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Future changes in terrestrial carbon fluxes over Northern Eurasia under uncertainty in 21st century climate change

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In this study, we investigate possible changes in terrestrial fluxes of carbon dioxide over Northern Eurasia in response to future climate change. Northern Eurasia is a major player in the global carbon budget because of boreal forests and peatlands. Circumpolar boreal forests alone contain more than five times the amount of carbon of temperate forests and almost double the amount of carbon of the world's tropical forests. In light of observed climate change in the region and future climate projections, it is important to quantify the possible impact of climate change on the carbon budget in the region.

A large ensemble of climate simulations of the 21st century carried out with the MIT Integrated Global System Model (IGSM) linked to the NCAR Community Atmosphere Model (CAM) is used to investigate future terrestrial carbon fluxes over Northern Eurasia. The IGSM-CAM is an integrated assessment modeling framework that couples a human activity model to an earth system model of intermediate complexity model. In the IGSM-CAM framework, multiple sources of uncertainty in regional climate projections can be considered and their contributions quantified: emissions projections, global climate system response to changes in greenhouse gases and aerosol concentrations and natural variability. The IGSM-CAM ensemble consists of: two emissions scenarios, a "business as usual" scenario and a 660 ppm of CO_2-equivalent stabilization (similar to the Representative Concentration Pathways RCP8.5 and RCP4.5 scenarios); three values of climate sensitivity (the median, and the 5th and 95th of the marginal posterior probability density function with uniform prior); and five different representations of natural variability. Finally, terrestrial fluxes of carbon dioxide are estimated using the MBL Terrestrial Ecosystem Model (TEM), a process-based ecosystem/biogeochemistry model. The results of this study provide new insight on the uncertainty in future terrestrial carbon fluxes over Northern Eurasia and the contributions of key sources of uncertainty in future climate change projections.