KINEMATICALLY CONSTRAINED, LINKED AND FULLY COUPLED DYNAMIC RUPTURE AND TSUNAMI MODELING OF THE 2020, M_W 7.0 SAMOS EARTHQUAKE

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The tsunamigenic M_W 7.0 Samos earthquake was the deadliest earthquake of 2020 and ruptured a north-dipping normal fault within the eastern Aegean Sea. We aim to unravel the complexity of rupture and tsunami generation by comparing kinematic source models with kinematically informed 3D dynamic rupture models and using different tsunami modeling techniques. We compare two data-driven finite-fault models (Heidarzadeh et al., 2021; Plicka et al., 2022) in 3D kinematic rupture models and select a preferred model based on the comparison against seismic, geodetic, and tsunami observations. Shear stress changes in dip direction of this model inform two spontaneous dynamic rupture models (Tinti et al., 2021): models with uniform and depth-dependent initial normal stress generate comparable peak slip amplitudes. The dynamic rupture model with decreased normal stress near the surface results in extended surface rupture and wider seafloor subsidence within Kuşadası Bay. Kinematic and kinematically informed dynamic rupture simulations show significant differences in (low-frequency, $<$2 Hz) peak horizontal velocities. We use the kinematic and dynamic rupture models as time-dependent sources for one-way linked and fully coupled earthquake-tsunami modeling (Abrahams et al., 2023; Kutschera et al., 2024). In the more efficient shallow-water tsunami simulations, we identify long-term tsunami reverberance lasting locally up to four hours. The tsunami synthetics of the more complex fully coupled earthquake-tsunami simulations (Krenz et al., 2021) contain a higher frequency content than the smoother one-way linked tsunami waveforms. Our analysis may help to design and guide rapid workflows for the joint assessment of physics-based seismic and tsunami hazards.

Note: Figure is on the next page.

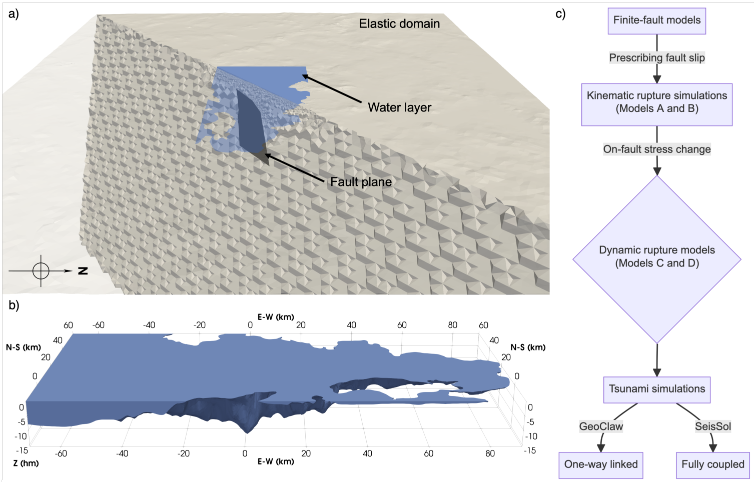

Figure 1. a) Transection of the three-dimensional unstructured tetrahedral mesh for the elastic domain (grey) including the water layer (blue) and the north-dipping fault plane (black) of Plicka et al. (2022). The fault plane has a strike/dip/rake of 265°/40°/-110° and intersects the seafloor. The static mesh refinement is visible near the fault plane and the transected domain. b) Dimension of the water layer. Here, we prescribe a rigidity of $\mu = 0$ (Krenz et al., 2021; Kutschera et al., 2024). c) Workflow of this study. We start with two finite-fault models and prescribe their slip distribution in kinematic rupture models. Based on our joint assessment of the kinematic rupture models and their comparison against seismic, geodetic, and tsunami observations, we select a preferred model. We compute and use the on-fault shear stress change in dip direction of this model to inform two spontaneous dynamic rupture models, which enables us to test the mechanical viability of the kinematic model.