Geophysical Research Abstracts,
Vol. 10, EGU2008-A-00923, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-00923
EGU General Assembly 2008

Considerations on an integrated approach for mapping mud-flow and lava-flow susceptibility and hazard, by means of numerical modelling and GIS techniques, historical and geo-environmental analyses, recently applied in Southern Italy

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An integrated method for mapping mud-flow and lava-flow susceptibility and hazard has recently been tested to different study areas of Southern Italy, by making use of numerical models, and GIS-techniques for data analysis, besides geo-environmental and historical evaluations. Maps have been obtained through a statistical approach, by simulating a high number of events in a parallel computing environment (cluster). Simulations have been performed in successive sets, by progressively increasing the spatial density of the sources of hypothesised events. Employed models (Sciddica for mud flows, Sciara for lava flows) have first been calibrated and validated against past events occurred in the same study areas (or within similar geo-environmental settings). At this purpose, genetic algorithms revealed to be a useful and efficacious tool for tuning model parameters. The study areas are located: in Campania (Pizzo d'Alvano massif, Valle Caudina, Ischia), and in Calabria (Tyrrhenian coastal sector, between the villages of Bagnara and Scilla; in the surroundings of Vibo Valentia; Jonian coastal sector, between Copanello and Locri), as far as mud-flow phenomena are concerned; in Sicilia (Eastern flank of Mt. Etna), regarding volcanic issues. The selected areas are quite diffusely urbanised, and are crossed by notable networks (road, railway). They have repeatedly been affected by either mud-flow or lava-flow damaging events in historical time. Some of the recentmost damaging events, related to

either mud-flow or lava-flow phenomena, have been selected for each study area, aiming at model calibration and validation. A quantitative evaluation of the simulations, with respect to the real cases, has been performed by means of a simplified function of “fitness”, mainly considering the areas affected by the simulated and/or the real events. A regular grid of possible sources has then been hypothesised. For each source, a statistically-significant number of simulations has been planned, by adopting combinations of sources’ and “material” characteristics, selected by considering available geological and historical data. Performed simulations have been stored in a GIS environment for successive analyses and map elaboration (at present, for some of the considered areas, the final set of simulations is still in progress). Probabilities of activation, empirically based on past events, have been assigned to each source of the grid, by considering its location and other geological information. Similarly, different probabilities can be assigned to each “type of event”, by taking into account their observed historical frequencies, and by analysing the triggering mechanisms. Finally, two types of maps have been realized for each study area. The first one (susceptibility map) has been realised without assigning any probability to the performed simulations, by simply counting the frequencies of flows affecting each site. In the second (hazard map), information on past events has been taken into account, and probabilities have been “empirically” attributed to each simulation, based on location of sources and types of event. Obtained results are only preliminary, as they are based on a subset only of the overall planned simulations. Nevertheless, they clearly depict the most susceptible and hazardous sectors, according to the assumed criteria. In the present study, the main assumptions of the adopted methodological approach are briefly commented, together with a description of its strong and weak points, with reference to some of the mentioned case studies.