Short-term probabilistic hazard assessment of tephra dispersal: application to the Neapolitan area

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During volcanic unrest episodes, as well as during eruptions, it is of primary importance to produce short term tephra fallout forecast, and frequently update it to account for the rapidly evolving situation. This information is crucial for crisis management, since tephra may heavily affect building stability, public health, transportations and evacuation routes (airports, trains, road traffic) and lifelines (electric power supply). Theoretically, this assessment should be based on sound modeling procedures stemming from frequently updated meteorological forecast and information about the crisis evolution. In addition, the relevance of epistemic uncertainties arising from the forecast of the future eruption dynamics and wind conditions, and from the tephra dispersal model, should be estimated.

Here, we present a new methodology for short term hazard assessment of tephra fallout. This methodology is based on the model BET_EF, in which measures from the monitoring system are used to routinely update the forecast of some parameters related to the eruption dynamics, that is, the probabilities of eruption, of every possible vent position and every possible eruption size. Then, considering all possible vent positions and eruptive sizes, tephra dispersal models are coupled with frequently updated meteorological forecasts. Finally, these results are merged through a Bayesian procedure, accounting for epistemic uncertainties at all the considered steps.

As case study, we report the application of this procedure to Mt. Vesuvius. Tephra dispersal is simulated using two models (the analytical HAZMAP and the numerical FALL3D models respectively). We consider three possible eruptive sizes (a low, a medium and a high eruption scenario respectively) and five possible vent positions (the central crater vent location, and four radial sectors on the volcano slopes). The analysis is performed using the evolving volcano dynamics as simulated during the Civil Protection exercise MESIMEX (2006). The probabilities related to eruption dynamics, and estimated by BET_EF, are based on monitoring parameters, and relative thresholds, that were set and published before the beginning of the exercise.