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Assessing the hazard posed by lava flows at Mt Etna (Italy) through numerical simulations: sensitivity to input settings

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Lava flows pose a significant threat to human properties and infrastructures at densely populated, active basaltic volcanoes such as Mount Etna. To effectively tackle this issue, the emerging technique is to create hazard maps through the simulation of possible future lava flows. Recently, for Mount Etna, a number of hazard maps by lava flows have been derived in this way by using similar procedures but different codes for the simulations. Here we consider in detail one of these maps, derived by using the DOWNFLOW code, to explore the sensitivity of the map with respect to input settings. Three parameters are varied within ranges close to values recently applied to derive similar hazard maps: (i) the spacing between computational vents; (ii) the spatial probability density function (PDF) for future vent opening; and (iii) the expected length of future lava flows. It is important to recall that points (i) and (ii) describe settings which are used, exactly in the same form, when working for a similar target with different simulation codes such as MAGFLOW or SCIARA. The effect of increasing the spacing between computational vents tends to be compensated at the lower elevations, and a vent spacing smaller than about 500 m warrants an overall difference with respect to a reference map which is smaller than 6–8%. A random subsampling of the elements used to obtain the input vent opening PDF (-20%, -40% and -60%) originates significant but drastically smaller differences in the obtained map with respect to the reference one ($\sim$10%, $\sim$12.5% and $\sim$17% respectively, on average). In contrast, our results show that changes in the expected flow length originate, by far, the highest changes in the obtained hazard map, with overall differences ranging between $\sim$20% and $\sim$65%, and between $\sim$30% and $\sim$95% if computed only over inhabited areas. The simulations collected are further processed to derive maps of the confluence/diffluence index, which quantifies the error introduced, locally, when the position of the vent is misplaced by a given distance.