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Constraining modelled global vegetation dynamics with multiple satellite observations

Wouter Dorigo (1), Matthias Forkel (1), Nuno Carvalhais (2), Markus Drüke (3), Sibyll Schaphoff (3), and Kirsten Thonicke (3)

(1) TU Wien, Department of Geodesy and Geoinformation, Vienna, Austria (wouter.dorigo@tuwien.ac.at), (2) Max Planck Institute for Biogeochemistry, Jena, Germany, (3) Potsdam Institute for Climate Impact Research, Potsdam, Germany

The response of land ecosystems to future climate change is among the largest uncertainties in the climate/carbon cycle feedback. Dynamic global vegetation models (DGVMs) are a key tool to assess the impacts of climate change on vegetation distribution, biomass, and land carbon exchange. Carbon cycle uncertainties in DGVMs depend partly on the simulated distribution and temporal changes in vegetation cover and its interactions with photosynthesis, biomass allocation and turnover. The present-day availability of multiple satellite observations can potentially help to constrain DGVMs. Here we use satellite-derived datasets of the fraction of absorbed photosynthetic active radiation (FAPAR), sun-induced florescence (SIF), above-ground biomass of trees (AGB), land cover, and burned area to constrain phenology, productivity, and vegetation dynamic parameters in the LPJmL4 DGVM. Both the prior and the optimized model accurately reproduce present-day estimates of the land carbon cycle. However, the optimized model better reproduces observed spatial patterns of biomass and tree cover. The optimized model shows regionally-dependent increases and decreases in vegetation and ecosystem carbon turnover times. In summary, optimizations of dynamic global vegetation models against multiple satellite observation improve regional simulations of vegetation and carbon cycle dynamics.