Perfectly matched layers for a compressible nonhydrostatic ocean model *(research)*

Scientific advisors Eric Blayo (LJK, UGA) - Eric.Blayo@univ-grenoble-alpes.fr - 04 57 42 17 11
Laurent Debreu (LJK, Inria) - Laurent.Debreu@inria.fr - 04 57 42 17 25
Emilie Duval (LJK, Inria) - Emilie.Duval@inria.fr

Location Laboratoire Jean Kuntzmann, team AIRSEA
IMAG building, 700 avenue centrale, 38401 Saint Martin d'Hères

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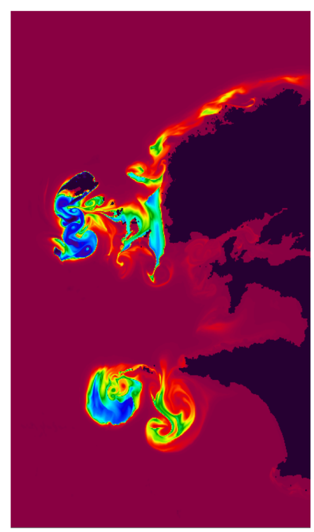
Context Ocean circulation models are used, similarly to atmospheric models, for numerous applications, like long-term climate simulations, seasonal forecasting, or short-range operational forecast, either at global or regional scales. Most ocean circulation models are based on the so-called *primitive equations*, which make use of the hydrostatic approximation. This approximation neglects the vertical acceleration and results in a balance between the vertical pressure gradient and the gravity. From a dynamical point of view, this is justified by the fact that oceanic flows are generally characterized by large differences between horizontal and vertical scales and by a strong vertical stratification that limits vertical mixing. From a computational point of view, the hydrostatic approximation decreases the computational burden by one order of magnitude w.r.t. solving the nonhydrostatic equations.
However continuous improvement in numerical modeling and in computing resources leads to more and more sophisticated ocean modeling systems, which aim at representing the full ocean physics. In the context of the French national initiative CROCO (`www.croco-ocean.org`), a new model is currently being developed, that will have the capability of resolving very fine scales. This model will thus be able to solve, at least locally, compressible nonhydrostatic equations and to couple this local solution with a hydrostatic solution computed on a much larger domain.

Objectives In this context, the objective of this work is to prepare such coupled simulations by investigating the potential of Perfectly Matched Layers (PMLs) for these equations. PMLs are so-called "open boundary conditions", i.e. boundary conditions that should be able to mimic the behavior of a free open limit, by letting quantities go out of the domain without spurious reflections. PMLs are particularly efficient in the context of wave propagation, and have also been tested for systems of first-order PDEs. During this training period, the objectives will be to :



- make a review of some scientific papers designing PMLs for different systems of equations
- apply this methodology to compressible nonhydrostatic equations
- perform a theoretical analysis of its performance
- design a numerical case test for validation
- perform and analyze numerical simulations

Prerequisites basic knowledge in numerical analysis, programming skills

References

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