BURKINA FASO: Dry Season is from March to August and wet season is September to December. Collect up to 10 irrigated and non-irrigated polygons from each tile. Note that most of the tiles will not have any irrigated areas. Don't label in those tiles. Try to keep the total area of irrigated and non-irrigated polygons the same.

Polygon labeling rules

Dry season in Amhara is defined as Dec 1 — May 1. In Northern Nigeria it is Jan 1-Aug 1
Rainy season in Amhara is defined as June 1 — Nov 1. In Northern Nigeria it is Aug 1-Dec1
So the seasons vary as you move across the Sahel and it is important to establish (will be done and provided by Hasan) what this is for the country the labels are being collected for.

For an **irrigated polygon** to be confirmed, it must have

1. A clear EVI peak in the dry season
    a. This EVI peak must be > 0.3.
    b. Multiple timesteps (>2 points) of continuous vegetation growth before, and senescence after.
    c. Note ~98%+ of the time, there will also be a peak in the rainy season.
2. Multiple time steps with an EVI below 0.25 across the year.

For a **non-irrigated polygon** to be confirmed it must have

1. No EVI peak in the dry season.
2. A single EVI peak larger than 0.3 occurring sometime during the rainy season.
    a. Multiple timesteps (>2 points) of continuous vegetation growth before, and senescence after.
3. Multiple time steps with an EVI below 0.25 across the year.

General rules/guidelines:

1. Polygons must be no larger than 10 Ha.
2. Stick to drawing polygons, not rectangles.
3. Save polygons 1-by-1, i.e. saving a single polygon. I will convert polygons to a single GeoJSON later.
4. Try to have an equal number of samples from both irrigated and non-irrigated classes per tile.
    a. Similar in # of polygons and overall areas of polygons
    b. This will often mean under sampling/not sampling non-irrigated areas
5. Ignore a tile if there is no visible dry season crop growth throughout, i.e. do not collect non-irrigated (negative) samples.
6. Do not draw any polygons on barren/evergreen/urban land.
7. Polygons should only include land cover areas that appear 'continuous'.
    a. Use your judgement here so that you're not including heterogeneous land cover types in a single polygon.
8. Do not save a polygon if you are at all uncertain about whether it fits the class in question. Instead draw a smaller polygon that you can be sure of, or ignore the area entirely.
9. Feel free to change the background display S2 imagery to look at other months of dry season imagery
10. Toggle between the Google Earth satellite so you can confirm that the area in question is cropland.

Areas of interest

Fig 1: Single cropping cycle from phenology map of the Sahel shown in a grayscale image

- The areas in the white are regions where we expect the methodology to work because these are areas with prolonged dry season.
- I will create and provide outline based on a threshold for these regions
- These will be split into 10km x 10km grids which can be divided amongst the enumerators for regions to look at and label
- Not all of these grids will have irrigated plots. The enumerators should find grids that have irrigated plots. These will show up as green against a background of dry season imagery. It should be verified that the plots appearing as green are indeed croplands.

Burkina Faso labeling example

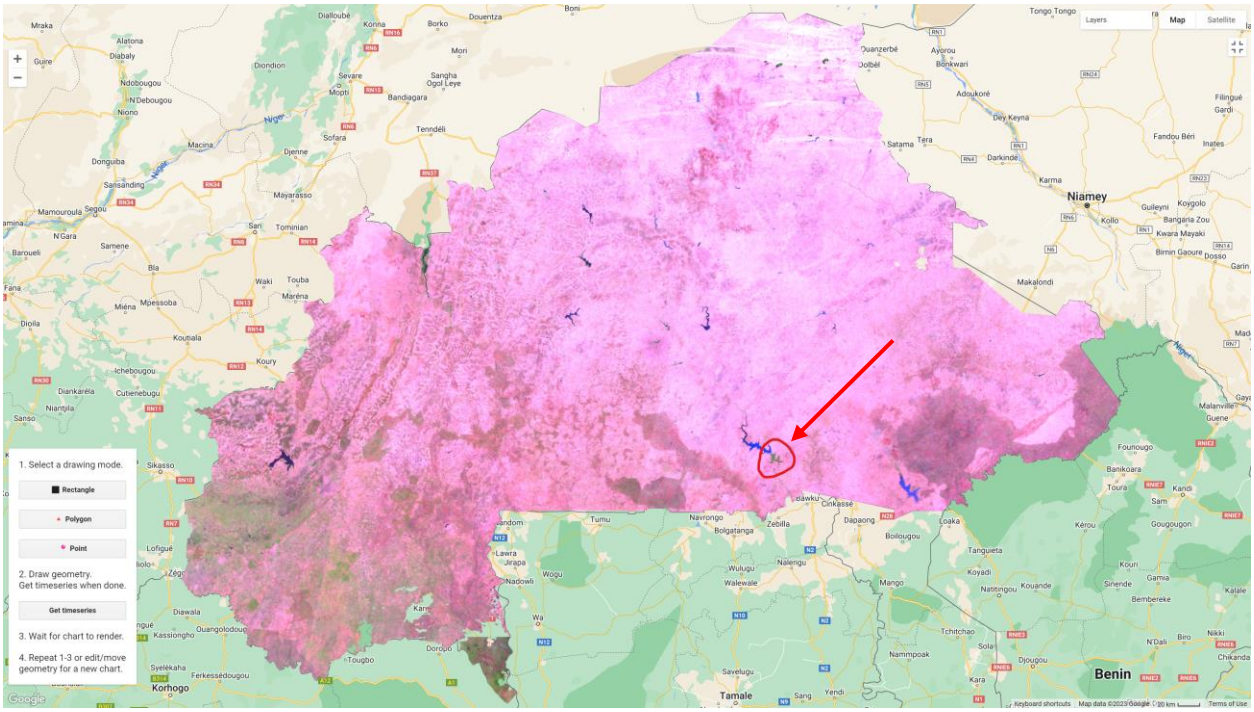


Fig 2: False color composite of dry season (April 2023) Sentinel 2 images for Burkina Faso. Red arrow points to an area of interest

- A false color composite from Sentinel 2 images in April is shown to look at the dry season. SWIR2, NIR and blue is used for RGB bands
- Let's zoom into a region south east of the water body that is circled in red

Fig 3: Area of interest zoomed into from Fig 2. Background image is the same false color composite

Fig 4: True color composite of high-resolution satellite imagery

- Switching to high resolution satellite base imagery lets us zoom into the plots, examine the texture of the area and determine if indeed it is cropland and not forests, areas for logging, trees, swamps or other evergreen regions that would appear green during the dry season.

- Let’s examine a couple of plots

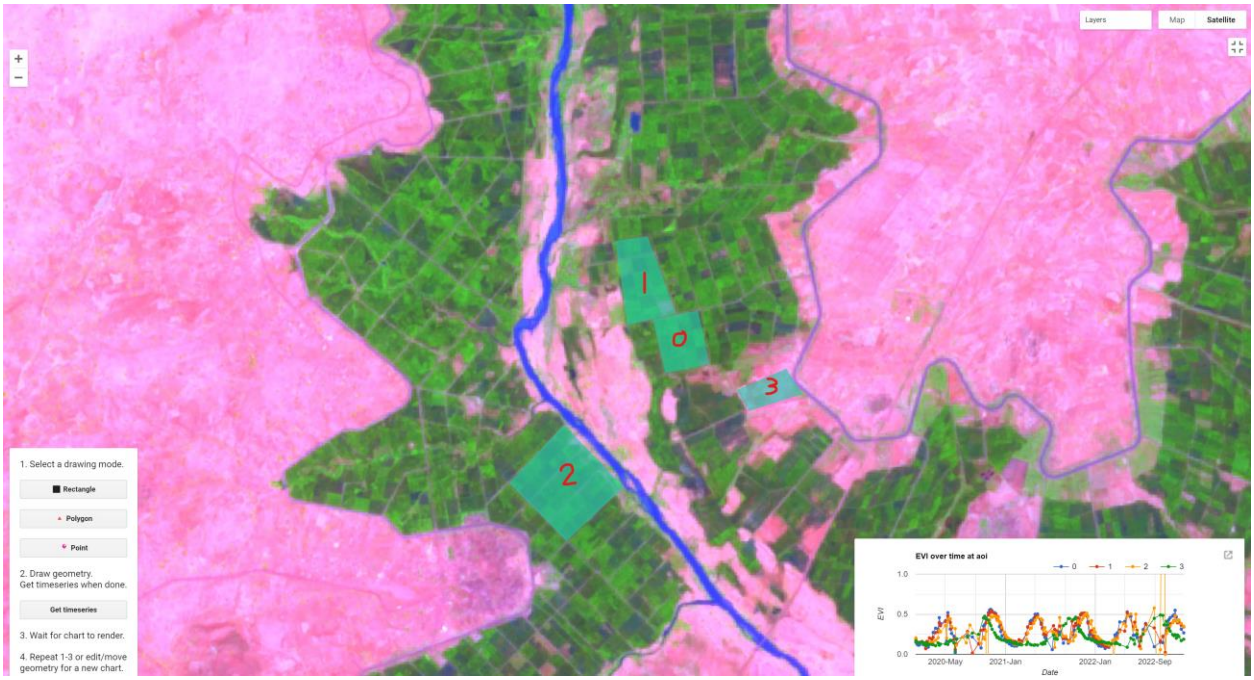


Fig 5: Polygons drawn over areas of interest and corresponding mean S2 EVI time series of all the pixels in the polygon

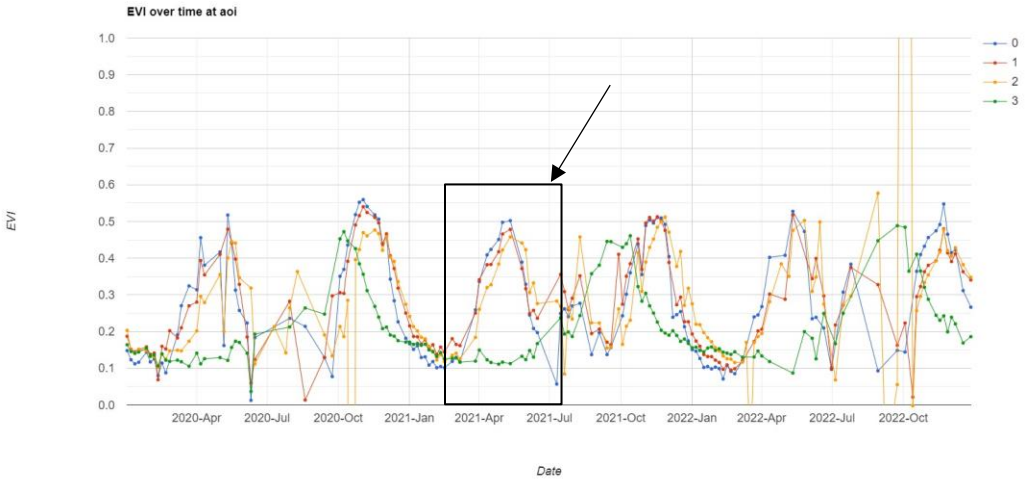


Fig 6: Plots of EVI time series zoom in. The dry season in 2021 is outlined by a rectangle and an arrow is used to denote the dry season peak

- Plots 0, 1 and 2 are irrigated croplands and 3 is non-irrigated croplands
    - Plots 0, 1 and 2 have dry season peaks are observed in the period from March to August denoted by an arrow in the plot. This means that the plots are irrigated in the dry season outlined by a rectangle. These polygons can be drawn and saved as irrigated plots

- Polygons similar to 3 that do not have a dry season EVI peak would be saved as non-irrigated plots.

Examples of bad labeling/polygons

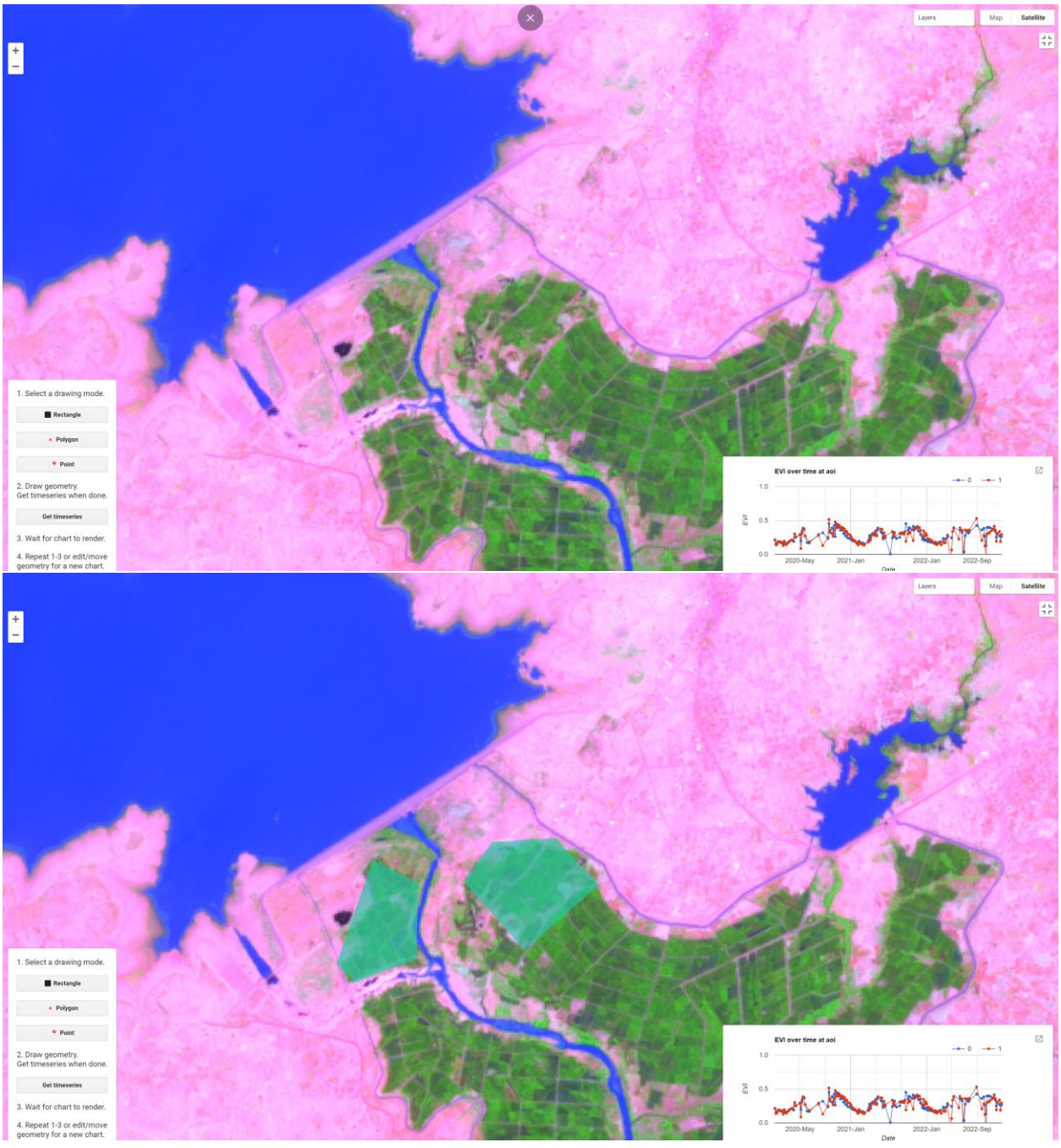


*Fig 7: Example of polygons that include **heterogenous land cover** (i.e parts of non-irrigated croplands are included with the polygon drawn over an irrigated region)*

1. The first example in Fig 7 is of drawing polygons are not precise and do not capture the extent of the plots properly. Now there are limitations of how precise an enumerator can be with S2

resolution imagery but the goal is to be as precise as possible. However, drawing very complex polygons with a lot of vertices is not the goal either. Ideally you should be able to capture the plot with 4-8 vertices.

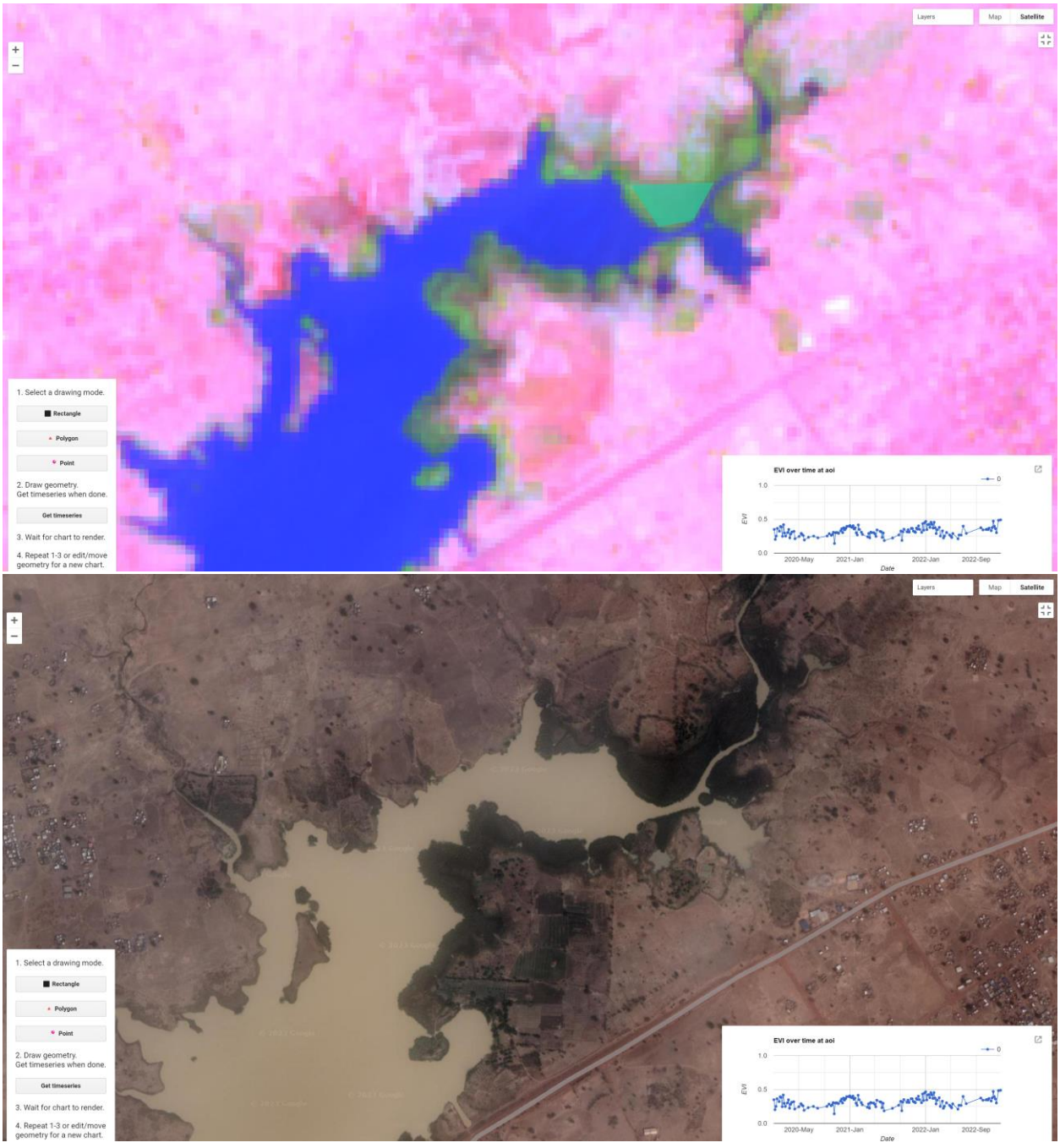


Fig 8: Example of polygons that include ***evergreen land cover***

2. The second example in Fig 8 is of drawing irrigated polygons because they appear green but not looking at the satellite imagery or the evi time series. Both of these show that this is a riparian area/ evergreen land cover. Other examples of evergreen regions may include forest reserves, swamps etc. (see example 4)

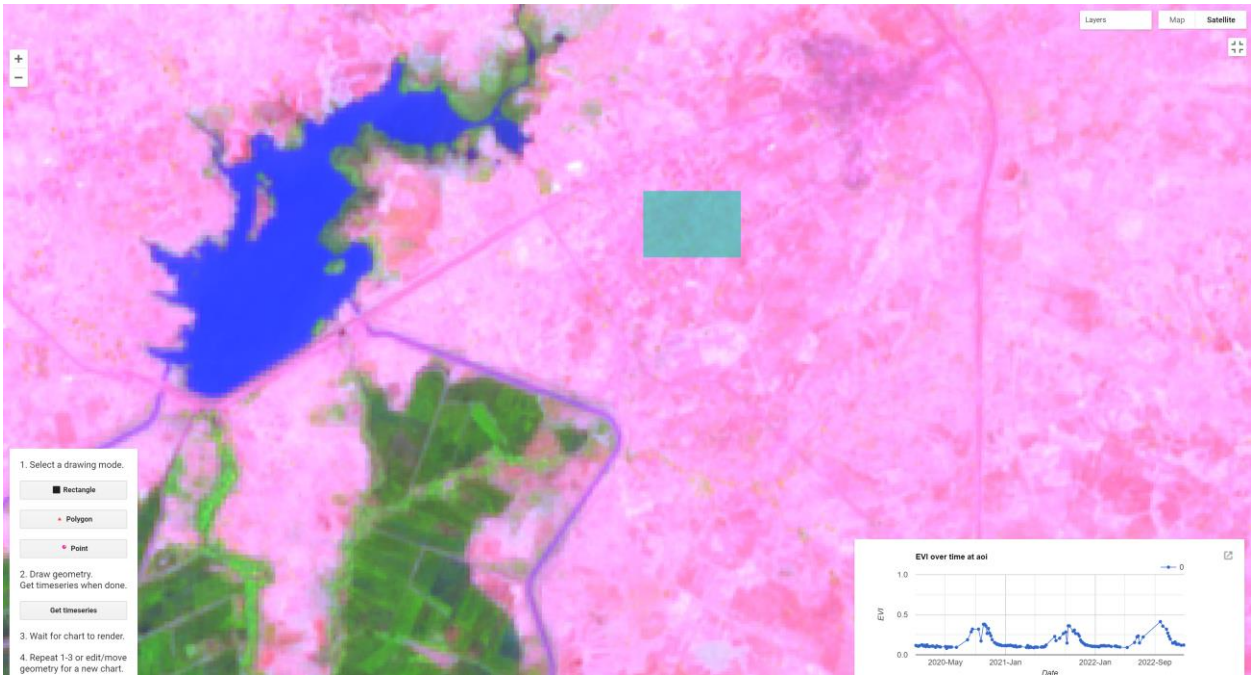


Fig 9: Example of non-irrigated polygon drawn over a residential area with S2 false color composite of dry season imagery

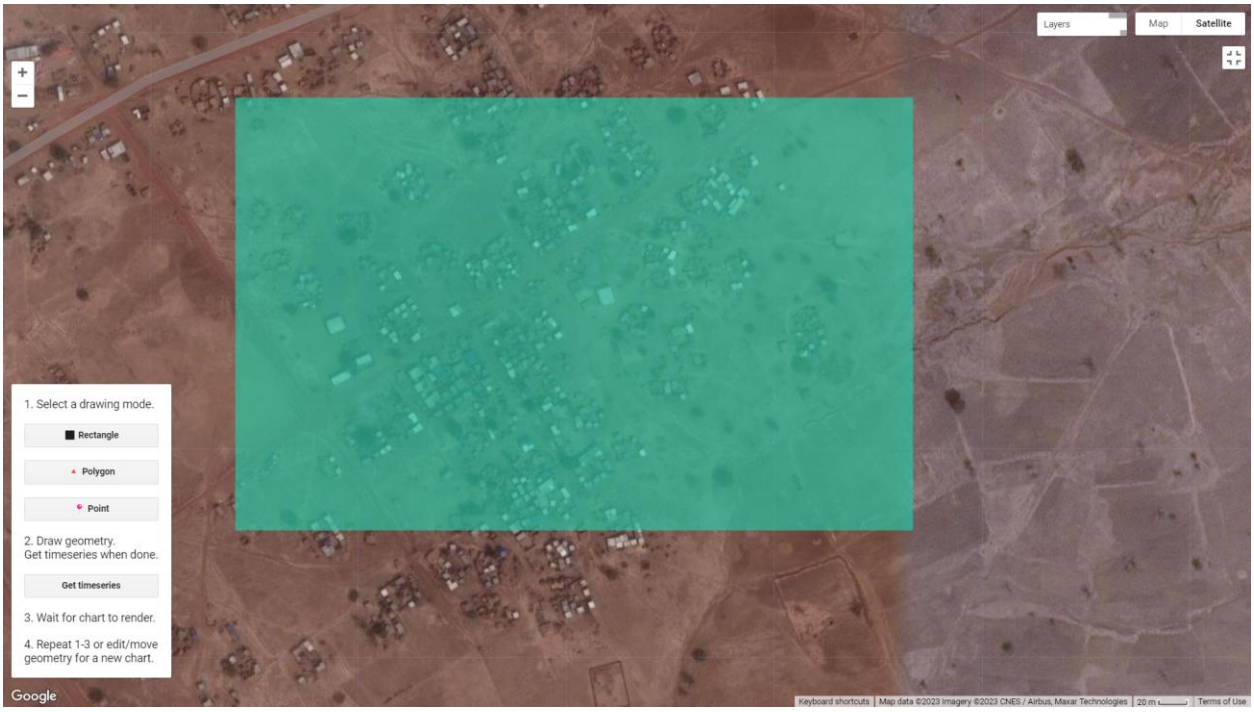


Fig 10: Example of non-irrigated polygon drawn over a residential area zoomed in with true color composite from high resolution imagery

3. Third example in Fig 9 and 10 is of drawing non-irrigated plots. This example shows that the polygon drawn is not actually a cropland but residential area. While this is hard to infer from the Sentinel 2 time series but is clearly evident by looking at high resolution imagery which reveals the houses in the area under the polygon.

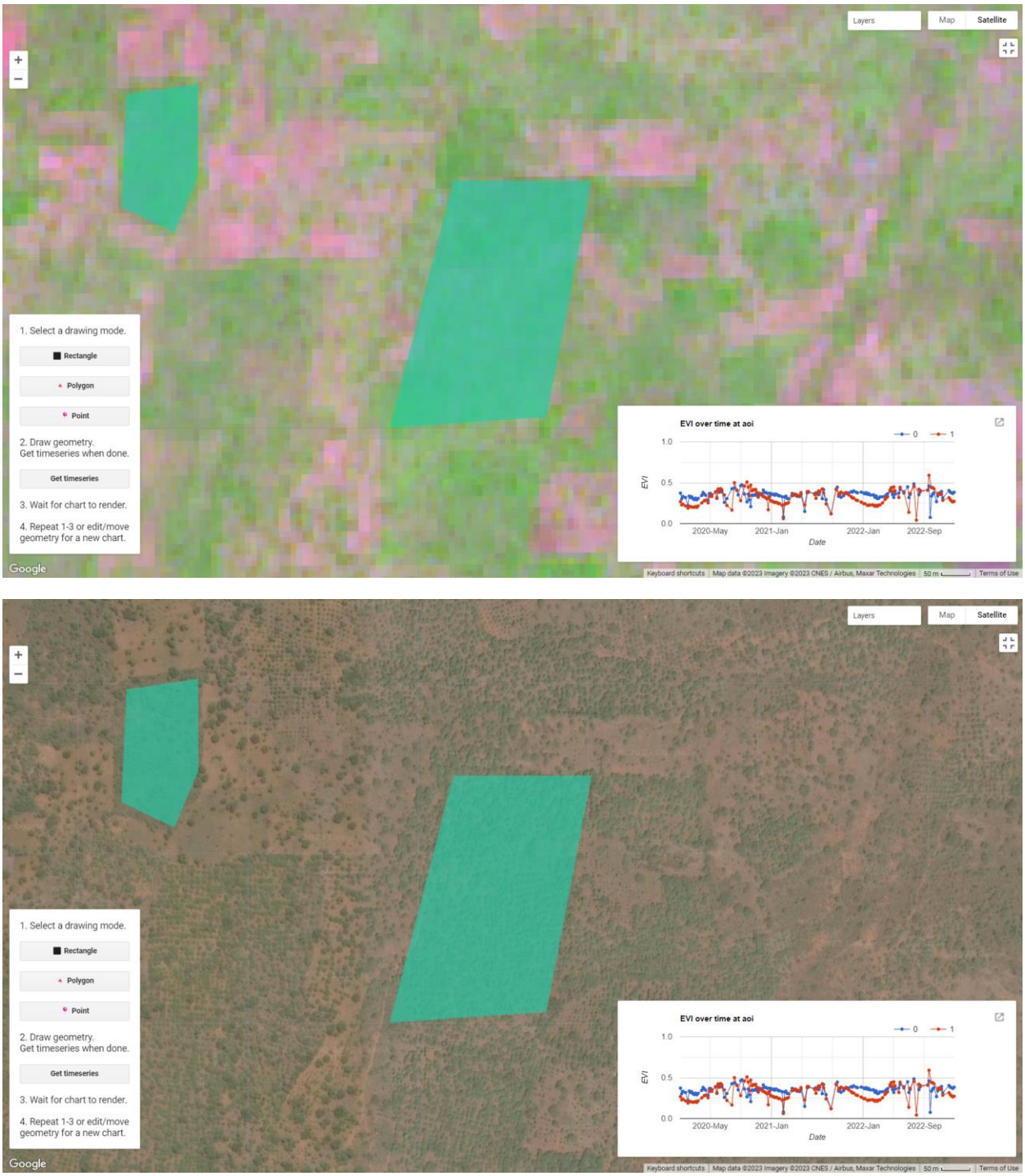


Fig 11: Example of polygons that include ***evergreen land cover***

4. The fourth example in Fig 11 similar to the second example is of drawing irrigated polygons because they appear green but not looking at the satellite imagery or the evi time series. Both of these can be used to deduce that this area has a lot of trees/ evergreen land cover.

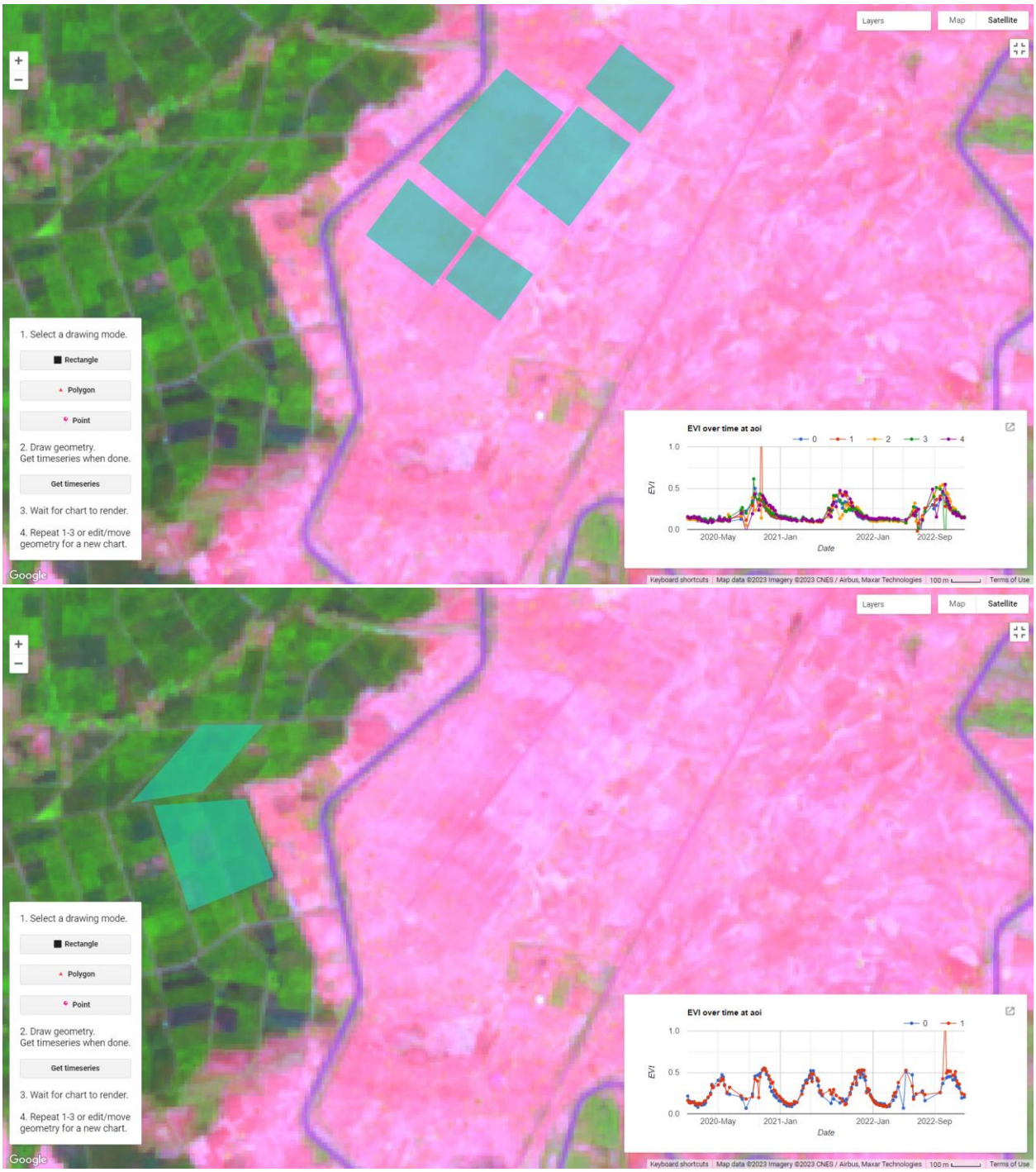
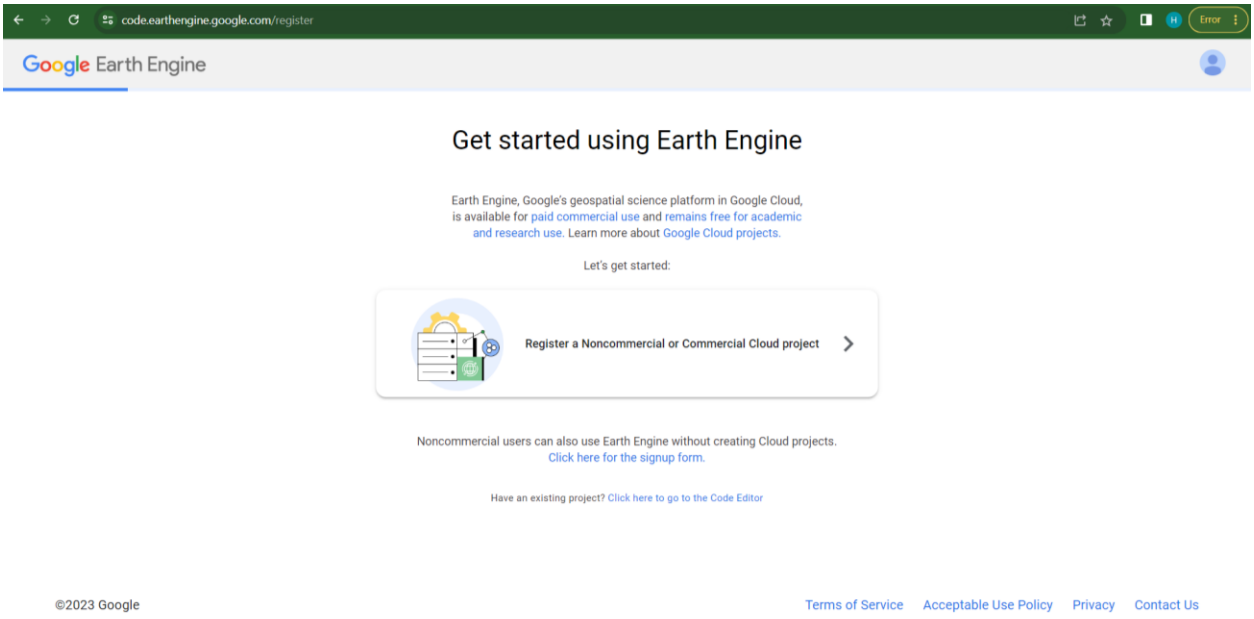


Fig 11: Example of under sampling, First part of the figure shows non- irrigated polygons collected in the region and second part shows irrigated polygons collected in the region.

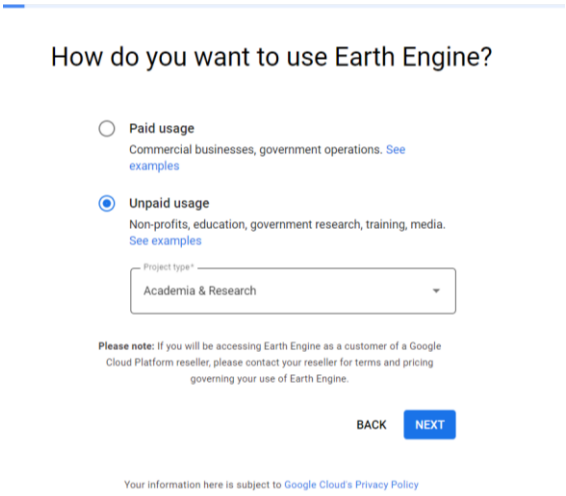
5. Let's assume that the 10km x10km tile you're looking at has few irrigated plots and a lot of non-irrigated polygons can be collected as shown in the figure. You should try to sample the polygons such that the total areas of the irrigated and non-irrigated polygons collected is roughly the same. In the example above, this can be achieved by collecting 2-3 more irrigated polygons and keeping the number of non-irrigated polygons the same.

EARTH ENGINE ACCOUNT

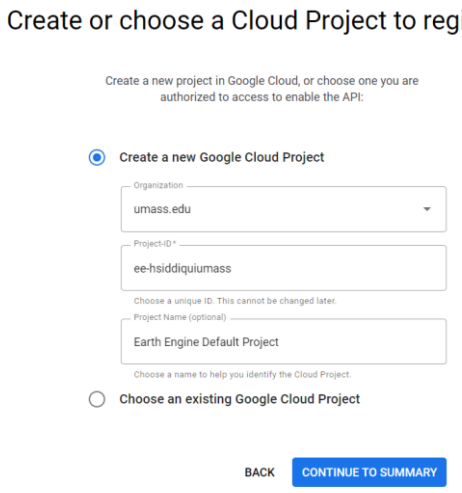
1) Go to Sign up for Earth Engine account



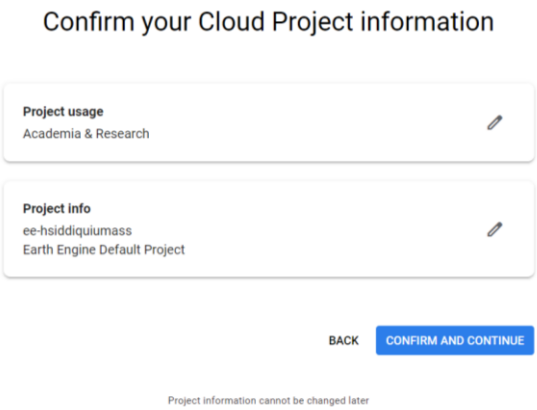
2) Select Academia & Research under unpaid usage



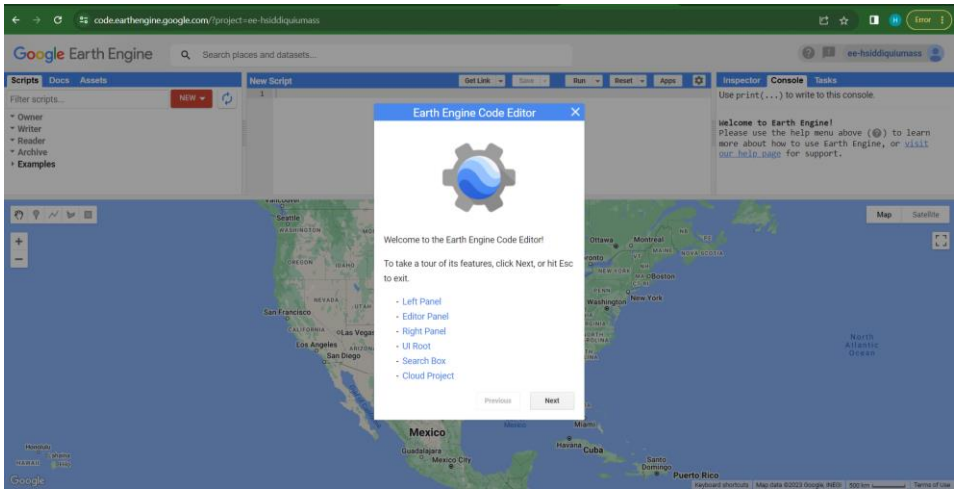
3) Create a Cloud Project using the email. Enter a project ID.



4) It will give you an error if you haven't signed up for google cloud console before. Open the link in the error message in a new tab and accept the terms and conditions.

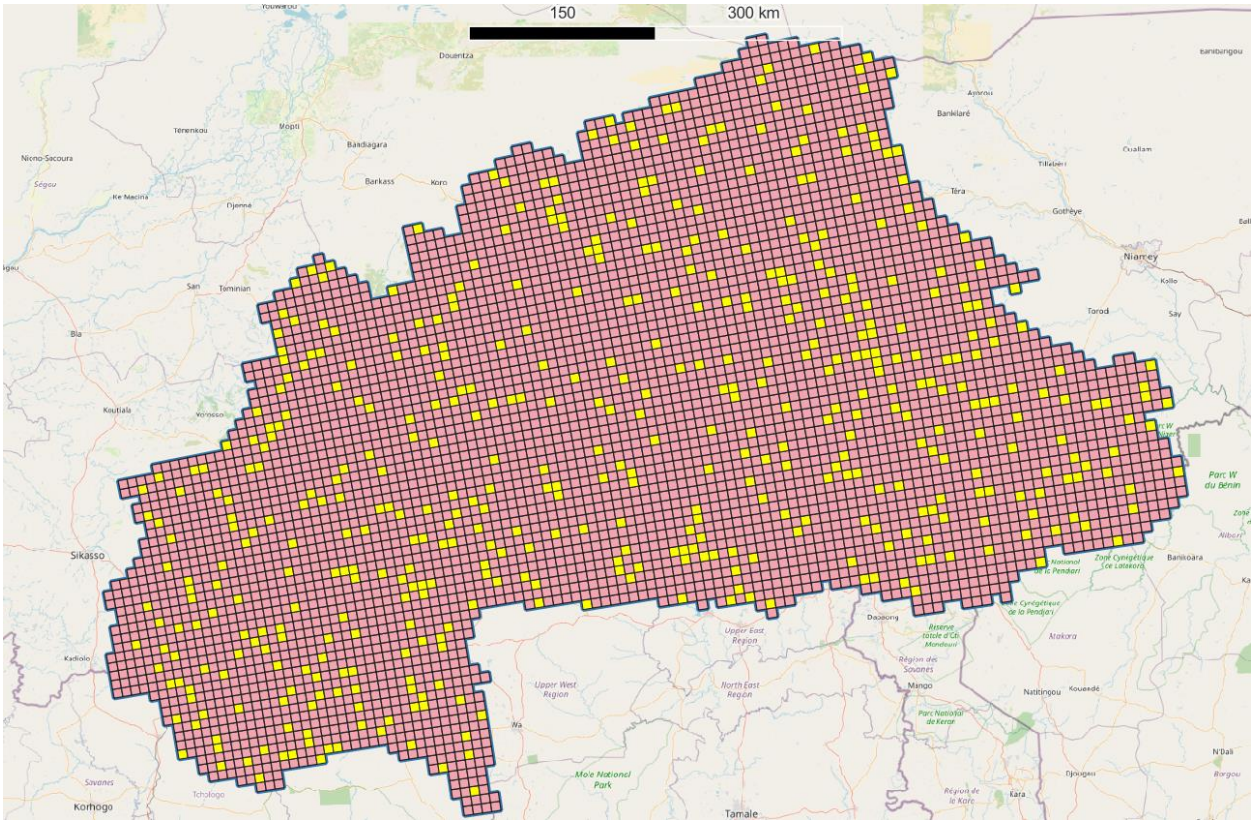


5) Once the account is created, you should be redirected to the earth engine code editor that looks like this

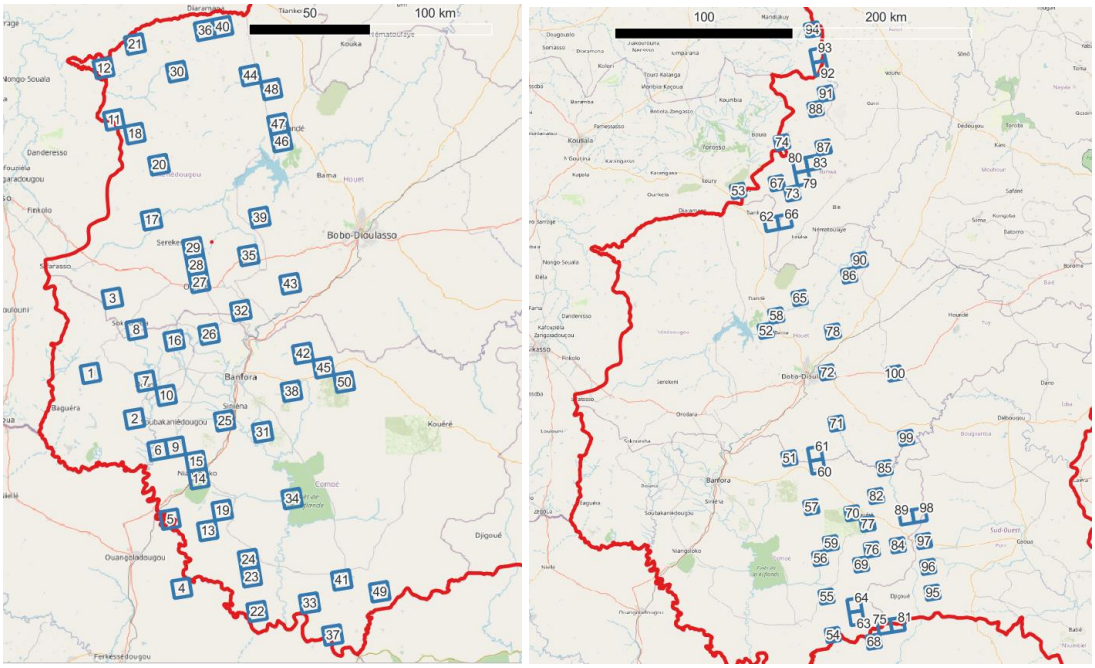


ADDING GRID FOR LABELING

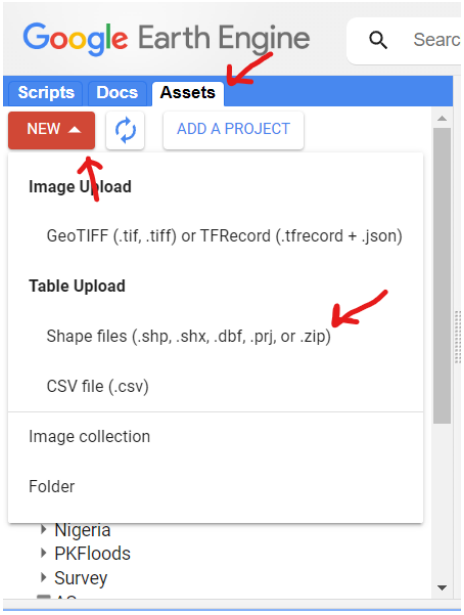
The country is divided into a grid to make it easier for labeling. Out of this 10% will be randomly selected to use for labeling.



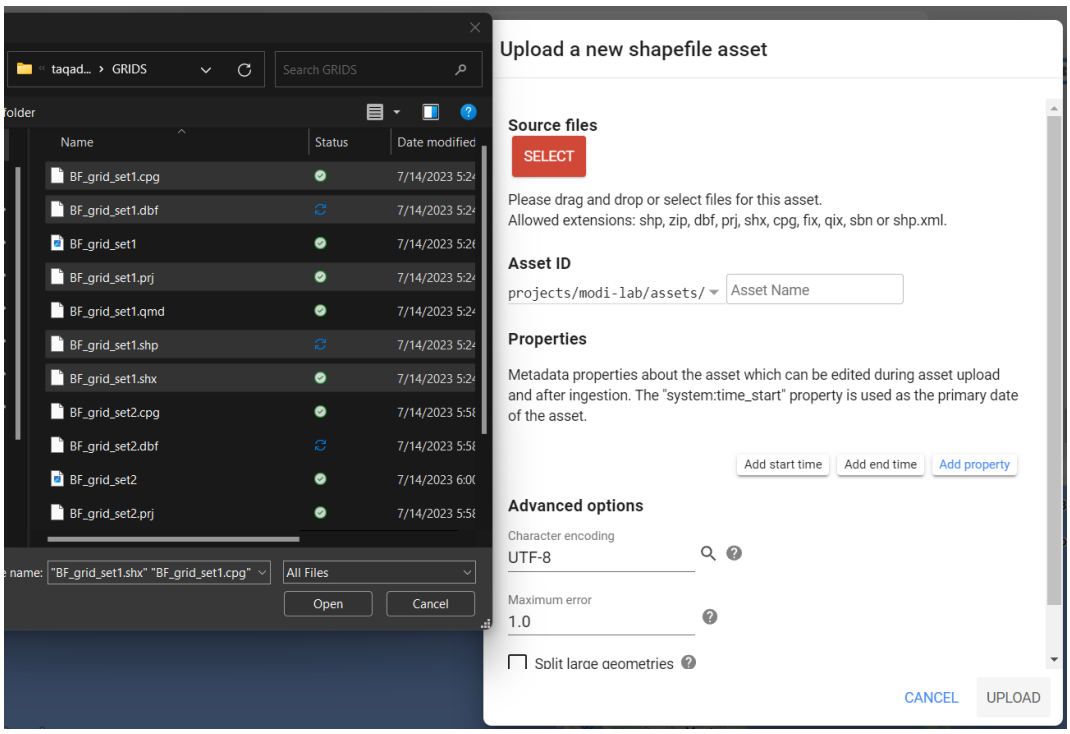
These randomly selected tiles are then split into a set of 50 tiles and numbered to help track the tiles.



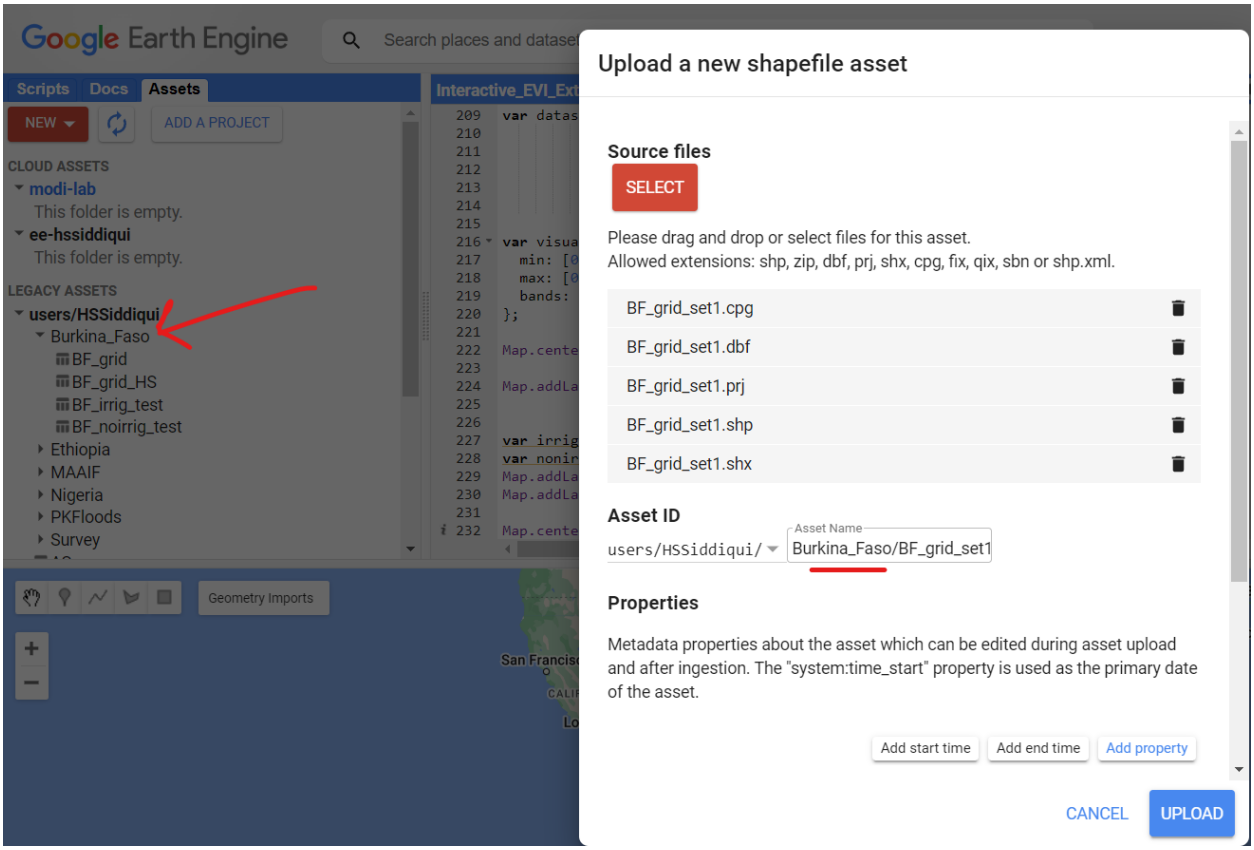
To load the tiles in Google Earth Engine, go to Assets-> New->shapefiles



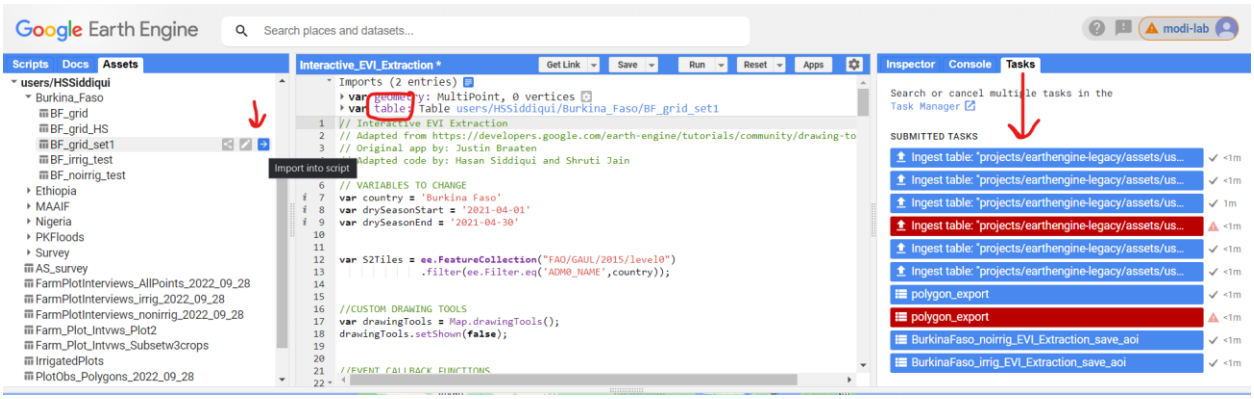
Select the files to upload. Note that you need to upload all the files for the set except the screenshot and the .qmd files (I will try to get rid of these files but in case they are left in the folder) which are not supported



You can create a folder to organize the files (optional). Hit upload to upload the files to your assets.



Once the files are uploaded (you can check status under tasks), click refresh and they will appear in your assets. Import them to the script to use the grid for labeling.



Make sure the featureCollection matches the name of the asset imported example in this case “table”. Add the following lines of code at the end if they are not already in the script and run to use the grid.

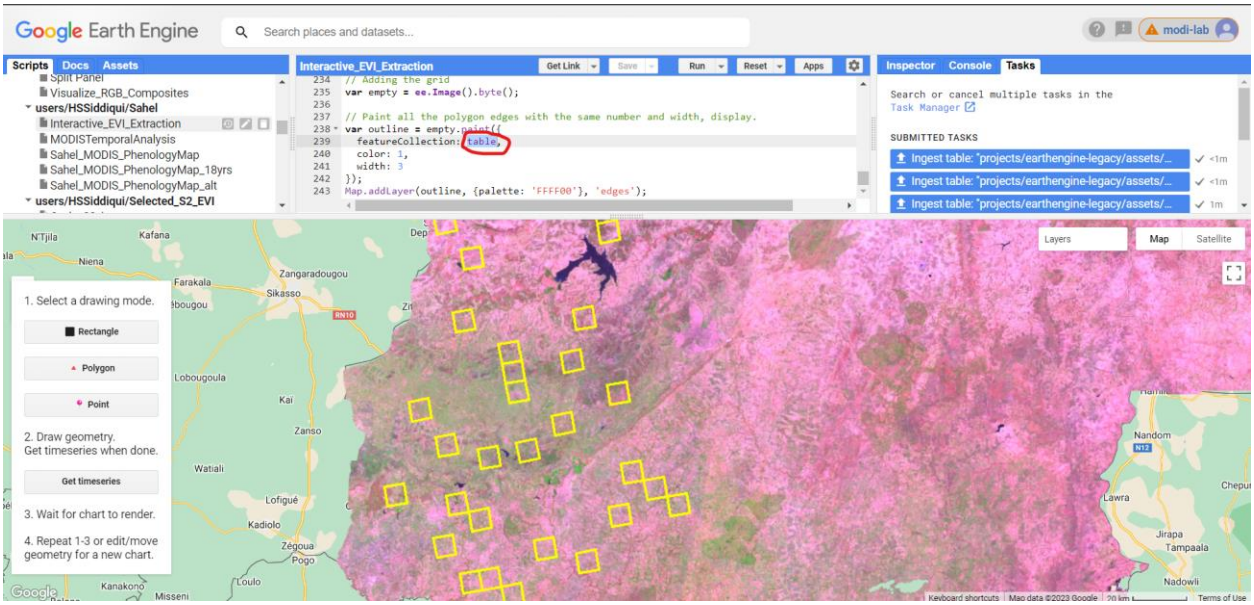
```
// Adding the grid

var empty = ee.Image().byte();
```

// Paint all the polygon edges with the same number and width, display.

var outline = empty.paint({featureCollection: table, color: 1, width: 3});

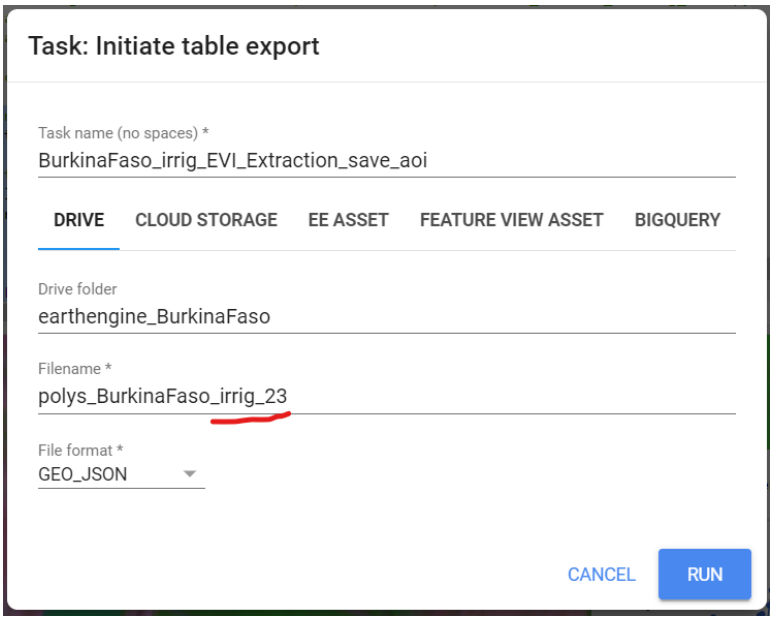
Map.addLayer(outline, {palette: 'FFFF00'}, 'edges');



SAVING POLYGONS

Once a polygon is drawn and the get timeseries button is used to inspect the S2 time series, a task will appear to save the polygon. Note if this is done multiple times, multiple tasks will appear with the task on the top corresponding to the most recent polygon drawn. You can rerun the script to get rid of the unwanted tasks. If you are satisfied with the polygon drawn and want to save it, click Run

In the pop up specify the task name (optional but helps to keep track) and drive folder and filename with the right name (important e.g., _irrig_20, _irrig_21, _noirrig_23 etc.). Click run to save the polygon.



You can set some of the names in the script so you don't have to modify it every time you run a task and only have to add a number at the end of the filename (e.g., _irrig_20, _irrig_21, _noirrig_23 etc.)