



Net carbon losses in Central African forests revealed by high-resolution biomass change maps

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Dense humid forests in Central Africa hold vast biomass carbon stocks but face increasing pressure from logging, clearings, and fire disturbances. Many of these disturbance events have a small spatial scale and are missed by current satellite observations. To address this knowledge gap we generated annual 10 meter resolution maps of canopy height from 2019 to 2022 using a deep learning model fusing spaceborne lidar height measurements with Sentinel radar and optical imagery. The maps reveal widespread previously undetected small disturbance patches, with 87% of all the disturbances being of less than 1 ha in size. These disturbance patches smaller than 1 ha account for 48% of the biomass carbon gains in regrowing forests and for 37% of carbon losses from deforestation. We found a net carbon loss of $-58 \pm 9 \text{ Tg C yr}^{-1}$ composed of a gross loss of $-126 \pm 7 \text{ Tg C yr}^{-1}$ partially offset by a gain of $68 \pm 6 \text{ Tg C yr}^{-1}$, implying a turnover of biomass carbon from disturbances of 0.52% per year. The Democratic Republic of the Congo is a small net source of carbon ($-46 \pm 6 \text{ Tg C yr}^{-1}$) due to degradation, despite having the largest carbon gains in young secondary forests. Across the Congo Basin, protected areas show a net biomass loss of $-4 \pm 1 \text{ Tg C yr}^{-1}$, with a gross loss of $-14 \pm 1 \text{ Tg C yr}^{-1}$, highlighting uneven conservation outcomes. Our

remote-sensing data aggregated into national carbon budgets align well with country-level inventories and bookkeeping model estimates, paving the way for spatially explicit and transparent carbon monitoring.