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Assimilation of Tower and Satellite-Based Methane Observations for Improved Estimation of Methane Fluxes Over Northern Eurasia

Globally, wetlands are the largest natural source of methane to the atmosphere, and some 30 percent of global wetlands are in northern Eurasia. Methane is a strong greenhouse gas, but despite the importance of wetland methane emissions to the global carbon cycle, estimates of their contribution vary widely due in part to poor knowledge of the extent of wetlands and due to the paucity of direct measurements of wetland methane emissions. Methods of estimating methane fluxes over northern Eurasia that are based solely on in situ measurements are, therefore, subject to large errors.

This is a small proposal as specified in Section 1.4 of the Land Cover/Land Use Change element (A.4) of the NASA ROSES-2008 solicitation. In accordance with the call, the proposed research will be collaborative with the funded research project Estimation of CO2 and CH4 fluxes in Siberia using a tower observation network, of which of Drs. Toshinobu Machida and Shamil Maksyutov of the National Institute for Environmental Studies, Tsukuba, Japan (NIES) are co-PIs. The companion NIES project is funded by the Ministry of Environment, Japan, through its Global Environment Research Coordination System. In accordance with the NASA call, the NIES project is in its first or second year (funding period April 2007 through March 2012). The collaboration we propose here would link ongoing modeling work by the PI at the University of Washington that is intended to predict the spatial distribution of methane emissions over Eurasian Arctic lowlands from lakes and bogs with field work being conducted by Drs. Machida and Maksytov at NIES.

The overarching science question to be addressed by this proposal is: How do wetland methane emissions in western Siberia respond to environmental conditions over daily, seasonal, and interannual time scales, and over a range of spatial scales from flux tower footprints of roughly 1 km2 to the scale of the major Eurasian Arctic river basins? Subsidiary questions include: a) can western Siberia wetland methane emissions in be effectively monitored by a combination of models, flux towers, and remote sensing observations?; b) can the tower and/or satellite atmospheric methane concentration observations be used to constrain errors in or identify areas for improvements in models?; c) How much do SAR-based surface water products improve estimates of land surface methane emissions?; and d) can integration of satellite-based atmospheric methane concentrations with tower-based surface flux measurements via data assimilation methods lead to better understanding of the space-time distribution of methane emissions over northern Eurasia ?