



EARTHQUAKE PROBABILITIES BASED ON EARTHQUAKE INTERACTIONS

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The best indicator of earthquake probability is the occurrence of recent earthquakes. Several studies show that many earthquakes are triggered in part by preceding events. Aftershocks are the most obvious examples, but many large earthquakes are preceded by smaller ones. The large fluctuations of seismicity rate due to earthquake interactions thus provide a way to improve earthquake forecasting significantly. We have developed a model to estimate daily earthquake probabilities in Southern California, using the Epidemic Type Aftershock Sequence model [Kagan and Knopoff, 1987; Ogata, 1988]. The forecasted seismicity rate is the sum of a constant external loading and of the aftershocks of all past earthquakes. The background rate is estimated by smoothing past seismicity. Each earthquake triggers aftershocks with a rate that increases exponentially with its magnitude and which decreases with time following Omori's law. We use an isotropic kernel with a power-law decay as a function of the distance from the mainshock to model the spatial distribution of aftershocks. The model also assumes that all earthquake magnitudes follow the Gutenberg-Richter law with a uniform b -value. We have developed a procedure for testing time-dependent or time-independent forecasts based on the evaluation of the likelihood of each model [Schorlemmer et al., 2003]. A retrospective test using a daily update of the forecasts between 1/1/1992 and 1/1/2003 shows that the short-term model increases the probability of an earthquake occurrence by a factor 16 compared to the long-term time-independent forecast.