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A 1DH mathematical and numerical scheme for dry granular flows

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Geophysical granular flows are characterized by a mixture of solid particles and an interstitial fluid. Snow avalanches or rock avalanches fall into the category of granular flows in which the interstitial fluid is air: they are composed by particles of snow and ice or rock immersed in air. Due to the complexity of these phenomena, there are many issues still open regarding the modeling of such types of granular processes.
All the existing models for dry granular flows are based on the integration of the mass conservation and momentum conservation equations, for both the phases (two-phase approach) or for the whole mixture (one-phase approach). They differ from each other in the definition of different closure relations or in the empirical relations adopted to reproduce the entrainment effect, which is a key feature of the models.
We present a 1D depth integrated mathematical model, which is based on a two phase approach. It is characterized by at least three main innovative aspects: i) the equations needed to describe mathematically the two-phase flow are derived from the mass balance of the two phases (solid particles and fluid, that is air) and the momentum balance for the solid phase; ii) it is a mobile bed model, accounting for erosion and deposition without any artificial formulation; iii) the solid phase concentration is not considered constant, but it is assumed to be a function of the velocity of the flow and of the flow depth. Furthermore, to close the system of equations we used two closure relations.
The model has been numerically solved through a path conservative finite volume scheme and the first results are quite promising.