PhD project offer (Biological oceanography and modelling) at ISMER-UQAR

Title: Quantifying Uncertainty in Zooplankton-Mediated Biological Carbon Pump Processes

Institution: The Institut des Sciences de la Mer de l'Université du Québec à Rimouski (ISMER-UQAR) is currently seeking a PhD candidate to work on modelling project that is part of a large national research program, 'Transforming Climate Action - TCA' which aims to better understand the ocean's ability to absorb CO_2 and regulate temperatures, including through the Biological Carbon Pump (https://www.ofi.ca/programs/transform-climate-action). ISMER-UQAR is the leading francophone marine research center in Canada (https://www.uqar.ca/institut-des-sciences-de-la-mer-ismer/). Known for its interdisciplinary excellence, ISMER offers advanced analytical facilities and state-of-the-art marine infrastructure. Nestled in the picturesque city of Rimouski, Quebec, ISMER is a key hub for maritime research and education in Canada, providing an exceptional setting for the scientific community.

Context and project description: The Biological Carbon Pump (BCP) is responsible for exporting organic carbon from the ocean surface to its interior, where it can be transformed into inorganic carbon and sequestered, thereby significantly reducing atmospheric CO2 levels. Zooplankton, such as copepods, contribute to the BCP through various mechanisms including grazing on primary producers, respiration, egestion, non-predatory mortality and trophic transfer. However, our uncertainty in these zooplankton-mediated BCP processes can propagate and reduce confidence in predictions of how the BCP will respond to climate change.

There is a long history of studies demonstrating that modeling choices for grazing by zooplankton greatly impact simulated ecosystem structure and function (e.g. Chenillat et al., 2021; Archibald et al., 2022), for example, with grazing shown to be the largest source of inter-model uncertainty in ocean biogeochemical models (Rohr et al., 2023). However, uncertainty in zooplankton mortality is also important (e.g. Cruz et al., 2021; Talmy et al., 2024), with respect to both rates and fates (i.e. predation vs. production of sinking carcasses) as well as temporal and spatial variation in predators and the environment (e.g. Neuheimer et al., 2009). The PhD project objective is to use sensitivity studies to characterize how variation in these critical formulations can propagate and potentially compromise quantification of the BCP function. The candidate will intend to begin with 1D regional studies using modifications to the model ECOSMO (Daewel et al. 2013) coupled with GOTM (Burchard et al., 1999), and extend to 3D regional model framework as the project matures.

Supervision: The PhD student will be supervised by Dr. Déborah Benkort (ISMER-UQAR) and co-supervised by Dr. Wendy Gentleman (Dalhousie), Dr. Frédéric Maps (ULaval), Dr. Tyler Eddy (Memorial University of Newfoundland) and Dr. Gesche Winkler (ISMER-UQAR). Although this PhD student will be based at ISMER, the project also involves another PhD student at Dalhousie, as well as technical support at

Laval University. Thus, all students will be trained in an interinstitutional environment, including the TCA project community, providing a collaborative, interdisciplinary, and stimulating context.

Funding: $30k/year is available for three years. Possibility of extending funding to a fourth year.

Project start : 2024 - 2025

Required qualifications : Candidate must have a relevant Master's degree in Ecology, Biology, Oceanography, or a related field, with experience in marine ecology, biological oceanography, or other relevant disciplines. The student will be expected to develop statistical and mathematical models to describe observed patterns and work with large physical and biological oceanographic datasets. As such, previous experience with (or at least a keen interest in learning) a programming language such as Fortran, R, or Python will be needed. Candidate must meet the basic requirements for admission to the PhD program in oceanography at UQAR.

Foreign students: The successful candidate will be eligible for an exemption from foreign student differential tuition fees (website information in French only). If this exemption is granted, students will pay the same tuition fees as Quebec students.

Application process: Candidates should provide a cover letter, a CV, contact details of two referees, as well as a short (~300 to 500 words) explanation of their motivation in response to this project description. Application should be submitted to Déborah Benkort (Deborah_benkort@uqar.ca) and Wendy Gentleman (Wendy.Gentleman@dal.ca). Application period will close on September 15, 2024.

Our workplace is committed to inclusivity, aiming to attract, retain, and develop staff based on inclusive principles. We value the diversity brought by different gender identities, ethnicities, sexual orientations, disabilities, and ages. All applicants are welcome and will be treated equally.

References:

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Rohr, T., Richardson, A. J., Lenton, A., Chamberlain, M. A., & Shadwick, E. H. (2023). Zooplankton grazing is the largest source of uncertainty for marine carbon cycling in CMIP6 models. *Communications Earth & Environment*, *4*(1), 212.

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Daewel, U., & Schrum, C. (2013). Simulating long-term dynamics of the coupled North Sea and Baltic Sea ecosystem with ECOSMO II: Model description and validation. *Journal of Marine Systems*, *119*, 30-49.

Burchard, H., & Petersen, O. (1999). Models of turbulence in the marine environment—A comparative study of two-equation turbulence models. *Journal of Marine Systems*, *21*(1-4), 29-53.