Geophysical Research Abstracts
Vol. 14, EGU2012-7079, 2012
EGU General Assembly 2012

Linking acoustic emission signatures with grain-scale mechanical interactions during granular shearing

G Michlmayr (1), D. Cohen (2,3,1), and D Or (1)

(1) ETH Zurich, Institute of Terrestrial Ecosystems, Zurich, Switzerland (gernot.michlmayr@env.ethz.ch), (2) Dept. of Geological & Atmospheric Sciences, Iowa State University, Ames, Iowa, United States, (3) University of Geneva, Institute for Environmental Sciences, Carouge, Switzerland

Acoustic Emissions (AE) are high frequency (kHz range) elastic body waves, generated in deforming granular material during particle collisions, frictional slip, or other types of abrupt grain-scale mechanical interactions. The direct link with particle micro-mechanics makes AE a useful tool for gaining insights into mechanical aspects of progressive shear failure in granular material and slow granular flows. The formation of shear plane in granular matter involves numerous internal restructuring and failure events with distinct dynamics resembling features of critical phase transition. Following establishment of a shear plane, subsequent deformation involves episodic slip events interrupted by arrested flow (stick-slip behavior). We developed a model for interpreting measured AE signatures in terms of micro-failures during progressive granular shear a considering AE generation mechanisms and propagation of acoustic signals within granular material. Results from shear frame experiments include information on strains, stresses and acoustic emissions during deformation controlled tests on glass beads and sand. The number of failure associated AE event rates peaks with maximum shear resistance of the granular material. Intermittent slip events during stick-slip deformation are found to be closely related to low frequency AE events ($\sim$1kHz). Statistics of AE events and their temporal development are reproduced using a simple fiber-bundle model. A conceptual AE generation and propagation model accounts for conversion of mechanical events into elastic waves. In addition to gaining insights concerning grain-scale mechanical interactions, the AE method offers a useful tool for monitoring hazardous geologic mass movements, such as landslides, rock avalanches or debris flows.