Lidar reveals the long-term legacy of Amazon forest degradation

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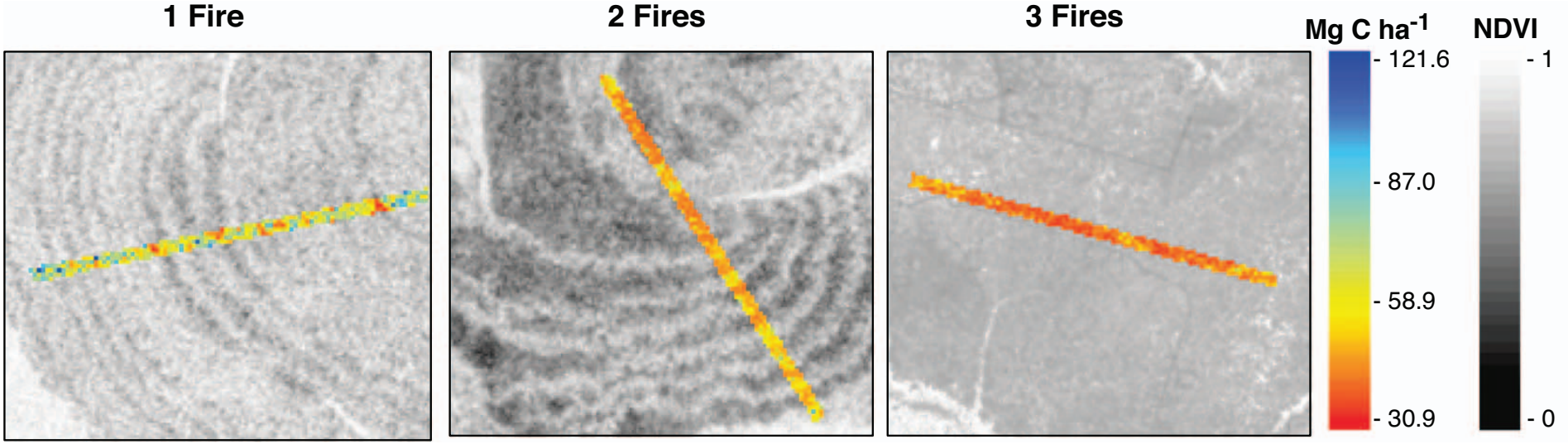

Long transects of airborne lidar (5,000 m x 200 m) capture reductions in carbon stocks (Mg C ha^{-1}) and habitat heterogeneity for Amazon forests after the first, second, or third understory fire, visible in Landsat data (NDVI).

Background: Forest degradation is widespread across the Amazon, yet degradation emissions are excluded from carbon monitoring systems like REDD+ due to data gaps on forest recovery from logging and fire.

Analysis: We analyzed forest inventory data, airborne lidar, and a 32-year Landsat time series to characterize forest carbon stocks and 3D forest structure 1-15 years following specific degradation pathways.

Results: Carbon stocks were lower in burned forests than logged forests, and repeated burning resulted in a non-linear decline in carbon stocks and habitat heterogeneity. Neither logged nor burned forests recovered their original carbon stocks within 15 years of recovery.

Significance: This study provides the first comprehensive set of emissions factors needed to include logging and fire in estimates of carbon emissions from Amazon forests for REDD+, reduce uncertainty in the global carbon budget, and improve climate and land use projections.