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A double coordinate system for submarine avalanches modelling

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The main goal of this work is to deal with the simulation of immersed granular avalanches. This kind of problems has been treated through averaged models following the pioneer work of Savage and Hutter [Acta Mech. 86, 1991], where a shallow water model is proposed to study dry aerial avalanches. This model has been successfully applied to simulate real and laboratory experiments. In [Bouchut, Fernández-Nieto, Mangeney, Lagrée. Acta Mech. 199, 2008], a
Savage-Hutter type model has been proposed taking into account the curvature of a general bottom. Thus, the avalanche is described using local coordinates in terms of the bottom.

In the case of submarine avalanches it is necessary to take into account the interstitial fluid (see [Iverson, Denlinger. J. Geophys. Re. 106, 2001]) but in this work we focus on the coordinate system in the derivation of the model.
Thus, in the case of a submarine avalanche, we consider a water top layer and a submerged granular layer, that can be described using only one coordinate system (Cartesian or local coordinates). Nevertheless, this is not appropriate to correctly describe the behavior of both, water and granular layers.

In this work we present the derivation of a new two-layer shallow model of Savage-Hutter type to study submarine avalanches. Our approach consider two different coordinate systems to deal with the modelling of both, the fluid and the granular layers over a fixed bottom. The
fluid layer is described in Cartesian coordinates; based on previous works [Bouchut et al. 2008 and Fernández-Nieto, Vigneaux. Sema Semai Springer Series 3, 2014] and a change of variables from Cartesian to local coordinates is performed for the description of the granular layer. Coulomb friction law is imposed at the bottom and we also consider the friction between the fluid and the granular material. The latter is defined in such a way the obtained model accounts with a dissipative energy balance.

Finally, we check the validity of the model with several numerical tests and, in particular, the
results are compared to laboratory experiments.

Auteurs principaux: Mme MANGENEY, Anne (IPGP); M. FERNÁNDEZ-NIETO, Enrique D. (Université de Séville); NARBONA-REINA, Gladys (Université de Séville); M. DELGADO-SÁNCHEZ, Juan Manuel (Université de Séville)

Orateur: NARBONA-REINA, Gladys (Université de Séville)

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