Geophysical Research Abstracts, Vol. 7, 02711, 2005
SRef-ID: 1607-7962/gra/EGU05-A-02711

Numerical simulation of lava flows based on Lattice Boltzmann technique

L. D'Auria (1), A. Costa (1), G. Macedonio (1)
(1) INGV - Osservatorio Vesuviano

Numerical solution of the complete conservation equations for real lava flows is often practically impossible because of the high complexity of these processes. On the other hand, risks and damages associated with lava flows propagation require a quantitative description of this phenomenon and a reliable forecast of lava flow paths. To overcome the computational difficulties, simplified models are usually adopted, including 1-D models and cellular automata. In this work we use a recent simplified 2D model based on the conservation equations for lava thickness and depth-averaged velocities and temperature. The core of the method is a system of differential equations, the Shallow Water Equations (SWE) coupled with a convective-diffusive equation for the thermal balance of the lava flow. In the last 15 year, a new method for modeling fluid dynamics, called Lattice Boltzmann method (LBM) appeared in scientific literature. This method solves the mesoscopic Boltzmann equation, rather than macroscopic equations as the Navier-Stokes. This make the numerical code much more easier to implement in situations with complex boundary conditions. Since the mathematical structure of the SWE is similar to 2D Navier-Stokes equations then the LBM can be used also for this kind of simulations. In this work we propose an hybrid method that solves equations for for lava thickness and velocity were solved by using a new algorithm based on Lattice Boltzmann technique while the equation describing the energy balance was solved by adopting a classical finite difference method. The used approach has the advantage to be very quick, allowing a major decrease in the computational time. The method was applied to reproduce the flow on simple topographies to be compared with some analytical solutions and to simulate real lava flows at Etna.