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Groundwater and the Amazon dry-season evapotranspiration

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In this work we test the hypothesis that groundwater is a key regulator of seasonal evapotranspiration (ET) in the Amazon, using a coupled groundwater-surface water model (LEAF-Hydro-Flood), forced with ERA-Interim reanalysis, at 2km grid and 4min steps over 11 years (2000-2010), and validated with available observations of streamflow, seasonal flooding, water table depth, soil moisture and ET fluxes. We find that, first, the water table can be <2m deep over >40% of the Amazon in the wet season and >20% in the dry season, sufficiently shallow to directly support vegetation. Second, the shallow water table effectively reduces wet-season soil drainage loss leading to larger soil water stores before the dry season arrives, giving the Amazon a strong start. Third, capillary rise from the water table can reach the root zone and maintain high ET rates in the peak dry-season. Fourth, the delayed and muted response to rainfall is a key mechanism whereby groundwater buffers dry-season surface stress; valley water table lags 1-2 months and terra-firme 3-4 months behind seasonal rain, causing groundwater to be the shallowest when the surface is dry. Fifth, this temporal delay also expresses itself as spatial patterns; continued soil drainage and hill-to-valley groundwater convergence keep moist valleys all year round and form a structured mosaic of wet-dry patches in the dry season, maintaining high ET in the lower parts of the Amazon landscape. Over the southeastern Amazon, large area averages of monthly ET differ by $\sim$1mm/day in July and August between two parallel simulations, one with and the other without the groundwater.