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"Human influence on Amazon's aboveground carbon dynamics intensified over the last decade"
Fendrich et al. Nature Communications, 2025

The Amazon rainforest plays a central role in the global carbon cycle, storing about 102 PgC in aboveground biomass and accounting for nearly 14% of annual terrestrial carbon fixation. Yet its carbon sink capacity is under increasing threat. This study provides a new high-resolution reconstruction of annual aboveground carbon (AGC) changes from 2010 to 2020, using a statistical disaggregation of passive microwave data (L-VOD from SMOS) combined with land-use, climate, and disturbance datasets.

The results reveal that the Amazon lost a net −0.37 ± 0.17 PgC over the decade. Gains from undisturbed forests (+0.33 PgC) and secondary forest regrowth (+0.33 PgC) were outweighed by losses from deforestation (−0.55 PgC), degradation (−0.42 PgC), and conversion to agriculture (−0.06 PgC). These findings show that human-driven processes are now the dominant cause of carbon losses in the basin.

Undisturbed forests still acted as a carbon sink, but their contribution was increasingly offset by recurrent degradation and clearance. Degradation, although often producing smaller losses per hectare than deforestation, affected a much larger area and therefore contributed substantially to emissions. Secondary forests showed promising regrowth potential, but their gains remained too limited to balance ongoing losses.

The share of carbon losses occurring in human-influenced land rose significantly over the study period, particularly during extreme climate events such as the 2010 and 2015–16 El Niño episodes. By the late 2010s, human activities accounted for about 60% of all gross losses during El Niño years, illustrating the compounding effect of climate variability and land-use pressures.

Alarmingly, even protected areas and indigenous lands were not immune: degradation and deforestation within these territories intensified between the first and second half of the decade. This trend raises concerns about enforcement and long-term forest resilience.

The study highlights the importance of integrating near-real-time, high-resolution monitoring of forest carbon dynamics. The new maps reduce uncertainties compared with previous datasets and allow for finer attribution of gains and losses to human versus natural drivers. They demonstrate that intensifying land-use pressures are undermining the Amazon's capacity to act as a global carbon sink.

If unchecked, this trajectory could push the region closer to a tipping point, with cascading impacts on biodiversity, climate regulation, and regional water cycles. Strengthening forest conservation policies, reducing degradation, and curbing deforestation remain urgent priorities.

Overall, the findings underscore that the Amazon is no longer a stable carbon sink, but one increasingly shaped by human actions. Without decisive intervention, its role in mitigating climate change will continue to weaken.

References

Fendrich, A., Feng, Y., Wigneron, JP. *et al.* Human influence on Amazon's aboveground carbon dynamics intensified over the last decade. *Nat Commun* 16, 6681 (2025). https://doi.org/10.1038/s41467-025-61856-1