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TITLE: Model Estimates of Pan-Arctic Lake and Wetland Methane Emissions

ABSTRACT BODY: Lakes and wetlands are important sources of the greenhouse gases CO2 and CH4, whose emission rates are sensitive to climate. The northern high latitudes, which are especially susceptible to climate change, contain about 50% of the world's lakes and wetlands. With the predicted changes in the regional climate for this area within the next century, there is concern about a possible positive feedback resulting from greenhouse gas emissions (especially of methane) from the region's wetlands and lakes. To study the climate response to emissions from northern hemisphere lakes and wetlands, we have coupled a large-scale hydrology and carbon cycling model (University of Washington's Variable Infiltration Capacity model; VIC) with the atmospheric chemistry and transport model (CTM) of Japan's National Institute for Environmental Studies and have applied this modelling framework over the Pan-Arctic region. In particular, the VIC model simulates the land surface hydrology and carbon cycling across a dynamic lake-wetland continuum. The model includes a distributed wetland water table that accounts for microtopography and simulates variations in inundated area that are calibrated to match a passive microwave based inundation product. Per-unit-area carbon uptake and methane emissions have been calibrated using extensive in situ observations. In this paper, the atmospheric methane concentrations from a coupled run of VIC and CTM are calibrated and verified for the Pan-Arctic region with satellite observations from Aqua's Atmospheric Infrared Sounder (AIRS) and Envisat's Scanning Imaging Absorption Spectrometer for Atmospheric Cartography (SCIAMACHY) instruments. We examine relative emissions from lakes and wetlands, as well as their net greenhouse warming potential, over the last half-century across the Pan-Arctic domain. We also assess relative uncertainties in emissions from each of the sources.

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