



Offer #2021-03620

Post-Doctoral Research Visit F/M Reduction of hydrodynamic-biological models and inclusion of temperature evolution scenarios

Contract type : Fixed-term contract

Level of qualifications required : PhD or equivalent

Fonction : Post-Doctoral Research Visit

Level of experience : Recently graduated

About the research centre or Inria department

The Inria Sophia Antipolis - Méditerranée center counts 34 research teams as well as 7 support departments. The center's staff (about 500 people including 320 Inria employees) is made up of scientists of different nationalities (250 foreigners of 50 nationalities), engineers, technicians and administrative staff. 1/3 of the staff are civil servants, the others are contractual agents. The majority of the center's research teams are located in Sophia Antipolis and Nice in the Alpes-Maritimes. Four teams are based in Montpellier and two teams are hosted in Bologna in Italy and Athens. The Center is a founding member of Université Côte d'Azur and partner of the I-site MUSE supported by the University of Montpellier.

Context

There are strong scientific evidences on the adverse effects of climate change on the global ocean. These changes will have a drastic impact on almost all life forms in the oceans with further consequences on food security, the ecosystems in coastal and inland communities. Despite these impacts, scientific data and infrastructures are still lacking to understand better and quantify the consequence of these perturbations on the marine ecosystem. It is necessary not only to gather more data but also to develop and apply state-of-the-art mechanisms capable of turning this data into effective knowledge, policies, and action.

The [Inria project OcéanIA](#) aims at developing new artificial intelligence and mathematical modeling tools to contribute to the understanding of the structure, functioning, underlying mechanisms, and dynamics of the oceans and their role in regulating and sustaining the biosphere, and tackling the climate change. OcéanIA will structure Inria's contributions around a global scientific challenge in the convergence of Artificial Intelligence, Biodiversity & Climate Change.

The Inria BIOCORE team develops and applies mathematical and computational methods to the study of ecosystems and microbial community.

<http://team.inria.fr/biocore>

Assignment

The assessment of oceanic primary production, or the amount of material produced by the photosynthetic activity of planktonic algae, is a major issue in contemporary oceanographic research. In particular, a better assessment of the evolution of carbon fluxes associated with climate change is a key point to predict climate and biodiversity in the future decades according to the scenarios identified by the IPCC. At small scales, carbon fluxes are estimated using coupled physical-biogeochemical models that predict ocean circulation together with their associated physico-chemical forcings (temperature, salinity, pH, etc.). Biological activity is then estimated using models that derive production from light intensity and nutrient distribution. However, current models rarely take into account the influence of temperature on these mechanisms. As a result, it is currently difficult to accurately predict how phytoplankton will respond to increases in mean ocean temperature.

Areas of high biological activity are hydrodynamically active and variable areas in which organisms see their environment fluctuating over time. An important issue in current research is to find biological models that can be integrated into a 3D physical scheme able to represent in a relevant way the different time scales involved. These models require very high computational costs and it is impossible to automatically and systematically explore a large number of scenarios over long periods. In particular, it is not possible to simulate different hypotheses of adaptation of phytoplankton species to ocean warming and acidification. The objective of the study will be to implement strategies to reduce and simplify these models using Deep Learning type approaches, in order to benefit from agile predictive tools capable of analyzing a large number of scenarios.

Main activities

The post-doc takes place within the Inria project OceanIA. The objective is to propose a reduction strategies for coupled physical-biological models. In a first step, these approaches will be conducted on simple hydrodynamic models coupled to a phytoplankton growth model. The hydrodynamic model developed by the Ange team of Inria Paris, and implemented in the Freshkiss code, allows to efficiently discretize the system of Navier-Stokes equations. This first simplified model leads to a model of intermediate complexity, which will allow us to test different reduction strategies. The inclusion of the temperature effect will also be tested on this simplified case study.

In a second step, outputs of more elaborate models describing biogeochemical fluxes (PISCES, ECO3M) will be used. The algorithms tested at small scale will be deployed on these more sophisticated cases, including the addition of the temperature effect to characterize the consequences of its progressive increase.

The Inria clusters can be mobilized to extend the range of possible scenarios. CO2 fluxes as well as biodiversity indices will be calculated for different climate evolution scenarios. A validation phase on a very limited number of scenarios will assess the quality of the predictions of the simplified model compared to the detailed biogeochemical model.

Skills

PhD defended after 2019, in biological modelling, preferentially with ocean applications. Skills in applied mathematics, especially in the Artificial Intelligence field and Computational Fluid dynamics (CFD) will be appreciated.

Benefits package

- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking (after 6 months of employment) and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

Remuneration

Gross Salary: 2653 € per month

General Information

- **Theme/Domain** : Modeling and Control for Life Sciences
Biologie et santé, Sciences de la vie et de la terre (BAP A)
- **Town/city** : Sophia Antipolis
- **Inria Center** : [Centre Inria d'Université Côte d'Azur](#)
- **Starting date** : 2021-09-01
- **Duration of contract** : 2 years
- **Deadline to apply** : 2021-08-21

Contacts

- **Inria Team** : [BIOCORE](#)
- **Recruiter** :
Bernard Olivier / Olivier.Bernard@inria.fr

About Inria

Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

The keys to success

The candidate must be motivated for environmental application, and especially oceanography with a solid background in modelling and applied mathematics.

Warning : you must enter your e-mail address in order to save your application to Inria. Applications

must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.

Instruction to apply

Defence Security :

This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST). Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

Recruitment Policy :

As part of its diversity policy, all Inria positions are accessible to people with disabilities.