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Modeling and numerical approach of dispersive waves in goephysical flows

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When modelling and simulating geophysical flows, the Nonlinear Shallow-Water equations, hereinafter SWE, is often a good choice as an approximation of the Navier-Stokes equations. Nevertheless, SWE do not take into account effects associated with dispersive waves. In recent years, effort has been done in the derivation of relatively simple mathematical models for shallow water flows that include long nonlinear water waves.

Classically, this is done by using Boussinesq-type models [1], which incorporate high order derivatives in order to improve dispersion relations. Nevertheless, the numerical treatment of such high order terms may be cumbersome. In recent years, an alternative based on the so-called non-hydrostatic systems has been proposed. These non-hydrostatic models allow to improve the dispersion relation of the SWE while avoiding high order derivatives.

In fact, it is shown in [2] that both approaches are essentially equivalent, while the non-hydrostatic approach has several advantages over Boussinesq-type models. In practice, non-hydrostatic systems may be solved by incorporating a relaxation of the divergence-null constraint. The resulting hyperbolic system may be then discretized by using a high-order path-conservative scheme.

Non-hydrostatic systems may also be combined with multilayer techniques. In that way, the more number of layers we use, the better the dispersion relation we obtain.

REFERENCES

[1] J. Boussinesq. Théorie des ondes et des remous qui se propagent le long d'un canal rectangulaire horizontal, en communiquant au liquide contenu dans ce canal des vitesses sensiblement pareilles de la surface au fond. *Journal de Mathématiques Pures et Appliqués*, pages 55–108, 1872.

[2] C. Escalante and T. Morales de Luna. A general non-hydrostatic hyperbolic formulation for boussinesq dispersive shallow flows and its numerical approximation. *Journal of Scientific Computing*, 83(3):62, June 2020.