Analysis of tsunamis generated by two great Kurile earthquakes of 15 November 2006 and 13 January 2007

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Two great earthquake, Mw 8.3 and 8.1, occurred off Simushir Island along the Kurile trench on November 15, 2006, and January 13, 2007, respectively. The 2006 earthquake was a typical underthrust event occurred along the plate interface between the Pacific plate and the Okhotsk plate. The 2007 earthquake was an intraplate event occurred in the outer-rise region with a normal fault type mechanism. Both earthquakes generated tsunamis which observed at the many tide gauges along the Pacific coast in Japan, Russia, and USA. Some damages were reported at Sanriku in Japan and at Crescent City in USA by the tsunami generated by the 2006 earthquake. No damages were reported for the 2007 earthquake. The tsunamis were first arrived at the tide gauges in Japan about 2-4 hours after the origin times of the earthquakes. The significant phenomenon of those tsunamis in Japan was large later phases observed about 7-10 hours after the origin times of the earthquakes. In this study, we first numerically computed two tsunamis, and compared the observed and computed tsunami waveforms to estimate the seismic moments of two earthquakes. We also try to discuss the generation mechanisms of the large later phases observed at tide gauges in the Japan.

For the 2006 earthquake, eight tsunami waveforms observed at three tide gauges in Japan, Hanasaki, Miyako, and Chichijima, two tide gauges in Hawaii, Hilo and Kahului, and three tide gauges in the west coast of USA, Port Orford, Arena Cove, Port San Louis, were used to estimate the slip amount of the earthquake. The trust type fault plane (strike 220 degree, dip 25 degree, rake 96 degree) which estimated by Yamanaka (http://www.eri.u-tokyo.ac.jp/sanchu/Seismo_Note/2006/EIC183.html) was used for the tsunami computation. The length and width of the fault model were 200km and 80km, respectively.

For the 2007 earthquake, four tsunami waveforms observed at three tide gauges in Japan,Hanasaki, Miyako, and Chichijima, and one ocean bottom pressure sensor (DART system) installed by the NOAA-PMEL. The normal fault plane (strike 220 degree, dip 37 degre, rake -108 degree) which also estimated by Yamanaka (http://www.eri.u-tokyo.ac.jp/sanchu/Seismo_Note/2007/EIC184.html) was used for the tsunami computation. The length and width of the fault model were 130km and 30km, respectively.

By comparing the observed and computed tsunami waveforms, we estimated the slip amounts of 5.1 m for the 2006 earthquake and 6.4 m for the 2007 earthquake. By assuming the rigidity of 4 x 10∗∗21 Nm/s∗∗2, the seismic moment is calculated to be 3.3 x 10∗∗21 Nm (Mw8.3) for the 2006 earthquake and 1.0 x 10∗∗21 Nm (Mw8.0) for the 2007 earthquake. This estimated seismic moment is consistent with that shown in the Harvard CMT catalog, 3.37 x 10∗∗21 Nm (Mw8.3) for the 2006 earthquake and 1.65 x 10∗∗21 Nm (Mw8.1) for the 2007 earthquake. This implies that the excitations of seismic waves and tsunamis are consistent with each other. The preliminary analysis of the computed tsunami indicated that the large later phase observed in Japan can be caused by the scatter of the tsunami at the shallow region near Emperor Seamounts.