A NEW NOWCASTING METHODOLOGY BASED ON PRECIPITATION DATA FROM A DENSE AWS NETWORK AROUND BEIJING AREA

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ABSTRACT

With the development of a dense AWS (automatic weather station) network around Beijing area, a rain-gauge network comparable with radar observation was set up during the past few years since the 2008 Beijing Olympics. High spatial density rainfall data can be updated every 5 minutes and used for radar QPE verification. In this paper, a new methodology was presented to forecast the 30 minutes rainfall based mainly on rain-gauge data for a severe rainfall case on June 23, 2011. The better spatial coverage of radar observation was also included to make out more reliable rainfall estimation. Verification on this algorithm and the operational products was conducted, and the results show that: high spatial and temporal resolution surface rainfall can directly reflects the evolution of precipitation, so uncertainties of radar observation including errors during data conversion and with different scanning strategy can be avoided, and dense rain-gauge data can be well applied to nowcasting operation.

Key words： AWS (automatic weather station), rainfall, radar, nowcasting, methodology

1. INTRODUCTION

Traditionally, the surface rain-gauge observation was used to give a better Z-R relationship for radar QPE. But with the great improvement of the updating time and spatial coverage, it naturally comes into sight to use it directly for nowcasting with the help of radar observation. A new methodology was presented in this paper to use 5-minute dense rainfall data to give a direct rainfall forecast with the help of good spatial coverage from the surrounding radar network. The QPFs from the new methodology and ANC were then compared against the calibrated surface observation.

2. DATA

The dataset used in the paper study is for the severe rainfall case on June 23, 2011. And it's from the operational network of more than 200 AWS stations and mosaic of 19 levels from 6 Doppler radar around Beijing area running in synchronized mode with VCP21. The precipitation forecast products generated every 6 minutes are from BJ-ANC system which upgraded from the Auto-Nowcast (ANC) system. 30 minutes accumulated rainfall forecast products are used for this study.

3. METHODOLOGY

For better regional rainfall estimation, advantages of surface rain-gauge and weather radar should be carefully considered together. Steps are designed to get more credible rainfall distribution based on AWS rainfall and radar reflectivity data.

1）Calculate 30 minutes AWS rainfall for specific area around Beijing；

2）Interpolation was conducted for the specific area to generate rainfall field；

3）Using 30 minutes radar reflectivity accumulation to reform the AWS-derived rainfall coverage, the rainfall coverage should be consistent with the radar pixels greater than 30dBZ (here 30dBZ was the composite reflectivity from 500 to 3000meter which considered to be the appreciable precipitation threshold in Beijing area according to the radar data statistics). The earlier 30 minutes regional rainfall accumulation can then be used to forecast the future 30 minutes rainfall with the direction and speed from the linear extrapolation algorithm based on radar images. The QPFs was verified at last to show the difference between ANC and calibrated rainfall distribution.

4. RESULTS ANALYSIS

To give a better estimation of surface rainfall, 30 minutes AWS rainfall and radar mosaic (echo with reflectivity greater than 30dBZ) accumulation was combined. Fig.1 shows the 30 minutes rainfall.

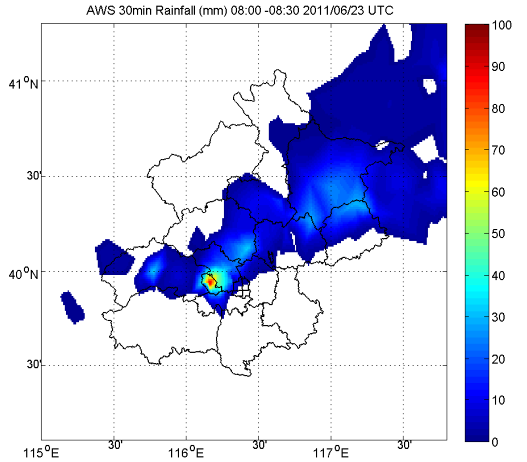

Fig1 AWS rainfall accumulation 08:00-08:30 UTC

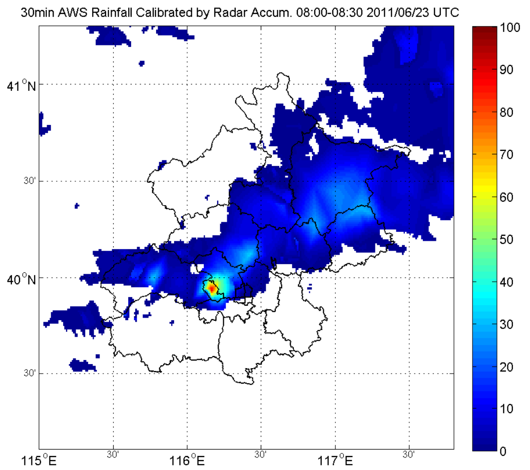

Fig2 Calibrated AWS 30 minutes rainfall with radar mosaic coverage correction 08:00-08:30 UTC

Based on real-time Z-R relationship from AWS and radar reflectivity, the calibrated AWS 30 minutes rainfall with radar mosaic coverage correction can be generated in Fig.2. Then the area with sparse rain gauge can be well filled or calibrated.

The forecast products are compared to ANC products and verified using Q-Q plot and scatter plot with surface observation. Table 1 shows the correlation coefficients between observation and forecast.

Table 1 Correlation coefficients between observation and forecast

Time(UTC)	AWS vs. ANC	Calibratedr30 vs. ANC	Calibratedr30 vs. F30
0830:0900	0.677	0.6796	0.609
0900:0930	0.577	0.5808	0.3898
0930:1000	0.600	0.6140	0.369

The result also shows that the Q-Q plot of forecast matches that of observation much better with the new methodology compared to ANC against obs. The verification for the new method is good in Q-Q plot and doesn't show a good enough performance in scatter plot. By now, the simple linear extrapolation algorithm based on the whole echo region was used and its optimization should improve the scatter plot performance.

5. CONCLUSIONS

The idea for this study is that the high spatial and temporal resolution surface rainfall data can directly reflects the evolution of precipitation trends, so uncertainties of the radar observation including most errors during data conversion and with different scanning strategy can be avoided with the AWS rain-gauge data as the main data source for extrapolation algorithm, and it can be an effective way to use rain-gauge data and be well applied to nowcasting operation. Also, the calibrated AWS rainfall can be a good estimation of real rainfall for nowcasting verification.

6. REFERENCES

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