# Some High-Resolution Simulation Results for Quasi Three-Dimensional and Two-Phase Mass Flow Dynamics

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**Abstract:** Landslides, debris avalanches, debris flows, and flash floods are highly destructive and unpredictable geophysical mass movements. So, the study of their dynamics is very important for mountainous countries like Nepal which witnesses a large number of catastrophic events every year. We employ the general two-phase mass flow model developed by Pudasaini (2012). This model, as a set of non-linear PDEs, is a comprehensive theory that accounts for a strong interaction between the solid and fluid phases. Not only the buoyancy but also other three dominant physical aspects of the mass flows, such as enhanced non-Newtonian viscous stress, virtual mass force, and generalized drag are incorporated in the model. Simulation results provide the time and spatial evolution of solid and fluid components, geometrical evolution of the debris mixture as a whole, and the solid and fluid velocities in the flow directions. Simulation results reveal some observable phenomena in real two-phase debris flows, namely, the formation of a strong front surge head dominated by solid followed by a relatively long tail, mainly consisting of fluid (Kattel, 2014). The results obtained for different physical and material parameters, including the virtual mass coefficient, the drag coefficient, the density ratio and the basal friction angle show that the simulation strategies and the model equations can be applied to study the flow dynamics of a wide range of geophysical and industrial mass flows like snow/rock avalanches, flow of powders and grains in process engineering, debris flows, flash floods as well as glacial lake outburst floods (GLOF). This helps in adopting mitigation measures against natural hazards, as well as in enhancing production process of mixture materials in industries.

**Keywords:** Mathematical modeling, Two-phase mass flows, Debris flows, High-resolution numerical simulation, Natural hazards, Mitigation measures.

## References:

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