IMPACT OF DWR RADIAL WINDS, REFLECTIVITY AND CUMULUS PHYSICS ON THE NOWCASTING OF MCCs

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ABSTRACT

The quantitative data such as Doppler Weather Radar (DWR) radial winds and reflectivity are useful for improvement of the numerical prediction of weather events like squalls. Mesoscale convective systems (MCCs) are responsible for majority of the squall and hail events and related natural hazards that occur over Bangladesh and surrounding region in pre-monsoon season. In this study, DWR observations (radial winds and reflectivity) of Bangladesh Meteorological Departments (BMD) are used during 3 May 2012 squall event in order to update the initial and boundary conditions through three-dimensional variational assimilation (3DVAR) technique within the Weather Research Forecasting (WRF) modeling system. The model results are also compared with the Kalpana-1 images and the India Meteorological Department (IMD) predicted results in order to evaluate the model performance.

Keywords: Squall, MCCs, WRF, 3DVAR assimilation, DWR radial winds, reflectivity.

1. INTRODUCTION

Modern radars are important equipments for nowcasting Local Severe Storms which appear in the form of Nor'westers or 'Kal Baisakhis' in Bangladesh and eastern region of India during pre-monsoon season (March to May). However, the lead time of forecasting can be increased only by the numerical weather prediction models. An attempt has been made to simulate the storms using WRF model. It indicates that NWP models are very important for obtaining guidelines for forecasting local severe storms. Study of Radar data showed that the Nor'westers propagate in the form of parallel bow shaped squall lines having horizontal length of more than 250 km at 12 to 14 UTC. The model underestimated the strength of the squall lines in general in its present configuration. The simulated results showed the presence of strong vertical wind shear and an advection of warm air forming a solenoidal field during the Nor'wester (Das et al. 2006).

2. MATERIALS AND METHOD

The WRF Model has been used over the study domain. The model is run at 3 km resolution with 27 vertical levels using initial and boundary conditions obtained from NCMRWF T254L64 global model. 6 hourly NCEP-FNL Data (1°x1°), GTS data are utilized in the Experiments. Kain-Fritsch and Grell-Devenyi (GD) ensemble cumulus scheme have been used in the model run.

Table 1: Realized weather phenomena over Bangladesh on 3 May 2012.

Station	Lat. Lon.	Wind Speed kph	Occurrence Time (UTC)
Khulna	22.78 89.53	64	1420
Dhaka MMO	23.52 90.24	96	1508
Dhaka PBO	23.77 90.38	61	1526
Rangpur	25.73 89.23	74	1810

3. RESULTS AND DISCUSSION

The impact of 3DVAR assimilation upon the first guess is studied here. It is seen that the experimental (DA) runs have simulated 10m wind speed of about 12-24 m/s in big patches in the West Bengal and northwest region. Whereas the control run has produced 10m wind speed greater than 12 m/s over the region. High shear regions are wide spread in the West Bengal and Bihar region in the experimental forecasts whereas, the control forecasts have small wind shear restricted over a small region (Barker et al. 2004). Fig. 1 presents the reflectivity, for forecasts valid at 12 UTC of 03 May, 2012. 850hPa horizontal winds in the experimental forecasts are having higher gustiness over the region of the observed system compared to the control forecasts.

3.1 T- Φ gram analysis of 03 May 2012

Dhaka T- Φ gram indicated LI -3.25, K index 23.5 and Totals Totals Index 41.8 at 0000 UTC. The total precipitable water content stayed at 37.46 mm favouring convective activity. Kolkata T- Φ gram indicated LI -7.67, K index 33.7, Totals Totals Index 53.0 and a very high CAPE (2976.17 J/kg) and low CINE (-117.58 J/kg) at 0000 UTC. The total precipitable water content stayed at 44.14 mm favouring convective activity (Dasgupta et al., 2005).

3.2 Doppler Weather Radar and Kalpana-1 Satellite Analysis

Doppler Weather Radar (DWR) Kolkata recorded the vertical extent of the system of about 16 km and the RADAR reflectivity 45 dBz. Moderate convection was seen over northwest Bay by Kalpana-1 satellite imagery (CTT-60^{0}C) which was moving northeastwards and expanded over Bangladesh (Fig. 2).

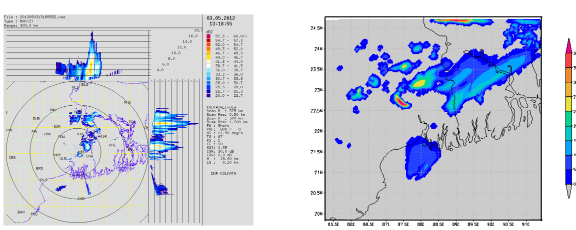

Fig. 1: Observed and WRF Model simulated Reflectivity on 3 May at 1200 UTC.

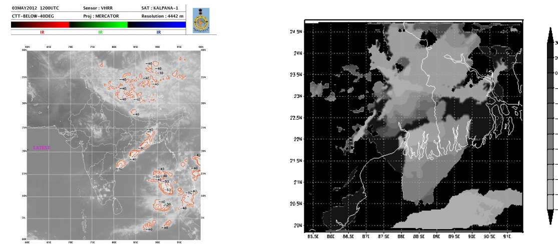

Fig. 2: Observed and WRF Model simulated CTT on 3 May 2012 at 1200 UTC

4. CONCLUSION

The overall superiority of data assimilation is not strongly revealed from the present case study. But, the impact of data assimilation is very clearly highlighted. The experimental and the control simulations are close to the observations. The skill scores of the forecasts have to be examined. Forecasting accurate location and time of occurrence of thunderstorms is still a challenge for the modellers.

5. REFERENCES

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