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Carbon budget of oligotrophic mires in the Southern Taiga of Western Siberia under anthropogenic impact

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Role of peatlands in the global greenhouse gases budget is highly relevant. According to present estimates peatlands in undisturbed conditions act as a sink for the atmospheric carbon. Anthropogenic impact on peatlands (melioration, changes in land use, influence of underground water catchments) results in water table lowering, changing in vegetation cover, and degradation of peat deposit. Peatlands could provide a significant positive feedback for climate changes if warming and peatlands drying stimulates bulk soil organic matter decomposition which enhances CO2 release to the atmosphere. Western Siberian peatlands usually represented big bog massifs. Big peatlands have higher stability to external influence. Small peatlands have all signs of big bogs but react on changes in environmental variables more quickly.

The present study is devoted to investigation of primary carbon fluxes (CO2 emission and net primary productivity) and carbon balance at oligotrophic bogs in native condition (key area "Bakchar") and under anthropogenic impact (key area "Ob'-Tom'"). The key area "Bakchar" is located between the Iksa and Bakchar rivers (56o58'N 82o36'E) at the Bakcharskoe bog (area 1400 km2). The key area "Ob'-Tom'"is located in the northern part of Ob' and Tom' interfluve (56o21'N 82o31'E). The "Bakchar" key area includes the following ecosystems: pine–shrub–sphagnum community, a similar community with stunted (low) pine trees, and sedge–sphagnum fen. Two small peatlands were studied at Ob' and Tom' interfluve. Kirsanovskoe bog includes pine– shrub–sphagnum community and sedge fen. Timiryazevskoe bog was represented by pine– shrub–sphagnum (TPSS) community and sedge fen.

An infrared gas analyzer OPTOGAS 500.4 (OPTEC Corp., St.-Petersburg, Russia) attached to a static opaque plastic been used for carbon dioxide emission measurements. The net primary productivity was measured by clipping method (Golovatskaya and Dyukarev, Plant Soil 2009).

Peatlands at "Ob'-Tom'" key area are under impact of water catchments for Tomsk city supply. Changes in deep waters results in changes of hydrological regime and environment transformations. Water level drawdown leads to increase of aerobic layer thickness, intensification of plant remains decomposition, peat layers compacting and rises of CO2 emission from the surface. Carbon dioxide emission from bogs of "Ob'-Tom'" key area is about two times higher than emission from pristine bogs ("Bakchar" key area).

Aboveground net primary productivity determined without tree layer at all studied peatlands has similar values. Belowground net primary productivity at "Ob'-Tom'" key area if 4-7 times higher than at "Bakchar" key area depending on the ecosystem type. An essential increase in root density after water level depletion results in increase on total net productivity by 2.4 times. Carbon budget for pristine peatlands ("Bakchar" key area) varies from 27 (open fen) to 46 (low ryam) gC/m2/yr. Peatlands of "Ob'-Tom'" key area accumulates about 210 gC/m2/yr in average. Our observations of the elements of carbon exchange have shown that at present all studied peatlands act as carbon sinks. Long-term water table lowering at least at first stage stipulates carbon removing from the atmosphere and accumulation in a form of peat.

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