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Evaluation of long-period ground motion generated from intraplate earthquakes around Ibaraki and Fukushima prefectures

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After the occurrence of 2011 Tohoku-Oki earthquake, phenomena of long period ground motion have been observed at seismic observation stations around the coastal region of Ibaraki prefecture for the occurrence of shallow depth intra-plate earthquakes (including 2011 Fukushima Hamadori earthquake) around Ibaraki and Fukushima prefectures. Before the occurrence of Tohoku earthquake, there was little noticeable intra-plate large earthquake, and physical mechanism and characteristics of generation of long-period ground motion mostly remain unclear. Therefore, we believe that better understanding the physical mechanism and characteristics of generation of long-period ground motion will lead to improving the evaluation of nature of seismic wave propagation and ground motion around the coastal region of Ibaraki prefecture. And also, it will lead to more reasonable evaluation of earthquake-proof safety of important infrastructures and subsurface structure around this region.

In this research, as main factor generating long-period ground motion, we focus on nature of basement underground structure model beneath the coastal region of Ibaraki prefecture. First, we constructed 3D underground structure model beneath this region, on based on the underground structure model of the Headquarters for Earthquake Research Promotion of Ministry of Education Culture, Sports, Science and Technology in Japan (http://www.jishin.go.jp/main/chousa/12_choshuki/, Koketsu et al., 2008, Koketsu et al., 2009). Based on the structure model and using finite element method, we performed seismic wave propagation simulation of intraplate crustal earthquakes (moderate scale, M<6.0), generated around Ibaraki and Fukushima prefecture. For optimizing the 3D underground structure model, we used seismic observation stations of KIK-net and Japan Atomic Energy Agency around this region. In the analysis we evaluated the generating factors of long-period ground motion by comparing the results of waveform modeling based on 1D layered structure model and on 3D structure model.

As the result, we confirmed that 3D structure model could better generate the long-period ground motion which 1D layer structure model could not, and understood that generation of long-period ground motion is originated from the nature of basement structure beneath seismic stations. Furthermore, we performed waveform modeling of 2011 Fukushima-ken Hamadori earthquake and confirmed availability of 3D underground structure model for evaluating intraplate large earthquakes around Ibaraki region.

Keywords: 3D structure, Seismic wave propagation, Hamadori, FEM simulation