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Dry seasons and dry years amplify the Amazon and Congo forests' rainfall self-reliance

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Rainfall is a key determinant of tropical rainforest resilience in South America and Africa, of which a substantial amount originates from terrestrial and forest evaporation through moisture recycling. Both continents face deforestation that reduces evaporation and thus dampens the water cycle, and climate change that increases the risk of water-stress induced forest loss. Hence, it is important to understand the influence of forest moisture supply for forest rainfall during dry periods. Here, we analyze mean-years and dry-years dry-season anomalies of moisture recycling in the South American (Amazon) and African rainforests (Congo) over the years 1980-2013. Annual average reliance of forest rainfall on their own moisture supply (ρ_{for}) is 26 % in the Amazon and 28% in the Congo forest. In dry seasons, this ratio increases by 7% (or ~2 percentage points) in the Amazon and up to 30 % (or ~8 percentage points) in Congo. Dry years further amplify dry season ρ_{for} in both regions by 4-5 %. In both Amazon and Congo, dry season amplification of ρ_{for} are strongest in regions with a high mean annual ρ_{for}. In the Amazon, forest rainfall self-reliance has declined over time, and in both Amazon and Congo, the fraction of forest evaporation that recycles as forest rainfall has declined over time. At country scale, dry season ρ_{for} can differ drastically from mean annual ρ_{for} (e.g., in Bolivia and Gabon, mean annual ρ_{for} is ~30% while dry season ρ_{for} is ~50 %). Dry period amplification of ρ_{for} illuminates additional risks of deforestation as well as opportunities from forest conservation and restoration, and is essential to consider for understanding upwind forest change impacts on downwind rainfall at both regional and national scales.