



SIMULATION OF PYROCLASTIC FLOWS OF COLIMA VOLCANO, MEXICO, USING THE TITAN2D PROGRAM

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A new numerical code for simulating granular avalanches, TITAN2D, was used to model block-and-ash flows from the 1991-1999 eruptions of Colima Volcano, Mexico. The block-and-ash flows were simulated on a gridded Digital Elevation Model (DEM), which was prepared and imported using a standard GIS function library (GRASS).

The TITAN2D program is based upon a model for an incompressible Coulomb continuum, a 'shallow-water' granular flow. The conservation equations for mass and momentum are solved with a Coulomb-type friction term at the interface between the granular material and the basal surface. It is assumed that conservation of energy can be neglected to first order because the coarse grain size typical of the basal avalanche results in minimal thermal effects on avalanche propagation. The resulting hyperbolic system of equations is solved using a parallel, adaptive mesh, Godunov scheme. The Message Passing Interface (MPI) API allows for computing on multiple processors, which increases computational power, decreases computing time, and allows the use of large data sets. Adaptive gridding allows for the concentration of computing power on regions of special interest. Mesh refinement captures the leading edge of the avalanche, as well as

locations where the topography changes rapidly. Mesh unrefinement is applied where solution values are relatively constant or small.

There were thousands of rockfalls and numerous block-and-ash flows during the 1991-1999 eruptions of Colima Volcano, with volumes ranging from a few cubic meters to 10^6 m^3 . We have records of numerous flows, which include volume, run out distance, deposit area, and in some cases a videotape record of flow propagation. The flows originated from a vent plugging dome, lava flows or minor column collapse. All flows followed cross-slope concavities on the upper edifice, and channels or relative topographic lows on the lower edifice. The flows propagated for distances up to 4 km from the source. We are investigating whether, for a given flow volume, the TITAN2D model approximates run out distances. The model does have difficulty resolving cross-slope extent of the flows in areas where the natural flow was confined within channel walls that were poorly resolved on the DEM.