Geophysical Research Abstracts,
Vol. 11, EGU2009-6382, 2009
EGU General Assembly 2009

Early aftershock statistics

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In the Limited Power Law model (LPL) we consider that after a triggering event – the so-called mainshock – rocks subject to sufficiently large differential stress can fail spontaneously by static fatigue. Then, earlier aftershocks occur in zones of highest stress and the c-value, i.e. the delay before the onset of the power-law aftershock decay rate, depends on the amplitude of the stress perturbation in the aftershock zone. If we assume that this stress perturbation is proportional to the absolute level of stress in the area, the model also predicts that shorter delay occur in zones of higher stress. Here, we present two analyses that support such a prediction. In these analyses, we use only aftershocks of $2.5 < M < 4.5$ earthquakes to avoid well-known artifacts resulting from overlapping records. First, we analyze the c-value across different types of faulting in southern California to compare with the differential shear stress predicted by a Mohr-Coulomb failure criterion. As expected, we find that the c-value is on average shorter for thrust earthquakes (high stress) than for normal ones (low stress), taking intermediate values for strike-slip earthquakes (intermediate stress). Second, we test the hypothesis that large earthquakes occur in zones where the level of stress is abnormally high. Instead of the c-value we use the $< t >$-value, the geometric average of early aftershock times. One more time, we observed that $M > 5$ earthquakes occur where and when the $< t >$-value is small. This effect is even stronger for $M > 6$ earthquakes.