Trial operation of the Local Forecast Model at JMA

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1. Introduction

The Japan Meteorological Agency (JMA) is developing the Local Forecast Model (LFM) – an NWP model with a horizontal grid spacing of 2 km – to contribute to aviation weather forecasts around airports and provide more detailed information for the prevention of disasters caused by heavy rainfall. In advance of the LFM's scheduled introduction to actual operation in 2012, a period of trial operation was started in November 2010. In this trial, the model is run eight times a day with a forecast domain covering the middle and western parts of Japan (Fig. 1), and test products are provided to aviation users for evaluation.

2. Trial operation specifications

The specifications of the trial operation are summarized in Table 1. The LFM is based on JMA's non-hydrostatic model (JMA-NHM: Saito et al. 2006) in the same way as the operational Mesoscale Model (MSM: Hara et al. 2007) with a horizontal grid spacing of 5 km. The MSM uses a cumulus parameterization scheme in conjunction with a bulk-type microphysics scheme, while the LFM uses only a microphysics scheme to explicitly represent moist convection.

3. Verification results

Ahead of the trial operation, the LFM was experimentally operated in the same domain as the trial operation (Ishimizu et al. 2010). This section outlines verification results for operation during the period from June 2010 to August 2010. Figure 2 shows the bias score (BS) and the equitable threat score (ETS) of precipitation forecasts against Radar/Raingauge-Analyzed precipitation. The BS for precipitation averaged for each 20-km square mesh shows that the LFM tends to overestimate precipitation areas for intense rainfall (Fig. 2 a). In contrast, the BS for maximum precipitation in each 20-km square mesh shows that the LFM is closer to unity than that in MSM forecasts (Fig. 2 c). The ETS for the maximum precipitation in each 20-km square mesh shows that the LFM forecasts precipitation more accurately than the MSM (Fig. 2 d). These tendencies have also been detected for smaller-domain operation (Nakayama et al. 2007; Takenouchi et al. 2008). The above-mentioned results show that the LFM is able to appropriately forecast the maximum intensity of heavy rainfall. Figures 3 and 4 show verification of wind speeds in LFM and MSM forecasts against the Wind Profiler Network and Data Acquisition System (WINDAS), which covers the islands of Japan with a special resolution of 130 km on average. The wind speed biases show the same tendency in both models, and the root mean square error is smaller in LFM forecasts than in MSM results at altitudes below 1 km. This indicates the improvement of lower atmosphere winds as desired for aviation weather forecasts around airports.

4. Future plans

JMA plans hourly operation of the LFM for the domain covering the islands of Japan from 2013. As the verification results obtained here indicate that the LFM tends to overestimate forecasts of heavy rainfall, we will investigate ways to improve the related physical processes.

References

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Table 1. Specifications of the LFM for trial operation

Horizontal mesh (grid spacing)	800 x 550 (2 km)
Vertical layers	60 (top level: 20 km)
Forecast period/frequency	9 hours, 8 times/day
Lateral boundary	MSM
Data assimilation	Rapid update cycle using JNoVA-3DVar
Moist physics	3 ice bulk microphysics (snow, ice, graupel)
Cumulus parameterization	Not used

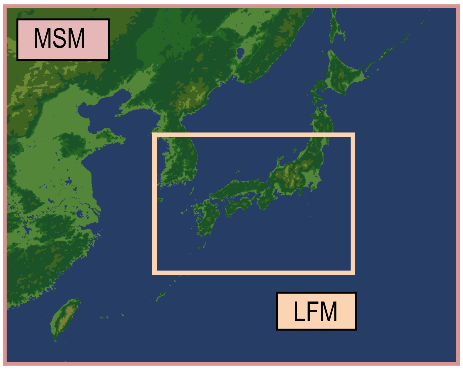

Fig. 1: Model domains

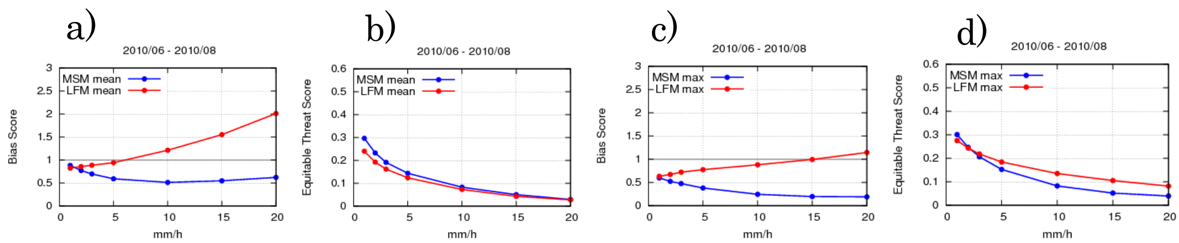

Fig. 2: (a) Bias scores for hourly rainfall amounts according to the LFM (red line) and the MSM (blue line) against the threshold of rain intensity (averaged for each 20-km square mesh on land and over the sea in coastal areas); (b) as per (a), but for equitable threat score (ETS); (c) as per (a), but for the maximum in each 20-km square mesh; (d) as per (c), but for ETS

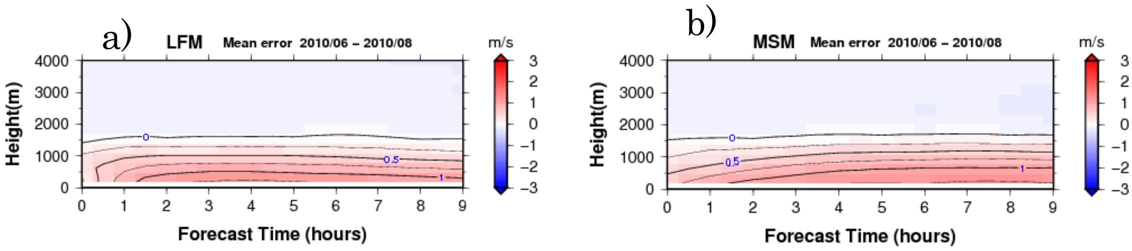

Fig. 3: Mean error of wind speed against WINDAS: (a) LFM; (b) MSM

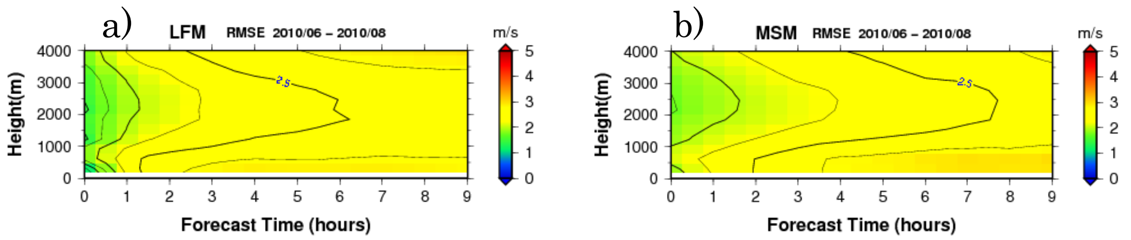

Fig. 4: RMSE of wind speed against WINDAS: (a) LFM; (b) MSM