**Question 1**

**Objective**: To map, detect and validate deforestation in an AOI between the 2 periods 1-10 July 2019 and 21-30 Aug 2019 using Sentinel-1 data

**AOI**: Make a square buffer of 5x5 km around the following coordinates

Latitude -0.685065°

Longitude 116.462648°

**Software/Programming language**: Python

**Task**:

1. Download a Sentinel-1 dual-polarization GRD image from sci-hub or Google Earth Engine.

Answer:

I used sentinel S1 GRD from google earth engine where it is can be done directly on the colud, the used programming language is python.

1. Read the image in Python and develop a code to detect deforestation alerts (can be points or polygons) for the two periods of interest in the given AOI

**Answer:**

The used method for assessing the deforestation is Radar Forest Degradation Index (RFDI);

RFDI = (VV -VH )/ (VV +VH ).

Where; represents the radiometrically and geometrically corrected SAR backscattering coefficient for each polarization combination.

Classification of RFDI:

RFDI < 0.3 represents dense forest cover,

0.3 > RFDI < 0.9 represents degraded surface,

RFDI > 0.9 represents deforestrated surface

The alerts are points and exported to two geojson files. (I did not add the date the attribute table, it needs more time)

1. Compare the increase in deforestation from the first period to the second

**Answer:**

The deforestation areas are defined as the areas where the Radar Forest Degradation Index is larger than 0.9. Hence, these areas were masked in the code to count in July and August as shown in figure 1. Figure 1 shows that the number of deforestation pixels has decreased. This could be attributed to the poor accuracy of the RFDI in assessing the deforestation.

However, the number of valuable areas to degradation has increased from July to august as shown in figure 2.

Graphical user interface, text, application, email

Description automatically generated

Figure1

Graphical user interface, text, application, email

Description automatically generated

Figure 2

**Validation**

1. Use the Sentinel-2/Google Earth imagery from 2019 to validate the results

Answer:

Three methods to validate the degradation:

1) Comparison with Normalize Difference Vegetation Index (NDVI) from Sentinel 2 images at points scale.

2) Comparison the histograms of RFDI (Sentinel 1) and NDVI (Sentinel 2).

3) comparison between the RFDI and the Sentinel 2 imagery and the Google Earth imagery

**The first method (comparison with NDVI):**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **point** | **coordinates** | | **July** | | **August** | |
| **latitude** | **longitude** | **RFDI** | **NDVI** | **RFDI** | **NDVI** |
| **Point 1** | -0.658 | 116.457 | 0.8 | 0.12 | 0.65 | 0.28 |
| **Point 2** | -0.699 | 116.478 | 0.824 | 0.1 | 0.6 | 0.3 |

**In July:**

The RFDI of 0.8 indicates to deforested area while the NDVI of 0.12 indicates to no vegetation areas.

**In august:**

The RFDI was 0.824 which indicates deforested area while the NDVI was 0.1which indicates dense **vegetation areas.**

**2- Comparison of the histograms:**

The histograms of the RFDI indicates no increase in the deforestation from July to August. However, the histograms of the NDVI indicates a significant increase in the deforestation as shown in Figure 3 and 4.

**3- comparison between the RFDI and the Sentinel 2 imagery and the Google Earth imagery**

Figure 5 and 6 represents the true color composite Sentinel 2 in July and August respectively. However, the comparison between the deforestation map and the Sentinel 2 imagery was not proceeded due to the clouds in the optical images. These cloud needs to mask first, and the time was limited.

Conclusion: the RFDI has limitations in monitoring the deforestation.

Chart, line chart

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Figure 3 , Histogram for the RFDI in July and August

Chart

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Figure 4 , Histogram for the NDVI in July and August

A screenshot of a computer

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**Figure 5 represents the true color composite Sentinel 2 image in July**

A screenshot of a computer

Description automatically generated with low confidence

**Figure 6 represents the true color composite Sentinel 2 image in august**

1. Tell us how you can further improve the accuracy of the deforestation detection

Answer:

To increase the accuracy, we can apply;

1) Speckle filter to reduce the speckle noise

2) Apply another approach in the deforestation assessing instead of the RFDI because of its poor accuracy.

3) The used image are Sentinel 1 images with C band. This band’ ability to penetrate and interact with the forest volume is limited compared with L band. Hence, using L band will improve the accuracy of the assessment.