



Open Sea-02: A degassing chamber to monitor the dissolved CO₂

Type of the project

Semester project

Laboratory

Smart Environmental Sensing in Extreme Environnements – SENSE

Professor

Professor Jérôme Chappelaz

Supervisor

Professor Jérôme Chappelaz

Contact person at Sailowtech

Alexandre Tellier, Bénédicte Lunven

Student

To be determined

Context

Sailowtech is an association and a MAKE project that aims to raise awareness of environmental issues, particularly those relating to aquatic environments. It promotes frugal and participative field science, open-source science, and low-tech approach. To achieve this, Sailowtech organizes scientific sailing expeditions in lakes, seas, and oceans to discover field science, test the protocols and devices build by students during the semester.

Understanding the dissolution of greenhouse gases in the ocean is crucial because it directly influences ocean acidity, which has profound implications for marine ecosystems and biodiversity. Additionally, the ocean serves as a significant carbon sink, playing a key role in regulating Earth's climate by mitigating the impact of excess atmospheric greenhouse gases.

Although common in-situ measurement methods of dissolved greenhouse gases exists for a while, there is no standard open source design proposed to implement it. The idea of this project is to take advantage of simpler sensors that measure the concentration of CO₂ in the gas phase, by developing a device that allows liquid samples to be transferred **from the liquid to the gas phase**. Such equipment would be affordable and portable, enabling its use in sailing expeditions such as those organized by Sailowtech.

Description of the project

The open SeaO2 is a device for measuring the flow of CO₂ between the atmosphere and the ocean. It has been designed in the low-tech philosophy, i.e. to be open-source, sustainable, useful and low-cost.

The aim of this semester's project is to finalize version 1 of this instrument, based on feedback from the Arvor expedition, and then to characterize its performance in the laboratory. The finalization of the instrument will require changes to its various connectors, certain mechanical parts (modification of 3D printed or CNC machined parts, such as the degassing chamber plug to improve sealing) as well as an overhaul of the computer program which declines the taking of measurements.

System characterization consists of validating in the laboratory that the instrument fulfills its function (measuring the partial pressure of dissolved CO₂) and with what performance (response time, measurement range, potential bias or hysteresis, etc.), by comparing the system with a reference probe and different solutions. This would probably be done on the lÉXplore platform near Pully.

The profile sought is that of an autonomous, proactive student, interested initially in prototyping work, then in calibration and measurement in the laboratory.

This project has been set up in partnership with Prof. Jérôme Chappellaz's SENSE laboratory. **The student will have to travel to Sion for the characterization phase once the prototype is complete; the lab will pay for the transport.** The other stages of the project can be carried out on the EPFL campus in Lausanne.



Indicative calendar

Sem1&2 : Meet J.Chappellaz and Alexandre Tellier who built the first prototype.

Sem 3: Get to know the project and the various modifications to finalize the system

Sem 4: Order all the parts needed for the modifications

Sem 5&6: Start doing the modifications



Sem 7: Intermediate presentation with Sailowtech

Sem 8&9&10: finish the modifications

Sem 11&12&13: start the calibration and characterization

Sem 14: Final presentation with Sailowtech

Summer 2025 : Possible participation in the sailing expedition of Sailowtech

Deliverables

1. A functioning and, if time allows it, calibrated degassing chamber that can be used on a future Sailowtech cruise ideally for summer 2025.
2. An oral presentation at the end and in the middle of the semester to present the results of the project.
3. A document explaining the changes made to the device to make it reproducible as well as presenting the characterization results.
4. Complete the Sailowtech's Github that we will use as documentation

Documentation

As a starting point, you can find the documentation to our present Sea-O2 version on: <https://kdrive.infomaniak.com/app/drive/1213921/shared-with-me/1213921/9546/preview/pdf/9621>

Planned interaction with Sailowtech

The objective of this project is to develop a device that can be used during a Sailowtech cruise or instruments tests campaign. Consequently, there will be several meetings with Sailowtech (approximately seven per semester, or as required) to monitor progress. Furthermore, the relevant technical staff at Sailowtech will be available for advice and assistance.

Finally, you will be counted as a member of Sailowtech, and will therefore be able to take part in the various activities and potentially test the device during one of our expeditions.

Contact

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