Geophysical Research Abstracts
Vol. 19, EGU2017-15157, 2017
EGU General Assembly 2017
© Author(s) 2017. CC Attribution 3.0 License.

Lava cooling modelled with GPUSPH

Gaetana Ganci (1), Vito Zago (1,2), Giuseppe Bilotta (1), Annalisa Cappello (1), Alexis Herault (1,3), and Ciro Del Negro (1)

(1) Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Catania - Osservatiorio Etneo, Catania, Italy (gaetana.ganci@ingv.it), (2) Dipartimento di Ingegneria Elettrica Elettronica e Informatica, Università di Catania, Catania, Italy, (3) Conservatoire National des Arts et Métiers, Paris, France

Lava flows are highly complex flows exhibiting non-Newtonian rheology with temperature dependent viscosity and phase transition. The details of the rheology and its dependency on the physical and chemical properties of the lava need to be further addressed. GPUSPH is a fully three-dimensional model for the simulation of the thermal and rheological evolution of lava flows that relies on the Smoothed Particle Hydrodynamics (SPH) numerical method. Thanks to the Lagrangian, meshless nature of SPH, the model incorporates a more complete physical description of the emplacement process and rheology of lava that considers the free surface, the irregular boundaries represented by the topography, the solidification fronts and the non-Newtonian rheology. We present here the validation of the GPUSPH thermal model, including phase transition (particularly solidification). Validation is done against a number of different problems of growing complexity: the classical Stefan problem, for which analytical solutions are possible, the cooling of a lava lake (compared against semi-analytical solutions) and the cooling of a lava flow comparing the results against a FEM model. We also model the crust formation and thickening, studying the evolution of solidification over time in relation to emplacement characteristics such as total flow thickness and the thermal parameter of liquid and solid lava (emissivity and conductivity). Finally we compare GPUSPH results with a real case study on Etna volcano during the 12th August 2011 lava fountain for which we collected thermal camera data.