Geophysical Research Abstracts,
Vol. 11, EGU2009-13011, 2009
EGU General Assembly 2009

Soil Moisture, Inundation, and Methane Emissions from Siberian Wetlands from Models and Remote Sensing

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Estimation of methane emissions from high-latitude wetlands and changes that may occur in a warming climate have important implications for projections of global warming, due to the strength of methane as a greenhouse gas and the substantial fraction of global methane emissions that come from high latitudes. Efforts to monitor high-latitude methane emissions are hampered by the sparseness of in situ data at high latitudes, and in Northern Eurasia in particular. While biogeochemical modeling can provide estimates of methane emissions in such areas, the lack of in situ measurements also makes it difficult to calibrate and/or constrain these models. Remote sensing products based on synthetic aperture radar can be used for this purpose. We compare multi-temporal remotely-sensed estimates of saturated soil and inundation extent derived from the ALOS/PALSAR L-band sensor to simulations of these same quantities from our modeling framework, which consists of the Variable Infiltration Capacity macroscale hydrological model (VIC), extended to include carbon cycling and coupled to a methane emissions model. We focus on multi-temporal sequences over two growing seasons (2006 and 2007) for various locations in the West Siberian Lowlands. We explore the effects of model parameter uncertainty on the errors between simulations and remote sensing estimates, and on the magnitudes and distributions of simulated methane emissions. In addition, we examine the interannual variability of simulated inundation and methane emissions for the period 1948-2007.