Ghana Data Cube Tutorial **July 31, 2018**

An Investigation of Mining along the Ankobra River

YouTube Recording: https://youtu.be/Fihhhwb5WLM

Step #1 - Google Earth Pro

Review two areas of known illegal mining (provided by Ghana) and use visual imagery to evaluate the land change and timing of the mining activities. Click on the "Historical Imagery" button to view the time series of images. The images are not very clear and the time series is updated randomly every few years.

Region #1 - South Ankobra River

2002

2011

2013

December 2017

Region #2 - North Ankobra River

2002 2015

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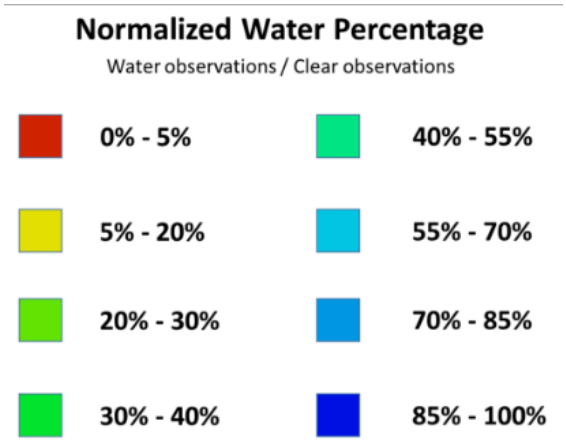
Step #2 - Open Data Cube User Interface Tool

Website: http://18.219.161.250/

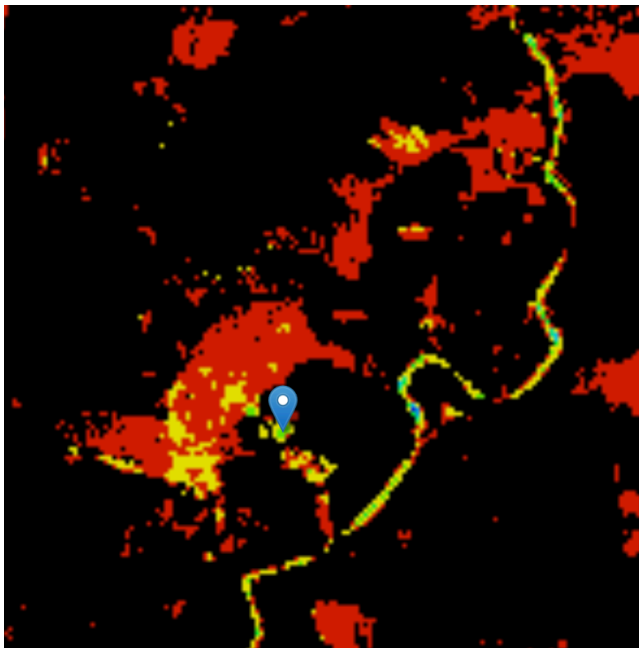
Menu: Tools > Water > Water Detection

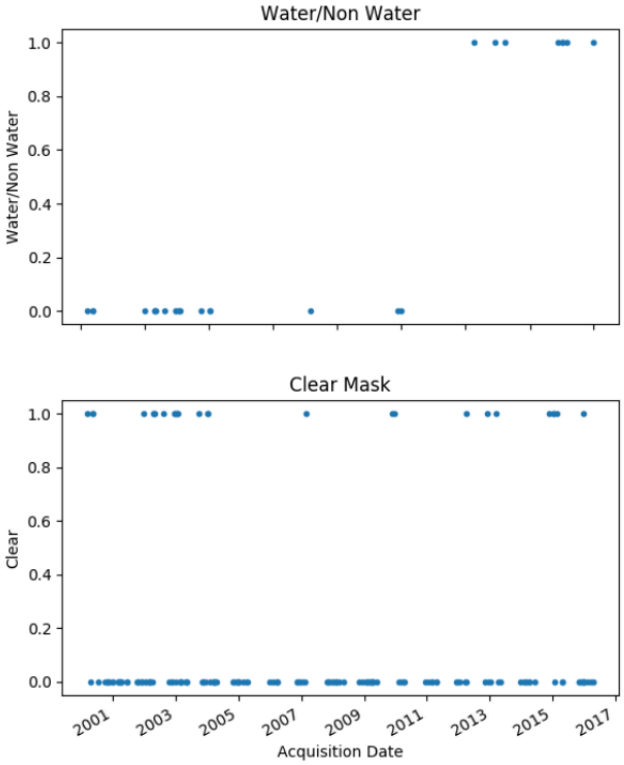
The images below show the existence of water over the region from 1999 thru 2016. Areas of RED are infrequent water, likely due to rare rain and flood events. Areas of YELLOW are located near mining areas as these bodies of water did not exist for the entire time period, but have persisted since the mines were created. Many of the water bodies resulting from mining are hard to detect since the water is very turbid and often appears as bare soil.

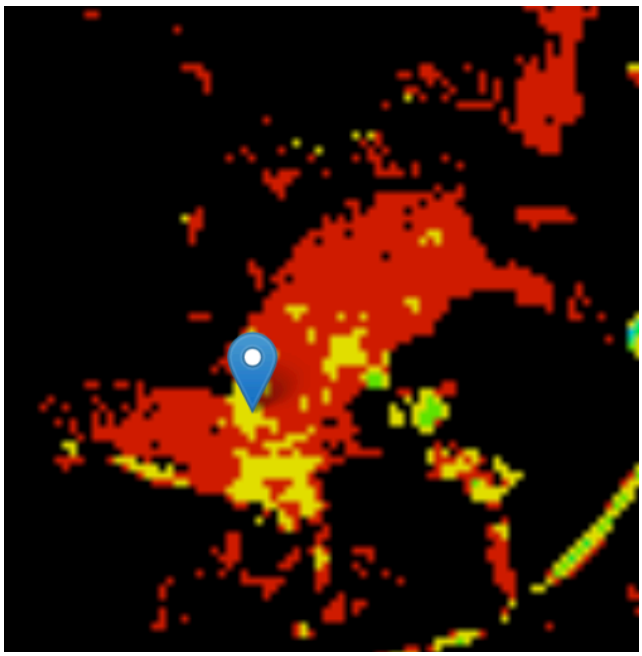


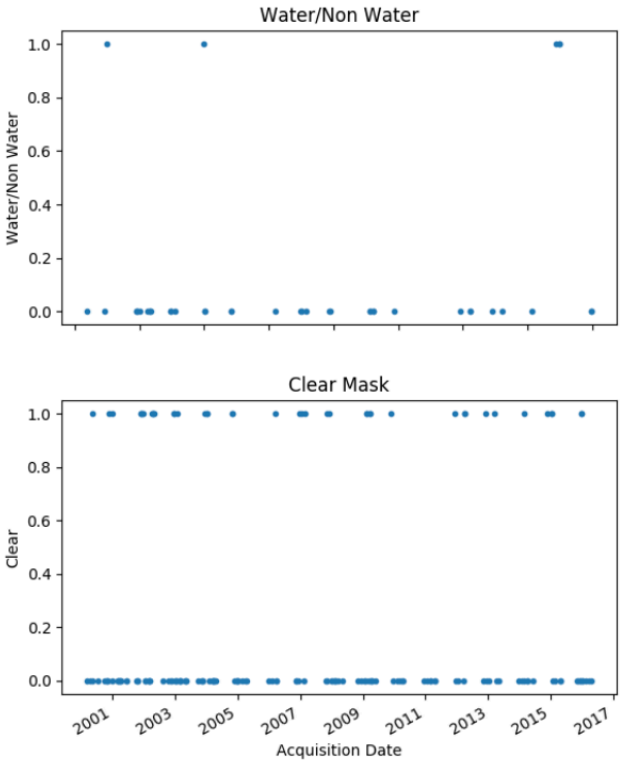
Region #1 - South Ankobra River

Latitude: 5.10 to 5.14
Longitude: -2.26 to -2.22



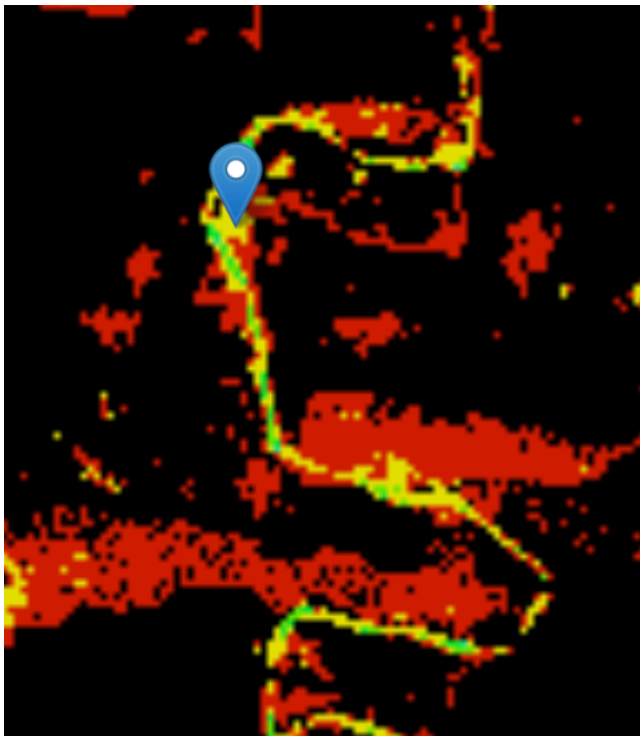


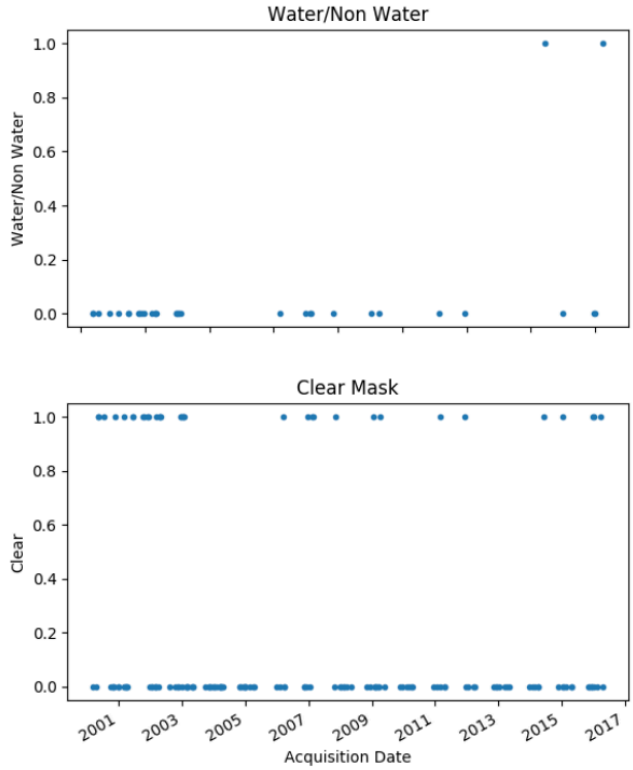


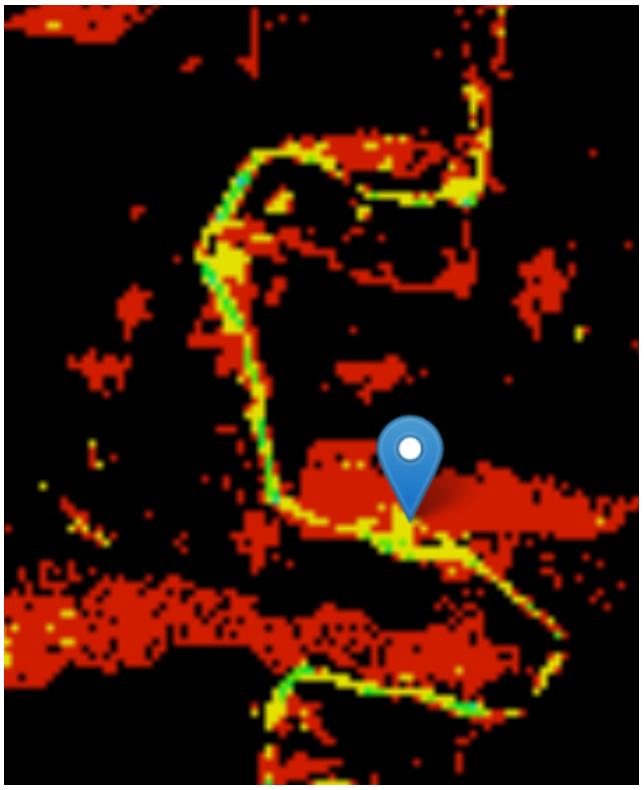


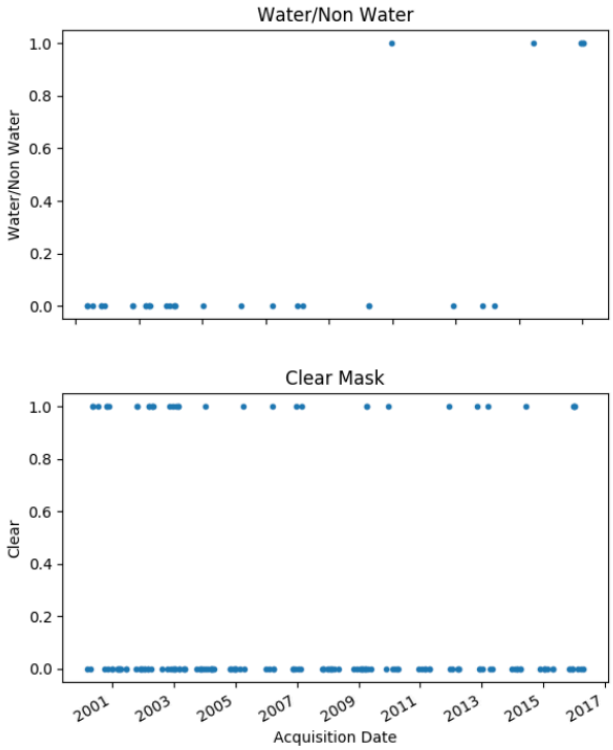
Region #2 - North Ankobra River

Latitude: 5.205 to 5.234
Longitude: -2.21 to -2.19









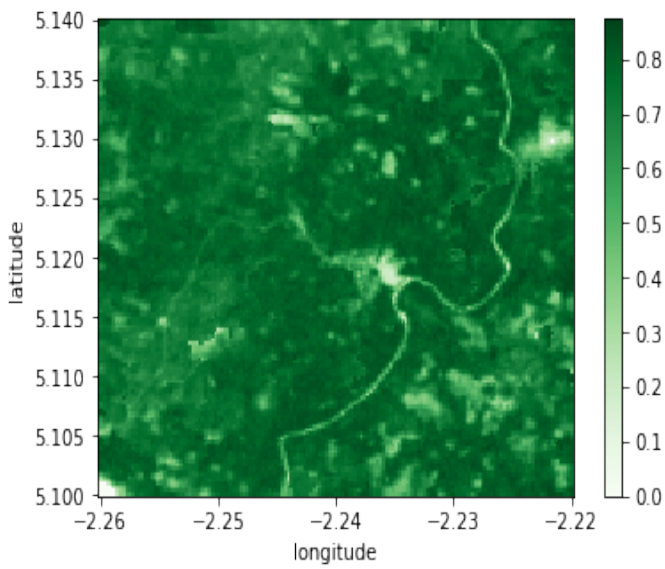
Step #3 - Open Data Cube Jupyter Notebooks

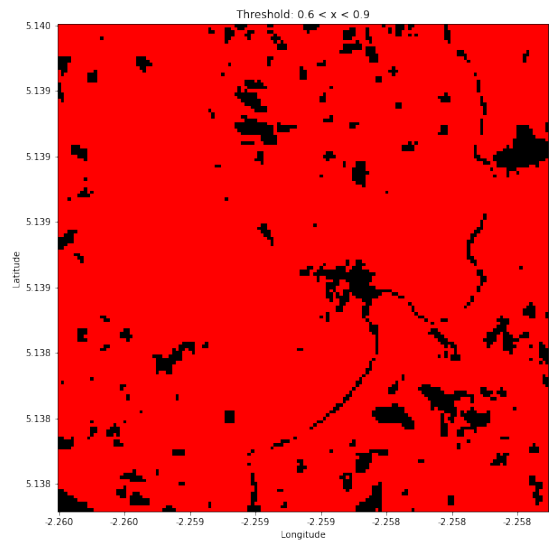
Website: http://18.219.161.250:8000
Password: ardcuser
Filenames: Ghana_Mining_Tutorial and Ghana_Mining_L8

Region #1 - South Ankobra River

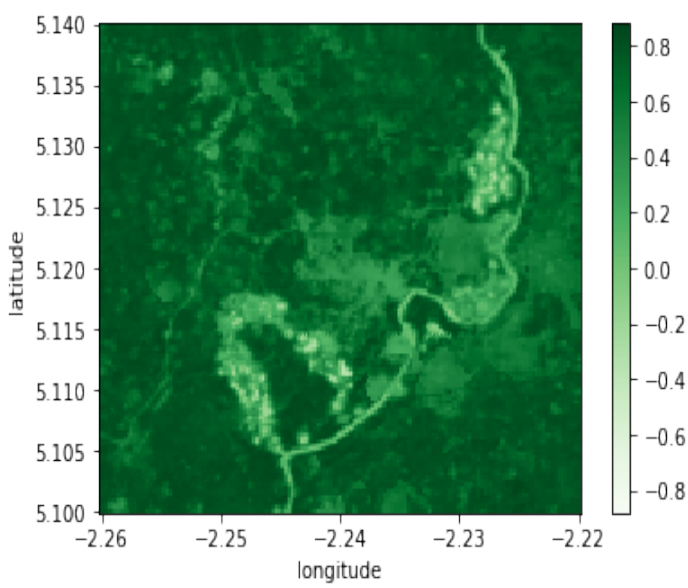
* NDVI is a measure of vegetation extent and can be used to see changes in forest and agriculture
* Values of NDVI between 0.6 and 0.9 are typical of dense vegetation, such as forests (left images)
* The RED/BLACK images (right) apply a threshold for NDVI=0.6 to 0.9 (RED)

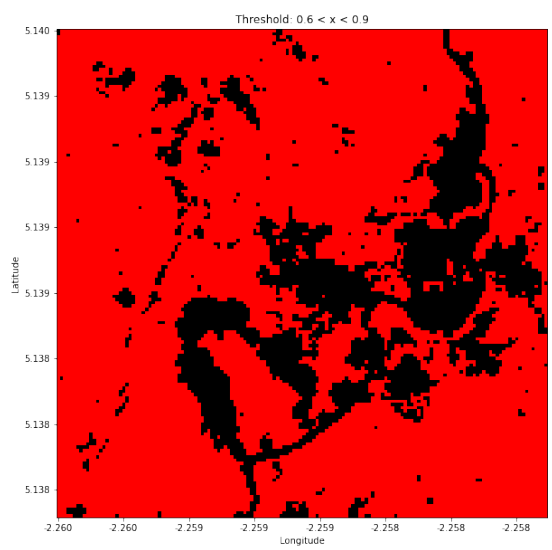
<u>Year 2000</u> 92.1% of the area in the "threshold image" is dense vegetation (forest)



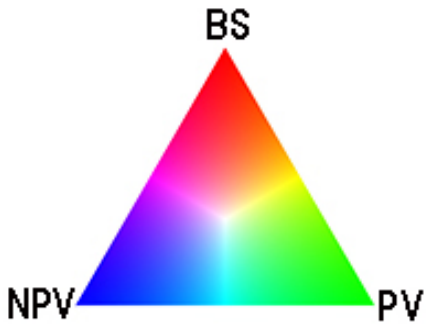


<u>Years 2016-2017</u> 78.9% of the area in the "threshold image" is dense vegetation (forest)



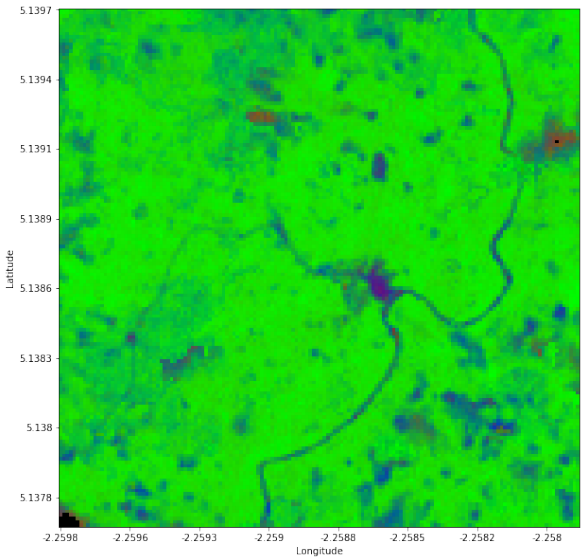


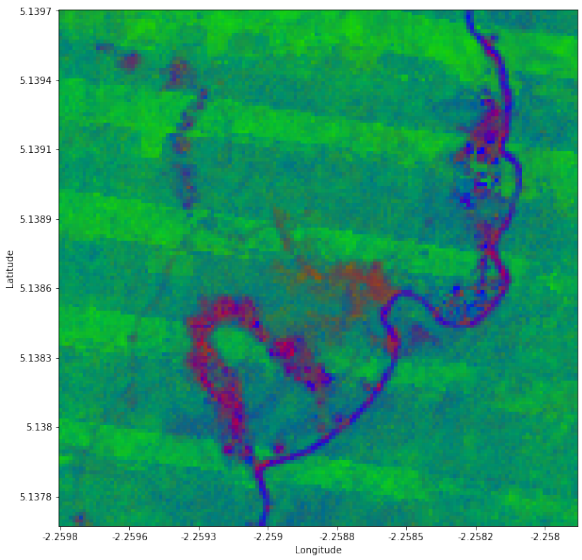
Another method for evaluating land change is to use "Fractional Cover". This product determines the fraction of Photosynthetic Vegetation (PV), Non-Photosynthetic Vegetation (NPV) and Bare Soil (BS) for each pixel. Colors are assigned to these parameters to achieve an RGB image.



Red = Bare Soil (BS)
Green = Photosynthetic Vegetation (PV)
Blue = Non-Photosynthetic Vegetation (NPV)

In most cases, water falls into the "bare soil" category, so the regions where mining has left water behind or urbanized villages are easily seen in RED. In addition, the areas of deforestation where trees have been cleared and the land remains covered with dead trees and debris, will fall into the NPV category (BLUE).





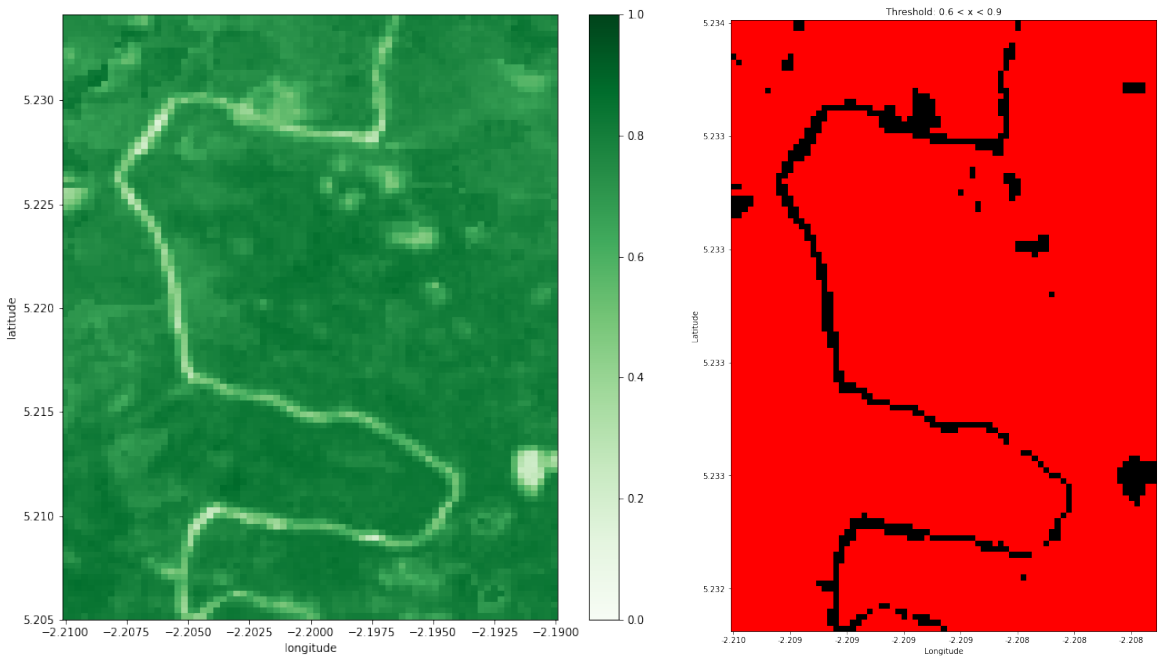
One can apply a threshold to the PV (photosynthetic vegetation) values to assess land change extent. For example, using a PV threshold (0.3 to 1.0), it is possible to measure the loss in vegetation over the time from 2000 to (2015-2017). Those results are below.

Year 2000 = 99% vegetation
Years 2015-2017 = 93% vegetation
Change = 6% loss in vegetation

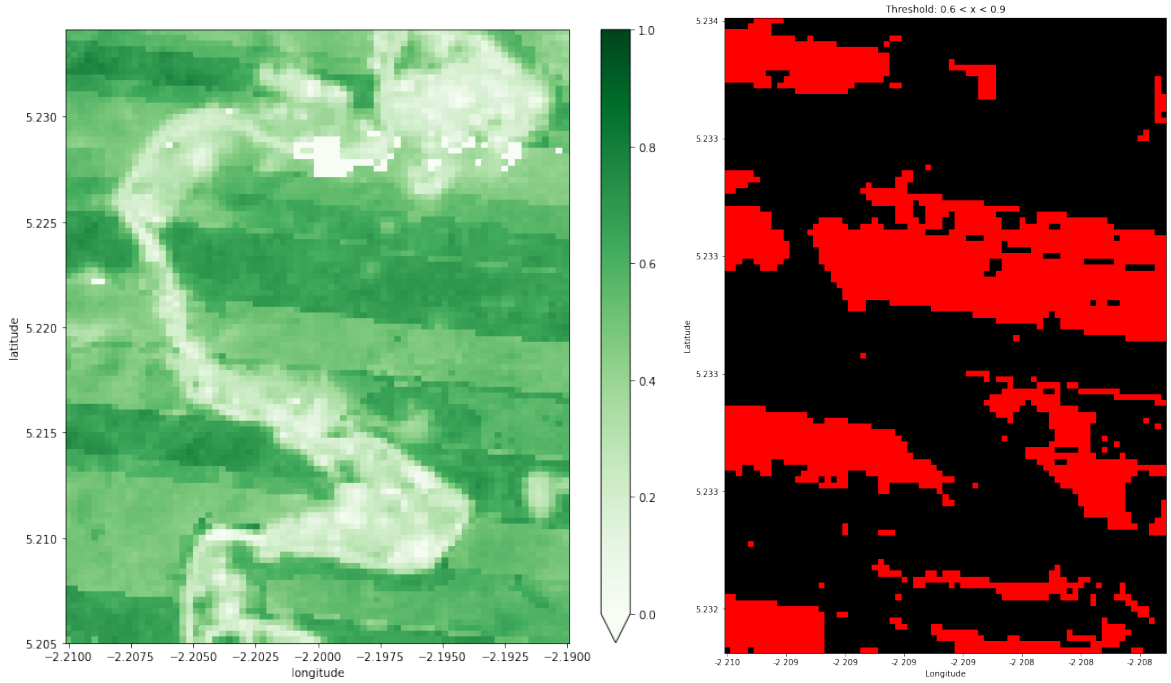
Region #2 - North Ankobra River

In some cases you will find that NDVI does not produce valid results due to the limited number of clear images and the Landsat "banding" issue. An example is shown below where the year 2000 results appear valid but the year 2017 results appear to have data issues, even though the vegetation loss along the river is still evident.

Year 2000: NDVI (left), NDVI Threshold (right)

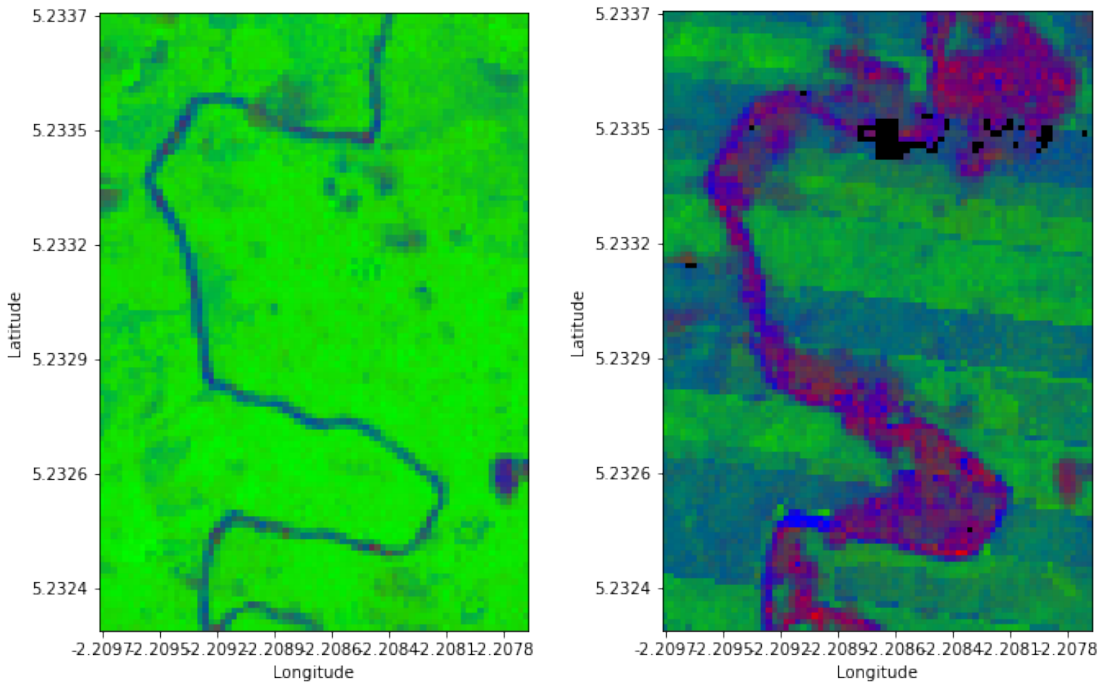


Year 2017: NDVI (left), NDVI Threshold (right)



In cases where the NDVI results have issues with limited data or "banding", it is necessary to consider other data products, such as Fractional Cover. Those results are shown below.

Fractional Cover: Year 2000 (left) and Year 2017 (right)



Threshold Analysis using Fractional Cover

PV (0.3 to 1.0) ... green areas are photosynthetic vegetation

Year 2000 = 98% vegetation, Year 2017 = 75% vegetation (below right)

Change = 23% loss in vegetation