Tsunami synthetics using mechanic-based earthquake rupture scenarios

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The present study theoretically assesses the tsunami height along the coasts excited by possible great earthquakes that will occur in the Nankai Trough subduction zone and simulates observable records for ocean-bottom pressure gauges. First, by surveying energy balance, we constructed multi-segment rupture scenarios using the GNSS observations and the earthquake mechanics. We estimated a shear-stress distribution along the plate boundary from the GNSS data analyses (Noda et al. 2018 JGR) and calculated coseismic slip distributions to release the accumulated stress. Then, employing an idea of the energy conservation of the earthquake faulting, we evaluated the possibility of each multi-segment rupture. The released strain energy by shear faulting should be larger than the energy dissipated on the fault. However, for some scenarios, the released strain energy was smaller than the dissipated energy calculated from assumed slip weakening friction laws. Such rupture scenarios cannot occur in the viewpoint of earthquake mechanics.
We then theoretically synthesize ocean-bottom pressure changes of the earthquake rupture scenarios caused by both seismic waves and tsunamis using a simulation method based on elastic and fluid dynamics (Saito and Tsushima 2016 JGR; Saito et al. 2019 Tectonophysics). Seismic-wave contributions to ocean-bottom pressure changes are critically important for the synthetics in near-field or inside rupture areas because the seismic waves overlap with tsunami signals and work as noise for real-time tsunami monitoring. The records simulated in this study can be used to examine the monitoring ability of a deep-ocean observation network for megathrust earthquakes and tsunamis in this region.

Keywords: Tsunami hazard, Earthquake mechanics, Wave theory

