Postdoctoral position

Modelling the impacts of pollutions in global marine ecosystems

We are advertising a 24-month post-doctoral position, extendable up to 39-months, in the framework of the PPR Ocean & Climate project PREVENT (*Predicting the evolution and biological impact of the oceanic exposome within the context of environmental transitions*).

We are seeking a talented quantitative scientist to work at the interface between ecotoxicology, Dynamic Energy Budget and marine ecosystem modelling. The position is based in Sète, in the MARine Biodiversity, Exploitation and Conservation (MARBEC) laboratory (http://www.umr-marbec.fr/en/).

The PREVENT project focuses on studying the **oceanic exposome** by analysing the combined effects of both legacy and emerging pollutants on marine organisms and ecosystems in the **global ocean**. It aims to understand the **present and future cycles of key contaminants**, such as **mercury, lithium and microplastics**, their transfer through food webs, and their potential **accumulation and toxicity for marine life**. The project uses a **transdisciplinary and innovative approach** combining experimentation, modelling, and observation. It integrates advanced modelling tools (NEMO-PISCES-APECOSM) to simulate pollutant dispersion and biological impacts in the **global ocean**, from physics to fish communities. Lastly, it develops **future scenarios** of pollutant emission based on SSP-consistent energy transition pathways and simulates the associated **impacts on ecosystems** to inform marine pollution **regulation policies**.

The postdoc will implement a generic **TK-TD** (toxicokinetics and toxicodynamics) model[1], in a global ecosystem model[2] that represents the trophodynamics of generic communities. The resulting APECOSM-tox model will represent the transfer of toxicants through predation of contaminated prey or absorption directly from the seawater, their propagation and

[1] We will use the DEBtox (e.g. Jager et al., 2014), which is a TK-TD approach based on the Dynamic Energy Budget (DEB) theory (Kooijman, 2010). It represents the transfer, the bioaccumulation and the toxicity of pollutants in individual organisms. In the DEBtox framework, the contaminant is first taken up into the different compartments of the body then it affects at least one of the metabolic processes of the DEB (assimilation, growth, reproduction, maintenance, development, survival). The DEBtox can be used to study cocktail effects on individual organisms (Jager et al., 2014).

[2] We will use APECOSM (e.g. Maury, 2010; Dalaut et al., 2025), which is a 3D eulerian marine ecosystem model that represents the dynamics of size-structured communities (small, medium, and large -e.g. skipjack and yellowfin tuna- epipelagic fish, large deep-diving epipelagic fish -e.g. bigeye tuna, swordfish-, migratory and resident mesopelagic organisms, demersal and benthic fish, and benthic invertebrates). It integrates individual, population and community levels mechanistically with a trait-based approach (Maury & Poggiale, 2013). In APECOSM the uptake and use of energy for individual growth, maintenance, development, reproduction and mortality are modelled according to the DEB theory (Kooijman, 2010), modified to account for the effects of aerobic metabolism on interspecific parameters' scaling rules (Maury et al., 2019). Physical drivers from the OGCM NEMO (temperature, currents, mixing) as well as biogeochemical drivers from PISCES (phytoplankton, zooplankton, particles, light and oxygen) control the biological and ecological dynamics at various levels in APECOSM.

bioaccumulation in trophic chains and their potential toxic effects on the dynamics of marine communities. It will be used to infer the **ecological effects of pollutants** on **marine biodiversity worldwide** and project their **evolution along the project's scenarios**, considering simultaneously the **impacts of chemical pollutions and climate change**, two of the major drivers of biodiversity loss identified by the IPBES (IPBES, 2019).

Description of the position:

The postdoctoral researcher will first **estimate the DEB-tox parameters** using a likelihood approach and an already existing and highly efficient DEB parameters estimation software that he-she will adapt to toxicity data for this purpose. The whole life cycle (from eggs to eggs) growth, development and reproduction **data collected experimentally in the project** on a model species will be used to estimate the DEB parameters. The experimental data collected on the effects of chemical exposure on life-history traits will be used to estimate the parameters of the toxicity module of the DEBtox. These parameters describe the TK-TD of single and combined (cocktail) contaminant exposure and their effects on fish physiology, assimilation, growth, reproduction, maintenance and mortality (Ashauer and Jager, 2018).

In a second step, the DEB-tox parameters will be used in **APECOSM-tox** to simulate the transfer and bioaccumulation of pollutants in trophic chains and their potential toxic effects on the dynamics of marine communities in the global ocean at 1° resolution. The simulation will be assessed against **large-scale observation data** that are available in the project (e.g. Médieu et al., 2022, 2023).

Finally, the APECOSM-tox model will be run along the **future climate/pollution scenarios** developed in the project and the projections analysed.

Duration, salary: The successful candidate will be hired by IRD for a maximum of 39 months with a salary depending on experience, in accordance with IRD rules, as well as social security and paid leave in accordance with French legislation. The position will be available from 1st of October 2025.

Required Experience: A PhD is required, with an experience in oceanography, fishery science, toxicology, DEB theory or marine ecology as well as very good quantitative skills (applied mathematics or engineering) and a strong interest for numerical modelling. Ease in using linux and programming languages (python, C/C++) is necessary.

Contact for applications: Applications should be sent as soon as possible to Olivier Maury (olivier.maury@ird.fr). They should include a CV with publication record, a statement of research interests and the names of two referees. Review of applications will begin as soon as received, and the position will remain open until filled.

References:

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