SIMULATION OF SNOW STORM OVER JAPAN

Koji Wada, Hiroyuki Kusaka, and Hiromaru Hirakuchi
Central Research Institute of Electric Power Industry, Abiko, Japan

1. INTRODUCTION

In winter, north part of Japan is one of the heaviest snowfall regions. It is because the cold outbreak from the Eurasia continent is transformed to warm and moist air-mass by Japan sea, and run up against the Japanese mountains. Also, it is known that heavy snow storm is generated by the explosive cyclogenesis.

If the surface temperature is about 0 to 2 degrees centigrade, the snow changes its nature to wet snow, and the snow accretes to the civil engineering structure such as power line. There is a demand for the prediction that when the snow accretion will occur.

In this study, we simulate heavy snowfall and severe snow accretion case using MM5 and WRF, and confirm the applicability to the snow accretion hazard.

2. MODEL CONFIGURATION

WRF Version 2.1.1 and MM5 Version 3.6.1 were used. The first domain is 150 x 150 grid point with 30-km grid spacing, and second domain is 151 x 151 grid point with 10-km grid spacing with 2-way nesting (Fig. 1). NCEP-FNL data is used for creating the initial and boundary conditions. The numerical integration starts at 00 UTC 22 Feb 2004, and runs for 30 hours. The MM5 and WRF model configuration is in Table 1.

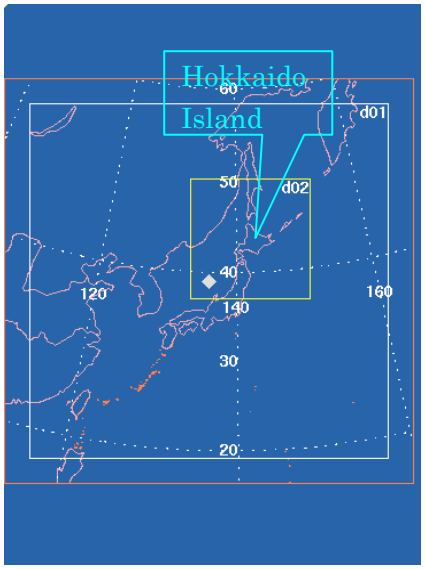


Figure 1. Model domain used by the MM5 and WRF simulations.

Table 1. Configuration of the MM5 and WRF model setting.

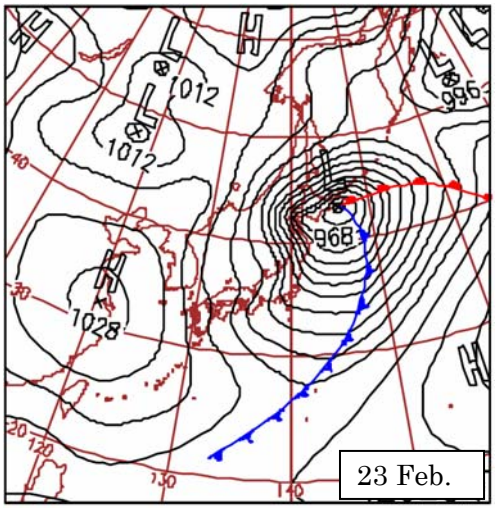
Cumulus Parameterization	MM5	WRF
Microphysics	Goddard Micro physics	Purdue Lin et al.
Radiation	RRTM scheme	RRTM/ Dudhia
Surface Scheme	5-layer soil model	5-layer thermal diffusion model
Planetary Boundary Layer	MRF PBL	MRF PBL
Cumulus Parameterization	Grell scheme	Grell Devenyi ensemble scheme

3. SIMULATION RESULTS

We selected the simulation case when the developing low ran through Hokkaido on 22-23 February 2004(Figure 2(a)). Figure 2 (b) and (c) show simulation results by MM5 and WRF.

Both models seem to represent the developing low and front properly. Comparison between observational weather station data and model shows good accordance with each other.

But in the neighborhood of the center of the depression, the model (especially MM5) showed rapid eastward progression (Fig. 3). In this case, compared with MM5, WRF showed the depression developed more deeply (Fig. 4).



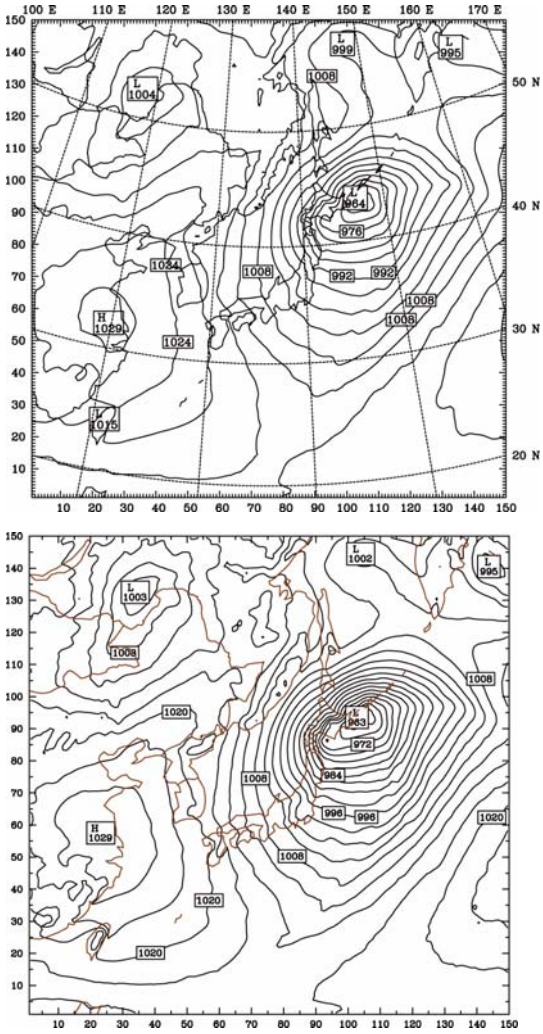


Figure 2. Surface weather chart on 00Z 23 February 2004 (Upper), Sea level pressure field by MM5 (middle), SLP by WRF (lower).

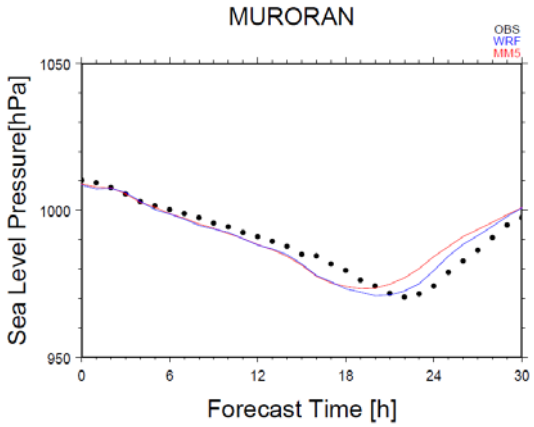


Figure 3. Sea level pressure time series at Muroran city (south part of Hokkaido).

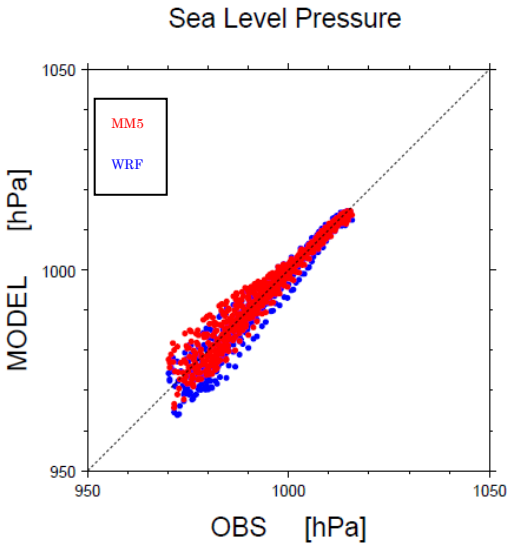
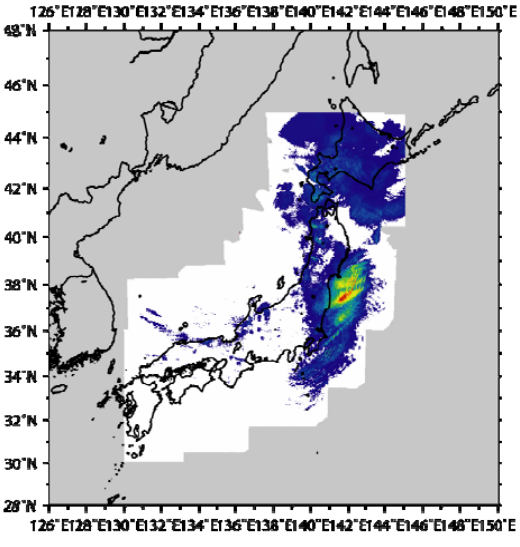


Figure 4. Scatter plot of observational sea level pressure and MM5 (red) WRF (blue) at 18 weather stations in Hokkaido.

Figure 5 shows 1-hourly precipitation distribution of observation, MM5 and WRF. MM5 and WRF showed passable accordance with observation.



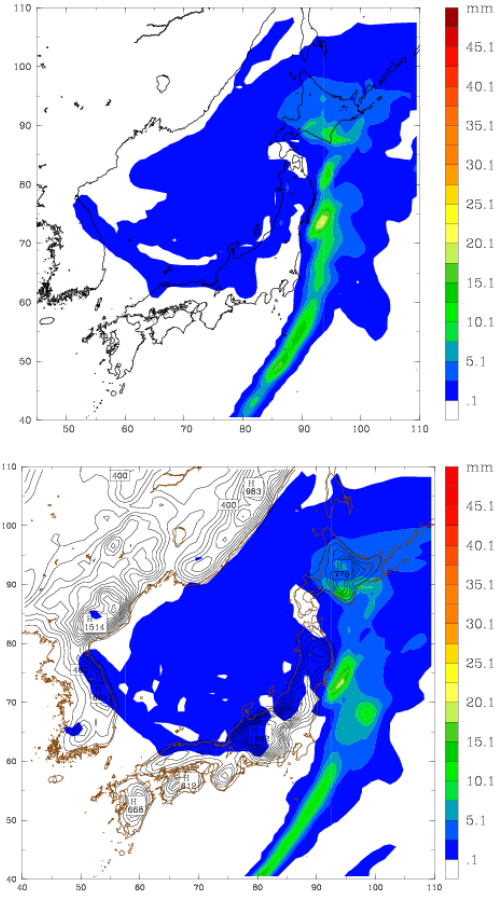
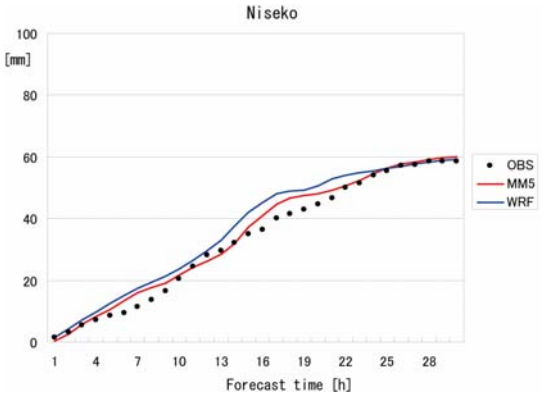


Figure 5. 1-hourly precipitation on 18Z February 2004. (Upper: Observation, middle: MM5, lower WRF)



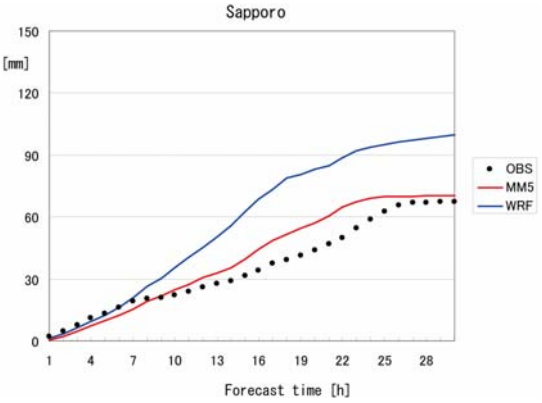


Figure 6. Accumulated precipitation at Niseko [heavy snowfall region southwestern district of Hokkaido](Upper) and Sapporo (Lower).

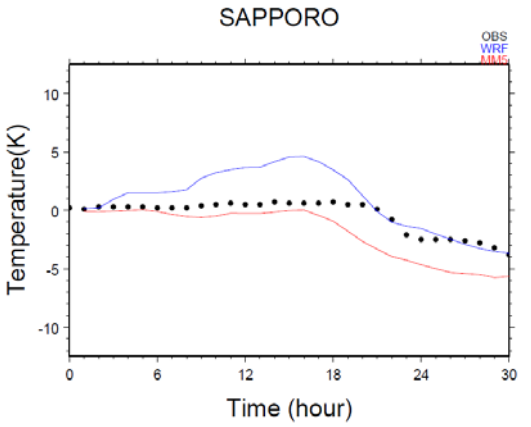


Figure 7. surface temperature time series at Sapporo.

Time series of the accumulated precipitation is also good accordance with observation (Fig. 6). This shows that the model output have the possibilities that we can estimate the hazardous nature of the snow accretion.

Figure 7 shows the time series of the surface temperature at Sapporo. MM5 showed good representation around the 0 degree centigrade, but WRF showed several degree centigrade warmer than observation. Figure 8 is the Scatter plot of observational surface temperature and MM5 (red), WRF (blue) at 18 weather stations in Hokkaido.

Compared with the MM5, WRF shows a little bit warm trend. This characteristic also appeared in the other winter depression case.

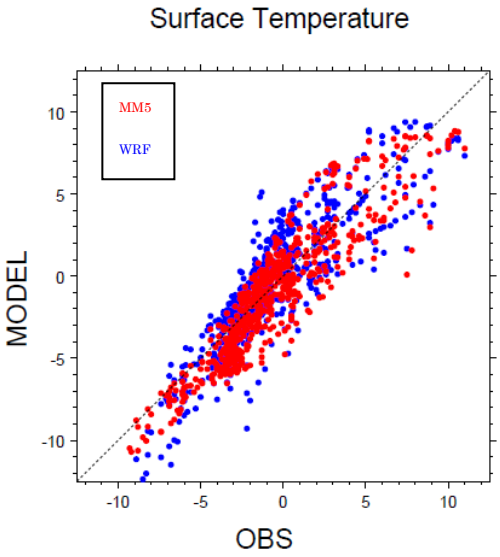


Figure 8. Same as Fig. 4 but for surface temperature.

5. SUMMARY

We simulated a strong wind with snowfall event that caused disaster in Japan, using the MM5 and WRF modeling systems.

The simulation was successfully done, and both models represent the development of the traveling low with a cold front, particularly the strength and shape of the traveling low and the movement of the front. The WRF model showed the a little bit warm bias in compared with MM5, but the model output have the possibilities that we can estimate the hazardous nature of the snow accretion.