Eddy Covariance measurements over a pre-alpine lake

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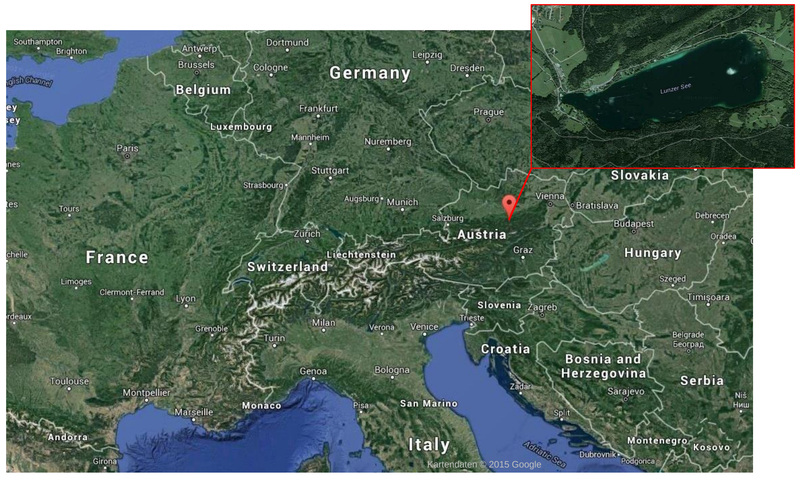
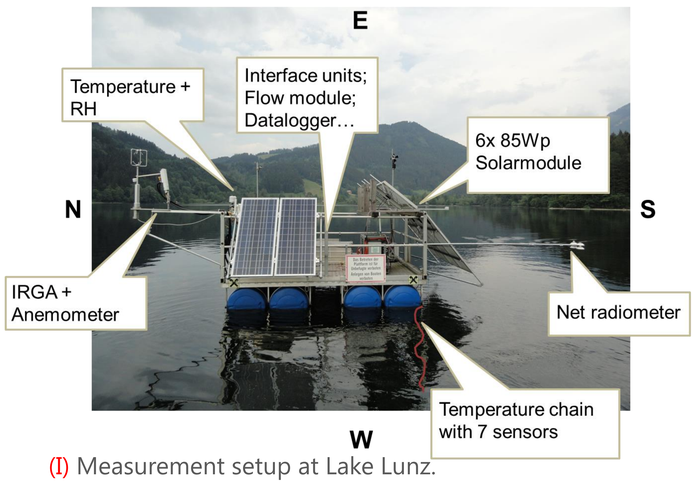
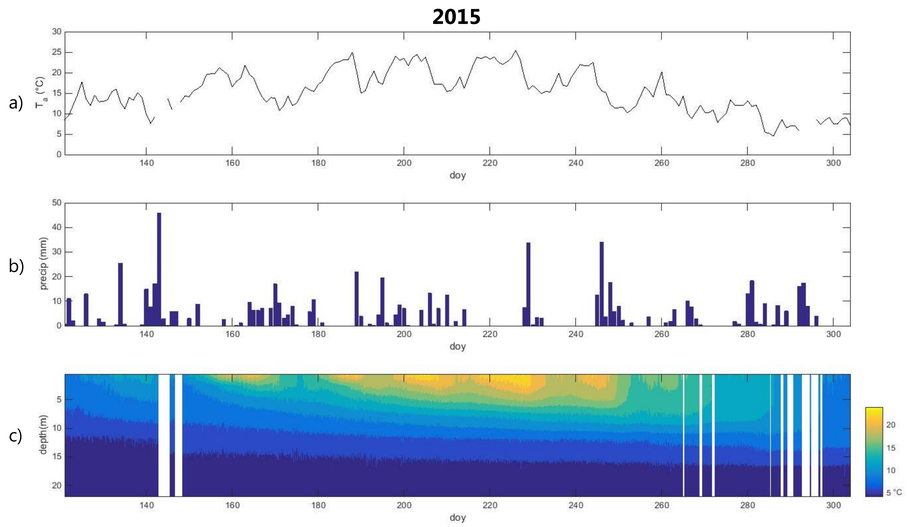


Background: Recent research indicates that inland waters are significant contributors to the global carbon cycle. However, up to now, long-term direct measurements of carbon dioxide (CO_2) and methane (CH_4) fluxes above freshwater ecosystems are sparse and the knowledge on the magnitude of the fluxes and the involved processes needs to be improved.

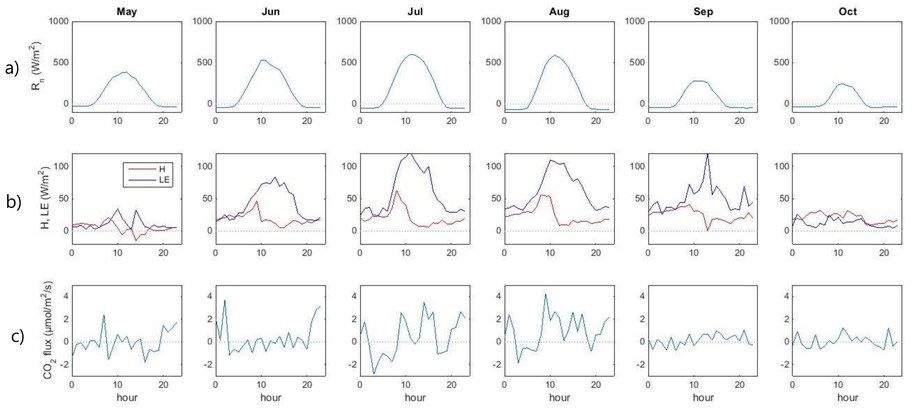
Here, we use the eddy covariance method for year-round monitoring of CO_2-, sensible and latent heat fluxes above Lake Lunz (I), a small pre-alpine lake in lower Austria. During the ice free period, also the water temperature profile was measured with 7 sensors at 0.5 m, 2.5 m, 5 m, 8 m, 12 m, 17 m and 22.5 m depth with high temporal resolution.



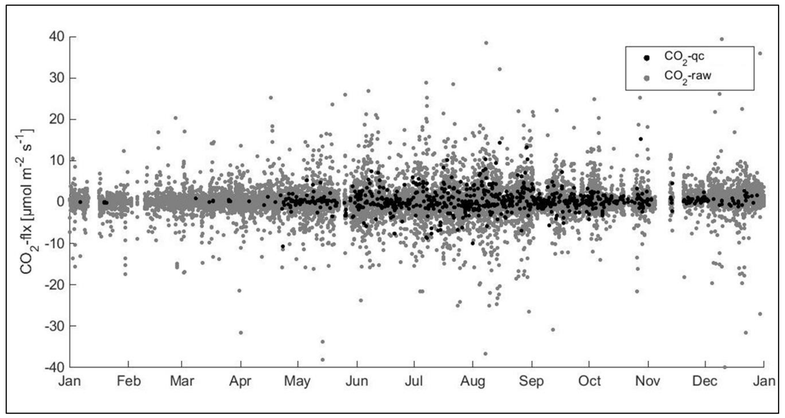
(I) Measurement setup at Lake Lunz.



(II) a) Mean daily air temperature, b) precipitation and c) water temperature profile of Lake Lunz.



(III) Monthly mean daily variation of a) net radiation, b) sensible and latent heat flux and c) CO_2 flux.



(IV) Measured CO_2 flux before (grey dots) and after (black dots) quality control.

Results: The water temperature profile shows an increase of the surface temperature in line with the increase of air temperature during summer (II). The precipitation data indicates a cooling of the surface water temperature during/subsequent to rain events.

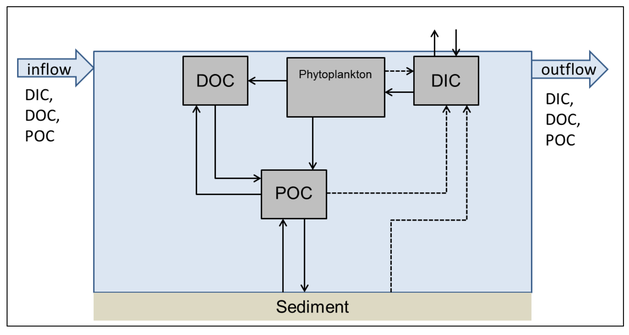
The monthly mean amplitudes of the sensible (H) and latent (LE) heat flux follow the seasonal course of net radiation and were highest during the summer month (July, August), with a clear peak of H in the early morning hours (III).

After extensive quality control, about 10 % of the CO_2-flux data remain. The average measured flux over the entire year 2015 was about 0.35 gC m^{-2} d^{-1} (IV) and did not show a clear diurnal pattern (III c).

Our results suggest that Lake Lunz acts as a small source of CO_2.

Outlook: This study is part of a cooperation project with the overarching aim to study possible effects of past, present and future hydrological extremes on carbon fluxes at catchment scale. The results presented here are part of the first step: to establish the complete carbon balance of a pre-alpine lake by measuring the most important carbon fluxes in the lake-stream continuum.

Future work includes combining the measured carbon fluxes, linking them to precipitation and discharge data of the lake catchment and to develop a simple process-based model (V) to analyze implications of future hydrological extremes.



(V) Exemplary representation of lake carbon model.

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