P2.13 THE EFFECT OF USING LAPS IN THE MESOSCALE NUMERICAL PREDICTION FOR HEAVY RAINFALL

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1. INTRODUCTION

Heavy rainfalls frequently strike Korea Peninsula in June to July over monsoon season. Convective cell, blamed for heavy rainfall events, generally has a meso-β scale of ~10^1 km. To improve the forecast skill over the intense convective system both the development of better numerical model and introduction of data assimilation for better initial data set of model have been tried. In this case study Local Analysis and Prediction System (LAPS) developed by FSL since 1990 is applied to produce high-resolution fields to mesoscale numerical model for simulation of heavy rainfall event occurring over South Korea in July 1998. We focus on whether LAPS process could have a considerable effect on the skill for rainfall in model simulation. More detailed reviews of LAPS are available in McGinley (1996). The heavy rainfall case chosen here has marked highest hourly precipitation (145mm/hr) ever in South Korea. Rainfall of about 200-300mm is recorded over a few stations in 6 hours.

2. DATA AND METHODS

The first guess data used here is from Global Data Assimilation and Prediction System (GDAPS) which is operated in every 6 hours by Korea Meteorological Administration (KMA). This is a global 1.875° resolution data set. Data introduced to LAPS are GTS (SYNOP, TEMP, BUOY, and SHIP) data, GMS brightness temperature over the domain, and radar reflectivity of 5 radar stations in Korea. And MM5 by PSU/NCAR is adopted. The model is configured with 23 sigma levels and a 50×50 horizontal grid with 36km resolution in coarse domain, 55×52 grid with 12km in nested domain over East Asia (Fig. 1).

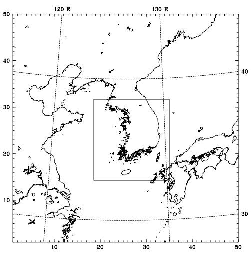

Fig. 1. Model domain

Anthes-Kuo and no cumulus parameterization schemes are selected in coarse and nested domain, respectively. High-resolution Blackadar PBL scheme, mixed-phase (Reisner) moisture scheme, and cloud-radiation scheme are given. Model was runned from 00UTC 31 July 1998 for 24 hours.

3. RESULTS

We designed 5 different runs as follows: Cntl, no modification of first guess field by LAPS; Exp. A, all data processed by LAPS; Exp. B, C, and D, same as Exp. A but for excluding satellite, radar, and rawinsonde data, respectively.

Figure 2 shows 850hPa wind and geopotential analysis fields of Exp. A and Cntl, respecitively, when heavy rainfall began. Low pressure system is well organized in Cntl. Trough from China, however, intrudes to the southern Korea where heavy rain falls and ridge in East Sea strengthen in Exp. A. A major difference is significant change of geopotential height. Although wind direction of low-level jet is modified to southerly over the southern Korea, overall wind field is not considerably changed. LAPS mainly changes mass field rather than wind field.

Figure 3 shows the amount of total rainfall from 12 to 18UTC in all experiments. Here the total rainfall denotes area-averaged precipitation within 6×5 grid (60*48km) in model domain where heaviest rain occurred at each time. This rainfall was computed over moving area at every hour as rainfall area migrated to the east. Observed rainfall shows 209mm during 6 hours. While corresponding result of experiment Cntl is 70mm, Exp. A gives 80mm and Exp. B produces best result of 140mm. Every run made convective cell over the southern Korea, but Cntl moves eastwards faster than observation, Exp. D shows weak intensity of rainfall cell. In Exp. B heaviest rainfall region coincided with that of observation, which give a best result. Also it indicates that satellite data might not be well assimilated with others. On the other hand Exp. D shows the worst results. It could be assumed that radar, satellite, and GTS surface data modify moisture and temperature field over the surface or a few limited layer by LAPS. But rawinsonde data provide information such as temperature, humidity, and wind over the vertical profile to influence the convection even though its density is smaller.

4. DISCUSSION

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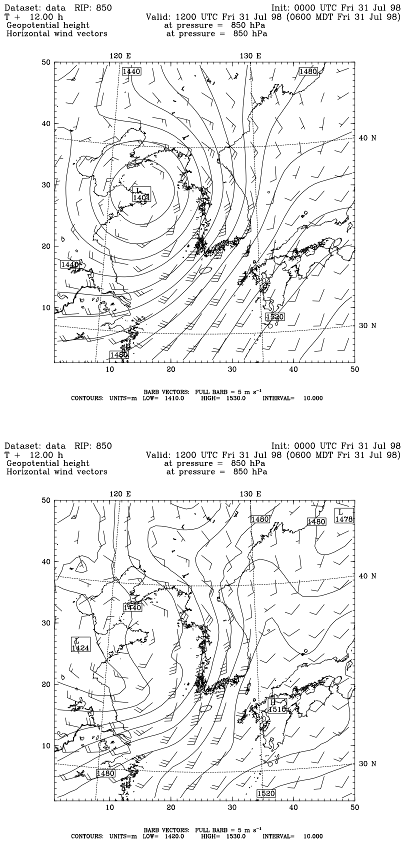

Fig. 2. 850hPa analysis field at 12UTC 31 July. Upper panel indicates from Cntl, lower panel from Exp. A.

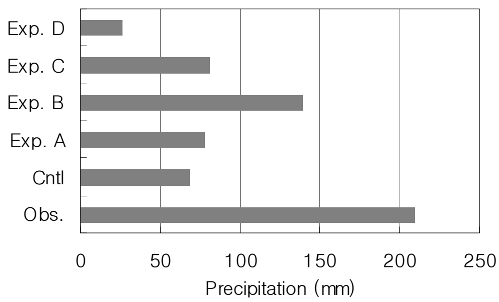

Fig. 3. Comparison of observed (Obs.) and simulated total precipitation during 6 hours.

A case study of mesoscale numerical simulation is conducted over the heavy rainfall event using input data processed by LAPS. Modified fields from the combination of surface GTS, radar, and rawinsonde data produced a double the rainfall of unmodified experiment. Results of case studies like this would largely depend on the model configuration such as scheme, grid size, and so on, so that more careful interpretations would be needed.

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McGinley, D. L. 1995: LAPS; A new view and update. FSL Forum, 1-13.