

A comparative study on probabilistic prediction of small repeating events east off NE Japan by various renewal models

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We computed the probabilities of recurrent earthquake with identical waveform that repeats on small asperities on the plate boundary east off NE Japan, using various statistical renewal models. Because of large number of repeating sequences with frequent recurrences, they are very useful to score the probability prediction and to evaluate the applied models. Prediction models correspond combination of various distributions for time interval between successive events and procedures for processing data, e.g. large/small sample theories.

In total, thirty-three models are applied for ninety-three series of repeaters, consisting of five or more events from January 1993 through June 2006, to estimate the probabilities of recurrent event in three intervals, six, twelve, and eighteen months. Based on Brier score and the mean log-likelihood, we evaluated predictions and compared performance of models.

Prediction models on the large sample theory are low graded, because available data of a series are usually as few as five to ten events and parameters obtained from them are inaccurate and unstable. Ones on the small sample theory and Bayesian approach with lognormal distribution are high graded. Unfortunately it is too difficult for us to apply the distributions, Brownian Passage Time, gamma, and Weibull, for the probability prediction on small sample theory and Bayesian approach. Difference in the mean log-likelihood between the high graded models and Poisson process models is 0.13 in average and it is statistically very significant in total likelihood. It suggests that the time dependent model is valid for recurrent earthquake with identical waveform.