# Projecting the Black Sea's ecosystem and ecosystem services in a future climate. Trends, tipping points and resilience assessment.

A 4-year PhD or 2-year postdoctoral position is available at the Liège University (MAST group, Department of Astrophysics, Geophysics and Oceanography) in collaboration with the Stockholm Resilience centre to perform and analyse regional climate model projections over the Black Sea.

The research project aims at performing an ensemble of model simulations of the physical and biogeochemical state of the Black Sea over different scenarios of atmospheric conditions and river discharges. The modelling system consists of a (one-way) coupled atmosphere-ocean model. The atmospheric model is the regional atmospheric model (MAR), the oceanographic model couples the Nucleus for European Modelling of the Ocean (NEMO) hydrodynamical model and the BiogeochemicAl Model for Hypoxic and Benthic Influenced areas (BAMHBI). The different components of the modelling system are run at the Liège University in the frame of European projects.

## Research activities

The candidate will have to analyse the ensemble of model simulations for the Black, and, in particular, to:

(1) Analyze the ensemble of historical simulations, assess its quality and ability to represent the uncertainty.
(2) Estimate the magnitude of various sources of uncertainty (e.g. atmospheric forcings, model parameterization, natural variability).
(3) Perform statistical analysis in order to detect trends, tipping points, time of emergences, pattern of changes and drivers of changes.
(4) To detect extreme events like marine heatwaves and coastal hypoxia.
(5) To determine ecosystem services bundles in a current and future climate.

All these analyses will focus on the assessment of changes in ecosystem state and services in a current and future climate and to tentatively estimate the acceptable limits of these changes ("safe operating" space of stressors).

## In addition to the scientific project described here above, the successful candidate will have to:

- Travel to project and international scientific meetings
- For the PhD candidate, to follow the Doctoral Formation mandatory for obtaining a PhD.
- To help in the supervision of master students and teaching activities performed by the group.

## Requirements for application

- For PhD candidate: Applicants must have completed a master's degree in a field closely related to geosciences, physics, engineering or equivalent.
- For post-doc candidate: Applicants must have a PhD in geoscience (ocean, atmosphere, climate), physics , mathematics or equivalent. An expertise in (big) data analysis is an added value.

- Skill in programming in languages like Phyton, FORTRAN, is required.
- Good to very good written and verbal English communication skills are required.
- Good communication skills for communicating results to different audiences

## Our offer

- A 4-year (for the PhD) and 2-year (for the post-doc) full time contract starting as early as possible
- An attractive salary.
- The successful candidate will benefit from a dynamic working environment benefiting from the research projects of the groups in different fields of oceanography connecting modelled predictions with observations and end-users requirements (e.g., Horizon Europe NECCTON, the Copernicus Marine Service, H2020 BRIDGE, UN Decade GOOD program, EU Digital JPI Ocean and Climate CE2COAST).
- Enjoyable living and working conditions. The Liège University offers comprehensive and innovative training programs, which enable early-career scientists to carry out their research in the best possible conditions, in compliance with the European Charter for Researchers. The candidate will work closely with Profs. Marilaure Grégoire (ULiège), Susa Niiranen (Stockholm Resilience center).

**How to Apply**: The candidate should send by e-mail his/her curriculum vitae, a covering letter of motivation, together with two references (name and email address), to **Marilaure Grégoire** (email: mgregoire@uliege.be).

The position will remain open until filled; but the selection will start from November 20th, 2023.

ULiege is strongly committed to promoting equality and diversity, and is labelled HRS4R for Human Resources 'Excellence in Research Award' for institutions (https://euraxess.ec.europa.eu/jobs/hrs4r). All appointements will be made on merit.