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Estimation of rupture directivity of the 2016 Gyeongju, Korea, earthquake sequence using peak ground velocity

DongHyeop Seol, Tae-Seob Kang, and Hyun Jae Yoo
Division of Earth Environmental System Science, Pukyong National University, Busan 48513, Republic of Korea

The rupture directivity causes variations in the ground motion at different source azimuths. Rupture directivity was estimated for the 2016 Gyeongju earthquake (Mw 5.5), its foreshock (Mw 5.1), and 22 aftershocks (Mw $\geq$ 3.0) using relative peak ground velocity (PGV) changes. The PGVs were estimated using velocity data recorded at the regional seismograph networks administered by Korea Meteorological Administration and Korea Institute of Geoscience and Mineral Resources, and at the temporary aftershock monitoring network. Epicentral distance was limited with 120 km to prevent the effect that the post-critical Moho reflections (SmS) governs the peak amplitude of waveform. The Boatwright's method, in which the rupture directivity function could be estimated based on the relative peak ground motions of seismic stations, was applied for station correction and inversion of rupture directivity. The fault rupture direction was estimated by using Ben-Menahem's directivity function. The inversion results were compared with focal mechanisms for each earthquake and with aftershocks distribution pattern. The results show that the foreshock (Mw 5.1) and mainshock (Mw 5.5) have opposite rupture directivity and both directions are well correlated with the aftershock distribution. The fault plane solution and rupture directions estimated in this study show that the subparallel multiple ruptures are responsible for the 2016 Gyeongju earthquake sequence.