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21st century projections of terrestrial carbon fluxes over Northern Eurasia: the role of land legacy, future land use change and future climate change

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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 this study, we investigate possible changes in terrestrial fluxes of carbon dioxide over Northern Eurasia over the 21st century. We estimate the contributions of land legacy, future land use change and future climate change.

We present three sets of simulations of terrestrial fluxes of carbon dioxide over Northern Eurasia from 1500 to 2100 using the MBL Terrestrial Ecosystem Model (TEM), a process-based ecosystem/biogeochemistry model: (1) fixed land cover corresponding to year 2005; (2) historical land use land cover change from 1500 to 2005 and fixed land cover corresponding to year 2005 until 2100; (3) historical land use land cover change from 1500 to 2005 and RCP land use land cover change scenarios until 2100. Each set of simulations is forced by a large ensemble of climate simulations using the MIT IGSM-CAM model, which accounts for the uncertainty in projections of future climate change in order to obtain robust estimates of the contribution of land legacy, land use change and climate change. The climate ensemble consists of: two emissions scenarios, a "business as usual" unconstrained emissions scenario and a stabilization scenario, similar to, respectively, the RCP8.5 and RCP4.5 scenarios; three values of climate sensitivity (2.0°C, 2.5°C and 4.5°C corresponding to the 5th percentile, median, and 95th percentile of the marginal posterior probability density function with uniform prior) and associated net aerosol forcing chosen to best reproduce observed climate change; and five different representations of natural variability.

The results of this study provide new insight on projections of future terrestrial carbon fluxes over Northern Eurasia.