WORLD METEOROLOGICAL ORGANIZATION

COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION
OPAG-UPPER-AIR

JOINT MEETING

CIMO EXPERT TEAM ON UPPER-AIR SYSTEMS INTERCOMPARISONS
First Session

AND
INTERNATIONAL ORGANIZING COMMITTEE (IOC) ON UPPER-AIR SYSTEMS INTERCOMPARISONS
First Session

GENEVA (SWITZERLAND), 17-20 MARCH 2004

Distr.: RESTRICTED

CIMO/OPAG-UPPER-AIR/
/ET-UASI-1/IOC-1/Doc. 3.4(4)

(11.II.2004)

ITEM: 3.2, 3.4

Original: ENGLISH ONLY

NATIONAL PROGRESS REPORTS ON TESTING QUALITY OF NEW RADIOSONDES

Preliminary Quality Analysis for Chinese L-band Radar - GTS1 Radiosonde Upper-Air Observation System

(Submitted by Guo Yatian, China)

Summary and purpose of document

This document provides quality analysis of a new upper-air system, including tests and comparisons of new radiosonde developed by China Meteorological Administration.

Action proposed

The meeting is invited to note and comment on the information contained in the report and take it into account when discussing agenda items 3.2 and 3.4

Preliminary Quality Analysis for Chinese
L-band Radar -GTS1 Radiosonde Upper-air Observation System

1. Introduction

CMA operates an upper-air observation network of 89 Stations. Most of stations are using 403MHz mechanical radiosonde and a secondary wind finding radar sounding system that has been used in the network for nearly forty years. With the advent of modern communication, computer and engineering technologies, CMA began to develop next generation of upper-air system in later 1990's. The new upper-air system still uses secondary radar as a wind finding means, but it uses 1680MHz frequency instead of 400MHz frequency. It is to avoid the frequency interference existed in the 400MHz frequency band. The new radiosonde uses electronic sensors to measure meteorological elements. The new upper-air system has obvious advantages over the existing system. It is easy to use and maintain. The wind tracking is performed automatically. The observation data shows significant improvements in PTU measurement accuracy. Nanjing Daqiao Machine Factory manufactures the L-band radar, and Shanghai No.23 Radio Factory produces the radiosonde. The existing operational upper-air system was also provided by these two manufactures. After more than two years of field experiment and validation, the first L-band radar-radiosonde system began putting into operational use in Beijing (54511) in January 2002. This marked the beginning of CMA radiosonde replacement program. According to the plan of radiosonde system replacement, CMA is gong to upgrade all the old system with the modern one in recent years. In 2003, total of thirteen upper-air stations have been upgraded. They are Jiuquan (52533), Zhangye (52316), Yinchuan (53614), Guiyang (57816), Guilin (57957), Qingdao (54857), Nanjing (58238), Quxian (58633), Kuerle (51656), Zhangqiu (54727), Weining (56691), Shanghai (58362) and Hangzhou (58457). Twenty more stations will be upgraded in 2004.

In order to ensure the data consistency, it is regulated that all stations to be upgraded must carry out one month of concurrent comparison observations with the old system. So far, all the upgraded stations have finished the comparison. Comparison with Vaisala-RS80 was only made in Beijing (54511) in July 2001. Beside of this, data monitoring and quality control have been performed routinely by use of numerical weather predication products. This paper takes Qingdao (54857) as an example to discuss the results of the system comparison and data monitoring.

2. Brief description of the upper-air system

2.1 Radar System

Type: secondary radar
Frequency: 1680Mhz
Antenna: antenna array composed of four antennas

2.2 Radiosonde

The radiosonde working with L-band radar is called GTS1 radiosonde. It has digitalized modular structure. Its sample rate is one record less than every two second. It has rather strong anti-interference capability and very good measurement accuracy.

- Temperature

Sensor: rod thermistor with 1mm diameter, high reflection coating
Features:

Temperature range	accuracy
40℃ ~–80℃	±0.3℃
50℃ ~ 40℃	±0.4℃
–80℃ ~–90℃	±0.4℃

- Humidity

Sensor: carbon hygristor
Features:

Humidity range	accuracy
15% ~ 95% RH	±5 % RH (above -25℃)
	±10% RH (below -25℃)

- Pressure

Sentor: silicon pressure sensor, coupled with temperature compensation
Features:

Pressure range	accuracy
Greater than 500hPa	±2 hPa (50℃ ~–40℃)
Less than 500hPa	±1 hPa (50℃ ~–40℃)

3. Comparison with the GZZ2 radiosonde

In June 2003, GTS1 radiosonde had been compared with GZZ2 radiosonde in Qingdao upper-air station before putting into operational observation. The following two figures show the results of the comparison flights. When the comparisons were being held, the GTS1 radiosondes were released at the same time with GZZ2, but under different balloons. This was to avoid the interference to the operational flights. The comparison was held at both 00Z and 12Z. Figure-1 shows the geopotential and temperature bias for all flights. It is shown that the temperature difference is less than 1°C in the troposphere (below height of 150 hPa) and not greater than 5°C in the stratosphere. The geopotential height bias increases with the height. The height bias can reach 50 meters at the level of 100 hPa. The thick red lines are the average biases for geopotential and temperature. Figure-2 shows the average geopotential and temperature biases for both 00Z and 12Z. From ground to 50-hPa levels, the average geopotential bias is about 10 meters and the temperature bias is about 0.4°C up to 30 hPa. This average curves show a good consistency between the new and old systems.

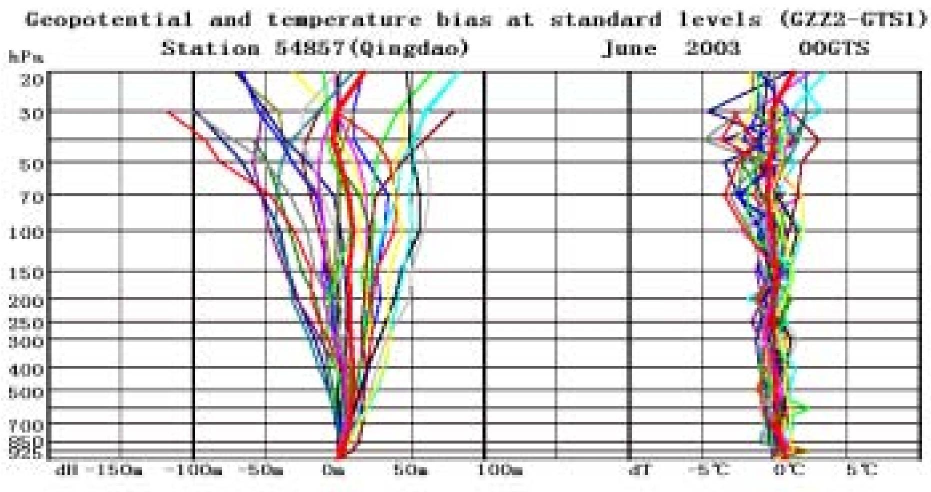

Figure 1

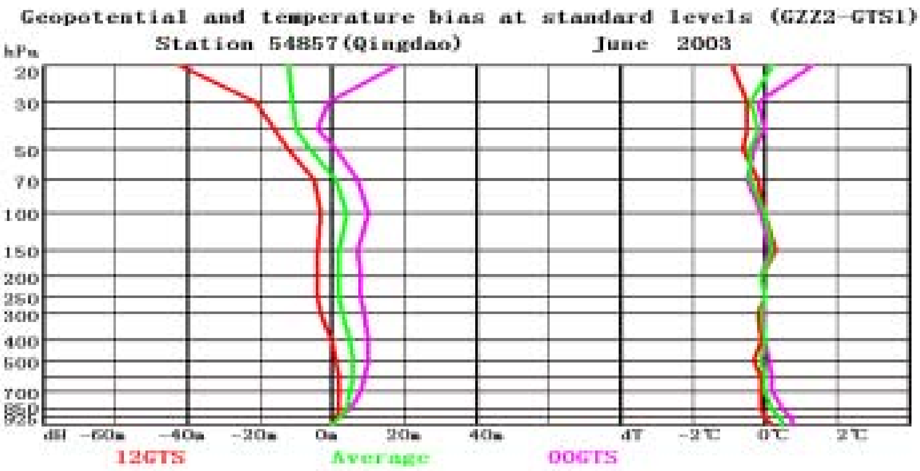

Figure 2

Figure-3 shows the average relative humidity biases for both 00Z and 12Z. The average temperature and relative humidity curves were also depicted in the left column for reference. Below the height of 400 hPa, the average humidity bias is within 10%. But at the height of about 200 hPa, the bias can reach 18%. Figure-4 shows the average wind direction and speed biases for both 00Z and 12Z. Below the height of 100 hPa, the wind direction bias is small, but at the height of 70 hPa, the wind direction bias reaches -6 degree. The wind speed bias shows similar tendency. The wind speed bias is small in the troposphere. But in the upper level, the wind speed bias increases with height; the maximum speed bias reaches 1 m/s.

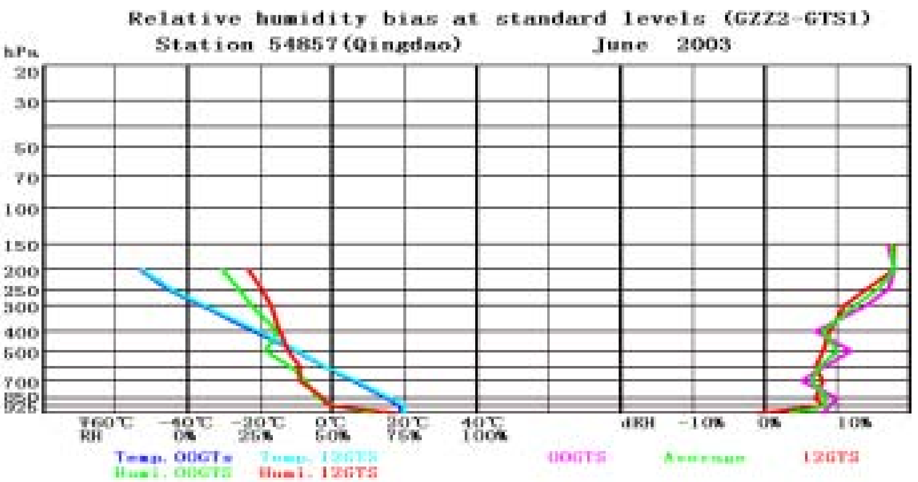

Figure 3

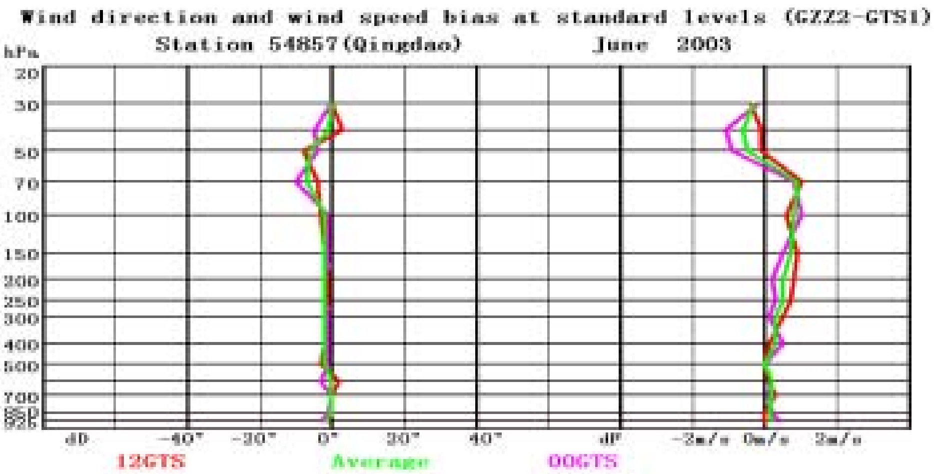

Figure 4

4. Comparison with Vaisala RS80

The comparison with Vaisala RS80 radiosonde was conducted in Beijing in July 2001. Total of nine flights were released. The comparison was made simultaneously. Both GTS1 and RS-80 radiosondes ascended under same balloon. All the flights were made in daytime. The average comparison results are depicted in the following two figures. Figure-5 shows the average differences of pressure, temperature and humidity between GTS1 and RS80. The average pressure bias is about –1 hPa in the low level, but in most of the up level, the bias remains -0.5 hPa.

The temperature bias is about 0.2°C in the troposphere, but at height of 50 hPa, the bias reaches 0.5°C. The humidity bias is within 10%. Figure-6 shows the average differences of geopotential height between GTS1 and RS80. The geopotential bias is very small below the height of 400hPa but increases with height. The maximum geopotential bias can reach 17 meters.

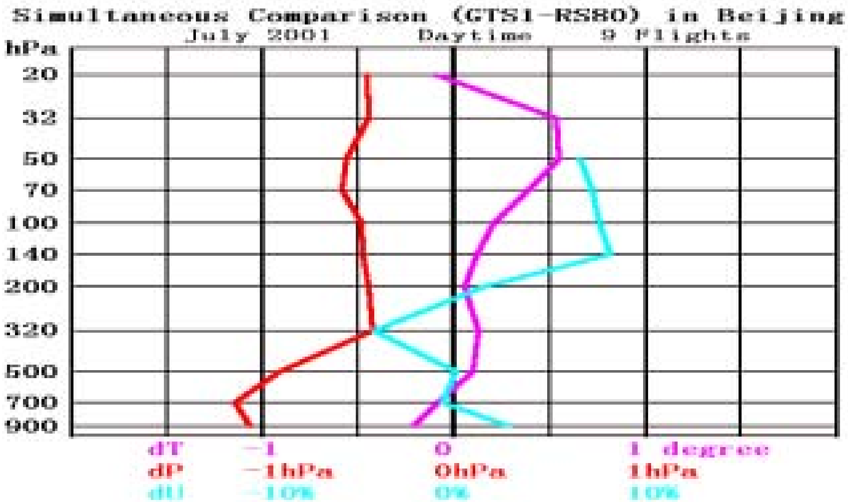

Figure 5

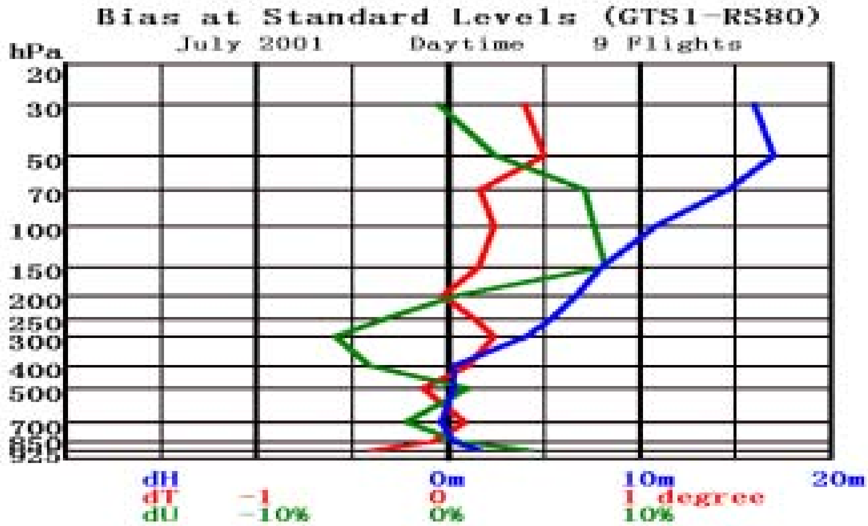

Figure 6

5. Quality control and consistency analysis

In 2000, China has begun monitoring upper-air observation with the reference to numeric weather forecast 6-hour output. The monitoring procedure is carried out daily. The OB-FG data has been provided through network. Data analysis is performed every month. With this quality control system, all the upper-air observation has been monitored. The following are the monitoring results for Qingdao upper-air station. Figure 7 shows all the OB-FG results of Qingdao in June 2003 for GZZ2 radiosonde. Figure 8 shows all the OB-FG results of Qingdao in June 2003 for GTS1 radiosonde. By comparing these two figures, it can be seen that the geopotential deviations of GZZ2 from FG disperse significantly with height. But the geopotential deviations of GTS1 behave rather uniform. The temperature deviations of two radiosondes show similar tendency but the GTS1 show a little clear structure. These results indicate that the GTS1 has big advantage over the GZZ2 and the geopotential height differences in figure-1 are mainly due to the GZZ2.

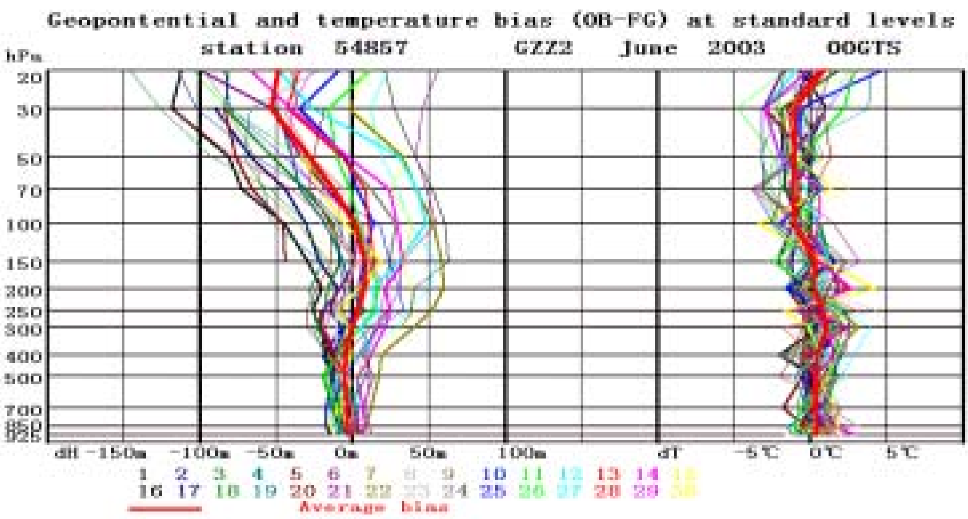

Figure 7

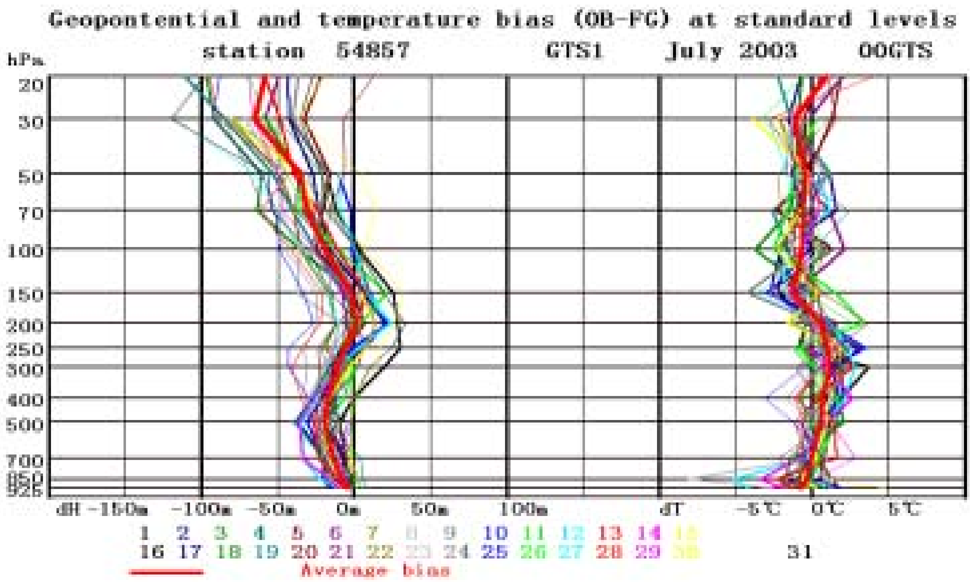

Figure 8

6. Conclusion

- On average, there is no significant systematic bias between the GZZ2 and GTS1. This is mainly because the observation of GZZ2 has been undergone error correction. Therefore, the application of GTS1 will not produce significant bias in climatic data.

- The preliminary statistics of OB-FG indicate that the GTS1 provide stable and reliable data for upper-air observation. It has obvious advantages over the GZZ2. The application of GTS1 will be beneficial to numerical weather forecast.