Modelling biogeochemical processes in the Baltic Sea

Summary

Aim of the PhD project is to develop a setup of ocean models for modelling the biochemical processes in the Baltic Sea, including the coastal waters of Estonia. Successful PhD applicant will be working with numerical ocean models at HPC centers in TalTech and EuroHPC machine LUMI and collaborate with other ocean modellers around Baltic Sea.

Research field:	Earth sciences
Supervisors:	Dr. Germo Väli Dr. Taavi Liblik
Availability:	This position is available.
Offered by:	School of Science Department of Marine Systems
Application deadline:	Applications are accepted between June 01, 2025 00:00 and June 30, 2025 23:59 (Europe/Zurich)

Description

The research

The continuation of eutrophication and extension of the hypoxic areas and oxygen debt in the Baltic Sea is among one of the biggest human induced environmental stressors in the region. Numerical simulations provide a perfect tool to estimate the possible impacts of applied measures (such as BSAP) and activities reducing the eutrophication in the sea. The aim of the proposed PhD project is to model the biogeochemical processes in the Baltic Sea using the state-of-the-art hydrodynamic models GETM (General Estuarine Transport Model) and MOM (Modular Ocean Model) on various spatiotemporal scales (from synoptic variability to inter-annual changes and regional domain to overall Baltic Sea).

Within the project, the PhD student will prepare a MOM based model setup for the GoR/GoF that is applicable for studying the biogeochemical processes in the region, while continuing developing the existing GETM based model setups for the Baltic Sea. Multi-year simulations will be performed either at TalTech HPC (High-Performance Computing Centre) or at LUMI machine available from EuroHPC.

The student will analyze the model results and observational data to enhance the knowledge on the biogeochemical processes in the Baltic Sea. He/She will also participate in monitoring cruises to collect data and use the existing datasets for validation of the model.

The main aims of this PhD project are: 1) developing and calibrating GETM-ERGOM model for the eastern part of the Baltic Sea 2) setting up MOM-ERGOM model for the eastern part of the Baltic Sea 3) analyzing the biogeochemical processes in the simulations

The thesis should address the following questions: 1) Which numerical model is the most promising to use for Estonian coastal waterbodies? 2) How do submeso- and mesoscale processes affect biochemistry in the eastern part of Baltic Sea? 3) What are the future perspectives for applying BSAP for Estonian coastal waterbodies?

Responsibilities and (foreseen) tasks

- Developing and calibrating further the existing model systems for the Baltic Sea based on GETM model
- Setup and usage of MOM-ERGOM model for the Baltic Sea and regional high-resolution setups for the Gulf of Finland and Gulf of Riga
- Analysis of the model simulations
- Participation in and data collection during monitoring cruises
- Writing scientific papers

Applicants should fulfil the following requirements:

- a master’s degree in natural sciences (physics or mathematics, geosciences, environmental sciences or similar field)

- a clear interest in the topic of the position
- excellent command of English
- strong and demonstrable writing and analytical skills
- capacity to work both as an independent researcher and as part of a team
- capacity and willingness to provide assistance in organizational tasks relevant to the project

(The following experience is beneficial:

- Experimental and/or theoretical oceanography
- Programming in Fortran and Python/MatLab/R
- Experience in HPC systems and/or Linux machines
- Working knowledge of numerical modelling
- Working knowledge of statistics
- Working knowledge of netCDF and grib format and oceanographic databases

The candidate should submit a research plan for the topic, including the overall research and data collection strategy. The candidate can expand on the listed research questions and tasks, and propose theoretical lenses to be used.

We offer:

- 4-year PhD position in one of the largest marine physics research centers in Estonia
- The chance to participate in research and applied science projects
- Opportunities for conference visits, research stays and networking with globally leading universities and research centers in the fields of Baltic Sea research and marine science

About the department

Tallinn University of Technology (TalTech), the only technological university in Estonia, is the flagship of Estonian engineering and natural sciences. Here the synergy between different fields (technological, natural, exact, economic, and health sciences) is created and new ideas are born.

The Department of Marine Systems at TalTech is a leading oceanographic and meteorological R&D unit in the Baltic Sea region. We focus (1) on marine physics research, (2) on oceanographic process research based on scientific analysis to find cause-and-effect relationships, and (3) on developing marine monitoring and modelling services. We have long-term experience in numerical modelling of the circulation of the Baltic Sea along with the biogeochemical processes. We collaborate closely with researchers from other research centers around Baltic Sea, such as FMI (Finnish Meteorological Institute), IOW (Institute for Baltic Sea Research), SMHI (Swedish Meteorological and Hydrological Institute).

(Additional information)

For further information, please contact Germo Väli (germo.vali@taltech.ee) and Taavi Liblik (taavi.liblik@taltech.ee) or visit https://taltech.ee/en/department-marine-systems

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