

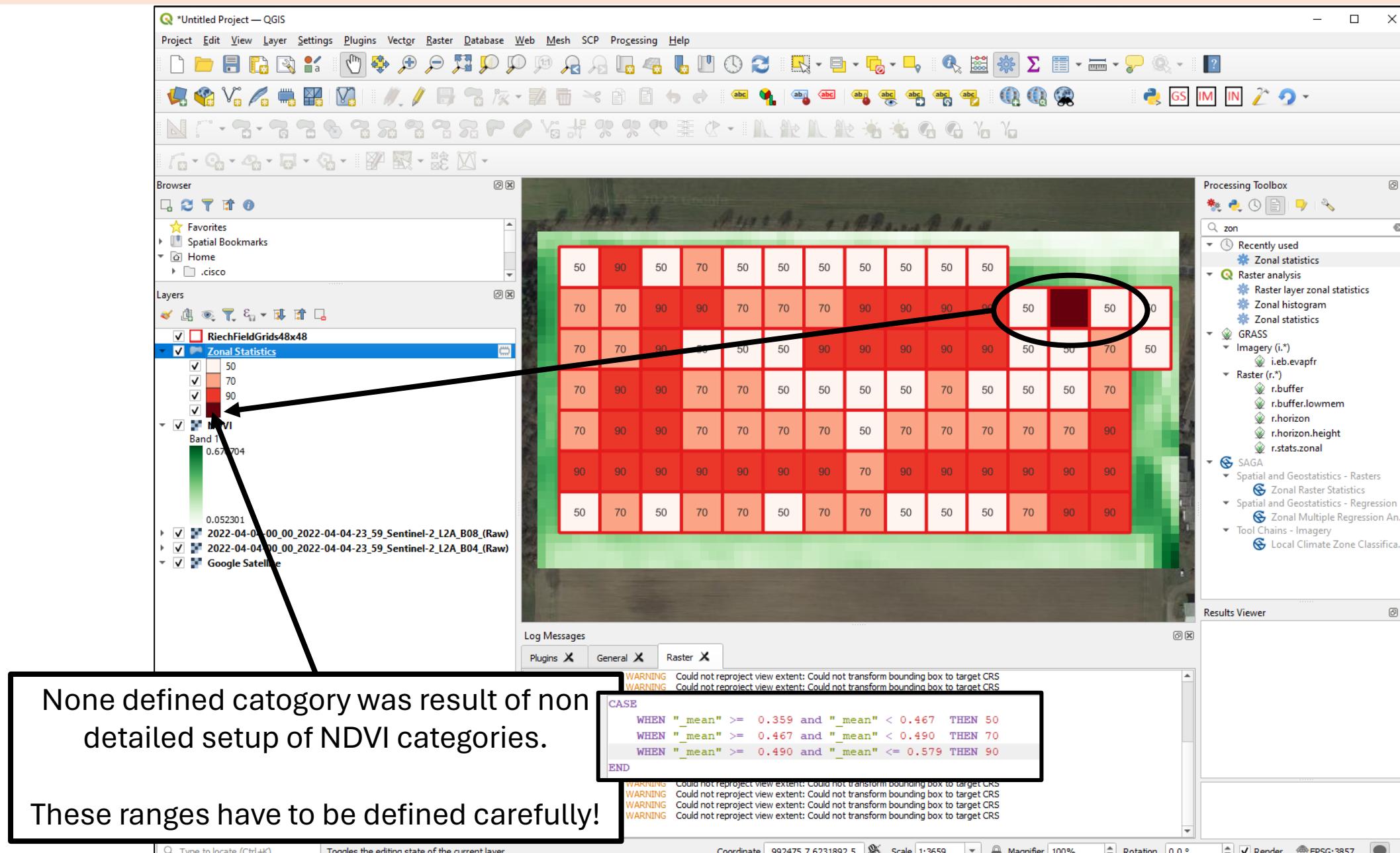
Zonal Statistics layer – Labels -> Single Labels -> agrYieldMax (value) -> will N application values to each corresponding grid



Zonal Statistics layer – Symbology -> Categorized -> agrYieldMax -> Classify



Zonal Statistics layer – N application mat generated!



Discussion