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## A regional view of the linkages between hydro-climatic changes and deforestation in the Southern Amazon

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Linking the Amazonian deforestation to changes in the hydrological cycle remains a puzzling question, addressed here through the use of recent global databases analyzing the relations between key hydro-climate variables (Precipitation (P), potential and actual evapotranspiration (PET and AET, respectively)), the surface water-energy balance and indices of forest cover change (regional forest loss ratio -RFL and regional non-forest vegetation ratio -RNF) for Southern Amazon (south of 8°S) and over the 1981-2018 period. The Southern Amazon constitutes a peculiar region due to specific climatic characteristics and shows a higher significant deforestation rate in comparison with the Northern Amazon. We further subdivided the study region into three subregions called Southern Bolivian Amazon (15° S–21° S, 57° W–70° W), Southern Peruvian Amazon (8° S–15° S, 77° W–65° W) and Southern Brazilian Amazon (8° S–15° S, 65° W–50° W). The surface water-energy balance is analyzed using a pixel-based Budyko-like theoretical framework approach, which discriminates energy-limited regions from water-limited regions. Southern Bolivian Amazon is shown to have undergone the strongest forest transition, becoming water-limited in conjunction with high forest loss. In this region, there is a significant relation between RFL values above 40%, P decrease, PET increases and AET decrease. These results suggest that areas with RNF values higher than 40% are prone to shift from an energy-limited to a water-limited state and remain trapped in this new state. Regions further north remain energy-limited due to minor P changes and even though significant increases in PET and decreases in AET are observed, associated with deforestation (high values RFL). This is typically the case in the 'Arc of Deforestation'. In the Southern Bolivian Amazon, land use transition is associated with much larger changes from closed forest to a low-tree cover state as compared to regions further north - by at least a factor three as a proportion of area. Our findings indicate a clear link between hydro-climatic changes and deforestation, providing a new perspective on their spatial variability on a regional scale.

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