

Global earthquake potential, 1999

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We present a global model of earthquake potential, defined here as a probability of occurrence per unit area, magnitude, time, and focal mechanism parameters. The model is based on the occurrence of past earthquakes only, with no information, at present, on plate tectonics, faults, earth structure, etc. We assume that the earthquake potential is separable into factors depending on location, magnitude, and time respectively. The magnitude distribution is assumed fixed (a Gamma distribution with a corner magnitude of about 8.5) and the time function is constant within yearly intervals, so that for a given year the earthquake potential is uniquely defined by a spatial function. That spatial function is assumed to be a weighted average of previous earthquake occurrence, where the weighting kernel decreases with distance and increases in proportion to magnitude. There are only three variable parameters in the model, corresponding to a distance scale, the rate of decrease with distance of the spatial function, and an aspect ratio defining the degree of directionality of the spatial kernel. Once the parameters are specified, the model can be tested unambiguously against future earthquake occurrence using a likelihood test. After successful retrospective tests, we began forward testing at the beginning of 1999. Yearly testing will be based on a likelihood value obtained by evaluating the earthquake potential function at the site of each qualifying earthquake.

The model may have practical value, if it works well, but its primary value will be scientific. In the future we will develop alternative models based on plate tectonic deformation rates, geodetically determined strain rates, and models for specific regions based on fault geometry and activity. We'll also include published ideas about maximum magnitude, time dependence, etc. We'll test these alternates against our basic seismicity model using the likelihood ratio test, accelerating the improvement of these ideas. We welcome collaboration to test alternative hypotheses that can be expressed in terms of earthquake potential as defined above, as long as they forecast at least a few dozen earthquakes.

