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A new simulation tool for automatic dilute and dense gas dispersion modelling

Fabio Dioguardi[1], Silvia Massaro[2], Giovanni Chiodini[2], Antonio Costa[2], Arnau Folch[3], Giovanni Macedonio[4], Laura Sandri[2], and Jacopo Selva[2]

[1]British Geological Survey, The Lyell Centre, Edinburgh, United Kingdom (fabiod@bgs.ac.uk)
[2]Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Bologna, Bologna, Italy
[3]Barcelona Supercomputing Center, Barcelona, Spain
[4]Istituto Nazionale di Geofisica e Vulcanologia, Osservatorio Vesuviano, Naples, Italy

The emission of volcanic gases can occur both during volcanic eruptions and in quiescent stages of the volcanic activity. This process can affect the air quality in the areas downwind; in fact, many gas species can be a threat to human health and even life at concentrations and doses above species-specific thresholds. Gas emissions can be of different types, the two main categories being dilute passive degassing and heavy gas flow. The former occurs when the gas concentration is low and/or temperature is high, hence its density is lower than the atmospheric density; the latter takes place when the gas density is higher than the atmosphere and the gas accumulates onto the ground and may flow as a gravity current more or less affected by the wind. Examples of the first and second types of emissions are fumaroles and limnic explosions, respectively.

Numerical modelling is one of the approaches used to quantify the hazard related to these processes. Ideally, for hazard quantification purposes numerous simulations originating from varying the most important input parameters (e.g. wind field, emission rates, etc.) in their range of uncertainty should be carried out. The whole process of gas dispersion modelling is time consuming, since it starts with the assessment of the wind field with an ad-hoc meteorological model, proceeds with the actual gas dispersion simulation and concludes with the post-processing stage. In order to simplify the whole workflow with the final aim to manage numerous simultaneous simulations for hazard assessment applications, we created APVGDM (Automatic Probabilistic Volcanic Gas Dispersion Modelling), a simulation tool made of a collection of Python scripts. APVGDM is interfaced with two dispersion models that can be selected by the user depending on the application of interest: a dilute (DISGAS) and a dense gas (TWODEE) dispersion model. The post-processing script is capable of building Empirical Cumulative Distribution Functions (ECDF) of the gas concentrations combining the outputs of multiple simulations; the ECDF can be interrogated by the user to produce outputs at the desired exceedance probability. Here we present APVGDM and some application examples showing the wide range of options that the tool offers.