The hydroclimate-vegetation relationship in the Amazon basin during the last 20 years: an analysis focused on the southwestern region

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The relationship between multiple hydroclimatic variables and vegetation conditions in the upper Madeira Basin (southwestern Amazon) has been analyzed. Vegetative dynamics are characterized using NDVI dataset as an indicator of the photosynthetic capacities of vegetation. Hydroclimatic variability is analyzed using satellite-based precipitation datasets, observed river discharge, and satellite measurements of terrestrial water storage (TWS). Our results show that the vegetation in the Basin varies from energy- to water-limited. During the peak of the wet season (January-February), rainfall, discharge, and TWS are negatively correlated with NDVI ($r=-0.48$ to $-0.65$), suggesting that during this period the vegetation is mainly energy-dependent. Outside this period, these correlations are positive ($r=0.55$ to 0.9), suggesting that vegetation depends mainly on water availability. This higher water dependence is more noticeable during the vegetation dry season (VDS; June-October). Considering the predominant land cover types, differences in the hydroclimate-NDVI relationship are observed. Evergreen forests remain energy-limited during the beginning of the VDS, but they become water-dependent almost at the end. Savannas show a different behavior, where water dependence occurs months before the onset of the VDS. On the other hand, unlike the other variables, the TWS better explains the NDVI in evergreen forests during the VDS ($r=0.7$ to 0.85). This is probably because evergreen forests are more dependent on deep soil water. A spatial analysis between hydroclimatic variables and the NDVI shows the predominance of positive correlations in most of the basin. However, specific areas do not show significant correlations. The weak relationship in these areas is explained by two factors i) very wet conditions during most of the year in the "rainfall hotspot" regions, where the vegetation is not water-limited, and ii) recent land-use changes (deforestation) that break the natural response in the hydroclimate-vegetation system. These findings provide new evidence on the impacts of the land cover changes on the natural relationship between vegetation and hydroclimatic variability, which is particularly relevant given the increasing rates of deforestation in this region during recent years.