Forest and Vegetation Monitoring Using Sentinel-2 Imagery in the Northern Part of Democratic Republic of Congo

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ABSTRACT

Forest monitoring is vital for accessing over-all success of the 2030 Agenda because forests play a significant role in meeting many Sustainable Development Goals (SDG), especially SDG 15. Our study evaluates the contribution of sentinel-2 data for mapping forests in Democratic Republic of Congo. Afforestation and halting deforestation are recognized as key pathways for countries to reach their mitigation targets, because forests can serve as major carbon sinks (SDG 13). The aim of this study is to evaluate the changes in forest and vegetation over a period of In this study, we have evaluated the use of freely available satellite data for monitoring of forests and vegetation using NDVI.

OBJECTIVE

The aim of this study is to evaluate the changes in forest and vegetation over a period of 5 years during 2016-2021 with freely available satellite data using Normalized Difference Vegetation Index (NDVI).

INTRODUCTION

Monitoring forest and vegetation through remote sensing takes into account various considerations, techniques and processes. Satellite-based monitoring is often based on spectral calculations incorporating surface reflectance registered by sensors. The ESA's Sentinel-2 mission has found application in the monitoring of forest state and disturbances (Hoersch, 2013).

Figure 1: The map of DR Congo.

Our study area is located in the northern part of Democratic Republic of Congo (DR Congo). It is a tropical country in the African sub-continent divided by equator, our study area lies north of equator within this country. Humidity is high, and it rains throughout the year. Agriculture, animal husbandry, fishing, and forestry combined provide employment for more than three-fourths of the labor force and, on average, account for more than two-fifths of GDP (Payanzo et al., 2021). This report covers a study area of 1142.54km2.

DATA AND METHODS

Image selection and downloading, Minimal possible cloudiness level, as well as full tile coverage, was taken into consideration. The method of nearest neighbour was used for resampling as it allows to preserve the original pixel values. NDVI is computed as the difference between B8 (NIR) and B4 (Red) reflectance divided by their sum. As the observation were made only on the basis of NDVI values, we faced difficulties sometimes as NDVI has some down sides such as we cannot calculate the NDVI values of the pixels those were covered by the clouds, as there were no reflections there. The NDVI value enabled us to assess approximate condition of forest and vegetation in this area during a five years period. Figure 3 and 4 below shows the details of how the vegetation has changed over the period of five years.

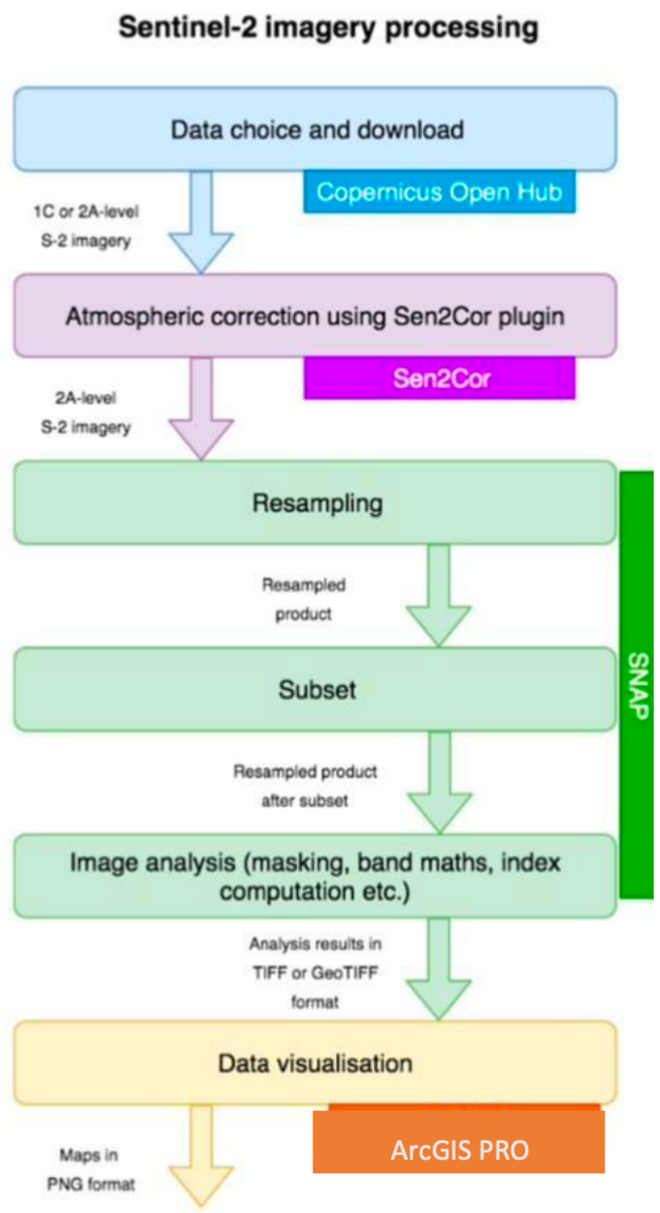

Figure 2: The workflow of the project.

RESULTS AND FINDINGS

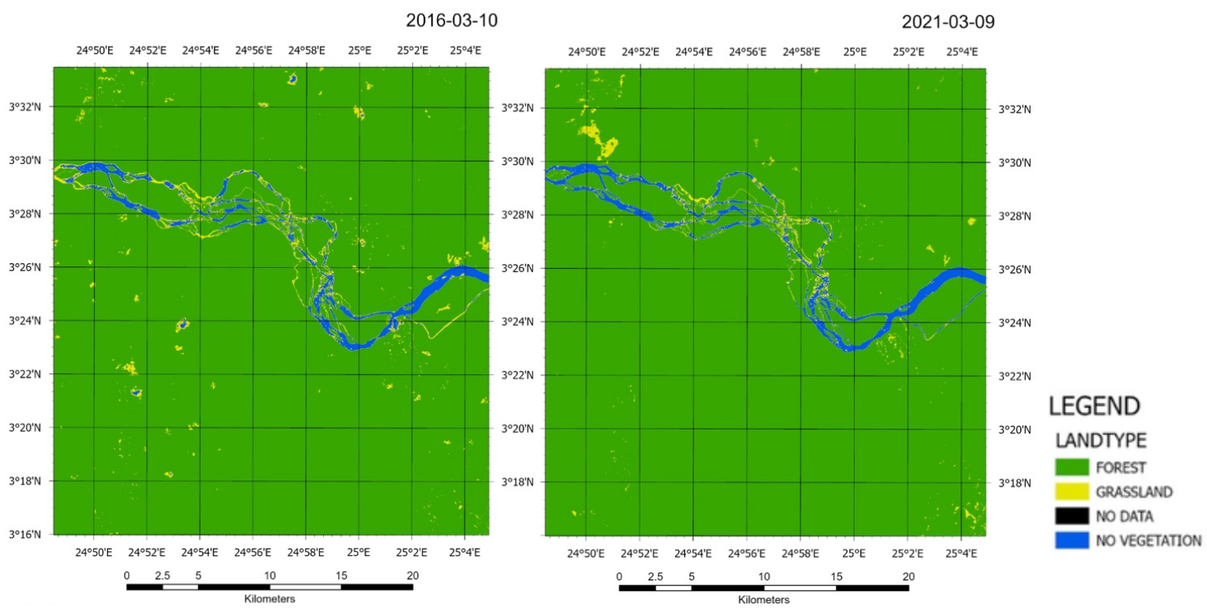

Figure 3: Above images show the land cover comparison during the period of 2016 and 2021

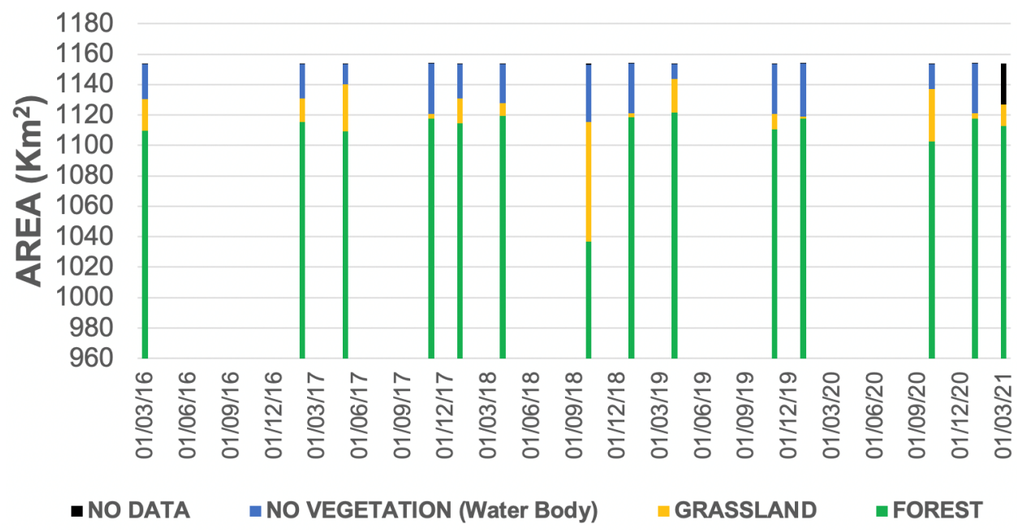

Figure 4: Above images show the land cover changes during the period of 2016 and 2021

However, the NDVI values for the whole area has not seen a significant change, the forest coverage as well as grasslands have changed over time in this area (Fig.2). It's important to know that the NDVI is an indicator of the plant's health and not a way to diagnose a particular condition (Huang et al.,2021). NDVI can be used with other index such as Leaf Area Index (LAI), MERIS Terrestrial Chlorophyll Index (MTCI), Modified Chlorophyll Absorption Ratio Index (MCARI), etc, to deliver more precise and informative results. Important thing to note here is these observations are a continuous process, hence, periodical analysis is important to keep the track of changes in the area. As weather plays an important role in vegetation change, an observation of a short duration should not be considered very accurate.

REFERENCES

Hoersch, B.: Sentinel-2, User Handbook, European SpaceAgency (ESA), 2013.

Huang, S., Tang, L., Hupy, J. P., Wang, Y., and Shao, G.: A commentary review on the use of normalized difference vegetation index (NDVI) in the era of popular remote sensing, J. For. Res., 32, 1–6,https://doi.org/10.1007/s11676-020-01155-1, 2021.

Payanzo, N., Cordell, D. D., Lemarchand, R., and Wiese, B. M.: Democratic Republic of the Congo|Culture, History, & People, https://www.britannica.com/place/Democratic-Republic-of-the-Congo, [Online; accessed 21. Apr. 2021], 2021.