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Comparison of local kinematic rupture joint inversion approaches for tsunami early warning: Examples of the 2017-2020 Mw > 6.3 East Aegean earthquakes

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The fast inversion of reliable centroid moment tensor and kinematic rupture parameters of earthquakes occurring near coastal margins is a key for the assessment of the tsunamigenic potential and early tsunami warning (TEW). In recent years, more and more multi-channel seismic and geodetic online station networks have been built-up to improve the TEW, for instance the GNSS and strong motion networks in Italy, Greece, and Turkey, additionally to the broadband seismological monitoring. Inclusion of such data for the fast kinematic source inversion can improve the resolution and robustness of its' solutions. However, methods have to be further developed and tested to fully exploit the potential of such rich joint dataset.

In this frame, we compare and test two in-house developed, kinematic / dynamic rupture inversion methods which are based on completely different approaches. The IDS (Iterative Deconvolution and Stacking, Zhang et al., 2014) combines an iterative seismic network inversion with back projection techniques to retrieve subfault source time functions. The pseudo dynamic rupture model (Dahm et al., in review) links the rupture front propagation estimate based on the Eikonal equation with the dislocation derived from a boundary element method to model dislocation snapshots. We used the latter in both a fast rupture estimate and a fully probabilistic source inversion.

We use some Mw > 6.3 earthquakes that occurred in the coastal range of the Aegean Sea as an example for comparison: the Mw 6.3 Lesbos earthquake (12 June 2017), the Mw 6.6 Bodrum earthquake (20 July 2017), and the recent Mw 7.0 earthquake which occurred at Samos on 30 October 2020. The latter earthquake and the resulting tsunami caused fatalities and severe damage at the shorelines of Samos and around the city of Izmir, Turkey.
The fast estimates are based on only little data and/or prior information obtained from the regional seismicity catalogue and available active fault information. The large number of seismic (broadband, strong motion) and geodetic (high-rate GNSS) stations in local and regional distance

from the earthquake with good azimuthal coverage jointly inverted with InSAR data allows for robust inversion results. These, and other solutions, are used as a reference for the comparison of our fast source estimates.
Preliminary results of the slip distribution and the source time function are in good agreement with modelling results from other authors.

We present our insights into the kinematics of the chosen earthquakes investigated by means of joint inversions. Finally, the accuracy of our first fast source estimates, which could be of potential use in tsunami early warning, will be discussed.