Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

MIS036-P110 Room:Convention Hall Time:May 27 14:15-16:15

Alteration of stress field due to the occurrence of the 2011 Off the Pacific coast of Tohoku earthquake (Mw9.0)

Shinya Hiratsuka[1*], Tamao Sato[1]

[1]Hirosaki University

A giant earthquake of Mw 9.0 took place off the Pacific coast of Tohoku on March 11, 2011. It caused a large tsunami of 10-20 m and wrought devastation in northeast coastal Japan. An interplate earthquake of Mw 7.5-8.0 had been anticipated off the Pacific coast of Miyagi in the near future, and yet an earthquake as large as Mw 9.0 had not been regarded as impending. Since this earthquake is so huge that the stress field in and around the source region has been disturbed immensely. In this paper, we look at the change in stress field brought about by this earthquake through the change in the Coulomb Failure Function (dCFF), and discuss its effect on aftershocks and future earthquake probabilities in the surrounding region.

The geometry of the fault is based on the configuration of upper plate interface of the subducted Pacific plate determined by Takeuchi et al. (2008). The coseismic slip distribution is given with reference to that estimated by the Geospatial Information Authority of Japan (GSI). The top of fault is placed at a depth of 6.5 km along the axis of the Japan Trench. The attitude of each fault segment is fitted to the local strike and dip of the plate interface. Along the dip direction, the segments are divided by their depths down to 50 km at a depth interval of 10 km. The slip amplitudes are more than 20 m over the segments off the Pacific coast of Miyagi. Given a rigidity of 40 GPa, this fault model constitutes a Mw 8.9 earthquake. The horizontal displacements calculated for the fault model agree with the ones observed at the GPS sites of GEONET operated by GSI. A good agreement between the observed and calculated displacements provides a rationale for using the fault model to evaluate the stress change due to the earthquake. The source code developed by Okada (1992) is used to calculate the displacements and strains, assuming a half-space medium with a Poisson's ratio equal to 0.25. The internal friction coefficient is assumed to be 0.4. Here we restrict the target area to northeastern Japan. Based on the general feature of focal mechanisms in northeastern Japan and the focal mechanisms of aftershocks determined by the F-net of NIED, we selected several types of target earthquakes.

The results suggest that the increased activity of normal-fault earthquake after the main shock is explained by a large positive dCFF of 1-5 MPa prevailing over a vast area in and around the source region. The areas adjacent to the northern and southern borders of the source region where another large interplate earthquakes might occur are occupied by a positive dCFF of 0.1-1.0 MPa. The dCFF for the reverse faults in the shallow crust suggests that the future probability of reverse fault earthquake will be decreased in the land area of Tohoku, with notes that the Rikuu earthquake occurred soon after the 1896 Meiji Sanriku earthquake that may have transferred a similar stress change to the land area.

Keywords: Off the Pacific coast of Tohoku earthquake (Mw9.0), giant earthquake, Coulomb Failure Function, subduction zone, induced seismicity, interplate earthquakes