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How dynamic deformation of the vertical sea floor affects the tsunami generation and propagation: a numerical sensitivity analysis

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The shallow features of the seismic ruptures both for the subduction megathrust and tsunami earthquakes have been shown to affect the tsunami generation and hence the inundation intensity.
In this framework, both numerical and experimental results have shown how the interaction between the shallow part of fault interface and the seismic radiation which has been emitted earlier during the rupture, reflected by free surface and trapped in the hanging wall can lead to enhanced up-dip rupture propagation. This in turn may generate transient ground motion that is larger than the final static vertical displacement. Here, we analyzed the possible contribution of this dynamic transient amplification to the tsunami generation.
We performed 1-D numerical tsunami simulations using both the hydrostatic version of Tsunami-HySEA and by approximating the dispersive non-hydrostatic regime by means of the Multilayer-HySEA model. We simulate the tsunami source by imposing time dependent initial conditions as computed from 1-D dynamic rupture simulations. We investigate the spatial and temporal characteristic scales of transient sea floor displacement in relation to the tsunami features. To analyze how this dynamic effect may contribute to enhancing the tsunamigenic potential the simulated tsunami waves are compared to a simulation where a static sea-floor displacement is used as a tsunami source.
Preliminary results showed that the landward propagating tsunami wave period is affected while the amplitude of this wave remains almost unchanged. Conversely, as the rupture slows down, the effect of dynamic deformation mostly increases the tsunami amplitude of the wave toward the open ocean, that is, in the same direction as the rupture propagation and the displacement accumulation.
A further parametric analysis will be performed to investigate how the transient co-seismic displacement influences the tsunami. We aim to address how the tsunami features depend on: the seismic rupture properties (e.g., fault geometry, presence of slow layers just below the sea-floor); and on the different coastal morphologies (e.g., presence of fjords).