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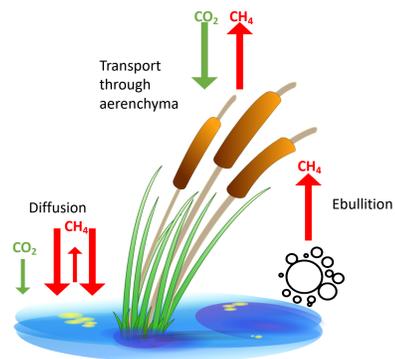
How Relevant are Alpine Freshwater Ecosystems for the Global Methane Budget?



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1. Overview

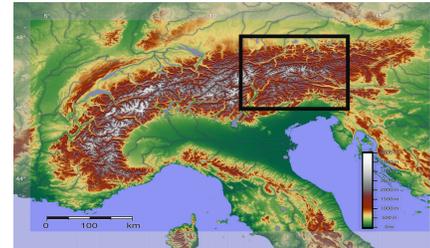
- Lakes are a sink of CO₂ but at the same time they can be an important source of methane (Bastviken et al. 2011, Holgerson and Raymond 2016, Sanches et al. 2019, Saunois et al. 2019). There is need for reducing uncertainties of our estimates. In doing this, all the pathways need to be considered.
- The main objective of this study is to improve data availability and quality about methane emissions from lakes in regions particularly sensitive to an increasing climatic variability like the Alpine region.



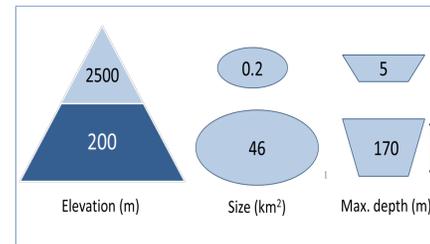
- We made use of an innovative mobile eddy covariance system. We installed the instruments on a small boat and performed measurements while cruising. Meteorological and bio-physical data got recorded simultaneously.
- We made use of chambers and dissolved gasses approaches for validation.
- We visited several natural and man-made lakes across a transect of two degrees of latitude across the Alps across the ice-free season during the years 2018 and 2019.

2. Approach

a. Area of Interest (AOI)



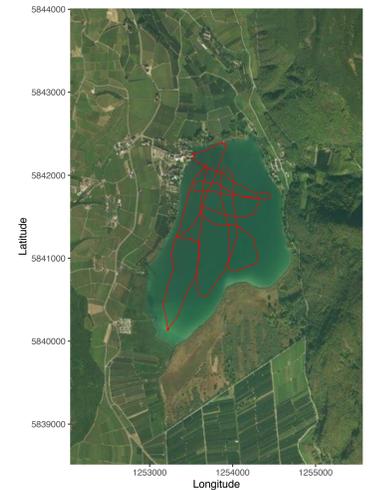
b. Morphological properties of lakes in the AOI



c. The platform with installed instruments

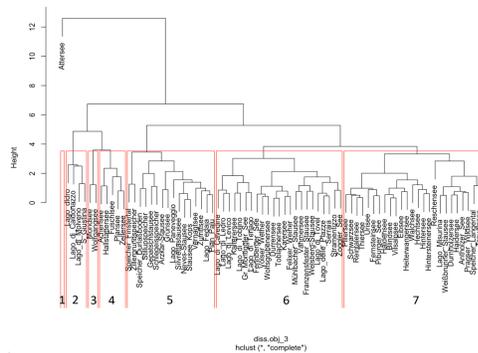


d. Example of a sampling cruise (Kalterer See)

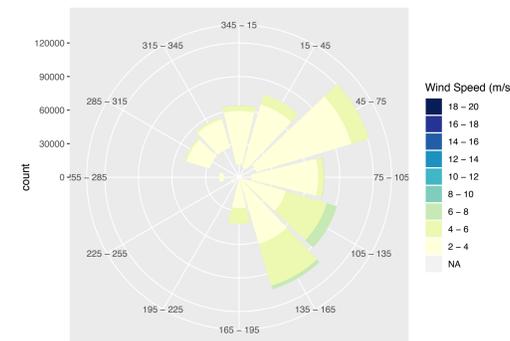


3. Results

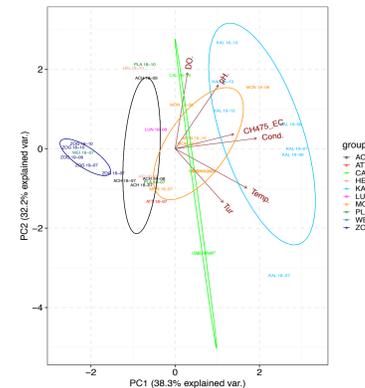
a. Clustering of geo-morphological parameters for sampling design



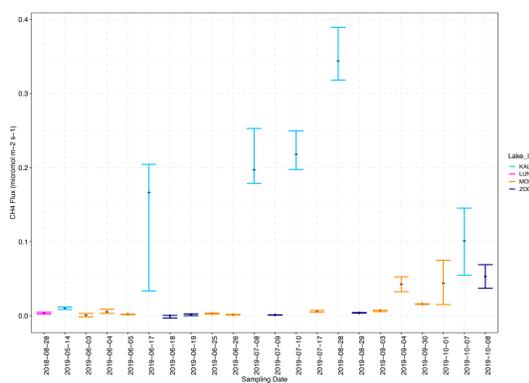
b. Corrected wind speed and direction during a sampling cruise



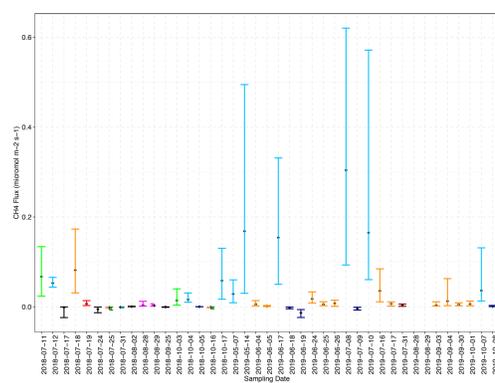
c. PCA of main predictors for high fluxes



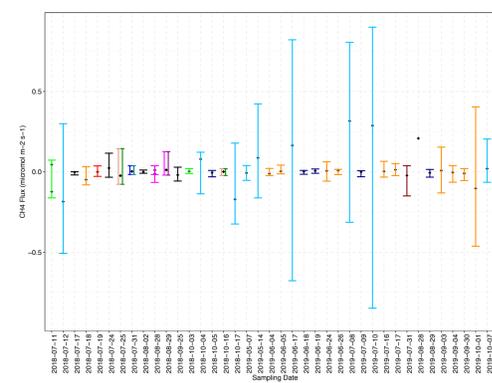
d. Fluxes and uncertainties from chamber sampling



e. Fluxes and uncertainties from dissolved gases sampling



f. Fluxes and uncertainties from eddy covariance



4. Conclusions

- Even lakes at high elevation are supersaturated with CH₄.
- Measurements across a latitudinal range of lakes show a trend towards higher CH₄ emissions from warm lakes at low elevation.
- The main predictors are dissolved oxygen, pH, conductivity, temperature and turbidity.
- Kalterer See - a shallow, small lake in the southern part of the AOI – showed the highest CH₄ concentrations/fluxes.
- The temporal variability of mobile eddy covariance measurements is consistent with other established methods.
- The spatial variability of CH₄ fluxes is caught by means of mobile eddy covariance measurements and needs to be analyzed with ancillary data.



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Bastviken, D. et al. 2011. "Freshwater Methane Emissions Offset the Continental Carbon Sink". Science 331(6013): 50–50
 Holgerson, M.A., and Raymond P.A. 2016. "Large Contribution to Inland Water CO₂ and CH₄ Emissions from Very Small Ponds". Nature Geoscience 9(3): 222–26
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 Saunois, M., et al. „The Global Methane Budget 2000–2017“. Earth Syst. Sci. Data Discuss., in review, 2019



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