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Mortality as a key driver of the spatial distribution of aboveground biomass in Amazonian forests: results from a Dynamic Vegetation Model

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Dynamic Vegetation Models (DVMs) simulate energy, water and carbon fluxes between the ecosystem and the atmosphere, between the vegetation and the soil, and between plant organs. They also estimate the potential biomass of a forest in equilibrium having grown under a given climate and atmospheric CO2 level.
In this study, we evaluate the carbon stocks and fluxes simulated by the DVM ORCHIDEE across Amazonian forests, by comparing the simulation results to a large set of ground measurements (220 sites for biomass, 104 sites for wood productivity). Especially, we analyse the discrepancies in biomass with regards to discrepancies in wood productivity and those in the carbon lost through mortality.
We found that the simulated AGWB spatial distribution differs significantly from the observations, which is explained by two factors. First, wood productivity spatial variations with climate and nutrient availability are not well reproduced by the model. However, when we correct this first problem, the errors on the spatial variations in biomass become exacerbated. Thus, the key factor explaining the misrepresentation of biomass is the spatially constant annual rate of mortality.
It is then important to introduce a spatially variable rate of mortality. Previous studies showed that Amazonian forests with high productivity have a higher mortality rate than forests with lower productivity. We introduce this relationship by linking the rate of mortality to the wood productivity. This results in improved modelling of biomass spatial variations. We discuss the possibility of modifying the mortality modelling in ORCHIDEE, and the opportunity to improve forest productivity modelling through the integration of biomass measurements, in particular from remote sensing.