CONTROL ID: 1500408

TITLE: The Role of Fractional Inundation and Saturation in the Carbon Cycle of West Siberian Peatlands

ABSTRACT BODY: Boreal and Arctic wetlands store immense amounts of carbon and vent this carbon to the atmosphere as the greenhouse gases carbon dioxide and methane. While it has long been known that these emissions are sensitive to soil moisture, and, further, that soil moisture conditions are heterogeneous at scales smaller than the grid cells used in global (and regional) climate models, few studies have examined the effects of fractional inundation and saturation on total carbon uptake and release at large scales. Here we use a large-scale hydrology model (Variable Infiltration Capacity; VIC), extended to represent carbon cycling and methane emissions, in conjunction with both remote sensing datasets (derived from AMSR-E, QuikSCAT, and PALSAR) and extensive in situ observations, to account for the time-varying areas and greenhouse gas emissions of inundated, uninundated but saturated, and unsaturated peatlands in the West Siberian Lowlands over the last 60 years. We also examine parameter uncertainty and the responses of these peatlands to possible end-of-century climate change. Emissions of both methane and carbon dioxide, as well as the distribution of peatland carbon storage, are found to depend on both fractional saturated area and soil temperature. Because microtopography exerts a strong control on the areal extents of inundated and saturated peatlands, and on the distribution of water table depth in the unsaturated peatlands, it is important to represent microtopographic effects at the large scale. Net carbon emissions are particularly sensitive to changes in growing season length, the magnitude and timing of snowmelt, and fractional saturation in the transitional months at either end of the growing season, due to the strong inhibition of aerobic respiration under saturated conditions. Therefore, more large-scale observations of saturated extent are needed to reduce uncertainties in simulated carbon fluxes.

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AUTHORS/INSTITUTIONS: T.J. Bohn, D.P. Lettenmaier, , University of Washington, Seattle, WA;
E. Podest, K.C. McDonald, , NASA/JPL, Pasadena, CA;
R. Schroeder, K.C. McDonald, , CCNY/CUNY, New York, NY;
N. Pinto, , University of Maryland, College Park, MD;
M. Glagolev, , Moscow State University, Moscow, RUSSIAN FEDERATION;
S. Maksyutov, , National Institute for Environmental Studies, Tsukuba, JAPAN;
M. Heimann, , Max Planck Institute for Biogeochemistry, Jena, GERMANY;

SPONSOR NAME: Theodore Bohn

CONTACT (E-MAIL ONLY): tbohn@hydro.washington.edu