



The Status of BDS/GPS-Based Meteorological Applications in China

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August, 2018

Outline

I

Operational Applications of BDS/GPS in Meteorology

II

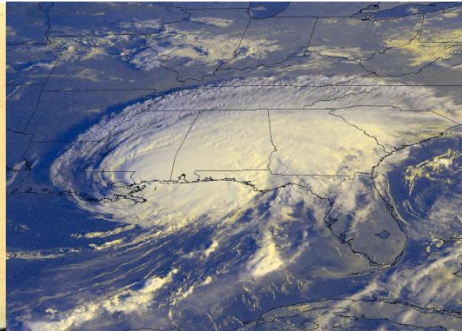
BDS/GPS Experimental Observation Research

III

Outreach Programs

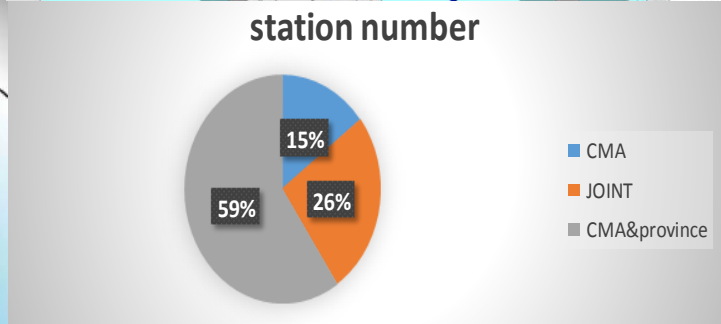
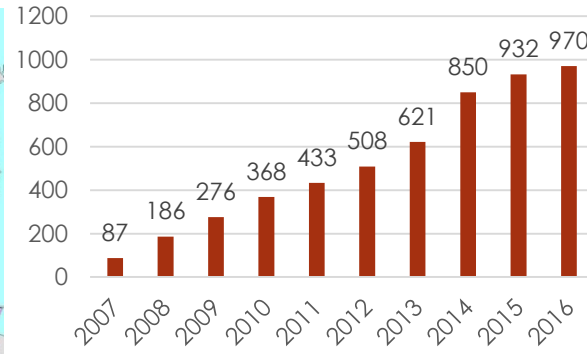
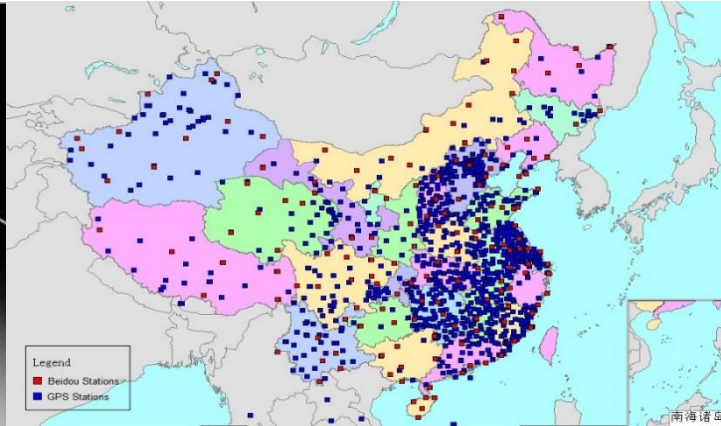
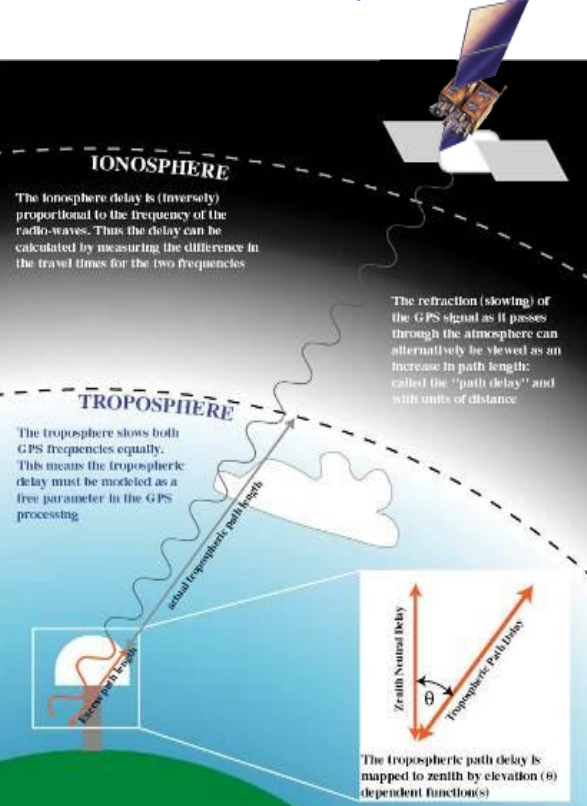
Main Objectives

- Improve the current meteorological observation system with BDS/GPS technique.
- Exploit BDS/GPS signals in remote sensing of water vapor, temperature and ionospheric electron concentration, physical parameters of the land and sea surface.
- Update the current operational system with BDS/GPS modules and technique.



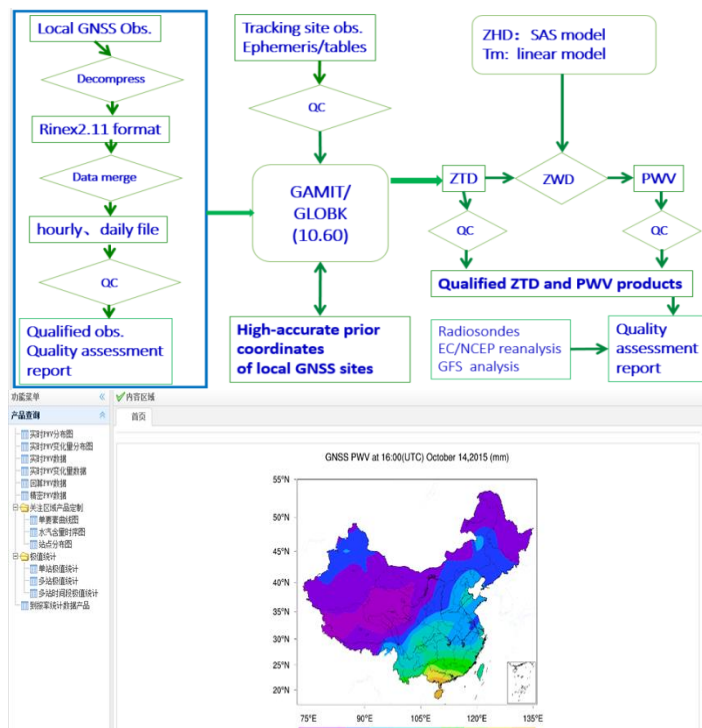
BDS/GPS Continuous Operational Stations

- Ground-based BDS/GPS CORS stations can provide reliable and accurate refractivity and moisture observations at low cost under all weather.
- The ground-based BDS/GPS/MET network in China consists of 1050 stations. The stations have increased by 12 times since 2007.
 - 15% were constructed and operated by CMA
 - 26% by agencies of CSA, CSGIA and DOL.
 - 59% by local provinces.



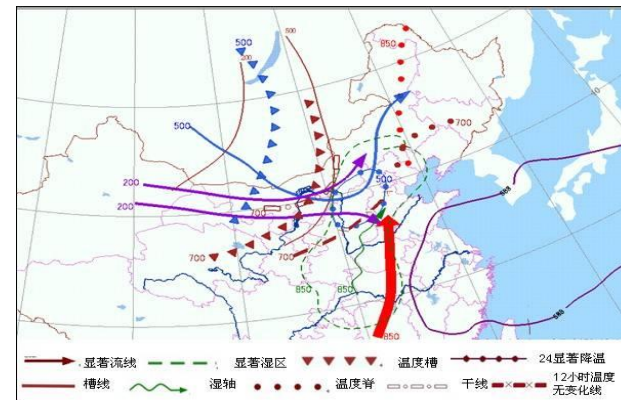
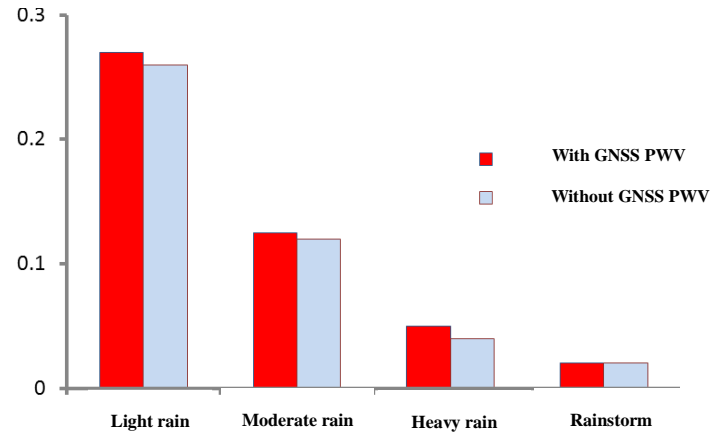
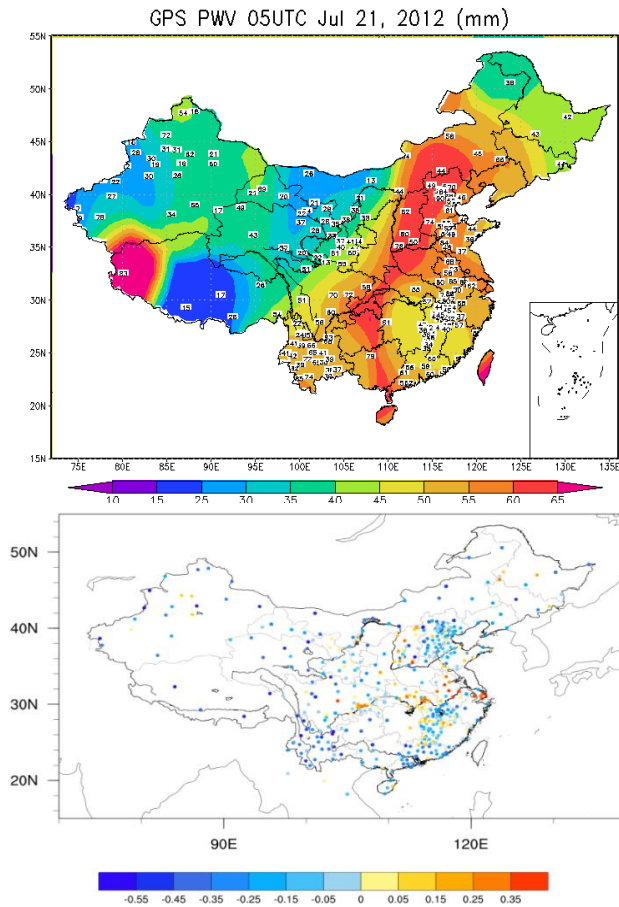
Data Processing

The Meteorological Observation Center in the China Meteorological Observation is responsible for the PWV retrieval. Raw data, collected at BDS/GPS stations, are transmitted to the data center near real time, and processed to water vapor product hourly, then the PWV observation are broadcasted to meteorological users.



Meteorological Applications of PWV

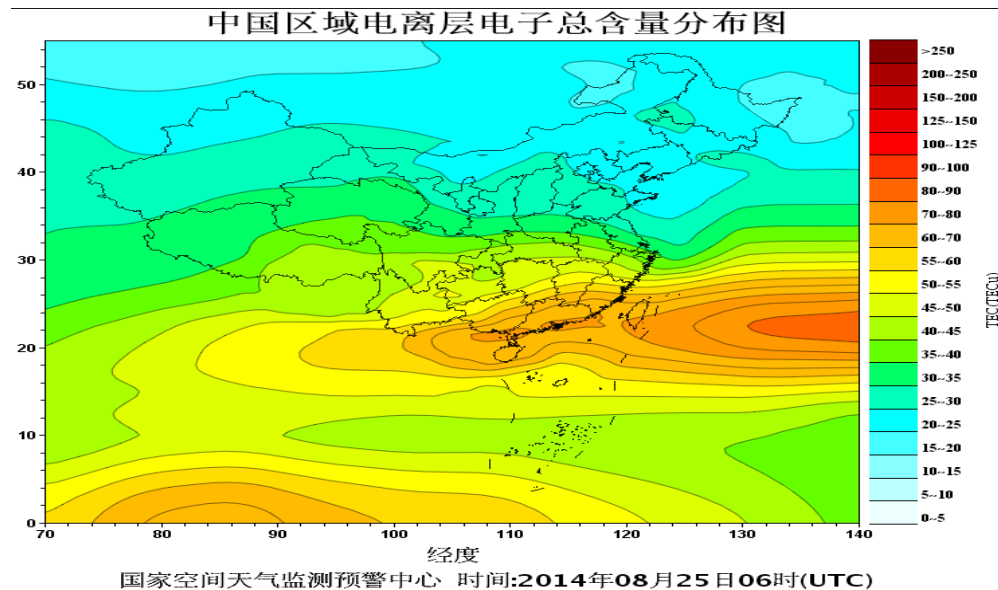
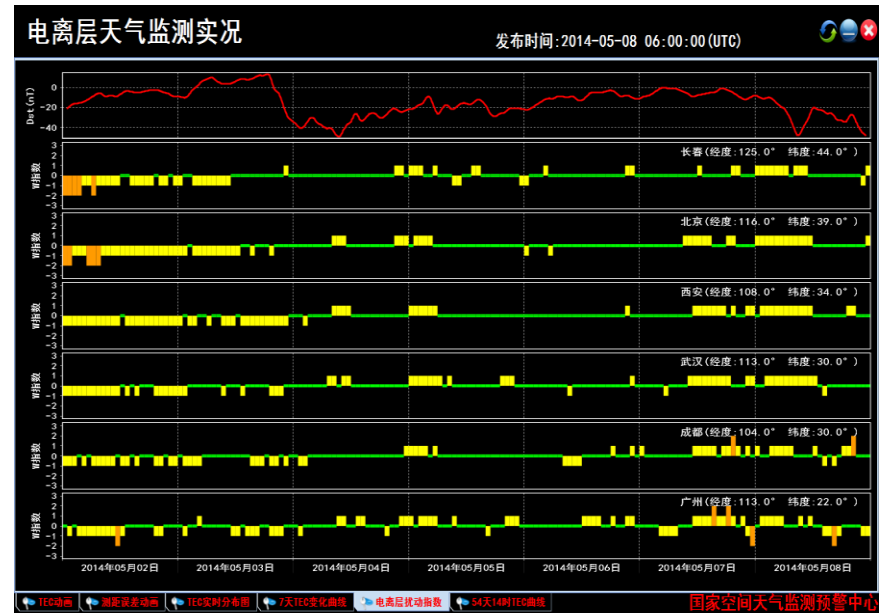
- Early warning of the severe weather
- Accurate Rainfall Forecast for the NWP model



After assimilating PWV data into regional model GRAPES, the skill of the precipitation forecast for 24-hour has improved significantly.

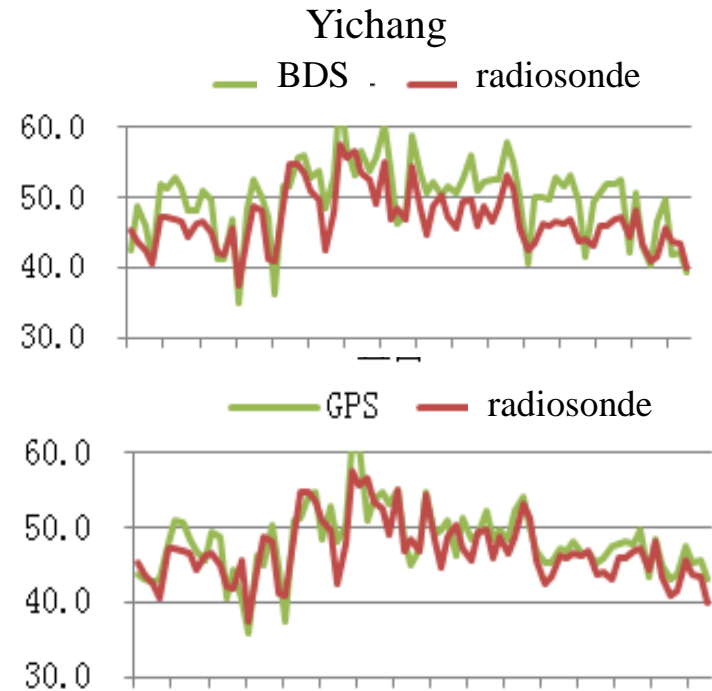
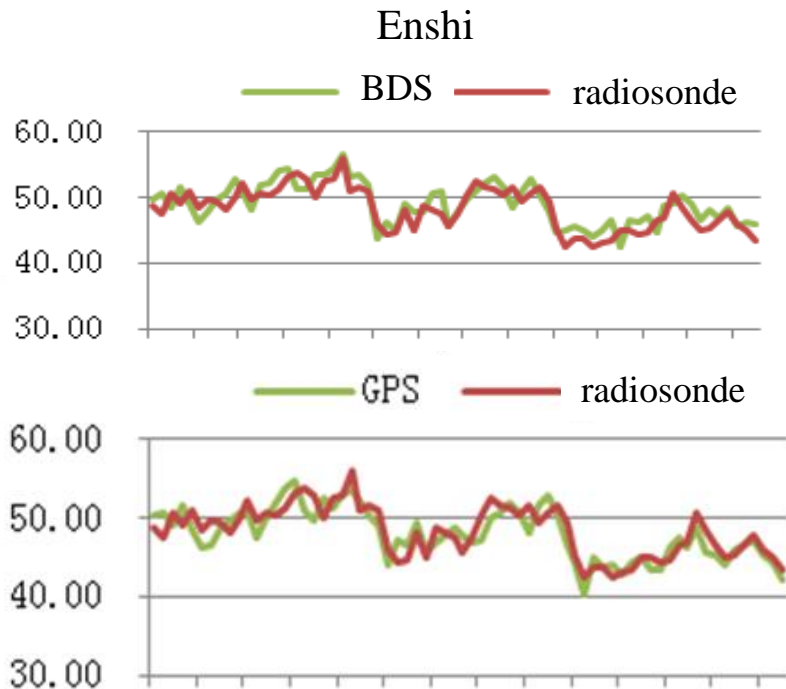
Operational TEC observation

- The national space weather center use the data to retrieve TEC over China in near real time.
- The product is provided to the users in the space weather and the telecommunication.



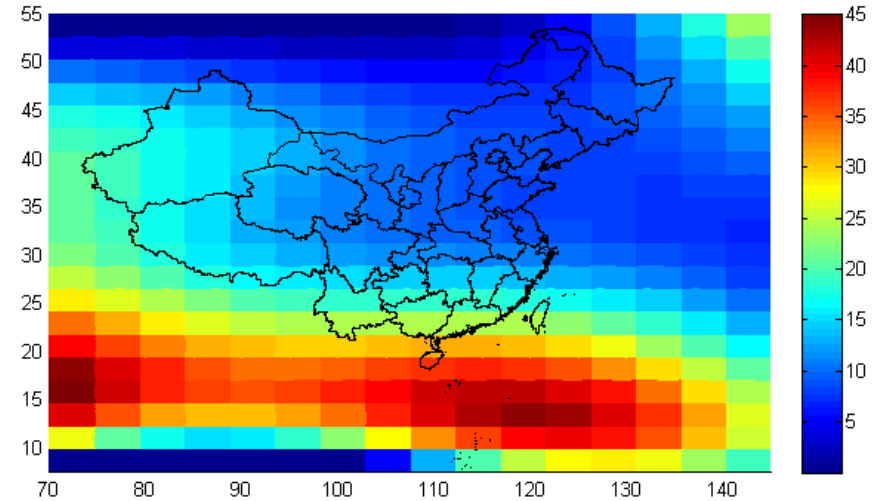
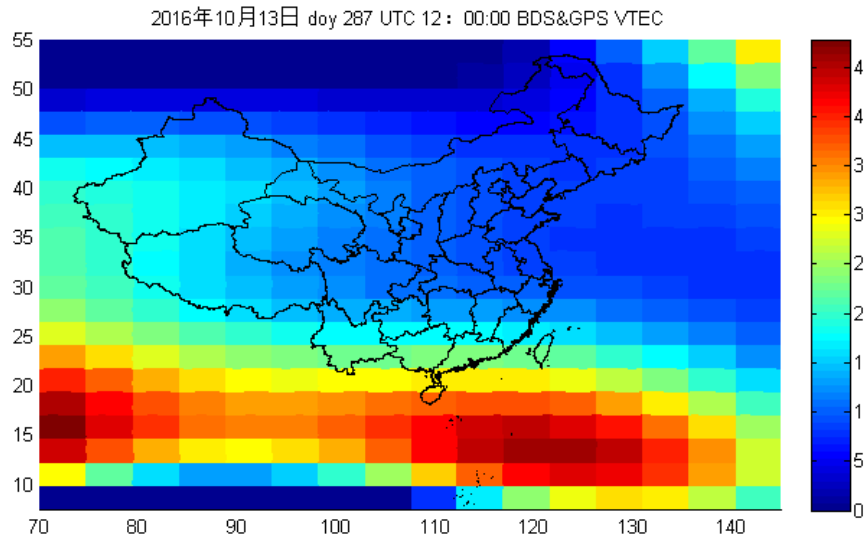
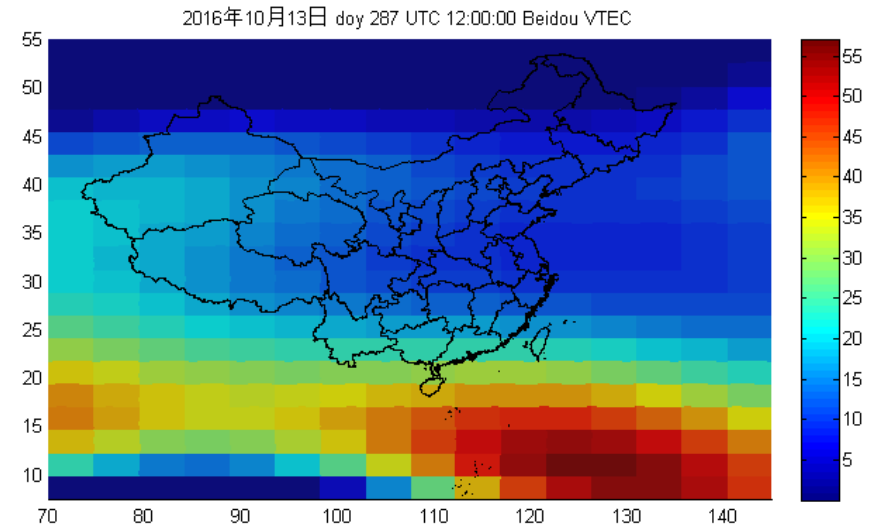
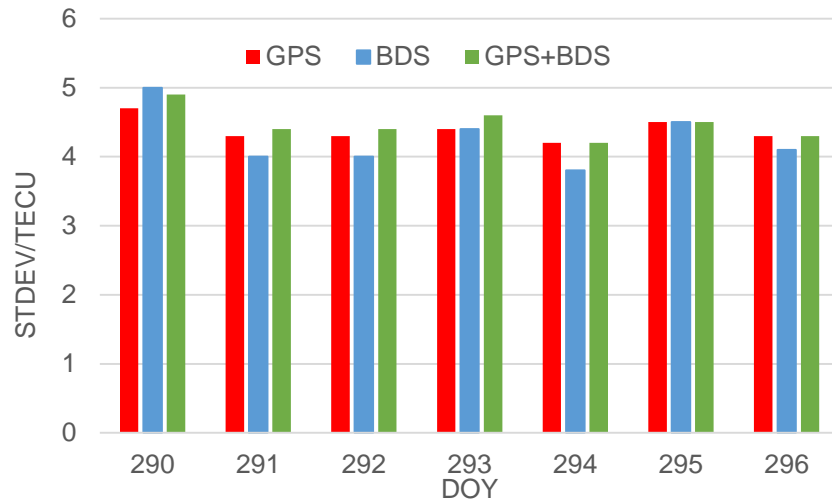
Evaluation of PWV with BDS

The precipitable water vapor(PWV) observations are compared among BDS, GPS and the radiosonde. The PWV accuracies of BDS ,GPS and the radiosonde are comparable.



Evaluation of TEC retrieval accuracy

TEC products are generated for both BDS and GPS. These products have been compared with data produced by CODE. It shows that the TEC with BDS gains a good performance with the accuracy of less than 10 TECU (RMSE).



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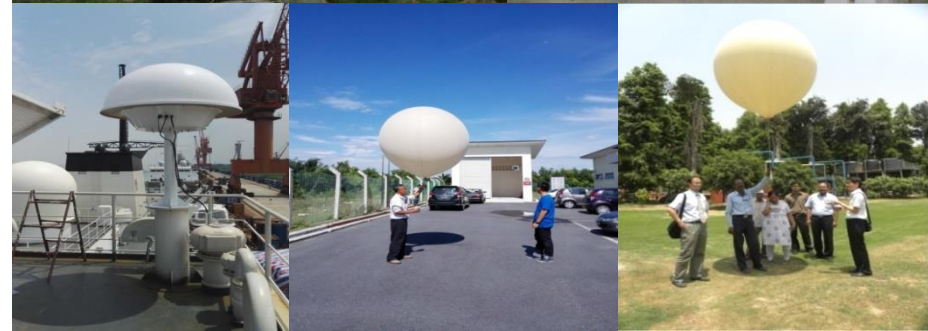
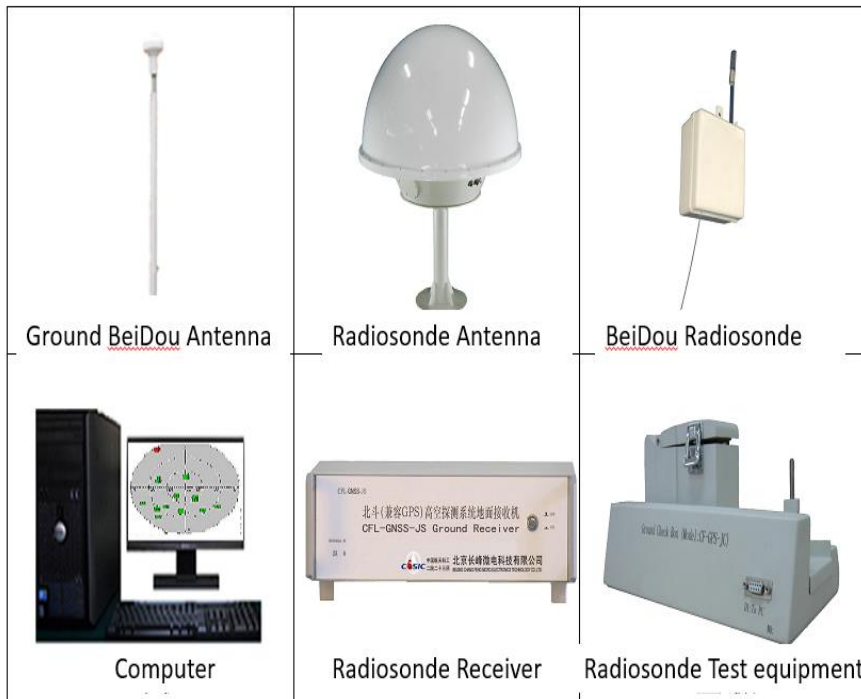
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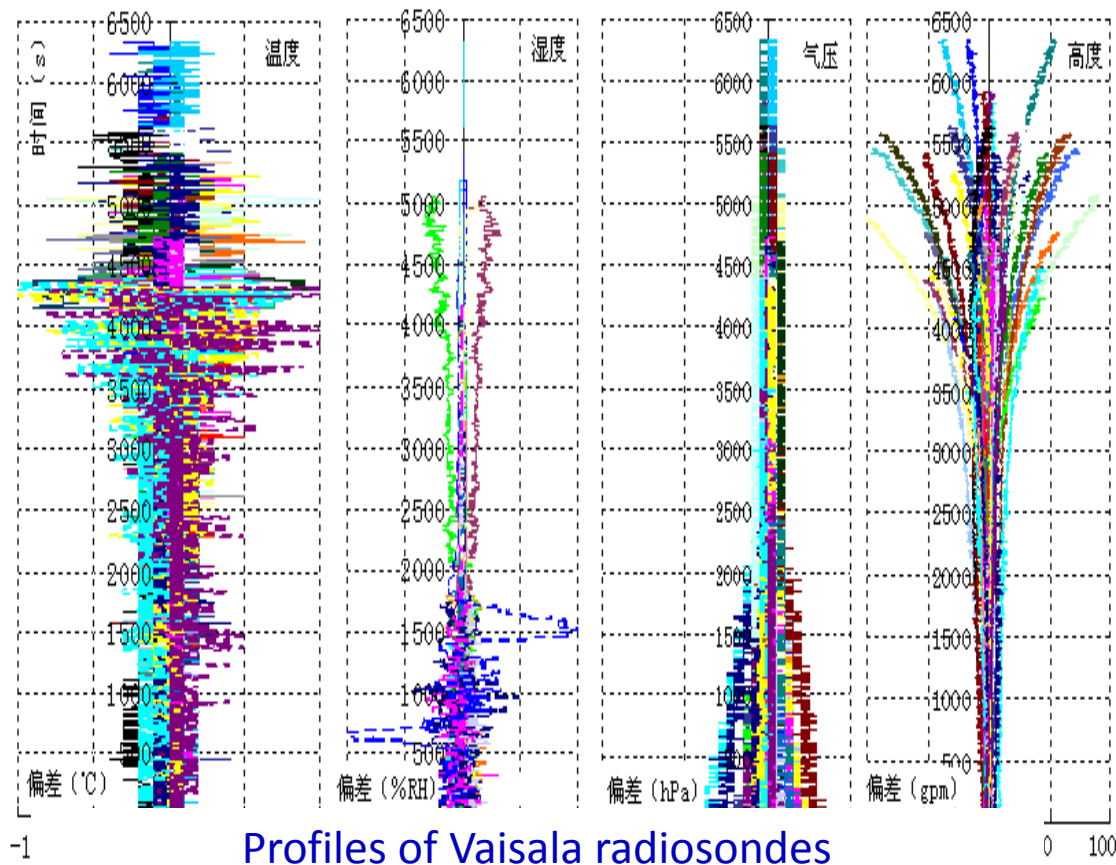
The BDS/GPS Radiosonde System

- CMA launched the development of the BDS radiosonde system under the support of the project, “Demonstration of early warning application of BDS in atmosphere, ocean and space monitoring”.
- The BDS radiosondes have been released at the stations of Beijing, Wuhan, Haikou, Yangjiang, Xilinhaote. The BDS radiosondes manufactured by Beijing Changfeng corporation have been purchased by the meteorological services of South Korea, India and Malaysia. This system is very easy to use and is warmly welcomed by observers.



The BDS/GPS Radiosonde System

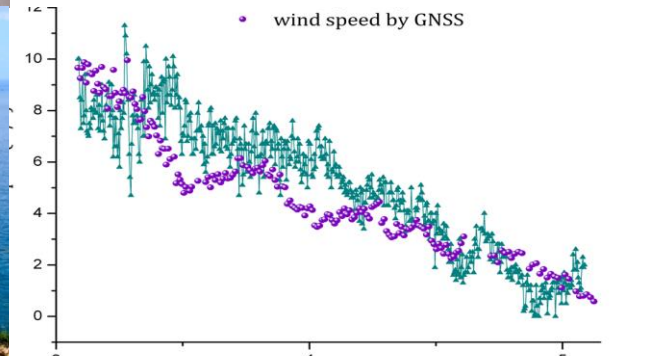
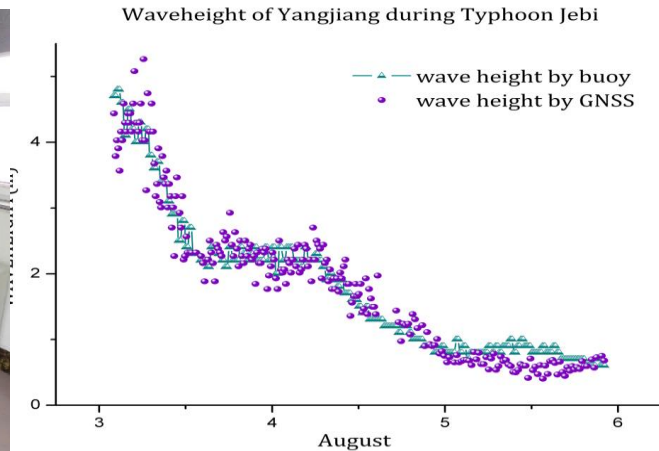
Test shows that the sounding capability of BDS radiosonde is much better than that of current operational L-band radar electronic radiosonde system and reaches the advanced class in the world.



Profiles of the BDS/GPS Radiosondes on August 15, 2016 in Beijing

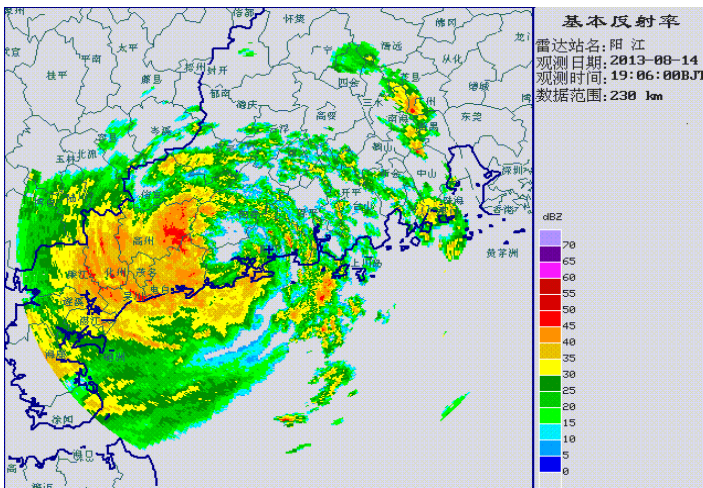
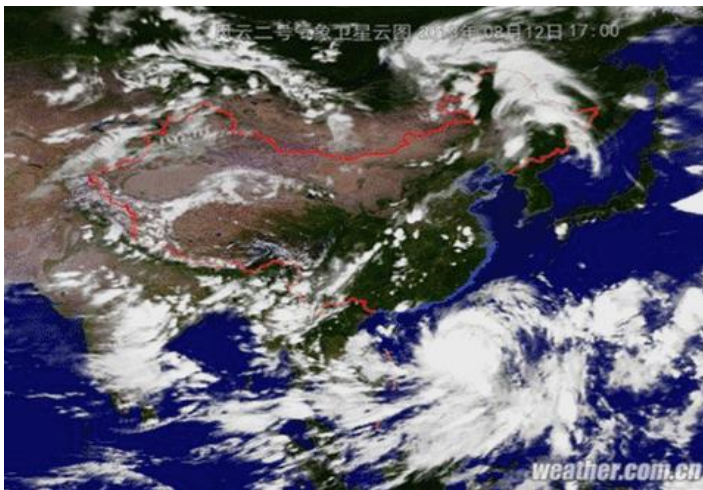
The Sea Wind and Wave Detection with BDS/GPS

CMA also launched the development of the BDS sea surface wind and wave observing system. The operational test has been conducted at Weihai, Shangdong province, and Yangjiang, Guangdong province. The characteristic of BeiDou GEO satellites has advantages in long-term and stable observations of the specific region because of its geostationary constellation configuration.

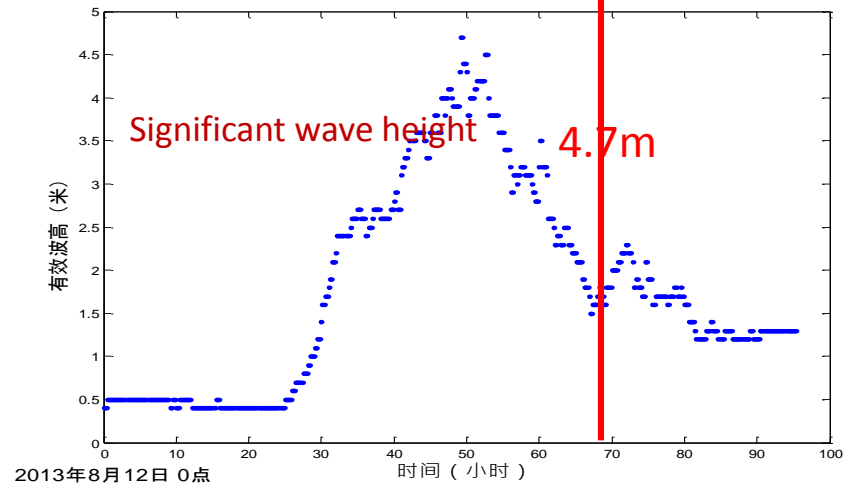
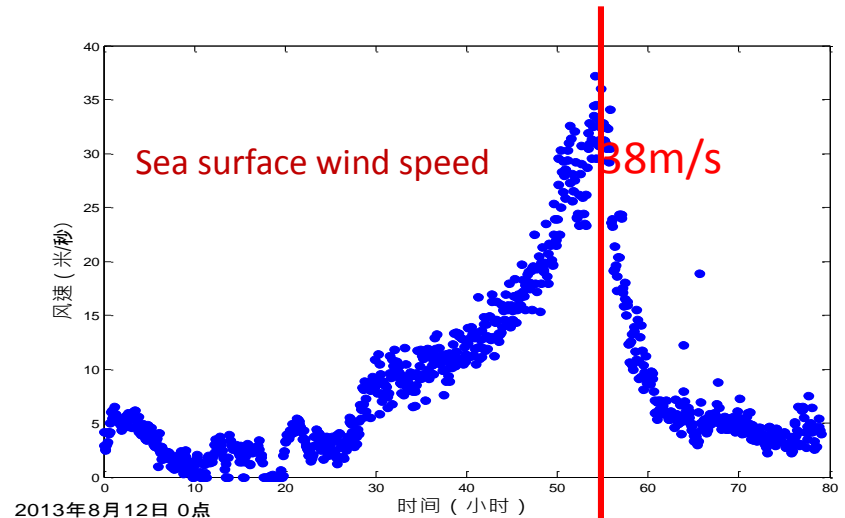


The Sea Wind and Wave Detection with BDS/GPS

In 2013, the sea surface wind and wave observing system using BDS was set up at Yangjiang, Guangdong province. The wave height and sea surface wind were observed when the typhoon passed. With the data, we can forecast the track and the intensity of the typhoon.



Yangjiang, Guangdong province



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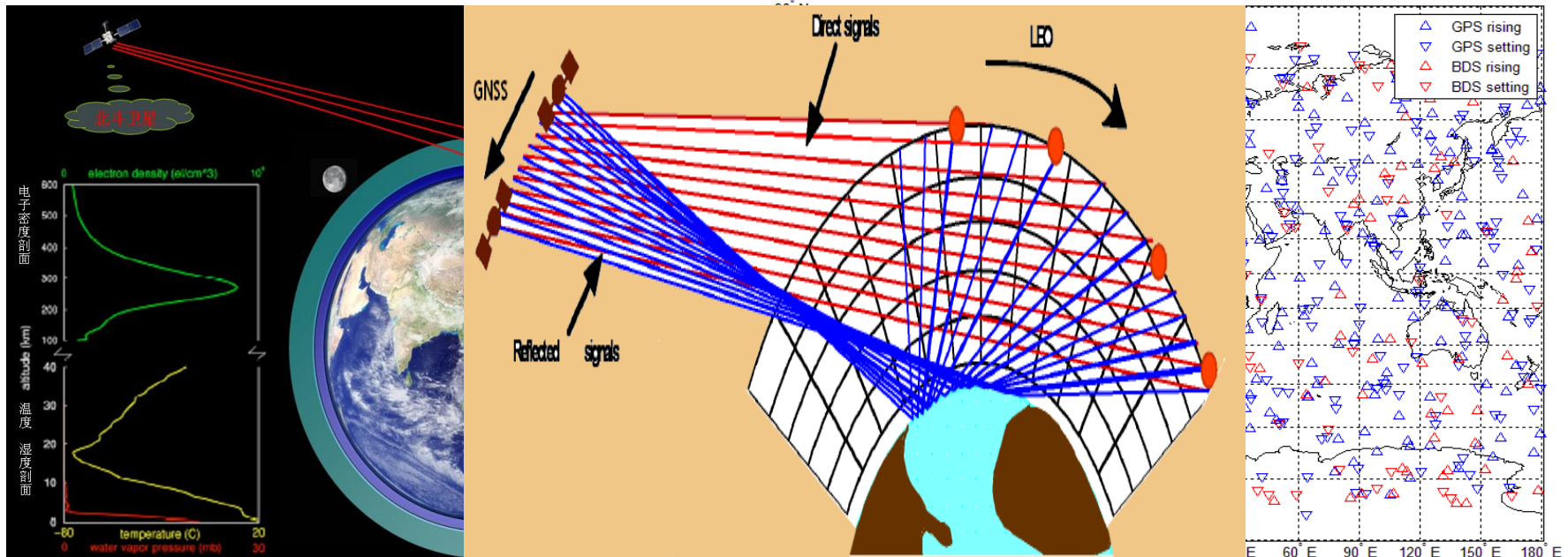
BDS/GPS Radiosonde System

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Outreach Programs

FY-3 Satellite BDS/GPS Occultation Sounder-GNOS

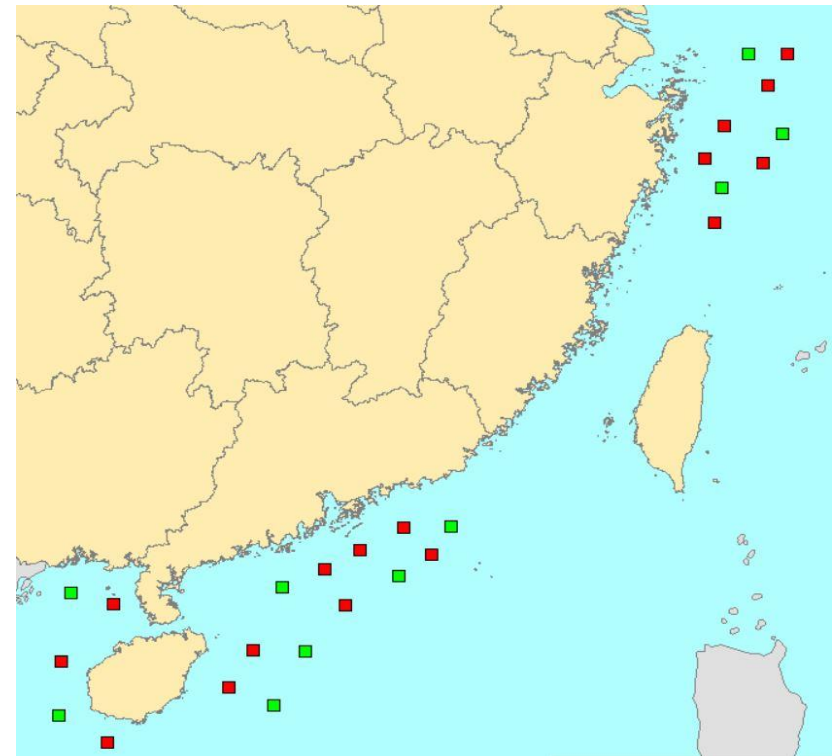
Occultation remote sensing plays a critical role to acquire the numerous profiles of troposphere and ionosphere. GNOS-1 is one of the payloads carried by FY-3C satellite, which is capable of receive GPS and BDS limb signals to retrieve the profiles of ionospheric electron density as well as the temperature, pressure and humidity. GNOS-2, the updated version of GNOS-1, is capable of observing the sea-surface wind from FY-3E. It will be launched in 2019.



Program for the BDS/GPS-R stations

The marine meteorological observation program was proposed in 2018 and will be completed in 2022. The ground-based BDS/GPS-R observation system was designed to improve marine meteorological monitoring and early warning capabilities from nearshore to offshore area.

Continent	Area	Province	Quantity
BDS/GPS/MET Station	East Sea	Jiangsu	3
		Zhejiang	6
	South Sea	Guangdong	8
		Guangxi	2
		Hainan	7
BDS/GPS-R Station	East Sea	Jiangsu	1
		Zhejiang	2
	South Sea	Guangdong	3
		Guangxi	1
		Hainan	3



■ BDS/GPS/MET Station (16)

■ BDS/GPS/MET Station + BDS/GPS-R Station (10)

Summary

1. BDS/GPS applications in meteorology have made an important effect on meteorological science and technology. Further effort is needed to promote its wide use.
2. Ground-based Application in meteorology is in the process of improvement. CMA will introduce more policies to support the applications and development of the BDS/GPS in meteorological field.
3. Great potentials are expected in the space-based GNSS-R application. FY-3E is the first meteorological satellite to conduct GNSS-R ocean wind observation in the world.

A gravel path leads from the foreground towards a row of five large, leafy green trees on a grassy hill. The sky is bright blue with scattered white clouds. The text "THANKS FOR YOUR ATTENTION" is centered across the path.

THANKS FOR YOUR ATTENTION