

Workshops Summary

Morning Workshops

Camille Minaudo

Title: High-Resolution GHG Flux Measurements in Aquatic Systems

Description: This workshop will provide training on the collection and processing of high-resolution in situ incubation time series for estimating greenhouse gas (GHG) fluxes using portable gas analysers (e.g., Picarro, Li-Cor) and the *goFlux* R package.

The session will include a brief overview of the theoretical basis of flux estimation with chamber incubations, followed by a practical introduction to *goFlux*, including its extension for aquatic ecosystems. If conditions permit, a short field session to the shore of Lake Banyoles will be conducted to collect example time series. Participants will then process the data and compare results in a guided discussion, highlighting variability arising from methodological choices and underscoring the need for harmonised and reproducible workflows.

Resources:

Rheault, K., J. R. Christiansen, and K. S. Larsen. 2024. goFlux: A user-friendly way to calculate GHG fluxes yourself, regardless of user experience. *Journal of Open Source Software* 9: 6393. doi:10.21105/joss.06393

Minaudo, C. and others. Uncertainty in aquatic greenhouse gas flux estimates arises from subjective processing of floating chamber time series. *Limnology and Oceanography: Methods* n/a: e70054. doi:10.1002/lom3.70054

Manuel Toro (Centre for Hydrographic Studies-CEDEX) and Ignacio Granados (Sierra de Guadarrama National Park)

Title: Winter limnology: The Art of Instrumenting Remote Lakes (Without Dying in the Process)

Description: How many times has the perfect experimental design fallen victim to the realities of fieldwork? We are all familiar with the logistical challenges involved in transporting and installing equipment, and the frustration of seeing months of planning come to nothing because of unforgiving conditions. Installing continuous-recording instrumentation in high-mountain ecosystems or extreme latitudes is not just a technical challenge; it is a battle against environmental uncertainty. This workshop addresses solutions to the critical challenges that compromise the integrity of our data: strategies for equipment trapped in surface freezing or displaced by mechanical thrust during thaw, snow avalanche

impact on sensors beneath lake ice cover, buoy systems that withstand drastic changes in water level and strong runoff currents without losing their geolocation, 'lightweight' deployment and recovery techniques when harsh meteorological conditions prevent the use of small inflatable boats, mitigation of biofouling and other biotic factors (including humans) during long-term recording periods that threaten the integrity of the sensors. The aim: to share experiences and systems that are low-cost, highly durable and lightweight, ensuring that, despite adversity, the data reaches its destination.

Afternoon Workshops

Daniel Mercado-Bettin

Title: Hybrid Lake Modelling with Process-Based Models and Machine Learning

Description: Lake models usually come in one of two types: physics-based models built on scientific equations, or data-driven models that learn patterns from observations. This workshop shows you how to combine the two, and how to turn the result into something useful. Using Lake Banyoles (GLEON location in 2026) as our case study, you'll build a simple physics-based model, train a machine learning to correct its errors, and combine the two into a single hybrid prediction. The end result is a live, next-day forecast for swimmer safety. Powered by weather forecast data, it predicts water temperature and oxygen conditions from surface to bottom. Everything is hands-on in R.

Lalama Jabby and Francisca Casas-Cordero

Title: Decolonial Perspective and Scientific Practice. Introductory Workshop

Description: In this session, we will learn about colonialism and its lasting influence on science and ecology, including the environmental impacts of resource extraction. Through a guided exercise, participants will reflect on how coloniality shapes professional practices and co-create a shared document to support more critical, decolonial approaches.