An Ultra-high Resolution Numerical Weather Prediction with a Large Domain Using the K Computer

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In Japan, heavy rainfalls occasionally cause disasters such as debris flows and floods that induce severe damage to society. The high resolution numerical weather prediction (NWP) model has found to be important for this kind of disaster mitigation.
Accuracy of numerical prediction models depends on several factors such as resolution, domain size, dynamics and physical processes. Especially, finer grid spacing contributes to improving the representation of deep moist convection, reducing discretization errors, and expressing more realistic topography. However, little studies have conducted ultra-high resolution simulations (100 m scale) with a large model domain. Such a high resolution, large domain experiment needs a very large computational resource such as the K computer.
The authors have conducted ultra-high resolution experiments of heavy rain events with K computer and the Japan Meteorological Agency nonhydrostatic model (JMA-NHM). The case studies are the heavy rain events in Izu Ohshima on October 2013 and Hiroshima on August 2014.
The objectives of this study are to examine whether an ultra-high resolution NWP model with a large domain is able to produce more accurate forecast and to elucidate its reason. The four factors of the NWP model were investigated: (1) grid spacing (up to 250 m), (2) turbulence closure model (Mellor-Yamada-Nakanishi-Niino [MYNN] level 2.5 and 3, and Deardorff [DD]), (3) model domain (1600x 1100 km, and 200 km square), and (4) terrain data.
One of the main findings is the 250-m grid model with the finest terrain representation showed the best performance in both case studies. The results of this study demonsrate that the very high resolution NWP model with the large domain has the potential ability to better predict the meso-beta scale rain.

Keywords: K computer, Ultra-high Resolution Numerical Weather Prediction, JMA-NHM

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