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# Uncertainty propagation analysis applied to volcanic ash dispersal at Mt. Etna by using a Lagrangian model

Mattia de' Michieli Vitturi (1), Federica Pardini (1), Antonio Spanu (2), Augusto Neri (1), and Maria Vittoria Salvetti (3)

(1) Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Pisa, Pisa, Italy (demichie@pi.ingv.it), (2) Deutsches Zentrum für Luft- und Raumfahrt, München, Germany, (3) Dipartimento di Ingegneria Civile e Industriale, Università di Pisa, Italy

Volcanic ash clouds represent a major hazard for populations living nearby volcanic centers producing a risk for humans and a potential threat to crops, ground infrastructures, and aviation traffic. Lagrangian particle dispersal models are commonly used for tracking ash particles emitted from volcanic plumes and transported under the action of atmospheric wind fields. In this work, we present the results of an uncertainty propagation analysis applied to volcanic ash dispersal from weak plumes with specific focus on the uncertainties related to the grain-size distribution of the mixture. To this aim, the Eulerian fully compressible mesoscale non-hydrostatic model WRF was used to generate the driving wind, representative of the atmospheric conditions occurring during the event of November 24, 2006 at Mt. Etna. Then, the Lagrangian particle model LPAC (de' Michieli Vitturi et al., JGR 2010) was used to simulate the transport of mass particles under the action of atmospheric conditions. The particle motion equations were derived by expressing the Lagrangian particle acceleration as the sum of the forces acting along its trajectory, with drag forces calculated as a function of particle diameter, density, shape and Reynolds number. The simulations were representative of weak plume events of Mt. Etna and aimed to quantify the effect on the dispersal process of the uncertainty in the particle sphericity and in the mean and variance of a log-normal distribution function describing the grain-size of ash particles released from the eruptive column. In order to analyze the sensitivity of particle dispersal to these uncertain parameters with a reasonable number of simulations, and therefore with affordable computational costs, response surfaces in the parameter space were built by using the generalized polynomial chaos technique. The uncertainty analysis allowed to quantify the most probable values, as well as their pdf, of the number of particles as well as of the mean and variance of the grain size distribution at various distances from the source, both in air and on the ground. In particular, results highlighted the strong reduction of the uncertainty ranges of the mean and variance of the grain-size distribution with increasing distance from source and the significant control of particle sphericity on the dispersal process.

References

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