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Rapid Finite-Fault Models for Three Large Earthquakes in Sichuan, China

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Seismic risk in China is high. In particular Sichuan province has been hit hard in recent years with the successive occurrence of the 2008 MW 7.9 Wenchuan, 2013 MW 6.6 Lushan, and 2017 MW 6.5 Jiuzhaigou earthquakes with more than 87,000 fatalities and economic losses of about 1.5 trillion US dollars. In the scope of the National System for Fast Report of Intensities and Earthquake Early Warning project, the China Earthquake Administration (CEA) is building a nationwide earthquake early warning (EEW) system with about 3,200 strong-motion, ∼2,000 broadband and ∼10,200 low-cost MEMS sensors. The MW 7.9 Wenchuan mainshock and other large earthquakes are challenging for EEW, because traditional seismic network stations tend to saturate and source dimensions need to be known to predict seismic ground-motion at high accuracy. In this study, we run playbacks of local and regional on-scale strong-motion waveforms recorded by the China Strong Motion Networks Center (CSMNC) during the MW 7.9 Wenchuan, MW 6.6 Lushan, and MW 6.5 Jiuzhaigou earthquakes to study the possible performance of the Finite-Fault Rupture Detector (FinDer) algorithm (Böse et al., 2018). We show that the FinDer line-source models agree very well with the later observed aftershock distributions and finite-fault models determined from waveform inversion. If the available set of strong motion data had been operated in real-time and available to such an EEW system, more than 70% of sites experiencing shaking intensities of MMI IV-VI could receive 5 or more seconds of warning, and more than 30% of sites experiencing shaking intensities of MMI VI-IX could receive 10 or more seconds of warning. FinDer finite-fault models could also help providing faster and more accurate loss estimates in the aftermath of devastating earthquakes.