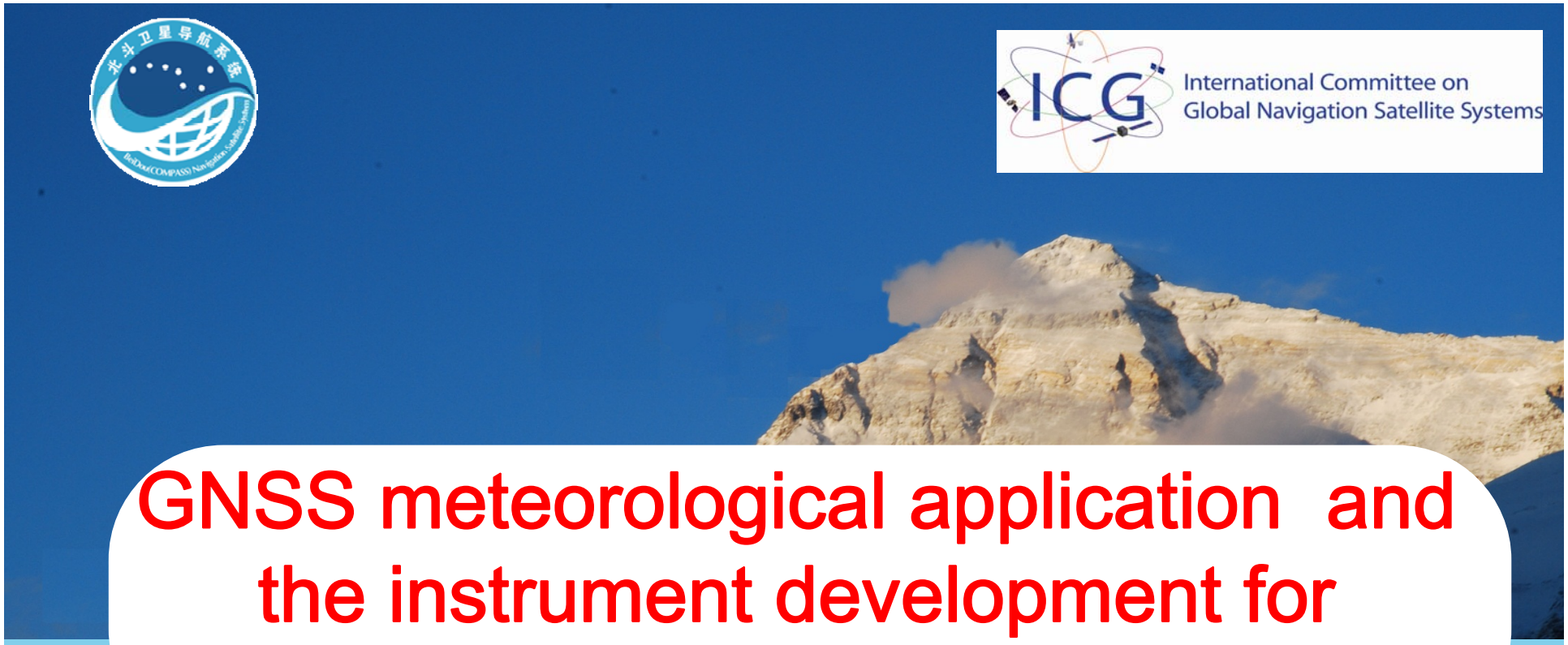

International Committee on Global Navigation Satellite Systems

GNSS meteorological application and the instrument development for BeiDou

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气象探测中心

Abstract

- Introduction to the GNSS/MET for BeiDou
- The development of the BeiDou radio-sonde system
- The development of the GNOS for BeiDou occultation on FY-3

Introduction to the GNSS/MET for BeiDou

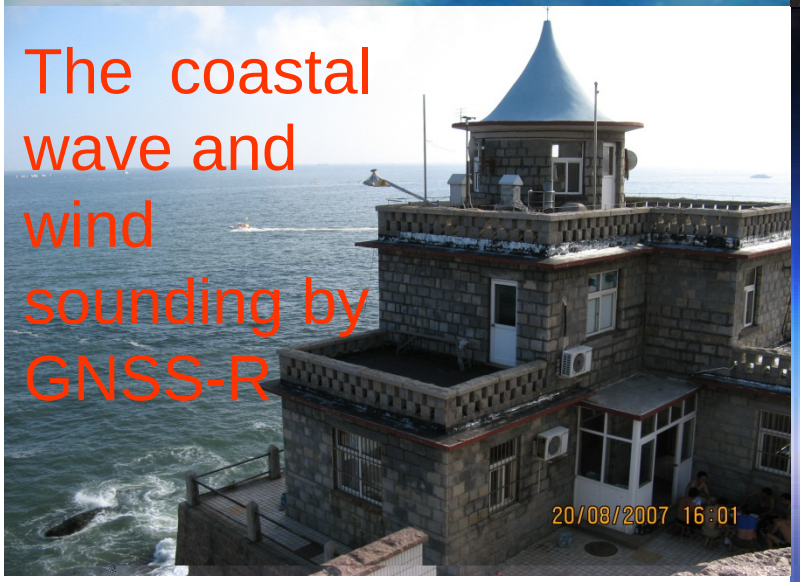
In 2011, China meteorological administration implemented an application – the demonstration project of the atmosphere and marine sounding based the BeiDou navigation system and its meteorological application.

It aims to enhance the 3D observation for the local severe weather over the focused area, to increase the ability of data gathering for the weather forecast, and to better the service of the weather warning over the remote and undeveloped region.

Introduction to the GNSS/MET for BeiDou

The BeiDou radio-sonde system

The Beiou continuous operational reference system

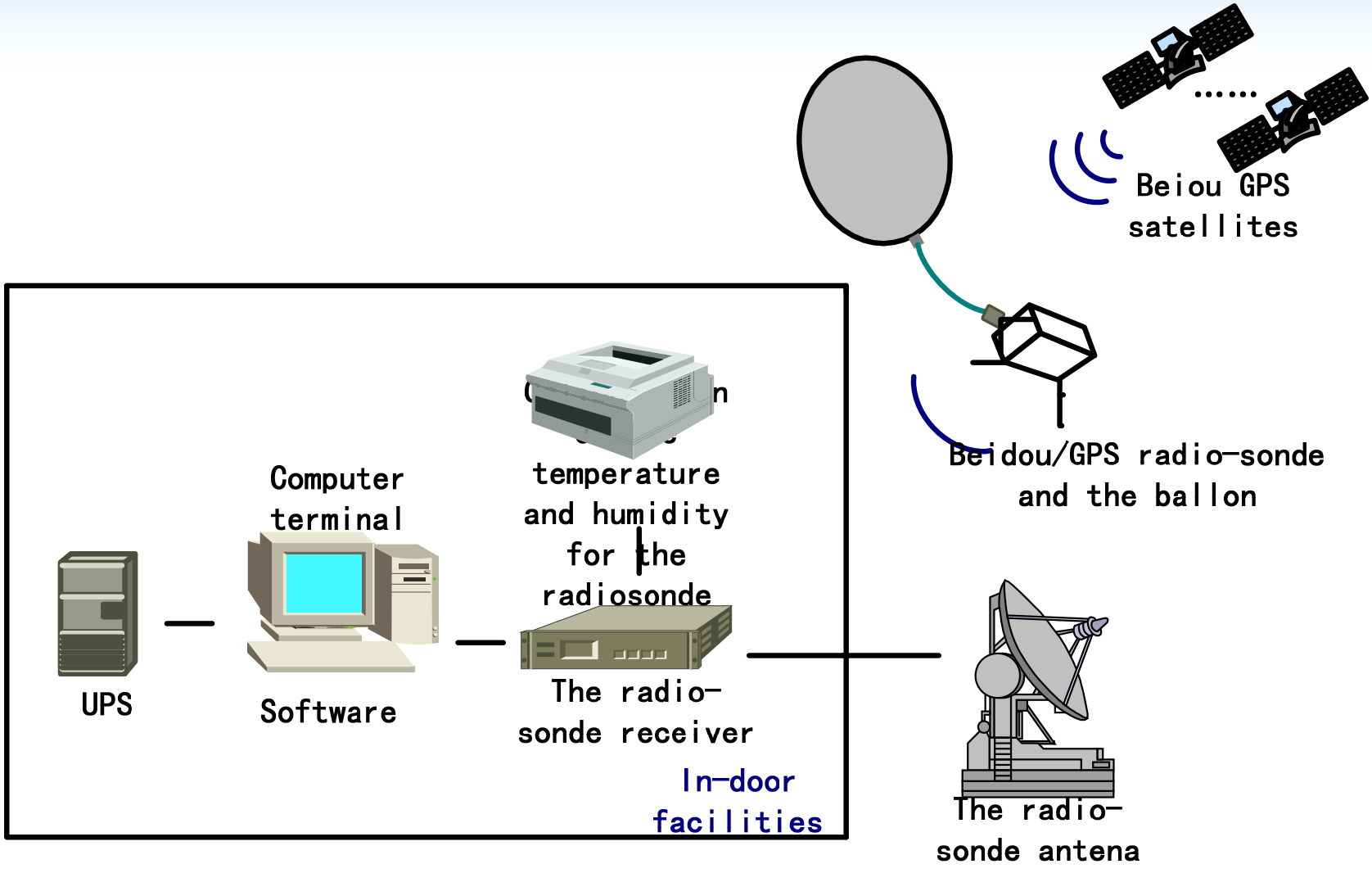


The coastal wave and wind sounding by GNSS-R

The severe weather warning with BeiDou DCP

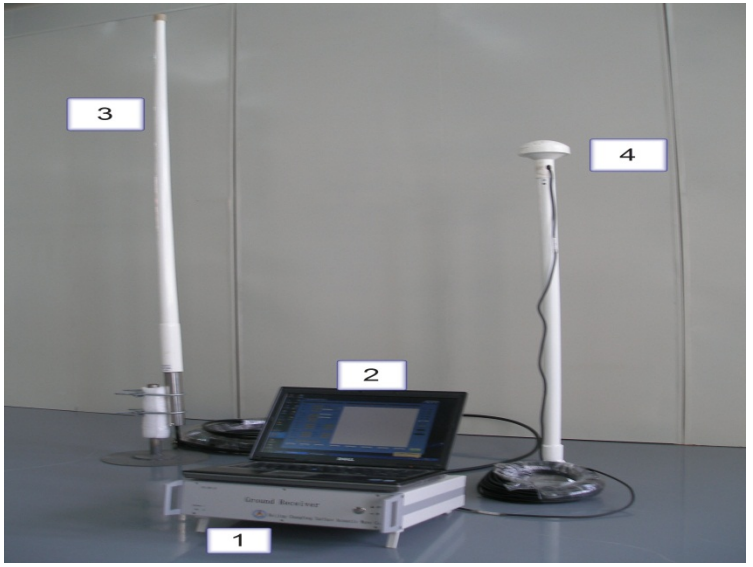
The development of the BeiDou radio-sonde system

❖ Construction of the BeiDou radio-sonde system



The development of the BeiDou radio-sonde system

- The radio-sonde
- The surface receiving system
  - 1、The receiver
  - 2、The computer and processing software
  - 3、The radio-sonde antenna
  - 4、The reference differential receiver and antenna



The development of the BeiDou radio-sonde system

- The BeiDou wind sounding module is the CC50 BeiDou/GPS receiver by Beijing oriental navstar science Co. Ltd.
- The BeiDou antenna is a ceramic active microstrip antenna.

The development of the BeiDou radio-sonde system

- The system experiments was conducted in 2010 and 2011.
- In 2010, the BeiDou radio-sonde was compared with the international GPS radio-sonde.
- In 2011, the BeiDou radio-sonde was used for the evaluation of the operation test for BeiDou.

The development of the BeiDou radio-sonde system

Exp 1—static test

- The static performance of positioning and velocity measurement

Model	CEP50 (m)	horizontal STD (m)	Elevational STD (m)	Velocity STD(m/s)	Average PDOP
GPS	2.10	2.67	5.49	0.02	1.8
BeiDou	4.91	6.06	13.12	0.02	2.6
GPS+ BeiDou	2.18	2.8	6.33	0.02	1.2

Test time：2012-09-12、2012-09-18、2012-09-20

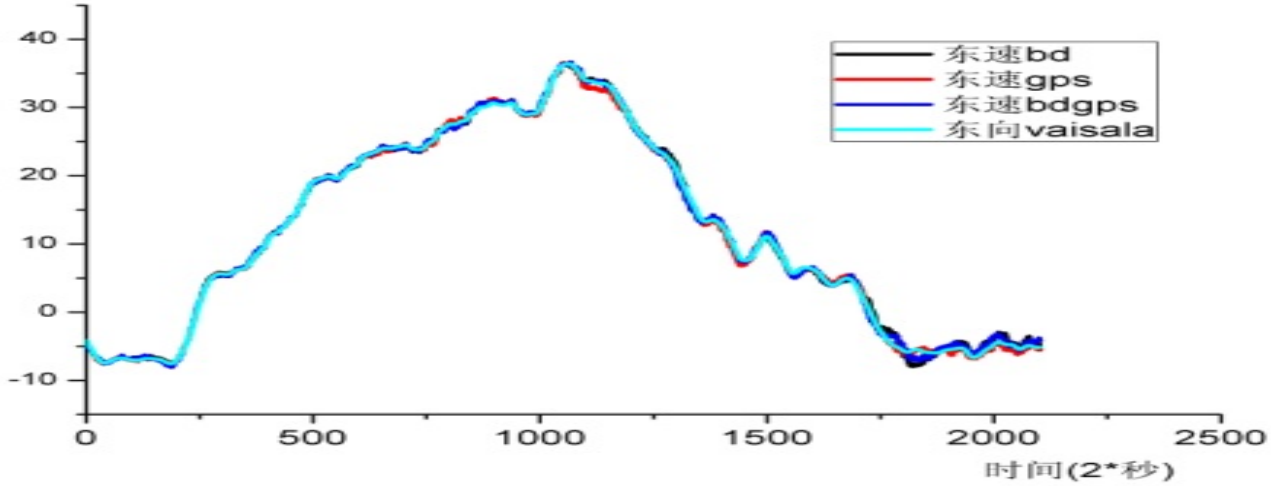
The development of the BeiDou radio-sonde system

Exp 2—Field experiment

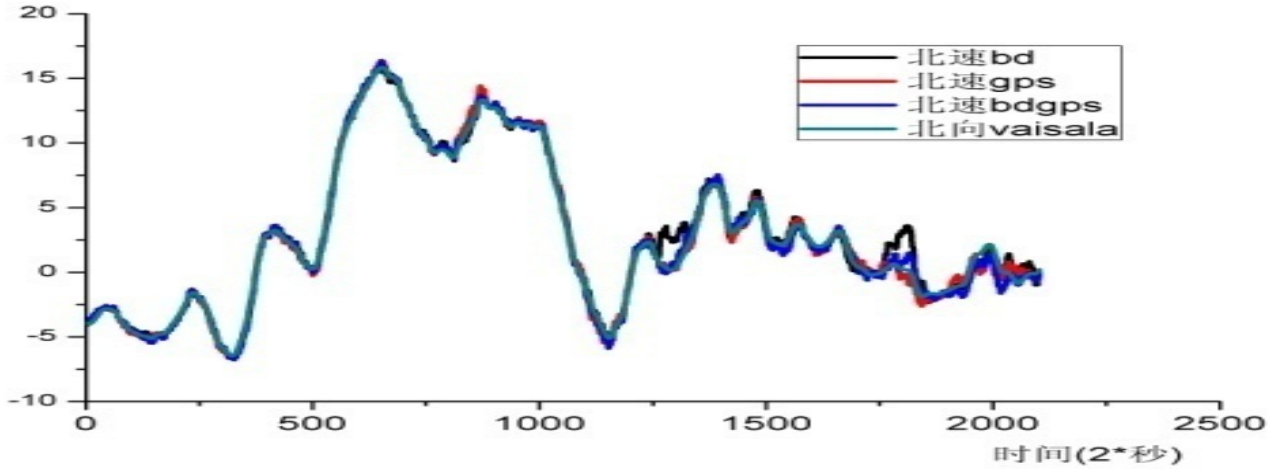
- Compare the performance of positioning and velocity measurement with the BeiDou radio-sonde and the reference GPS radio-sonde tied to the same balloon.
- the BeiDou radio-sonde uses 3 models for positioning and velocity measurement:
  - BeiDou Satellites only
  - GPS satellites only
  - GPS and BeiDou Satellites
- The reference GPS radio-sonde is Vaisala GPS R92 。

The development of the BeiDou radio-sonde system

East wind



North wind



The development of the BeiDou radio-sonde system

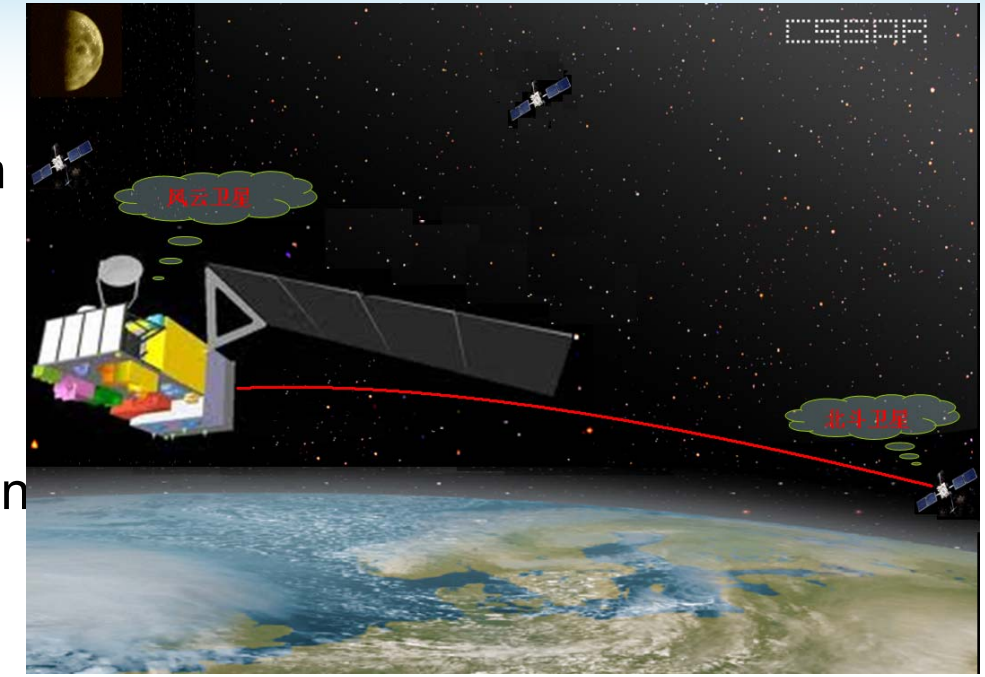
Statistical result

Precision	Wind Speed (m/s)	Wind Direction (degree)
BeiDou only	0.60	4.8
GPS only	0.54	4.0
Bending with GPS and BeiDou	0.50	4.0

The precision demand of current wind sounding is 1 m/s in speed and 5 degrees in direction. It suggest that the module can meet the operational demand of upper air wind sounding with 3 models to measure the wind.

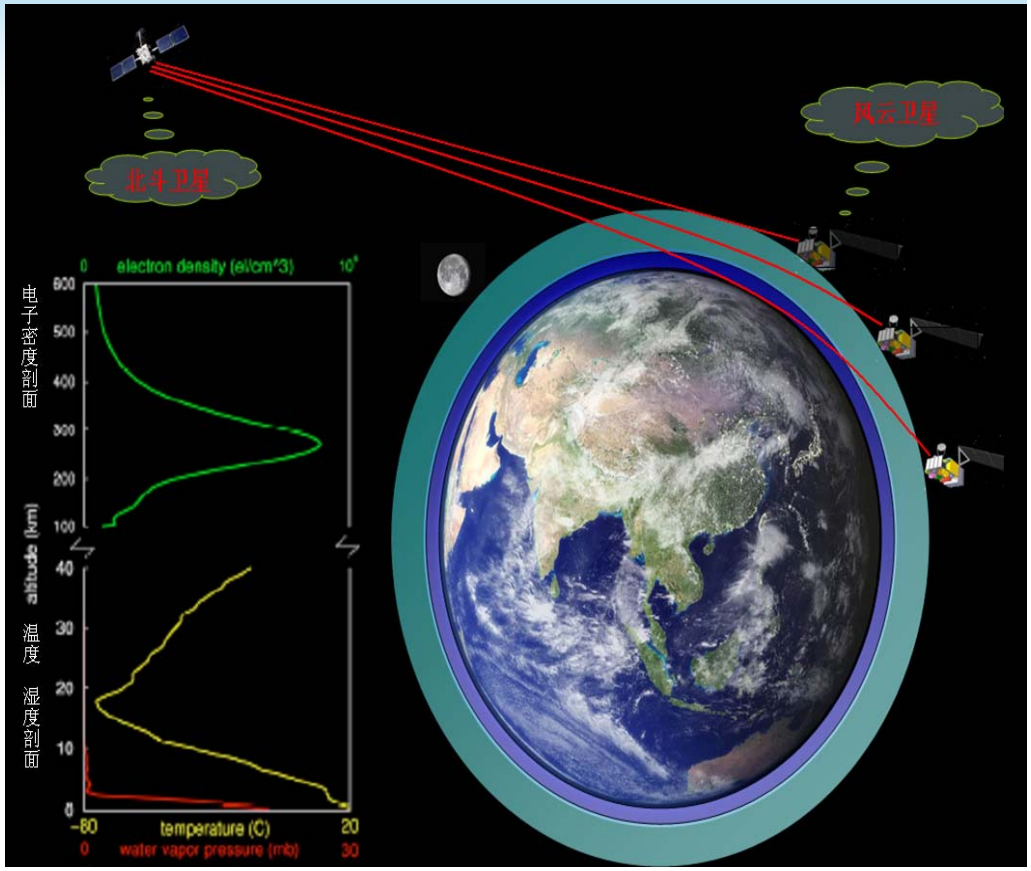
The development of the GNOS for BeiDou occultation

- The high precision GNSS receiver is needed for the application of the remote sensing of IPW and TEC. Lauched on the satellite, such receiver even adapted to the circumstance of very high speed.
- The GNOS(GNSS Occultation Sounder) will be first launched on China FY-3 /02 (lauched in 2013).
- The Occultation application demands high technique of receiver manufacturing and processing of high precision of positioning and remote sensing.



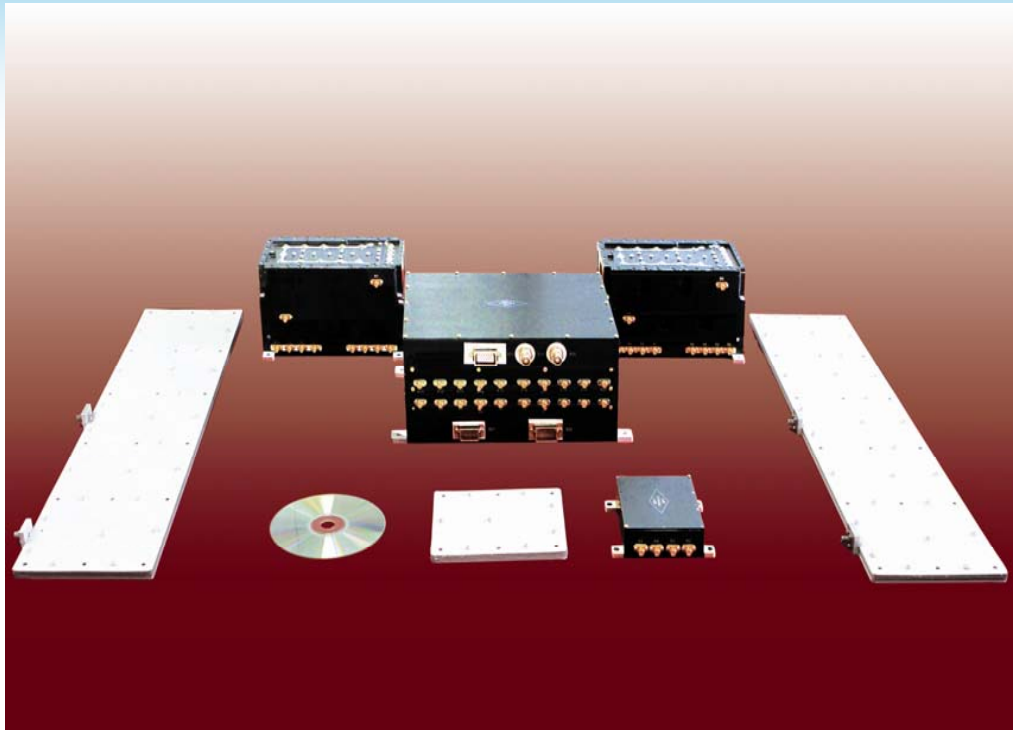
The development of the GNOS for BeiDou occultation

The GNOS receives the earth limb occultaion BD/GPS signal, refracted passing through the atmosphere, retrieving the atmospheric profile of temperature, humidity, and ionospheric profile of TEC, by very high measurement of the path bending and the phase amplitude change.



The development of the GNOS for BeiDou occultation

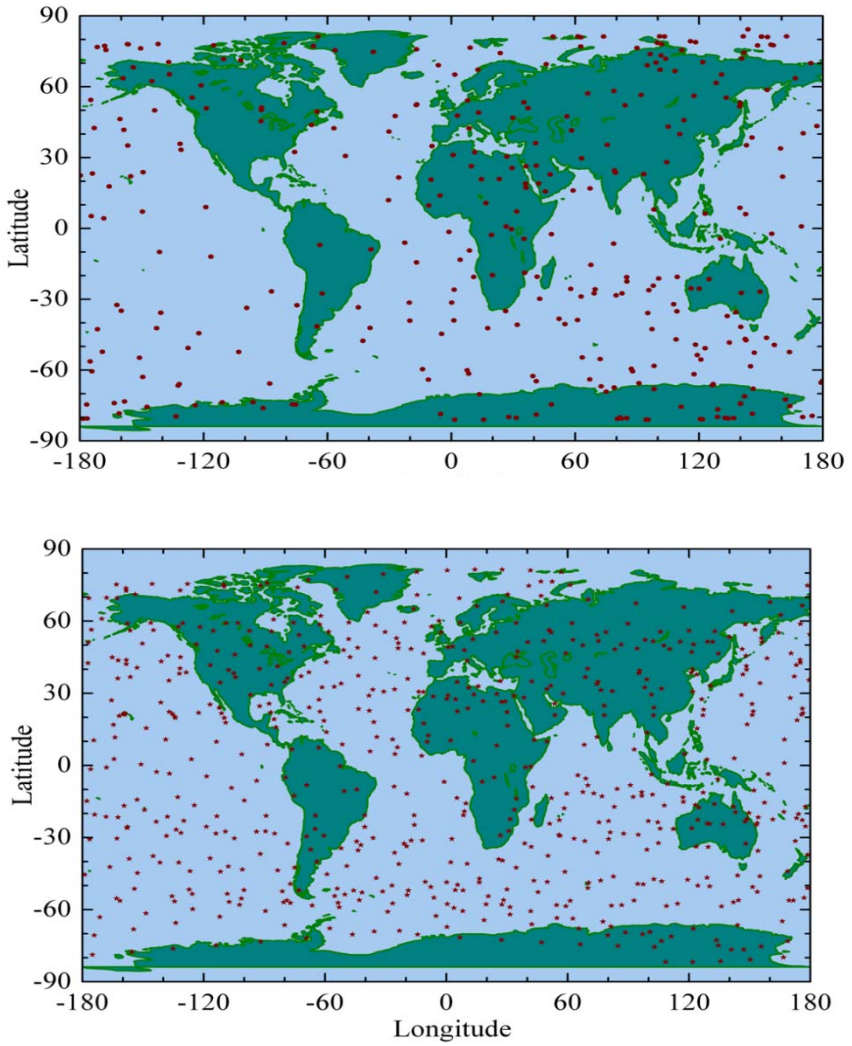
- GNOS receiving both the GPS and the BeiDou signal with 8 positioning charnels and 8 occultation charnels.
- It is consisted of 3 RTF units, a DSP unit and 3 antenna for the forward /backward occultation and the zenith postioning.
- It adopts the open loop tracking technique in the occultation receiving.



GNOS manufactured by
The space technique and application research center of CSA

The development of the GNOS for BeiDou occultation

- With GPS ，about 500 occultation events can be detected.
- With BeiDou orbit of 5GEO/3IGSO/4MEO and 4GEO/3IGSO/2MEO, 320 and 640 events can be detected respecively. (Simulated right)

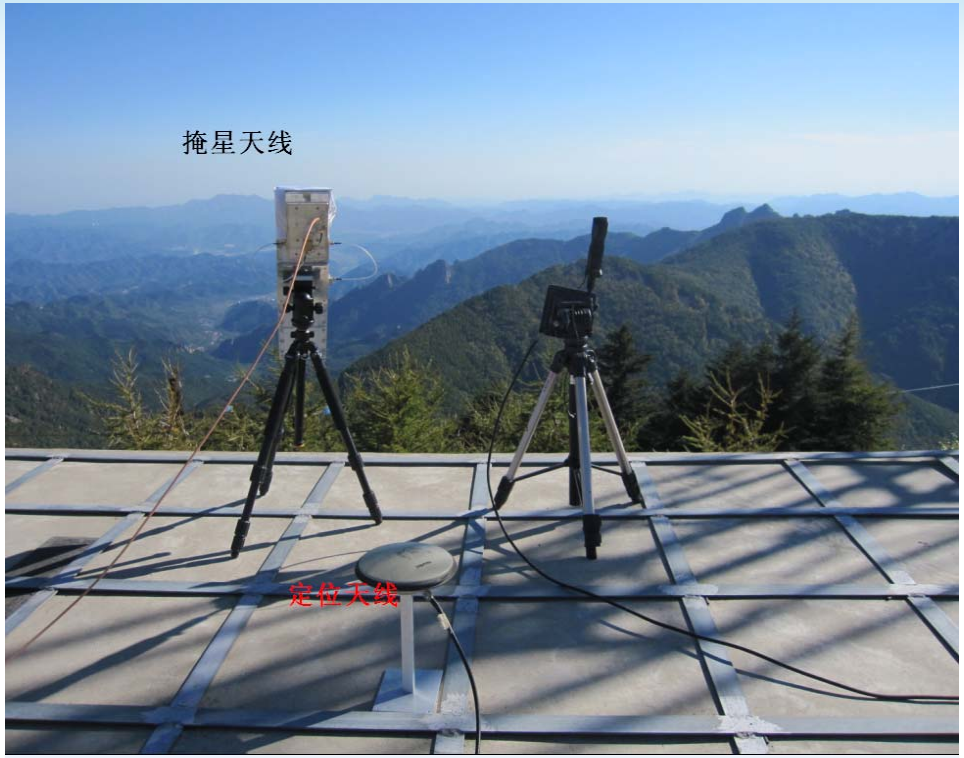


The development of the GNOS for BeiDou occultation

In 2012，CMA and CSSA jointly conducted the first surface test—the mountain based BeiDou occultation experiment.

The test began on 2012-9-18 and ended on 2012-9-28.

The GNOS was set up on the mountain top of the Mount Wuling（117.478°E，44.598°N，2083.28m）with its antenna facing the southeast and covering azimuth of 180 and elevation angle of -35 to +35.



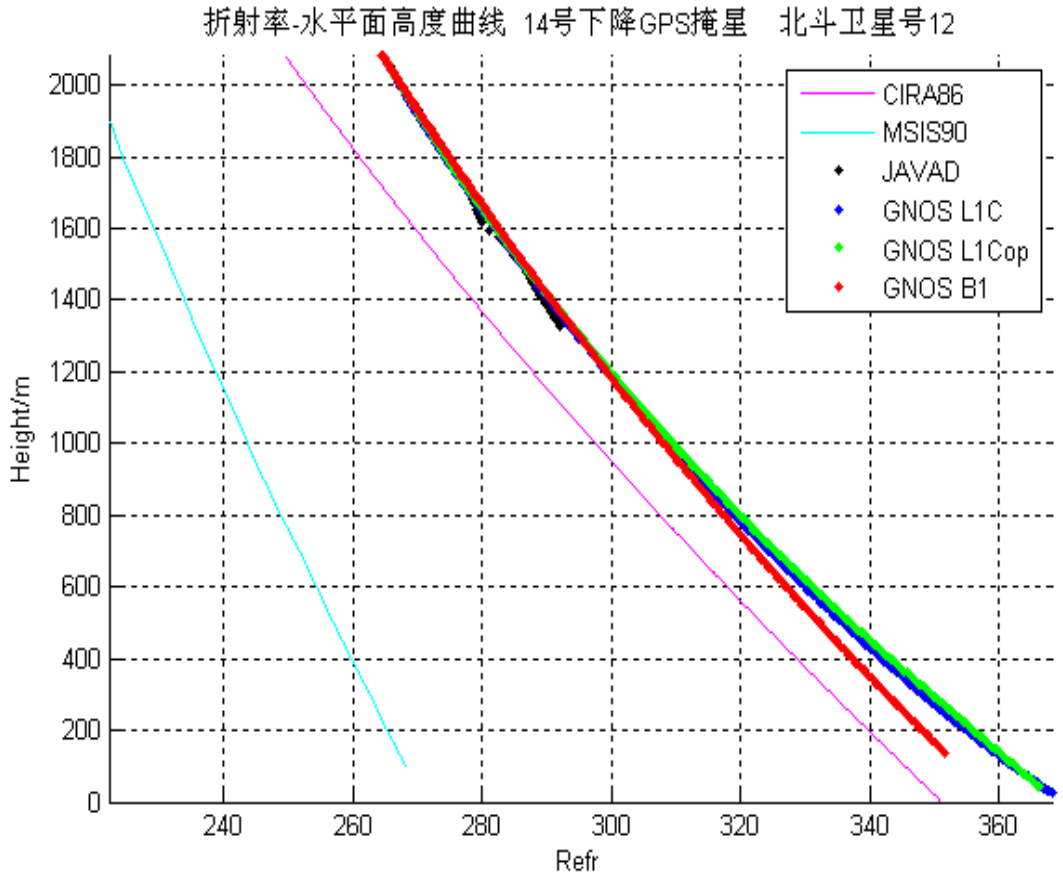
Surface test—the mountain based BeiDou occultation experiment

The development of the GNOS for BeiDou occultation

Total 55 BeiDou occultation events were received, with 14 of MEO11 and 12，and 41 of IGSO.

The development of the GNOS for BeiDou occultation

Comparison of the retrieval from BeiDou (PRN 12) and GPS (PRN14) at 6:00 in 2012-9-23. The result shows less than 3% of reflectivity exist between the GPS and the BeiDou.



PS: black for JAVAD/L1C retrieval

Blue for GNOS with close loop retrieval

Green for GNOSwith L1C open loop retrieval

Red for GNOS BeiDou retrieval

Purple for CIRA86 computation

Light blue for MSIS90 computation

Summary

- The successful development of the BeiDou radio-sonde system is a trademark for the demonstration and construction of china’s next upper air sounding system.
- The GNOS occultation application will enhance the technique of high precision receiver manufacturing and positioning and remote sensing, and deepen and widen the BeiDou scientific application.


谢谢！