Highly Dynamic Methane Emission from the West Siberian Boreal Floodplains

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Methane production from riparian wetlands may cause significant CH4 emissions to the atmosphere. However, seasonal floodplains of many high-latitude rivers are still not represented in studies on methane emissions. A major river in West Siberia is Ob River; it is one of the longest rivers in the world. Despite its potential importance, field observations of the CH4 fluxes in that domain were mainly focused on peatlands and lakes. The present study is a first attempt to estimate variability of methane fluxes from West Siberian boreal floodplains. Results of the study can be used for further data upscaling, especially in combination with floodplain area data.
Methane emission measurements were made by static chamber method during 2015-16 summer periods. Test sites were located at the Ob River floodplain near Khanty-Mansiysk city, Russia, as well as within smaller floodplains in taiga zone.
Flux medians varied in two orders of magnitude from zero to 17.5 mgC/m^2/h. Aiming at further upscaling, we managed such heterogeneity by classifying studied environments with following criteria: i) floodplain width (small or large), ii) microrelief (elevated or depressed), iii) inundation during the measurements («wet» or «dry»). Within this framework, several classes were found to be similar in CH_4 emission rates: i) «wet» and «dry» depressions of large floodplains had highest fluxes of 4.21 mgC/m^2/h with interquartile range (IQR) of 5.17 mgC/m^2/h, ii) «wet» elevations within large floodplains and all small «wet» floodplains had lower flux median of 1.47 mgC/m^2/h with IQR of 2.99 mgC/m^2/h, iii) «dry» elevations within large floodplains and all small «dry» floodplains had the lowest median of 0.07 mgC/m^2/h with IQR of 0.26 mgC/m^2/h.
This observations highlight high variability of emission, which is most evident in depressions within large floodplains, where a few rare but large emission events can contribute significantly to the total emission rates. It was also found that there were only slight difference between emissions from «wet» and «dry» depressions. It can be related to the presence of constant overwetting due to close position of underground waters or water accumulation after precipitation periods.
Besides the common variability of methane fluxes, we also observed «hot moments» of methane emission. In particular, time-series measurements at Ob floodplain revealed sudden peak in emissions just after the main water subsiding (comparing to the fluxes during the flooding period). Results also indicated gradual decreasing of emissions and its dispersion from 5.89 mgC/m^2/h to 3.51 mgC/m^2/h during two weeks of soil drying. We hypothesize that gas bubbles were initially accumulated in soil during the inundated period when the gas diffusion rate was limited and hydrostatic pressure was high. Such accumulation was confirmed by dissolved CH4 concentration measurements in sediments revealing 10 times higher CH4 concentration in comparison with the water column. We suggested that further methane release could be triggered by abrupt hydrostatic pressure decrease induced by water drawdown. Since the threshold concentration of dissolved methane correlates with the water column depth, water level drop might lead to gas generation from the solution and the enlargement of the volume of the gas phase with further

ebullition.
As the next step, we need systematic measurements of methane fluxes and their combining with floodplain mapping for further data upscaling.

Keywords: welands, methane, greenhouse gasses, arctic, Siberia

