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Moisture sources of the Amazon carbon source

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Among the greatest threats to the global climate is the possibility that the Amazon rainforest, Earth's largest carbon stock, becomes a net carbon source. To estimate the Amazon's carbon budget, Gatti et al. (2021) performed 590 atmospheric vertical profiling measurements from four sites using aircraft over the course of eight years. They found that intact forests of the southeastern Amazon already act as a carbon source. This is likely related to decreased precipitation levels, stressing the importance of maintaining or enhancing precipitation levels in that region. The level and variability of precipitation partly depends on the land cover at the location where the moisture has evaporated. Forests in the Amazon enhance evapotranspiration, which significantly contributes to regional precipitation levels. This spatial connection between evapotranspiration and precipitation implies a causal link between forest cover at a certain location and the carbon budget at remote locations. To determine these evapotranspiration-precipitation connections, we use a high-resolution Lagrangian atmospheric moisture tracking model forced with ERA5 reanalysis data. We determine the seasonally changing spatial distributions of the moisture sources of different parts of the Amazon that have different carbon dynamics. We obtain land characteristics of these moisture-source areas to explore the potential of forest restoration for maintaining or regaining the carbon sink in the Amazon. We find that, on average, about one-third of the precipitation in the area identified as a carbon source originates as evaporation from land, the majority of which in this region itself. We find seasonality in the amount of moisture that is recycled within this region, peaking in the fourth quarter. The results indicate that deforestation in the southeastern Amazon may accelerate the carbon emissions from remaining intact parts of the Amazon. Further, they show where forest restoration may be prioritized to prevent these emissions.