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Methane emissions from alpine lakes - the ALCH4 project

Katharina Scholz (1), Franco Miglietta (2), Ruben Sommaruga (1), Giustino Tonon (3), and Georg Wohlfahrt (1)

(1) University of Innsbruck, Institute of Ecology, Biology. Innsbruck, Austria, (2) FoxLab Forest & Wood Science, Fondazione E.Mach. San Michele all'Adige (Trento), Italy, (3) Free University of Bozen-Bolzano, Faculty of Science and Technology. Bozen, Italy

Methane (CH_4) is a very potent greenhouse gas which plays a crucial role in the earth's climate. Presently, wetlands are considered the most important natural CH_4 source while freshwater ecosystems are generally neglected in global CH_4 budgets. However, recent research indicates that freshwater ecosystems receive as much carbon as the oceans and that lakes and rivers should be considered active contributors to the global carbon cycle rather than 'neutral pipes'. Because of their anoxic and highly reductive conditions, lakes may be strong but so far overlooked CH_4-emitters. Direct measurements of CH_4 fluxes from lakes and rivers are sparse and mainly concentrated to boreal or tropical regions. For the alpine region, a preliminary study indicates that lakes are oversaturated with CH_4 but direct flux measurements are lacking. The aim of the ALCH4 project is to directly quantify CH_4 fluxes from various lakes and reservoirs at different elevations in North and South Tyrol and the Trentino using the eddy covariance (EC) method. For this, a mobile EC station will be used, which consists of an aluminum boat equipped with sensors to monitor the CH_4 (and CO_2) concentrations, the three wind components, and the speed and 3D orientation of the boat at very high frequency (10-20 Hz). Additional parameters like air and water temperature, relative humidity and radiation will also be recorded. Measurements will also be accompanied by and compared to chamber and funnel measurements. Currently, the equipment and the analysis method are tested and adjusted and measurements will begin in spring 2018. Within the framework of ALCH4 the following hypotheses will be tested:

1. CH_4 emissions of similar lakes will decrease with increasing elevation because of lower temperatures and a positive correlation between CH_4 production by microorganisms and temperature.
2. More productive lakes or lakes with a larger and/or more productive catchment will have higher CH_4 emissions.
3. Shallow lakes will have higher CH_4 emissions because the distance from the sediment to the surface, along which CH_4 can be oxidized, is shorter. Reservoirs in the Alps are often built in narrow and steep valleys. Therefore, reservoirs can be expected to have lower CH_4 emissions compared to shallower natural lakes at similar elevations.
4. CH_4 emissions will vary temporally with expected relative maxima during ice-out, overturning or lake stratification, and might also be influenced by weather conditions.