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Enhancement of GEONET Real-time Analysis System for Covering over Japan

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Geospatial Information Authority of Japan (GSI) has been operating a continuous GNSS observation network system, known as GEONET (GNSS Earth Observation Network System), since 1994. Currently, GEONET consists of approximately 1,300 nationwide GNSS stations and its analysis center. Each station collects GNSS data with 1Hz sampling and those data are transmitted to the analysis center in real-time. GSI offers the observation data to the public in order to support various types of public surveys in Japan and precise positioning services using GNSS.

In the field of disaster prevention or mitigation, GEONET also plays very important roles by monitoring crustal deformation occurred by such as earthquakes or volcanic activities. In addition, after the 2011 off the Pacific coast of Tohoku Earthquake (Mw9.0), it is pointed out by a governmental committee that GEONET should be utilized for tsunami early warning by offering a first realistic estimation of moment magnitude (Mw) after large earthquakes. It is based on the fact that GNSS real-time positioning generally has big advantages in estimating moment magnitude (Mw) of the large earthquakes compared to short-period seismometers in terms of avoiding underestimation problem.

Since then GSI has been developing a new GEONET real-time analysis system, named REGARD (Real-time GEONET Analysis System for Rapid Deformation Monitoring), jointly with Tohoku University. It is designed for estimating permanent displacement field and Mw of giant earthquakes and notify the results in real-time. First, the GEONET data are processed by RTKLIB ver.2.4.1 (Takasu, 2011) for real-time GNSS positioning. We adopt both 'RAPiD' technique (Ohta et al., 2012) and the Early Earthquake Warning (EEW) information (Kamigaichi et al., 2009) for automated detection process of permanent displacements. Once the displacements are detected, corresponding fault source model is immediately estimated and the system sends the results to registered addresses by e-mail.

GSI launched its prototype system in April 2012 with 143 stations covering mainly Tohoku region and also has been evaluating its performances using archived data of some past earthquakes. We verified that the system successfully could estimate appropriate Mw values just after a couple of minutes in case of large events (e.g. Mw8.9 in the 2011 Tohoku earthquake), whereas it hardly detect proper values if the size of earthquake is less than Mw7.5. Based on the results and performances of the prototype system, we upgraded REGARD in 2013 for covering all over Japan by using most GEONET stations and enhancing its redundancy by carrying out two independent processing in parallel. This new system was launched in April 2014.

We present the evaluation results of the prototype system and introduce the upgraded REGARD including future plans focusing on exploiting to tsunami warning.

Keywords: GEONET, RTK-GPS, Real-time