A new database of independently estimated eruption source parameters devoted to eruptive column model evaluation

Samantha Engwell¹, Thomas Aubry², Sebastien Biass³, Costanza Bonadonna⁴, Marcus Bursik⁵, Guillaume Carazzo⁶, Julia Eychenne⁷, Mathieu Gouhier⁷, Don Grainger⁸, Mark Jellinek⁹, David Jessop⁶,⁷,¹⁰ Larry Mastin¹¹, David Pyle⁸, Simona Scollo¹², Isabelle Taylor⁸, Alexa Van Eaton¹¹, Kristi Wallace¹¹, and Mark Woodhouse¹³

¹British Geological Survey, The Lyell Centre, Edinburgh, United Kingdom of Great Britain and Northern Ireland (sameng@bgs.ac.uk)
²University of Cambridge, UK
³Earth Observatory of Singapore, Nanyang Technological University, Singapore
⁴University of Geneva, Switzerland
⁵University at Buffalo, USA
⁶Institut de Physique du Globe de Paris, France
⁷University of Clermont Auvergne, France
⁸University of Oxford, UK
⁹University of British Columbia, Canada
¹⁰Volcanological and Seismological Observatory of Guadeloupe, IPGP, France
¹¹US Geological Survey, USA
¹²Istituto Nazionale di Geofisica e Vulcanologia, Osservatorio Etneo, Italy
¹³University of Bristol, UK

Eruptive column models are crucial for managing volcanic crises, forecasting future events, and reconstructing past eruptions. Given their central role in volcanology and the large uncertainties weakening their predictions, the evaluation and improvement of these models is critical. Such evaluation is challenging as it requires independent estimates of the main model inputs (e.g. mass eruption rate) and outputs (e.g. column height). Despite recent efforts to extend datasets of independently estimated eruption source parameters (ESP) (e.g. Mastin 2014, Aubry et al. 2017), there is no standardized, maintained, and community-based ESP database devoted to the evaluation of eruptive column models.

Here we present a new ESP database designed to respond to the needs of the plume modelling community, and which will also be valuable to observatories, field volcanologists, and volcanic ash advisory centers. We compiled data for over 130 eruptive events with independent estimates of: i) the mass eruption rate; ii) the height reached by the column; and iii) atmospheric conditions during the eruption. In contrast with previous ESP datasets, we distinguish estimates of column height that relate to different phases (ash and SO2) and parts of the column (plume top or umbrella). We additionally provide the total grain size distribution, uncertainties in eruption parameters, and multiple sources for atmospheric profiles for events where these parameters are
available. The database also includes a wealth of additional information which will enable modelers to distinguish between different eruptions when evaluating or calibrating models. This includes the type of eruption, the morphology of the plume (weak/transitional/strong), and the occurrence and mass entrained within pyroclastic density currents.

We will apply the new database to revisit empirical scaling relationships between the mass eruption rate and “plume height”. In particular, we will show how such relationships depend on the type of height (e.g. SO2 height vs. ash top height) and eruption (e.g. magmatic vs. phreatomagmatic) considered. We will also discuss the difficulties and limitations of compiling ESP estimates from the literature as well as characterizing fundamentally unsteady volcanic events by a single value for each ESP.