Improvements of the GEONET real-time analysis system (REGARD) for more reliable operation

*Takamatsu Naofumi[1], Satoshi Kawamoto[1], Satoshi Abe[1], Kohei Miyagawa[1], Yusaku Ohta[2]

1. Geospatial Information Authority of Japan, 2. Research Center for Prediction of Earthquakes and Volcanic Eruptions, Graduate School of Science, Tohoku University

The displacement data produced by GNSS observations never saturate for large earthquakes in contrast to seismometer data that has a limitation of instrument saturation. Geospatial Information Authority of Japan has launched a real-time GNSS analysis system named “REGARD” which estimates finite fault models based on the Japanese nationwide GNSS network GEONET. The REGARD system has been in operation since April, 2016. The system experienced 2016 Kumamoto earthquake, and provided a single rectangular fault model with very high variance reduction (VR) of 96%. The REGARD system has been become increasingly important for rapid response to major earthquakes for providing coseismic displacements, finite model estimate, and moment magnitude rapidly. Therefore, the system should be assessed by large number of real events for more robust operation and reliable results without false alerts.

The REGARD system originally had a method to judge false alerts by excluding finite fault estimates with VR<80%. The threshold was determined using synthetic data based on past plate boundary earthquakes around Japan listed in Sato et al. (1989). However, some false alerts could not be excluded with only one method; we found 4 false alerts for experimental results using all events with M>4 for a year from April, 2016 to March, 2017. All the false alerts occurred in single rectangular fault estimates. The false alerts were caused by (1) a noise at a reference station for the relative positioning and (2) abnormal positioning results due to multipath, cycle slip, etc. If the data of the reference station is contaminated by some noise, common mode noises occur on positioning results at all rover stations. Single rectangular fault model could fit those errors very occasionally because the fault location, length, and width are solved as free parameters.
In this paper, firstly we show some new procedures to reduce false alerts from the REGARD system. We have introduced a translation parameter that stands for the common mode noise and excluded the effect in the VR estimation. Furthermore, we have introduced a procedure that accepts only the results with displacements over 10 cm observed at least three neighboring stations. The number of false alerts became zero with these new procedures. We also show some other improvements of the REGARD system. Finally, we show future plans about utilization of the information from the REGARD system for other systems that relate to disaster preventions.

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