Methane emissions from lakes in the Alpine region: insights from two years of mobile eddy covariance flux measurements

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Lakes are considered an important natural source of methane (CH₄). However, direct measurements of lake-atmosphere gas exchange are still sparse especially in the Alpine region. To overcome this shortcoming, we designed a mobile eddy covariance (EC) station to measure CO₂, CH₄, and energy fluxes at various lakes in the Alps. EC measurements were compared to flux measurements using floating chambers and related to abiotic and biotic factors like temperature, lake morphometry, dissolved components and trophic status.

During the first year, measurements were conducted at 9 lakes at different elevations ranging from 200 to 1900 m.a.s.l. to capture the spatial variability. The following year, measurements were repeated more frequently at three contrasting lakes to capture the seasonal trends of the fluxes.

The results indicate that all lakes were supersaturated with CH₄. However, there was a high variability in the magnitude of CH₄ emissions between lakes with generally higher emissions from warmer lakes at low elevation. In particular, the lake at the lowest elevation, Lake Caldaro, had highest dissolved CH₄ concentrations and emissions and showed a clear seasonal trend with emissions peaking during the hot summer months. In contrast, the lake at the highest elevation, Lake Zoccolo, showed low CH₄ concentrations and emissions with highest concentrations in fall when the water level was low.