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Real-time slip profiles from back-projection of dynamic displacement amplitudes derived from strong-motion waveforms: Demonstration for the 2008 M_w 7.9 Wenchuan (China) earthquake

Allie Hutchison (1,2), Maren Böse (2), Jiawei Li (2,3,4), and John Clinton (2)

(1) Institute Français des Sciences Technologies des Transports de L'Aménegement et de Réseaux (IFSTTAR), Champs-sur-Marne, France (allie.hutchison@ifsttar.fr), (2) Swiss Seismological Service (SED), Swiss Federal Institute of Technology (ETH), Zurich, Switzerland, (3) Institute of Geophysics (IGP), China Earthquake Administration (CEA), Bejing, China, (4) School of Earth and Space Sciences (SESS), Peking University, Bejing, China

Earthquake early warning (EEW) can provide seconds to minutes of warning preceding the arrival of hazardous seismic radiation from an earthquake as it occurs. Several EEW systems are in development that utilize real-time seismic and/or geodetic observations to either constrain the growth and final size of the rupture and subsequently determine the resulting ground motions, or to characterize the intensity of ground motion without consideration of earthquake source properties; both types ultimately issuing a warning to affected populations. Here, we develop a module for EEW that incorporates coseismic slip evolution and its relationship to rupture length. Localized slip is used to predict the final amount of slip that can be expected as the rupture endures, aiding in producing a more robust and faster EEW system. Perrin *et al*., [2016] uses a global dataset of large magnitude earthquakes to identify a generic relationship between slip distribution and final rupture length, which indicates that after maximum slip is reached at roughly 0.4 * final rupture length, the slip distribution is approximately linear and notably, that the largest slip occurs on the most mature sections of the fault. Coseismic slip data can thus also be used to infer the final extent of ongoing fault ruptures. Using the GPSlip algorithm [Böse et al., 2013] that employs the empirical relationship of Yamada [2007], we back project peak ground displacement (PGD) amplitudes onto the source fault to determine 1D slip profiles and to estimate final slip profiles and rupture dimensions. We demonstrate the application for the 2008 M_w7.9 Wenchuan (China) earthquake, where we double integrate strong-motion records for displacement and continuously back project amplitudes onto finite-source models determined by the Finite Fault Rupture Detector [Böse *et al*., 2018]. The results of the back projection and prediction are consistent with slip inversions suggesting that this method is indeed useful to improve EEW.