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Temporal variability of methane fluxes in West Siberian taiga bogs and its implications for estimating regional methane emission

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The West Siberia Lowland (WSL) is the biggest peatland area in Eurasia and is situated in the high latitudes experiencing enhanced rate of climate change. During 2015-16 summer periods, seasonal measurements of methane emission were made at the field station «Mukhrino» in the WSL middle taiga zone. The study was made at 3 wetland ecosystem types covering 80% of the taiga wetland area: i) waterlogged hollows or depressed areas with water level above the moss surface, ii) oligotrophic hollows or depressed parts of bogs with water level beneath the moss surface, iii) forested bogs with dwarf shrubs-sphagnum vegetation.

Seven series of measurements were made by a static chamber method in 2016 and four series – in 2015. In 2015, we observed non-typical weather conditions including early dry spring and short cold rainy summer. Oppositely, weather conditions in 2016 were closer to average long-term with warmer drier summer. Significant difference between these years allowed analyzing the temporal variability and its sources.

Average methane flux rates from forested bogs were 0.57 mgC4/m2/h in 2016 and 0.33 mgC4/m2/h in 2015. Seasonal dynamic during both years had similar concave downward shape. The highest fluxes were observed in June and were corresponded to the highest WTL, the main limiting factor of emission from forested bogs. The lowest fluxes in July were related to the low WTL combining with the highest temperature of upper methanotrophy layer.

Average methane flux rates from oligotrophic hollows were 7.18 mgC4/m2/h in 2016 and 4.28 mgC4/m2/h in 2015. Seasonal dynamic of methane emission was indistinct in 2015. On the contrary, in 2016 it had regular seasonal pattern with peak emissions in July, which were four times higher than in 2015. WTL was not the limiting factor for CH4 emission from oligotrophic hollows, because even in the driest ones it was only 10 cm below the surface. Thus, the difference between peak emissions in 2015 and 2016 was mainly related to the temperature, which was considerably higher in 2016.

Average methane flux rates from waterlogged hollows were 2.19 mgC4/m2/h in 2016 and 4.07 mgC4/m2/h in 2015. Seasonal dynamic had prominent shape in both years, however, peak emissions were observed in different months. Overall, patterns of emission in these ecosystems had more complicate nature and needs future investigations.

Regional methane emission was estimated using new wetland map by Terentieva et al. (2016). Seasonal dynamic data for 2015-16 years gave the regional flux of 161 and 1257 kt4/yr for forested bogs and oligotrophic hollows, respectively. Similar values were obtained using not seasonal dynamic but only flux medians for 2015-16 years. However, the usage of old dataset gave only 32 and 841 kt4/yr for forested bogs and oligotrophic hollows, respectively. Thus, seasonal dynamics data had lower impact on regional methane emission estimate comparing to interannual variability data.

Terentieva, I.E., Glagolev, M.V., Lapshina, E.D., Sabrekov, A.F., Maksyutov, S. Mapping of West Siberian taiga wetland complexes using Landsat imagery: implications for methane emissions // Biogeosciences. 2016. V. 13. № 16. P. 4615-4626.