Geophysical Research Abstracts
Vol. 19, EGU2017-14870, 2017
EGU General Assembly 2017


# Spatial and temporal variability of greenhouse gas emissions from a small and shallow temperate lake

Leandra Praetzel, Marcel Schmiedeskamp, Tanja Broder, Caroline Hüttemann, Laura Jansen, Ulrike Metzelder, Ronya Wallis, Klaus-Holger Knorr, and Christian Blodau

University of Münster, Institute of Landscape Ecology, Research Group Ecohydrology and Biogeochemistry, Germany (leandra.praetzel@uni-muenster.de)

Small inland waters ($< 1$ km$^2$) have recently been discovered as significant sources and sinks in the global carbon cycle because they cover larger areas than previously assumed and exhibit a higher metabolic activity than larger lakes. They are further expected to be susceptible to changing climate conditions.

So far, little is known about the spatial and temporal variability of carbon dioxide ($CO_2$) and methane ($CH_4$) emissions and in-lake dynamics of $CH_4$ production and oxidation in small, epilimnetic lakes in the temperate zone. Of particular interest is the potential occurrence of “hot spots” and “hot moments” that could contribute significantly to total emissions.

To address this knowledge gap, we determined $CO_2$ and $CH_4$ emissions and dynamics to identify their controlling environmental factors in a polymictic small (1.4 ha) and shallow (max. depth approx. 1.5 m) crater lake (“Windsborn”) in the Eifel uplands in south-west Germany. As Lake Windsborn has a small catchment area (8 ha) and no surficial inflows, it serves well as a model system for the identification of factors and processes controlling emissions.

In 2015, 2016 and 2017 we measured $CO_2$ and $CH_4$ gas fluxes with different techniques across the sediment/water and water/atmosphere interface. Atmospheric exchange was measured using mini-chambers equipped with $CO_2$ sensors and with an infra-red greenhouse gas analyzer for high temporal resolution flux measurements. Ebullition of $CH_4$ was quantified with funnel traps. Sediment properties were examined using pore-water peepers. All measurements were carried out along a transect covering both littoral and central parts of the lake. Moreover, a weather station on a floating platform in the center of the lake recorded meteorological data as well as $CO_2$ concentration in different depths of the water column.

So far, Lake Windsborn seems to be a source for both $CO_2$ and $CH_4$ on an annual scale. $CO_2$ emissions generally increased from spring to summer. Even though $CO_2$ uptake could be observed during some periods in spring and fall, $CO_2$ emissions in the summer exceeded the uptake. $CO_2$ and $CH_4$ emissions also appeared to be spatially variable between littoral areas and the inner lake. Shallow areas turned out to be “hot spots” of $CO_2$ emissions whereas $CH_4$ emissions were - against our expectations - highest in the center of the lake. Moreover, $CH_4$ ebullition contributed substantially to total $CH_4$ emissions.

Our results show the importance of spatially and temporally highly resolved long-term measurements of greenhouse gas emissions and of potential controlling factors to address diurnal, seasonal and inter-annual variability as well as possible feedbacks to climate change.