Geophysical Research Abstracts,
Vol. 11, EGU2009-7136, 2009
EGU General Assembly 2009

Finding resolution limits of the spatiotemporal earthquake correlation function using ETAS simulations

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Statistical earthquake likelihood models require a spatial kernel to describe the distribution of triggered earthquakes from a background event; the current generation of models employ various theoretical kernels based on a simple 1/r or 1/r2 spatial decay. Correlation Function for Triggered earthquakes (CFT) can provide the empirical probability of a triggered earthquake as a function of space and time from a mainshock. However, the resolution and confidence of the spatial kernel obtained through correlation function techniques remain to be established. Here we investigate these factors by applying the CFT to ETAS model catalogue simulations. We run the CFT on thousands of synthetic ETAS catalogue realizations with characteristics similar to the European PDE catalogue, to establish the distribution of kernel parameters that are returned. The CFT recovers the general form of the power-law or gamma-function spatial kernel that is employed in generating the catalogue. For random spatial and temporal background seismicity and an isotropic distribution of aftershocks the mean parameter values are close to that of the input value, but with considerable variability. We then investigate changes in the distribution of recovered parameters when allowing for anisotropic distribution of aftershocks and distribution of the background events as given by a declustered catalogue. We use these catalogue simulations to test the sensitivity of the CFT to magnitude dependent triggering, catalogue boundaries in space and time and clustered trigger events.