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Earthquake environmental effects and Bayesian analysis of ground motion models using chimney fragility curves, 2021 Mw 5.9 Woods Point earthquake, Victoria, Australia

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Abstract

The Mw 5.9 Woods Point earthquake is the first strike-slip earthquake to be investigated using Earthquake Environmental Effects (EEEs) in Australia. EEEs were surveyed and categorised using the Environmental Seismic Intensity Scale. EEEs identified following the earthquake suggest lower-than-expected ground motions within the epicentral region and show asymmetry in their intensity distribution. There is evidence for EEEs produced through high structural vulnerability of weak geomorphic elements and evidence for a lack of EEEs. There were no observed primary EEEs. It appears the strike-slip kinematics of the fault rupture, and ca. 4 km depth of the source fault, resulted in a halo of low seismic shaking immediately proximate to the source fault. A Bayesian approach was used to evaluate the performance of commonly used ground motion models using observed earthquake damage to chimneys (and non-damage) and chimney fragility curves. Relative performance of ground motion models in the near-field of the Woods Point earthquake is generally consistent with pre-earthquake expert elicitation-based hierarchical rankings of models developed for the Australian National Seismic Hazard Assessment in 2018, although individual ground motion model weightings vary significantly.

Keywords: earthquake environmental effects, ground motion models, unreinforced masonry, Bayesian analysis