Verification of QPF for 5km-NHM predicted precipitation amount and area in Kanto Area, Japan

Teruyuki Kato*

Meteorological Research Institute, 1-1 Nagamine, Tsukuba, Ibaraki, 305-0052, Japan

1. Introduction

The Quantitative Precipitation Forecast (QPF) of Meteorological Research Institute / Numerical Prediction Division unified nonhydrostatic model (MRI/NPD-NHM; Saito et al, 2000) has been verified by Kato et al (1998). However, they examined the QPF of 10 km-model only during the monsoon season in Kyushu, southwestern part of Japan. In near future, MRI/NPD-NHM plans to be used as the operational mesoscale model of Japan Meteorological Agency (JMA). Thus, the purpose of this study is to verify the QPF of MRI/NPD-NHM with a higher resolution for a longer period. This verification can clarify some problems in MRI/NPD-NHM. The verification is made for the rainfalls observed in Kanto Area, middle part of Japan between January and December in 2000.

2. Numerical models and verification method

The 5km-resolution of MRI/NPD-NHM (5km-NHM) made an 18-hour forecast twice a day. The initial conditions of 5km-NHM were produced by interpolating the 3-hour forecasts of the operational regional model of JMA (RSM). The boundaries were also made by the forecast of RSM. Microphysics including the ice-phase was used as a precipitation scheme. No convective parameterization scheme was incorporated. The domain and terrain of models are shown in Fig. 1. The verification was made for the predicted total precipitation amount and area in comparison with Radar-AMeDAS analyzed rainfall (R-A). As shown by red rectangle in Fig. 1b, the verification area is divided into mountainous (i.e., above a height of 125 m), plain, and sea regions to examine the effect of terrain.

3. Monthly averaged total precipitation amount and area

Monthly averaged total precipitation and area of R-A, RSM, and 5km-NHM in the whole verification area are shown in Fig.2. The precipitation area is classified by precipitation intensity. Total precipitation amount predicted by RSM is larger than twice of that estimated by R-A. This is caused from the overestimation of weak rainfall less than 10mm h^{-1}. 5km-NHM also overestimated the precipitation by 1.8 times larger than R-A.

Noted that in the summer season the precipitation of 5km-NHM almost agrees with that of R-A. The characteristic features found in the summer are remarkable in the mountainous region. This agreement is resulted from the 5km-NHM having predicted some thunderstorms that occurred in the mountainous region.

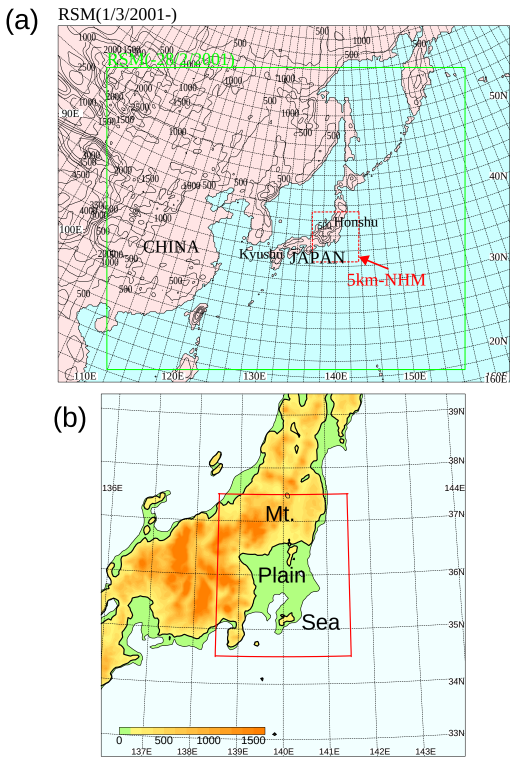

Fig.1 Domain and terrain of (a) RSM and (b) 5km-NHM. Red rectangle of (b) is the verification area.

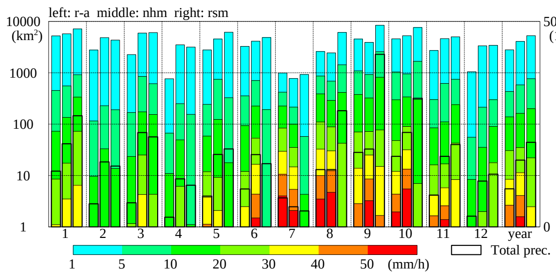

Fig.2 Monthly averaged total precipitation and area classified by precipitation intensity.

*Corresponding author address: Teruyuki Kato, Meteorological Research Institute, 1-1 Nagamine, Tsukuba, Ibaraki 305-0052 Japan: e-mail: tkato@mri-jma.go.jp

4. Reproductibity of diurnal variation

Diurnal variation of averaged total precipitation amount estimated by R-A has the maximum at 08-09 UTC (in the evening) on land, and at 19-20 UTC (in the early morning) on the sea. 5km-NHM successfully reproduced this characteristic features, while the reproductibity of RSM is not good (especially in the mountainous region). This is resulted from the high resolution of 5km-NHM that can express the fine terrain.

In the diurnal variation of precipitation area with intensity larger than 30mm h^{-1}, the maximum appears at 08-11UTC in the mountainous region, and at 12-13UTC in the plain region. This is caused by the movement of precipitation systems from the mountainous to plain regions. 5km-NHM well reproduced the maximum in the mountainous region, but the predicted rainfall in the plain region is considerably small.

Since no hydrometeor was given in the initial conditions of 5km-NHM, some stand up time of precipitation is taken. This time is estimated to be about 3 hours.

5. Verification results

Figure 3 shows the correlation coefficients of total precipitation amount and area predicted by 5km-NHM and RSM in the whole verification region against those of R-A. The prediction accuracy of total precipitation Pamount and area with intensity less 10mm h^{-1} is better for RSM than 5km-NHM. This is found in the all divided regions. The good correlation coefficients of RSM are resulted from the overestimation of the weak precipitation. It is remarkable that the accuracy of 5km-NHM becomes wrong with time, while the decrease of accuracy is small for RSM. This decrease is largest in the plain region (Fig.4).

6. Conclusion

MRI/NPD-NHM has good accuracy for the prediction of precipitation with intensity larger than 20mm h^{-1}. Especially, the accuracy for the rainfall in the mountainous region is considerably better than that of RSM. However, as pointed out by Kato et al (1998), the accuracy for the prediction of weak precipitation is not good for 5km-NHM. In the future, the overestimation of predicted total precipitation amount must be examined. This may be caused by the use of forecasts of RSM as initial and boundary conditions. Further, the effect of precipitation scheme, i.e., whether the single use of microphysics for a 5km grid is O.K. or not, must be studied.

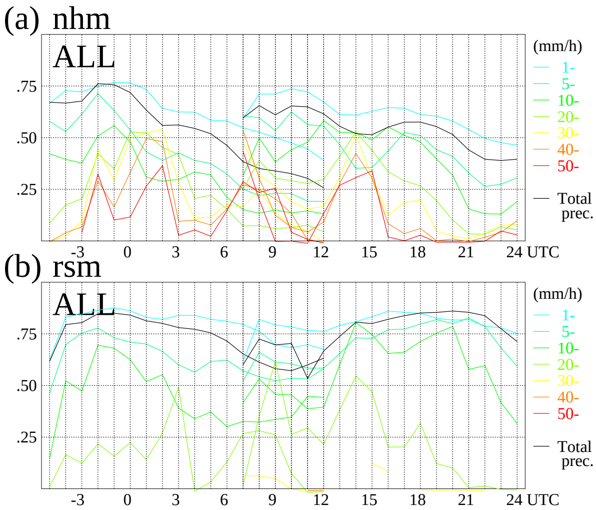

Fig.3 (a) Correlation coefficients for total precipitation amount and area between 5km-NHM (T=1-18 hours) and R-A. (b) Same as (a), but for RSM (T=7-24 hours).

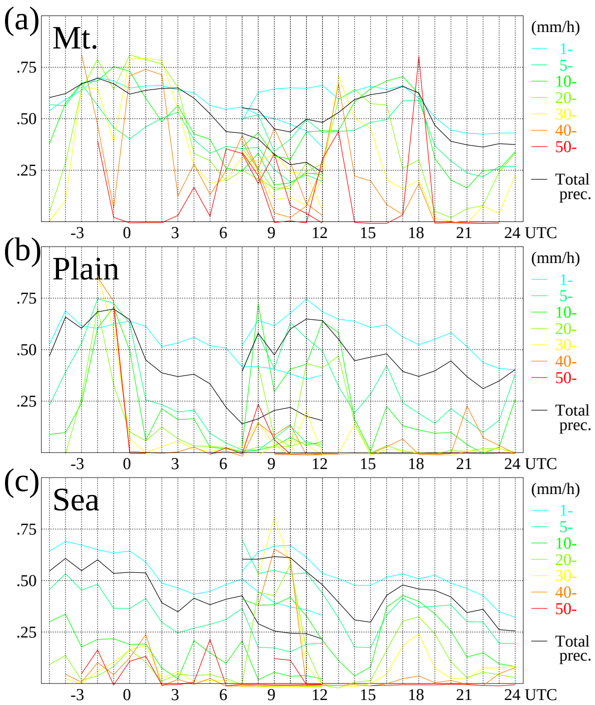

Fig.4 Same as Fig. 3a, but for (a) the mountainous, (b) plain, and (c) sea regions.

References

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