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High-resolution quantification of aboveground carbon change over the tropics

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Tropical ecosystems play an important role in regulating the global carbon balance. Existing studies have extensively analyzed the carbon dynamics of tropical forests, the largest terrestrial component of the global carbon budget, showing a likely neutral contribution of tropical forests to the global carbon cycle. However, high-resolution dynamics of aboveground carbon (AGC) change of the whole tropical terrestrial ecosystem and its processes remain rarely investigated. In this study, we first used low-frequency L-band passive microwave observations to derive wall-to-wall maps of annual AGC stocks over the tropics at 25-km spatial resolution. Using high-resolution satellite observations of land-cover change and biomass maps and random forest models, we separated the AGC stock into various ecosystems, including forest, shrub, and short-vegetation (grass and crop), and attributed the change to different degradation processes such as fires and deforestation at 100-m resolution. Our preliminary results show that total AGC stocks in tropical ecosystems increased by +2.25 [+1.19,+3.29] PgC (the range represents the minimum and maximums of the multiple estimates) from 2010 to 2020. The coast of Brazilian Mata Atlantica, Central African Republic, and east Tanzania are the hotspots of net increase, while the Arc of Deforestation in the Amazon basin and the Congo Basin show substantial net losses. Gross losses from non-fire deforestation and fire totaled -1.62 [-1.38,-1.86] PgC yr^{-1}. We also observed strong recovery in African burned regions, possibly due to post-fire regrowth and additional recovery resulting from declining fires in the region. Our results highlight the importance of explicit temporal and spatial mapping of tropical carbon dynamics at high resolution, which can help us better understand the role of tropical terrestrial ecosystems in the global carbon cycle.