

## High-frequency rupture areas during the 2011 off the Pacific coast of Tohoku Earthquake inferred from seismic intensity

KANDA, Katsuhisa<sup>1\*</sup>, TAKEMURA, Masayuki<sup>1</sup>, Kiyoshi Hirotsu<sup>2</sup>, ISHIKAWA, Kazuya<sup>2</sup>

<sup>1</sup>Kobori Research Complex Inc., <sup>2</sup>Tohoku Electric Power Co., Inc.

The source process of the 2011 off the Pacific coast of Tohoku Earthquake (Mw9.0) was complex and included multi sub-events. From the view of strong ground motion, there were two major peak waveforms observed around Tohoku district. These were caused by two major sub-events off Miyagi Prefecture near the epicenter. We divided each observed strong motion time history into two parts related to the two sub-events based on visual judgment. The inversion analysis was carried out to reveal high-frequency rupture areas using measured seismic intensity related to each sub-event as well as the whole event. We found that the first high-frequency rupture area was located near the hypocenter and extended northward. The second high-frequency rupture area had a substantial overlap with the first one and was nearer coastline of Miyagi Prefecture than the first, and its magnitude for seismic intensity is the same as the first. The result of the whole event shows that the high-frequency rupture areas consist two major parts. The north major part is related to two sub-events off Miyagi Prefecture. The south major part was located off-shore area near the north of Ibaraki Prefecture. Furthermore, we found that the first high-frequency rupture area was similar to that of the 1793 Kansei earthquake that was one of the major historical earthquakes in this region and the west of the high-frequency rupture area of the first two sub-events was overlapped with those of historical M7 class earthquakes off Miyagi Prefecture in 1861, 1897, 1936, 1978 and 2005 more or less. It shows that the events off Miyagi Prefecture do not be treated as simple characteristic earthquakes.

We compared the high-frequency rupture areas with the source processes presented by other researchers. At first, compared to the strong motion generation area (SMGA) models proposed by three research groups, our result is quite similar to the SMGAs of Kurahashi and Irikura (2011) in terms of rupture sequence and location. Secondly, the comparison with the rupture front process obtained from far-field P-waves using the back-projection method by Zhang et al. (2011) reveals that the three high-frequency rupture areas correspond to northward first rupture off Miyagi up to 60 seconds from origin, southwestward second rupture off Miyagi in next 40 seconds and southward third rupture from off-Fukushima to off-Ibaraki in final 40 seconds, respectively. Finally, compared to the source process obtained from joint inversion using near-field strong motion, teleseismic and geodetic data by Koketsu et al. (2011), we find that the first high-frequency rupture area corresponds to slowly expanded rupture process from the hypocenter, the second one corresponds to westward rupture with large slip from the trench accompanied with tsunami, and last one corresponds southward rupture up to off-shore of north Ibaraki Prefecture. The energy centroids of the second and last high-frequency rupture area are located at terminal rupture area of asperities. We have detected the same characteristics in the analysis of other historical interplate events [Takemura and Kanda (2008)].

Keywords: seismic intensity, inversion analysis, high frequency, the 2011 off the Pacific coast of Tohoku Earthquake, historical earthquake off Miyagi Prefecture, source process