A MULTILAYER SYSTEM WITH MASS EXCHANGE FOR SHALLOW WATER FLOWS COUPLING WITH MOVING BED EQUATION

E. Audusse*, **F. Benkhaldoun**×, **S. Sari**×, **M. Seaid**†

*×LAGA, Université Paris 13
99 Av J.B. Clement, 93430 Villetaneuse, France
e-mail: audusse@math.univ-paris13.fr,fayssal@math.univ-paris13.fr,sari@math.univ-paris13.fr

†School of Engineering and Computing Sciences, University of Durham
South Road, Durham DH1 3LE, UK
e-mail: m.seaid@durham.ac.uk

ABSTRACT

Due to computational issues associated with the free surface Navier-Stokes or Euler equations, the simulations of geophysical flows are often carried out with shallow water type models of reduced complexity. For these vertically averaged models, efficient and robust numerical techniques (relaxation schemes, kinetic schemes) are available and avoid to deal with moving meshes.

However when flows with large friction coefficients, with significant water depth or with important wind effects are considered, the horizontal velocity can hardly be approximated – as in the Saint-Venant system – by a vertically constant velocity. To drop this limitation a multilayer Saint-Venant model has been introduced, where the different layers have their own velocities. This first approach was closely related to some works devoted to the solution of a system of two non-miscible fluids. Here we propose to study a new class of multilayer Saint-Venant systems that allows the fluid to circulate from one layer to the connected ones. In this model the multilayer approach consists in prescribing the vertical discretization of the horizontal velocity by performing a Galerkin approximation in Lagrangian formulation. This leads to a global continuity equation and allows mass exchanges between layers.

We first focus on the comparison of different numerical strategies to handle the specific difficulties of this class of systems. In particular we compare the extensions of the kinetic schemes and of the finite volume method of characteristics. Then we consider an extended model where we include an equation that takes into account the influence of the flow on the bottom topography and we compare the numerical results that are obtained for classical and multilayer approaches with available experimental data.

REFERENCES

[1] E. Audusse, A multilayer Saint-Venant System : Derivation and Numerical Validation, *Discrete Contin. Dyn. Syst. Ser. B* **5**, pp. 189-214 (2005)

[2] E. Audusse, M.O. Bristeau, B. Perthame and J. Sainte-Marie, An Exchanging Mass Multilayer Saint-Venant System for Shallow Water flows, *submitted.*