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Reconstruction of inundation and greenhouse gas emissions from Siberian wetlands over the last half-century

T. J. Bohn[1]; E. Podest[2]; R. Schroeder[2]; K. C. McDonald[2]; C. Chiu[3]; L. C. Bowling[3]; M. Glagolev[4]; D. P. Lettenmaier[1]

1. Civil & Environmental Engineering, University of Washington, Seattle, WA, United States.
2. Water and Carbon Cycles Group, Jet Propulsion Laboratory/NASA, Pasadena, CA, United States.
3. Agronomy, Purdue University, West Lafayette, IN, United States.
4. Moscow State University, Moscow, Russian Federation.

Changes in greenhouse gas emissions such as methane (CH4) and carbon dioxide (CO2) from high-latitude wetlands in a warming climate may have important implications for projections of global warming, due to the large amounts of carbon stored in high-latitude soils and the high greenhouse warming potential of methane. As much as 1/3 of global natural methane emissions come from high latitudes. Efforts to monitor high-latitude greenhouse gas emissions are hampered by the sparseness of in situ data at high latitudes, especially in Northern Eurasia. While biogeochemical modeling can provide estimates of greenhouse gas emissions in such areas, the lack of in situ measurements also makes it difficult to constrain these models. Fortunately, emissions of greenhouse gases, especially methane, are sensitive to hydrologic variables such as inundation that now can be observed via passive microwave and synthetic aperture radar remote sensors. Here we apply a combination of large-scale hydrologic/biogeochemical models and remote sensing observations across the West Siberian lowlands to estimate soil moisture, inundation, and greenhouse gas fluxes. Our modeling framework consists of the Variable Infiltration Capacity macroscale hydrological model (VIC), extended to include carbon cycling and coupled to a methane emissions model. In particular, our modeling framework includes a parameterization of the spatial distribution of soil moisture, which allows us to compare our simulated emissions to both large-scale remote sensing observations and point-scale in-situ observations. We have calibrated this framework using observed streamflow, inundation products derived from PALSAR and AMSR-E, and in situ water table and greenhouse gas emissions observations. Using the calibrated model, we examine the interannual variability of simulated inundation and greenhouse gas emissions across W. Siberia for the period 1948-2007.

http://www.hydro.washington.edu/~tbohn/CARBON_NEESPI/index.html

Contact Information
Theodore J. Bohn, Seattle, Washington, USA, 98105-0000, click here to send an email