Study on applicability of corrected empirical Green's function method considering near and intermediate field terms to real earthquakes

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Extremely large strong ground motions were recorded during the main shock of the 2016 Kumamoto earthquakes (M_j7.3) at near fault stations such as Mashiki and Nishihara. Permanent displacements exceeding 1 m and peak velocities exceeding 100 cm/s were also recorded at these stations. Near and intermediate field terms, which cause permanent displacements, have rarely been considered in practical strong ground motion simulations for engineering purposes. We have been working on method to incorporate these terms into the strong ground motion simulation with the corrected empirical Green’s function method by using the simple method to consider these terms by Nozu (2006). While verification for this method was conducted by comparison with analytical solutions, applicability to real earthquakes needs to be investigated. In this study, in order to validate the applicability of this method to real earthquakes, we applied the method to the main shock of the 2016 Kumamoto earthquakes focusing on near fault records, and studied several related issues. The area on the fault which for which near and intermediate terms should be considered was firstly examined. These terms attenuate rapidly compared to far field terms and therefore shallow rupture area with thickness of several kilometers seems enough to explain near fault permanent displacements. However, the shallow rupture area cannot fully explain the permanent displacement exceeding 1 m observed at K-NET OHZU (KMM005), which locates 6 km north of Nishihara. Effective rupture area on the fault was larger for KMM005 than for Nishihara because KMM005 locates further from the fault than Nishihara. Then, in this study, we considered near and intermediate field terms from deeper area, in addition to shallow area, to explain displacements at both KMM005 and Nishihara. The near and intermediate field terms include frequency components not only around 0 Hz but also over 0.2 Hz, which will be significantly affected by the site effects. Therefore, in this study, empirical site amplification and phase effects are considered for near and intermediate field terms for frequencies over 0.2 Hz.

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