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Evaluation of debris-flow model parameterization through laboratory investigations

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In engineering practice simulation tools for predicting the flow and deposition behavior of debris flows are often based on of simple rheologic equations describing bulk flow resistance. Model parameterization and validation is often connected to large uncertainties due to the lack of field data. Moreover it has been shown that debris flow simulation models are generally limited in representing actual flow mechanics of most natural flows. In this contribution we test the possibility to parameterize simple flow models by laboratory investigations at different scales. We estimate parameters for the Bingham model from a suite of laboratory experiments in different setups, including a standard viscometer, a tilt board, a conveyor belt, and a rotating drum. Material samples were taken from fresh deposits of a muddy debris flow and analyzed over a range of volumetric sediment concentrations and maximum grain sizes. Our results are relatively consistent between most setups. Estimated rheologic parameters show an exponential dependence on volumetric sediment concentration and a systematic variation for mixtures of different maximum grain sizes. Our data shows that a rheologic interpretation of bulk flow behavior seems feasible at the laboratory scale, but the possibility of extrapolation of rheologic parameters for the prototype flow to be directly used in numerical simulation tools is expected to be limited.