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Diversity, Adaptability and Ecosystem Resilience

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Our ability to predict climate change and anticipate its impacts depends on Earth System Models (ESMs) and their ability to account for the high number of interacting components of the Earth System and to gauge both their influence on the climate and the feedbacks they induce. The land carbon cycle is a component of ESMs that is still poorly constrained. Since the 1990s dynamic global vegetation models (DGVMs) have become the main tool through which we understand the interactions between plant ecosystems and the climate. While DGVMs have made it clear the impacts of climate change on vegetation could be dramatic, predicting the dieback of rainforests and massive carbon losses from various ecosystems, they are highly variable both in their composition and their predictions. Their treatment of plant diversity and competition in particular vary widely and are based on highly-simplified relationships that do not account for the multiple levels of diversity and adaptability found in real plant ecosystems. The aim of this GREENCYCLES II project is to extend an individual-based DGVM to treat the diversity of physiologies found in plant communities and evaluate their effect if any on the ecosystem's transient dynamics and resilience.

In the context of the InterSectoral Impacts Model Intercomparison Project (ISI-MIP), an initiative coordinated by a team at the Potsdam Institute for Climate Impact Research (PIK) that aims to provide fast-track global impact assessments for the IPCC's Fifth Assessment Report, we compare 6 vegetation models including 4 DGVMs under different climate change scenarios and analyse how the very different treatments of plant diversity and interactions from one model to the next affect the models' results. We then investigate a new, more mechanistic method of incorporating plant diversity into the DGVM "Hybrid" based on ecological tradeoffs mediated by plant traits and individual-based competition for light.