DO PHYSICS-BASED DYNAMIC RUPTURE MODELS CAPTURE GROUND-MOTION VARIABILITY? INSIGHTS FROM THE 2023 TURKEY EARTHQUAKE SEQUENCE

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One of the challenges of empirical ground-motion models is the ability to capture the observed ground-motion variability, which may stem from different source, path and site effects. This challenge may be addressed by simulated data from physics-based, non-ergodic earthquake simulations. Dynamic rupture models capture the non-linear interaction of source, path and site effects in a self-consistent way and, once integrated with observations, reproduce a variety of geodetic and seismic data well to first order (e.g., Taufiqurrahman et al., 2022; Jia et al., 2023; Gabriel et al., 2023). However, the variability in ground motions, specifically in long-period pulse orientation, periods (Tp) and amplitudes, may not be fully reproduced. Here we investigate the effects of incorporating both on-fault and structural small-scale heterogeneities within 3D dynamic rupture models of the 2023 Turkey earthquake doublet on the spectral content and the variability of modelled ground motions. We analyse the effects due to fractal on-fault roughness, heterogeneous distribution of fracture energy (Dc) and supershear (Abdelmeguid et al., 2023) compared to sub-shear initiation. Our results suggest that Dc heterogeneity has the most significant influence on Tp variability, while fault roughness appears to mostly affect high-frequency radiation. Supershear rupture initiation minimally increases the variability of Tp and pulse orientation. We plan to explore additional source, path, and site effects, such as including regional VS30 models, to comprehensively capture ground-motion variability and ultimately enhance seismic hazard assessment.

Note: Figure is on the next page.

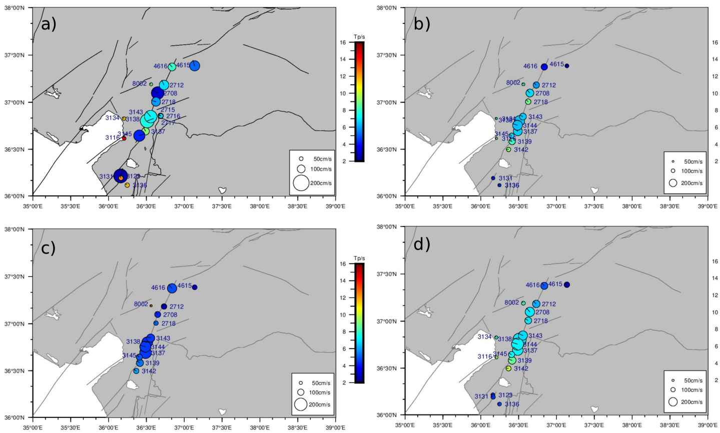

Figure highlighting the different pulse properties for the a) observed data, b) smooth fault reference model, c) rough fault model and d) model with Dc heterogeneities. The size of the circles corresponds to the amplitude, the colour represents the period and the lines within the circles represent the orientation of the pulse extracted at each station.