

A Review of and Perspectives on Global Change Modeling for Northern Eurasia

*Erwan Monier¹, David Kicklighter², Andrei Sokolov¹, Qianlai Zhuang³, Irina Sokolik⁵, Richard Lawford⁶, Martin Kappas⁷, Sergey Paltsev¹, Pavel Groisman⁴

1. Massachusetts Institute of Technology, 2. Marine Biological Laboratory, 3. Purdue University, 4. National Oceanic and Atmospheric Administration, 5. Georgia Institute of Technology, 6. Morgan State University, 7. Georg-August-Universität Göttingen

Northern Eurasia is made up of a complex and diverse set of physical, ecological, climatic, and human systems, which provide important ecosystem services, including the storage of substantial stocks of carbon in its terrestrial ecosystems. At the same time, the region has experienced dramatic climate change, natural disturbances, and land management practices over the past century. For these reasons, Northern Eurasia represents both a critical region to understand and a complex system with substantial challenges for the modeling community. This review is designed to highlight the state of past and ongoing efforts of the research community to understand and model these environmental, socioeconomic, and climatic changes. We further aim to provide perspectives on the future direction of global change modeling to improve our understanding of the role of Northern Eurasia in the coupled human-Earth system. Major modeling efforts have shown that environmental and socioeconomic impacts in Northern Eurasia can have major implications for the biodiversity, ecosystems services, environmental sustainability, and carbon cycle of the region, and beyond. These impacts have the potential to feedback onto and alter the global Earth system. We find that past and ongoing studies have largely focused on specific components of Earth system dynamics and have not systematically examined their feedbacks to the global Earth system and to society. We identify the crucial role of Earth system models in advancing our understanding of feedbacks within the region and with the global system. We further argue for the need for Integrated Assessment Models (IAMs), a suite of models that couple human activity models to Earth system models, which are key to address many emerging issues that require a representation of the coupled human-Earth system.

Keywords: Global change, Northern Eurasia, Earth System Models, Coupled human-Earth system, Climate change, Ecosystems