

# Foreshocks had been Observed since Two Days before the 2011 off the Pacific Coast of Tohoku Earthquake, Mar. 11, 2011!

Yoshiaki FUJII

Rock Mechanics Laboratory

Hokkaido University, JAPAN

Long-term predictions have been given for some giant earthquakes as the possibility of occurrence in several ten years based on periodicity of earthquake occurrence. Long-term predictions help people reinforce buildings, construct embankments, prepare evacuation system, etc. but never help people evacuate "before" giant earthquakes occur. On the other hand, short-range predictions seem difficult because sometimes we can observe precursors but sometimes we can't. Sometimes earthquakes occur after precursors but sometimes they don't. However, obvious foreshocks were observed in Japan before the 2011 off the Pacific coast of Tohoku Earthquake.

Daily rate of earthquakes with JMA (Japan Meteorological Agency) seismic intensity equal to or more than 1 is shown in Fig. 1. Less than ten earthquakes were usually observed in a day in Japan. The daily rate began to significantly increase on two days before the main shock. Number of earthquake detection per day for Hokkaido, Iwate, Miyagi, Fukushima, Ibaraki, Chiba, Tokyo, Shizuoka, Niigata and Okinawa before the main shock is shown in Fig. 2. No foreshocks were detected in Okinawa. Significant foreshocks were detected in Miyagi, Iwate and Fukushima. A few foreshocks were detected in Hokkaido, Chiba, Tokyo, Shizuoka and Niigata.

Precise analyses should be made based on distribution of location of foreshock sources, however, possibility of earthquake occurrence around Miyagi could be suggested even from this kind of very simple data analyses. Foreshocks were detected also in Iwate and Fukushima. Vastness of the seismic source of the main shock could have been predicted if an effective forecasting system had been developed.

Damage of buildings and infrastructures could have been unavoidable, off course, even if people had been forced to evacuate until the daily rate recovered to, say, less than 10 earthquakes/day. More than thousands

of people however could have safely evacuated with their families taking valuables and emergency goods.

Aftershocks are occurring not only off the Pacific coast but also in Tohoku, in Chuetsu, around Mt. Fuji, in Tokyo Bay, Tokara Islands and everywhere in Japan relieving tectonic stress. The daily rate showed a peak on the day after the main shock but has not converged yet. Aftershocks should be carefully observed for a while.

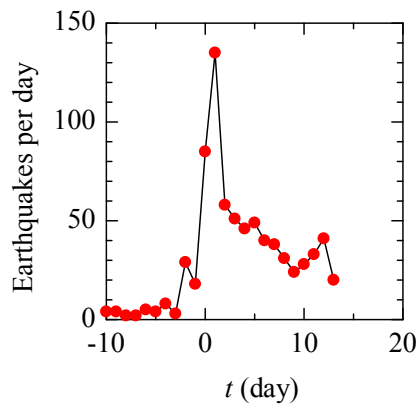


Fig. 1 Daily rate of earthquakes in Japan with JMA seismic intensity equal to or more than 1 (source: Japan Meteorological Agency Web Site in Japanese, <http://www.jma.go.jp/jma/menu/jishin-portal.html>). Time is set at 0 for Mar. 11 (JST) when the main shock occurred.

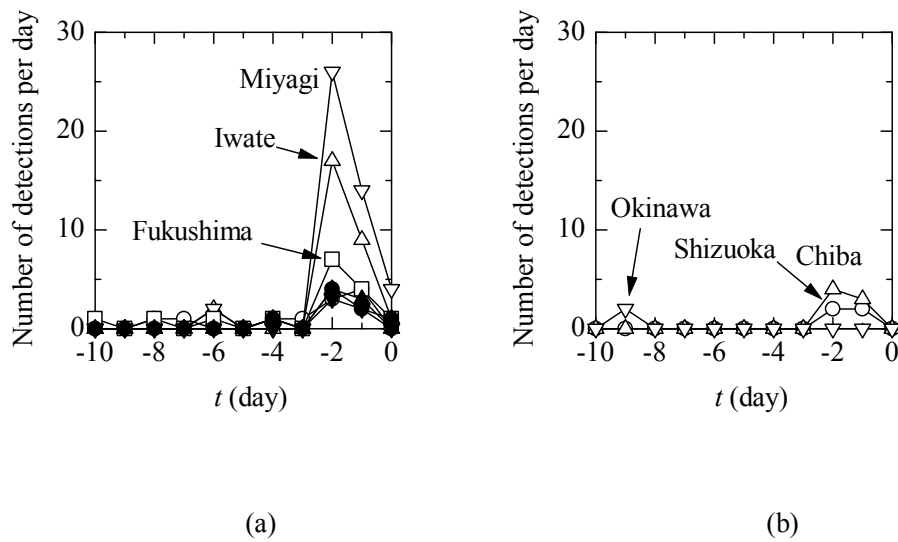


Fig. 2 Number of detection per day for some prefectures (source: Japan Meteorological Agency Web Site in Japanese, <http://www.jma.go.jp/jma/menu/jishin-portal.html>) before the main shock. Time is set at 0 for Mar. 11 (JST) when the main shock occurred. (a) Open circle: Hokkaido, solid circle: Ibaraki, solid triangle: Chiba, solid reversed triangle: Tokyo.