

From NDVI to N application map (agriculture)

Lecture notes preparation - about conceptual framework

(Education purpose)

Emir Memic

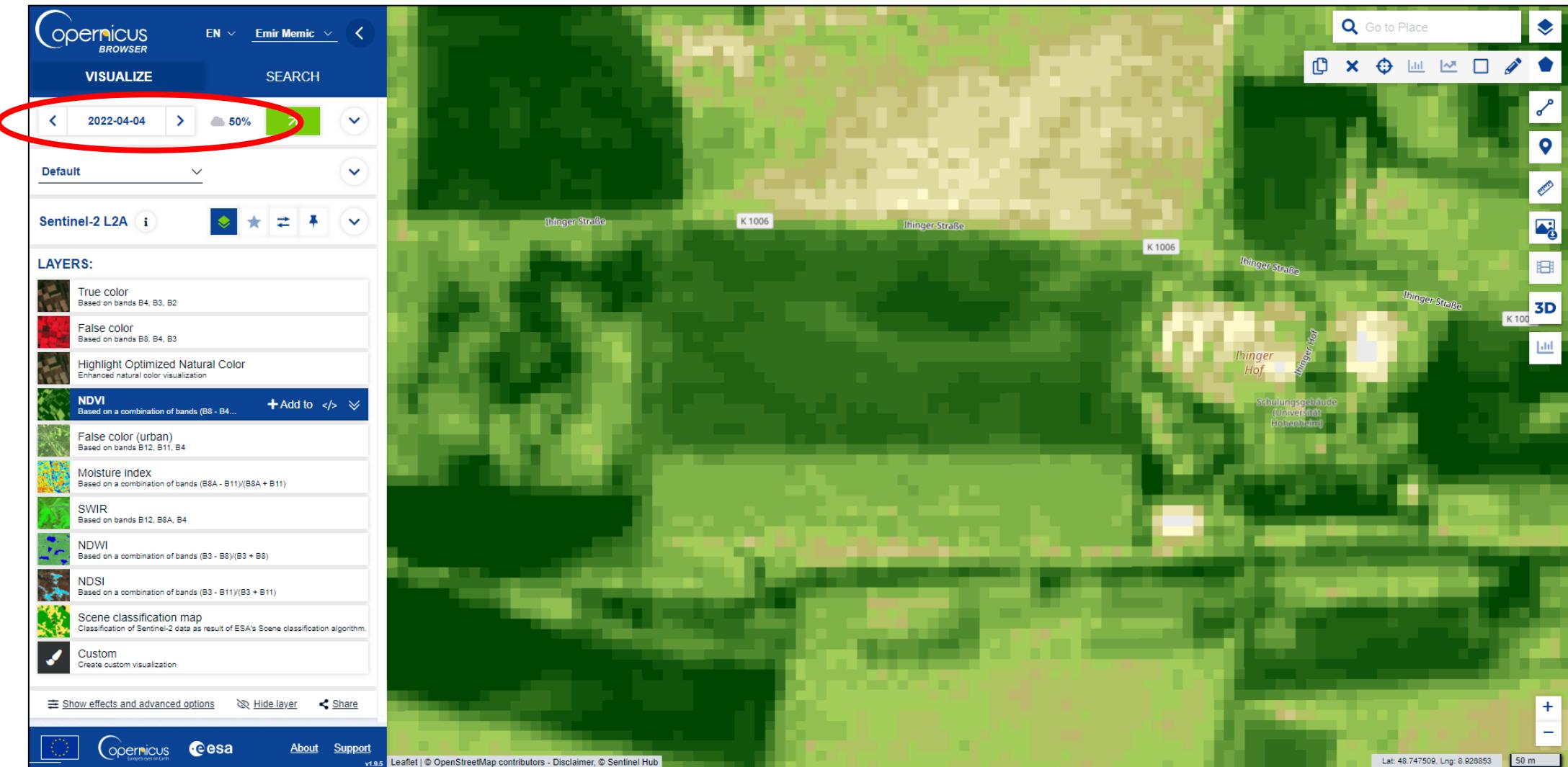
(University of Hohenheim)

Feb 2024

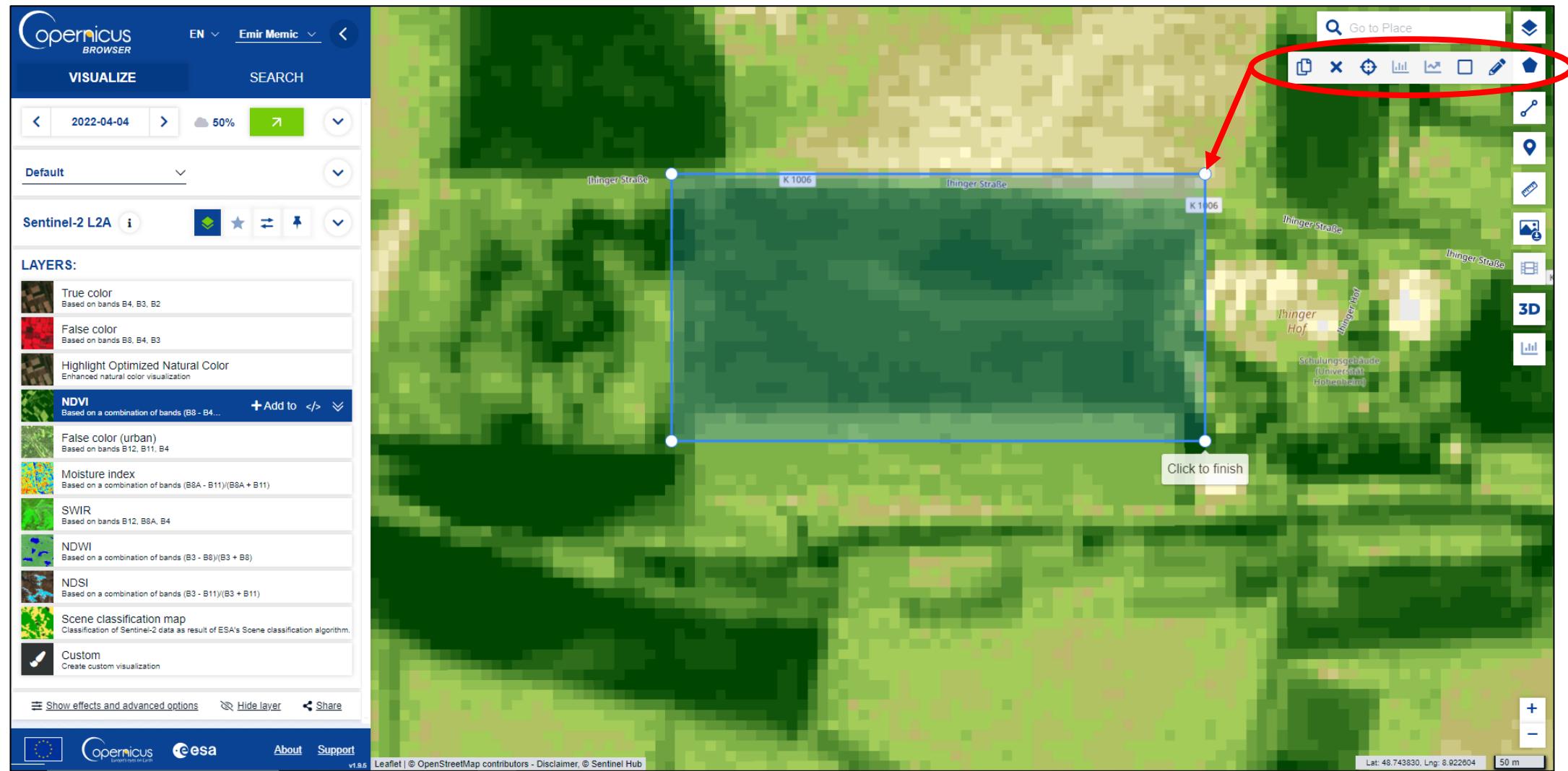
Outline

- 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

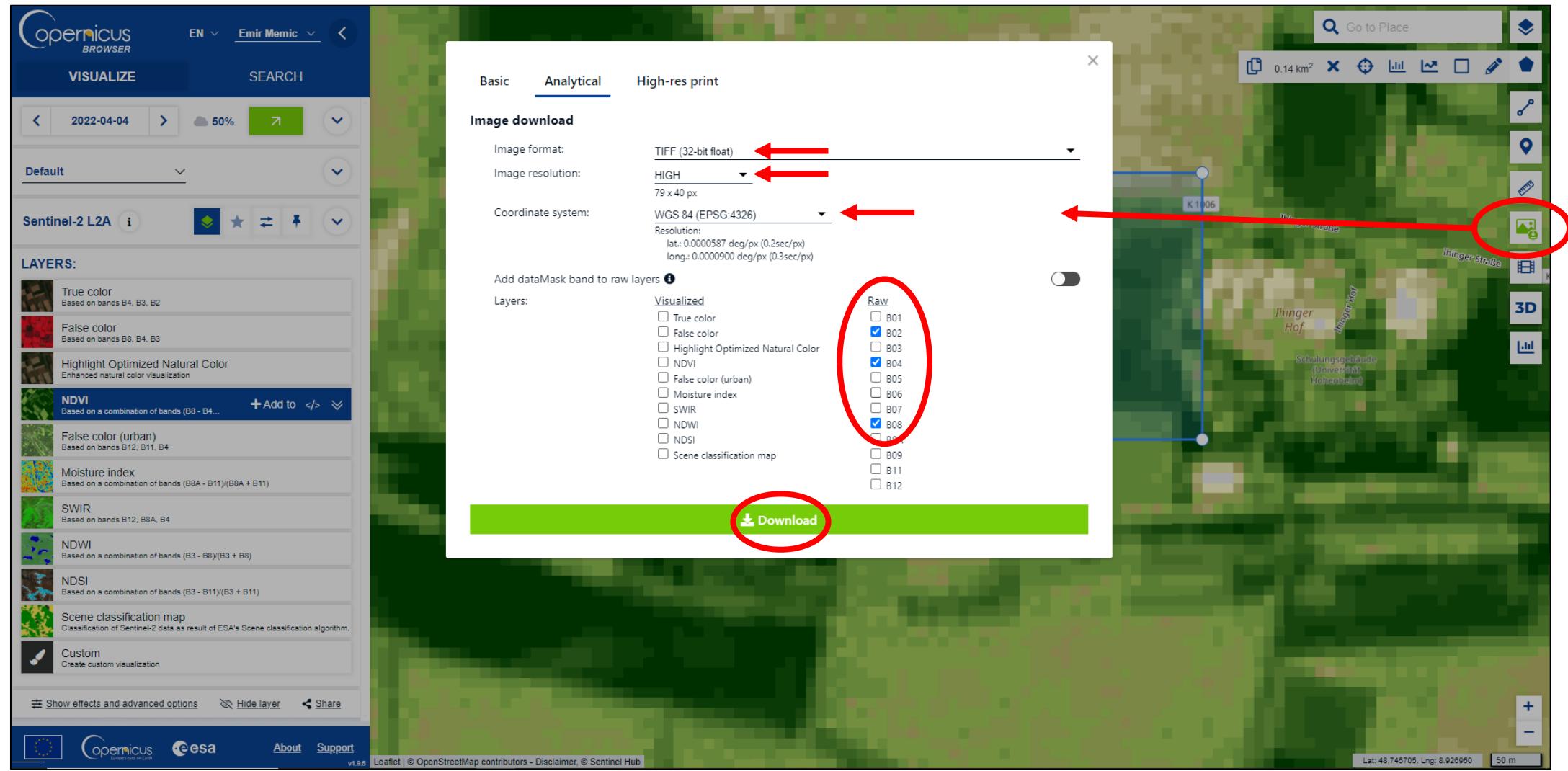
Acquiring satellite images via Copernicus Browser



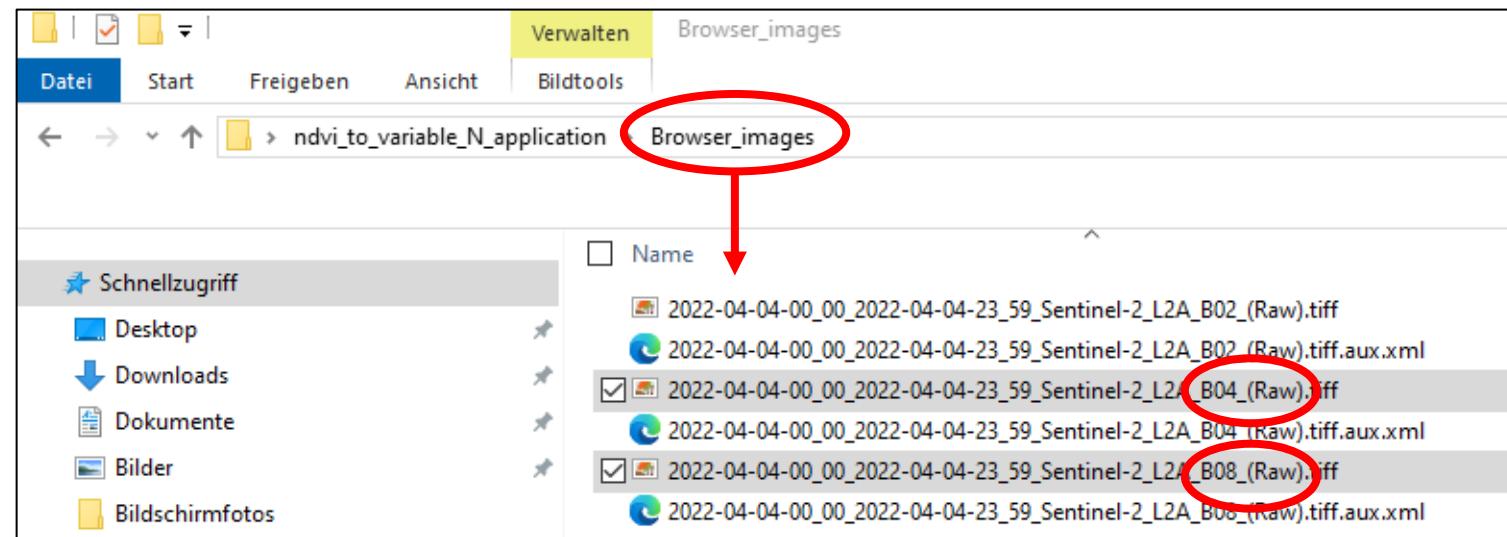
Delineating area of interest (polygon) for downloading



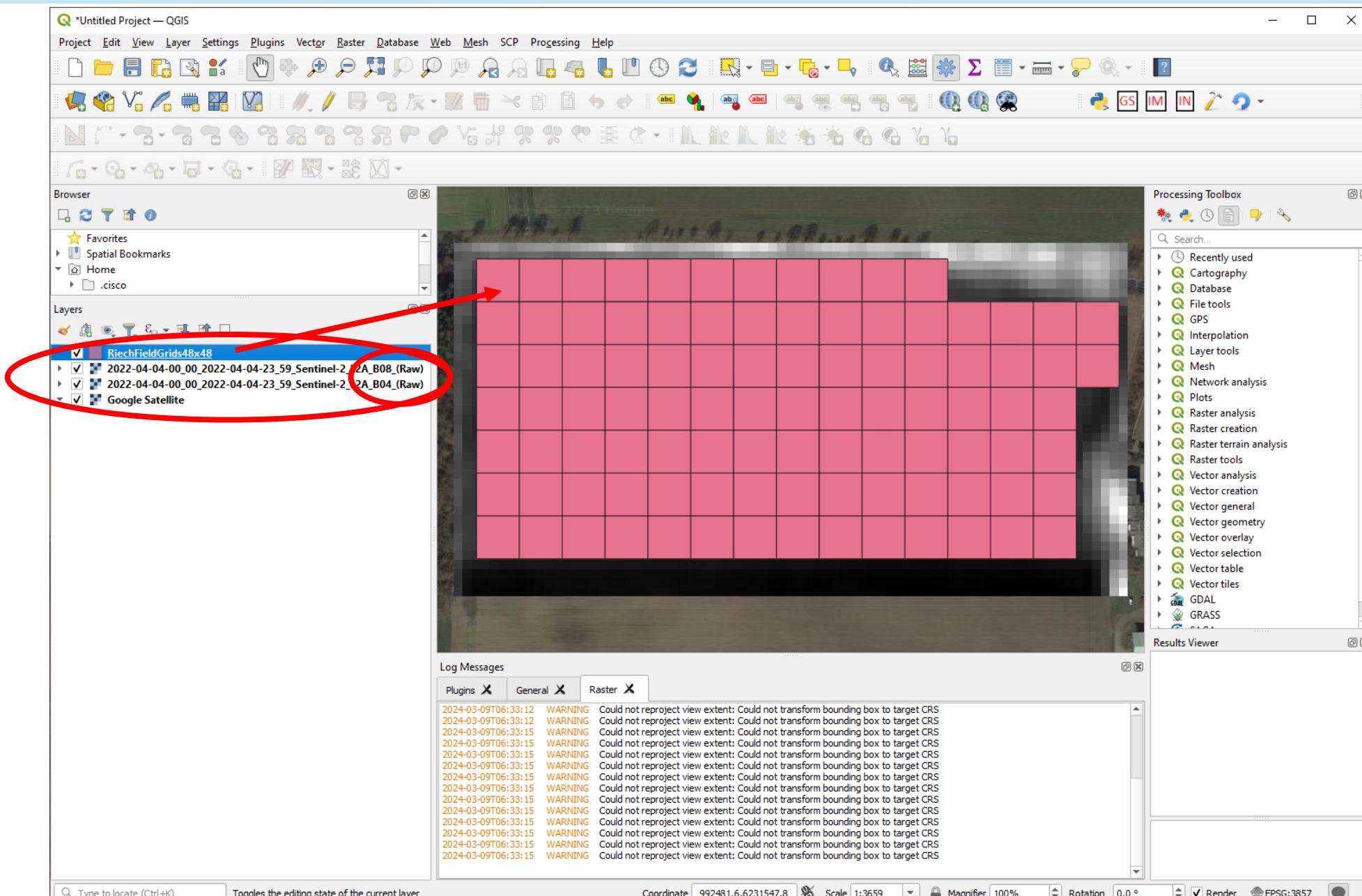
Downloading bands of interest – B02 (Blue), B04 (Red) and B08 (NIR)



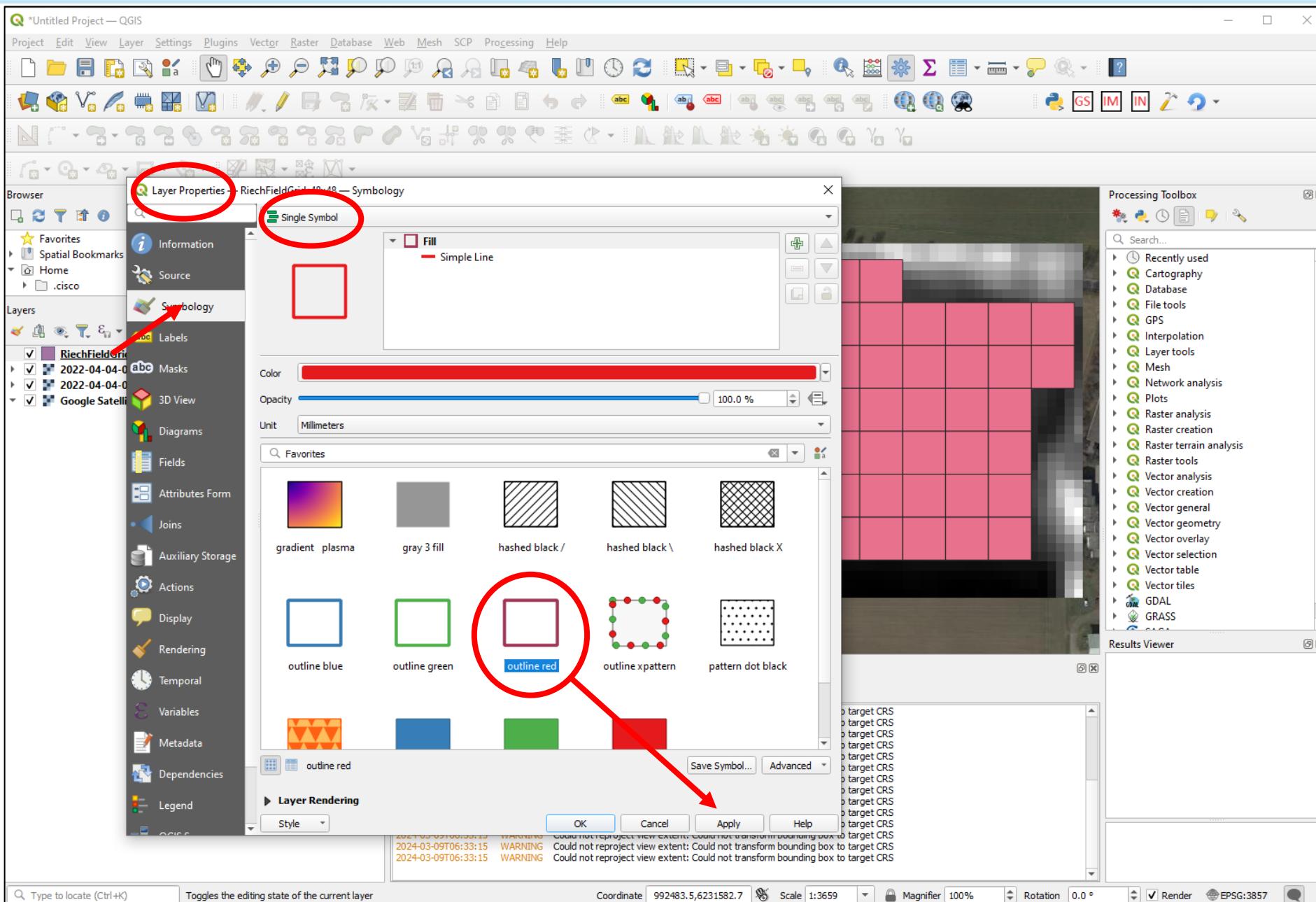
Downloaded and unzipped row data – for this example only B04 and B08 required for NDVI calculation



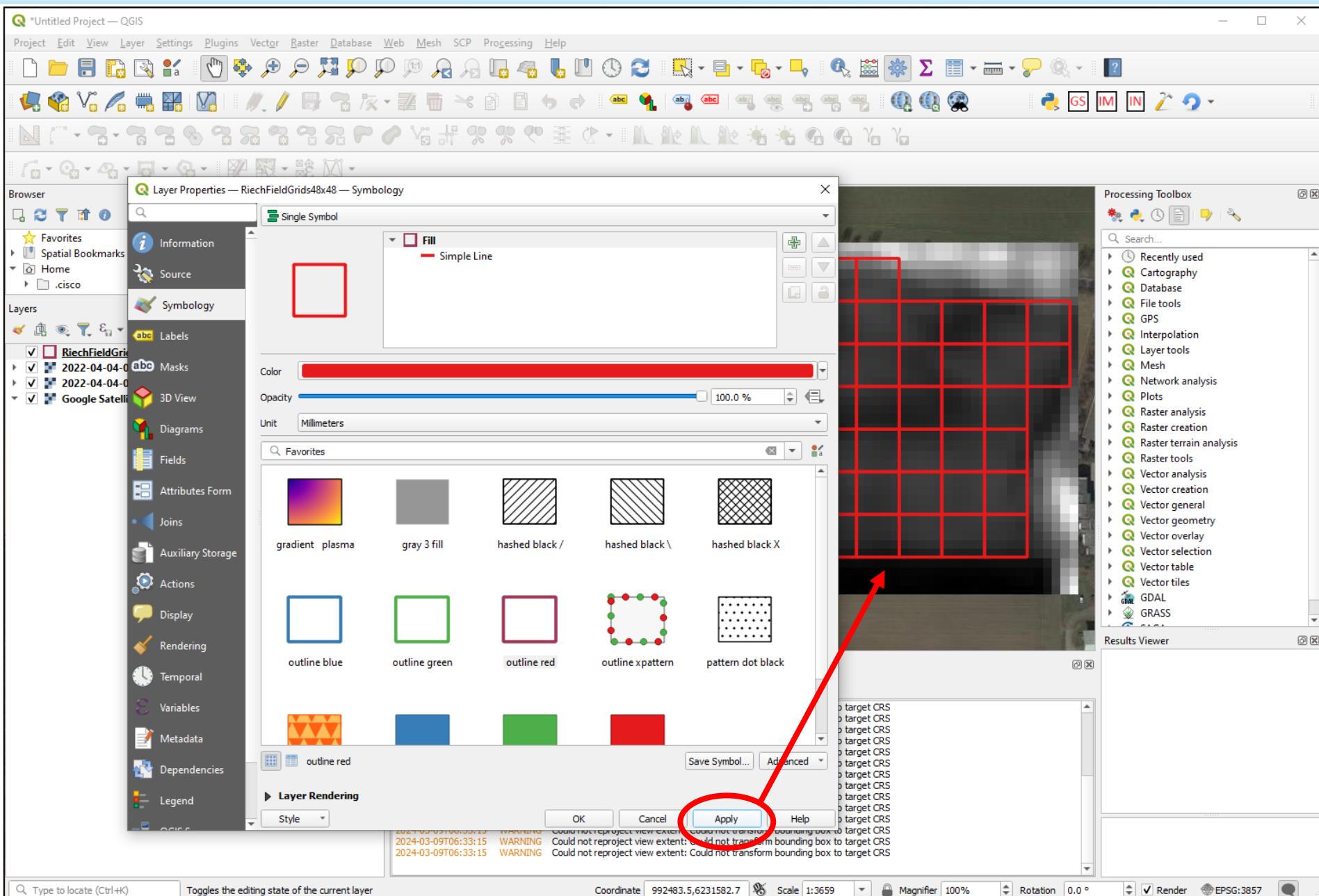
Uploading required data into QGIS (drag and drop): georeferenced images and raster grid of area of interest



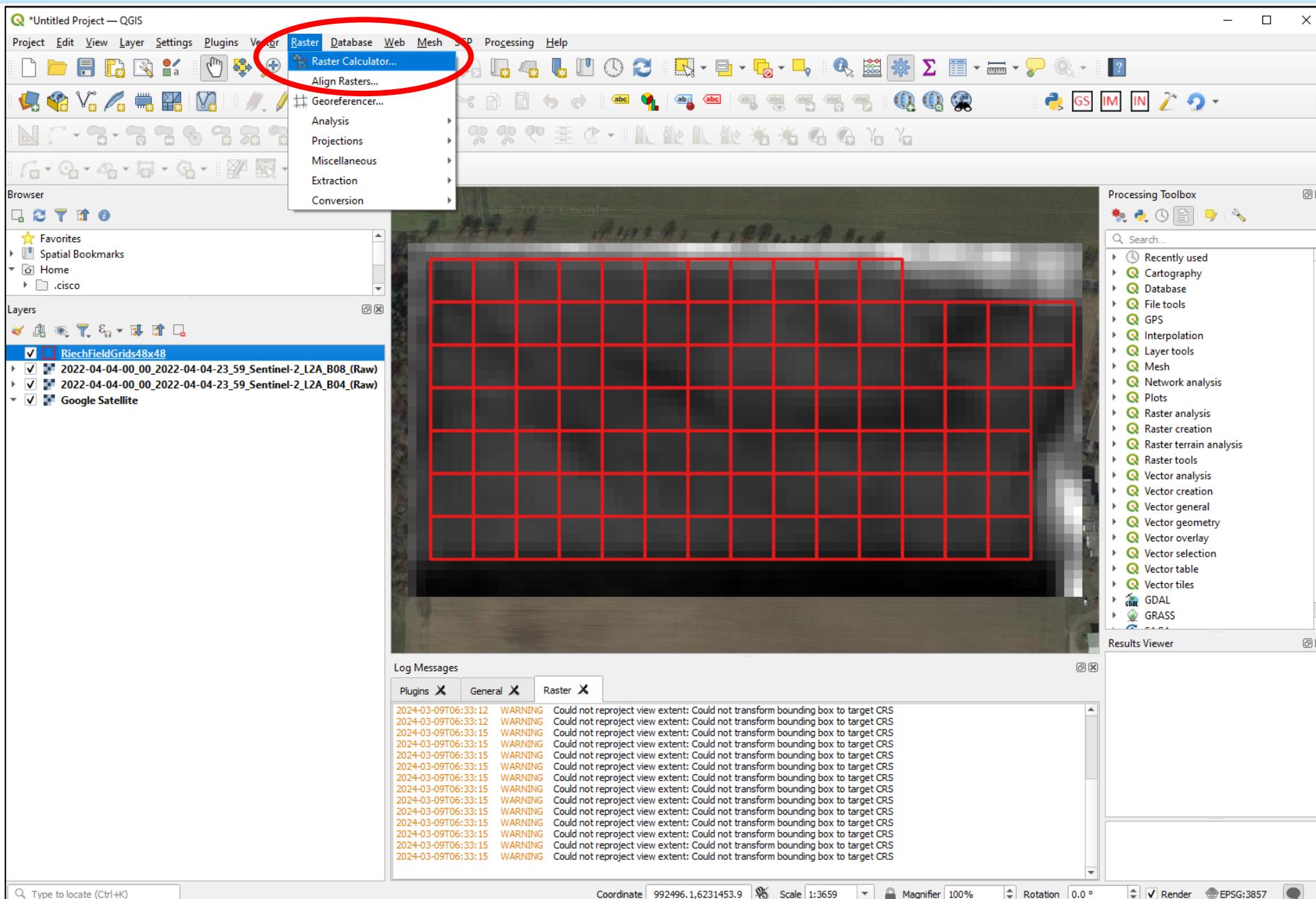
Modifying of the girds to get transparent background – Layer Properties -> Symbology -> Single Symbol



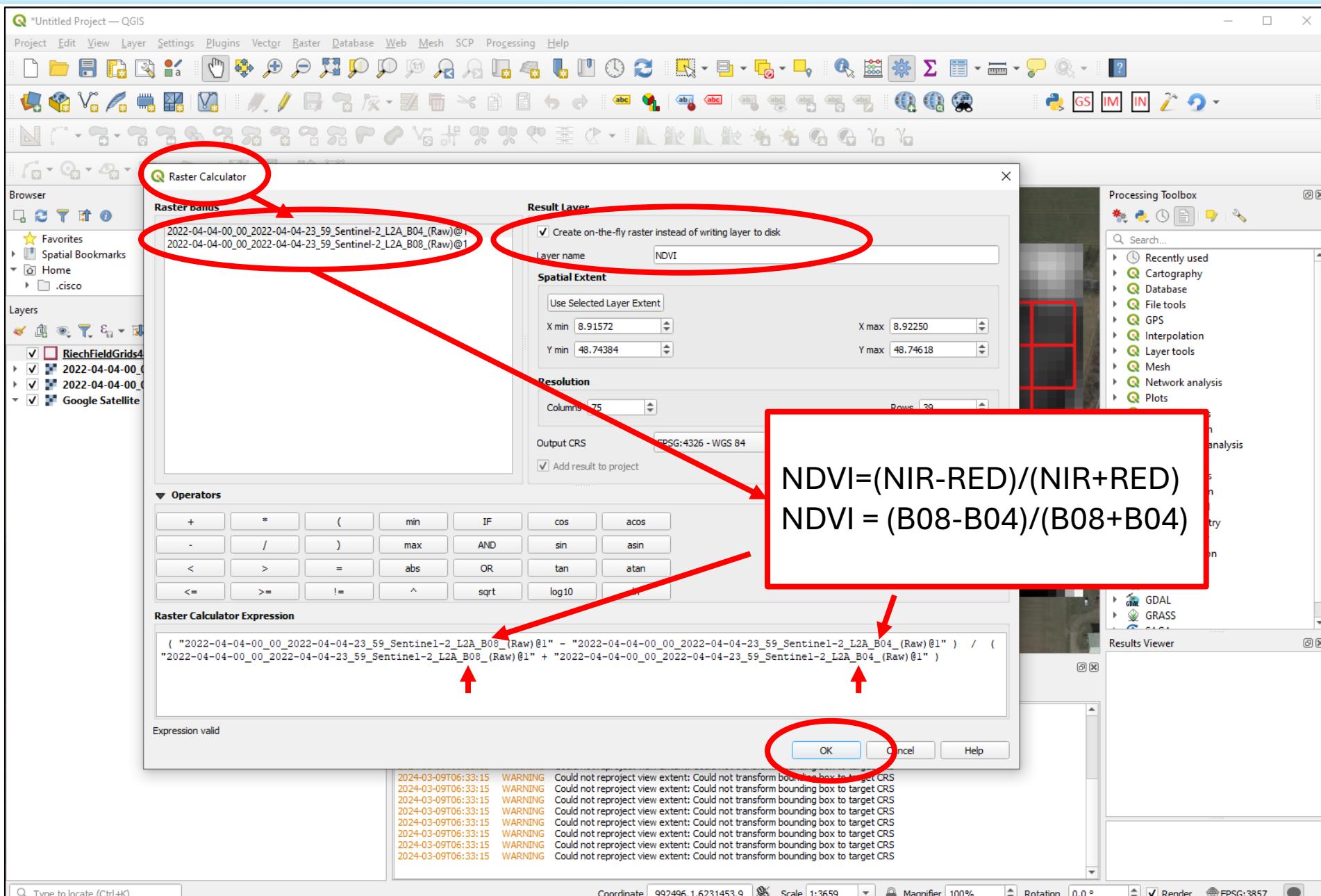
Modifying of the girds to get transparent background – when executed



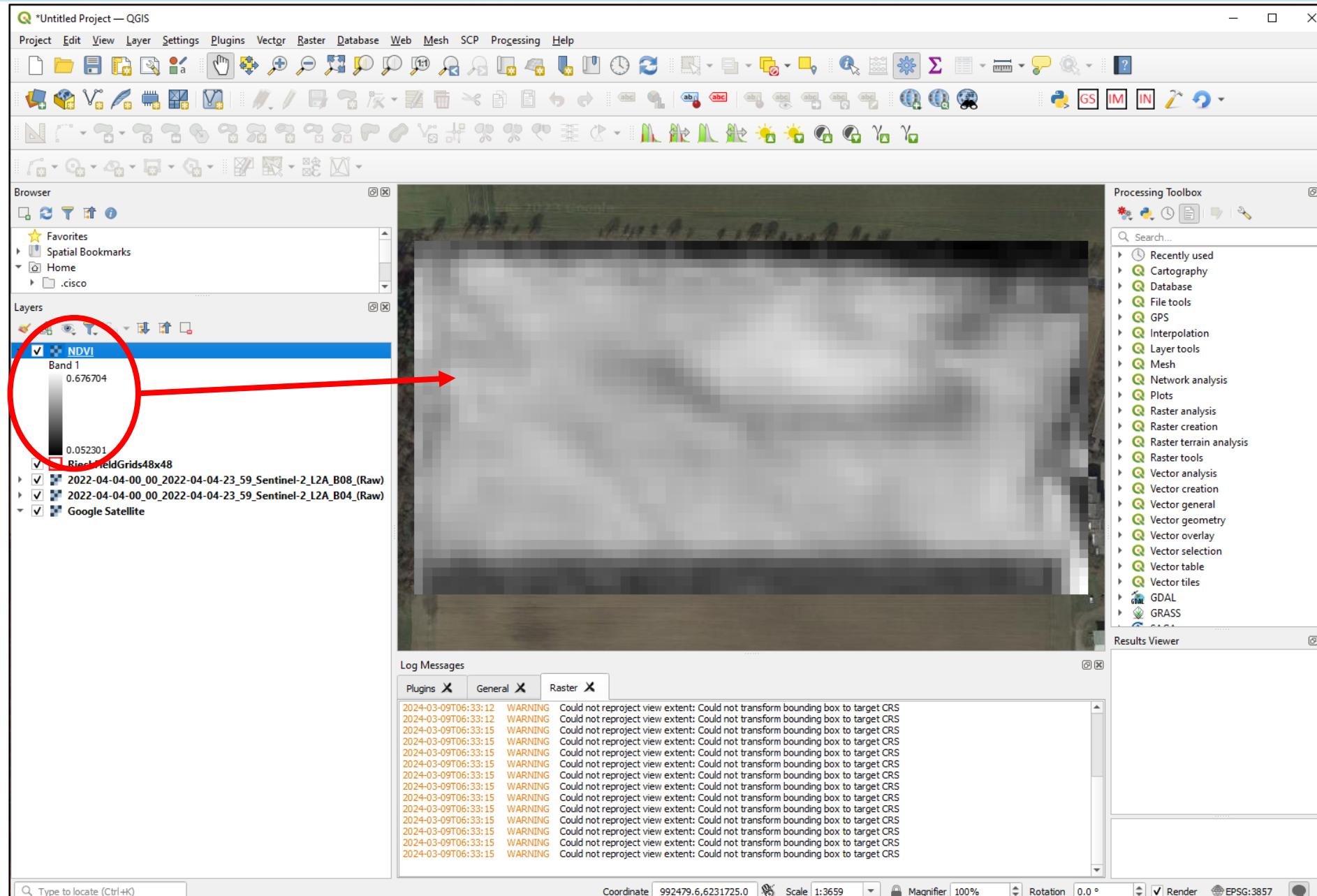
Calculating NDVI is conducted with Raster Calculator – Raster -> Raster Calculator



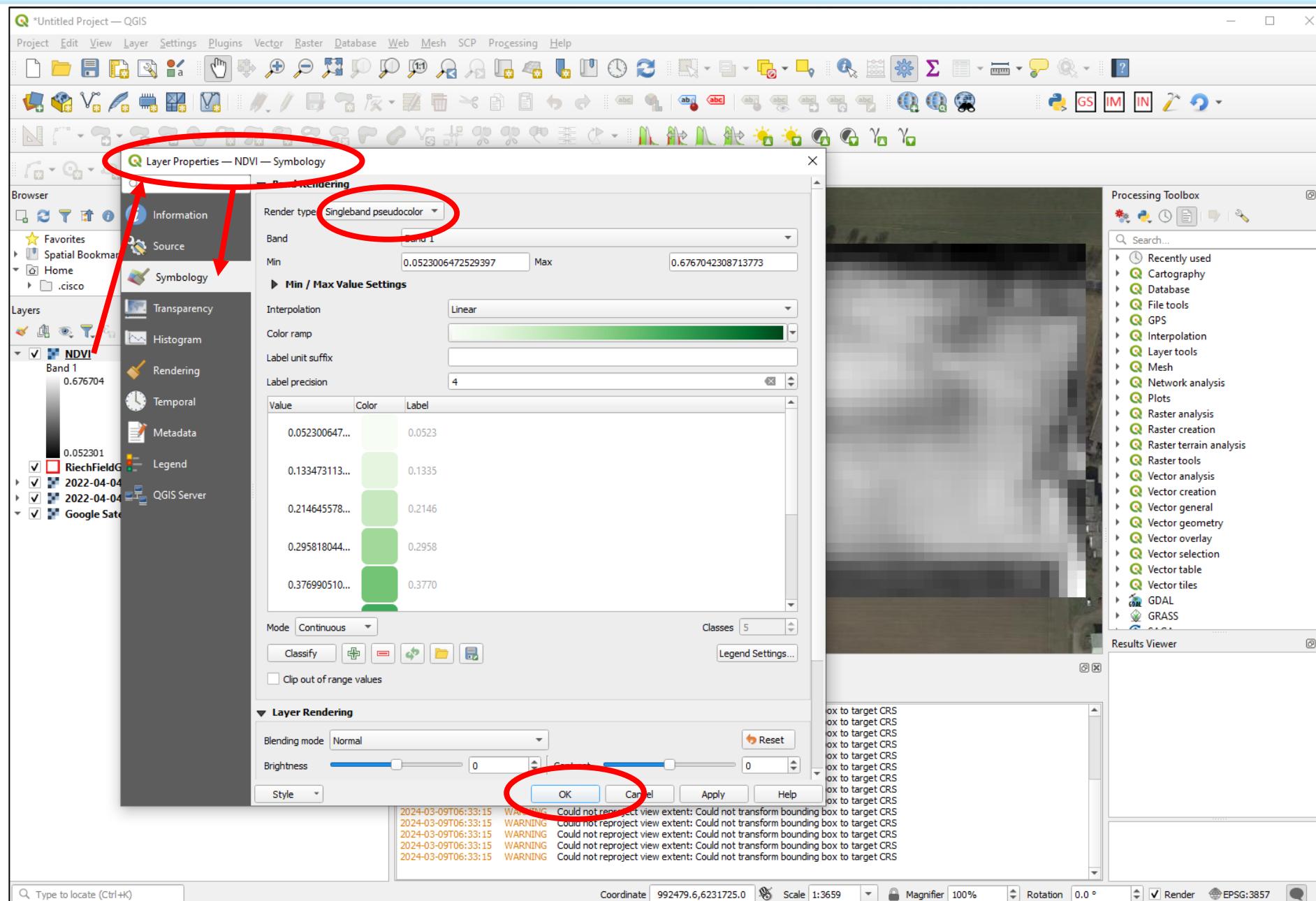
In Raster Calculator – minimum action required to calculate NDVI is indicated with red circles and arrows



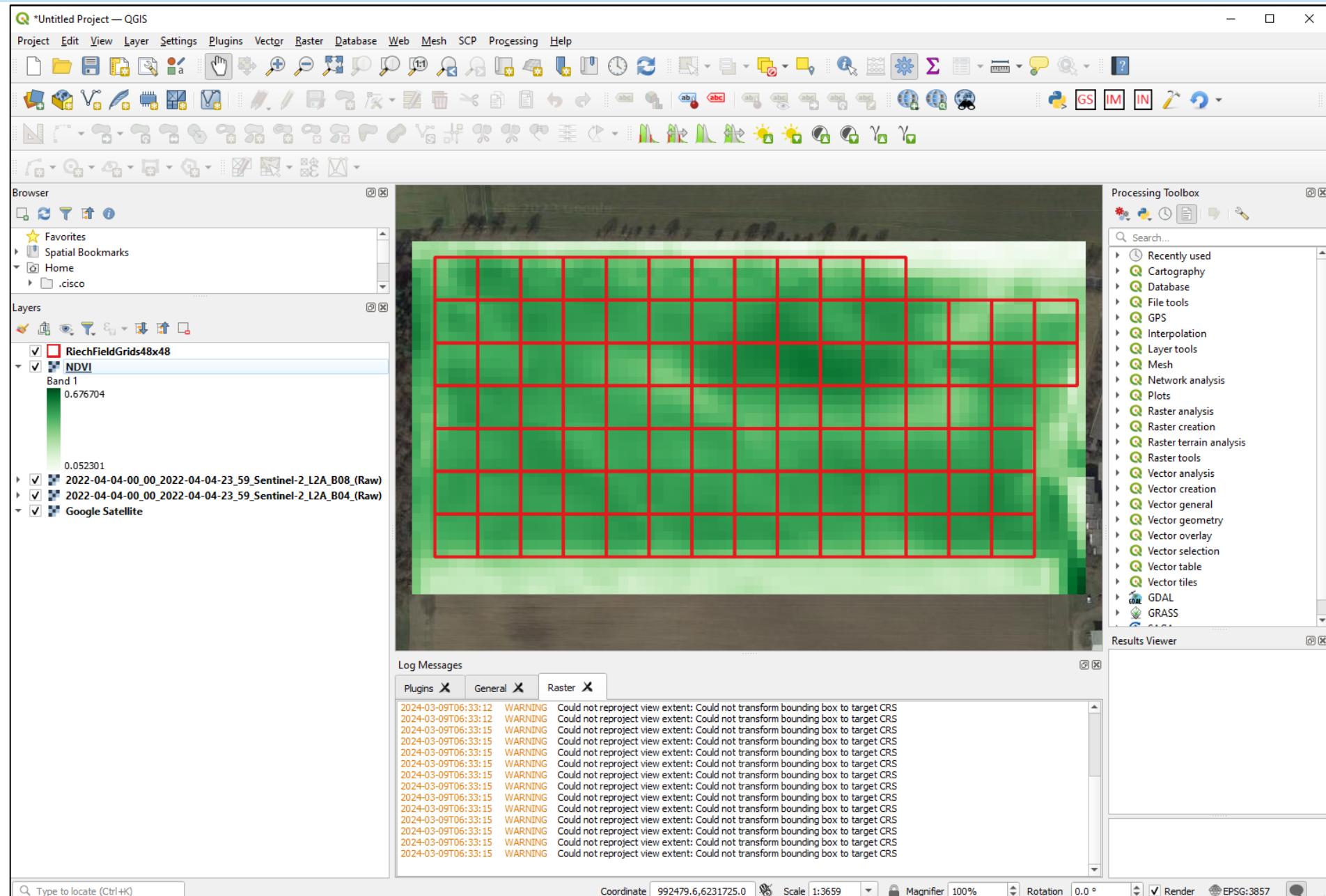
After Raster Calculator calculations are conducted a user gets NDVI layer in QGIS



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

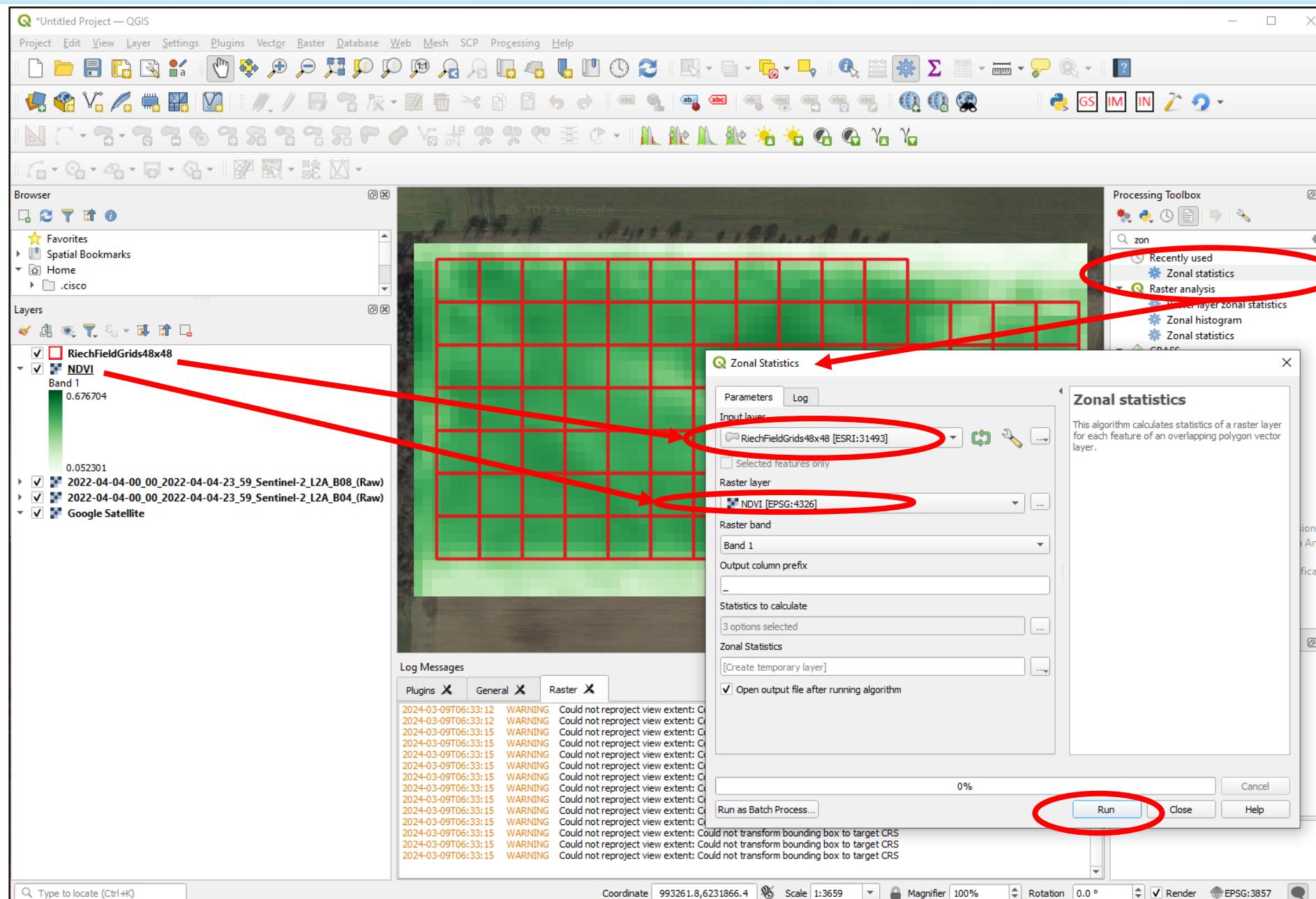


NDVI layer in green

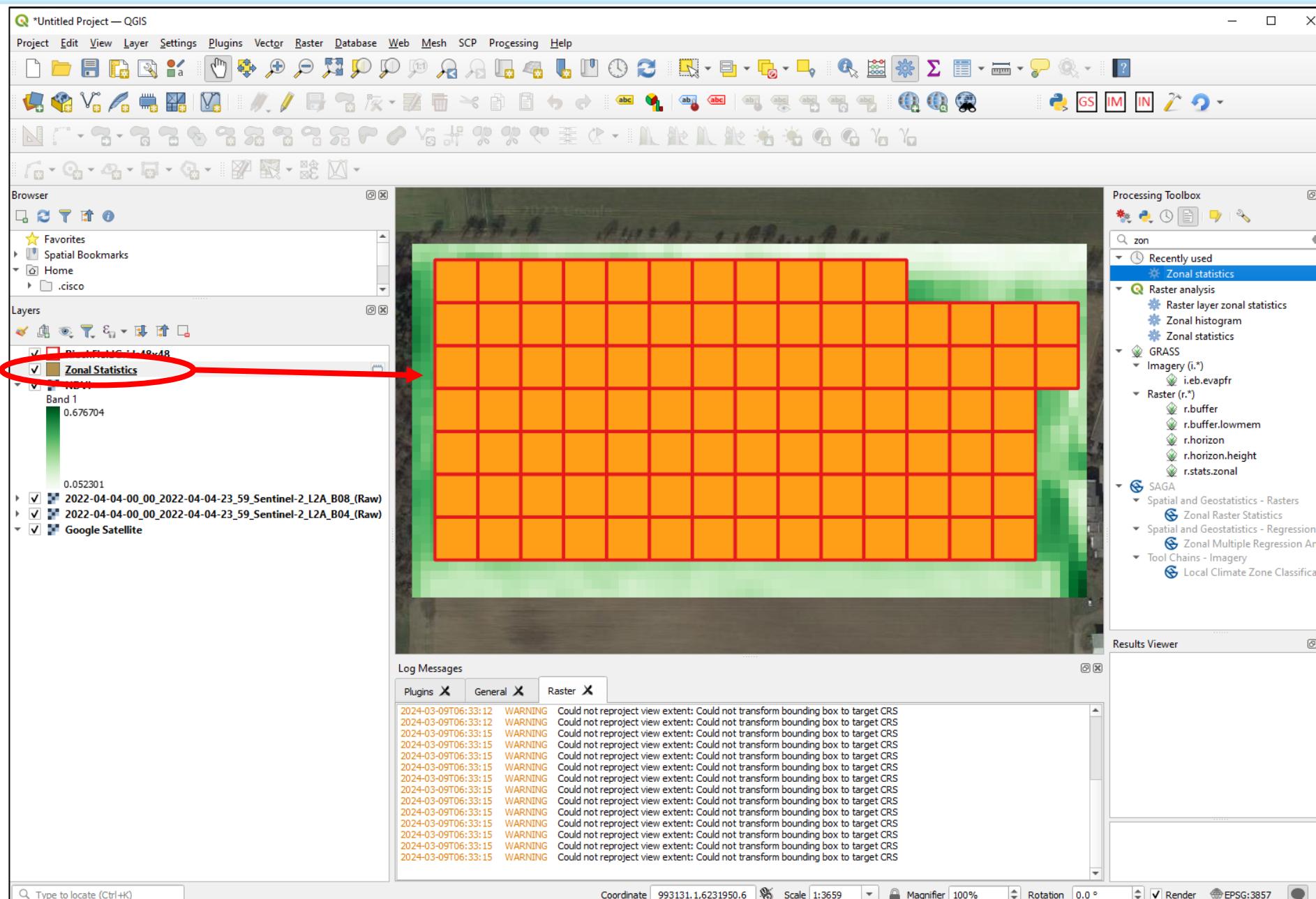


QGIS-based NDVI analysis

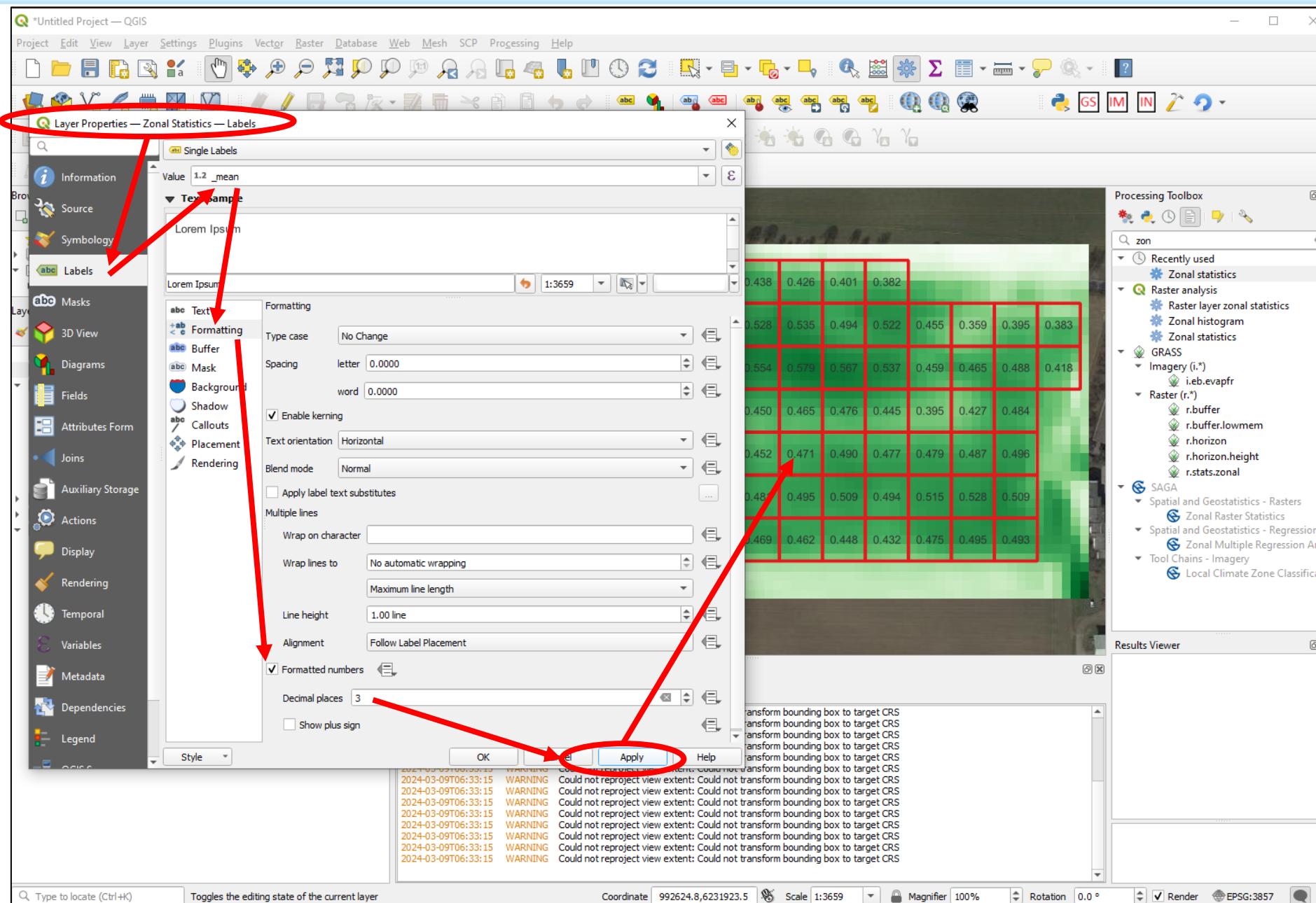
Calculating NDVI for each grid – based on Grid layer and NDVI layer with Zonal Statistics



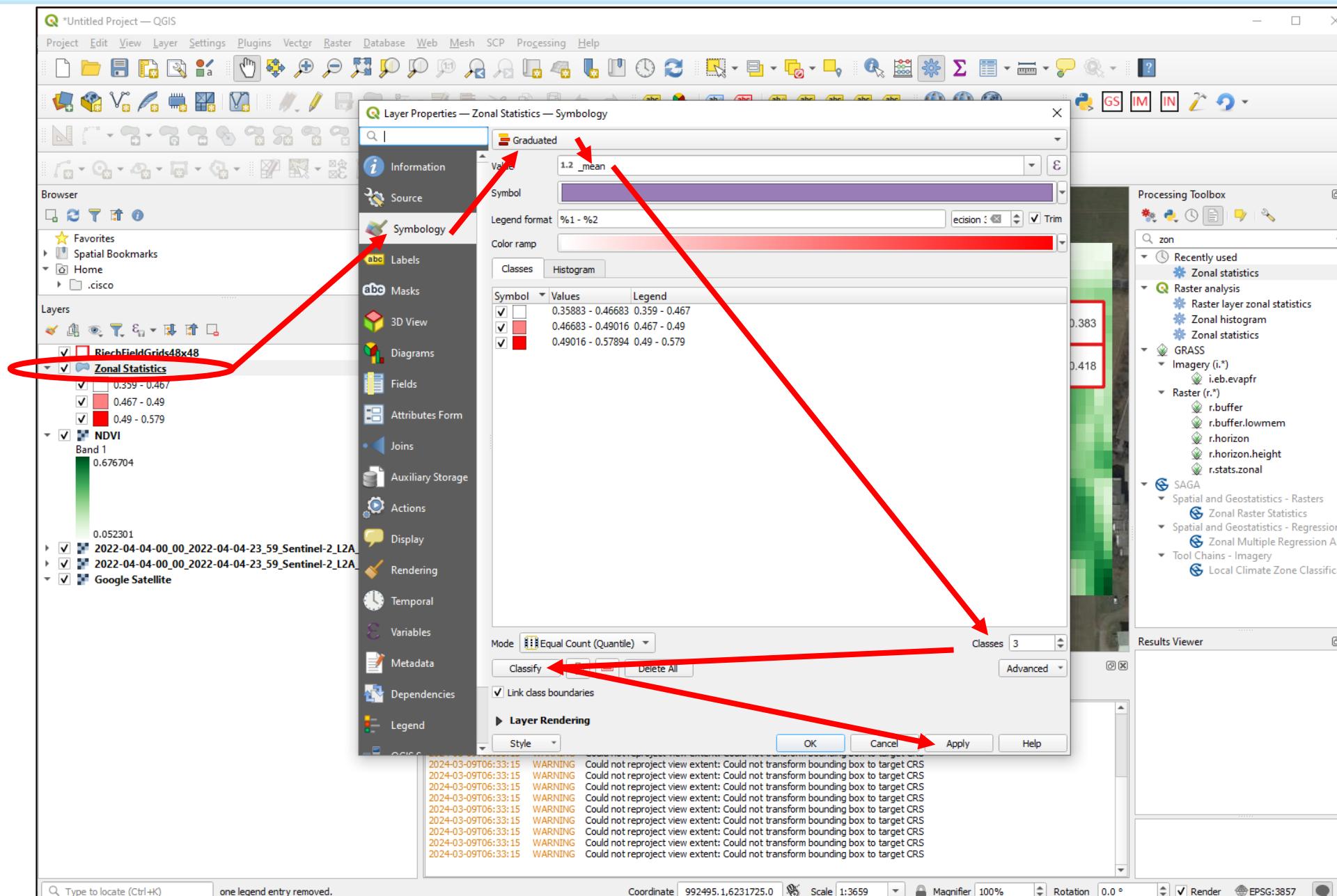
Zonal Statistics after execution produce Zonal Statistics (temporary layer)



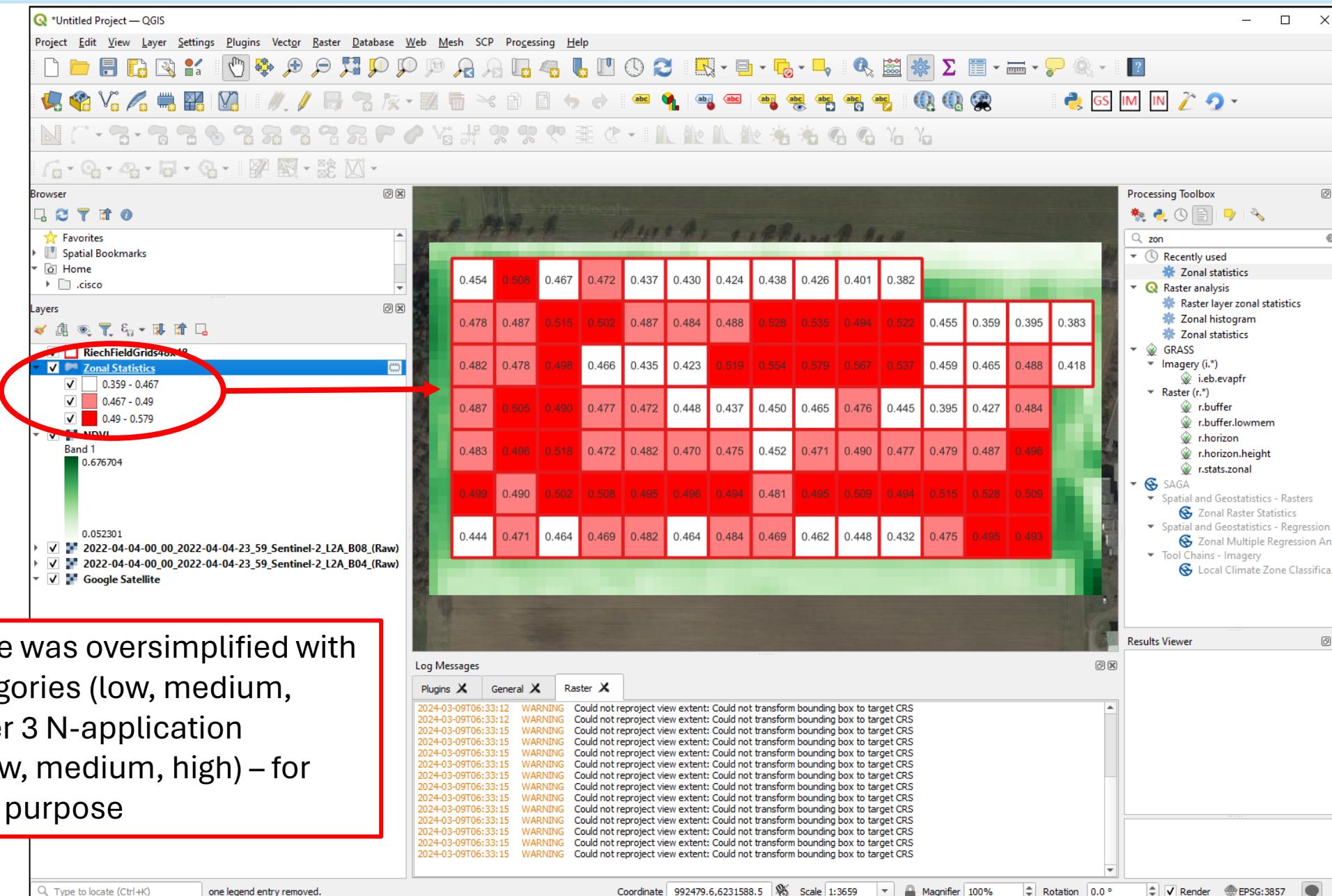
Zonal Statistics layer – to show NDVI for each grid – Layer Properties -> Labels -> Single Labels -> _mean (value select)



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)



This example was oversimplified with 3 NDVI categories (low, medium, high) for later 3 N-application amounts (low, medium, high) – for educational purpose

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 the following components:

- Toolbar:** Standard QGIS toolbar with various tools for selection, measurement, and analysis.
- Layers Panel:** Shows several layers including "RiechfieldGrids40_10", "Zonal Statistics" (which is highlighted with a red oval), "NDVI", and "Google Satellite".
- Attribute Table:** A table titled "Zonal Statistics — Features Total: 97, Filtered: 97, Selected: 0" with 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...	0.47848999025...
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...

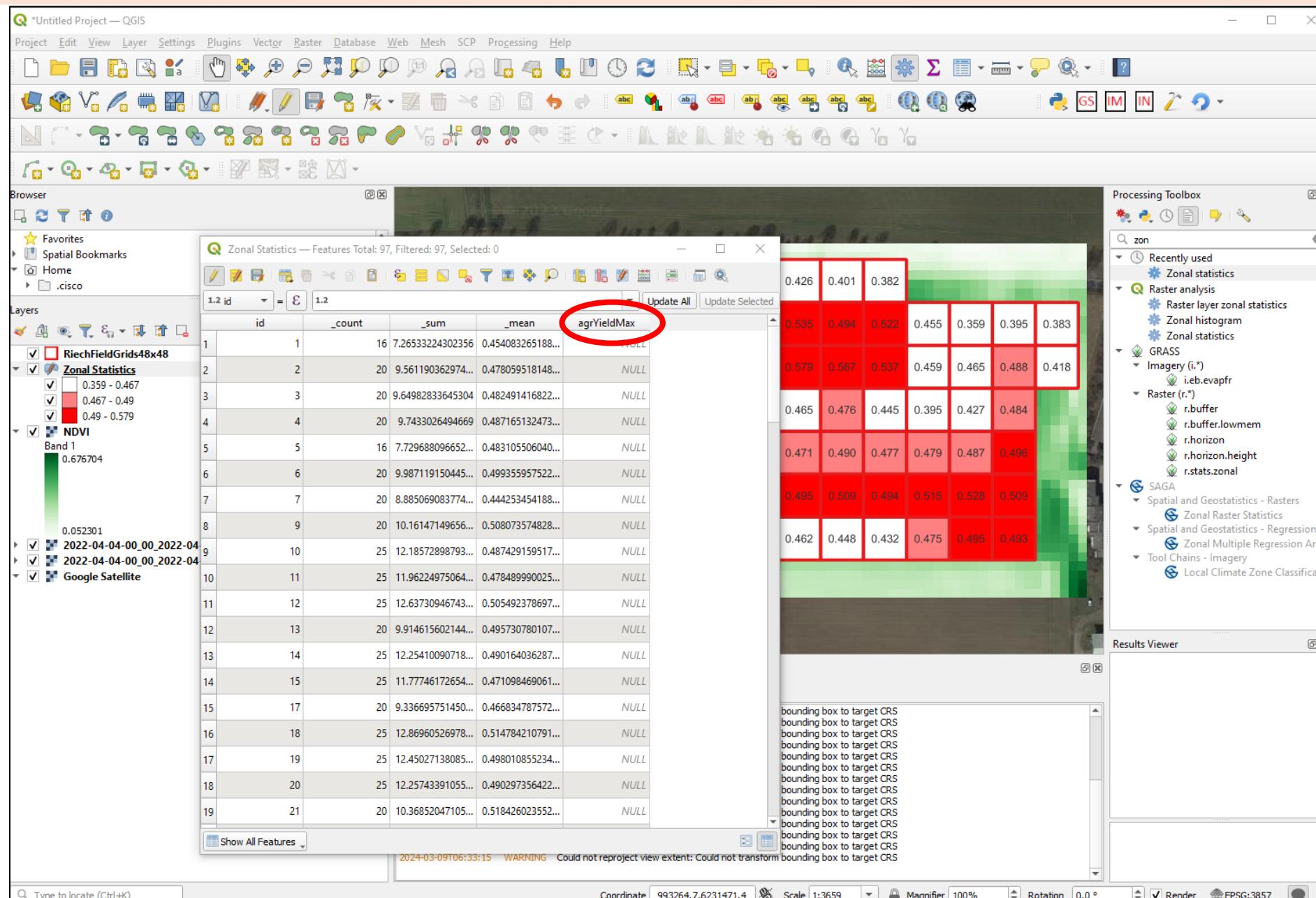
- Raster View:** A 10x10 grid of colored pixels representing the zonal statistics. The colors correspond to the values in the attribute table.
- Processing Toolbox:** Shows the "zon" search results, including "Zonal statistics" under "Raster analysis".
- Results Viewer:** Displays a list of processing steps: transform bounding box to target CRS, transform bounding box to target CRS, etc.

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 several windows open:

- Project Bar:** Standard QGIS project bar with tabs for Project, Edit, View, Layer, Settings, Plugins, Vector, Raster, Database, Web, Mesh, SCP, Processing, and Help.
- Toolbar:** Standard QGIS toolbar with various icons for selection, measurement, and analysis.
- Browser:** Shows the project structure with layers like "RiechFieldGrids48x48", "Zonal Statistics", and "NDVI".
- Zonal Statistics Window:** Shows a table with columns: id, _count, _sum, and _mean. The table contains data for 12 zones (rows 1-12). A red circle highlights the "Update All" button at the top right of this window.
- Add Field Dialog:** A modal dialog titled "Add Field" with fields for Name (set to "agrYieldMax"), Comment, Type (Whole number (integer)), Provider type (integer), and Length (set to 10). A red circle highlights the "Name" field.
- Raster View:** A 48x48 pixel grid visualization where each cell's color and value represent a statistical measure. The values range from 0.398 (dark red) to 0.554 (light green).
- Processing Toolbox:** Shows the "zon" search results, including "Recently used", "Raster analysis", "GRASS", and "SAGA" tool categories.
- Results Viewer:** An empty panel for displaying processing results.

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:

- Attribute Table Window:** Shows a table with columns: id, _count, _sum, _mean, and agrYieldMax. The agrYieldMax column contains NULL values.
- Field Calculator Window:** Shows the expression: 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. The "Update existing field" checkbox is checked.
- Legend Window:** Displays a color scale from red (0.438) to green (0.382).
- Layers Panel:** Shows layers: RiechFieldGrids48, Zonal Statistics, and NDVI.
- Processing Toolbox:** Shows recently used tools: Zonal statistics, Raster analysis, Raster layer zonal statistics, and Zonal histogram.

A red arrow points from the "Update existing field" checkbox in the Field Calculator to the agrYieldMax column in the Attribute Table. A green arrow points from the Field Calculator window to the agrYieldMax column in the Attribute Table.

This code when added into Field Calculator consol to allocate N kg value: If NDVI is **bigger or equal to 0.359** and **less then 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

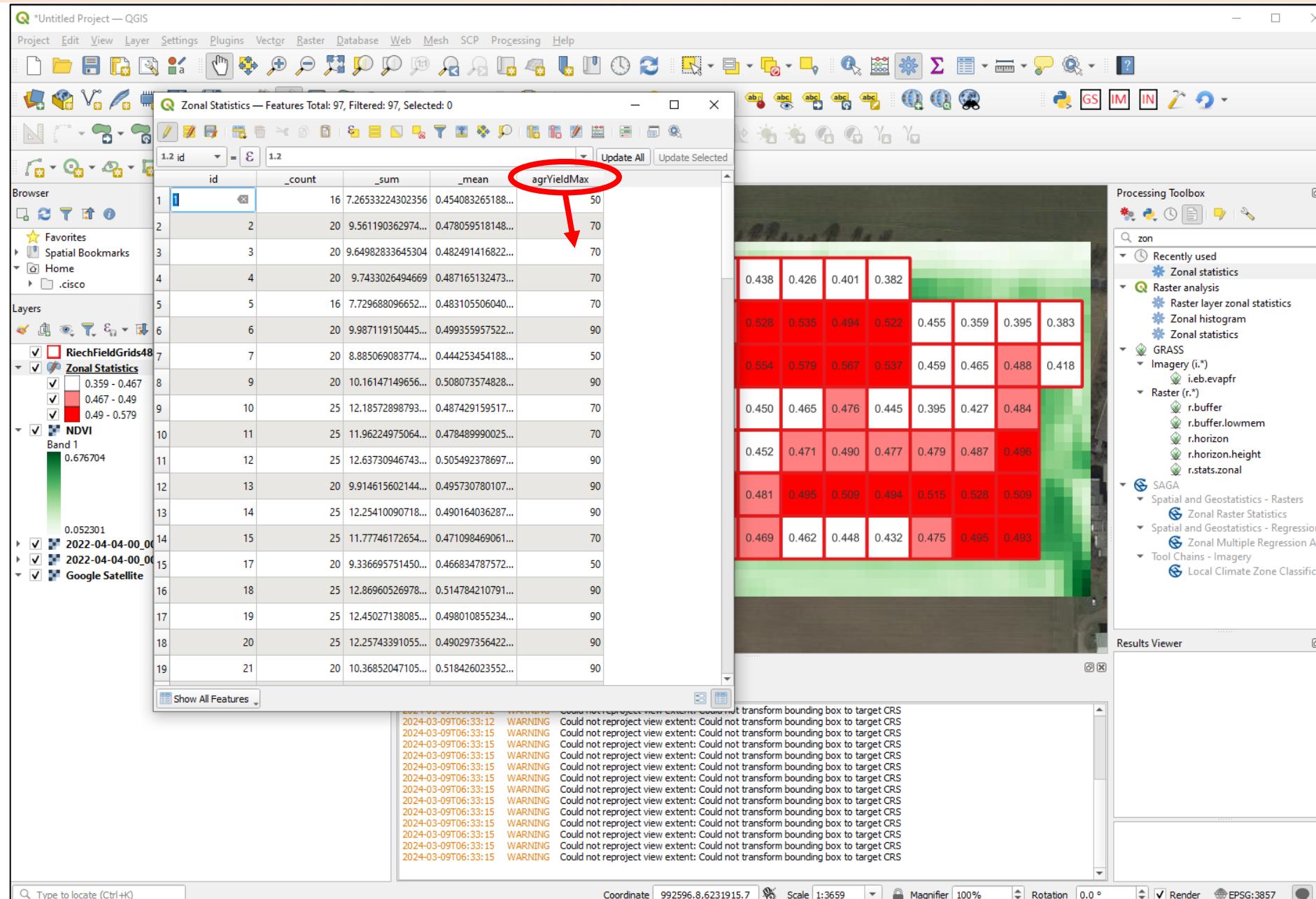
WHEN "_mean" >= 0.467 and "_mean" < 0.490 THEN 70

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



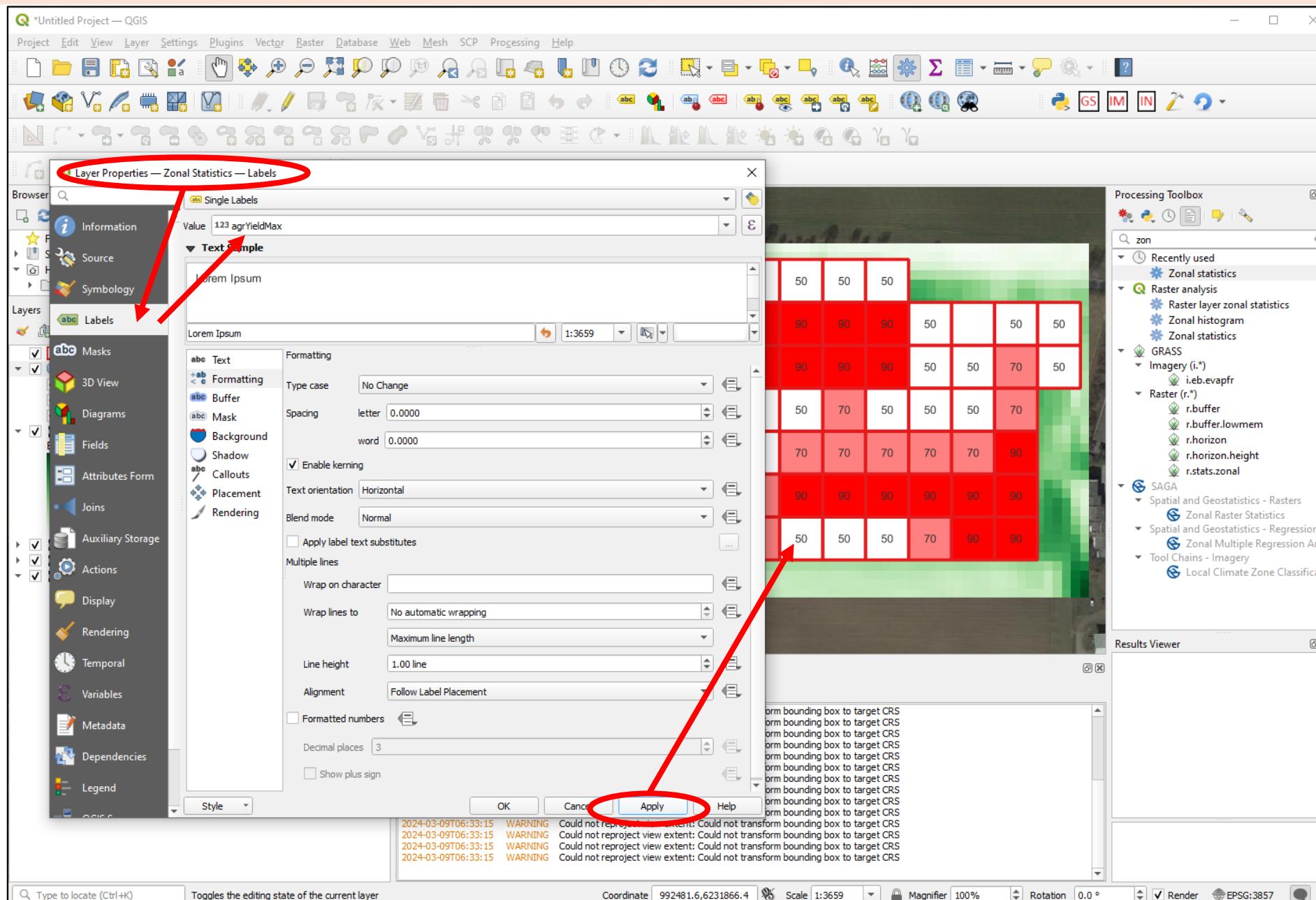
N prescription map processing

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

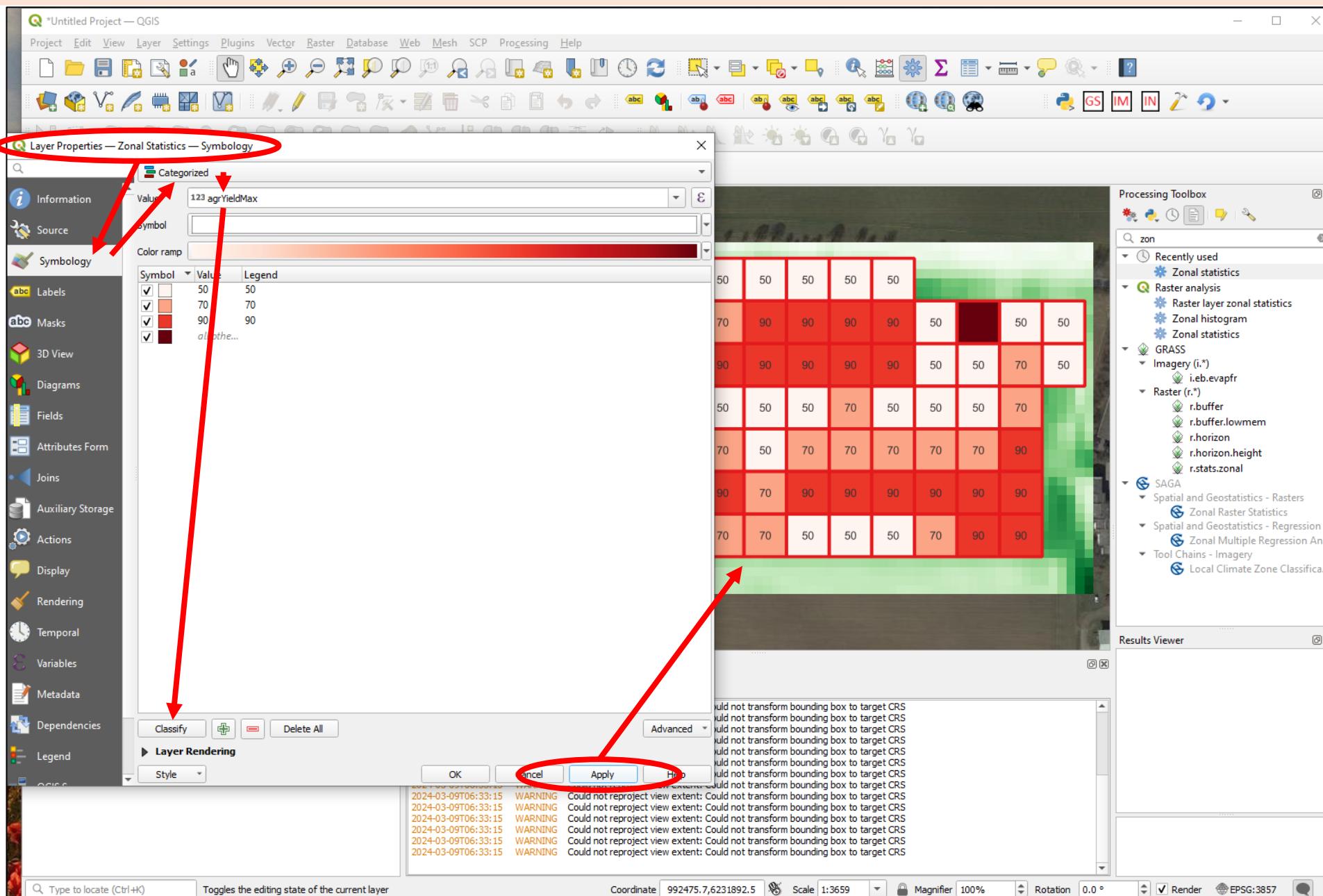
The screenshot shows the QGIS interface with the following elements:

- 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:** Lists layers including 'RiechFieldGrids48', 'Zonal Statistics' (selected), 'NDVI' (Band 1), and several date layers ('2022-04-04-00_00', '2022-04-04-00_00').
- Table View:** Shows a 'Zonal Statistics' table with columns: id, _count, _sum, _mean, and agrYieldMax. The table includes rows for various categories and their corresponding statistics.
- Message Dialog:** A 'Stop Editing' dialog box is open, asking '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.

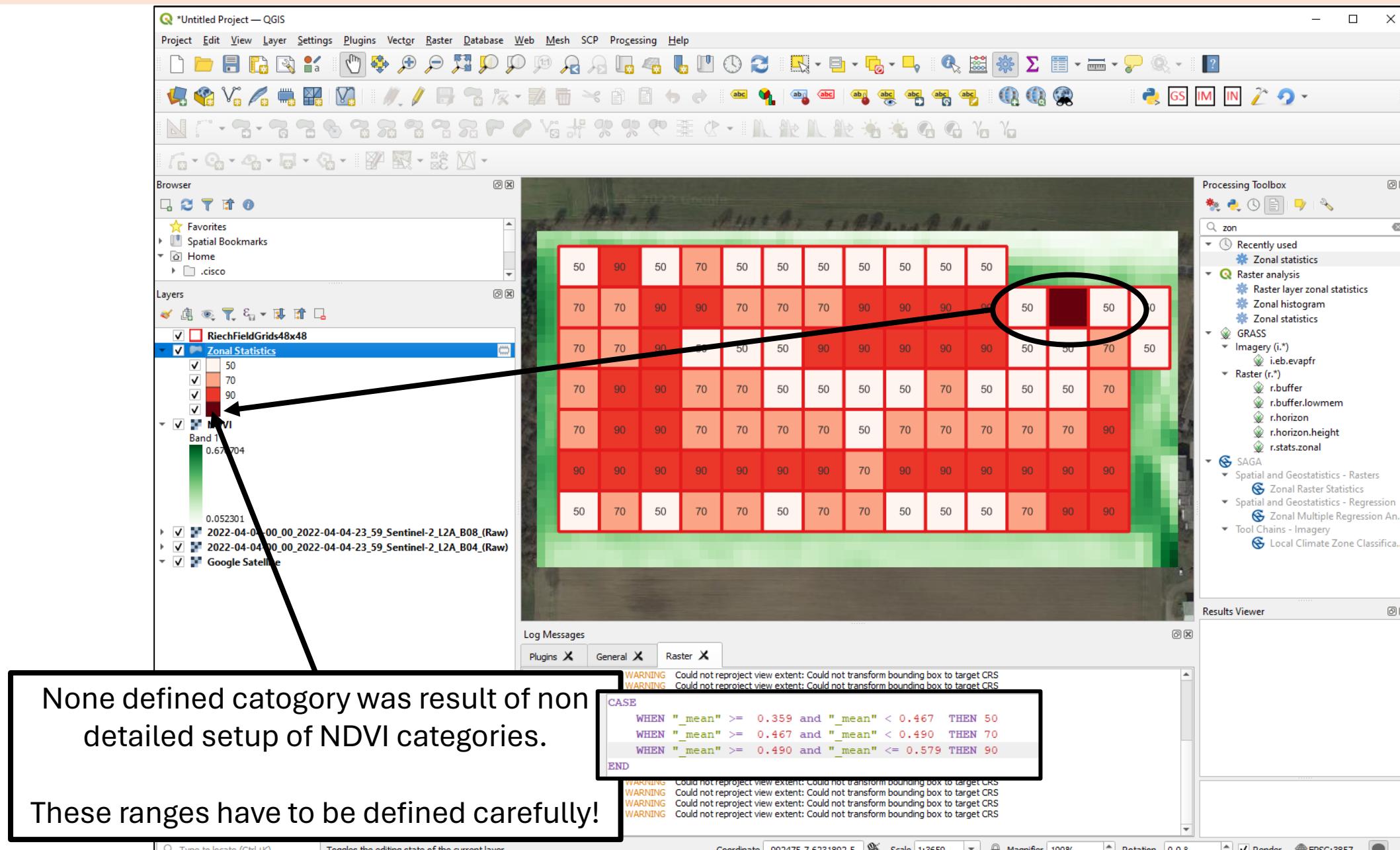
Zonal Statistics layer – Labels -> Single Labels -> agrYieldMax (value) -> will N application values to each corresponding grid



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



Zonal Statistics layer – N application mat generated!



Discussion