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# Diffusive methane flux from lakes has a distinct within-lake spatial distribution

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Methane ($CH_4$) is an important greenhouse gas and lakes, while understudied, are known to contribute significantly to natural $CH_4$ emissions. As such, lakes play a key role in the greenhouse gas budget of the landscape they lie in and reliable estimates of the total greenhouse gas emissions of lakes are necessary to incorporate lakes into the terrestrial greenhouse gas balance. Data on lake $CH_4$ emissions are limited, however, and whole-lake methane flux estimates inevitably depend on extrapolations of single or few measurements on a lake, and are in the case of diffusive flux often estimated based on measurements of wind-speed and surface water $CH_4$ concentrations. Hence, there is a clear need to improve our understanding of the spatial and temporal dynamics of these emissions.

In the study we present here, we assessed the within-lake spatial variability of diffusive methane flux from 13 lakes in Northern and Western Europe using the floating chamber approach. We obtained a spatially resolved (4 stations along a transect) measure of diffusive $CH_4$ flux and the main components of diffusive flux, $k$ (piston velocity) and $C_{aq}$ (surface water $CH_4$ concentrations). These measurements were done in late summer and represent a period of approximately six hours (between ca. 10:00 and 16:00). Our results show a distinct within-lake spatial variability. Most notably, we found that diffusive $CH_4$ fluxes and $k$values were significantly (2 to 3 times) higher in the central parts of the lakes than in the near-shore zones. In contrast, $C_{aq}$ tended to be lower in the central zones. We conclude that estimates of whole-lake diffusive $CH_4$ flux based on extrapolations of single point measurements of diffusive flux and $C_{aq}$ and/or wind speed-derived $k$ values may lead to considerable errors.