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Simulations of the Basal Forces Generated by Dam Breaks: Comparison Between Continuous and Discrete Models

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Numerical simulations of granular flows have been widely developed and used during the last two decades. Depending on the situation and scale of the simulations, different methods are used, each having specific pros and cons. Among them, three main methods can be distinguished such as; discrete, continuous or depth-averaged approach. At the laboratory scale, discrete approach consists of representing all the grains and contacts. When the amount of grains are important enough to consider the granular medium as an effective fluid, Navier-Stokes simulations can be performed using an appropriate rheology for the fluid, like the -rheology. However, when simulations are performed on geophysical scales none of these two methods can be used because of the enormous computation time required to solve them. To cope up with this issue, the depth-averaged approachs wherein the normal velocities are neglected, considerably reduce the computation time.

Even though all these models have been widely used, it is not clear exactly what information can be extracted about the forces exerted to the ground. These forces represent a new way of visualising a geophysical granular flow. Indeed, very recently, the recorded seismic signals from geophysical granular flows were used to interpret these forces. As a result, seismic data can be used to extract information on the flow dynamics which was missing due to the difficulties of direct observation (ashes, dust, etc...). Being able to compute and interpret the forces generated by a granular flow on
the ground represents a new way for calibrations of numerical methods and is a key point in analysing seismic data generated by granular flows and subsequently in understanding the landslide dynamics at the geophysical scale.

After a quick presentation of the numerical differences between the three models, we present comparisons between discrete, continuous [1] and depth-averaged [2] models. Besides, we put forward this study on the values taken by the forces generated on the ground during the evolution of granular dam breaks. Although, these three methods give relatively the same final deposits, in good agreement with the experiments, we observe they lead to very different dynamics in terms of flow acceleration, forces and histories.

1. http:basilisk.fr.

2. A. Mangeney et al., JGR 112 F02017 (2007)