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Synthetic ground-motion simulation using a spatial stochastic model with slip self-similarity: Toward near-source ground-motion validation

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Near-fault ground motion is a key to understand the seismic hazard along the fault, and is a challenge by the approach of ground motion prediction equation. This paper presents a developed stochastic-slip-scaling source model, a spatial stochastic model with slip scaling of the slipped area, toward ground motion simulation. We considered the near-fault ground motion of the 1999 Chi-Chi earthquake (Mw 7.7) in Taiwan, which having the most massive near-fault data of a disaster earthquake, as a reference for validation. Including the developed stochastic-slip-scaling source model, two scenario source models, mean-slip model, characteristic-asperity model were also used for the examination on the near-fault ground motion. We simulated synthetic ground motion through 3D waveforms and validated these simulations by using observed data and the ground-motion prediction equation (GMPE) for Taiwan earthquakes. The mean slip and characteristic asperity scenario source models over-predicted the near-fault ground motion. The stochastic-slip-scaling model proposed in this paper is more accurately approximated to the near-fault motion compared with the GMPE and observations. This is the first study to incorporate slipped-area scaling in a stochastic slip model. The proposed model can generate scenario earthquakes for predicting ground motion.