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Source Rupture Process of the 2016 Kumamoto, Japan, Earthquake Inverted from Strong-Motion Records

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On 15 April, 2016 the great earthquake with magnitude Mw7.1 occurred in Kumamoto prefecture, Japan. The focal mechanism solution released by F-net located the hypocenter at 130.7630°E, 32.7545°N, at a depth of 12.45 km, and the strike, dip, and the rake angle of the fault were N226°E, 84° and -142° respectively. The epicenter distribution and focal mechanisms of aftershocks implied the mechanism of the mainshock might have changed in the source rupture process, thus a single focal mechanism was not enough to explain the observed data adequately. In this study, based on the inversion result of GNSS and InSAR surface deformation with active structures for reference, we construct a finite fault model with focal mechanism changes, and derive the source rupture process by multi-time-window linear waveform inversion method using the strong-motion data (0.05∼1.0Hz) obtained by K-NET and KiK-net of Japan. Our result shows that the Kumamoto earthquake is a right-lateral strike slipping rupture event along the Futagawa-Hinagu fault zone, and the seismogenic fault is divided into a northern segment and a southern one. The strike and the dip of the northern segment are N235°E, 60° respectively. And for the southern one, they are N205°E, 72° respectively. The depth range of the fault model is consistent with the depth distribution of aftershocks, and the slip on the fault plane mainly concentrate on the northern segment, in which the maximum slip is about 7.9 meter. The rupture process of the whole fault continues for approximately 18-sec, and the total seismic moment released is 5.47×1019N·m (Mw 7.1). In addition, the essential feature of the distribution of PGV and PGA synthesized by the inversion result is similar to that of observed PGA and seismic intensity.