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Peculiarities of correlation length time evolution in the area of large earthquake preparation

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A long-range earthquake correlation in the area of large earthquake preparation is predicted by the concepts of "self-organized criticality", "critical point behavior", and "finite-time singularity" that have reinforced each other during the last decade. This result is based on the well-known effect of correlation length growth when a physical system approaches to the critical point. The growth of correlation length of earthquakes as an indicator of critical point behavior prior large earthquake was discussed by Zoller et al. (2001). However correlation length is associated with a characteristic distance of attenuation of local disturbance of media in physics and the term "correlation length of earthquakes" needs an additional definition. Zoller et al. define correlation length $\xi(t)$ of N consecutive earthquakes occurred is a relatively large area Ω, as the median of the length distribution of links, which form a connected minimal tree graph "spanning" on epicenters of these events and tested the hypothesis that correlation length $\xi(t)$ grows according to a power low $\xi(t) \sim (t_f - t)^{-k}$ where $t < t_f, \quad t_f$ is the time of main shock and 0<k<1.

However if the area over which the earthquake activity is correlated grows with time, this algorithm of correlation length estimation can results in more complicated behavior of correlation length. We assume that evolution of regional stress field initiates self organization of some part of regional fault system inside area $\Omega_p(t) \subset \Omega$ which results in growth of probability of occurrence of earthquakes inside area Ω_p in comparison of probability of occurrence of earthquakes in this area in the case of absence of large earthquake preparation. If small area Ω_p appears inside the area Ω than correlation length $\xi(t)$ must decrease because the contribution of events separated by small distance in correlation length increases in this case. After that correlation length growth

following the space-time development of the area Ω_p. The decrease of correlation length before its growth is an additional precursor of the process of large earthquake preparation. The analysis of behavior of correlation length of acoustic emission events recorded during laboratory experiments of rock destruction and correlation length of seismicity in the area of preparation of large Kamchatka and Italy earthquakes confirms this assumption. We propose that this effect can be used as an additional premonitory pattern of large earthquake preparation.