Characteristic of fault geometry of the 2016 Mw7.8 Kaikoura Earthquake, New Zealand inferred from high precision aftershock distribution

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On November 14, 2016, a large earthquake with Mw7.8 occurred in northeastern South Island, New Zealand. The earthquake showed a complex rupture process involving many faults. Based on geodetic and geologic observation, previous studies (e.g., Clark et al., 2017) pointed out that over 20 faults were ruptured by the main shock. Two previous studies have relocated aftershocks using double-difference techniques (Mouslopoulou et al., 2019; Lanza et al., 2019). However, the event distribution in these studies was not always sufficient to reveal the fine fault geometry due to the low station spacing above the focal area within 50 km. More precise fault geometries than the previous studies are required in order to examine the relationship between coseismic fault behaviour and the observed surface breaks. In this study, we used temporary seismic stations that were deployed close to the rupture area prior to the main shock occurrence. We applied the double-difference earthquake relocation algorithm (Waldhauser and Ellsworth, 2000) to the phase data including time-domain waveform cross-correlation (Poupinet et al., 1984).

We obtained the hypocenter distribution concentrating around the surface breaks, with a depth range from 5 km to 25 km. From the aftershock distribution, we identified 10 or more faults. The geometry of the fault planes is consistent with the focal mechanism of the relatively large events in each cluster. In particular, one of the faults in this study, which was located in the area of large coseismic slip, may correspond to the fault orientation of the main shock inferred from its CMT solution.

Keywords: Kaikoura Earthquake, New Zealand, high precision hypocenter location, aftershock distribution, fault geometry

