GC41C-0825: Assimilation of Tower and Satellite-Based Observations for Improved Estimation of Methane Fluxes over Northern Eurasia

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Changes in greenhouse gas emissions such as methane and carbon dioxide from high-latitude wetlands in a warming climate have important implications for 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 observations at high latitudes, especially in Northern Eurasia. One promising approach is to assimilate spatially sparse tower- and satellite-based observations into large-scale process-based models. In addition, because methane fluxes are sensitive to hydrologic variables such as inundation, passive microwave satellite observations of surface water can also be assimilated. Here we apply an ensemble Kalman smoother to assimilate in situ and satellite observations into our modeling framework, which consists of the Variable Infiltration Capacity (VIC) model, extended to include carbon cycling and coupled to a methane emissions model. This framework is, in turn, coupled to the atmospheric tracer model of Japan's National Institute for Environmental Studies (NIES) to estimate methane concentrations over the West Siberian Lowlands. Observations assimilated include methane concentrations at towers operated by NIES, total column methane concentrations observed by the JAXA GOSAT satellite, and the surface water product of NASA's Jet Propulsion Laboratory derived from AMSR-E and QuickScat observations. We compare the performance of assimilations using these different types of observations and explore how these observations constrain model parameters such as soil moisture content, water table depth distribution, and soil carbon content.