Coupling hydrostatic and nonhydrostatic ocean circulation models

(research)

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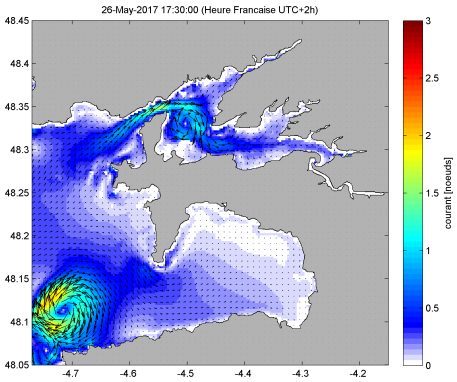
Context Ocean circulation models are used, similarly to atmospheric models, for numerous applications, like long term climate simulations, seasonal forecasting, or short range operational forecast, either at global or regional scales. Most ocean circulation models are based on the so-called *primitive 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. A natural idea is thus to build systems that couple local nonhydrostatic models to larger scale hydrostatic ones. Such a coupling is quite delicate from a mathematical point of view, due to the different nature of hydrostatic and nonhydrostatic equations (where the vertical velocity is either a diagnostic or a prognostic variable). Blayo and Rousseau (2016) performed a first work in this direction, which analyzes the conditions to be satisfied at the interface between both models, and derives possible interface conditions to be used in an iterative coupling algorithm. However this study is fully theoretical.

Objectives In this context, the objective of this work is to study a possible numerical implementation of those ideas. This covers several aspects :

- design of a coupling algorithm and of its interface conditions
- theoretical analysis of its convergence
- design of a numerical case test for validation
- realization and analysis of numerical simulations
- optimization of the interface conditions for improving the convergence rate



Prerequisites basic knowledge in numerical analysis, programming skills

References

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