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PSEUDO-DYNAMIC SOURCE MODELING WITH 1-POINT AND 2-POINT STATISTICS OF EARTHQUAKE SOURCE PARAMETERS

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Ground motion prediction is an essential element in seismic hazard and risk analysis. Empirical ground motion prediction approaches have been widely used in the community, but efficient simulation-based ground motion prediction methods are needed to complement empirical approaches, especially in the regions with limited data constraints. Recently, dynamic rupture modelling has been successfully adopted in physics-based source and ground motion modelling, but it is still computationally demanding and many input parameters are not well constrained by observational data. Pseudo-dynamic source modelling keeps the form of kinematic modelling with its computational efficiency, but also tries to emulate the physics of source process. In this study, we develop a statistical framework that governs the finite-fault rupture process with 1-point and 2-point statistics of source parameters in order to quantify the variability of finite source models for future scenario events. We test this method by extracting 1-point and 2-point statistics from dynamically derived source models and simulating a number of rupture scenarios, given target 1-point and 2-point statistics. We propose a new rupture model generator for stochastic source modelling with the covariance matrix constructed from target 2-point statistics, that is, auto- and cross-correlations. Our sensitivity analysis of near source ground motions to 1-point and 2-point statistics of source parameters provides insights into relations between statistical rupture properties and ground motions. We observe that larger standard deviation and stronger correlation produce stronger peak ground motions in general. The proposed new source modelling approach will contribute to understanding the effect of earthquake source on near-source ground motion characteristics in a more quantitative and systematic way.

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