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Supersaturation and evasion of carbon dioxide in surface waters of small palsa catchment in Western Siberia

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Northern ecosystems are important components of the global carbon cycle. Nowadays we are observing climate changes in the Arctic that are connected with natural and anthropogenic processes. These processes affect ecosystems, changing their biogeochemical cycles, hydrological regime, structure and functioning. As a result, permafrost degradation occurs and runoff changes.
Changes in the quantity and quality of dissolved carbon, which comes from terrestrial ecosystems, have an impact on the carbon balance in the wetlands, as well as influence the carbon balance of the entire catchment. Nowadays we have a restricted understanding of the biogeochemical processes and relationship between terrestrial ecosystems, wetlands and the atmosphere in northern regions of Russia. Therefore we cannot model changes in the chemical composition of surface waters and carbon fluxes.
The main aim of this study is to quantify carbon dioxide exchange between terrestrial and aquatic ecosystems a case of study from the wetland complex of Western Siberia. The study area is located in the North of Western Siberia, in the discontinuous permafrost zone: at the northern boundary of the northern taiga subzone. The main objects: palsa bogs, water-filled ditch-like hollows and thermokarst lakes.
Concentration of CO_2 in waters was directly measured using the “headspace equilibration” method. The essence of the method is to balance the water sample with atmospheric air. Then, the concentration of CO_2 in the syringe and in the atmospheric air was measured, and by complex calculations [Halbedel, 2015], the concentration of dissolved carbon dioxide was determined. Gaseous losses from the water surface to the atmosphere (evasion) were determined using the direct floating chamber method. It involves gas emission measurements in the restricted volume of the chamber during a specific time interval. A portable gas analyzer was used for CO_2 concentration measurements [Bobrik, 2018].
Concentration of dissolved CO_2 (pCO_2) varies from 153.1 ppm to 1163.2 ppm in lakes. In palsa bogs CO_2 (pCO_2) was from 4009.4 ppm to 220322.0 ppm, in water-filled ditch-like hollowsvaries from 12013.2ppm to 241142.9 ppm.
Thus, lakes can be sink or small source of carbon dioxide. Palsa bogs are significant sources of carbon, as evidenced by direct evasion data, which is 85.5±25.3mg/m2/hr on the average. These data are comparable with the CO_2 emission values from the soil surface of permafrost peatlands 94.0±47.9mg/m2/hr on the average. Water-filled ditch-like hollows also are sources of carbon dioxide.

References:
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