KEY OBSERVATIONAL CONSTRAINTS ON DYNAMIC RUPTURE SIMULATIONS: FAULT GEOMETRY AND REGIONAL STRESS TENSOR FIELD

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Recent dynamic rupture simulations demonstrate the reproducibility of natural large earthquakes (e.g., Ando and Kaneko, 2018, GRL). We present the analysis results for the 2023 Türkiye-Syria earthquake sequence and the 2024 Noto-Peninsula, Japan earthquake as two new examples, clarifying the importance of the 3D fault geometry and stress tensor that control the dynamic rupture processes. We perform the fully dynamic rupture simulations using the boundary integral equation method accelerated with the fast domain partitioning method (Ando, 2016, GJI). This method is capable of handling non-planar 3-D fault geometries at the time complexity of O(N2M) and the memory use of O(N2). We built models of the fault geometry and regional stress field based on observations. The simulation results (forward models) are compared with the coseismic observations and slip inference (inverse models) in these two cases. The simulations reproduce the primary characteristics of the observed rupture processes and slip distributions. For the mainshock (the first event) of the 2023 event, the simulation reproduces the rupture propagations through the three major segments with the branch and bends. The simulated process includes the observed time delay for the backward branching. The simulation results for the 2024 event basically reproduce the coseismic surface displacement captured by SAR, showing the particular uplift associated with a fault bend. Our results demonstrate the reasonable gain in the forecastability of the dynamic rupture processes with the observational constraints of the fault geometry and stress tensor field. This further suggests the importance of building these structural models beforehand.