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SPECIAL ISSUE: MEMOVOLC

PREFACE

UNCERTAINTY QUANTIFICATION IN LAVA FLOW HAZARD MODELING AND REAL-TIME SOURCE TERM PROVISION

The idea of this special issue comes out of discussions at the workshop on "*Uncertainty Quantification in Lava Flow Hazard Modeling and Real-Time Source Term Provision*" held at the Istituto Nazionale di Geofisica e Vulcanologia (INGV) in Catania (Italy) during February 2017. The workshop was supported by the MeMoVolc network of the European Science Foundation, and was attended by delegates from Italy, France, UK, Germany, Spain, and the USA. At the workshop, researchers expert in lava's physical properties, satellite volcano hot spot detection, lava flow modeling, and effusive crisis response were brought together to share experiences and perspectives on the current capabilities in application of remote sensing and modeling to better forecast hazards during effusive eruptions. In addition, the workshop led to a community-wide agreement that many scientific uncertainties still need to be resolved in model-based hazard assessments, and this requires support through the creation of a special working group. This special issue consists of 15 papers focused largely on the conclusions of the MeMoVolc workshop, as follows.

Giordano presents a review of recent advances in the field of magma rheology. The results and approaches focus on multiphase (i.e. melt+bubbles+crystals) rheology of natural systems, and are applicable to the emplacement of lavas, dykes, and sills, as well as to magma eruption dynamics during explosive eruptions.

Calvari gives an overview of diverse lava flow surfaces, morphologies and structures in a framework of their associated eruptive parameters. This is done to guide preliminary, but prompt, hazard evaluations that can be applied during the initial phases of effusive volcanic crises at basaltic volcanoes.

Kolzenburg et al. discuss new data on the rheological evolution of a crystalizing, high-Mg, basalt from Piton de la Fournaise volcano. The data presented serve to expand the existing modest based on experimental databases that consider the non-equilibrium rheology of lavas, and are intended as a step towards better understanding underlying rheological processes and their link to flow dynamics.

Pick et al. investigate limits of the dual-band method when used to derive estimates of a lava flow size and temperature when represented as a sub-pixel feature in infrared satellite images. The satellite measurement situation is simulated through an indoor analog experiment, using a steady heat source, which is observed by thermal cameras measuring at the wavebands commonly used by satellite sensors.

Ganci et al. constrain the lava volume emitted at Mt Etna during the 17-25 May 2016 eruption using pre-eruptive and post-eruptive digital elevation models obtained from satellite images acquired by the Pléiades constellation, which provides very-high spatial resolution images in tri-stereo mode. The total volume estimated from DEM differencing bounds that derived from thermal data obtained from other satellite-based sensors.

Coppola et al. use the MIROVA system to measure heat radiated by the growing lava field during the 2014-2015 eruption at Holuhraun (Iceland). The results suggest that the MIR-derived radiant flux essentially mimics the overall trend of lava discharge rates, with only a minor influence due to the emplacement style and evolving eruptive conditions.

Ramsey et al. perform a detailed FLOWGO-based modeling study of lava flows emplaced at Tolbachik volcano during the 2012-2013 and the 1975-1976 eruptions. The results show that incorporating a two-component emissivity model linked to the fraction of molten lava and cooled crust is an important factor for model accuracy and is especially critical for large, high effusion rate flows.

Filippucci et al. numerically model cooling and dynamics of lava flowing in a rectangular channel driven by gravity. A far field thermal boundary condition allows the assumption of constant temperature or constant heat flow as boundary conditions to be overcome; providing more realistic results.

Zago et al. evaluate the accuracy and robustness of the GPUSPH particle engine, based on the Smoothed Particle Hydrodynamics (SPH), method. The results of benchmark tests of growing complexity are reported in terms of correctness and performance, highlighting the benefits and drawbacks derivred from the use of SPH to simulate lava flows.

Lev et al. provide a primer on modern analog lava flow experiments in the laboratory. The authors discuss several open questions about lava flow emplacement and the ways in which future improvements in experimental methods, such utilization of three-phase suspensions and materials with complex rheologies and imaging of flow interiors.

Tsepelev et al. present two-dimensional numerical models of steady-state lava flows to analyze the development of the lava crust depending on the heat flux into the atmosphere from the lava surface, lava viscosity, discharge rate, and lava front propagation rate.

Cappello et al. demonstrate the potential of the integrated use of satellite remote sensing techniques and lava flow modelling during the 2017 eruptive activity of Mt Etna. This combined approach provides insights into lava flow field evolution by supplying detailed views of flow field construction that were useful for more accurate and reliable forecasts of eruptive activity.

Tarquini et al. test the new MrLavaLoba probabilistic code for the simulation of lava flows during the emplacement of the Holuhraun 2014-2015 lava flow (Iceland). The simulations highlight that small-scale morphological features in the pre-emplacement topography can strongly influence the estimates of the area likely to be inundated and the thickness of the final lava flow field.

Harris at al. focus on satellite-based surveillance of volcanic hot spots coupled with modeling to allow ensemble-based approaches to crisis response. The authors complete benchmark tests on an effusive crisis response protocol aimed at delivering product for use in tracking lava flows during the April–May 2018 eruption of Piton de la Fournaise.

Hajian et al. present two Machine Learning approaches to classify volcanic activity using multivariate geophysical data, namely the Decision Tree and K-Nearest Neighbour methods. The models are implemented using a data set recorded at Mount Etna (Italy), over the period 1 January 2011 – 31 December 2015; a period which encompassed lava fountain events and intense Strombolian activity.

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ARTICLES (FINAL ORDER)