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Simulation of past lahar events at the most active Mexican volcanoes: Popocatépetl and Volcán de Colima

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Lahar modeling has been widely used to define lahar transport and flood-prone areas. Some models (e.g. FLO2D) allow the possibility to take into account physical and dynamic parameters of the flows, including the rheological properties of the fluid and the sediment concentration of the mixture. Nevertheless, one of the issues during the application of these models is to define precisely these parameters, especially in past lahar events whose dynamic characteristics are inferred only by textural analysis of its deposits. Two lahar episodes that occurred at Colima and Popocatépetl volcanoes (México) are modeled using the FLO2D code, with the scope to define the parameters that control flow simulation and their reliability. The Lahar Patrio at Volcán de Colima was used to evaluate the model performance related to the influence of input hydrograph shape and Manning n-value in the absence of real data. The Popocatépetl 2001-lahar was used to evaluate the model response to lahars with different rheologic behaviors. Input parameters for lahar modeling like hydrograph, Manning n-values, and rheologic coefficients were derived from geophone data, channel geometry and textural characteristics of the deposits. Three parameters were used to validate the simulations: the percent length ratio, the fitness function, and flow depths. This approach shows that a simplified hydrograph can be a good approximation for lahar simulation. On the contrary, Manning-n coefficient has a stronger influence on simulation results. The greatest uncertainty in lahar modeling with FLO2D is the selection of rheologic coefficients since very little changes in their magnitude can affect the simulation results. When a proper assessment of these input parameter uncertainties is performed, results obtained with FLO2D can be very useful for lahar hazard evaluation.