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Tsunami Simulation and Seismic Source Characterization: A Case Study of the March 18, 2021 Offshore Bejaia Earthquake (Mw 6.0) in the Western Mediterranean

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On March 18, 2021, a magnitude Mw 6.0 earthquake occurred offshore the Algerian coasts near Bejaia, resulting in a tsunami with offshore amplitudes smaller than a few millimeters that crossed the western Mediterranean Sea. This study pursues three primary objectives: firstly, to assess the ability of tsunami simulations to replicate tide-gauge observations; secondly, to ascertain the relevance of seismic sources calculated within the context of tsunami early warning systems, against tsunami generation and observations; and thirdly, to evaluate the sensitivity of simulations to grid resolutions and earthquake parameters.
Within the Mediterranean Sea, only a limited number of coastal tide gauges recorded the tsunami. Among these, select French tide gauge stations captured water waves with amplitudes smaller than a few centimeters and periods ranging from five to twenty minutes, often associated with harbor or bay resonances.
Numerical simulations of the tsunami were conducted utilizing the operational code Taitoko employing six distinct source fault models. Notably, two of these models provided rapid source detection and characterization within the framework of tsunami warning systems at CENALT (Centre National d'Alerte aux Tsunamis, France). The integrated code Taitoko employs a system of multiple nested grids. For this event, it solved standard Boussinesq equations within the Mediterranean grid, while employing nonlinear shallow water equations in coastal and harbor grids, each with resolutions of 25 and 5 meters, respectively. Regardless of the fault model employed, the model satisfactorily reproduced the observed time series of water heights in both phase and amplitude at Nice and Monaco, while some discrepancies are found and discussed for most of the other locations.