Postdoctoral position
Investigate phytoplankton low frequency variability from high resolution climate projections and machine learning

Starting Date: **01 September 2024** 12 months fixed-term contract

Application deadline: **15 June 2024** (or until the position is filled)

Supervisors:
E. Martinez (elodie.martinez@ird.fr) biogeochemistry/ocean color (LOPS Brest),
P. Brehmer, marine ecologist (LEMAR Brest).

Collaborators:
M. Lengaigne, oceanographer/climate physicist & H Demarcq, oceanographer (MARBEC Sète).
T. Gorgues, biogeochemistry/numerical modeler & E. Pauthenet, oceanographer physicist/machine learning (LOPS),
R. Fablet & L. Drumetz, machine learning (Lab-STICC Brest),

Salary: 34,52 k€ (gross) /year

Host institution

The position is affiliated with the Physical and Space Oceanography Laboratory (LOPS), a Joint Research Unit associated with the University of western Brittany (UBO) both belonging to the European University Institute of the Sea (IUEM). Recently recognized as one of the world's premier oceanographic centers (ranked 5th in the Shanghai ranking 2023), LOPS spearheads cutting-edge research in ocean dynamics across various temporal and spatial scales. Our four LOPS research teams (Coastal Ocean, Ocean and Climate, Oceanic Scale Interactions, and Satellites and Air-Sea Interface) pioneer programs contributing to the advancement on the relationships between the ocean and other compartments of the Earth system such as the atmosphere, ice and living organisms.

Based in Plouzané (France), the postdoc opportunity is within the "Ocean and Climate" team.

The project

NextGEMS is a collaborative European project (https://nextgems-h2020.eu; PI Bjorn Stevens at the Max Planck Institute for Meteorology and Irina Sandu at the ECMWF). This postdoctoral position falls under the “Storms and Ocean” NextGEMS theme, led by Noel Keenlyside (UiB Norway). NextGEMS, funded by the EU’s Horizon 2020 program, will tap expertise from fourteen European Nations to develop two next generation Storm-Resolving Earth-system Models (SR-ESMs). The much finer grid of nextGEMS’ models allows them to explicitly represent essential climate processes – storms, associated with precipitating deep convection, the effects of the landscape on the atmosphere, the effects of ocean eddies on the ocean heat transport, and its interaction with ice-sheets – that existing climate models now either ignore, or represent empirically. Past research has shown that the physically based approaches nextGEMS exploits are effective in reducing systematic and long-standing errors in conventional climate models, thereby creating a better – more physical – foundation for projections. Because nextGEMS's SR-ESMs will increase simulation realism on many fronts, they are expected to open new scientific frontiers and shine new light on how the Earth system responds to human activities.

Within this thematic framework, and based on experience in our team (Martinez et al., 2020a; 2020b; Roussillon et al., 2023) advanced machine learning techniques will be used to derive climate projections of phytoplankton biomass from oceanographic and atmospheric physical predictors from SR-ESMs in order to ultimately deconvolute and investigate the influence of the anthropogenic signal from that of the natural low-frequency variability.

Selected references:

Roussillon, J., Fablet, R., Gorgues, T., Drumetz, L., Littaye, J., & Martinez, E. (2023). A Multi-Mode Convolutional Neural Network to reconstruct satellite-derived chlorophyll-a time series in the global ocean from physical drivers. Frontiers in Marine Science, 10, 1077623.

Martinez, E., Gorgues, T., Lengaigne, M., Fontana, C., Sauzède, R., & Fablet R (2020a). Reconstructing Global Chlorophyll-a Variations Using a Non-linear Statistical Approach. Front. Mar. Sci., 7:464. doi: 10.3389/fmars.2020.00464.

Martinez, E., Brini, A., Gorgues, T., Drumetz, L., Roussillon, J., Tandeo, P., ... & Fablet, R. (2020b). Neural Network Approaches to Reconstruct Phytoplankton Time-Series in the Global Ocean. Remote Sensing, 12(24), 4156.

Your activities

1. Apply machine learning tools and supervised methods already developed and in use within our team to learn the relationships between the concentration of Chlorophyll-a ("Chl", a proxy of phytoplankton biomass) from satellite observations and physical oceanographic and atmospheric predictors (temperature, wind, etc.) from the SR-ESM models over the historical time period. Then, apply these machine learning schemes on the physical predictors from the two nextGEMS SR-ESM climate projections over the next decades. This part of the work will be performed with our team support (additional collab. with R. Fablet and L. Drumetz from the LabSTICC lab).
2. Assess the part of the natural variability vs. anthropogenic trend in Chl predictions.
3. Characterize the underlying physical and climate mechanisms.
4. Compare these results with those already obtained by our team on the low resolutions CMIP6 ESMs (collaboration from point 2 to 4, with M. Lengaigne from the MARBEC lab.)
5. Following a first assessment at global scale from point 1 to 4, a focus will be performed specifically on the North West African region for points 2 and 3, where questions about the evolution of the small pelagic fish arise (collaborations with P. Brehmer from LEMAR and H. Demarcq from MARBEC laboratories).
6. Disseminate your findings through publication in peer-reviewed "rank A" journals and effective communication of results.

Candidate profile

We seek candidates with a PhD in physical oceanography or biogeochemistry with a background in numerical modeling and/or climate projections.

Additionally, candidates should possess:

- Proficiency in numerical tools and big data algorithms, including Python, Keras, etc.
- Proficient English language skills (level 2).

The collaborative and intellectually stimulating work environment requires individuals who demonstrate:

- A penchant for teamwork, skill-sharing, and involvement in ambitious projects.
- Adaptability and a willingness to collaborate across interdisciplinary boundaries.

Application procedure

The position is for a one-year contract, preferably starting in September 2024. Interested applicants are encouraged to submit the following documents via email to Elodie Martinez (elodie.martinez@ird.fr) by June 15, 2024:

- Letter of motivation
- CV
- Recommendation letters of two referees