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2011 年東北地方太平洋沖地震と 1896 年明治三陸地震の津波波源モデル
Tsunami source models of the 2011 Tohoku and 1896 Sanriku earthquakes

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We estimated the tsunami sources of the 2011 Tohoku earthquake and 1896 Meiji Sanriku tsunami earthquake by modeling the tsunami waveform data and tsunami height data along the coasts.

The spatial and temporal slip distribution of the 2011 Tohoku tsunami source was inverted from 53 tsunami waveforms recorded at ocean bottom pressure gauges, GPS wave gauges, and coastal wave and tide gauges (Satake et al., 2013, BSSA). The result shows that fault slip started near the hypocenter and very large (> 25 m) slip occurred on the deep plate interface near the hypocenter within ~ 2.5 min, then huge (up to 69 m) slip occurred at the shallow part near the trench axis and propagated to the north. The final slip distribution shows that the slip increases toward the trench axis. The average slip on a 550 km long and 200 km wide fault is 9.5 m, and the total seismic moment is 4.2 x 10^{22} Nm (Mw = 9.0). The slip distribution can be decomposed into a shallow slip near the trench axis (Mw = 8.8) and a deeper slip on the plate interface (Mw = 8.8).

The shallow slip near the trench axis is similar to the proposed model of the 1896 Sanriku tsunami earthquake (Tanioka and Satake, 1996, GRL), which is inferred from the tsunami records at three tide gauges (Hanasaki, Ayukawa and Choshi). The maximum tsunami height observed at tide gauges was 1.2 m at Ayukawa, which is much smaller than the observed one for the 2011 tsunami (> 8 m), while the maximum tsunami height (~ 40 m) along the Sanriku coast was similar to the 2011 tsunami. The tide gauge records and the coastal tsunami heights from the 1896 Sanriku earthquake can be explained by halving the slip of the 2011 source model on the northern subfaults along the trench axis (200 km x 50 km). The seismic moment is ~ 3 x 10^{21} Nm (Mw = 8.2). While the average slip of ~ 9 m is similar to the previous estimates (Tanioka and Seno, 2001, GRL), the slip increases toward south. This indicates that both the 1896 and 2011 earthquakes had similar slip distribution along the trench axis.

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