Development of short range analysis and prediction system

Jong-Chul Ha*, Yong-Hee Lee, Jeong-Soon Lee, Hee-Choon Lee and Hee-Sang Lee
National Institute of Meteorological Research, KMA, Seoul, Republic of Korea
* Email: bellfe@metri.re.kr

1. Introduction

Precipitation forecast for the short-range period (0-12 h) is one of the most challenging issues due to the "spin-up" of cloud systems in numerical weather prediction models. The diabatic initialization can improve precipitation initiation and evolution of precipitation (Shaw et al., 2001). Short range analysis and prediction system (SRAPS) was developed for practical use. A diabatic initialization technique was applied to the SRAPS with the additional use of radar reflectivity and lightning data and the system was designed to update forecasts every 3 hours. For this application, analysis strategy was improved to supply the analysis field within 10 minutes after analysis time. Efficient data-processing made it possible to reduce the time. Available all data sets were brought into use in analysis and it made the system optimized. The short range prediction system was build using the initial field of 3-D analysis system applying a initialization. This short-range prediction system showed a good performance on the precipitation prediction for the summer season in the previous years.

2. Analysis and prediction system

The SRAPS consists of two main components, analysis tools and prediction model. A 3-dimensional analysis is made from the Local Analysis and Prediction System (LAPS), which was originally developed by NOAA/GSD (Albers et al., 1996). Analysis fields from the LAPS are then used as initial conditions for mesoscale prediction model. The domain is nested with 15 and 5 km resolutions and 15 km domain is initialized every 3 h giving a guidance for relatively larger scale whether information. Fig. 1 shows the schematic diagram of analysis and prediction system.

The analysis system aims to produce analysis field with 5km horizontal resolution within 10 minutes at every hour. This system informs quickly forecasters of current weather. The system assimilates all the available in-suit data and remote sensing data such as satellite, radar and wind profiler. Table 1 shows all data used in the system. GTS data, wind profiler network data of Japan Meteorological Agency and AMDAR data are used only in 15km resolution analysis. The LAPS analysis modules include 3D wind, surface variables, 3D temperature, cloud, humidity, and some other derived variables.

In 2008 we replaced MM5 model with WRF model for forecasting. The resolution of model grid is 5 km in the horizontal, and the model has 40

levels in the vertical with its top at 50 hPa. The number of the model grids is set to 235×283 and the model integrates up to 18 hours. The WRF Single-Moment 6-class microphysics scheme, no cumulus parameterization, and the YSU planetary boundary layer parameterization were applied in the 5 km resolution forecast model. The lateral boundary conditions are provided by 15 km resolution forecast model.

3. Results of short-range forecast

Real time experiments were conducted and the quantitative precipitation forecasts (QPF) were verified against Automatic Weather Station observations. The results show that the diabatic initialization method is efficient to improve the short-range QPF skill of warm season precipitation events over Korea peninsula (Fig. 2). Explicit initialization of microphysical species would be a good approach to alleviate the spin-up problem. In the meantime, a series of sensitivity tests indicate that diabatic balance procedure of the method is essential component for sustaining initial cloud and describing relevant precipitation distribution.

We established display system for the results of forecast by homepage basically. And another method using GIS information was developed. The outputs from RIP are converted to Google Earth KML (Keyhole Markup Language) files. Because these are not bitmap images but vector images, users can zoom-in or rotate the results with no reducing resolution. So forecasters can watch more detail information (Fig. 3).

Acknowledgement

This study was supported by the project of the National Institute of Meteorological Research's "Development of Technique for the Very-short-range Forecasting and its Responses."

References

Albers, S. C., J. A. McGinley, D. L. Birkenheour, and J. R. Smart, 1996: The Local Analysis and Prediction System; Analysis of clouds, precipitation, and temperature. *Wea. Forecasting,* **11**, 273-287.

Shaw, B., E. Thaler and E. Szoke, 2001: Operational evalution of the LAPS-MM5 "Hot Start" local forecast model. *18th Conf. on Weather Analysis and Forecasting*. Fort Lauderdale. FL, Amer. Meteor. Soc., 160-164.

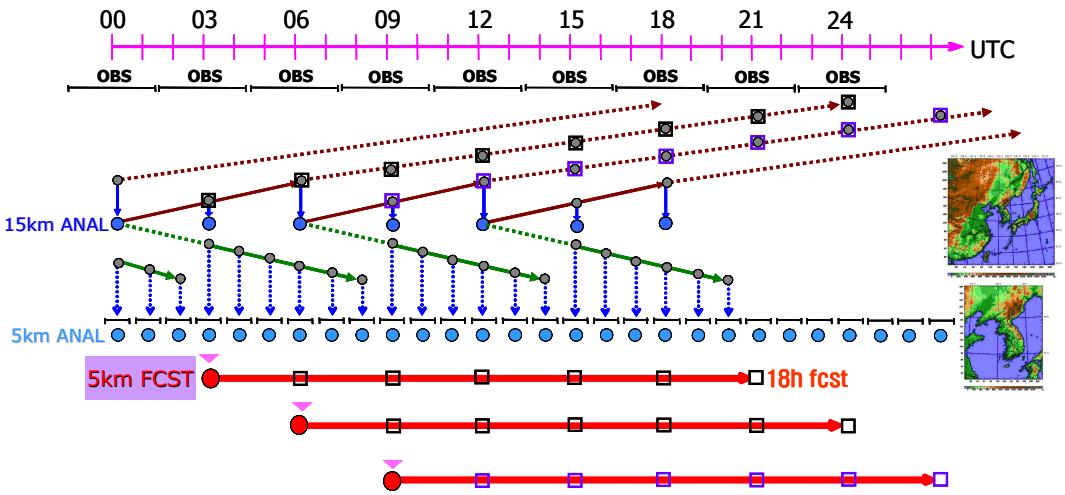

Fig. 1. Schematic diagram of short range analysis and prediction system.

Table 1. Data used in the local analysis system.

Type	Variable	Data Format	Numbers
Wind profiler	Wind	BUFR	11 sites in Korea
MTSAT	5 channel images	Binary	MTSAT-1R
Radar	Reflectivity	UF	11 sites in Korea
AWS	Temperature, Wind, Humidity	ASCII	614 sites in Korea
Lighting	Frequency	ASCII	-
AMEDAS	Temperature, Wind, Humidity	BUFR	222 sites
METAR	Temperature, Cloudiness	ASCII	30 ~ 41sites

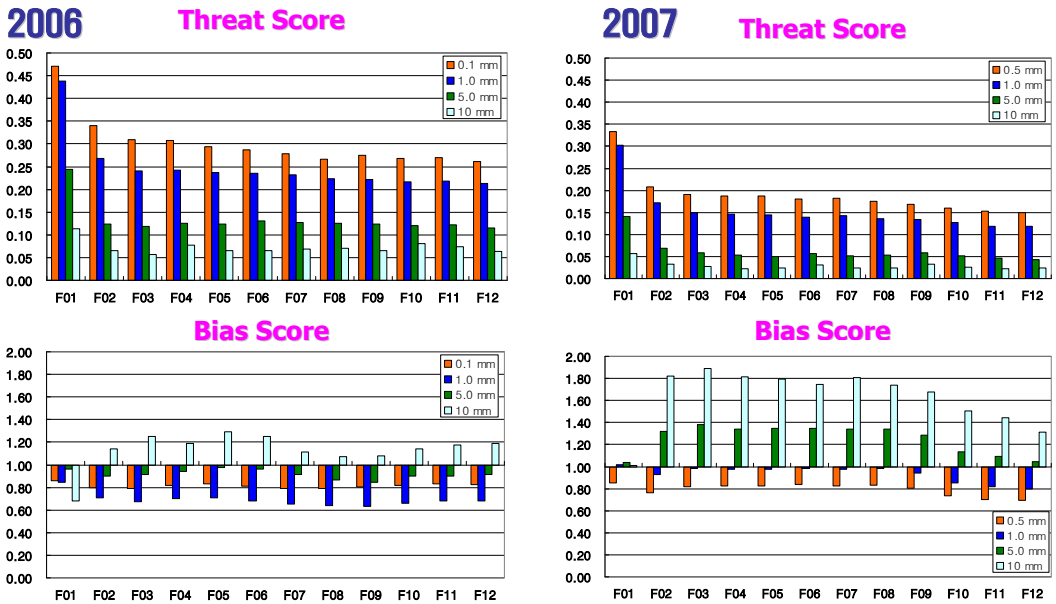

Fig. 2. The results of verification for quantitative precipitation forecasts against observations.

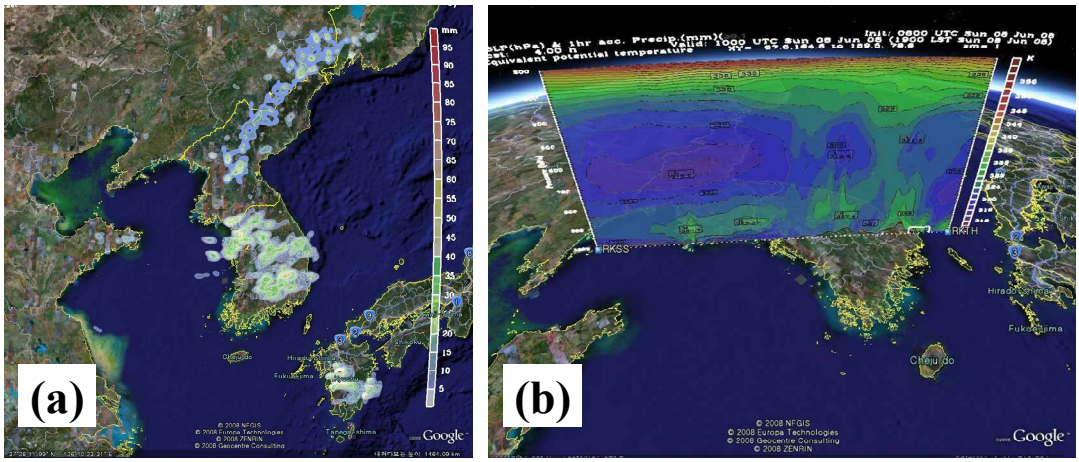

Fig. 3. (a) The 6h accumulated precipitation and (b) the cross-section of equivalent potential temperature on Google Earth.