Development and reliability of Real-time fault model estimation routines in the GEONET real-time processing system

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The recent development of GNSS and communication infrastructures provides real-time surface displacement data which enable us to estimate fault dislocation models for catastrophic earthquakes in real-time. The fault dislocation models estimated from geodetic measurements are free from saturation in seismometer data. Especially the use of real-time or near real-time fault model can constrain the size of tsunami following the large earthquake that is significantly important for disaster mitigations. Geospatial Information Authority of Japan (GSI) and Tohoku University have jointly developed a real-time analysis system in GEONET ‘’REGARD’’ to estimate earthquake sizes automatically. The prototype system is processing real-time streams from 143 GNSS stations. Once a large event is detected by using both RAPiD algorithm (Ohta et al., 2012) and Earthquake Early Warning issued from Japan Meteorological Agency (JMA), REGARD launches a fast, automated routine which estimates a single rectangular fault model by a non-linear inversion method. However, a rectangular fault model poorly reproduce near-field surface displacements caused by heterogeneous slip on a curved fault surface, which is the case of an anticipated large earthquake along the Nankai trough. Therefore, we are developing another routine to estimate slip distribution with triangular elements mapped on the plate boundary simultaneously.

To assess the performance of the two modeling approaches, that is an estimation of a single rectangular fault and an estimation of slip distribution on the plate boundary, we examined the two routines for previous large earthquakes including the 2003 Tokachi-oki earthquake (Mw8.0) and the 2011 Tohoku earthquake (Mw9.0) by streaming dummy real-time data to our real-time system. In addition, the simulated waveform data for the anticpated earthquake along the Nankai Trough (Todoriki et al., 2013) was also used.

The preliminary results show the slip distribution modeling routine successfully estimates the moment magnitude for the simulated earthquake along the Nankai trough within an acceptable calculation time of a few tens of seconds, although the single rectangular fault modeling routine fails to reproduce the simulated displacements. This suggests that an automated routine for slip distribution modeling should be implemented for the future earthquake along the Nankai trough and that an additional routine which choose “better model” in two modeling results estimated from both routines might be needed for the real-time processing system.