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Discussions

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

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The authors would like to express deep appreciation again to the editors and the re-
viewer for your useful comments on our manuscript entitled "A two-phase model for nu-
merical simulation of debris flows". The authors thus revised the manuscript carefully
and explained the questions presented by the reviewer. The following are the neces-
sarily responses for the comments in detail: (1) Debris flows are typical fluid-granular
flows and three classical two-phase models were presented by Iverson (1997), Pitman
(2005) and Pudasaini (2012). Iverson's model which is based on the mixture theory
ignored the interactions between the solid phase and fluid phase, is really a one phase
model. Pitman (2005) proposed a real two phase model in which buoyancy and drag

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force are considered, but the viscosity is ignored in this model. In Pudasaini's model,
buoyancy, drag force and a virtual mass are considered, and a non-Newtonian viscous
stress is used to model the fluid phase. As we know, the interaction forces between
solid and fluid phase of a two phase flow includes buoyancy, drag force, the virtual
mass force, lift force, Basset force, interfacial pressure force as well as the turbulent
Reynolds stress. However, it is too complex to consider all the interactions in one
model. It is reasonable to select one or two of the most remarkable quantities ac-
cording to the characteristics of the targeting debris flow. Erosion can change the solid
volume fraction of the flow and a non-Newtonian model is more suitable under this con-
dition, while if erosion is trivial Newtonian flow model can be used. Furthermore, real
debris flow can be very viscous (mud flow) or can be very fluidlyïijĹwater-rock flowïijĽ,
to simulate this two different debris flow with general model is very difficult. (2) The
model in this paper provided some modifications based on the forementioned three
classical models, and furthermore a high-resolution finite volume scheme based on
the Roe-type Riemann solver is programmed to solve the equations. (3) In the paper,
some improvements both on the model and algorithm are provided. However, too much
material cites references of Pitman (2005) and Pudasaini (2012) without modification
in writing of the paper. This will be revised in potential revisions.

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