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Monitoring deforestation in the Serranía de Chiribiquete in northern Colombian Amazon using time series analysis of satellite data

Deforestation monitoring is of significant importance for the ecosystem, climate change, and policy-making. The availability of optical and *synthetic aperture radar (SAR)* satellite remote sensing images, along with the development of time series change detection methods, has contributed to the increasing popularity of time series analysis in forest disturbance monitoring. However, there are few studies that compare the performance of optical and SAR imagery for this purpose. In this study, the Landsat and Sentinel-1 time series imagery from 2016 to 2021 was used to detect forest cover loss in the northern Colombian Amazon, which has experienced great deforestation following the signing of the Colombian peace agreement in 2016. The time series change detection method applied in this study is the *Continuous Change Detection and Classification (CCDC)* algorithm, as it flags land cover changes by differencing the predicted and observed data. The deforestation detected by 1040 Landsat and 1378 Sentinel-1 images indicates that deforestation gradually increased from 2016 to 2018 and then exhibited a fluctuating trend. The peak years of deforestation were observed in 2018 and 2020. The paired-samples t-test revealed that the difference between detected forest loss area by Landsat and Sentinel-1 data is statistically significant in study region 1, while it is not statistically significant in study region 2. Furthermore, the spatial distribution analysis indicated that the detected forest loss from 2016 to 2021 roughly followed the direction of the boundaries of the protected area. After assessing the accuracy using stratified random sampling, the overall accuracy values of 62.7% for Landsat and 43.3% for Sentinel-1 in detecting deforestation were obtained. Subsequently, a temporal accuracy assessment of the forest disturbance pixels successfully detected by Landsat and Sentinel-1 was conducted. The results showed that 62.8% of Landsat pixels and 74.9% of Sentinel-1 pixels accurately matched the corresponding actual years of deforestation. This study suggests that integrating

Landsat and Sentinel-1 data for forest disturbance monitoring may potentially yield better results in both spatial and temporal domains.

Keywords: Physical Geography and Ecosystem analysis, CCDC, Forest loss, Landsat, Sentinel-1, Change detection, NNP, FARC

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