Geophysical Research Abstracts, Vol. 7, 10519, 2005
SRef-ID: 1607-7962/gra/EGU05-A-10519

Predictive properties of the critical earthquake model

B.C. Papazachos, G.F. Karakaisis, C.B. Papazachos, E.M. Scordilis

Geophysical Laboratory, University of Thessaloniki, GR 54124, Thessaloniki, Greece (karakais@geo.auth.gr, Fax: +2310 99 8528)

Global data concerning preshock seismic activity show that the Benioff strain released by preshocks accelerates in a broad circular region (critical region) and decelerates in a narrower elliptical region with its large axis parallel to the mainshock fault strike (seismogenic region). The time variation of strain in both patterns follows a power-law (with a power m=0.3 for accelerating and m=3.0 for decelerating strain), expected by the critical earthquake model. This “accelerating-decelerating strain” pattern has predictive properties for the mainshock, expressed by empirical relations.

The radius, R (in Km), of the critical region is given by the relation:

$$\log R = 0.42M - 030 \log s_a + 1.28, \quad \sigma = 0.12 \tag{1}$$

where M is the magnitude of the mainshock and s_a (in Joule$^{1/2}$/yr.10^4km^2) is the long term strain rate in the critical region. The duration, t_c-t_s, of the accelerating preshock sequence is given by the relation:

$$\log(t_c - t_s) = 4.75 - 0.60 \log s_a, \quad \sigma = 0.10 \tag{2}$$

where t_c (in yeas) is the origin time of the mainshock and t_s is the start time of the preshock accelerating sequence. The center, Q (ϕ,λ), of the critical region is located by maximizing an index parameter, q_a, given by the relation:

$$q_a = \frac{P_a}{Cm} \tag{3}$$

where C is a curvature parameter which expresses deviation from linearity and P_a is the probability for a particular accelerating sequence to follow global reactions (1,2), and $q_a \geq 3.0$.

The length, a (in km), of the elliptical seismogenic region is given by the relation:

$$\log a = 0.25M + 0.47, \quad \sigma = 0.15 \tag{4}$$

and the duration, t_c-t_s, of the decelerating preshock sequence is given by the relation

$$\log(t_c - t_s) = 2.67 - 0.26 \log s_d, \quad \sigma = 0.12 \tag{5}$$

where s_d is the long-term strain rate in the seismogenic region. The center, F(ϕ,λ), of the seismogenic region is located by maximizing an index, q_d, given by the relation:

$$q_d = \frac{P_d m}{C} \tag{6}$$

where P_d is the probability for a particular decelerating sequence to follow the global relations (4, 5) and $q_d \geq 3.0$.

Relations (1, 4) can be used to estimate the magnitude, M, of an ensuing mainshock and relations (2, 5) for estimating its origin time, t_c. The epicenter, E (ϕ,λ), of an ensuing mainshock is determined by its distance from the center, F(ϕ,λ), of the seismogenic region. Retrospective "prediction" (postdiction) of already occurred mainshocks indicates model uncertainty $\pm$0.4 for the magnitude, M, of the mainshock, $\pm$2.5 years for its origin time, t_c, and less than 120Km for its epicenter location.