Geophysical Research Abstracts
Vol. 14, EGU2012-3219, 2012
EGU General Assembly 2012


# The Earthquake Frequency-Magnitude Distribution Functional Shape

A. Mignan
(arnaud.mignan@sed.ethz.ch)

Knowledge of the completeness magnitude Mc, magnitude above which all earthquakes are detected, is a prerequisite to most seismicity analyses. Although computation of Mc is done routinely, different techniques often result in different values. Since an incorrect estimate can lead to under-sampling or worse to an erroneous estimate of the parameters of the Gutenberg-Richter (G-R) law, a better assessment of the deviation from the G-R law and thus of the earthquake detectability is of paramount importance to correctly estimate Mc. This is especially true for refined mapping of seismicity parameters such as in earthquake forecast models. The capacity of a seismic network to detect small earthquakes can be evaluated by investigating the functional shape of the earthquake Frequency-Magnitude Distribution (FMD). The non-cumulative FMD takes the form $N(m) \propto \exp(-\beta m)q(m)$ where N(m) is the number of events of magnitude m, $\exp(-\beta m)$ the G-R law and q(m) a probability function. q(m) is commonly defined as the cumulative Normal distribution to describe the gradual curvature often observed in bulk FMDs. Recent results however show that this gradual curvature is potentially due to spatial heterogeneities in Mc, meaning that the functional shape of the elemental (local) FMD still has to be described. Based on preliminary observations, we propose an exponential detection function of the form $q(m) = \exp(\kappa(m-Mc))$ for $m < Mc$ and $q(m) = 1$ for $m \geq Mc$, which leads to an FMD of angular shape. The two FMD models (gradually curved and angular) are compared in Southern California and Nevada. We show that the angular shaped FMD model better describes the elemental FMD and that the sum of elemental FMDs with different Mc(x,y) leads to the gradually curved FMD at the regional scale. We show that the proposed model (1) provides more robust estimates of Mc, (2) better estimates local b-values, and (3) gives an insight into earthquake detectability properties by using seismicity as a proxy. Finally, theoretical implications in earthquake forecasting and predictability are discussed.