Observation and preliminary 3-D finite difference simulation of long-period ground motions (3 - 15 s) for the 2016 Mw 7.1 Kumamoto earthquake

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The Mw 7.1 Kumamoto earthquake, which occurred on 16th April, 2016, at 1:25 local time, is the largest inland earthquake to occur in Japan after the dense installation of K-NET and KiK-net strong-motion stations. Many previous studies based on the recorded ground motions from this earthquake noted that the non-existence of long-period structures such as high-rise buildings in the source area of the earthquake avoided potential risk that could be incurred due to the extremely large response spectra at periods of ~ 3 s to 7 s (e.g., Furumura, 2016). The occurrence of long-period ground motions near the source fault area of large earthquakes, particularly associated with the direct fault movement, has been well documented after the 1999 Chi Chi earthquake (Mw 7.6). On the other hand, if the size of earthquake becomes bigger such as the 1985 Mexico City earthquake (Ms 8.1), 2003 Tokachi Oki earthquake (Mw 8.3), 2011 Tohoku Oki earthquake (Mw 9.1), damaging long-period ground motions could be observed several hundred kilometers far from the source area. The 2016 Kumamoto earthquake also excited long-period ground motions at distant basins such as the Osaka basin which is located at a distance of about 400 km from the source area. Nonetheless, the motions were moderate and did not cause harmful effects on humans and infrastructures. The Kumamoto earthquake also reconfirmed that the long-period ground motions can propagate effectively in the north east region from the source area of the earthquake due to radiation pattern of the typical fault motions and crust-mantle structure in the region (Dhakal et al., 2016). In this paper, we describe the observed characteristics of long-period ground motions from the earthquake and compare a large number of recordings with synthetics from 3-D finite difference simulations. We employ the 1st grade subsurface velocity model reconstructed for the prediction of long-period ground motions by Headquarters for Earthquake Research Promotion and the source rupture model by Kubo et al. (2016) who used strong motion recordings within a distance of 100 km of the source fault for inversion. This study is expected to contribute to better understanding of the performance of the velocity and source models for the prediction of long-period ground motions from future big earthquakes.

References

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