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Lava flow numerical simulation for hazard evaluation and mitigatory actions

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The lava flows emplacement and path have been studied through field observations as well as through analytical and numerical modelling. Simulations of lava flow emplacement attempt to reproduce the interaction between a flow's physical properties, effusion rate history and the terrain, leading to the final flow extent and morphology observed in the field. Unfortunately, it is very difficult to establish straightforward relationships between physical properties of a lava flow and its morphologic parameters such as length or surface structure. In this work we investigated how the numerical simulation can be adopted for evaluating the effectiveness of mitigatory actions. The code MAGFLOW (developed at the TECNOLAB of the INGV, Catania) was utilized to simulate two lava flows emplaced on Etna south flank from the 2700 and 2550 m a.s.l. vents on 2001.
Three different simulations were carried out for assessing the performance of the barriers built during the eruption and for comparing them with alternative barrier configurations. The first test simulated the real event and was necessary to check the goodness of the reconstruction of the two emplacement histories by comparing the real and simulated flow spreading. The second test simulated the path the lava would have naturally followed without the human intervention because it was run on a pre-eruption DEM without including the barriers. The third test simulated an alternative intervention because it was run on a pre-eruption DEM modified for taking into account a barrier built in a position different from that of the actual barriers. This work also showed as lava flow simulations represent a fundamental support for planning the position of a barrier with respect to the lava path.
This work also evidence the importance of the availability of a pre eruption high – resolution Digital Elevation Model (DEM) for obtaining reliable results. The same analysis will be extended to other recent eruptions for supporting hazard assessment in a meaningful range of variation.