The Effect of Hi-resolution SST on Storm Scale Prediction in Point of Operational Prediction System

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1. Introduction

We launched operational storm scale prediction system for Regional Meteorological office (RMO). Halla Short Range Prediction System (HSRPS) is the in-house system including cluster system for super-computing and data assimilation system. The target area is the Cheju island (the area is 1825 km^2) located in the south sea of Korea. She has various meteorological characteristics by Halla mountain (1950 m) located at the center of the island. The locality of precipitation highly depends on the wind direction by mountain effect and Land-Sea breeze.

Generally high resolution numerical weather prediction depends on the high resolution data sets and its assimilation scheme. In case of Cheju island it is free from the lateral boundary problem caused by complex terrain. But the insufficient observation in the surrounding sea still remains unsolved problem respectively.

HSRPS has rapid updated cycle of high resolution sea surface temperature (SST) retrieved from GMS. In an operational aspect, GMS SST has several merits. GMS gets data in an every hour, so it covers wider space without missing values than polar orbit satellite. This gives short leading time to get SST in our interesting area with high resolution (5 km by 5 km)

The objective of this study is to examine the effect of high resolution SST in HSRPS and the local circulation changes.

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2. Prediction System

a. Halla Short Range Prediction System

We constructed the operational storm scale NWP system for Cheju regional meteorological office. Local Analysis and Prediction System (LAPS) and distributed parallel MM5 were selected for three-dimensional data assimilation and prediction. The computational platform is Linux cluster with 16 Pentium PCs which helps operating HSRPS on the site Cheju RMO. Parallel processing is worked by MPI (Message Passing Interface) (Kim *et al*, 1999).

b. GMS SST

We retrieved the high resolution SST from GMS. The retrieved scheme has two test, the gross test and uniformity test. The test was basically performed by the comparison between the mean value or standard deviation of 3 by 3 pixels and threshold value. Fig. 1 shows the schematic procedure of SST retrieval method. The procedure after thermal gross test and cloud masking is separated by day and night.

In the night, thermal uniformity test and split window test were performed by using two IR channels. Thermal uniformity test is the comparison test between the standard deviation of brightness temperature (11 μm) and threshold value. Respectively split window test is the comparison test between the two channel difference and two threshold values of IR.

In day time reflective gross test and reflective uniformity test was performed by using visible channel. The reflective gross test is the comparison test between the mean albedo of 3 by 3 pixels and threshold value. Reflectively uniformity test is the comparison test between standard deviation of albedo of 3 by 3 pixels and threshold value (Saunders and Kriebel, 1988).

After gross test and uniformity test, we retrieved SST by the linear regression of satellite zenith angle and each corresponding values. Finally we got GMS SST by the climatology correction.

c. Domains and model configuration

The model configuration is summarized in Table 1. The vertical layers is 31 in the terrain-following σ-coordinates. The computation is done separately in the 3 nested domain (27 km, 9 km, 3 km) whose horizontal resolutions are the same as LAPS analysis domains. And each domain size is a

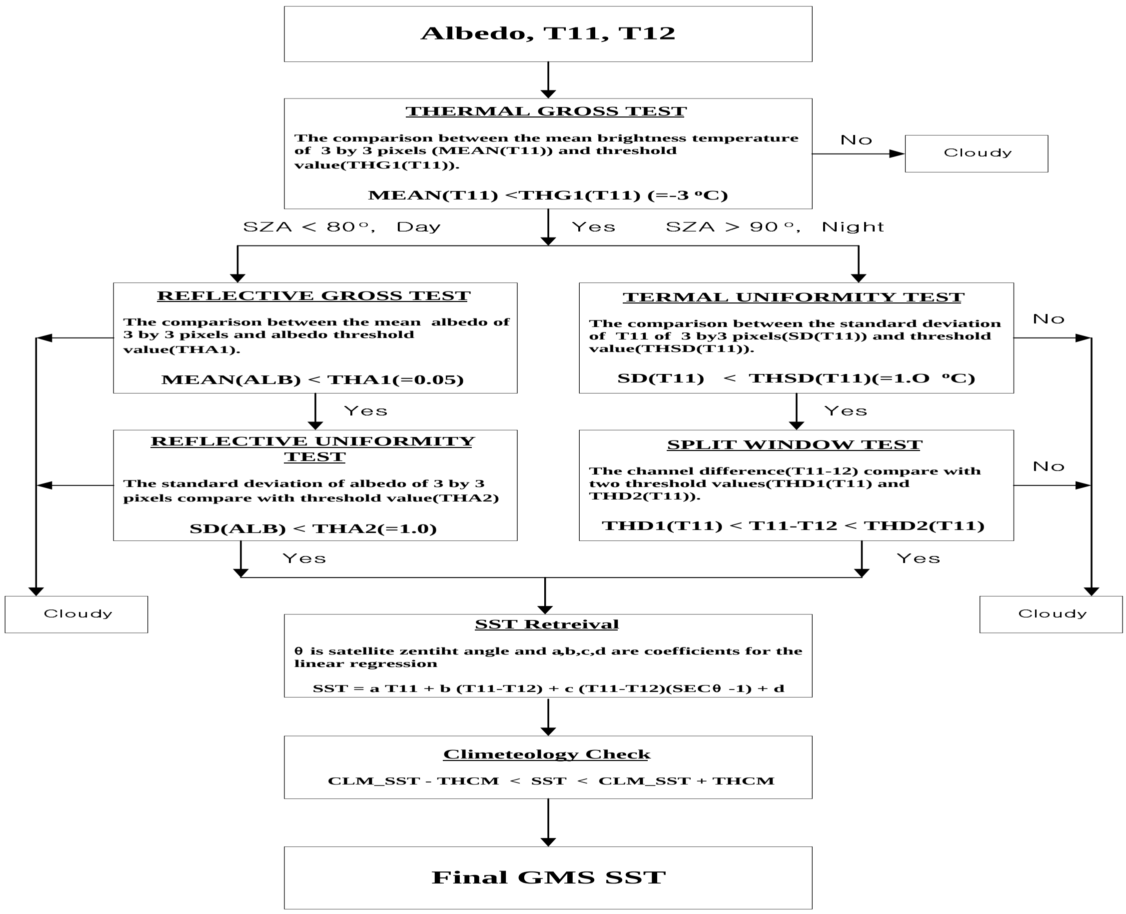


FIG. 1. Illustration of GMS SST retrieval scheme.

little smaller than that of LAPS.

Lateral boundary condition is the time-dependent inflow-outflow scheme. the boundary value of coarse domain gets from the operational KMA/MM5 (30 km resolution). prediction fields.

In the physical scheme, we used Grell as a cumulus parameterization, Mixed-Phase (Resiner) as explicit moisture scheme and MRF as a PBL scheme. Grell schem is used only the coarse grid model because we supposed that the precipitation can be simulated enough without cumulus parameterization in the fine grid models. The total integration time is 21 hours in this study. MM5 (3 km) forecasts were performed on cluster HANEUL, one of the distributed computers.

TABLE 1. The configuration of Distributed Parallel MM5 in HSRPS.

domain	domain 1	domain 2	domain 3
resolution	27 km	9 km	3 km
# of grid	57 × 51	61 × 55	61 × 55
vertical layer	31 layer (model top : 100 hPa)		
cumulus	Grell	none	
explicit moisture	Mixed-Phase (Reisner)		
PBL	MRF		
soil model	5 layer soil model		
radiation	interaction cloud and clear air		
shallow convection	On		Off
topo/landuse	USGS global 30 seconds		
initial data	Assimilated by KLAPS		
lateral boundary	MM5/KMA (30km)	mother domain (1 way nesting)	

3. Results and Conclusion

We constructed the rapid updated hiresolution SST base on GMS. Generally we used NOAA SST (1° × 1°) as an initial data for a mesoscale model (Fig. 2a). But the resolution model becomes finer, we must consider the effect of high resolution SST (Fig. 2b) in point of the air sea interaction

Fig. 2 shows NOAA SST (1° ×1°) and GMS SST (9 km ×9 km). Near the Cheju island which located at the center of domain, NOAA SST does not show the fine structure of the expansion of the Khroshio warm current. It shows only the diagonal SST gradient (Fig. 2a), but GMS SST has zonal gradient because of the Khroshio warm current (Fig 2b).

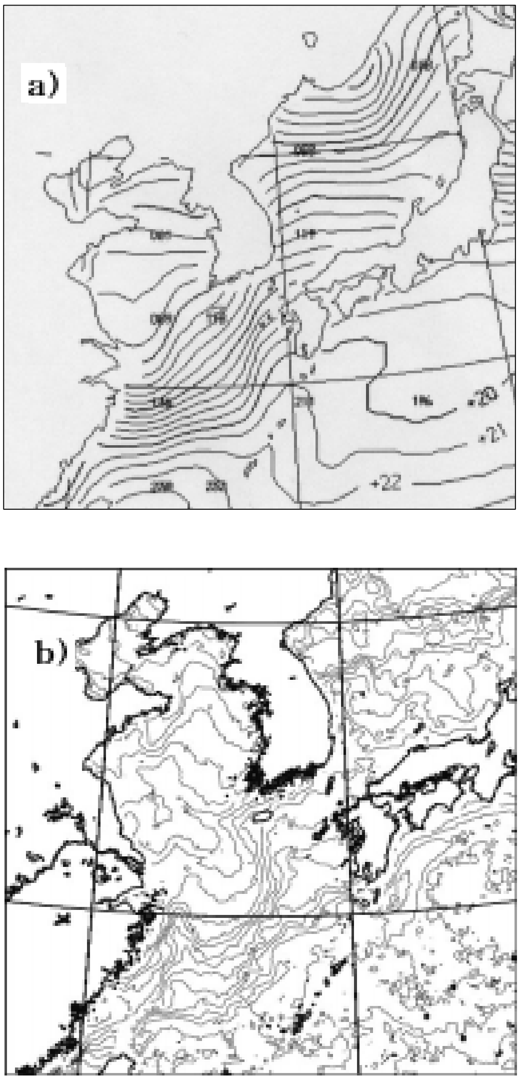
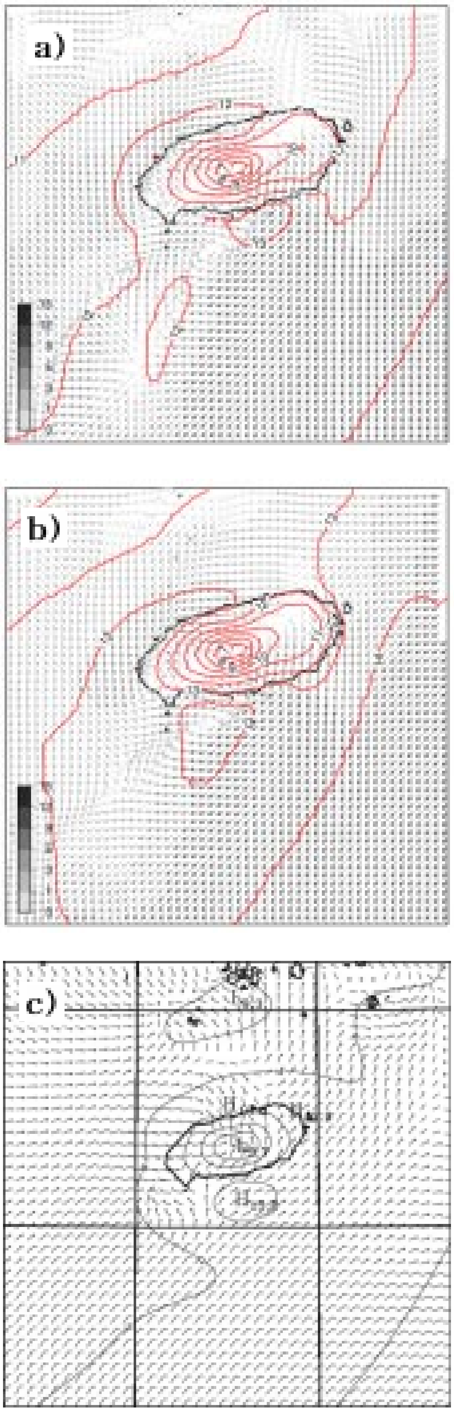


FIG. 2. The weekly mean of a) NOAA SST(1° ×1°) and the pentad mean of GMS SST from 31 March to 4 April.



Fɪɢ. 3. The surface wind (10 m) and temperature (℃) field of Cheju area (3 km × 3 km) at 1500 UTC, Aprih 4 (9 ours prediction) in case of a) NOAA SST (1° × 1°) and b) GMS SST (9 km × 9 km) c) analysis field of KLAPS.

Fig. 3 shows the surface wind (10 m) and temperature field at 1500 UTC, April 4, 2000 (9 hours prediction). In the north-east part of Cheju island, the easterly flow was found in NOAA SST (Fig. 3a). But the case of GMS SST, westerly flow was dominant (Fig. 3b), it is well matched with analysis field (Fig. 3c).

It turns out that the failure of the simulation of using NOAA SST is heritably caused by the failure of the 2nd domain simulation (9 km ×9 km). This domain covered the expansion of the Khroshio current. Further more it did not influenced in coarse domain prediction (not shown).

It is very important the role of rapid update GMS SST in the HSRPS for succeful prediction.

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References

Kim, Y., Y. H. Lee, J-H Oh, J-C Choi, 1999: Parallel processing under Linux cluster and operation of MM5, *Proceedings of Conference of Korea Meteorological Society*, KMA, Oct. 1999, 226-229.

Saunders R. W. and Kribal K. T., 1988: An improved method for detecting clear sky and cloudy radiance from AVHRR data. *Int. J. Remote Sens.*, **9**, 123-150.