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Summer fluxes of methane and carbon dioxide from a pond and floating mat in a continental Canadian peatland

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Ponds smaller than 10000 m2 likely account for about one third of the global lake perimeter. The release of methane (CH4) and carbon dioxide (CO_2) from these ponds is often high and significant on the landscape scale. We measured CO_2 and CH4 fluxes in a temperate peatland in southern Ontario, Canada, in summer 2014 along a transect from the open water of a small pond (847 m2) towards the surrounding floating mat (5993 m2) and in a peatland reference area. We used a high-frequency closed chamber technique and distinguished between diffusive and ebullitive CH4 fluxes. CH4 fluxes and CH4 bubble frequency increased from a median of 0.14 (0.00 to 0.43) mmol m$-$2 h^{-1} and 4 events m$-$2 h^{-1} on the open water to a median of 0.80 (0.20 to 14.97) mmol m$-$2 h^{-1} and 168 events m$-$2 h^{-1} on the floating mat. The mat was a summer hot spot of CH4 emissions. Fluxes were one order of magnitude higher than at an adjacent peatland site. During daytime the pond was a net source of CO_2 equivalents to the atmosphere amounting to 0.13 ($-$0.02 to 1.06) g CO_2 equivalents m$-$2 h^{-1}, whereas the adjacent peatland site acted as a sink of $-$0.78 ($^{-1}$.54 to 0.29) g CO_2 equivalents m$-$2 h^{-1}. The photosynthetic CO_2 uptake on the floating mat did not counterbalance the high CH4 emissions, which turned the floating mat into a strong net source of 0.21 ($-$0.11 to 2.12) g CO_2 equivalents m$-$2 h^{-1}. This study highlights the large small-scale variability of CH4 fluxes and CH4 bubble frequency at the peatland-pond interface and the importance of the often large ecotone areas surrounding small ponds as a source of greenhouse gases to the atmosphere.