Source imaging of the 2016 Kumamoto earthquake by back-projection of near-filed P wave records.

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A series of strong ground motion caused by 2016 Kumamoto earthquake (hereafter, Kumamoto earthquake) devastated the areas along Futagawa-Hinagu fault zone and strong ground shake with Japan Meteorological Agency Seismic Intensity Scale 7 was observed twice for the first time in domestic history of earthquake observation.
Several studies on the spatio-temporal slip distributions have been reported based on waveform inversion pointing out heterogeneity of rupture process, such as depth dependency of slip velocity function.
The direction and the speed at which fault rupture proceeds, as is well known, controls major feature of ground motion around the causal faults. About the Kumamoto earthquake, spatio-temporal distribution of seismic wave emission has been studied by several researchers and those results show that the rupture propagated across fault planes with different strike and dip. Abrupt acceleration of rupture speed has also reported and these fact features the heterogeneity of fault rupturing occurred during the Kumamoto earthquake.
Although rupture heterogeneity strongly affects strong ground motion, it has been only partially taken into account in the current framework of strong ground motion prediction. Slip velocity function and rupture velocity variable on the fault planes are expected to be take into consideration in the future strong ground motion evaluation, and actually, some attempts to incorporate such heterogeneity in fault models for ground motion prediction are under way in the world. Hence, accumulation of information on fault rupturing process is essential to constitute a heterogeneous source model. In this study, I applied back-projection technique to reveal the time history of seismic wave emission during the Kumamoto earthquake.
Strong motion records recorded at 27 KiK-net and K-NET stations within 100km hyopocentral distance were used. Waveforms were rotated according to seismometer orientation and offsets were removed. Then the records were integrated into velocity by lattice filter of Kinoshita(1986). Traveltime data were processed in the similar way as Takenaka and Yamamoto(2004) to obtain seismic emission image with more precision in relative location. Further correction for travel time data was made by using the difference between observed and calculated traveltime from the hypocenter.
The back-projection technique used in this study is similar to that by Kao and Shan(2004), and Ishii et al.(2005). Waveforms were stacked with a combination of Hann window and N-th root stacking. The fault plane was determined from distribution of aftershocks although no assumption for fault plane is necessary in back-projection method.
As a result, some image of rupture propagation from Takano-Shirahata segment of the Hinagu fault zone to Futagawa segment of the Futagawa fault zone was obtained, where the strike and the dip of those two fault planes are different. The rupture rapidly increased its seismic wave emission while it’ s moving toward northeast. However, both accuracy and resolution of the present results still leave plenty of scope for improvement. In the future study, I am planning to scrutinize data and data processing techniques, such as traveltime data and waveform stacking methods to get more exact and high-resolution image of the source process.

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Keywords: back-projection , source imaging, Kumamoto earthquake

