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Replies to referees and editors (May 13, 2025)

Dear Jean Dumoulin, dear anonymous referees,

We thank you kindly for your constructive criticism. Below, you find the latest conversation with our replies (italics). With uploading this letter comes the updated manuscript with the stated changes.

Public justification (visible to the public if the article is accepted and published):

This paper presents a "ground-based" light and autonomous automated monitoring system for lake and reservoir management. The instrumented platform is clearly described and documented. Example of results obtained during a Brazilian experimental field campaign are completing the presentation of this autonomous aquatic instrumentation system. Few additional information would be appreciated to better illustrate the performances reached in term of navigation and CO_2 measurements.

We thank the referees and our handling editor Jean Dumoulin explicitly for their constructive and encouraging comments. The remaining open questions regarding navigation performance (accuracy) and CO_2 determinations have been taken care of.

Additional private note (visible to authors and reviewers only):

I first want to thank authors for their interesting paper addressing "ground based" autonomous floating robot instrumented system for in-situ monitoring of water lake and reservoir in good and harsh conditions. Concerning your autonomous navigation system versus in action planned navigation campaign:

Thank you for your positive feedback. Your remaining questions have been taken care of in the revised manuscript. In addition, we quickly respond here.

Did you make reproducibility test on a lake close to your laboratory? If yes, please add results obtained during such campaign? If, no I would like to recommend to add in your paper an overview of results obtained for the 6 Brazilian lakes experimental campaign. It will give a better overview of actual performances of your present system and may pave the way to possible enhancement.

Yes, we did. Prior to the platform being taken to Brazil, we first tested ist development stages on a pond next to the institute and subsequently on ten different large reservoirs and pit lakes with different trophic levels – already in the context of another research project. In respect to results, we add a quote to one of our recent related publications (Röder E, Matschullat J, Rau A, Lau MP. 2024. Carbon dioxide emissions from temperate reservoirs and pit lakes of different trophic states. Inland Waters 1–45. doi 10.1080/20442041.2024.2388339).

Why not using an additional local ground based station for your GNSS to work in differential mode ?

An RTK solution is possible with two options: i) a physical reference station locally installed or ii) receiving data from an existing one in Brazil via the Internet. Option i): Here, we would have to add a radio link to connect the station and robot. Related to the context – the limited height of both systems' antennas and firm water surface damping effects – this is a challenging task. Option ii): This solution would always require an internet connection, likely unavailable in many scenarios.

In line with our approach to reducing complexity, we chose not to rely on an RTK reference station. Our focus was on developing a robust and self-contained system that performs reliably without depending on external infrastructure. The selected components are widely available and can be sourced in many countries worldwide during a campaign, ensuring operational flexibility and maintainability in diverse environments.

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Concerning CO_2 measurements: Please give at least results comparison between in-situ measurements and laboratory measurements made on samples acquired on one lake. It should contribute to the underline vision of having less precision measurement with very dense spatial coverage combined with high precision measurements in few locations for data analysis and models.

Generally speaking, each lake basin is an individual water body with different basin morphology, different trophic boundary conditions, etc. In addition, each basin is at least somewhat differentiated in itself. This means that there is no one gas respiration response for any basin. Depending on the scientific interest, one might set up a water-based eddy-covariance station to determine the respiration response over a larger lake water surface (e.g., Spank et al. 2023. Mobile eddy covariance measurements as a key to improve estimates of momentum, mass and energy fluxes between atmosphere and inland waters. PPNW 2023 Workshop on Physical Processes in Natural Waters, Brescia, Italy, 19.-23.06.2023; p 51-52). However that is very costly and makes sense only for longer-term monitoring purposes. If only shorter term and determinations that do not depend on air mass movement are wanted, then an aquatic robotic platform-based solution is superior and more economic Land-based eddy covariance towers are inadequate in this context, as they inevitably record mixed signals from both terrestrial and aquatic surfaces.

Current satellite-based methods lack sufficient spatial resolution to provide reliable signals. gas flux measurements. While other airborne techniques may address these spatial limitations, they generally involve substantially higher costs.

The following figure illustrates general observations comparing in-situ (on lake) CO_2-measurements with laboratory CO_2-determinations based on the gas samples collected concurrently with the on-board quantification using the Vaisala sensor.

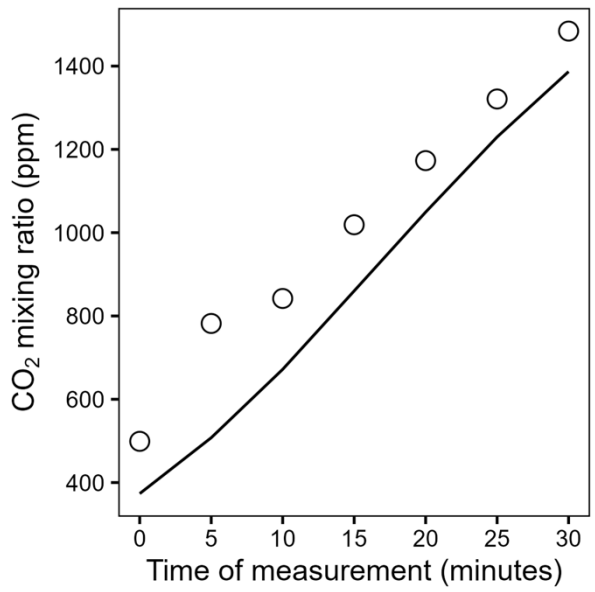

Figure 1 *Comparison of in situ measurement (Vaisala sensor, solid line) and gas sampling (gas chromatography, open circles) for an example CO_2 time series*

As the figure shows, the Vaisala sensor tends to deliver systematically lower mixing ratios as compared to the gas-chromatographic determination of the gas sampled obtained in parallel. This does not affect the flux calculation however, since the curves show rather similar behavior. We generally use the results from both methods in analyzing and interpreting the data.

Looking forward to see our work made available to a wider audience, we are glad that our work found appreciation.

Sincerely and for all authors and co-authors

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