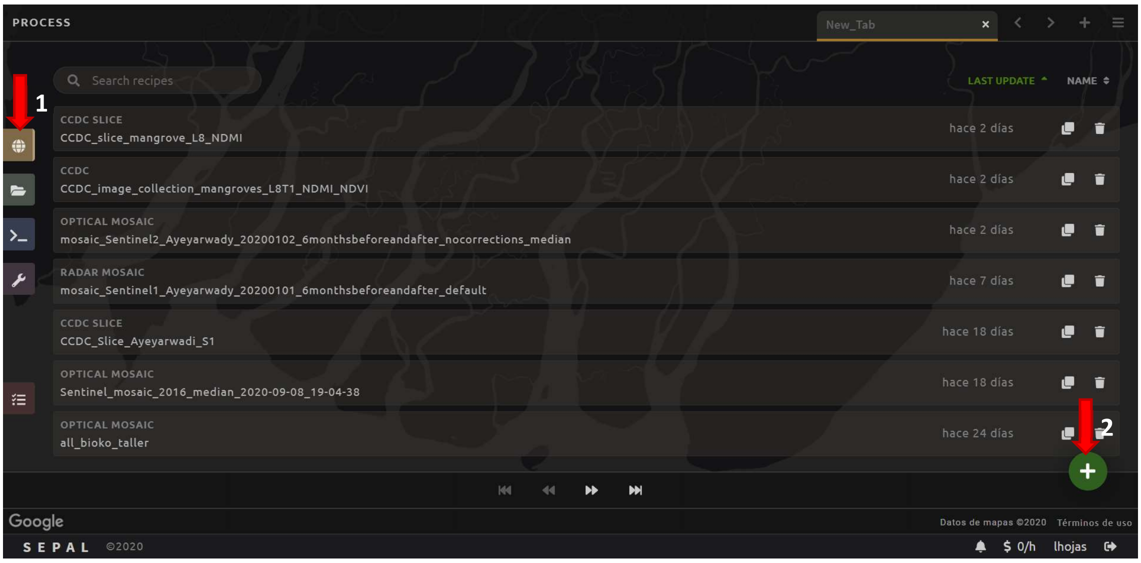
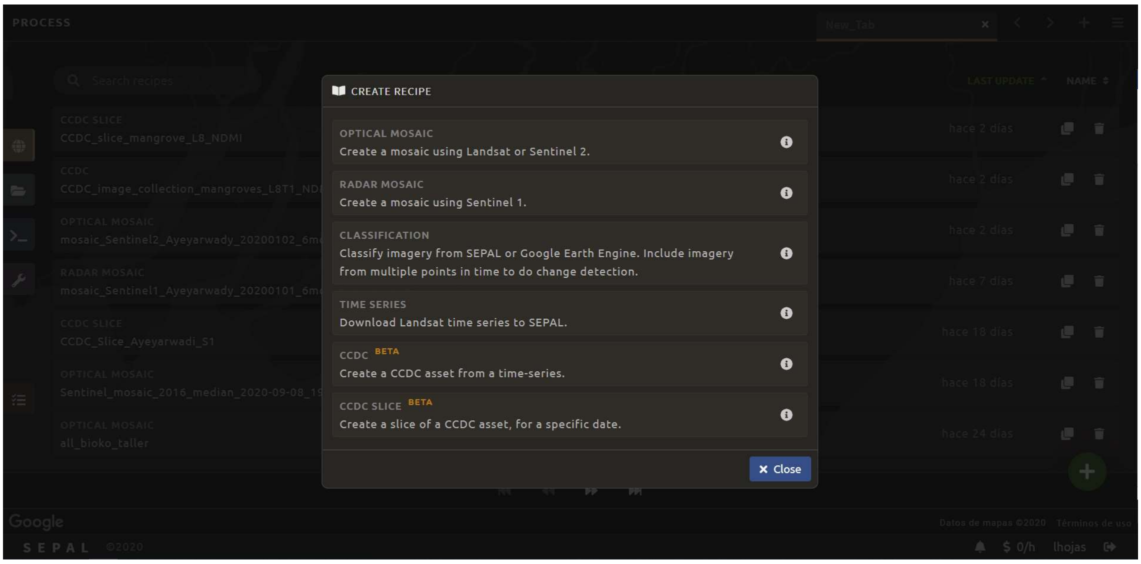
BREAKPOINT DETECTION BANDS TO DETECT LAND COVER CHANGES

Creating a CCDC asset from a time series of Landsat-8 in SEPAL

Go to process (1). Click on create new recipe (2).



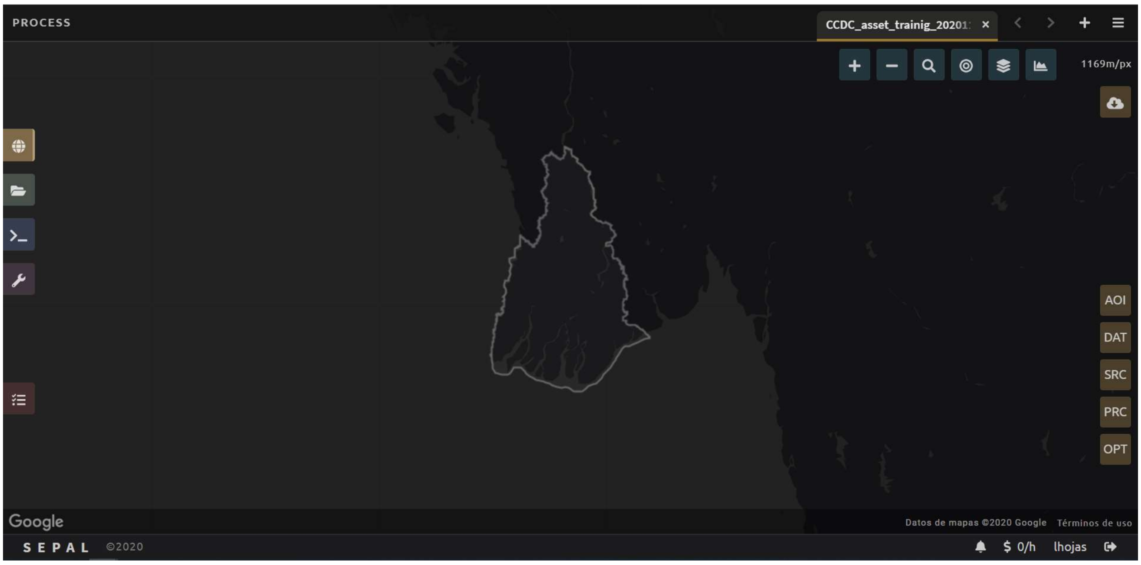
Select 'Create a CCDC asset from a time-series'.



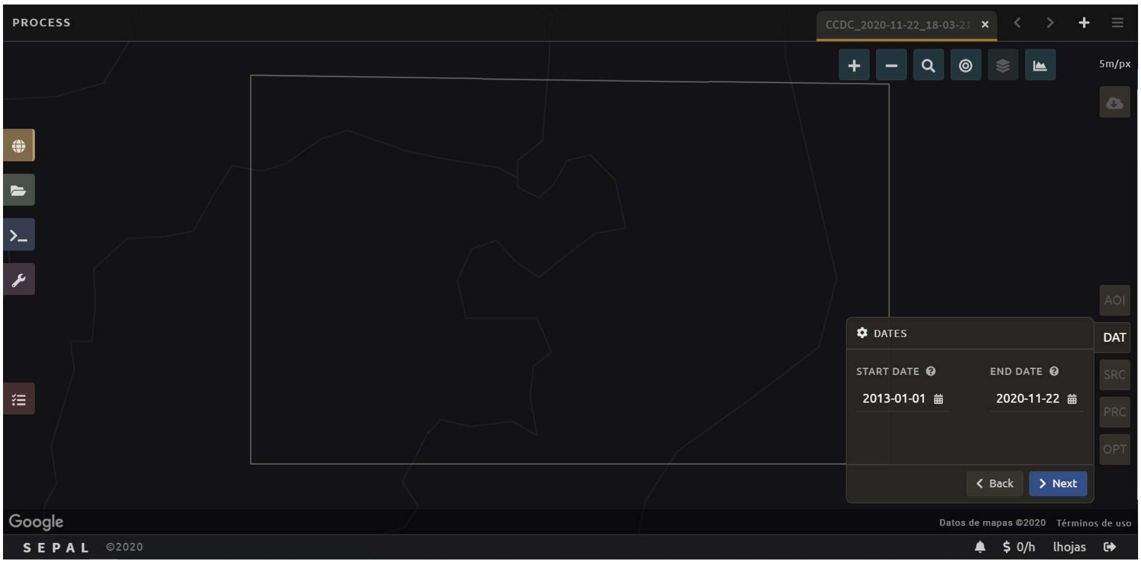
Options at the bottom right:

Area of interest:

Select from EEtable: Paste an ID table from Google Earth Engine. For the region of Ayeyarwady you can paste *users/lorenahojas/ayeyarwadi_dis*.

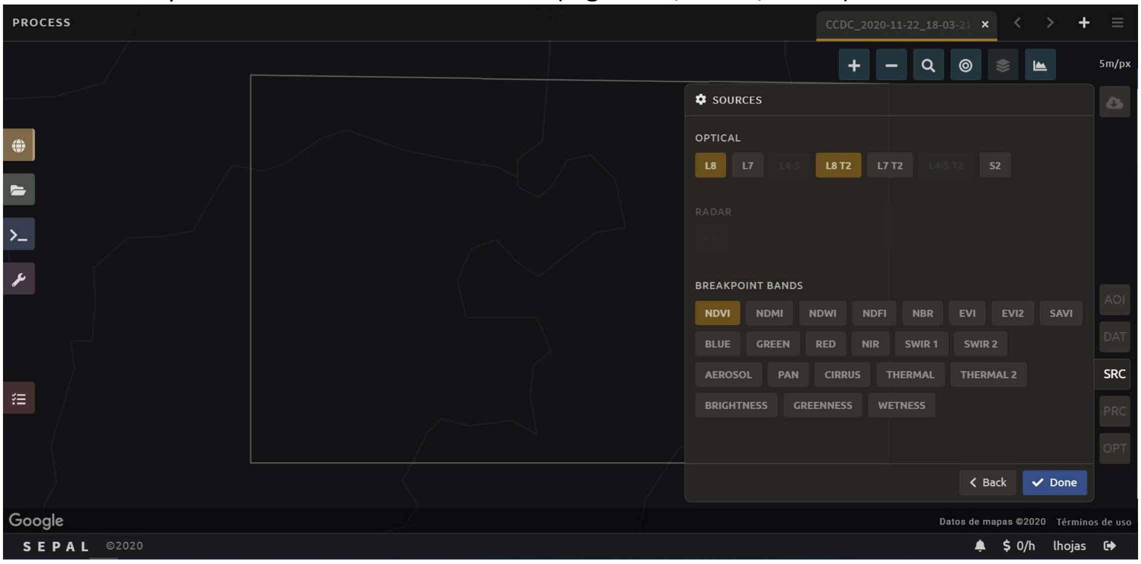


Dates: 1st January 2013 – today (L8 data is available since 2013)



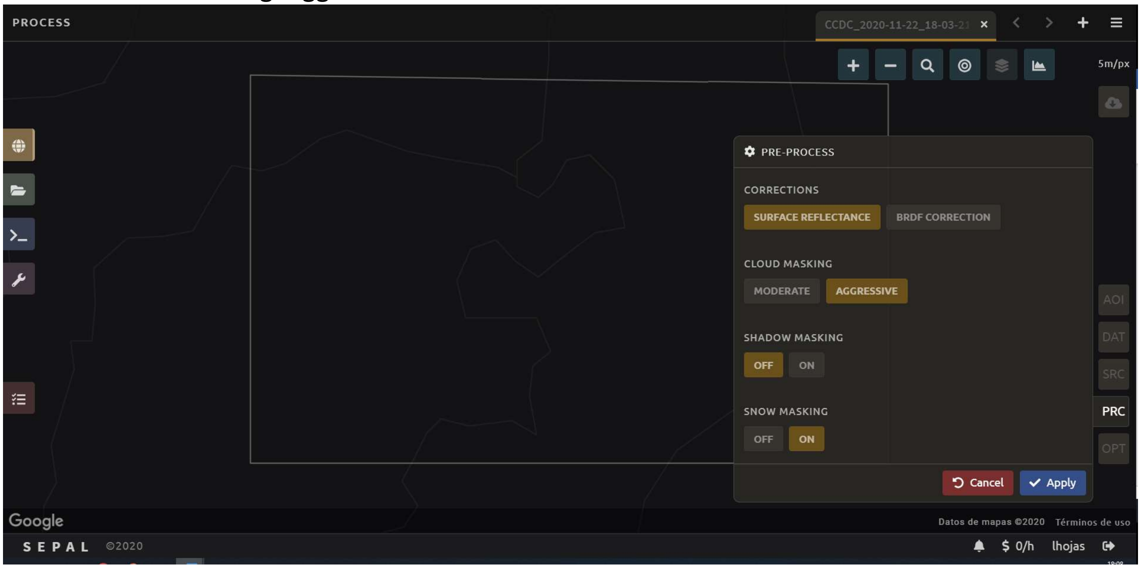
Sources:

- Optical: L8 + L8 T2
- Breakpoint bands: select one or more (e.g. NDVI, NDMI, NDWI).



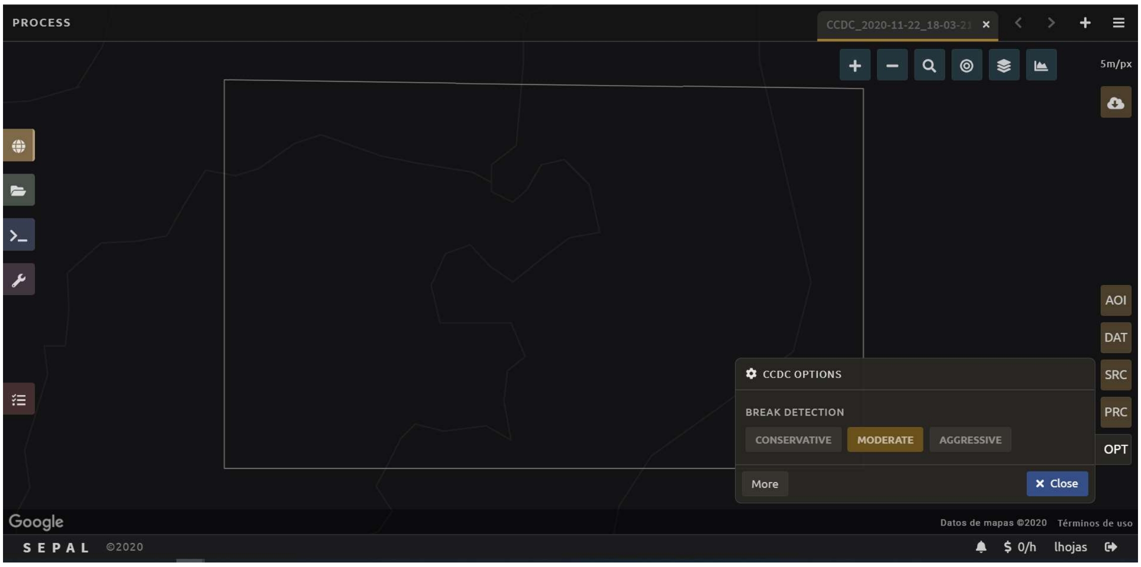
Pre-process:

- Corrections: surface reflectance
- Cloud masking: aggressive



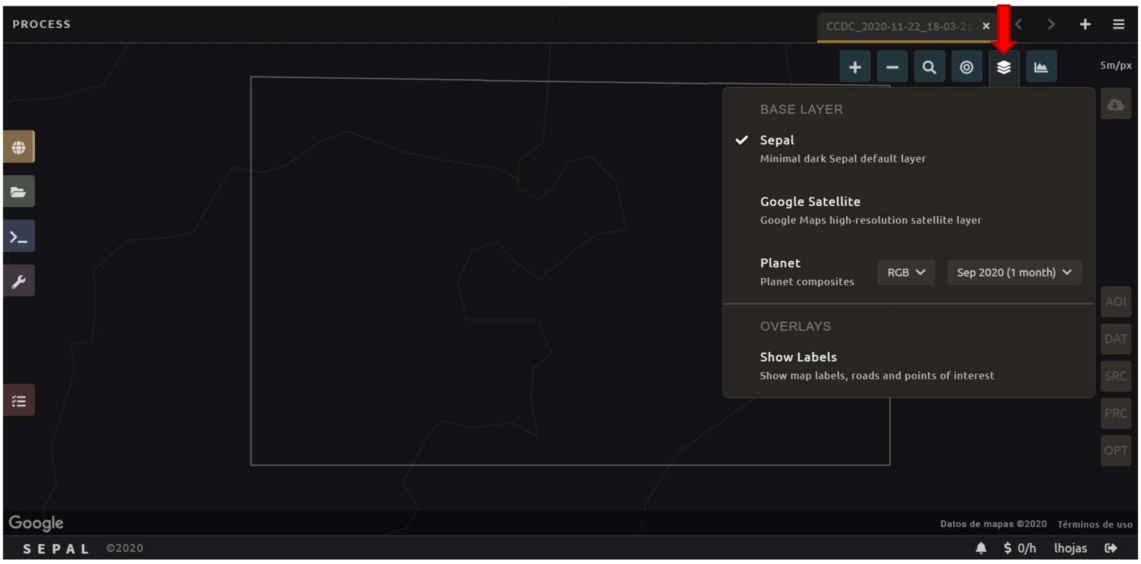
CCDC Options

- Break detection: moderate



Check time series for a plot

Base layer: apart from the SEPAL default layer you can select Google Maps high resolution satellite imagery or Planet composites (4,7m spatial resolution), in RGB or Color-Infrared.



Google Maps (you can find your plot)

Planet composites: There are monthly composites from September 2020 and historical 6-month composites from December 2018.

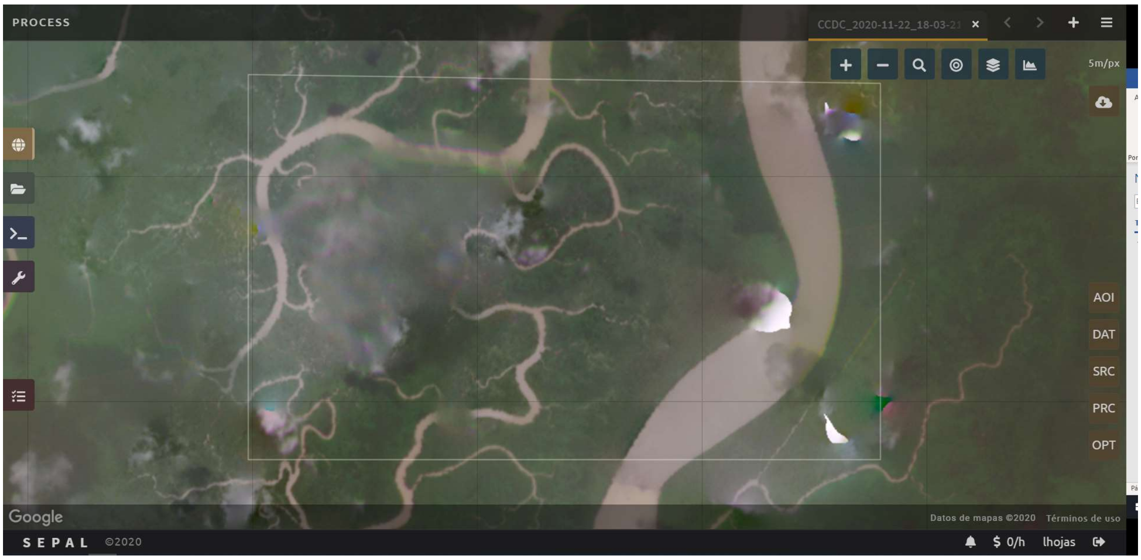
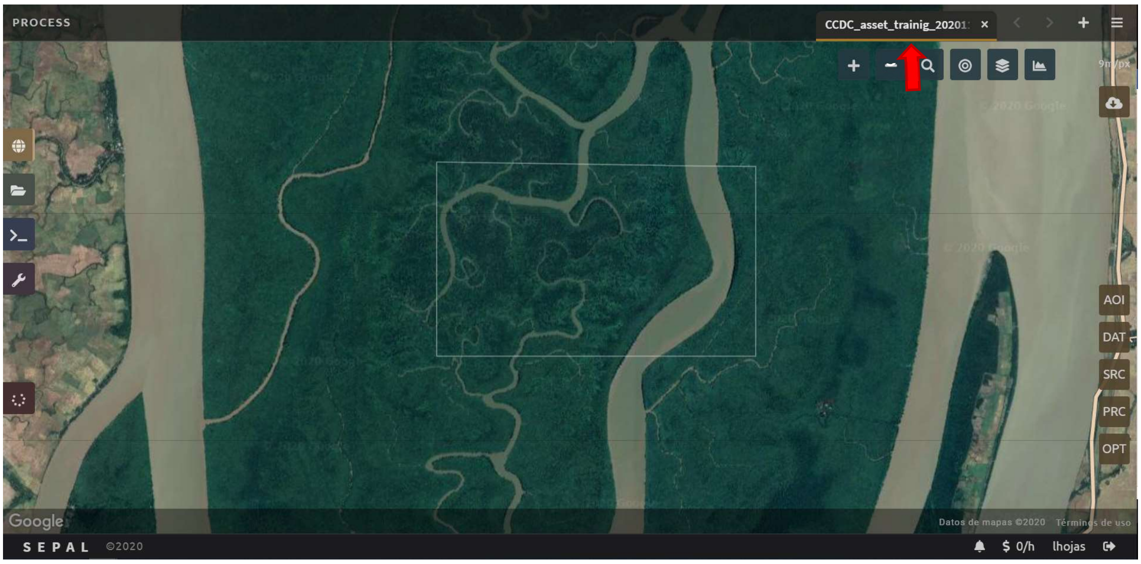


Chart time series for a pixel: Click on the location of your plot and the time series of the corresponding pixel will be displayed. You can check the coordinates in Google Earth (through Collect Earth) to confirm that the pixel falls inside your plot. The chart represents the regression model for each time segment (red and orange lines) for the vegetation index or band selected from the list (in the example below, the NDVI), the breakpoints detected by the index/indices selected previously (in the example just before the 2018-04-29) and the real observations (yellow dots).

To select the most suitable indices, you can pay attention to how well the yellow dots fit the model.

Give a name to save your recipe to save it.



With you chart open select SRC (sources) to change the breakpoint detection band/s.

The breakpoint detection bands are the bands on which the abrupt changes in your graphic are detected (the change between the red and the orange segments).

You can try to select one or several at the same time:

- NDVI (vegetation index)
- NDWI (water index)
- NDMI (moisture index)
- NDVI + NDMI + NDWI
- BLUE + GREEN + RED + NIR + SWIR1 + SWIR 2

And see which band or combinations of bands detect better the land cover change of your plot.

EXAMPLE: Plot 1 #96

This is the plot we review, with two changes between 31 December 2015 and 31 December 2020:

1. January 2016: stand initiation mangrove, natural change, possible flooding.
2. July 2020: conversion to cropland. This can be seen in the Sentinel mosaics and in the Planet data.

Image from March 2019

Image from February 2016:

Breakpoint band: NDVI. (The graphic shows NDVI values): it detects the second change.

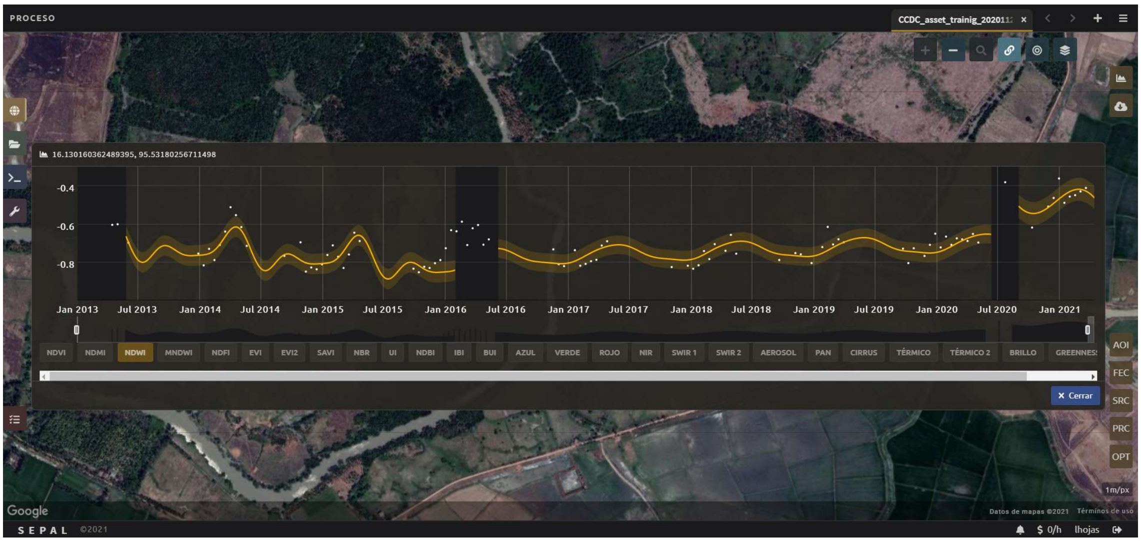
Breakpoint band: NDWI (the graphic shows NDVI values): it also detects the second change.

Breakpoint band: NDMI (the graphic shows NDVI values): it detects first and second change.

Breakpoint bands: NDVI + NDWI + NDMI (the graphic shows NDVI values): first and second change.

Breakpoint bands: blue + green + red + NIR + SWIR 1 + SWIR 2 (the graphic shows NDVI values): first and second change.

If instead of seen NDVI we see NDWI, the values rise in the break, that is why probably it is a flood.



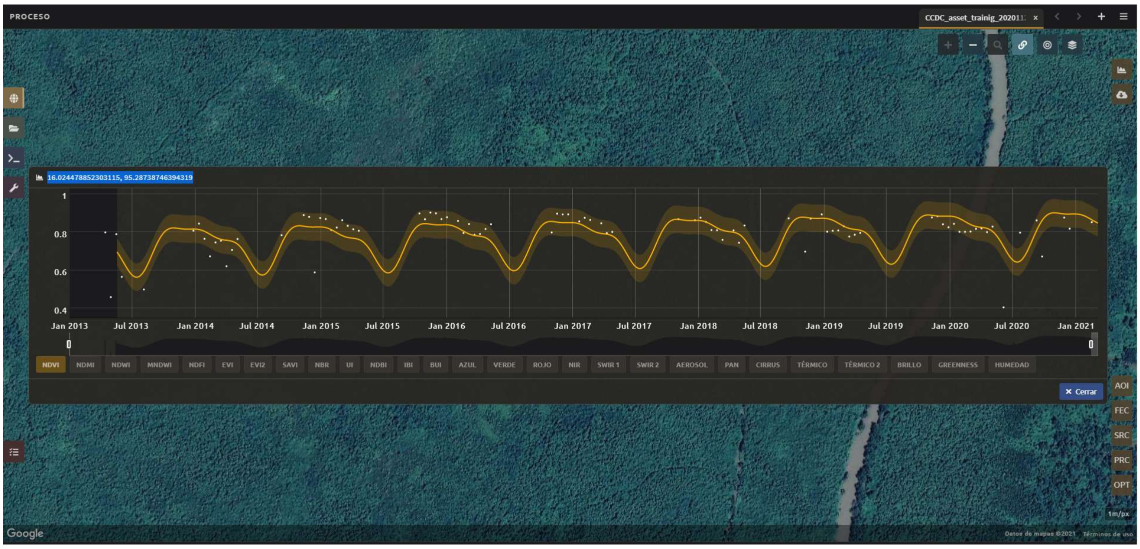
Vegetation indices trends: Apart from the breakpoints, we can also see the trend in NDVI along the years. The mangrove is in stand initiation process according to the field data, so NDVI is increasing each year (see maximum annual values). When the first breakpoint is detected (a possible flood), NDVI is increasing before but decreasing afterwards.

EXAMPLE: Plot 16 #111

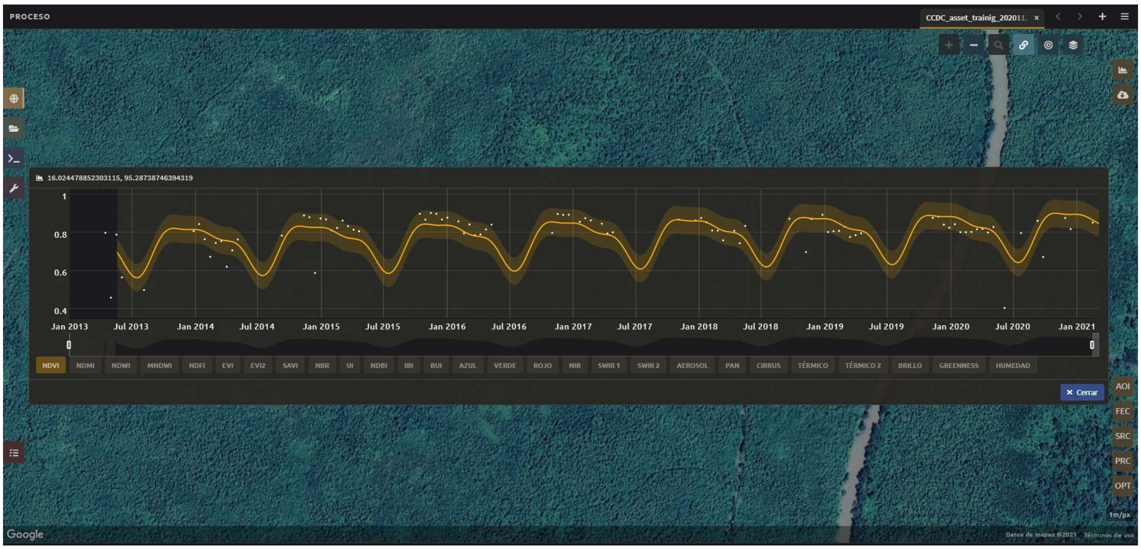
This is another plot, apparently with no cover change during the study period according to what we can see in all the data sources of Collect Earth. According to the field data it has mangroves with stand initiation. The NDVI trend along the years is increasing. NDMI detects a break, but during the break there are no dots, so probably the break in this case is due to the lack of data.

Image from November 2019.

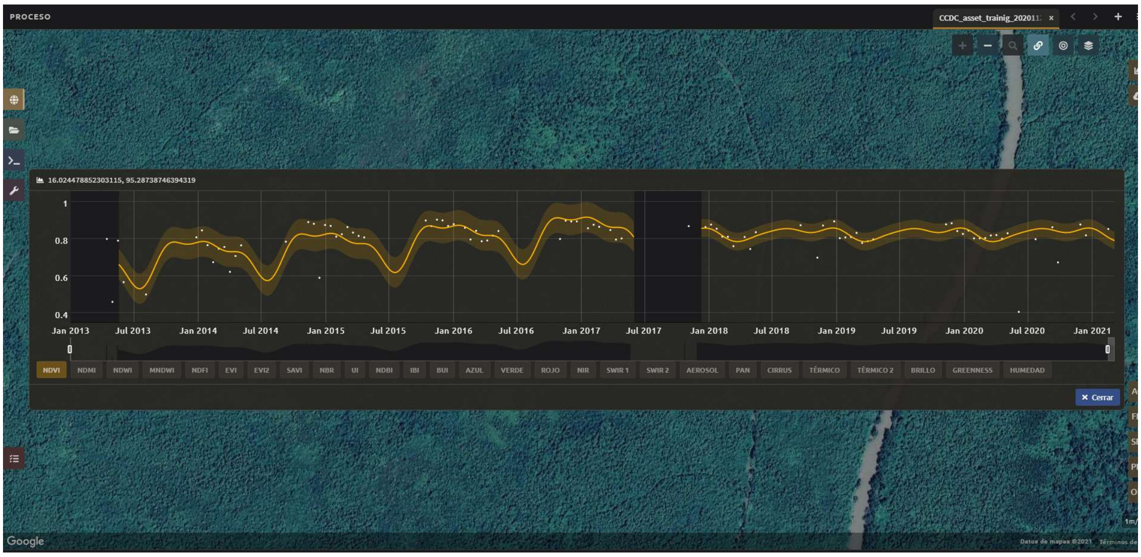
Breakpoint band: NDVI. (The graphic shows NDVI values)



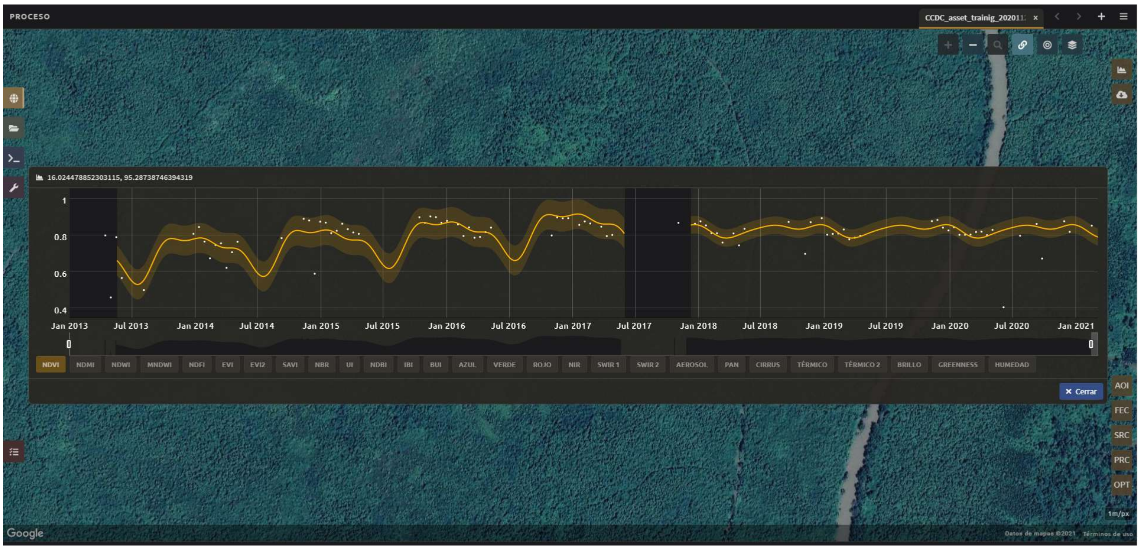
Breakpoint band: NDWI (the graphic shows NDVI values)



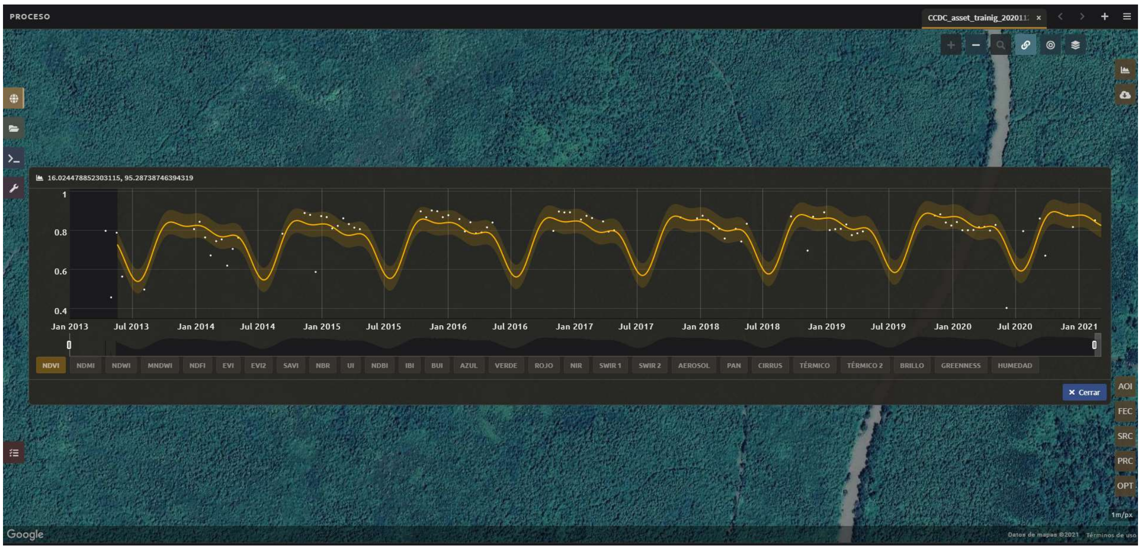
Breakpoint band: NDMI (the graphic shows NDVI values)



Breakpoint bands: NDVI + NDWI + NDMI (the graphic shows NDVI values)



Breakpoint bands: blue + green + red + NIR + SWIR 1 + SWIR 2 (the graphic shows NDVI values)



Exercise

Objective: check which band/s or index/indices are better to detect the breaks we want to detect.

According to (Zhu et al., 2020) is better to account with the combined use of spectral bands (blue, green, red, NIR, SWIR I and SWIR II) than using a single spectral band or index, and if all the essential spectral bands have been employed, the inclusion of other indices (like NDVI) does not further improve the algorithm performance.

From these two examples we can conclude that NDMI overestimate changes, and NDVI and NDMI can detect changes if they are abrupt (e.g., land cover changes but not natural? degradation). The combination of NDVI+NDMI+NDWI brings together the strengths and weaknesses of the three indices separately. Blue + green + red + NIR + SWIR I and SWIR II seems to do the best performance in case we want to detect also natural degradation, but according to the usual definition of degradation for REDD+ degradation is caused by human causes….

This conclusion is only based on these two plots and some others from the same region. To have a more robust conclusions we should repeat this exercise in more plots. For example, what happen when the degradation is caused by human intervention?