Revised methane emission estimate for West Siberia based on Landsat mapping of wetland types

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Quantifying boreal wetland extent and wetland methane emissions is important for estimating the amplitude of methane emission feedback to climate change and the relative contribution of natural and anthropogenic emissions at the national scale. Fine-scale heterogeneity of wetland landscapes and methane emission rates poses a serious challenge for producing regional-scale estimates of greenhouse gas fluxes based on point observations and wetland maps. In order to reduce emission uncertainties at the regional scale, we mapped wetlands and water bodies in the West Siberian lowland (WSL) using a supervised classification of Landsat imagery. Mapping was guided by training data composed of high-resolution images and field data collected at 41 test areas visited for observations of methane emissions with a static chamber method. The classification scheme suited for methane emission inventory included 7 wetland ecosystem types distinguishable on high resolution (1-2 m) images constituting 9 different wetland complexes distinguishable at the Landsat resolution. To support the use of 30 m Landsat images, fractional coverage of wetland ecosystems within each wetland complex type was estimated using high-resolution images. The total area of the WSL wetlands and water bodies was estimated to be 70.78 Mha. Various oligotrophic environments are dominant among wetland ecosystems, while different fens cover only 14% of the taiga area. In WSL, taiga contributes 85% to regional methane flux and tundra only 8%. Elevated environments as forested bogs and ridges emit at the lowest rates. They account for only 2% of the regional total emissions occupying almost 40% of the wetland area. Applying the new map resulted in total methane emissions of 4.6 TgCH4/yr which is higher than the earlier estimate based on paper maps, due to larger area fraction of mesotrophic open wetlands found in the middle taiga zone. The revision resulted from the changes in fractional coverages of methane emitting ecosystems due to the fill area coverage of the WSL with Landsat-based mapping.

Keywords: wetland mapping, Landsat, methane emissions, West Siberia

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