Experimental operation of a high-resolution local forecast model at JMA

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1. Introduction

The Japan Meteorological Agency (JMA) operates the meso-scale model (MSM) whose horizontal grid spacing is 5 km. In addition, a high-resolution local forecast model (LFM), whose horizontal grid spacing is 2 km, has been developed to provide more detailed information for disaster prevention and aviation safety. The LFM is planned to be operational in 2011 or later.

An experimental run of the LFM has been executed 3-hourly (8 times a day) since 1 June 2006 with a much smaller domain than that of planed operation.

This paper describes the specification and the results of this experimental run.

2. Specifications of the experimental LFM

The LFM has been developed based on the JMA nonhydrostatic model (Saito et al. 2006).

For its initial condition, a 3-dimensional variational (3DVAR) version of JNoVA (JMA Non-hydrostatic Model based Variational Data Assimilation System) is employed. And its boundary field is prepared from the operational MSM which runs every 3-hourly.

The initialization and the forecast of the experimental run are as follows (Fig.1). As the first step, the JNoVA-3DVAR is executed with 5km grid spacing using 3-hour forecast of the operational MSM as a first guess field, and the MSM is executed for 1 hour with a smaller domain than operational one (Fig.2). Then, a rapid update cycle is materialized through both the JNoVA-3DVAR and the MSM. In this assimilation, the assimilated data are wind and temperature observational data of AMeDAS[1], WINDAS[2], ACARS[3], Doppler radar, all of which are suitable instruments to capture mesoscale phenomena.

The forecast domain of the experimental LFM is Kanto area with 151 x 151 grid points (Fig.2).

The specifications of the experimental LFM and the operational MSM are summarized in Table 1.

Table 1. the Specifications of the operational MSM and the experimental LFM.

	MSM	LFM
Horizontal mesh (resolution)	721 x 577 (5km)	151 x 151 (2km)
Forecast period	15 hours	12 hours
Initial conditions	Meso 4DVar	JNoVA-3DVar
Lateral boundary	RSM*	MSM
Levels	50	60
Moist physics	3 ice bulk microphysics	Same as in MSM
Convection	Modified Kain-Fritsch scheme	None

* Regional Spectral Model

3. Verification results

In this section, the results of the experimental LFM are shown in terms of statistical verification scores in comparison to the operational MSM for the period from June to December in 2006.

The forecasted precipitation is verified against the Radar-Raingauge Analyzed Precipitation data. The verifications were carried out for every 20 km square mesh over land and sea near the coast. Fig 3 shows the bias (BS) and the equitable threat scores (ETS) of a mean and a maximum value in each mesh about one-hour precipitation forecast by the LFM and the MSM. The BS of the mean of the LFM shows more excess of precipitation area for heavier rain. The ETS in the mean of the LFM shows insufficiency of weak rain forecast. In contrast, the BS in the maximum of the LFM is closer to unity than that of the MSM. The ETS in maximum of the LFM is better than that of the MSM except weak rain. These results show that the LFM is able to forecast the peaks of heavy rain well.

Fig 2 shows the mean error (ME) and root

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[1] AMeDAS(Automated Meteorological Data Acquisition System) is a high-density surface observation network covering Japan.
[2] WINDAS(Wind Profiler Network and Data Acquisition System) is covering Japan with spatial resolution of 130 km on the average.
[3] ACARS(Aircraft Communications Addressing and Reporting System) reports weather information from aircrafts.

mean square error (RMSE) of the surface temperature and wind forecast by the LFM and the MSM against the AMeDAS data of about 80 points in the domain. On surface temperature, both the ME and the RMSE of the LFM are better all day than those of the operational MSM, but the LFM has a negative bias in day time. On surface wind speed, both the ME and the RMSE of the LFM are almost same as those of the MSM.

Reference

Saito, K., T. Fujita, Y. Yamada, J. Ishida, Y. Kumagai, K. Aranami, S. Ohmori, R. Nagasawa, S. Kumagai, C. Muroi, T. Kato and H. Eito, 2006: The operational JMA Nonhydrostatic Mesoscale Model. Mon. Wea. Rev., 134, 1266-1298.

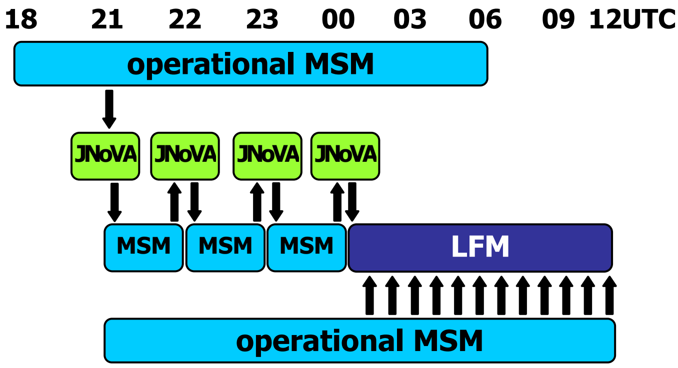

Fig 1. Initialization and Nesting procedure

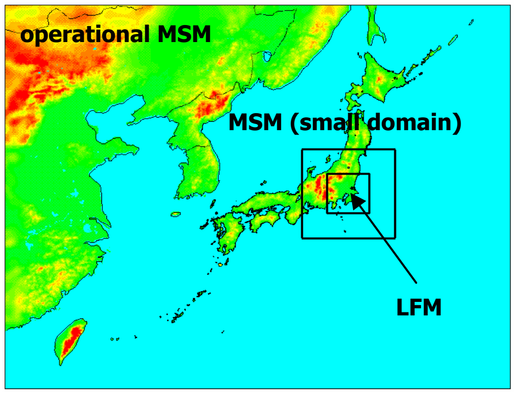

Fig 2. The Domain of models.

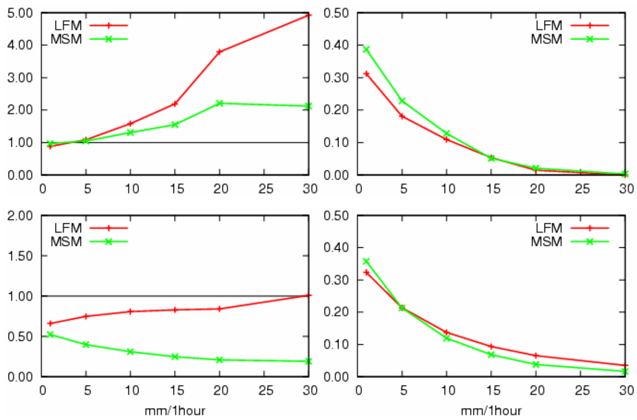

Fig 3. The bias and equitable threat scores of precipitation forecast against R-A (Radar-Raingauge Analyzed Precipitation). The red line indicates the LFM and the green line indicates the operational MSM. left : bias score, right : equitable threat score, upper : average , lower : maximum in every 20 km square mesh over land and over sea near the coast.

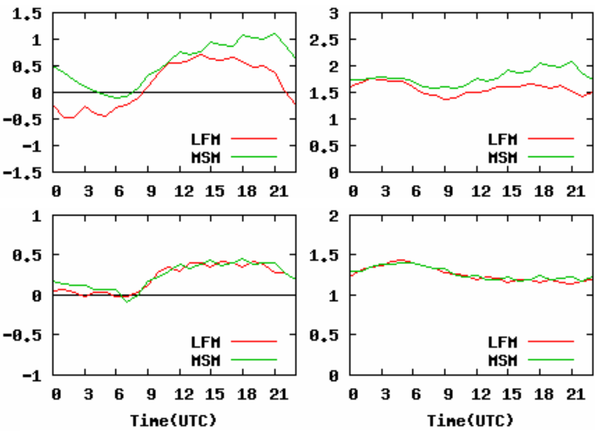

Fig 4. The Diurnal Change of mean errors (ME) and root mean square errors (RMSE) of temperature and wind speed (03 UTC is noon and 15 UTC is midnight at local time). The red line indicates the LFM and the green line indicates the operational MSM. left: ME, right: RMSE, upper: temperature, lower: wind speed.