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The influence of groundwater and land cover change on evapotranspiration in the Amazon Rainforest transition zone

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The Amazon rainforest's moisture recycling system provides water for rainfed agriculture, hydroelectric power generation and human consumption, and is, therefore, an important ecosystem service which is hugely important for the Brazilian economy. However, forest conversion to agriculture in the Amazon severally reduces the evapotranspiration (ET) flux, especially over varying groundwater levels. During the dry season, when precipitation is limiting, access to groundwater can help maintain ET rates. This strongly depends on the rooting depth of vegetation and groundwater depth. These effects on ET may lead to lowering atmospheric moisture, and in turn, less moisture available for downstream precipitation. Understanding how land cover changes impact the moisture recycling systems could significantly influence future decision making. The aim of this research is to improve our understanding of the influence of groundwater depth, land use change and their interaction with ET of forest and agricultural land cover.

We used one of the most commonly utilised remote sensing data products from MODIS (MOD16 - 8-day ET at 500m resolution) to investigate the temporal and spatial patterns of land cover change and evapotranspiration in the Amazon region from 2002 to 2017. First, we investigated groundwater's influence on the seasonality of ET under "stable" conditions, i.e. over areas that did not undergo land cover change during the study period. We found differences in seasonality as well as differences between deep and shallow groundwater for agricultural land cover types - Rangeland and Cropland.

Secondly, we examined periods of land-use transitions where forest has been converted to agriculture in order to investigate the effect of transition on ET. The loss of ET following land cover change was clear although the time until the new land cover's ET reflected that of a "stable" land cover was highly variable. Lastly, areas of forest gain were examined to assess ET of secondary forest and the length of time until recovery of this ecosystem service. This analysis showed that secondary forests take several years until ET reaches "stable" values but it does return to values within the range of those for primary forest. These results suggest that groundwater and land use changes interact in their effect on ET especially in the seasonality and the time to recover.