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Rapid and temporary increases in low flows in the Amazon explained by changes in root-zone water storage

Rodolfo Nóbrega and Iain Colin Prentice
Imperial College London, Georgina Mace Centre for the Living Planet, Silwood Park Campus, Buckhurst Road, Ascot SL5 7PY, United Kingdom (r.nobrega@imperial.ac.uk)

Increases in streamflow are often attributed to land-cover clearing (LCC) on the basis that it reduces soil infiltration capacity and increases surface runoff. Nonetheless, these changes can result from different hydrological mechanisms depending on the vegetation, and temporal and spatial scales. LCC triggers a series of changes in hydrological fluxes that have non-linear responses to precipitation and that were established upon the long-term balance with regional climatological, edaphic, and geological characteristics. We analysed streamflow and root zone water capacity (RZSC) to identify underlying relationships between stream dynamics and water consumption by plants. We used a time-series segmentation and residual trend analysis on streamflow and precipitation of high-order tributaries of the Tapajós River whose catchments underwent intense land-use changes over the past decades. We estimated the RZSC using the "Earth observation-based" mass-curve balance method by considering the annual land-cover changes over a >30-year period. We show that the reduction in the RZWC caused by changes in the water consumption by plants over the dry season is tightly associated with the increased baseflow contribution to rivers. Finally, we analysed gross primary productivity (GPP) and ET estimates generated by a model based on eco-evolutionary optimality that integrates the water and carbon cycles at the canopy level. We found that trends in ET from croplands are not as pronounced as trends in GPP. Although RZWC is quantified using the water deficit driven by ET, changes in RZWC are more correlated to changes in GPP. We show that the potential effects of vegetation responses to increasing atmospheric CO_2 concentrations on streamflow are still outweighed by impacts of land-use change on low flows in Amazon rivers. However, this might not be the case for all water cycle components, and, therefore, we highlight the importance of considering the carbon cycle in hydrological assessment studies.