Assimilation of Wind Profiling Radar data in GRAPES-MESO Model System

Wang Dan[1] (wangd@cma.gov.cn), Ruan Zheng[2], Zhu Lijuan[1], Li Feng[2], and Tian Weihong[1]

[1] Numerical Predition Center , China Meteorological Administration Beijing, China;
[2]Chinese Academy of Meteorological Sciences, China Meteorological Administration, Beijing, China;

1. Introduction

Wind is the direct driving force of weather formation. Compared with conventional observations, wind profiling radar(WPR) can provide wind information at higher resolution both at time(short than 6Mins) and space(tens to hundreds of meters). So it is looking forward to use WPR to improve the description of wind analysis through DA system. In order to realize the application of WPR in GRAPES-MESO model system,some basic work should carry out.The major purposes of this study is twofold:

I. To develop a WPR quality control procedure toward assimilation applications,
II. Investigate WPR data impacts on regional numerical model

2. Data and Quality control

2.1 WPR network in China

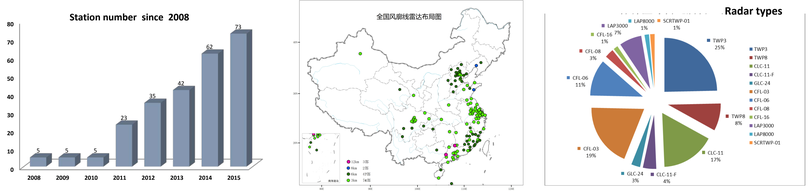
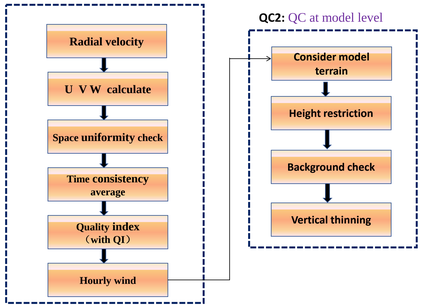


Figure 1. Overview of wind profiler network in China

2.2 Quality control procedure(a two-step method)

QC1: QC at instrument level



QC2: QC at model level

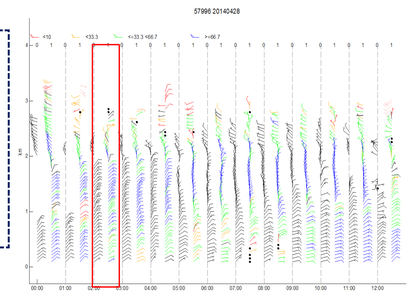
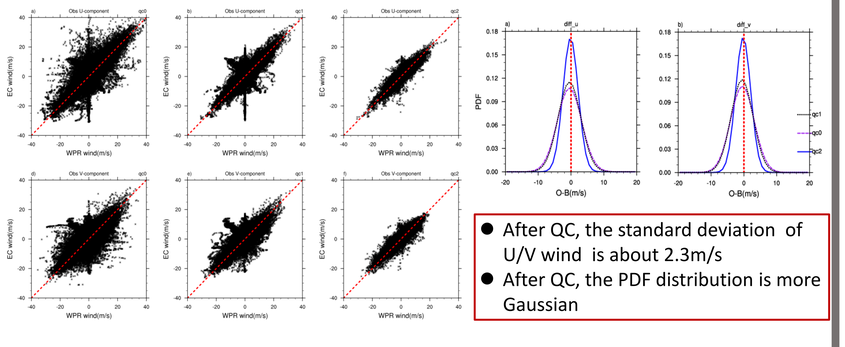


Figure 2. A two step QC flow and an example of hourly wind product with QI index

- QC1 is at instrument level, by using a unified algorithm to process data, to avoid the inconsistency caused by different manufacturers and radar types,
- QC2 is at model level, this is thought to be a combination of data represent problems and a lack of realism in model physics and insufficient model resolution

3. Data evaluation and validation

3.1 Compare with ERA-interim

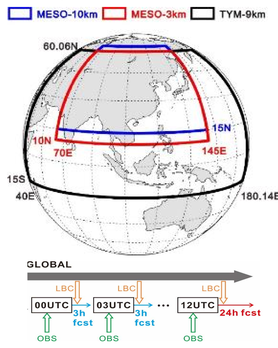


- After QC, the standard deviation of U/V wind is about 2.3m/s
- After QC, the PDF distribution is more Gaussian

Figure 3. Scatter and PDF distributions of WPR against ERA-interim at July 2015

4. Design of numerical experiments

4.1 Model setup



MESO -10kmL50

- Area:15°N-65°N, 70°E-145°E
- Model top: 50 levels,10hPa
- Forecast length:24 hours
- Obs:temp,synop,airep,ship , AMV,GPS/PW
- DA: 3DVAR
- Cycle interval: partial cycle , 3h rapid update
- Period:1-31 July,2015

Figure 4. Description of GRAPES-Meso model

4.1 Batch experiment result

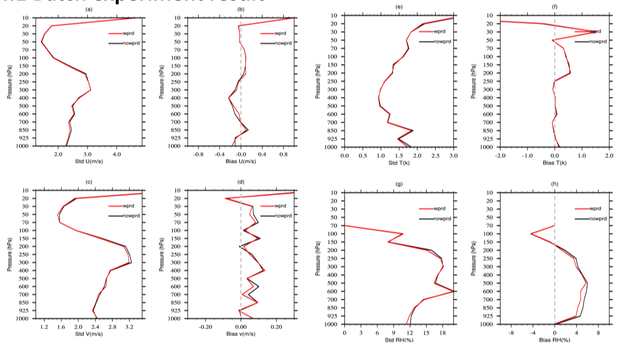


Figure 5. Vertical distribution of STD and Bias of analyzed filed against radiosonde

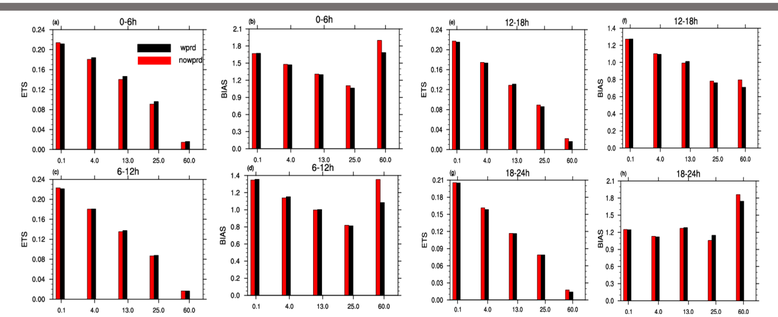


Figure 6. ETS and Bias scores of 6h accumulated precipitation

4.2 Case study (1510,typhoon 'Linfa')

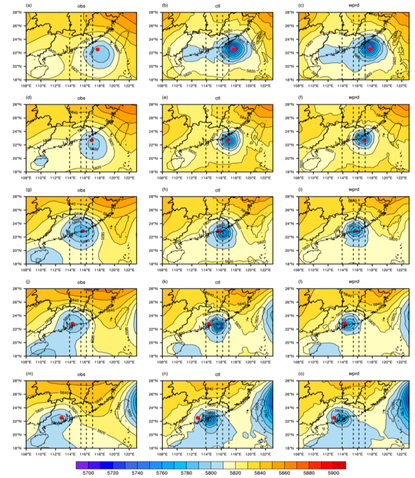


Figure 7. The 24h evolution of geopotential height at 500hPa from 1800UTC 8 July to 1800UTC 9 July

- WPR assimilation makes the track of typhoon closer to the best track
- WPR assimilation makes precipitation structure closer to the observation

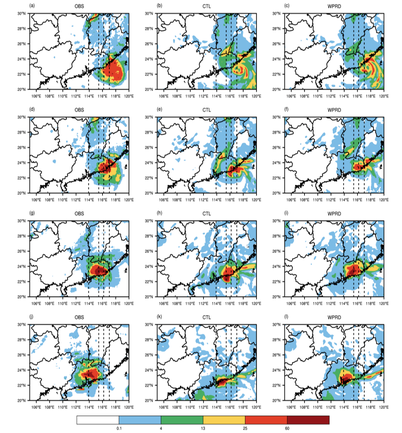


Figure 8. The evolution of 6h accumulated rainfall from 1800UTC 8 July to 1800UTC 9 July

5. Conclusions

- A prototype of two-step wind profier qulaity control algorithm is developed. Statistic results show that the data after control is more accurate and the OMB pattern is more Gaussian.
- The preliminary data assimilation results show that the Qced wind profiler data can improve the initial condition of the model, adjusting the dynamic and thermal structure, improving forecast skill of precipitation

Key Reference:
WANG Dan, RUAN Zheng, et al. A Study on Assimilation of Wind Profiling Radar Data in GRAPES-Meso Model[J]. *Chinese Journal of Atmospheric Sciences*, 2019, 43(3): 634-654. doi: 10.3878/j.issn.1006-9895.1810.18125