LAYER-AVERAGED APPROXIMATIONS FOR FREE SURFACE FLOWS: FLUIDS, LANDSLIDES AND SEDIMENT TRANSPORT

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ABSTRACT. In this talk a multilayer or layer-averaged approximation of Euler and Navier-Stokes equations for complex applications will be presented. Firstly, we focus on the derivation of this approach for Navier-Stokes equations with hydrostatic pressure and constant viscosity introduced in [3]. In this paper it is derived the multilayer model presented in the pionering work [1] as a discontinuous Garlekin method. Secondly, several applications of this technique will be presented: landslides with a $\mu(I)$-rheology multilayer approach (see [5]), suspended sediment transport (see [4] and [7]) and sediment transport with a semi-implicit discretization (see [2]). Finally, for the case of non-hydrostatic pressure, a hierarchy of dispersive layer-averaged approximations of Euler equations will be presented (see [6]).

Keywords: multilayer, free surface, sediment transport, landslides, non-hydrostatic

Mathematics Subject Classifications (2010): 35L02, 65M08, 76T20, 76T25

REFERENCES

[1] E. Audusse, M. Bristeau, B. Perthame, J. Sainte-Marie. A multilayer Saint-Venant system with mass exchanges for shallow water flows. derivation and numerical validation. *ESAIM: Mathematical Modelling and Numerical Analysis*, 45:169–200, 2011.

[2] L. Bonaventura, E.D. Fernández-Nieto, J. Garres-Díaz, G. Narbona-Reina. Multilayer shallow water models with locally variable number of layers and semi-implicit time discretization. *Journal of Computational Physics*, 364:209–234, 2018.

[3] E.D. Fernández-Nieto, E.H. Koné, T. Chacón. A Multilayer Method for the Hydrostatic Navier-Stokes Equations: A Particular Weak Solution. *Journal Scientific Computing*, 60:408–437, 2014.

[4] E.D. Fernández-Nieto, E.H. Koné, T. Morales, R. Bürger. A multilayer shallow water system for polydisperse sedimentation. *Journal of Computational Physics*, 238:281–314, 2013.

[5] E.D. Fernández-Nieto, J. Garres-Díaz, A. Mangeney, G. Narbona-Reina. 2D granular flows with the (I) rheology and side walls friction: A well-balanced multilayer discretization. *Journal of Computational Physics*, 356: 192–219, 2018.

[6] E.D. Fernńdez-Nieto, M. Parisot, Y. Penel, J Sainte-Marie. A hierarchy of dispersive layer-averaged approximations of Euler equations for free surface flows. *Communications in Mathematical Sciences*, 16(307),pp. to appear, 2018.

[7] T. Morales, E.D. Fernández-Nieto, M.J. Castro. Derivation of a Multilayer Approach to Model Suspended Sediment Transport: Application to Hyperpycnal and Hypopycnal Plumes. *Communications in Computational Physics*, 22(5):1439–1485, 2017.

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