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# Carbon fluxes in tropical forest ecosystems: the value of Eddy-covariance data for individual-based dynamic forest gap models

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The effects of climatic inter-annual fluctuations and human activities on the global carbon cycle are uncertain and currently a major issue in global vegetation models. Individual-based forest gap models, on the other hand, model vegetation structure and dynamics on a small spatial (<100 ha) and large temporal scale (>1000 years). They are well-established tools to reproduce successions of highly-diverse forest ecosystems and investigate disturbances as logging or fire events. However, the parameterizations of the relationships between short-term climate variability and forest model processes are often uncertain in these models (e.g. daily variable temperature and gross primary production (GPP)) and cannot be constrained from forest inventories.

We addressed this uncertainty and linked high-resolution Eddy-covariance (EC) data with an individual-based forest gap model. The forest model FORMIND was applied to three diverse tropical forest sites in the Amazonian rainforest. Species diversity was categorized into three plant functional types. The parametrizations for the steady-state of biomass and forest structure were calibrated and validated with different forest inventories. The parameterizations of relationships between short-term climate variability and forest model processes were evaluated with EC-data on a daily time step.

The validations of the steady-state showed that the forest model could reproduce biomass and forest structures from forest inventories. The daily estimations of carbon fluxes showed that the forest model reproduces GPP as observed by the EC-method. Daily fluctuations of GPP were clearly reflected as a response to daily climate variability. Ecosystem respiration remains a challenge on a daily time step due to a simplified soil respiration approach. In the long-term, however, the dynamic forest model is expected to estimate carbon budgets for highly-diverse tropical forests where EC-measurements are rare.