Institut de Recherche pour le Développement FRANCE

Postdoctoral Position

Assimilation of Tropical Moorings observations to better constrain the tropical dynamics, its variability, and improve the forecasting systems

Postdoctoral position (initial one year contract, with a possible additional year)

ABOUT IRD

French National Research Institute for Sustainable Development (IRD)
IRD is an essential scientific referent on major development issues and an internationally recognized multidisciplinary organization. It is a French public institute under the supervision of both education, research and innovation ministry and foreign affairs ministry. For more than 75 years, IRD has carried out an original approach to research, expertise, training and knowledge sharing for the benefit of territories and countries that make science and innovation one key tool of their development. Almost 40% of the Institute's staff are posted abroad and overseas.

Joint Research Unit – 065 LEGOS – affiliated to 4 French research and higher education institutions: CNES, CNRS, IRD, and UT3 within the Observatory Midi-Pyrénées, in Toulouse, south of France. Research at LEGOS focuses on the study of oceanography and water cycle. The main research areas include physical oceanography, marine biogeochemistry and geochemistry, as well as hydrology, and coupling with the cryosphere and atmosphere.

Mercator Océan International is a service provider of ocean information in real and delayed time. It is privately-owned non-profit company, providing a service that serves the public interest. The organization is funded by the five major French institutions involved in operational oceanography: CNRS (National Center of Scientific Research), Ifremer (French Research Institute for Exploitation of the Sea), IRD (Institute of research for Development), Météo-France and SHOM (Hydrographic and Oceanographic Service of the French Navy).
Environment, biodiversity, climate change, blue economy, education: the scientific and societal challenges linked to the oceans are numerous. To respond to this, Mercator Océan's mission is to describe, analyze and forecast the state of the global ocean, continuously, reliably and in real time, and to make this information relevant and accessible to all: public and commercial services, manufacturers, political decision-makers, associations, NGOs, teachers, citizens.
Based in Toulouse, near LEGOS, the company brings together a hundred employees, all of whom are committed to the sustainable development goals of the United Nations.
The candidate will join the Mercator Océan group and work in close collaboration with the LEGOS "DYNOTROP" (Dynamics of the Tropical Oceans) team, in particular with G. Ruggiero, E. Remy (Mercator Océan) and S. Cravatte (LEGOS).

LOCATION

Toulouse (France) LEGOS and Mercator Océan International

POSITION INFORMATION

Context
In the three tropical oceans, mooring arrays provide oceanic high-frequency subsurface data, from the surface to 700m, and meteorological data transmitted in real time. These are the PIRATA array in the Atlantic, the TAO/TRITON array in the Pacific and the RAMA array in the Indian Ocean. These data are ingested by operational centers, and assimilated into short, medium or long term forecast of either coupled and forced systems. The goal is to better constrain the state of the ocean and the atmosphere, to better estimate ocean processes in tropical regions, and ultimately to allow better short to medium range (i.e., seasonal) forecasts (Fuji et al., 2019). These data are crucial for observing, understanding and predicting synoptic events, and climate modes of variability.

Unfortunately, the large biases in the upper ocean dynamics of current models and the approximations made by the assimilation techniques hamper the influence of these observations in operational systems [Fujii et al., 2019]. Despite their high temporal sampling, moorings offer scarce data with a wide spatial spacing (located every 10-15 ° in longitude and 2-5 ° in latitude) that only locally affect the state of the ocean or the atmosphere in the current systems. And at these stage, the strength of the moorings that provide high frequency ocean-atmosphere co-located data is not exploited by operational systems in their current state.

In the near future, it is expected that the moorings will evolve and be equipped with more sensors near the surface, to allow better resolution of the ocean mixed layer variability (e.g. Cravatte et al., 2016; Smith et al., 2019; Foltz et al., 2019, Hermes et al., 2019). Real-time velocity data should also be available soon. These improvements are very promising, because a good initialization of the surface layer in the tropical oceans is a priori essential for a good sub-seasonal forecast. A necessary condition is that operational systems should be ready to make the best use of this improved observational networks.

Mission

The aim of the proposed post-doctoral position is to improve the Mercator Océan analysis system in the tropical band. This system (Lellouche et al., 2018) is based on the NEMO model component, in a ¼° global configuration, forced by ECMWF atmospheric fields. Observations are assimilated by means of a reduced-order Kalman filter with a three-dimensional multivariate modal decomposition of the background error and a 7-day assimilation cycle. Along-track altimeter data, satellite sea surface temperature, sea ice concentration, and in situ temperature and salinity vertical profiles are jointly assimilated. A 3D-VAR scheme provides a correction for the slowly evolving large-scale biases in temperature and salinity.

Main tasks

1) Better understand the physical processes that the observations should possibly be able to constrain in the ocean model, by comparing the model outputs at moorings locations and observations. Identify the associated time and spatial scales in order to define the corresponding model error covariance required to control those processes. Define corresponding physical metrics and indicators to quantify the data assimilation impacts, in concordance with Ocean Predict, CMEMS activities on observation impact studies.
2) Improve the system by adapting the spatial/temporal scales in the covariance matrix used by the assimilation to correspond to the ocean error structures found in the task (1). Depending on the shape of the spectrum of the error (i.e. the relative contribution of large and small scales), the candidate will work on the implementation of a multiscale assimilation procedure (Tissier et al., 2019) to improve the constraint on both large-scale and small-scale variability.
3) Participate in the implementation at Mercator of common metrics to allow a systematic feedback on the use of data, shared across the operational centers (statistics on data indeed ingested by the assimilation system, statistical analysis of analysis increments, deviations from observations before and after analysis). This will be part of the international effort currently under discussion in different frameworks such as the MOI DA Expert Team, with MetOffice, CMCC, NERSC and ECMWF, the Ocean Predict Data Assimilation, OSEval, and Intercomparison/Validation Task Teams [Hernandez et al., 2018].

If time allows, the ultimate goal will be to assess the impact of tropical moorings data on operational systems. OSE / OSSE type experiments might be performed [e.g., Fujii et al., 2019; Gasparin et al., 2019], in order to identify the characteristics of the observation system that best allow to constrain the state of the ocean at different spatial and temporal scales. Collaborations with other forecasting groups in Europe and with international partners of MOI may also start to assess the importance of the initial oceanic conditions, with and without moored data, on the sub-seasonal forecasts.

QUALIFICATION AND EXPERIENCE REQUIRED

Education and knowledge skills

We invite applications from candidates holding a PhD in data assimilation, physical oceanography, meteorology, or climate science. A background in data assimilation will be given priority. Experience in tropical dynamics, or in observational data analysis, or experience in ocean modelling would be an advantage.

Experience

The candidate should have good programming skills in Python and Fortran, good ability to work in a team, and good ability to communicate and write in English.

Conditions

The candidate must be within 5 years after his/her PhD defense, and should start no later than December, 1, 2020

CONTACT

Application (CV, motivation letter, list of publications, names of 2 referees) should be sent to :

recrutement.dr-occitanie@ird.fr and sophie.cravatte@ird.fr

Closing date to apply : **1 October 2020**