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Source Process of the 2010 Great Chile Earthquake (Mw8.8) Estimated Using Tsunami Waveforms

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The great earthquake, Mw 8.8, occurred in Chile on 27 February, 2010 at 06:34:14 UTC. The number of casualties by this earthquake was reached 800, and more than 500 people among that were killed by tsunamis. The large tsunami was generated by the earthquake and propagated through Pacific and reached along the coast of Pacific include Hawaii, Japan, and Alaska. Japan Meteorological Agency (JMA) issued the Tsunami Warning along the Pacific coast in Japan. The maximum tsunamis were observed at tide gauges or tsunami meters installed in Japan about 24-30 hours after the origin time of the earthquake. The maximum tsunami height of 1.2 m was observed at the tide gauge in Kuji, Japan. The tsunami was also observed at DART real-time tsunami monitoring systems installed in the Pacific by NOAA-PMEL.

In this paper, the tsunami waveforms observed at 9 DART stations, 32412, 51406, 51426, 54401, 43412, 46412, 46409, 46403, and 21413, are used to estimate the slip distribution of the 2010 Chile earthquake. The source area of 500km x 100km is divided into 5 subfaults of 100km x 100 km. The Global CMT solution shows the focal mechanism of the earthquake, strike=18degree, dip=18degree, rake=112degree. Those fault parameters are assumed for all subfaults. The shallowest depth of each subfault is fixed to be 20km. The tsunami is numerically computed on actual bathymetry for 5 subfaults. The finite-difference computation for the linear long-wave equations are carried out in the whole Pacific. The grid size is 5 minutes, about 9km. Tsunami waveforms at 9 DART stations are computed from each subfault with a unit amount of slip, and used as the Green's function for the inversion. The result of the tsunami inversion indicates that the largest slip of 17m is estimated at north of the epicenter, and the most northern subfault did not rupture by the earthquake. The total length of the rupture length is found to be 400km. The result also indicates the bilateral rupture process of the great Chile earthquake. The total seismic moment calculated from the slip distribution is 2.1×10^{22} Nm (Mw8.8) by assuming the rigidity of 4×10^{10} N/m². This seismic moment is consistent with those estimated by the other seismological analyses.

Keywords: Tsunami numerical simulation, slip distribution, 2010 great Chile earthquake