Geophysical Research Abstracts
Vol. 18, EGU2016-8942, 2016
EGU General Assembly 2016

Carbon stock and carbon turnover in boreal and temperate forests – Integration of remote sensing data and global vegetation models

Martin Thurner (1), Christian Beer (1), Nuno Carvalhais (2,3), Matthias Forkel (4), Tim Tito Rademacher (5), Maurizio Santoro (6), Markus Tum (7), and Christiane Schmullius (8)

(1) Stockholm University and the Bolin Centre for Climate Research, Department of Environmental Science and Analytical Chemistry (ACES), Stockholm, Sweden (martin.thurner@aces.su.se), (2) Max Planck Institute for Biogeochemistry, Jena, Germany, (3) Universidade NOVA de Lisboa, CENSE, Departamento de Ciências e Engenharia do Ambiente, Faculdade de Ciências e Tecnologia, Caparica, Portugal, (4) Technische Universität Wien, Department of Geodesy and Geoinformation, Vienna, Austria, (5) University of Cambridge, Department of Geography, Cambridge, UK, (6) Gamma Remote Sensing, Gümligen, Switzerland, (7) German Aerospace Center (DLR), German Remote Sensing Data Center (DFD), Wessling, Germany, (8) Friedrich-Schiller-University, Institute of Geography, Earth Observation, Jena, Germany

Long-term vegetation dynamics are one of the key uncertainties of the carbon cycle. There are large differences in simulated vegetation carbon stocks and fluxes including productivity, respiration and carbon turnover between global vegetation models. Especially the implementation of climate-related mortality processes, for instance drought, fire, frost or insect effects, is often lacking or insufficient in current models and their importance at global scale is highly uncertain. These shortcomings have been due to the lack of spatially extensive information on vegetation carbon stocks, which cannot be provided by inventory data alone. Instead, we recently have been able to estimate northern boreal and temperate forest carbon stocks based on radar remote sensing data. Our spatially explicit product (0.01° resolution) shows strong agreement to inventory-based estimates at a regional scale and allows for a spatial evaluation of carbon stocks and dynamics simulated by global vegetation models. By combining this state-of-the-art biomass product and NPP datasets originating from remote sensing, we are able to study the relation between carbon turnover rate and a set of climate indices in northern boreal and temperate forests along spatial gradients. We observe an increasing turnover rate with colder winter temperatures and longer winters in boreal forests, suggesting frost damage and the trade-off between frost adaptation and growth being important mortality processes in this ecosystem. In contrast, turnover rate increases with climatic conditions favouring drought and insect outbreaks in temperate forests. Investigated global vegetation models from the Inter-Sectoral Impact Model Intercomparison Project (ISI-MIP), including HYBRID4, JeDi, JULES, LPJml, ORCHIDEE, SDGVM, and VISIT, are able to reproduce observation-based spatial climate – turnover rate relationships only to a limited extent. While most of the models compare relatively well in terms of NPP, simulated vegetation carbon stocks are severely biased compared to our biomass dataset. Current limitations lead to considerable uncertainties in the estimated vegetation carbon turnover, contributing substantially to the forest feedback to climate change. Our results are the basis for improving mortality concepts in models and estimating their impact on the land carbon balance.