Did Triibo improve NDVI in São Miguel Do Gostoso?

Data Selected:

Files Selected:

The files to download are enormous, and it is not necessary to download all files for our project. Here are the files to download:

- Band 2
- Band 3
- Band 4
- Band 5

➔ Band 2 to 3 are for visual representation.
➔ Band 4 and 5 are for NDVI calculations.

Landsat-8 OLI & TIRS Sensors

Band Number	Description	Wavelength	Resolution
Band 1	Coastal / Aerosol	0.433 to 0.453 μm	30 meter
Band 2	Visible blue	0.450 to 0.515 μm	30 meter
Band 3	Visible green	0.525 to 0.600 μm	30 meter
Band 4	Visible red	0.630 to 0.680 μm	30 meter
Band 5	Near-infrared	0.845 to 0.885 μm	30 meter
Band 6	Short wavelength infrared	1.56 to 1.66 μm	30 meter
Band 7	Short wavelength infrared	2.10 to 2.30 μm	60 meter
Band 8	Panchromatic	0.50 to 0.68 μm	15 meter
Band 9	Cirrus	1.36 to 1.39 μm	30 meter
Band 10	Long wavelength infrared	10.3 to 11.3 μm	100 meter
Band 11	Long wavelength infrared	11.5 to 12.5 μm	100 meter

Road Map

The project is separated as follows:

A. Set the ground in 2015.
   Goal: Get familiar with QGIS, the data we need to download, the manipulation in order to fasten the process, get familiar with spatial data manipulation and then move to more complex data management (time series)
   How:
   1. Download 2015 data (bands of interest)
      <u>Learnings:</u>
      Download the following bands/files.
      - Band 1 (not useful but the order is important and it is easier to visual represents the band number if we don't skip Band 1.)
      - Band 2 (bleu)
      - Band 3 (green)
      - Band 4 (Red)
      - Band 5 (NRI)
      - Other text files (not particularly useful but light and we never know)

   2. Import data in QGIS.
   3. Compose the bands to get a visual representation.
      <u>Learnings:</u>
      Use *"Build Virutal Raster"* from GDAL, then go to the output layer and put the corresponding Band to the corresponding color spectrum.
      /!\ tick the checkbox "Place each input file into a separate band"

   4. Create the NDVI layer.
      <u>Learnings:</u>
      Use Raster Calculator (Not from the Toolbox, but from the Tab, there are more options). Then change the coloring to green scale color (Interpolation: Discrete / Mode: Equal Interval)

   5. Draw the polygons of Triibo (make a shape file)
   6. Draw the polygons of the AOI (area of interest), which is São Miguel Do Gostoso (shape file)
   7. Extract raster (landsat 8 bands composite layer) for AOI.
      <u>Goal:</u> Work with lighter files, it is not necessary to have the massive, large satellite image
      <u>Learnings:</u>
      Go to Raster tab, select *"Extraction"* and then *"Clip Raster by Mask layer"*.
      IMPORTANT: in the option <u>*"Assign a specific nodata value to output bands [optional]"*</u> set to -9999.0. Otherwise, the extraction will generate a rectangle around the mask. Here is the video used to make this operation:
      https://youtu.be/5ftv6I7G-ys?feature=shared

   8. Extract NDVI for AOI
   9. Extract raster (landsat 8 bands composite layer) for Triibo Mask.

Goal: Try and error, do we need the AOI to observe the NDVI increasing or can we simply observe the NDVI for Triibo. (My guess is that we don't need the AOI and we can simply focus on Triibo)

10. Extract NDVI for Triibo
    Learnings:
    1. Extracted from the AOI
    2. Extracted from the original NDVI layer (all satellite imagery)
       The result is the SAME!!! Probably less computational resource using the AOI.

11. Compute the average NDVI or other statistical indicator on the Triibo area.
    Learnings:
    Use the zonal statistics: https://youtu.be/jalq-x5gpEA?feature=shared
    Open the Attribute Table and find the data. The table is not very well structured, we might need to better define our polygon features.
    Use EXTRACTOR tool: https://youtu.be/jnpdKNGBXyc?feature=shared&t=298
    This tool is more advanced and provides a CSV files with statistical indicator.

Result A:

For Triibo in 2015 we have the following information

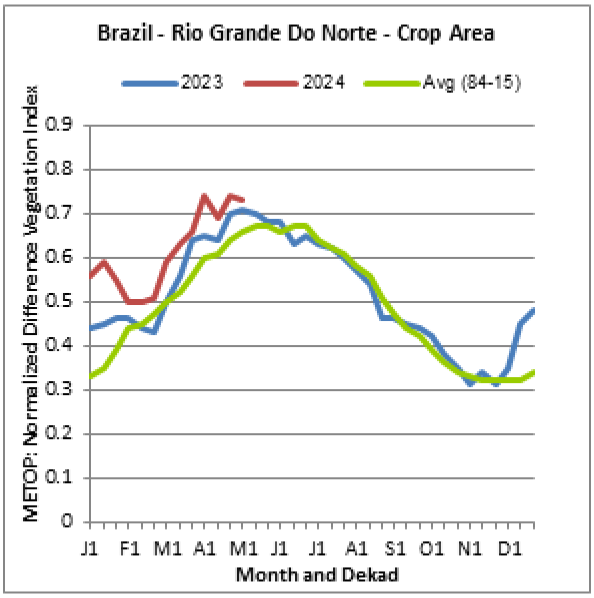
Date	**Mean**	Min	Max	Count
2015-07-25	0.390	0.099	0.572	106

Using EXTRACTOR

id	min	max	mean	median	std	majority	count
1	0.099357	0.572	0.390809	0.40124	0.086183	0.099357	107

Now we are comfortable with QGIS, the type of data we are working with and the manipulation we can download all the data and reproduce the steps faster and prepare the data for timeseries analysis.

B. Download Data
   Goal: Get quality and meaningful data from Application - GloVis (usgs.gov)
   How: To get a meaningful analysis, it starts from meaningful data. To get meaningful data, we must understand the NDVI and imagery satellite images.
   1. NDVI evolves throughout the year (according to the seasons). Brazil is a very large country with varying season in a tropical climate. For our region of interest, here is the NDVI evolution.



Therefore, we will focus on the highest NDVI period, meaning from May to July, which corresponds to the Rainy Season in this location. Which make sense because that is the moment when the nature gets back to life after the Dry Season. However, we must be careful, because rainy season means lots of cloud, which could be problematic to analyze satellite imagery.

2. Select the data with the following filter:
   - Date range: 01.01.2015 to today (23.05.2024)
   - Cloud cover: less than 5% (very important)
   - Seasonal (month): May-June-July

   Then carefully go through each selected scene and observe (visually) the quality of the image.

   According to this filtering we get the following dataset:

   1) 2015-07-25 (July)
   2) 2016-07-27 (July)
   3) 2017-07-14 (July)
   4) ~~2018-???~~ → No satellite image quality not good
   5) ~~2019-???~~ → Massive cloud on Triibo farm
   6) 2020-07-22 (July)
   7) 2021-06-23 (June)
   8) 2022-06-18 (June)
   9) 2023-07-31 (July) /!\ after computing Triibo polygon we find a cloud covering the lower-right corner of Triibo area by 5-10%. Evaluate the NDVI with cautions.

   Turns out May and June are really cloudy months! The quality of the image are very low.

The project continue on a Jupyter Notebook “EDA.ipynb”