Regional and Global Climate and Societal Impacts of Land-Use and Land-Cover Change in Northern Eurasia: A Synthesis Study Using Remote Sensing Data and An Integrated Global System Model

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Project duration: April 1, 2014 – March 31, 2017.

Project Summary: Under the auspices of the NASA Land-Cover and Land-Use Change (LCLUC) Program in the last decade or so, a significant amount of knowledge and data has been accumulated in the Northern Eurasian Earth Science Partnership Initiative (NEESPI) region. However, there have been very few efforts to take advantage of these major advancements in the region to investigate the feedbacks and effects of the regional LCLUC on the global climate and human society. Our previous research has coupled the human dimension of global socioeconomics and the dynamics of atmosphere, biosphere, cryosphere and hydrosphere within the MIT Integrated Global System Model (MIT IGSM) to assess the role of the NEESPI region in the global carbon cycle. Here we propose to take a further step to use the rich datasets, knowledge, collaborations, and predictive and analytical capabilities to improve our understanding of how the LCLUC, ecosystems and biogeochemical dynamics, climate, and humans have interacted in the region during the last three decades. Our improved understanding of established cause-effect relationships among these dynamics will be further incorporated into the IGSM to reveal potential data and knowledge gaps and to evaluate how future LCLUC will impact the global climate and socioeconomic systems. While our research focus is on the NEESPI domain, our model analysis will be conducted at the global scale. Our principal hypothesis is that the regional LCLUC has been mainly a function of natural processes (e.g., fire disturbance and permafrost degradation) and anthropogenic forcings (e.g., agricultural expansion or abandonment, peatland drainage, and timber harvesting). With the improved modeling capability, our overarching research questions will focus on evaluating: 1) changes in the regional LCLU due to both regional and global economic pressures for providing food, fiber and fuel to a growing population and intensified natural processes of fires and permafrost degradation; and 2) feedbacks of regional LCLUC to the earth system with respect to regional ecosystem and biogeochemical dynamics and the global climate and sociaeconomics during the 21st century. Our multidisciplinary US scientific team includes ecosystem scientists, biogeochemical modelers, climatologists, and economists, which will be reinforced by international collaborators from Russian Academy of Sciences. A series of workshops planned by the NEESPI program and our own two workshops in the first two years will strengthen the synthesis effort. We expect that the project will make a major contribution to the NASA LCLUC synthesis program and NEESPI's missions.