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Numerical simulation of dam-break mudflow based on the Herschel-Bulkley model

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Mudflow behaves normally the flowing properties of viscoplastic or pseudo-plastic stemming from flocculent network structures formed by fine particles within the mud. In order to obtain the dynamical characteristics of the dam-break of mudflow, a numerical model has been developed in the present study. The numerical model solved the Navier-Stokes equation with the Herschel-Bulkley model, which exhibits a plastic properties of fluid with shear-thinning. The two-step projection method are employed to solve the velocity field in present numerical model, and the Bi-CGSTAB technique are implemented to solve the pressure Poisson equation. The volume of fluid (VOF) method is used to track the broken the free surface. In this study, the numerical simulation of dam-break with Herschel-Bulkley fluid are implemented, the numerical results agree well with the other numerical results. Furthermore, when the shear-thinning index is equals to unity, the Herschel-Bulkley model becomes Bingham model. In this study, laboratory experiments of dam-break of slurry in the flume have been conducted to record data with time of the surface height of mudflow and pressure in the bottom of flume. The same cases with laboratory experiments are implemented in our numerical model, the numerical results match with the laboratory experiments. Finally, as a demonstration, the impact of mudflow on the structures are simulated and discussed.