Qianlai Zhuang - Purdue University

Changes of Land Cover and Land Use and Greenhouse Gas Emissions in Northern Eurasia: Impacts on Human Adaptation and Quality of Life at Regional and Global Scales

Northern Eurasia accounts for about 20% of the Earth’s land surface and 60% of the terrestrial land cover north of 40°N. It contains 70% of the Earth's boreal forests and more than two-thirds of the Earth's land that is underlain by permafrost. The region is covered by vast areas of peatland, complex tundra in the north and semi-deserts and deserts in the south, including the Mongolia plateau. The surface air temperature has increased in the last half century and this increase will continue during this century. To date, studies have generally focused on analyzing climate change effects on biogeochemical processes and mechanisms governing the carbon and water dynamics in the region or potential changes in the distribution of natural vegetation. While we will also examine such issues, here we propose to investigate how patterns of land use in Northern Eurasia may change in the future due to: 1) Economic pressures for providing food, fiber and fuel to a growing global population; 2) Opportunities for expanding managed ecosystems into areas that experience a more favorable climate in the future; and 3) Abandonment of managed ecosystems in other areas that experience a less favorable climate. In our investigation, we will examine how these future changes in land use and land cover influence the exchange of CO2 and CH4 between terrestrial ecosystems and the atmosphere, terrestrial carbon storage and primary productivity, water supply and radiative forcing of the atmosphere through changes in surface albedo. We will also assess how human adaptation and quality of life may be impacted by these changes. To conduct this analysis, we will use a system of linked models that include the MIT Emissions Prediction and Policy Analysis (EPPA) model of the world economy, the SiBCliM bioclimatic vegetation model, and the Terrestrial Ecosystem Model (TEM). The land-cover/ land-use modeling and biogeochemical modeling will be based on current relationships observed by satellite and remote sensing data. Future climate change scenarios will be prescribed using existing spatially-explicit time-series data sets that have been developed with climate models using various IPCC SRES emission scenarios. Our multi-disciplinary US scientific team includes ecosystem scientists, biogeochemical modelers, and economists, which will be reinforced by international collaborators from Russian Academy of Sciences, International Institute of Applied Systems Analysis (IIASA) in Austria, National Institute for Environmental Studies in Japan, and Chinese Academy of Sciences.