Geophysical Research Abstracts
Vol. 15, EGU2013-630, 2013
EGU General Assembly 2013

Wetland classification based on Landsat and its application for methane emission inventory of West Siberian taiga zone

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Quantification of the wetland methane emissions is complicated by large heterogeneity of the methane emission rates and wetland landscapes. Wetland mapping is important component for assessing the global methane emissions. West Siberia wetlands are the biggest wetland area in Eurasia, are situated in the high latitudes experiencing enhanced rate of climate change. A number of wetland, vegetation and peat maps of the West Siberia were developed in 1970s, but those are not easily applicable for methane emission mapping due to use of the generalized classifications which do not reflect heterogeneity of the landscapes at scales of less than 100 m. In this study, we developed a new wetland typology map based on Landsat imagery and applied it to scaling up the CH4 fluxes measured by a static chamber method. Taking into account relative abundance of different mire types a classification scheme oriented on methane emission estimates was developed. It is based on earlier classifications and consists of the simplest mire units or microlandscapes as the oligotrophic hollows, waterlogged hollows, forested bogs and ridges, fens (including poor fens and swamps) and wetland lakes. Taiga zone of West Siberia was chosen as a primary target for the land cover classification since its large wetland area. 68 Landsat scenes were classified. Totally, wetland area was estimated at 55.7 Mha that is slightly higher than the earlier estimate of 51.5 Mha (Romanova et al., 1977).

Methane emission rates vary strongly among the microlandscapes. While the highest amounts are emitted by waterlogged hollows followed by fens, the lowest rates are emitted by elevated landcover units such as forested bogs and ridges. According to our estimates they account for only 3% of the regional flux despite occupying almost 40% of the total wetland area. The oligotrophic and waterlogged hollows as parts of patterned bogs cover more than quarter of the mire territory accounting for almost half of the total CH4 emission. Lakes are widespread over taiga mire systems occupying 16% of the territory and contributing 15% of CH4 flux to the atmosphere. The rest of the territory is mainly occupied by fens, poor fens and swamps (13%) contributing 33% of the total CH4 flux. Applying the new map resulted in total methane emissions from taiga zone of 3.53 TgC/yr which is 87% higher than the former estimates by Glagolev et al. (2011). This considerable revision is caused by the changes in fractional coverages of methane emitting landscapes.

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