Initialisation of coupled ocean-atmosphere models.

Msc research Internship proposal

Supervisors

Florian Lemarié

Arthur Vidard

Location

AIRSEA project team (INRIA, LJK lab.)
Bâtiment IMAG – 700 avenue centrale
Campus Universitaire de Saint Martin
d'Hères, Grenoble

Keywords

Data assimilation, Schwarz methods, model coupling, optimal control.

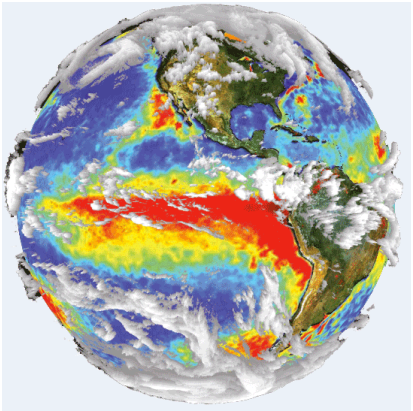
Contact

E-mail : Arthur.Vidard@inria.fr, florian.lemarie@inria.fr
Team's website : http://team.inria.fr/airsea

Context

The development of modelling systems is currently an important aspect in most disciplines. Almost no system can be considered as truly self contained therefore one has an increasingly tendency to develop the the coupling of several models (eg fluid-structure, ocean-atmosphere, ...).

In particular, recent years have seen a growing need for ocean-atmosphere numerical forecasts. Historically dedicated to long term climatic applications, they are more and more used for shorter meteorological range. In order to use such numerical models it is necessary to estimate their initial and boundary conditions. This can be done combining models and observations through so-called data assimilation methods. This is use routinely in meteorology or oceanography for every-day forecasts. However, these methods have been constructed to be applied on stand-alone models. Going from simple systems (a single uncoupled model) to complex systems (coupled models) would require to improve the assimilation methods, which are in that case currently suboptimal.



The development of efficient data assimilation methods for coupled models is a crucial step to improve the simulation and forecast of complex phenomena. Indeed, combining heterogeneous information (coupling heterogeneous models scale, multi-fluid, multi-phase and observations of all kinds) optimally is challenging

Topic description

For practical and scientific reasons a good starting point is generally to couple the assimilation systems rather than the model themselves. Current practice is to first assimilate data into the atmosphere model, correcting the ocean-atmosphere interface, and then use this corrected interface during the data assimilation into the ocean model. This ad-hoc approach can actually be seen as a first iteration of a more theoretically-grounded Schwarz iterative domain decomposition method and therefore the result consistency could be improved by repeating the process several times.

During this internship, the trainee student will first conduct a theoretical study on the convergence properties for simple data assimilation methods of such an iterative process, depending on the interface conditions. Then a simplified demonstrator will be implemented for illustration of the theoretical results. The system under consideration will be composed of two 1D equations coupled with conditions on the interface representative of those that are usually found in an ocean-atmosphere coupling. One of the goal here is to propose improved interface conditions that would accelerate the convergence of the Schwarz method.

This internship can lead to a PhD.

prerequisites

- Basic knowledge in numerical analysis and optimisation.
- Programming skills in python and/or Fortran.

Bibliography

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