Geophysical Research Abstracts
Vol. 14, EGU2012-6513, 2012
EGU General Assembly 2012

Power-law variability in rupture phenomena, How and why do PL exponents change toward the failure.

D. Amitrano

Universite J Fourier, ISTerre, Grenoble, France (david.amitrano@ujf-grenoble.fr, 0033-4-76-62-52-52)

Damage and sliding events associated with the deformation of brittle materials are observed to obey power-law distributions. This is verified at scales ranging from laboratory samples to the Earth's crust, for various materials and under various loading modes. Besides the claim that this is a universal characteristic of the deformation of heterogeneous media, spatial and temporal variations are observed in the exponent and tail-shape. These have considerable implications for the ability and the reliability of forecasting large events from smaller ones. There is a growing interest in identifying the factors responsible for these variations. In this present work, we first present observations at various scales (laboratory tests, field experiments, landslides, mining induced seismicity, crustal Earthquakes) showing that substantial variations exist in both the slope and the tail-shape of the rupture event size distribution. This review allows us to identify potential explanations for these variations (incorrect statistical methods, heterogeneity, stress, brittle/ductile transition, finite size effects, proximity to the failure). A possible link with the critical point theory is also drawn showing that it is able to explain a part of the observed variations considering the distance to the critical point. Using numerical simulations of progressive failure we investigate the role of mechanical properties on the power-law distributions. The results of simulations agree with the critical point theory for various macroscopic behaviors ranging from ductility to brittleness providing a unified framework for the understanding of power-law variability observed in rupture phenomena.