ESC2016-101, 2016
35th General Assembly of the European Seismological Commission

The static behaviour of tectonic aftershocks: From geometric to subdiffusion analysis

Arnaud Mignan
ETH, Institute of Geophysics, Zurich, Switzerland (arnaud.mignan@sed.ethz.ch)

The decay of aftershocks has recently been shown to follow a stretched exponential function instead of the Omori law (Mignan, Geophys. Res. Lett., 2015; Mignan, Seismol. Res. Lett., 2016). This triggers a complete re-investigation of aftershock statistics in Southern California and a new physical interpretation of these results: (1) After verifying the stretched exponential behaviour of aftershocks in time, I show that aftershocks follow a pure exponential in space and that there is no observed spatial diffusion with time. (2) I investigate the origin of aftershocks using geometric reductionism made possible by the Non-Critical Precursory Accelerating Seismicity Theory (N-C PAST) postulate, which states that spatial density switches from δb0 for background seismicity to δbp for activated events (such as foreshocks, induced seismicity and here aftershocks) when the static stress field σ(r) exceeds the threshold σ(rA*) $\propto$ $\Delta\sigma$* with r the distance to source. The postulate explains the exponential spatial distribution (assuming that aftershocks fill a noisy fractal network within rA*) and aftershock production (assuming a constant stress drop) with K(M) = δbp.V(M), V being the volume of a rounded cuboid centred on the fault of length l $\propto$ exp(αM), and with radius rA*. Finally the observed stretching factor $\beta \approx 0.4$, characteristic of aftershock subdiffusion, is explained topologically from the fractal dimension D $\approx$ 1.5.