Geophysical Research Abstracts
Vol. 14, EGU2012-12219, 2012
EGU General Assembly 2012

Computational modelling for landslide: molecular dynamic 2D application to shallow and deep landslides

G. Martelloni, E. Massaro, and F. Bagnoli

University of Florence (IT), Department of Energy Engineering and CSDC - Center of the Study of Complex System (gianluca.martelloni@unifi.it)

We propose a computational 2D mesoscopic models for shallow and deep landslides triggered by rainfall. Our models are based on interacting particles to describe the features of granular material along a slope: in case of shallow landslip, a horizontal layer with thickness of one particle is arranged, while in case of deep landslide a vertical section, with thickness of more particles, is considered. For shallow instability movement we consider that the triggering is caused by the decrease of static friction along sliding surface: particle triggering is caused by the passing of two conditions, i.e. a threshold speed of the particles and one on the static friction between particles and slope surface, based on the modeling of the failure criterion of Mohr-Coulomb. While for deep landslip a filtration model is considered to take into account the pore pressure increasing that is the real cause of triggering: the main hypothesis is the exceeding of a stress threshold on the maximum distance of particle interaction defined through a potential similar the Lennard-Jones one, also in this case a threshold speed is taken into account. For the prediction of the positions of these particles, after and during a rainfall, we use the Molecular Dynamic (MD) method which is very suitable to simulate this type of systems. The results are quite satisfactory in order to claim that this types of modeling could represent a new method to simulate landslide triggered by rainfall. In our simulations emerging phenomena such as fractures, detachments and arching can be observed. In particular, the model reproduces well the energy and time distribution of avalanches, analogous to the observed Gutenberg-Richter and Omori power low distributions for earthquakes. In particular the distribution of landslide mean kinetic energy shows a transition from Gaussian to power law, passing through Log-normal to decrease the coefficient of viscosity up to zero: this behavior is compatible with slow landslides (high viscosity) and rapid landslides (low viscosity). The main advantage of these Lagrangian methods is given by the capability of following the trajectory of a single particle, possibly identifying its dynamical properties. Finally, for a large range of parameter model values, in our simulations we observed a velocity pattern, with acceleration increments, typical of real landslides where is possible to apply the method of inverse number of surface displacement velocity (Fukuzono, 1985) for predicting the failure time.