High resolution simulation of the west Japan heavy rainfall in July 2018

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Abstract

Several landslides and floods caused by heavy rainfall in west Japan, on July 5th – 8th, 2018. To mitigate the damages of heavy rainfall and evacuate residents in a timely fashion, an accurate numerical weather prediction (NWP) system is vital. In the previous heavy rainfall event in Izu Ohsima in October 2013, the authors showed importance of grid spacing, planetary boundary layer (PBL) schemes, terrain data and model domain size (Oizumi et al., 2013)

In this study, we conducted an ultra-high resolution numerical weather prediction (NWP) simulations with a large domain area to this west Japan rainfall event in July 2018. Several important model factors (grid spacing, model domain size) influencing heavy rainfall forecasting in NWP models were investigated. An optimized version of NHM (Oizumi et al. 2015) for the K computer was used to this study with the model domains presented in Fig. 1. The model settings are listed in Table 1.

Fig. 2 shows the Radar-AMeDAS precipitation results. Fig.3 shows the results of 5-, 2-km and 500-m grid spacing models with the large and small model domain experiments. The result showed the 2-km resolution models showed better precipitation performance than 5-km resolution models. And the 500-m resolution models with both model domains showed better precipitation performance than 2-km resolution models. The 2-km and 500-m resolution models with the large model domain shows better performance than those with the small domain. Overall, the results indicated that using a high-resolution model (500 m grid spacing) with a large domain area provides an advantage for simulating torrential rain events.

Table 1. List of experiments using the large and small domain area

Experimental name	Grid spacing (m)	Time step (s)	Domain	Number og grids	Vertical level	Turbulence closure model	Cumulus parametrization	W threshhold (m/s)
KF5kmMY	5,000	24	LFM	321 × 221	50	MYNN3	CM with KF	3
CM2kmMY	2,000	10	LFM	800 × 550	60	MYNN3	CM	5
CM500mDD	500	2	LFM	3197×2197	85	DD	CM	no
KF5kmMY_L	5,000	24	LFM	633 × 521	50	MYNN3	CM with KF	3
CM2kmMY_L	2,000	10	LFM	1581 × 1301	60	MYNN3	CM	5
CM500mDD_L	500	2	LFM	6321×5201	85	DD	CM	no

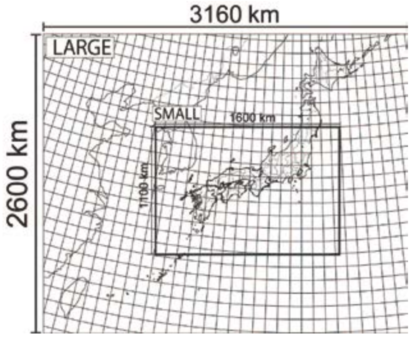

Fig. 1. Model domains used: large: 3160-2600 km, small:1600-1100 km.

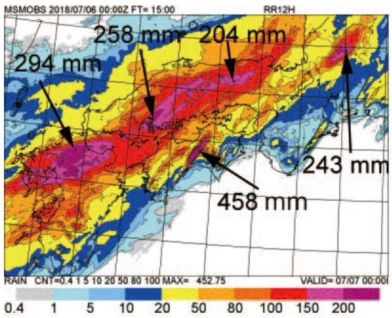

Fig. 2. Observed 12-hour precipitation from 1200 JST on July 6th to 0000 JST on July 7th

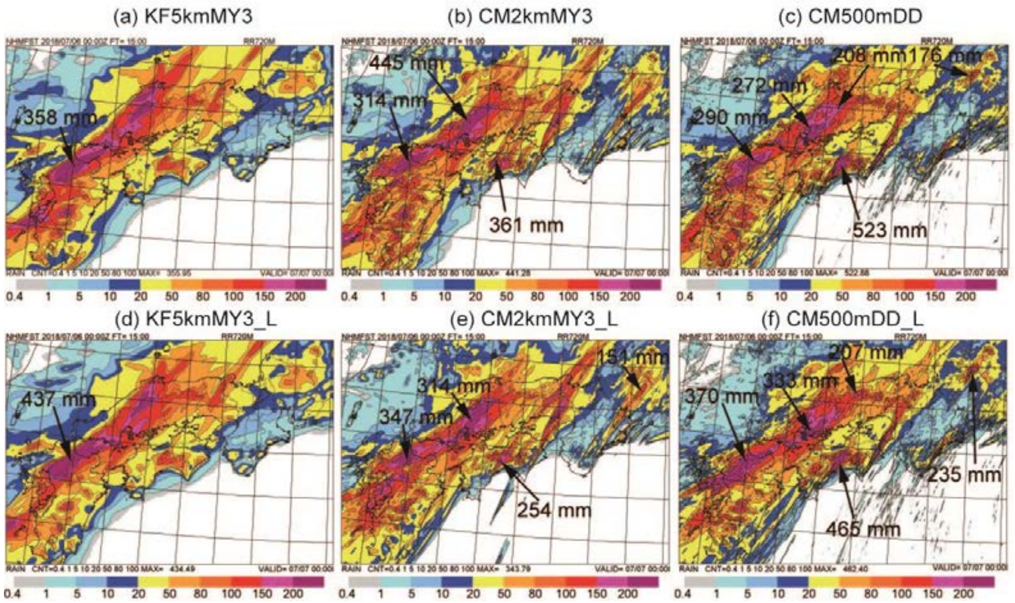

Fig. 3 12-hour precipitation from 1200 JST on July 6th to 0000 JST on July 7th. (a)-(c) are the small model domain results and (d)-(f) are the large model domain results.

References:

Oizumi, T., T. Kuroda, K. Saito, J. Ito, and S. Hayashi, 2015: Performance tuning of the JMA-NHM for the K supercomputer. *WGNE Blue Book*, 3-09.

Oizumi, T., K. Saito, J. Ito, T. Kuroda, and L. Duc, 2018: Ultra-high-resolution numerical weather prediction with a large domain using the K Computer: A case study of the Izu Oshima heavy rainfall event on October 15-16, 2013. *J. Meteor. Soc. Japan*, **96**.