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Quantifying the role of Northern Eurasia in global CO_2, CH4, and water dynamics during the 21st Century

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The largest increase of surface air temperature and related climate extremes have occurred in Northern Eurasia in recent decades, and are projected to continue during the 21st century. The changing climate will affect biogeography, land cover and biogeochemical cycles in the region, which in turn, will affect how global land use evolves in the future as humans attempt to mitigate and adapt to climate change. Regional land-use changes, however, also depend on pressures imposed by the global economy and environmental changes. Feedbacks from future land-use change will further modify regional and global biogeochemistry and climate. This study uses a suite of linked biogeography, biogeochemical, economic, and climate models to explore how climate-induced vegetation shifts in Northern Eurasia will influence land-use change and carbon cycling across the globe during the 21st century. We find that, at the global scale, while more land will be allocated towards food and biofuel crops due to increasing population and associated economic development, the climate-induced vegetation shifts in Northern Eurasia also significantly affect global land use and result in a global cumulative carbon sink of about 63 Pg C under the policy scenario that limits CO_2-equivelent greenhouse gas concentrations to 480 ppmv by the end of the 21^{st} century. In comparison with the policy scenario, under a no-policy scenario where CO_2-equivelent greenhouse gas concentrations reach 870 ppmv by the end of 21^{st} century, the global cumulative carbon sink is 11 Pg C less mainly due to carbon lost from global grasslands. Cumulative evapotranspiration from global terrestrial ecosystems considering global land-use changes with vegetation shifts in northern Eurasia is 8.05 and 8.35 million km^3 for the policy and no-policy scenarios, respectively. In the presentation, we will also discuss our analysis on CH_4 emissions from northern Eurasia in response to the changes of land cover and climate during this century.