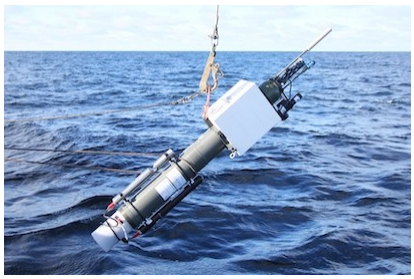
Research projects offer in physico-chemical oceanography at ISMER-UQAR

Parc national du Bic, Guillaume Cattiaux

Research vessel Coriolis II, ISMER



Argo float, IOW/M. Naumann

Join the team of Mathilde Jutras, a new oceanography professor at the Institut des sciences de la mer (ISMER) of the Université du Québec à Rimouski (UQAR), who will begin in June 2025. She is looking for students and researchers of all levels to form her research group.

Mathilde will hold a research chair of the Transforming Climate Action (TCA) program, a multi-university program dedicated to studying the role of the oceans in climate change. TCA is funded by the Canada First Research Excellence Fund and tunes nearly $400 million.

Mathilde's research focuses on the influence of physical processes on marine biogeochemical cycles, as well as the impact of climate change on the oceans, with a particular interest in the estuary and Gulf of St. Lawrence. Mathilde uses observational data combined with oceanographic models. She relies on a solid network of collaborators in Quebec and elsewhere. She is a member of the Québec-Océan research networks and the Argo program, which has deployed nearly 4,000 autonomous floats in the world's oceans.

Below are two proposals. It is also possible to develop other projects based on the particular interests of the student or researcher.

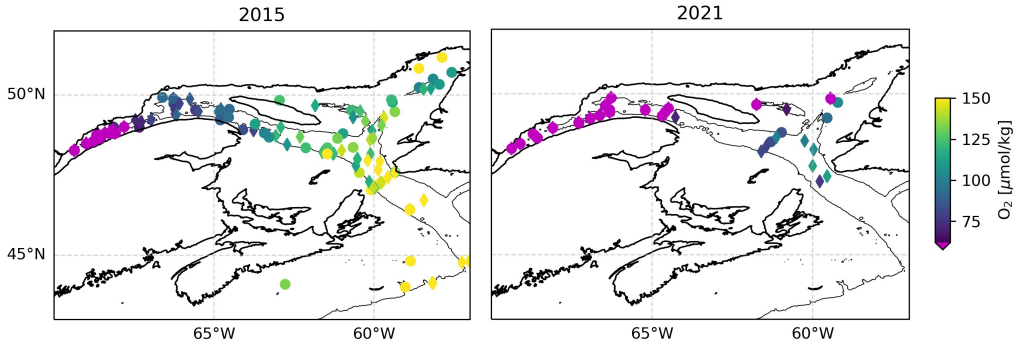
I) Master's project

Study of the factors controlling the shape of the St. Lawrence hypoxic zone

The St. Lawrence Estuary is running out of breath. For several decades, oxygen concentrations in its deep waters have been dropping, under the pressure of human activity and changes in climate. The hypoxic zone,

where oxygen concentrations are low enough to have detrimental consequences on marine life, is expanding. Its shape varies from year to year, depending on poorly understood physical and biogeochemical processes.

In this project, the student will analyze how spatial and temporal variability in currents, turbulent mixing (physical factors) as well as biological activity in the water column and sediments (biogeochemical factors) influence the shape of the hypoxic zone.



Hydrographic measurements of oxygen concentrations in deep waters (hypoxic in magenta) of the St. Lawrence Estuary and Gulf, in 2015 and 2021

The work will make use of data collected at sea and of oceanographic model outputs. The student will participate in the deployment and analysis of data from gliders, autonomous robots equipped with sensors. The gliders will be used to map the hypoxic zone, in particularl along the margins of the Laurentian Channel. Secondly, the student will analyze interannual variations in ocean currents using new high-resolution physical models of the Gulf of St. Lawrence. They will then link the observed variations to the model results to assess the influence of marine currents on the shape of the hypoxic zone.

This project addresses an important issue, given the significant socio-economic consequences of deoxygenation in that region. The results of this study will provide a better understanding of why certain areas of the St. Lawrence Estuary and Gulf are more severely affected, and allow to predict future trends.

Funding: 20 000$ for the first year (classes)
27 000$ for the following (research)

Starting date : June or Septembre 2025

The masters in Oceanography is designed for students with a background in physics, chemistry, biology, computer science, mathematics, environmental sciences or oceanography. Classes are in French.

II) Postdoctoral research project

The impact of mesoscale events on carbon marine carbon uptake

The oceans play a critical role in regulating the Earth's climate, having absorbed 25 (± 5)% of the carbon emitted by humans. The significant uncertainty surrounding this number reduces our ability to set GHG reduction targets that will limit global warming. To better constrain ocean carbon uptake, it is essential to better understand what regulates marine biogeochemical cycles. The emergence of high-frequency measurement platforms and high-resolution models have demonstrated the existence of daily, sub-seasonal and seasonal variations which have an impact on long-term trends and which have been neglected until now. One example is storms, which mix the water column and modify carbon and oxygen fluxes at the air-sea interface.

The aim of this project is to study how mesoscale phenomena affect biogeochemical properties and air-sea fluxes using observational data, and to assess the significance of these effects on global biogeochemical cycles using oceanographic models. Autonomous Argo floats equipped with biogeochemical sensors (BGC-Argo) sample the water column every 10 days in various ocean basins. By combining data from neighboring floats, we will identify storms and assess their impact on biogeochemical properties and air-sea fluxes. The global importance of the identified effects will be studied by extrapolating them to an ocean reanalysis. In the Gulf of St. Lawrence, a highly stratified hypoxic estuary, the recent decrease in ice cover in the winter, which corresponds to storm season, could have significant consequences on the biogeochemistry of the system. This will be studied using historical and new hydrographic data collected aboard the research vessel Coriolis II.

Finally, this position represents an opportunity to contribute to the development of a research group funded by a major program (TCA).

Part time possible.
Salary above the minimum established by the collective agreement of UQAR.
Starting date flexible.

Do not hesitate to contact me for any question or simply to discuss, at mjutras@hawaii.edu

The **Institut des sciences de la mer** (ISMER) at the Université du Québec à Rimouski (UQAR) is the largest French-speaking research institute in Canada dedicated to training and advancing knowledge in marine and coastal environments. It comprises 23 professor-researchers covering the four main disciplines of oceanography, and provides access to first-class research infrastructures, including research vessels. All teaching, social, and most research activities are in French, but some research activities are performed in English.

The **Université du Québec à Rimouski** (UQAR) is part of the Université du Québec network. It has nearly 7,000 students. Marine sciences are among the three main "axes of excellence" at the core of the institution.

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