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| **Identifying deforestation drivers in Cameroon using deep learning and Earth observation data** |
| Sub-Saharan Africa has become the region with the largest annual forest loss between 2010 and 2020, with 3.9 million hectares lost per year. It has also experienced the fastest agricultural expansion globally since 2015. Within the Congo Basin, where the second largest tropical forest in the world can be found, Cameroon has known the sharpest average annual rise in primary forest and tree cover loss between 2016 and 2021. Further understanding of the drivers of forest loss with a high level of detail and automation for up-to-date information is needed to: plan interventions focusing on specific areas and actions, design measures to address specific drivers, and define priorities for monitoring. However, a detailed, country-specific and comprehensive automated classification for the land-use changes leading to deforestation is lacking for Cameroon.  Here, we present Cam-ForestNet, a new deep-learning approach to automatically classify fifteen direct drivers of degradation and deforestation for Cameroon, combined with a newly-consolidated satellite imagery reference dataset. For this purpose, we compared the performance of different optical and SAR data (including Landsat-8, NICIFI PlanetScope, Sentinel-1, and Sentinel-2), different band combinations, and tested multi-sensor data fusion and time-series analyses. In addition, we assessed the contribution of auxiliary socio-economic and biophysical parameters for the identification of direct and indirect deforestation drivers, and their potential for predicting future threats and land use changes. Our results show the potential of Cam-ForestNet to monitor deforestation and prioritise interventions for organisations working on forest conservation, as well as to carry out post-event analyses to inform policy. This model is especially powerful as it displays a high performance in identifying detailed small-scale drivers, which is typically challenging.  We also explore the considerations and precautions needed to allow for the use of the method in ‘real-world’ applications including, for example: 1) the need for an interpretable confidence score, 2) an easy-to-use and easy-to-update platform, 3) in-country collaborations and engagement with various stakeholders, and 4) careful open data strategies with attention to privacy and security issues. Finally, we discuss the potential of using our framework for other locations in the Congo Basin area. |