



Protected Areas' Role in Climate-change Mitigation in Northern Eurasia

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In Northern Eurasia, about 2.0 million square kilometers of land are currently identified as protected areas, which provide society with many ecosystem services including climate-change mitigation. These areas represent about 13% of the protected areas identified across the globe. Combining a global database of protected areas, a reconstruction of global land-use history, and a terrestrial biogeochemistry model, we estimate that protected areas in Northern Eurasia currently sequester 0.05 Pg C annually, which is about one tenth of the carbon sequestered by all land ecosystems annually in this region (0.5 Pg C/yr) and also about one tenth of the carbon sequestered in all protected areas across the globe. Using an integrated earth systems model to generate climate and land-use scenarios for the 21st century, we project that rapid climate change, similar to high-end projections in the 5th Assessment Report of the Intergovernmental Panel on Climate Change, would cause the annual carbon sequestration rate in the protected areas of Northern Eurasia to increase to about 0.07 Pg C/yr by 2100. In contrast, the annual carbon sequestration rate for all protected areas across the globe drops to 0.3 Pg C/yr by the end of the 21st century. For the scenario with both rapid climate change and extensive land-use change driven by population and economic pressures so that development encroaches upon designated “protected areas”, we project that 0.6 million square kilometers of the protected areas in Northern Eurasia would be converted to other uses (10.7% of global protected area losses), and carbon sequestration in the remaining protected areas of Northern Eurasia would drop to 0.03 Pg C/yr by 2100. This small regional carbon sink is compensated by carbon losses in the remaining protected areas outside of the region so that overall no net carbon would be sequestered by global protected areas at the end of the 21st century if these areas are not truly protected.