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PYFLOW_2.0. A new open-source software for quantifying impact parameters and deposition rates of dilute pyroclastic density currents

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Dilute pyroclastic density currents (DPDCs) are one of the hazardous events that can happen during explosive eruptions. They are ground-hugging turbulent gas-particle flows that move down volcano slopes under the combined action of density contrast and gravity. DPDCs are dangerous for human lives and infrastructures both because they exert a dynamic pressure in their direction of motion and transport volcanic ash particles, which remain in the atmosphere during and after the passage of DPDC until they settle on the ground. Deposits formed by the passage of a DPDC show peculiar characteristics that can be linked to flow field variables. This has been the subject of extensive investigations in the past years leading to the formulation of a sedimentological model (Dellino et al. 2008), which has been used for evaluating the impact parameters of past eruptions on a statistical basis for hazard assessment purposes. The model has been recently translated in a Fortran code (PYFLOW, Dioguardi and Dellino, 2014).

Here we present the latest release of this code (PYFLOW_2.0) which, besides significant improvements in the code structure, computation times and the introduction of a user friendly data input method, allows to calculate the deposition time and rate of the ash and lapilli layer formed by a DPDC by linking deposit (e.g. componentry, grainsize) to flow (e.g. flow average density and shear velocity) characteristics as calculated by the aforementioned sedimentological model. The deposition rate is calculated by summing the contributions of each grainsize class of all components constituting the deposit (e.g. juvenile particles, crystals, etc.), which are in turn computed as a function of particle density, terminal velocity, concentration and deposition probability. Here we apply the concept of deposition probability, previously introduced for estimating the deposition rates of turbidity currents (Stow and Bowen, 1980), to DPDCs, although with a different approach, i.e. starting from what is observed in the deposit (e.g. the weight fractions ratios between the different grainsize classes). In this way we obtain more realistic estimates of the deposition rate, as the deposition probability of different grainsize constituting the DPDC deposit could be different and not necessarily equal to unity.

We finally present the application of PYFLOW_2.0 to pyroclastic flows generated during large scale experiments and some samples collected from DPDCs deposits of Pompei eruption at Vesuvius.

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