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Prediction of ground shaking from shaking itself: application of numerical shake prediction method for various frequency

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Many of the present Earthquake Early Warning (EEW) systems quickly determine the hypocenter and magnitude, and then predict strengths of ground motions. The Mw 9.0 Tohoku earthquake, however, revealed some technical issues with such methods: under-prediction at large distances due to the large extent of the fault rupture, and over-prediction because the system was confused by multiple aftershocks that occurred simultaneously. To address these issues, a new concept was proposed for EEW, in which the distribution of the present wavefield is estimated precisely in real time (real-time shake mapping) by applying a data assimilation technique, and then the future wavefield is predicted time-evolutionally by simulation of seismic wave propagation (Hoshiba and Aoki, 2014). Information on the hypocenter location and magnitude are not necessarily required in the method; instead physical processes are simulated from the precisely estimated present condition. The method is called "numerical shake prediction" by analogy to "numerical weather prediction" in meteorology. In this presentation, we will apply the numerical shake prediction method to the 2011 Tohoku Earthquake and the 2004 Mid-Niigata Earthquake (Mw 6.7) for not only frequency band of seismic intensity (that is, around 1 Hz (period of 1 s)) but also for various bands such as around 0.3 Hz (3 s) and 0.15 Hz (6 s). We will show that low frequency waves were trapped in the Kanto basin while high frequency waves passed by, and that the numerical shake prediction method is applicable even for low frequency of around 0.15 Hz in case of prediction of near future.

Keywords: Earthquake Early Warning, Real-time prediction of earthquake ground motion, Numerical shake prediction, long period ground motion