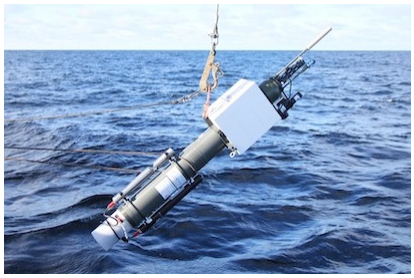
Parc national du Bic, Guillaume Cattiaux

Research vessel Coriolis II, ISMER



Argo float, IOW/M. Naumann

PhD project offer at ISMER-UQAR, in partnership with VLIZ

Under the supervision of Mathilde Jutras (ISMER-UQAR)
and Peter Landschützer (VLIZ)

Carbon sequestration during extreme events in the North Atlantic Ocean

The oceans absorb about 30% of the anthropogenic CO_2 emitted to the atmosphere (Friedlingstein et al., 2022). This number is however still poorly constrained by observations, despite the need to make accurate climate change predictions and to determine greenhouse gas reduction targets (Hauck et al., 2023). One aspect of the carbon cycle that is still poorly understood is the effect of subseasonal variability and extreme events on long-term carbon storage. In deep water formation regions such as the North Atlantic Ocean, subduction brings carbon from the surface towards the interior, where it can be sequestered for centuries to millenia. This subduction occurs in localized, short-term events (Portela et al., 2020). At the surface extreme events are short and strong perturbations that can for instance be associated with storms (Gruber et al., 2021). Intense winds can directly affect air-sea carbon fluxes, having shown to result in CO_2 outgassing (Carranza et al., 2024). Storms also mix the surface ocean, impacting nutrient supply to the surface ocean, which we hypothesize could have long-lasting effects on production and export.

Currently, most studies investigating subseasonal variations in biogeochemical cycles rely on models, with few using observations. The emergence of new data processing techniques based on machine learning and the expansion of autonomous sampling platforms programs equipped with biogeochemical sensors now offers the opportunity to study extreme events.

In this project, the student will be invited to generate regional high spatial (1 km x 1 km, multiple depth levels) and temporal resolution (daily) product of the carbonate system in the North Atlantic Ocean and use it to study small scale variability and its relation to long-term trends. The product will be built using Machine Learning techniques, gathering data from Biogeochemical Argo floats, Shipboard observations and Earth Observations from satellite missions. This first step will take advantage of expertise developed at VLIZ by Peter Landschützer's group, where a similar product was generated for the North Sea. Hence, this portion of the project will include **a research stay of a few months at VLIZ**.

The **remainder** of the project will take place at **ISMER**, where the product will be used to explore the impact of extreme events on carbon sequestration in three steps. (i) First, the student will characterize the impact of high frequency (sub-seasonal) variability on the carbonate system parameters throughout the water column. To do this, they will identify extreme events using criteria on wind intensity or concentration change, and compute air-sea fluxes and carbon export associated with those events. (ii) Second, they will determine the factors modulating this impact by looking for instance at the conditions during which these events occurred in terms of wind intensity, stratification, etc. (iii) Thirdly, they will investigate whether the observed impacts are short-lived or reflect in long-term carbon storage.

Starting date: flexible

Duration: 3 years

Financial support: 30 000 CAD$ per year plus support for international visits

To **apply**, please send a **CV,** recent **transcripts** and a **letter of motivation** at mjutras@hawaii.edu.
Deadline for application: **May 5th, 2025.**

The **Institut des sciences de la mer** (ISMER) at the Université du Québec à Rimouski (UQAR) is one of the main marine research institute in Canada. It is dedicated to training and advancing knowledge in marine and coastal environments, and favors a multi-disciplinary approach. It comprises 23 professor-researchers covering the four main disciplines of oceanography, and provides access to first-class marine research infrastructures. ISMER offers a human-scale and stimulating environments to all its students.

With a population of 50,000, **Rimouski** is the regional hub of the Bas-Saint-Laurent region in Quebec, Canada. This dynamic city, bordering the St. Lawrence estuary, is set in an exceptional natural environment.

Vlaams Instituut voor de Zee (VLIZ) is a research institute dedicated to strengthening science-based knowledge the ocean. Over the last 25 years, VLIZ has become a knowledge institution indispensable to the marine research landscape. VLIZ initiates and carries out multidisciplinary research and supports marine experts by providing research infrastructure, data, information and knowledge. VLIZ offers a stimulating working environment in which the well-being of employees comes first.