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On the application of kinematic models and diffusive processes for debris flows.

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Debris flows generally propagate along mountain torrents characterized by very steep slopes. Thus the dynamics of debris flows are primarily governed by gravitational and frictional forces, which are related to the channel slope and to the friction slope respectively. On the contrary, on milder slopes, also the forces originating along the flow-depth gradient can play an important role, as well as the inertial forces. The modelling of debris flows occurring on steep slopes is thus generally conducted by means of the application of the so-called kinematic model, which takes into account only the effects of slope and friction and neglect all the remaining terms. The application of kinematic models describes fairly well the experimental and field evidences of the propagation of debris flows along torrents, particularly the changes in space and time of discharge and flow stage.

Notwithstanding some questions may arise. These latter regard a) the diffusion processes that take place in debris flows: these cannot be theoretically predicted by kinematic models, since diffusion is a second-order process b) the influence of numerical diffusion on integration. In other words, theoretically speaking, the one-to-one relationship between discharge and stage, a key trait of the kinamatic wave, imposes a significant physical and mathematical constraint, that is the absence of dissipation. This is not generally shown by the application of numerical models to debris flows, even when the solution is analytically obtained.

In the paper a discussion of these aspects is made, by referring also to the debates

on the same subject arisen for flood waves. An application of a generalized diffusion wave model and of a kinematic model is proposed for a debris flow occurred in Rio Moscardo (Italy) and recorded by some ultrasonic sensors. The results show the limitations of the applied models, whose application is discussed by means of the calculation of dimensionless parameters proposed in literature.