Slip distribution of the 2003 Tokachi-oki earthquake estimated from the tsunami waveform inversion

Yuichiro Tanioka[1]; Kenji Hirata[2]; Ryota Hino[3]; Toshihiko Kanazawa[4]

[1] Hokkaido U; [2] JAMSTEC; [3] AOB, Tohoku Univ.; [4] ERI, Tokyo Univ

On 26 September 2003, a large Tokachi-oki earthquake occurred off southern coast of Hokkaido, Japan. Japan Meteorological Agency (JMA) provided the source parameters: origin time, 4:50:07.5 (Japanese Standard Time (JST)); epicenter, 41,46.7'N, 144,04.7'E; depth 42 km; the JMA magnitude,8.0. This earthquake generated large tsunamis causing damage along the southern coast of Hokkaido. The tsunami run-up height survey was conducted immediately after the earthquake. The slip distribution of the 2003 Tokachi-oki earthquake was estimated using the teleseismic body-waves by Yamanaka and Kikuchi (2003). In this paper, we estimated the slip distribution of the earthquake from tsunami waveform inversion technique using waveforms observed at tide gauges and ocean bottom pressure gauges.

We used the tsunami waveform data recoded at nine tide gauge stations, six in Hokkaido (Hanasaki, Akkeshi, Kushiro, Tokachi, TomakomaiE, and TomakomaiW) and three in Tohoku (Hachinohe, Miyako, and Kamaishi). We also used tsunami waveforms recoded at two ocean bottom tsunami-meters (OBTMs) deployed at depths of 990m and 1563m off Kamaishi, Tohoku.

We divided the source area of the 2003 Tokachi-oki earthquake into 14 subfaults. The subfaults cover the source area of the 2003 event estimated by Yamanaka and Kikuchi (2003) and also the source area of the 1952 Tokachi-oki earthquake estimated by Hirata et al. (2003). The subfault size is 40 km x 40 km. The strike and rake of the subfaults are fixed to be 230 and 90, respectively. To calculate the tsunami Green's functions, finite difference computations for the linear long-wave were carried out on the actual bathymetry. The grid size is basically 20 sec of arc (about 600m), but finer grid (4 sec) were used around the tide gauge stations.

The result of the tsunami waveform inversion shows that the largest slip of 3.9m is estimated on the subfault located off Hiroo. Another large slip of 3.1 m is estimated on the subfault located near Kushiro. The total seismic moment of the 2003 Tokachi-oki earthquake is 0.8 x 10**21 Nm. The slip distribution estimated from the tsunami waveform inversion is similar to the slip distribution estimated by Yamanaka and Kikuchi (2003) using the telesismic body waves. However, the slip distribution of the 2003 Tokachi-oki earthquake estimated in this study is clearly different from the slip distribution of the 1952 Tokachi-oki earthquake estimated by Hirata et al. (2003). The largest slip was estimated on the southeast part of the source area of the 1952 Tokachi-oki earthquake, but almost no slip was estimated on that part of the plate interface for the 2003 Tokachi-oki earthquake. The rupture area of the 1952 Tokachi-oki earthquake is extended to east from the rupture area of the 2003 Tokachi-oki earthquake.