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Non-hydrostatic simulation of tsunamis: application to the April 2014 Iquique earthquake

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The quantification of non-hydrostatic effects in tsunami modelling is still an open issue. We present here a new numerical method to solve the two-dimensional dispersive shallow water system with topography proposed recently by [3]. This model is a depth averaged Euler system and takes into account a non-hydrostatic pressure. Interestingly, this model is close to but not the same as the Green-Naghdi model. An incompressible system has to be solved to find the numerical solution of this model. The solution method [1,2] is based on a prediction-correction scheme initially introduced by Chorin-Temam [4] for the Navier-Stokes system. The prediction part leads to solving a shallow water system for which we use finite volume methods, while the correction part leads to solving a mixed problem in velocity and pressure. For the correction part, we apply a finite element method with compatible spaces on unstructured grids.

Several numerical tests are performed to evaluate the efficiency of the proposed method, in particular, comparisons with analytical solutions are given. Finally we simulate the tsunami generated by the Iquique earthquake that occured on April 1 2014 and compare the simulation with the tsunami data at two DART stations for both hydrostatic and non-hydrostatic models.

References

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