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Methane production and oxidation patterns along a hydrological gradient in Luther Bog, Ontario

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Methane emissions from natural peatlands contribute significantly to the global budget of atmospheric CH_4. In the northern hemisphere, where climate models predict rising temperatures and precipitation rates, these emissions are likely to rise. So far, little is known about the change of processes of methane production and oxidation, which influence the total amount of methane emissions, in peatland soils under warmer and wetter climate conditions. Our work focuses on anaerobic CH_4 production and aerobic CH_4 oxidation processes along a hydrological gradient in an ombotrophic bog in Ontario, Canada that was induced by creation of a reservoir in 1952. Along this transect, four sites were established differing in hydrologic conditions and vegetation patterns. We examined depth profiles of CO_2 and CH_4 concentrations and delta ^{13}C isotope ratios in the peat using silicon samplers, dialysis chambers and multi-level piezometers. Chamber flux measurements were used to determine carbon fluxes. Isotope mass balances were calculated based on ^{13}C isotope ratios and concentration profiles. By this approach the contribution of anaerobic CH_4 and CO_2 production to the total ER flux and the amount of oxidised CH_4 can be determined. In addition meteorological data, soil temperatures, moisture and water table levels were recorded. By raising data at different sites and dates and with the help of the additionally recorded parameters, we will be able to make predictions about changing CH_4 production and oxidation processes due to changing climate conditions. Preliminary results show that CH_4 concentrations in the soil profile are higher at the sites which are exposed to stronger water table fluctuations, whereas CO_2 concentration levels are lower at these sites. At all sites, CO_2 concentrations in the peat are increasing but CH_4 profiles are fairly stable. Moreover, isotopic signatures of $^{13}CH_4$ indicate that the importance of the production pathway changes with depth from acetoclastic to hydrogenotrophic methanogenesis. We argue that CH_4 production as well as CH_4 transport accelerate and that the proportion of CH_4 oxidized in the aerobic zone decreases with long-term wetter conditions.