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The role of changing climate and biogeography in Northern Eurasia in the dynamics of land cover and land use and carbon cycling at the global scale during the 21st century

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In recent decades, the largest increase of surface air temperature and related climate extremes have occurred in northern Eurasia. This temperature increase and extreme climate change are projected to continue during the 21st century according to climate models. The changing climate is likely to affect land cover and the biogeochemical cycles in the region. These changes in biogeography and biogeochemistry, in turn, will affect how land use evolves in the future as humans attempt to mitigate and adapt to future climate change. Regional land-use changes, however, also depend on pressures imposed by the global economy. Feedbacks from future land-use change will further modify regional and global biogeochemistry and climate. Using a suite of linked biogeography, biogeochemical, economic, and climate models, we explore how climate-induced vegetation shifts in Northern Eurasia influences land-use change and carbon cycling across the globe during the 21st century. We find that, by the end of the 21st century, the vegetation shift due to climate is a more important factor than the climate itself in driving land use change in Northern Eurasia. While climate policy appears to have little influence on the cumulative release of about 20 Pg C from Northern Eurasia over the 21st century, the redistribution of global land use causes the global terrestrial biosphere to sequester less carbon (43 Pg C) with implementation of a climate policy than without a policy (65 Pg C). The vegetation shift in Northern Eurasia induced from changing climate and demands of global economic growth significantly affect both regional and global land use and decreases carbon sink activities at both regional and global scales.

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