The slip distributions of the 1896 Sanriku and 2011 Tohoku earthquakes along the northern Japan Trench

*Kenji Satake[1], Yushiro Fujii[2], Shigeru Yamaki[3]

1.Earthquake Research Institute, University of Tokyo, 2.IISEE, Building Research Institute , 3.Seamus

The 1896 Sanriku earthquake was a typical “tsunami earthquake” with large tsunami despite its weak ground shaking. The tsunami source of the 2011 Tohoku earthquake extended toward north along Japan Trench with ~3 min delay. The 1896 source is located the north of this slip along the trench axis. Comparison of the two tsunamis shows that the runup heights along the northern and central Sanriku coasts were similar, but the amplitudes of the 1896 tsunami waveforms recorded on tide gauges at regional distances were much smaller than those of the 2011 tsunami. Computed tsunami from the northeastern part of the 2011 slip model roughly reproduces the 1896 heights on Sanriku coast, but much larger than the 1896 waveforms, consistent with the comparison of observed data. The 1896 coastal heights along Sanriku coast, arrival time at Miyako, and waveforms at regional distances are all reproduced by a 200 km long, 50 km wide fault with an average slip of 8 m, with large (20 m) slip on a 100 km x 25 km asperity. Assuming a rigidity of 2 x 10^{10} N/m^2, the seismic moment is 1.6 x 10^{21} Nm and the corresponding moment magnitude is Mw 8.1. The slip at the 1896 asperity (depth 3.5 to 7 km) was 3 to 14 m in 2011, while the shallower (0 –3.5 km) part slipped 3 m in 1896 but 20 to 36 m in 2011. Thus the large slips of the two earthquakes were complementary, and the large slip asperity was deeper in 1896.

Keywords: 1896 Sanriku tsunami earthquake, 2011 Tohoku earthquake, tsunami

