# Modeling leaf-phenology in Amazonia: impacts on carbon and water fluxes

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Contradictory results on the sensitivity of Amazon forests to drought exist, with observations of both green-up [1] and enhanced tree mortality [2] during the dry season. In addition, most of existing Dynamic Global Vegetation Models (DGVMs) assume simple or no phenology for tropical evergreen forests and fail to reproduce the observed seasonality of carbon fluxes [3]. To overcome these limitations, we have introduced a novel mechanistic description of tropical leaf-phenology in the ecohydrological model *Thetys & Chloris*, T&C [4]. The new model version accounts for the synchronization of leaf production with dry season litterfall and the effect of leaf quality and quantity on leaf photosynthetic capacity [5]. Model simulations are run for 32 sites in the Amazon basin over a 15-year period to disentangle the impacts of climatic variability and forest phenology on carbon/water fluxes in tropical South America. Simulation results reveal that leaf phenology explains the observed seasonality of carbon fluxes but the impact on evapotranspiration (ET) is limited (Figure 1) due to compensatory effects of canopy-atmosphere decoupling and leaf area index dynamics. Hence, while predictions by existing DGVMs potentially overestimate gross primary production (GPP), biases in simulated water/energy fluxes and forest response to drought are unlikely. Overall, our results provide a novel mechanistic description of tropical leaf-phenology, reconciling observations of dry season greening and water stress in Amazonia.

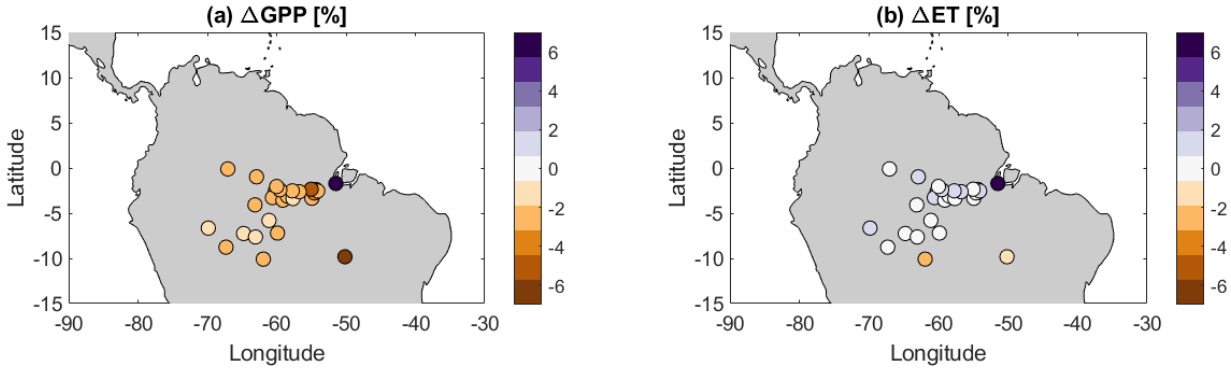


*Figure 1:* Phenology-induced changes in simulated (a) GPP and (b) ET at the 32 study sites. Changes in GPP are defined as $\Delta GPP=100*(GPP_{T\&C\ with\ phenology}- GPP_{T\&C})/ GPP_{T\&C}$, where $GPP_{T\&C}$ and $GPP_{T\&C\ with\ phenology}$ are the simulation results by the original and modified (i.e. with tropical leaf phenology) T&C model version. ΔET is calculated accordingly.

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