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Phisically Based Modeling of Lava Flows at Mt Etna

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Lava flows represent a problem particularly challenging for physically based modeling because the mechanical and thermal features of lava change over time. In order to generate complex trajectories due to the interactions between lava flows and the underlying topography, we need to model the main mechanical features of lava and the way they evolve over time depending on temperature. Another difficulty is to compute the simulation of lava flows at acceptable rates. The TecnoLab has developed a model for lava flow simulations based on Cellular Automatons, called MAGFLOW. An algorithm based on Monte Carlo approach to solve the anisotropic problem was included. A steady state solution of Navier Stokes equation, in the case of isothermal laminar pressure-driven Binghamian fluid (which is the most commonly used rheological model for lava), was taken into account as evolution function of CA. An improvement in the treatment of the front of an advancing lava flow was introduced. In particular, the front is considered as a Bingham fluid blocked from a variable amount of solid debris. This permit to make more similar the shape of the flow snout compared to those observed in the field. Heat of lava flow is carried in accordance with the flow motion. For the cooling mechanism, we consider the radiative heat loss only from the surface of the flow (the effect of conduction to the ground and convection to the atmosphere is neglected), and the change of the temperature due to mixture of lavas between cells with different temperatures. The achievements related to simulate the path of lava flow outpoured during some eruption of Etna volcano are shown.