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 (CO₂) from these ponds is often high and significant on the landscape scale. We measured CO₂ 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 CO₂ equivalents to the atmosphere amounting to 0.13 (−0.02 to 1.06) g CO₂ equivalents m⁻² h⁻¹, whereas the adjacent peatland site acted as a sink of −0.78 (−1.54 to 0.29) g CO₂ equivalents m⁻² h⁻¹. The photosynthetic CO₂ 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 CO₂ 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.