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How to choose methods for lake greenhouse gas flux measurements?

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Lake greenhouse gas (GHG) fluxes are increasingly recognized as important for lake ecosystems as well as for large scale carbon and GHG budgets. However, many of our flux estimates are uncertain and it can be discussed if the presently available data is representative for the systems studied or not. Data are also very limited for some important flux pathways. Hence, many ongoing efforts try to better constrain fluxes and understand flux regulation.

A fundamental challenge towards improved knowledge and when starting new studies is what methods to choose. A variety of approaches to measure aquatic GHG exchange is used and data from different methods and methodological approaches have often been treated as equally valid to create large datasets for extrapolations and syntheses. However, data from different approaches may cover different flux pathways or spatio-temporal domains and are thus not always comparable. Method inter-comparisons and critical method evaluations addressing these issues are rare.

Emerging efforts to organize systematic multi-lake monitoring networks for GHG fluxes leads to method choices that may set the foundation for decades of data generation and therefore require fundamental evaluation of different approaches. The method choices do not only regard the equipment but also for example consideration of overall measurement design and field approaches, relevant spatial and temporal resolution for different flux components, and accessory variables to measure. In addition, consideration of how to design monitoring approaches being affordable, suitable for widespread (global) use, and comparable across regions is needed.

Inspired by discussions with Prof. Dr. Cristian Blodau during the EGU General Assembly 2016, this presentation aims to (1) illustrate fundamental pros and cons for a number of common methods, (2) show how common methodological approaches originally adapted for other environments can be improved for lake flux measurements, (3) suggest how consideration of spatio-temporal dimensions of flux variability can lead to more optimized approaches, and (4) highlight possibilities of efficient ways forward including low-cost technologies that has potential for world-wide use.