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Quantification of the total methane emission from valley artificial reservoir – combination of measurements and process-based modelling

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In a context of global warming an important objective is an estimation of green-house gases fluxes into the atmosphere from different sources. Methane is a crucial green-house gas in the atmosphere with specific global warming potential 28 times larger than that of carbon dioxide. Our research is focused on estimation of methane emission from artificial Mozhaysk valley reservoir, located in Russia, Moscow region. The main goal of the study is to quantify the methane emission by two approaches – measuring the fluxes in situ on the reservoir and modelling the methane emission by 1D hydrodynamic and biogeochemical model. Combination of these methods provides more reliable result compared to using them separately. We expect, that firstly tested on Mozhaysk reservoir this approach can be applied to other artificial reservoirs, which is especially important for estimating carbon footprint of hydro energetics. The measurements on Mozhaysk reservoir have been carried since 2015. The patterns of spatial-temporal variability of methane flux are demonstrated. The highest values of methane emission during open-water period are typically observed in the end of summer, at the initiation of autumnal convective mixing. In this period, methane flux into the atmosphere can reach 350 – 390 mgC-CH_4*m^{-2}*d^{-1}. High values of methane flux, up to 400 mgC-CH_4*m^{-2}*d^{-1}, were observed after the storm events. As to spatial flux distribution, the highest values of methane emission were observed in the middle part of the reservoir and in shallow areas inhabited by macrophytes plants. The 1D hydrodynamic and biogeochemical model LAKE simulated high variability of methane flux into the atmosphere in the annual cycle. According to modeling results, the main pathway of methane into the atmosphere is ebullition, constituting more than 95% in total methane evasion into the atmosphere. The highest values of CH_4 flux according to model results take place in the beginning of spring period, after the ice-off, and during the mixing events. Modelling results for methane emission demonstrate satisfactory agreement to in situ measurements – the average annual methane emission during 5 years is 430 tons of C-CH_4 per year according to observation, and 380

tons of C-CH_4 per year in model simulations.

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