

## Forecast for small interplate repeating earthquakes near the east coast of NE Japan in 2009

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### 1. Introduction

A lot of sequences of small repeating earthquakes with nearly identical waveform have been found near the east coast of NE Japan. Those events in a sequence are considered to occur on the same small asperity surrounded by creeping zone on the plate boundary [Igarashi et al., 2003; Uchida et al., 2003]. They are unique data to test predictability of statistical models on renewal process, because the repeating events are identified objectively with waveform correlation and the recurrence times are short enough to evaluate the forecasts. Forecast bin to specify the event compared with those for CSEP by Schorlemmer et al. (2007) is thought to be rather smaller in volume of location and in focal mechanism but larger in magnitude. We prospectively estimated the probabilities of occurrence in 2009 for 145 sequences consisting of five events or more in the period from 1993 through 2008 and posted them on the following website.

<http://www.aob.geophys.tohoku.ac.jp/~uchida/kenkyuu/souji-yosoku/souji-kakuritsu-e.html>

### 2. Model for probabilities

We calculated the conditional probability for specified repeating event in the period from January 1 to December 31, in 2009 with a Bayesian approach using log-normal distribution for recurrence time interval between successive events on renewal process. Prior distribution is uniform and inverse gamma for mean and variance of logarithm of time intervals, respectively. Parameters in inverse gamma distribution was revised from those for the 2008 forecasts, because the score of the 2008 forecasts was worse than that of a model based on the small sample theory. The probability is a kind of binary forecast of occurrence.

### 3. Forecast and Testing

70 of 145 bins were filled with qualifying events in 2009, and it is somewhat larger than expectation of forecast, 61.2, which is not rejected the validity by N-test. However scores in mean log-likelihood,  $MLL=-0.647$ , and Brier score  $BS=0.228$  are so bad that the validity are rejected by L-test and BS-test, respectively, in which the seismic activities are supposed to be statistically independent among those bins.

We compared the performance of our model with alternative models. The R-test and dBS-test, test with the difference in Brier score, reveals that our model was significantly superior to a Poissonian model of  $MLL=-0.696$  and  $BS=0.251$ , and the lognormal distribution model of small sample theory,  $MLL=-0.678$  and  $BS=0.235$ . On the other hand, the  $MLL$  and  $BS$  of the 2009 forecasts are considerably worse than those of 2008 forecasts for 127 bins,  $MLL=-0.531$  and  $BS=0.178$ , partly because of triggering of repeaters by larger event.

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