Rapid kinematic finite-fault inversion for an Mw 7+ scenario earthquake in the Marmara Sea: an uncertainty study

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During the last century, the North Anatolian Fault (NAF) generated a series of devastating earthquakes, which generally propagated westwards, such that the main Marmara fault segment as a seismic gap. For the nearby megacity Istanbul, rapid seismic hazard assessment is currently of great importance. A key issue is how a strong earthquake in the Marmara Sea can be characterized reliably and rapidly using the seismic network currently operating in this region. In the frame of the MARsite project, several scenario earthquakes on the main Marmara fault are simulated through dynamic modelling based on a 3-D structure model. The synthetic datasets are then used to reconstruct the source processes of the causal events with a recently developed iterative deconvolution and stacking method based on simplified 1-D Earth structure models. The results indicate that, by using certain a priori information about the fault geometry and focal mechanism, the tempo-spatial slip patterns of the input scenarios can be well resolved robustly. If reasonable uncertainties are considered for the a priori information, the key source parameters, such as moment magnitude, fault size and slip centroid, can still be estimated robustly, while the detailed tempo-spatial rupture pattern may reveal significant variations. To reduce the effect induced by employing the inaccurate event location and focal mechanism, a new approach for absolute source imaging is proposed and tested for near real-time source inversion under the current network configuration in the Marmara Sea region. The results obtained are meaningful particularly for developing the rapid earthquake response system for the megacity Istanbul.