

Source Estimate for the 1960 Chile Earthquake from Joint Inversion of Geodetic and Transoceanic Tsunami Data

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The source of the 1960 Chile earthquake was re-estimated using the geodetic data, local tsunami data, and the newly usable transoceanic tsunami data. The 1960 Chile earthquake was the largest earthquake ever instrumentally recorded. However, different magnitudes were estimated using different data, e.g. Mw 9.7 was estimated from free oscillation (Kanamori and Anderson, 1975), the magnitude estimated from the geodetic data is Mw 9.3 (Barrientos and Ward, 1990; Moreno et al., 2009), and Fujii and Satake (2013) estimated Mw 9.2 from joint tsunami and geodetic data. In the present study, we used 301 coastal geodetic data (Plafker and Savage, 1970), five near-field tsunami data from South America, and 50 far-field tsunami data from North America, Asia, and Oceania. Due to the dispersion effect of elasticity of the Earth and ocean during long distance traveling, the far-field tsunami data were not used to estimate the earthquake source in previous studies. With the phase correction method (Watada et al., 2014), the dispersion effects at far-field stations are well explained and the data can be used for source estimation (Ho et al., 2017). In addition, we apply a nonlinear inversion method (NOMAD) with the optimal time alignment (OTA, Romano et al., 2016) which accounts for the arrival time mismatch between observed and synthetic data caused by inaccurate station location, inaccurate recording time, local bathymetry, or artificial structures. Our fault model shows that a rupture starts from the epicenter to the southern end at about 46°S with main slips at depths shallower than 50 km. The estimated magnitude was about Mw 9.2. There was a north asperity from 39°S to 43°S with slips of 20 to 30 m and a south peak at about 45°S with a slip of about 43 m. Our results also indicated that the south peak has a significant effect on the geodetic data measured in the south as well as some far-field stations located in the South Pacific Ocean.

Keywords: tsunami inversion, phase correction, 1960 Chile earthquake, transoceanic tsunami