Tsunami simulations and source inversions of recent earthquakes

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We upload preliminary tsunami simulation results on the IISEE "Reports of Recent Earthquakes" page (http://iisee.kenken.go.jp) after the occurrence of tsunamigenic earthquakes in the world. In the webpage (Figure 1), we show assumed tsunami source models, maximum tsunami-height distribution from the computation, animations of tsunami propagation. If tsunami data at tide gauges (TG) or DARTs (ocean bottom pressure gauges (OBPG) by NOAA) are available, the calculated tsunami waveforms are compared with the observed ones, and tsunami data inversions are further performed to estimate the tsunami sources (e.g. the 2004 Sumatra-Andaman (Fujii and Satake, 2007, BSSA), the 2010 Maule, Chile (Fujii and Satake, 2013, PAGEOPH), and the 2011 Tohoku (Fujii et al., EPS, 2011; Satake et al., 2013, BSSA) earthquakes). Here, we show a tsunami simulation result for the Alaska earthquake (Mw 7.9) on January 23, 2018 (Figure 2). We applied a phase correction method to the calculated tsunami waveforms and compared with the observed ones at far field. This correction method was introduced by Watada et al. (2014, JGR), which incorporates the delayed arrival and phase reversal of the first tsunami waves including the effects of elasticity of solid earth, compressibility of sea waver and gravitational potential variation. Recently, this method was applied for a tsunami waveform inversion of the 2010 Maule earthquake (Yoshimoto et al., 2016, GRL), and further improved additionally including the effect of ocean stratification and applied for the 2011 Tohoku earthquake (Ho et al., 2017, JGR).

In this presentation, we introduce re-estimated slip distributions of the 2004 Sumatra-Andaman earthquake (Mw9.1) from the tsunami data inversion using the phase-corrected Green's functions. The phase correction method by Ho et al. (2017, JGR) was applied to conventional linear long waves calculated at observation points such as TGs, OBPGs, and sea surface height (SSH) data points from satellite altimetry measurements. As the observed tsunami data, we used the tsunami waveforms at TGs in and around the Indian Ocean and the SSH data (Hayashi, 2008, JGR:O). We also synthesized the far-field tsunami waveforms from the estimated slip distributions to compare with the observed records at OBPGs located at the Drake Passage, a DART off Chile, and Syowa station in Antarctica.

The inversion results show that the reproducibility of tsunami waveforms at TGs and spatiotemporal SSH data are improved, although the phase-correction effects are not so significant for stations or data points within the Indian Ocean. The slip model which well reproduces the SSH data also explains the tsunami waveforms at the far-field stations more than 13,000 km, while the slip distribution inferred only from TG data does not well reproduce the SSH data.

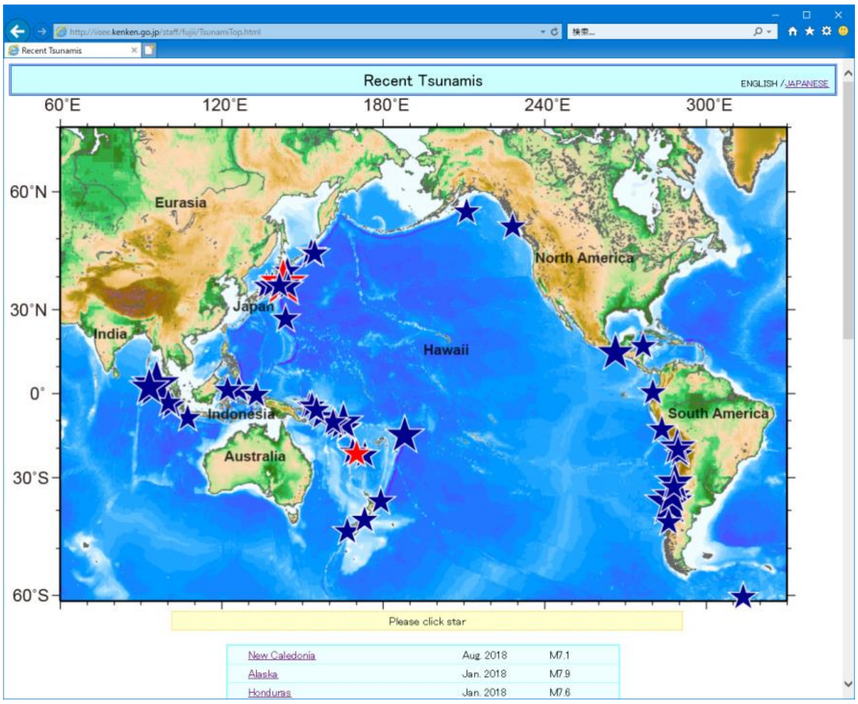

Figure 1. Epicenters of recent tsunamigenic earthquakes for which we performed tsunami simulations. (http://iisee.kenken.go.jp/staff/fujii/TsunamiTop.html)

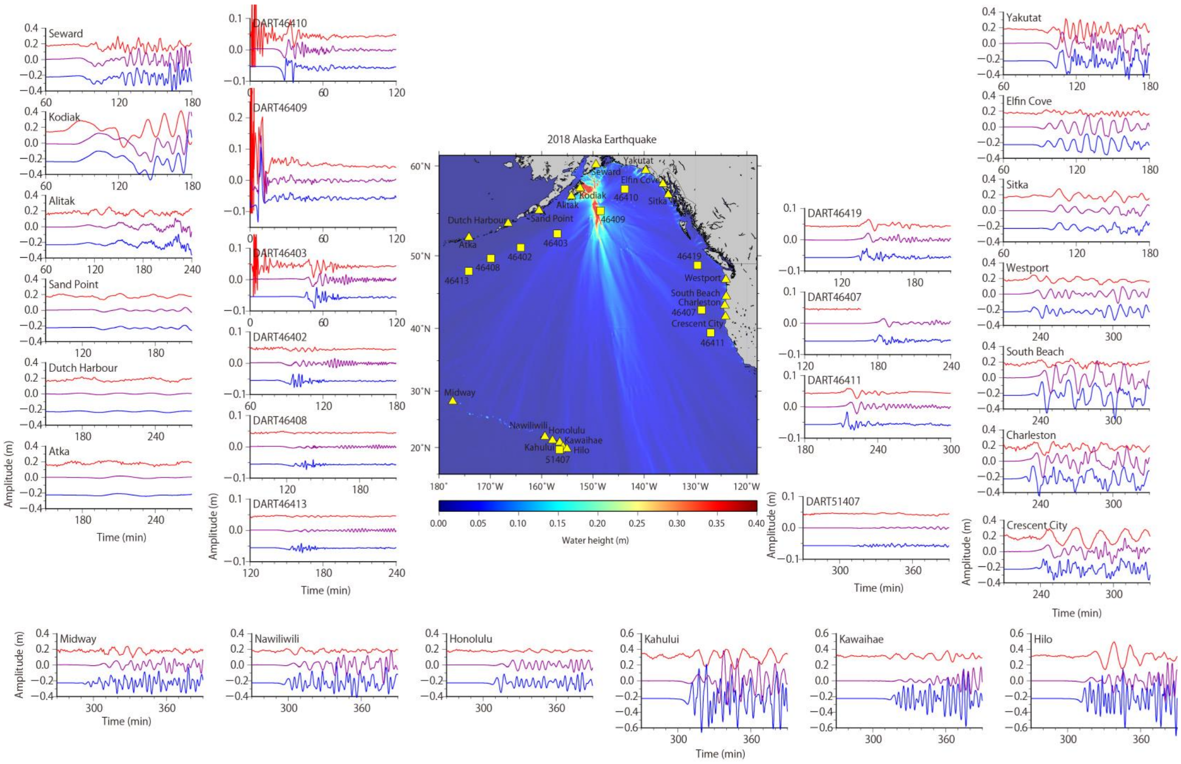

Figure 2. Simulated maximum tsunami height for the 2018 Alaska earthquake and comparisons of tsunami waveforms. Solid lines in red and blue indicate the observed tsunami waveforms and calculated ones, respectively. Purple lines show the phase-corrected tsunami waveforms.