

Interactive comment on “A two-phase model for numerical simulation of debris flows” by S. He et al.

Anonymous Referee #3

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The theme is certainly topical, because in the literature there are several models for debris flow simulation, but at the same time a comprehensive overview of all open issues is still lacking and some important aspects of the matter are still unresolved. The model presented here is a quasi-biphasic model, in which the granular phase is treated with a Coulomb plastic constitutive relation with constant friction angle. From this point of view, the model used here does not deviate from the model already introduced by Pitman and Le (2005) and by Pudasaini (2011), mentioned several times in the paper, and this fact undermines the originality of the paper.

However, many of the issues left open by the papers of Pudasaini and of Pitman & Le, are not even mentioned here, such as the choice to neglect any collisional component (shear dependent part) of the stress tensor T_s of the solid phase, the linear nature of

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the component of the drag forces of interaction between the two phases, the hypothesis of absence of turbulence (Reynolds stresses) in the liquid phase. The absence of reference to the latter point is particularly surprising when one considers that the authors acknowledge the great importance of the viscosity of the fluid phase.

These issues restrict the applicability of the model to a rather narrow class of problems. The greatest limitation of the model, however, lies in the fact that it is not able to simulate the processes of erosion and deposition. From this point of view, it is comforting that the authors acknowledge the need for a general model of debris flow to be able to simulate the effect of entrainment (and I would consider also deposition in the final stage of the flow), which is equivalent to saying that the bed elevation is (and should remain) a dependent variable of the problem. This consideration, which I agree perfectly with, severely limits the range of applicability of this type of rheological modeling of the debris flows. Moreover, in the literature there are now many two-phase models able to take this aspect into account. Furthermore, the authors are not able to validate their model with any experimental data, but give only a comparison with the results of an application of the model of Pitman and Le. The literature cited is rather incomplete. Finally, I find the last sentence of section 6 of the paper questionable: here the authors state that “The present model is relatively simple and is advantageous for the numerical solution and application”. I do not think that the present model is simpler than other models, but because of the above limitations it is not suitable for many applications.

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