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Carbon sequestration by subarctic peatlands of Western Siberian peatland ecosystems and responses to climate warming

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Western Siberian plain (57-67 ^{o}N, between Ural Mountains and Yenessei River) comprises the largest wetland complexes of the Northern hemisphere and because, in general, wetlands produce the greenhouse gas methane this area is supposed to form a substantial positive feedback to climate warming. The wetlands of Western Siberian plain include pristine peatlands (mires) and paludified forests spread over 3 Taiga zones and the Forest Tundra. Depending on the definition of peatland estimations the peatland surface area vary from 0.6 10^6 km^2 to 10^6 km^2 of which 15-20% is located in areas with (discontinuous) permafrost.

In 6 sites measurements have been performed in main mire types of above and below ground net primary production, plant and peat decompositions rates, moss growth and peat accumulation rates, fluxes of carbon dioxide (CO_2) and methane (CH_4).

From net primary production (NPP) measurements the mire ecosystems roughly render 150-500 $gCm^{-2}y^{-1}$, increasing from a key site in FT zone at 66^{o}N to a key area in the Southern Taiga (ST) at 56^{o}N. Variability between mire types was 10-35%, highest in the north. These data indicate that carbon sequestration by plant assimilation is substantial.

The measured CO_2 fluxes (chambers) were much lower than NPP. In general the assimilation and respiration fluxes as well as the methane fluxes increases from Northern to Southern sites. The carbon balances by mire type varied substantially. Calculated carbon budgets, where losses by run off were included, were 30-70 $gCm^{-2}y^{-1}$. These data are in the order of the carbon accumulation in peat-layers as calculated from ^{14}C dated core samples. The differences between NPP and carbon balance from gas flux are most probably explained by internal recycling of CO_2 freed by decomposition of dead organic matter and peat. Negative methane fluxes over sphagnum mosses of raised bogs point at uptake of methane.

By climate warming a part of the permafrost may disappear resulting in a northbound shift of vegetation-climate zones. Methane fluxes will rise because of decomposition of freshly thawed peat and possibly by additional fluxes from under ice trapped methane. By new settlement of mire vegetations carbon dioxide sequestration rate will rise. Excepting a latitude shift of one vegetation-climatic zone at a mean temperature change of 2 ^{o}C the actual CH4 flux from W-Siberian peatland of 2.4 10^{12} gCy^{-1} increases with 63% and the net CO_2 (uptake) flux of –15.6 10^{12} gCy^{-1} with 30%. By dynamic modeling of the radiative forcing of these flux changes a positive feedback on climate change was predicted for the 21^{st} century and thereafter turn into strong negative feedback.