# Coupling growth and mortality models to detect climate drivers of tropical forest dynamics

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Abstract

Climate models for the coming century predict rainfall reduction in the Amazonian region, including deep changes in water availability for tropical rainforests. Here, we develop an integrated modeling framework in order test the extent to which climate variables related to water regime, temperature and irradiance shape the long-term dynamics of neotropical forests. In a first step, a Bayesian hierarchical model was built to couple tree growth and tree mortality processes into a single modeling framework. Coupling a longitudinal growth model with a punctual mortality model was not an easy task. Past growth, related to the expected growth, was used as an indicator of the individual tree vigor, which is supposed to play a key role in the mortality process. A MCMC approach is used to estimate all the parameters simultaneously. The individual-centered model was explicitly designed to deal with diverse sources of uncertainty, including the complexity of the mortality process itself and the field data, especially historical data for which taxonomic determinations were uncertain. Functional traits are integrated as proxies of the ecological strategies of the trees and permit generalization among all species in the forest community. Data used to parameterize the model were collected at Paracou study site, a tropical rain forest in French Guiana, where 20,408 trees have been yearly censured over 18 years. Climate covariates were finally added as external drivers of the forest dynamics. These drivers are selected in a list of climate variables for which future predictions are available thanks to the IPCC scenario. Amongst climate variables, we highlight the predominant role of water availability in determining interannual variation in the dynamic of neotropical forests. And we stressed the need to include these relationships into forest simulators to test, *in silico*, the impact of different climate scenarios on the future dynamics of the rainforest.