Poster #1-50

Tropical Forest Degradation Modulates Energy, Water, and Carbon Cycles in the Amazon

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Tropical forest ecosystems are increasingly affected by human activities. In addition to deforestation, degradation from selective logging, fragmentation, defaunation, and fires alters the structure and composition of forests. Degradation impacts are concentrated at the forest frontier, with estimates that up to 70% of the forests are within 1km of forest edges. Yet, the impacts of forest degradation on ecosystem functioning remain uncertain. To better quantify and understand how changes in forest structure from degradation modulate the energy, water, and carbon cycle in Amazonian forests, we used an integrated approach that combines field and remote-sensing data with Ecosystem Demography Model (ED–2.2). We developed an algorithm to retrieve the vertical structure of forests at 50-m resolution, using a sample of 817 plots (total area = 200 ha) across the Amazon that were co-located with airborne lidar. A cross-validation analysis showed that the approach effectively captured the variability of forest structure among degraded forest classes and across regions. We then applied this method over 13,500 ha of intact and degraded forests in 5 study regions along a precipitation gradient in Eastern Amazon, to generate initial conditions for ED–2.2. First, we ran the ED–2.2 model for 3 of the study regions for which eddy covariance fluxes were available. We found that the model realistically represents the magnitude and seasonality of water fluxes and gross primary productivity, but it tends to overestimate sensible heat fluxes. In addition, we carried out 36-year (1981–2016) simulations for each of the 5 study regions, in which degraded and intact forests within each region were driven by the same meteorological drivers (MERRA–2 reanalyses and rainfall from MSWEP–2.2). Preliminary results indicated significant impact of forest structure on the seasonality of fluxes. For example, severely degraded forests showed more severe water stress and higher ground temperatures during the dry season than intact forests, and higher fire risk during mild droughts. In contrast, differences between degraded and intact forests were lower during the wet season and during extreme droughts. Our results also suggest that disturbance history sensitivity of tropical forests to drought and fire, especially during non-extreme events.