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Source rupture process of the 2016 Kaikoura, New Zealand earthquake estimated from the kinematic waveform inversion of strong-motion data

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On 2016 November 13, an Mw 7.8 earthquake occurred in the northeast of the South Island of New Zealand near Kaikoura. The earthquake caused severe damages and great impacts on local nature and society. Referring to the tectonic environment and defined active faults, the field investigation and geodetic evidence reveal that at least 12 fault sections ruptured in the earthquake, and the focal mechanism is one of the most complicated in historical earthquakes. On account of the complexity of the source rupture, we propose a multisegment fault model based on the distribution of surface ruptures and active tectonics. We derive the source rupture process of the earthquake using the kinematic waveform inversion method with the multisegment fault model from strong-motion data of 21 stations (0.05–0.35 Hz). The inversion result suggests the rupture initiates in the epicentral area near the Humps fault, and then propagates northeastward along several faults, until the offshore Needles fault. The Mw 7.8 event is a mixture of right-lateral strike and reverse slip, and the maximum slip is approximately 19 m. The synthetic waveforms reproduce the characteristics of the observed ones well. In addition, we synthesize the coseismic offsets distribution of the ruptured region from the slips of upper subfaults in the fault model, which is roughly consistent with the surface breaks observed in the field survey.