

MIS036-P92

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## Forecast test for major aftershocks of the 2011 off the Pacific coast of Tohoku earthquake

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After the occurrence of the 2011 off the Pacific coast of Tohoku earthquake at 14:46 on 11 March, aftershock activity was tried to forecast. As a result, among 15 alarms for major aftershocks up to the end of April, 9 were succeeded by aftershocks with a size of just assumed within the alarmed period.

In the present forecast, an alarm is based on the magnitudes of 10 aftershocks that occurred immediately before the time of the prediction (Yamashina, Abstract of the 2008 meeting of the Seismological Society of Japan). That is, when the mean magnitude of those 10 aftershocks is equal to or less than  $M_{min}+0.4$ , then major events with magnitudes of  $M_{max}+0.6(+/-0.5)$  are expected to occur. Here,  $M_{min}$  and  $M_{max}$  are the lower threshold of magnitude (assumed to be around 5.3, considering the magnitude difference from the main shock and the detectability of the available aftershock list) and the largest magnitude among 10 events paying attention to, respectively. Time period of the alarm was taken to be 2.2 times of the period between the first and the 10-th events (the factor was slightly extended from 2.0 which had been assumed before, because the time difference of the first and the 10th events are not the period in which 10 events are expected to occur but 9 on the average).

After testing the applicability of the present hypothetical method, the prospective forecast was started at 22:00 on 11 March. The first alarm was 'Possibility of  $M7.0+/-0.5$  by around 24:00 on the same day (expected probability: 20-30%)'. Although this resulted in false, an aftershock with a magnitude of 6.6(?) did occur only 13 minutes after this alarm period. Hereafter, alarms of the similar form were repeated. For example, the 11th alarm at 17:00 on 3 April was 'Increased probability of  $M6.7+/-0.5$  by around 06:00 on 11 April (50%)', which actually forecast the event of  $M7.1(?)$  at 23:32 on 7 April. In spite of several false alarms, 2/3 of whole alarms were proved to be successful in the present experiment.

A possible new alarm may be generated at every opportunity when an aftershock with a magnitude of  $M_{min}$  or greater occurs. However, the expected ranges of magnitude and time period may overlap with each other. In the case that a new alarm nearly overlapped with a previous one, it was neglected in the present experiment. Since the procedure was made by hand, it was sometimes not in time for the occurrence of major aftershocks.

Although the present rule of forecast was obtained empirically in 2008 for the Iwate-Miyagi inland earthquake, it seems to be supported by the Omori-Utsu and the Gutenberg-Richter laws at least to some extent. The factor of 2.0-2.2 to determine the length of the alarm period is considered to correlate with the features of those relations. As shown in the results, there is a limitation of the reliability of the present method of forecasts. However, such an effort is expected to help the better understanding on the situation of the aftershock activity.

Keywords: Off the Pacific coast of Tohoku, aftershock, forecast, alarm, Omori-Utsu law, Gutenberg-Richter law