Several PhD grants available on «Data assimilation, Learning and stochastic parametrization of ocean models through high-resolution observations»

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Context: ERC project STUOD in collaboration with Ifremer Brest and Imperial College London

Keywords: Data assimilation, stochastic parameterization and ocean models, Machine learning.

PhD at the crossing between Statistical Machine learning, dynamical systems, ocean dynamics, data assimilation.

Context. The precise numerical simulation of geophysical flows such as the atmosphere or the ocean is becoming a crucial need in many aspects of our everyday life for it strongly impacts many environmental and economical fields. We may think, among others, to applications related to climate studies, oceanographic analysis or weather forecasting which are of paramount importance for the study of global warming, the tracking of polluting sheets or the prediction of catastrophic events. Unfortunately, the laws ruling such geophysical processes depend on state variables evolving in huge dimensional spaces with a strong scale coupling in space and time. The range of these interactions is so large that only large-scale representations of the system of interest can be simulated. In the other hand, one may have access nowadays to series of finely resolved data sequences depicting the footprint of the small-scale flow action.

Goals. Recently efficient stochastic parameterizations have been proposed to deal with models errors associated to such large-scale representation [2,4]. This framework provides in addition a way to handle the propagation of uncertainties along time. The noise representing the neglected scales and its dynamics have nevertheless to be specified in a way or another. In the PhDs proposed we aim at exploring several techniques to characterize this noise from time series of high resolution data such as provided by satellite or by high-resolution simulations. The objectives of these different PhD thesis will consist in exploring the following topics:

- Modelling/simulation of stochastic ocean models for ensemble forecasting and uncertainty quantification
- Dynamics specification and learning of model errors from high-resolution data
- Data assimilation ensemble strategies to couple stochastic ocean model and high resolution satellite data

These PhD are funded by an ERC program in collaboration with Imperial College (London) and Ifremer (Brest). They will lead to strong collaborations with both institutions. These PhDs are at the crossing between several disciplines. We will explore several tools and models developed for Bayesian ensemble data assimilation [4], modal representations in fluid mechanics [3], realistic ocean models and codes, stochastic modelling and nonlinear filtering, statistical learning [1]. The objectives of the PhD will be defined with respect to the candidates' profile and willing.

 The candidates will work in the Fluminance team located in Rennes. The team is part of INRIA (www.inria.fr), which is one of the leading research center in computer sciences in France. Fluminance is as well affiliated to the mathematics research institute of the Rennes University (IRMAR). These PhD thesis will be led in strong collaboration with Imperial College and Ifremer (french oceanic research institute) within the ERC program "Stochastic Transport in upper ocean dynamics" (STUOD). The main research activities of Fluminance focus on the study of turbulent flows from image data sequences, which encompasses many issues for the analysis of experimental and geophysical flows. We refer the candidates to the team's website for more information:
http://www.irisa.fr/fluminance/indexFluminance.html

Duration: 36 month.

Skills and profile

The candidates should have a solid background in applied mathematics , or fluid mechanics, or geophysics. She/he must have a good knowledge of Matlab or Python, and Fortran or C/C++. He/She must have a master degree related to **fluid mechanics**, **computational physics** or **applied mathematics**.

Contact

Applicants must send their candidature (resume and letter of motivation) to

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Bibliography:

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