MERCATOR OCEAN INTERNATIONAL

Internship Master Project - W/M

5-6 months
Starting from late February / early March 2026

How to apply:
Send your cover letter and detailed resume with the following reference 2025-10/R&D/SeapoPym to recruitment@mercator-ocean.fr

Date of publication: 30/10/2025

Project title (for a Master 2 student internship): Development of a Transport Emulator for the SEAPODYM-LMTL Model Applied to Zooplankton and Micronekton Functional Groups.

Abstract:

This research aims to develop a numerical emulator of ocean transport for the SeaPoPym model, which simulates the dynamics of zooplankton and micronekton functional groups at a global scale. The emulator, designed using data from existing simulations based on advection-diffusion-reaction (ADR) equations, will be trained on high (1/12°) and low (1°) resolution configurations of SEAPODYM-LMTL. It will reproduce the effects of ocean transport on planktonic biomasses from environmental fields (forcings). The emulator will be coupled to the 1D version of the SEAPODYM model in python (SeaPoPym), which does not take transport into account. This coupling will make it possible to evaluate the capacity of the emulator to reproduce the spatio-temporal dynamics of a zooplankton and micronekton functional group different from those used for training. The results of the model with transport ADR and the model with emulator will be compared in order to validate the approach.

Main Objectives:

1) Analyze output from SEAPODYM-LMTL simulations including ADR-based transport:
   - Extract simulated biomass of various zooplankton and micronekton groups.
   - Collect corresponding environmental forcing fields (temperature, currents, primary production, and euphotic depth).
2) Develop a transport emulator using supervised learning:
   - Select an appropriate architecture (e.g., deep neural networks, spatial regression models, reduced-order modeling techniques).
   - Train the emulator to predict transport effects on biomass based on environmental forcings.
3) Integrate the emulator into a 1D SEAPODYM version without transport (SeaPoPym):
   - Adapt the emulator for seamless integration with the Python-based model.
   - Ensure temporal consistency and correct data exchange formats.
4) Perform a comparative study:
   - Compare the results of the full ADR model with those of the SeaPoPym model coupled with the emulator, including for a new functional group.
   - Evaluate the emulator's performance according to biological and statistical criteria (prediction errors, consistency of dynamics, etc.).

Proposed Methodology:

- Preprocess and analyze data from SEAPODYM-LMTL simulations.
- Design and train a machine learning or reduced-order model-based emulator (PCA, autoencoders, etc.).
- Implement in a scientific Python environment (NumPy, SciPy, Xarray, Dask, TensorFlow/PyTorch).
- Perform qualitative (maps, time series) and quantitative (RMSE, correlation) comparisons against reference simulations.

Prerequisites for this internship:

- Background in physics/applied math and artificial intelligence.
- Proficiency in Python and relevant data science/machine learning libraries.
- Foundation in mathematical modeling and dynamical systems.
- Knowledge of ADR equations in oceanographic contexts.
- Interest in marine ecology and biogeochemical modeling.

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Who are we?

Mercator Ocean International has been developing operational oceanography activities for nearly 30 years, as part of its public interest mission to preserve the ocean.

Many scientific and societal challenges must be met to ensure a sustainable ocean, whether they concern the environment, biodiversity, climate change, the blue economy or education. To meet these challenges, Mercator Ocean designs, develops, operates and maintains state-of-the-art digital systems capable of describing, analysing and forecasting the state of the ocean in 3D, continuously and in real time. The scientific information is then translated to be accessible to all, whether they are public or commercial services, political decision makers, industrialists, associations, NGOs, teachers or citizens. Mercator Ocean International thus combines scientific excellence and social commitment on a daily basis.

As a non-profit company under multinational governance (ES, FR, GB, IT, NO), we work in a climate of trust with our ten shareholder partners, all key players in the development of European oceanography.

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