Wind profiler network and data assimilation in China

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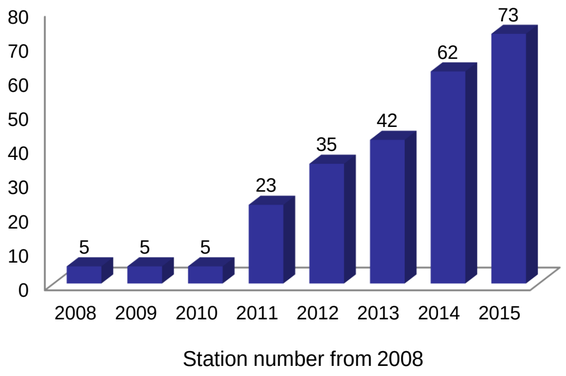
Aims of this study

The quality of the wind profiler data and the impacts of those data on regional numerical model are examined.

Wind Profiler Network

CMA is establishing a windprofiler network to get density wind profile observations. Till 2015, there are 73 stations in operation.



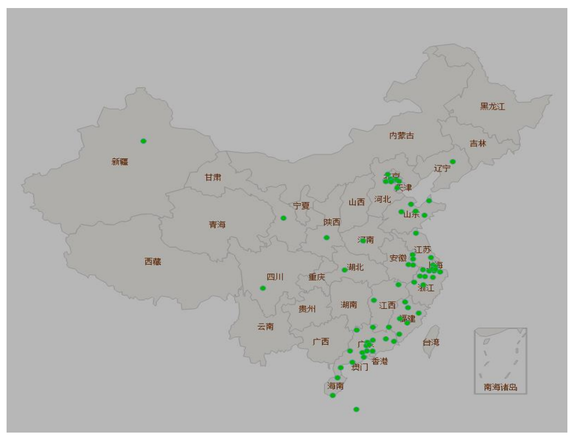


Fig.1 The wind profiler network

Data Quality Control

1. For Obs.-- Dynamic statistics of the obs.

The prototype of data quality control system was established which includes two levels, i.e. station level and nation level (Fig. 2).

Nation Level

Algorithm:

a. Symmetric beam check
b. Consensus averaging
c. Quality flagging
d. Weather categorize

Station Level

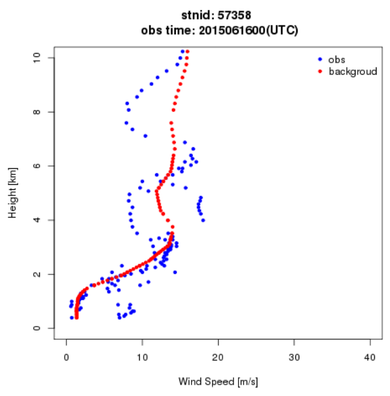
Algorithm:

a. Double-peaked spectrum identifying under precipitation condition
b. Integrated Ground clutter identifying using surface wind observation

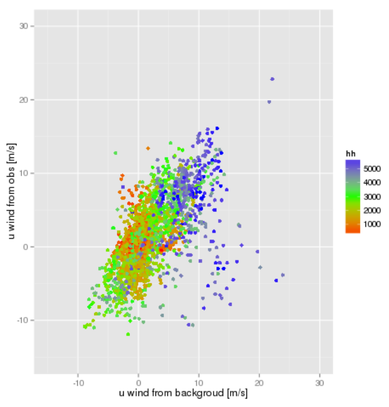
Fig.2 Data quality control algorithms

These data are acceptable, but:

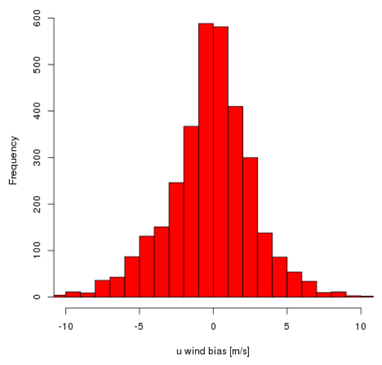
For both U/V components, the distributions of frequency density of O-B differences before QC (RAW) are close to, **but not very strictly Gaussian**. The large central density peak and more data locating on the left tail imply **the existence of outliers**. The situation can be identified more prominently that there are large discrepancies at both ends of the quantile-quantile scatter plots.



Wind profiler of the obs. and backgound at station: 57358



Scatter points of the U wind at station 57039



Obs. Error distribution of station: 57039

Fig.3 Dynamic statistics of the obs.

2. Automatic QC procedure for the DA

Dynamic Statistics of the obs
↓
QC1
↓
QC2
↓
QCed data

Obs. data statistics monthly

Automatic station blacklist based on the data acquisition rate and the correlation between the background.

Outliers' rejection in order to obtain the normal distribution

Data assimilation

Acquisition rate less than 20%

Corr. Coefficient less than 0.4

Outlier rejection algorithm: Iterated Reweighted Minimum Covariance Determinant (IRMCD)

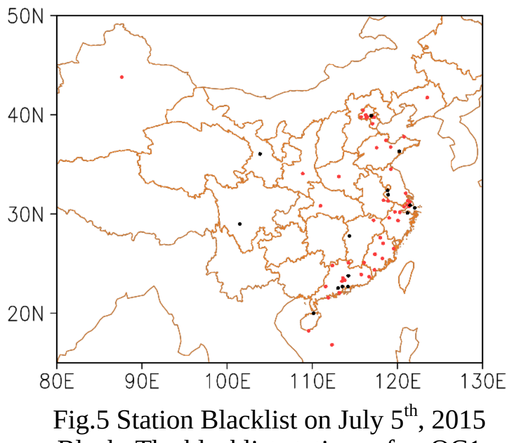
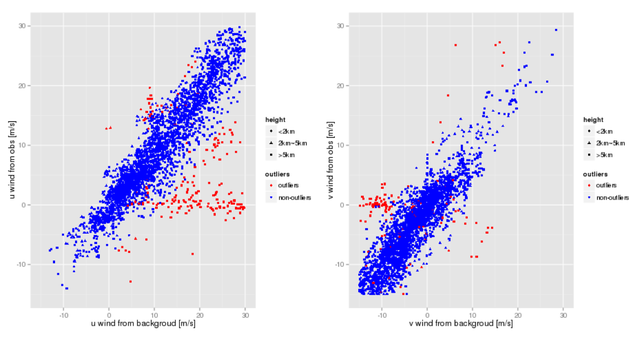


Fig.5 Station Blacklist on July 5th, 2015
Black: The blacklist stations after QC1
Data rejection rate: **7.93%**



Kurtosis: 13.60054 → 3.769943
Skewness: -2.661 → -0.4378

Kurtosis: 13.30893 → 3.461822
Skewness: 1.9338 → 0.0563

Fig.6 Improvement of kurtosis and skewness afrer outliers' rejection

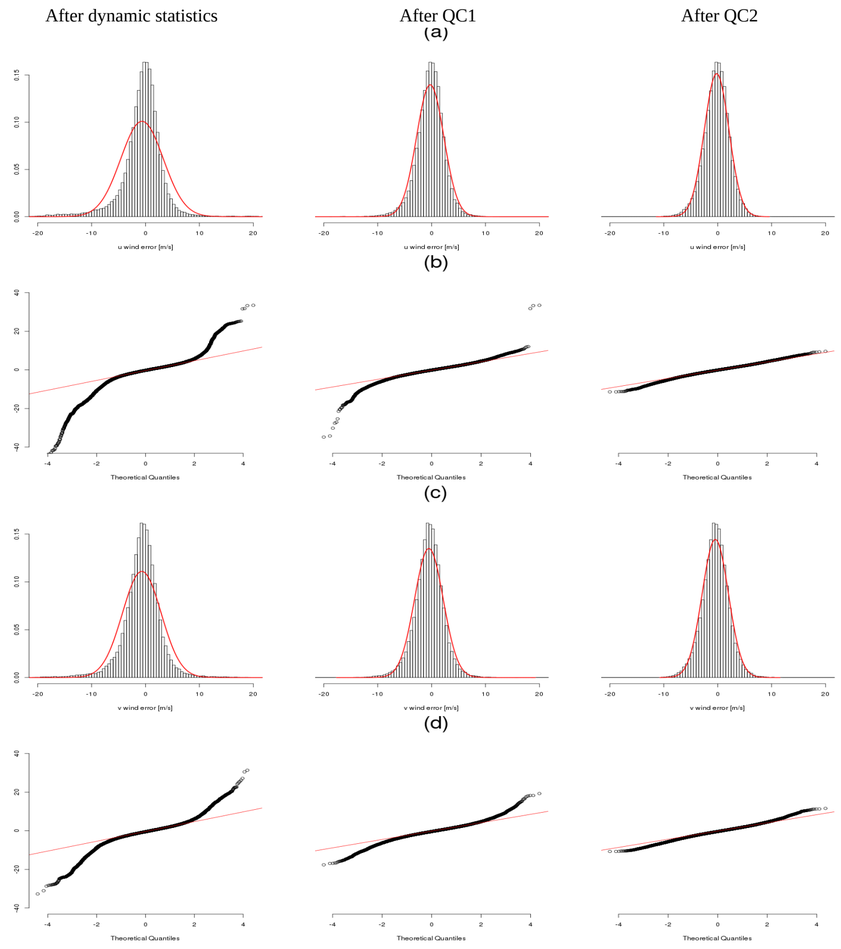


Fig.7 The probability density histograms (a,c) and QQ-plot (b,d). The variable is u^'(a,b) and v^'(c,d)

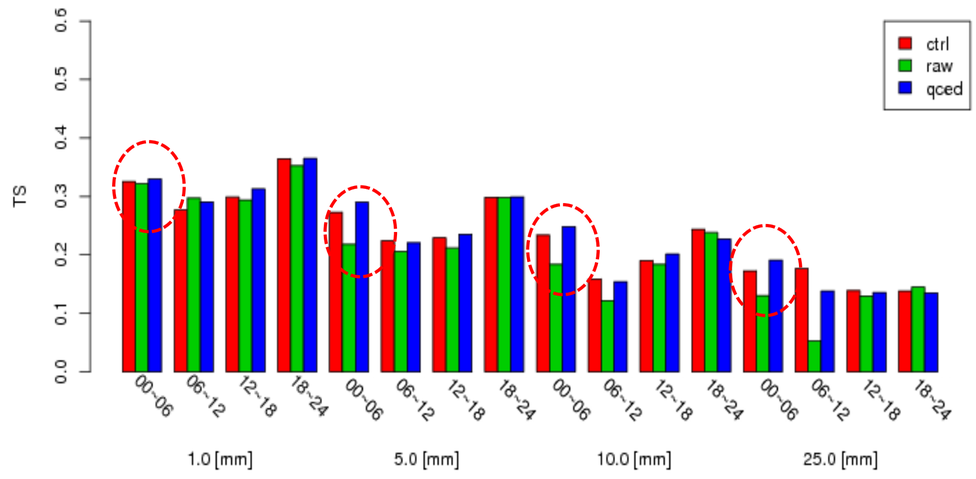
After taken the two QC steps, the standard deviation gradually decreases and especially, after QC2, the QQ-scatter plot almost well converges with the straight line, indicating most of outliers have been eliminated and the pdfs of O-B differences are much closer to the standard normal distribution.

Preliminary Data Assimilation Test

Exp. name	Control（CTL）	Sensitive one（RAW）	Sensitive two（QCED）
System	BJ-RUCv2.0		
Initial	GFS 6hr fcst	WRFDA anal. （GFS 6hr fcst + wind profiler obs.）	WRFDA anal （GFS 6hr fcst + qced wind profiler obs.）

- DA system： WRF-DA
- Fcst length： 24hr
- Initial time： 20150705-20150715, 00(UTC) per day
- Boundary and background： GFS fcsts
- Obs. data： average wind profiler obs. hourly
- Verification data：

  Routine Obs: surface and radiosound



Results: The QCed wind profiler filer data have positive impacts on precipitation prediction. After assimilating, the forecast of wind field at high altitude was effectively improved, and the ts score of the accumulated precipitation in the first six hours was significantly improved.

Summaries & Conclusions

The windprofiler network with 73 stations are in operation in 2015. A prototype of windprofiler data quality control system was developed and preliminary data assimilation results show that the QCed wind profiler filer data are useful for precipitation prediction. And the network should be optimized to avoid the large sparse areas.