Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SSS24-11 Room:303 Time:May 20 12:15-12:30

Tsunami-induced ground tilt changes observed by Hi-net and F-net in Japan

Takeshi Kimura[1*], Sachiko Tanaka[1], Tatsuhiko Saito[1]

[1]National Research Institute for Earth Science and Disaster Prevention

Oscillating ground tilt perturbations accompanied by the 2010 Maule, Chile, earthquake tsunami were observed over a broad inland area facing the Pacific Ocean coast in Japan by high-sensitivity accelerometers of Hi-net (Kimura et al., 2013, JGR) and broadband seismometers of F-net. In the present study, we investigated the characteristics of the ground tilt changes induced by the Maule earthquake tsunami using the Hi-net tiltmeter records. The very dense network throughout Japan revealed the precise distribution of the tsunami-induced perturbations. To demonstrate the link between the tsunami and the observed inland tilt changes, we also simulated the deformation of the solid Earth due to the ocean loading disturbances caused by the tsunami. Furthermore, based on our observations and a simple tsunami model, we discussed possible uses of land data in characterizing tsunami behavior, particularly in nearshore environments.

Through an analysis of ground tilt data observed at more than 500 Hi-net stations, we were able to obtain a detailed spatiotemporal distribution of the tsunami-induced tilt changes and reveal a relationship between the tilt amplitude and the distance from the coast. At distances of 1 km or less, the peak tilt amplitudes were ~5 x 10^{-8} rad and were almost constant with respect to the distance. At distances greater than 3 km, amplitudes were inversely proportional to the distance and reached ~5 x 10^{-9} rad approximately 50 km away from the coast. The dominant ground tilting directions were almost the same as the direction orthogonal to the coastline. The tsunami-induced signals were also observed at F-net stations in coastal area and small islands.

These observed ground tilt changes and their characteristics were successfully modeled with a loading deformation caused by sea level variations accompanied by the tsunami. Applying a two-dimensional boxcar tsunami model to the observed data, we estimated the water volume per unit length of coast for the Maule earthquake tsunami to be 2-7 x 10^3 m^3/m within the distance of 14-20 km seaward of the coastline.