



STATISTICAL STUDY OF THE GEOMETRY OF EARTHQUAKE FAULT SYSTEMS

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Earthquake faulting has several fractal properties including distances and times between pairs of earthquakes, earthquake size distributions, and angles between focal mechanisms of earthquake pairs. We review these fractal characteristics which are important in order to understand the fundamental problems of earthquake occurrence. For example, fault growth and the stresses from past earthquakes depend on the fractal shape of faults. Before discussing the relation between faults and earthquakes we need to find a formal rigorous definition of both phenomena. Because of the fractal properties of earthquake occurrence and earthquake fault geometry, such a definition is not a trivial task. We present the results of statistical studies of earthquake hypocenters and epicenters for global and local earthquake catalogs which show that earthquakes are distributed on a fractal set with a correlation dimension of about 2.2 for shallow seismicity. Moreover, the study of earthquake quadruplets indicates that earthquake rupture is not concentrated on a plane. These empirical results combined with mathematical conclusions on earthquake fault incompatibility imply that faults must rupture virgin rock and that the total number of faults is infinite. The distribution of short-term aftershocks in several local and global catalogs suggests that since earthquakes have fractal temporal features, even defining an 'individual' earthquake is problematic: earthquake catalog records appear to result from a complex interaction of fault ruptures, seismographic recordings, and their interpretation. For earthquake catalogs with large magnitude range, a significant part of the earthquakes (close-range aftershocks) is missing from the catalogs.