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Simulation of eruptive columns through the use of PUFF software

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PUFF is a volcanic ash tracking numeric model developed to simulate the behaviour of ash clouds in the atmosphere, with regard to wind field data operating during the eruptive event. This software is intended for use in emergency response situation during an eruption to quickly forecast the position of the ash cloud over some time interval in the immediate future.

PUFF initializes a discrete number of volcanic ash particles that represent a sample of the eruption cloud and calculates transport, turbulent dispersion, and fallout for each particle. Model output, elaborating with PUFF, is a binary file representing the 3-D location, size, and age of each simulated ash particle, one file for each requested forecast interval beyond the eruption date.

The results obtained from simulations with PUFF, are then compared with satellite images referred to the eruptive event, to validate the simulated model.

In this application, the model requires meteorological data of wind fields **GFS** (**G**lobal **F**orecast **S**ystem), acting in the real time, to forecast the movement and dispersion of the ash cloud. The model of analyses and forecast **GFS** is a global no-hydrostatic model, 100 km of resolution, initialized every 6 hours from National Centers for Environmental Prediction American **NCEP** from which it is possible to download wind field data through daily connection.

We simulated, through the use of software PUFF, an eruptive event of Etna utilizing real ash cloud parameters of the paroxysm of July 22 1998, but considering wind field data of September 2005. The results obtained showed that the volcanic ash particles,

inside the eruptive plume, are dispersed in the various levels of the atmosphere in response to the behaviour of wind fields at the various altitudes. The results showed also that the behaviour of eruptive plume changes considerably, even along 24 hours, causing the products to be distributed on the earth's surface in different directions, although generally the eruptive plume has an eastern direction or at the most it is pushed towards the South. Besides, we observed that the dispersion of the ash cloud changes also with erupted particles grain size. An increase in concentration of ash particles, in fact, is obtained when the grain size mean values are lowered. Similarly, a variation in dispersion is obtained when the logarithmic standard deviation of the particle size distribution is changed, enlarging the Gaussian distribution of the volcanic ash particles.

Finally, we tried to simulate an eruptive event both at Etna and at Vesuvio, leaving unchanged the parameters for the volcanic plume and using the wind field downloaded for September 2005. Comparing the simulations we noticed that even the products of two simultaneous events, at the two volcanic centers, display different dispersal axes. Our preliminary data prove that PUFF simulations could be an useful tool to forecast possible dispersal of pyroclastic fall products in case of a future event.