Frontiers special issue

Root dynamics: The Role of Nutrients, Water, and the Environment

**Title: Roots in tropical forests: Are soils more important than plant traits in vegetation models?**

**Authors:** Félicien Meunier, Marc Peaucelle, Wim Verbruggen, Hans Verbeeck

**Abstract:**

Drought stress is an increasing threat for plants in tropical forests, especially in the context of human-induced increase of drought frequency and severity as observed over the Amazon basin. In the global context of climate change, vegetation models are key tools to predict the future of tropical ecosystems as they allow simulating various range of future scenarios (climate, disturbance, etc.), and the corresponding response of the biome. Some model runs suggest a complete dieback of tropical forests or a rapid transition towards a Savannah-like ecosystem in the coming decades because of increasing drought frequency while others forecast an overall greenup due to CO2 fertilization and the ecosystem resilience. Part of the discrepancy between those outputs stem from the representation of soil hydraulics and plant below-ground processes that substantially differ between vegetation models. In addition, those models were mainly calibrated to represent aboveground dynamics of tropical forests whereas large uncertainties remain for soil properties at the regional level used. How sensitive vegetation models are to soil parameters and below-ground processes has been only sporadically addressed to this date, while it is critical to develop reliable model instances under increasing water demand and drought stress.

Here, we propose to compare the sensitivities of three state-of-the-art vegetation models, namely ORCHIDEE (big leaf), ED2 (cohort), and LPJ-GUESS (individual), to the variability in soil properties at the regional level over the Amazon. These three models differ in their representation of the rooting system and plant below-ground functioning. We show how the variability in growth primary productivity, evapotranspiration and experienced stress simulated by each model varies when changing soil properties in a representative range of values over the region.