Tier-2 downscale experiments of B08RDP

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1. Introduction In WWRP Beijing 2008 Forecast Demonstration Project /Research and Development Project, intercomparison on the forecasts with the cloud resolving model of the horizontal grid interval of 2-3km (Tier-2) is performed, besides Tire-1 experiment that is the mesoscale ensemble forecast with the grid interval of 15km. Targets of the Tier-2 experiment is the severe phenomena occurred in Beijing area. Squall line developed over the Beijing city on 1st August 2006 and thunderstorm on 30th July 2007 have been investigated so far. As for the squall line case, it was reported that the squall line was well reproduced by assimilation of ground-based GPS data by the UCAR and Beijing Meteorological Bureau (Kuo et al. 2007). We performed the downscale experiments with the non-hydrostatic model with the grid interval of 3km model on the thunderstorm occurred on 30 July. In this report, the results of this downscale experiment are explained.

2. Downscale experiment of thunderstorm on 30th July 2007. The convective rainfall of the thunderstorm was generated on the west of Beijing at 20LST 29th July, and then moved eastward. Radar reflectivity indicates that there are intense line-shaped bands extending from south to north embedded in the weak rainfall region. These bands kept their shape while they passed eastward. Three-hour precipitation over 70mm/3hour was observed near the Beijing city when this thunderstorm passed.

Mesoscale ensemble forecast was applied to this intense thunderstorm case. The initial perturbation was produced by normalizing the initial perturbation of operational one-week ensemble forecast to the scale of the analysis error of Meso-4Dvar system of JMA (Saito et al. 2006). The downscale experiments with the grid interval of 3km were performed from the initial fields, which were produced from 10 ensemble members and one control run. Figure 1 shows the rainfall regions of which rainfall was strongest (M05m) and weakest (M02p) among the ensemble members, in addition to the control run (M00). The line-shaped band was reproduced in members of M05m and CNTL. The line-shaped band was produced by the

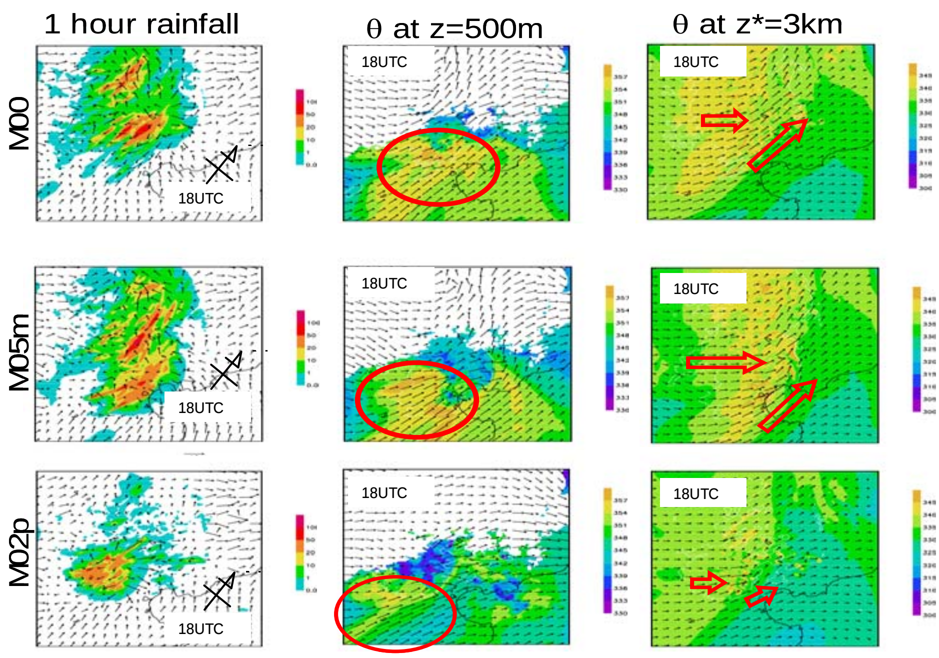

Fig. 1 Horizontal distribution of 1-hour rainfall, equivalent potential temperature at z=500m and 3km at 18UTC

convergence of the low-level inflow from the south and the cold pool. The convective cell was generated on the southern tip of the band, and then moved northward by the airflow above the height of 3km. The generation point and movement of convective cells is one of factors that determine the shape of the rainfall system. When M05m was compared with CNTL, equivalent potential temperature of the low-level inflow is higher, and the westerly flow penetrated at the height of 3km. This airflow enhanced the evaporation of the rain droplets, and then produced the intense cold pool. On the other hand, the rainfall was relatively weak and a line shaped band was not organized in M02p. Equivalent temperature was lower than CNTL. These results indicate that the environment that was different in each member produced the different type of rainfall system.

3. Comparison with Tire-1 experiments Does these downscale experiments have more information than the Tier-1 has? The grid point data with the interval of 15km was produced from output of Tier-2, and then compared with the result of Tire-1. Shapes of the rainfall system produced in Tier-2 experiments were similar to those of Tier-1 (fig.2). The boundary condition of Tire-2, which was produced by the interpolation of the output of Tier-1, determines the position of the intense convergence. The environment of Tier-2 was also similar to that of Tier-1. Thus the similar shape and type convective systems are produced. Next, rainfall amount of Tier-2 is compared with Tier-1. Rainfall amount was also similar to that of Tier-1 expect M04p (fig. 3). The rainfall amount was also controlled by the boundary condition. On the other hand, the maximum rainfall amount is larger than that of Tier-1. The rainfall region exceeding 1mm/3hour is smaller than Tier-1. These results indicated the rainfall region of Tier2 is more localized. This feature is confirmed by the histogram of rainfall. Namely, higher ranked rainfall of Tier-2 was larger than that of Tier-1. Heavy rainfall was often caused by slow moving rainfall system. Thus, the maximum rainfall is more important to forecast the heavy rainfall. The relationship between the environment and localization of the rainfall should be investigated.

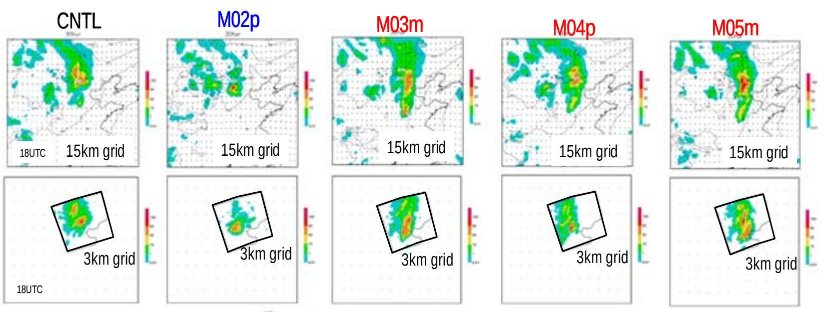

Fig.2 3-hour rainfall distribution of Tier-1 and Tier-2. Rectangular in lower panels indicate the model domain of Tier-2.

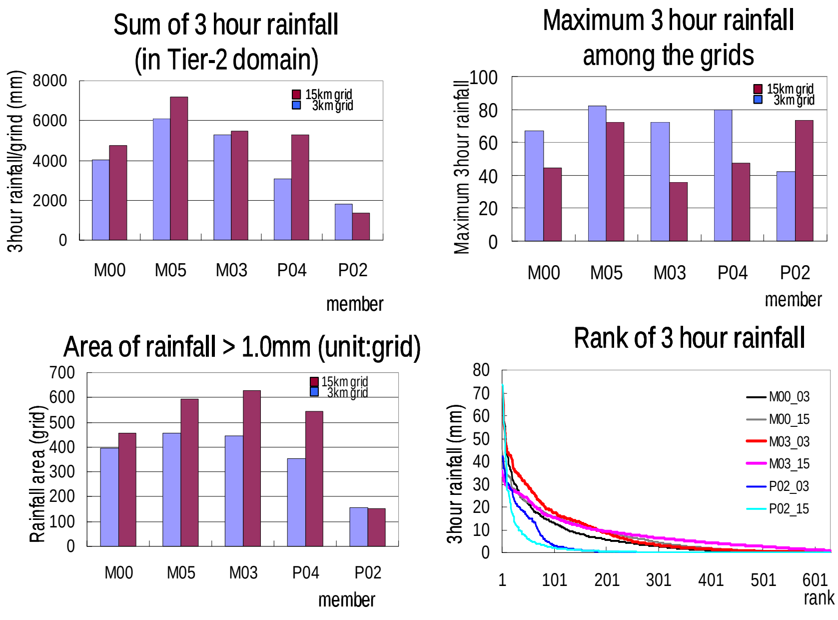

Fig. 3 Sum of 3-hour rainfall (upper left), maximum rainfall (upper right) and area exceeding 1mm/3hou (lower left) of Tier-1 and Tier-2. Histogram of the 3hour-rainfall (lower right)