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Determining methane fluxes from a Swedish lake (Tämnaren).

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Previous studies show that lakes can act as a major source of methane (CH4) to the atmosphere. CH4 is produced in the anoxic sediments in lakes and is transported to the atmosphere with different pathways: ebullition, vegetation, diffusion and storage flux. Previous estimations suggest that, the less frequently studied, ebullition and vegetation flux dominate the total CH4 flux.

CH4 fluxes from lakes can be directly measured with floating chambers (FC) or with the micrometeorological Eddy covariance (EC) method. FC's are cheap and easy to work with, but they only characterize a flux from a small enclosed area. In comparison, when using the EC method expensive and power consuming instrumentation are needed, but the results will give a continuous flux, measured over a large upwind area called the flux footprint. An indirect method that is also frequently used for flux estimations is a form of the bulk flux (BF) equation, where the dissolved CH4 in the water has to be measured. However the BF will only estimate the diffusive and storage flux.

In this study we made a comparison between the FC's and the EC method at Lake Tämnaren in central Sweden during summer and autumn of 2011. Additionally continuous measurements of dissolved CH4 in the water were made during a ten day period in the spring of 2011.
The results of the comparison indicate that on occasions when the EC method measures small fluxes and wind speeds are low, the FC's will measure higher fluxes compared to the EC method. This could indicate that the FC's create an artificial turbulence during low wind speeds that enhance the flux.

The EC results show a daily cycle of CH4, which was not captured during the one occasion with nighttime measurements with FC's. However this still has to be verified with more nighttime FC measurements.

Results from the continuous dissolved CH4 measurement show that the water has higher partial pressure of CH4 compared to the atmosphere, and that there is an indication of a decrease of dissolved CH4 for this time period. This decrease was found to be correlated with water temperature increase. A possible explanation could be that higher temperature will lead to more photosynthesize, which will increase the oxygen in the water and in turn more CH4 will be oxidized. With the BF equation the CH4 flux can be estimated from the dissolved CH4 measurements.