How GNSS Earth Observation Network System (GEONET) in Japan Contributes to Geohazards Mitigation

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Since 1994, the Geospatial Information Authority of Japan (GSI) has been operating a continuous GPS array, later known as GEONET, for surveying and crustal deformation monitoring in Japan. Here we review how this geodetic observing system contributes to the mitigation of geohazards, focusing on our recent experience with the devastating 2011 Tohoku Earthquake (M9.0), and on our new real-time analysis system for assisting early Tsunami warning.

1) At the time of the 2011 Tohoku Earthquake, GEONET recorded the largest horizontal coseismic deformation of about 5.3 meter at Oshika station, and revealed the land subsidence of about 0.5~1 meter along the Pacific coastal line near epicenter. The deformation field with 20km and 1 Hz resolution is an important geodetic constraint to understand the nature of the mega earthquake. It should be noted that the subsidence information was directly used for public warning against high tide water along the submerged coast by Tsunami.
2) Due to the large area crustal deformation, GSI released new official site coordinates for surveying for eastern part of Japan 80 days after the earthquake, confirming that the rate of postseismic deformation can be corrected by yearly update of semi-dynamic parameters. The early update of the official coordinates was urged from surveyors involved in reconstruction works after the earthquake.
3) Based on the hard lessons learned from the Tsunami disaster, GSI and Tohoku University developed a new real-time analysis system of GEONET named "REGARD" for real-time crustal deformation monitoring to assist Tsunami early warning. The system is designed to estimate moment magnitudes for large earthquakes by real-time fault model inversions.
4) To prepare for possible future mega earthquakes, the update and modernization of GEONET were accelerated, and from May 2013 QZSS and GLONASS data become available. This multi GNSS capability is expected to enhance stability of real-time crustal deformation monitoring as well as the availability of satellite surveying in mountainous and urban areas.