



iGMAS Status and Updates

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**International Cooperation Center
China Satellite Navigation Office**

**TENTH MEETING of the International Committee on Global Navigation Satellite Systems
Boulder, Colorado, United States of America
1 – 6 November 2015**

OUTLINE

I iGMAS Construction

**II iGMAS Monitoring &
Assessment Results**



iGMAS Construction



iGMAS & IGMA

- In March 2011, China first proposed the concept of international GNSS Monitoring and Assessment System (iGMAS).
- In June 2011, China proposed international GNSS Monitoring and Assessment services at the ICG conference in Vienna.
- In September 2011, at ICG-6, “*International GNSS Monitoring and Assessment*” (IGMA) sub-working group, co-chaired by China, IGS and Japan was set up, with its objective and tasks to promote international GNSS monitoring and assessment activities.



**international GNSS Monitoring
and Assessment System**



iGMAS Construction



iGMAS Objectives

- To establish a global real-time tracking network, which could track the whole orbits of BDS, GPS, GLONASS and Galileo satellites, as well as to be used as a platform with data collection, storage, analysis, management, publishing abilities.
- To monitor and assess the GNSS operational status and key indicators, generate precise ephemeris, earth orientation parameters, station coordinates and speed, global ionospheric delay and GNSS integrity to support satellite navigation technology testing, monitoring and assessment services in scientific research and various applications.

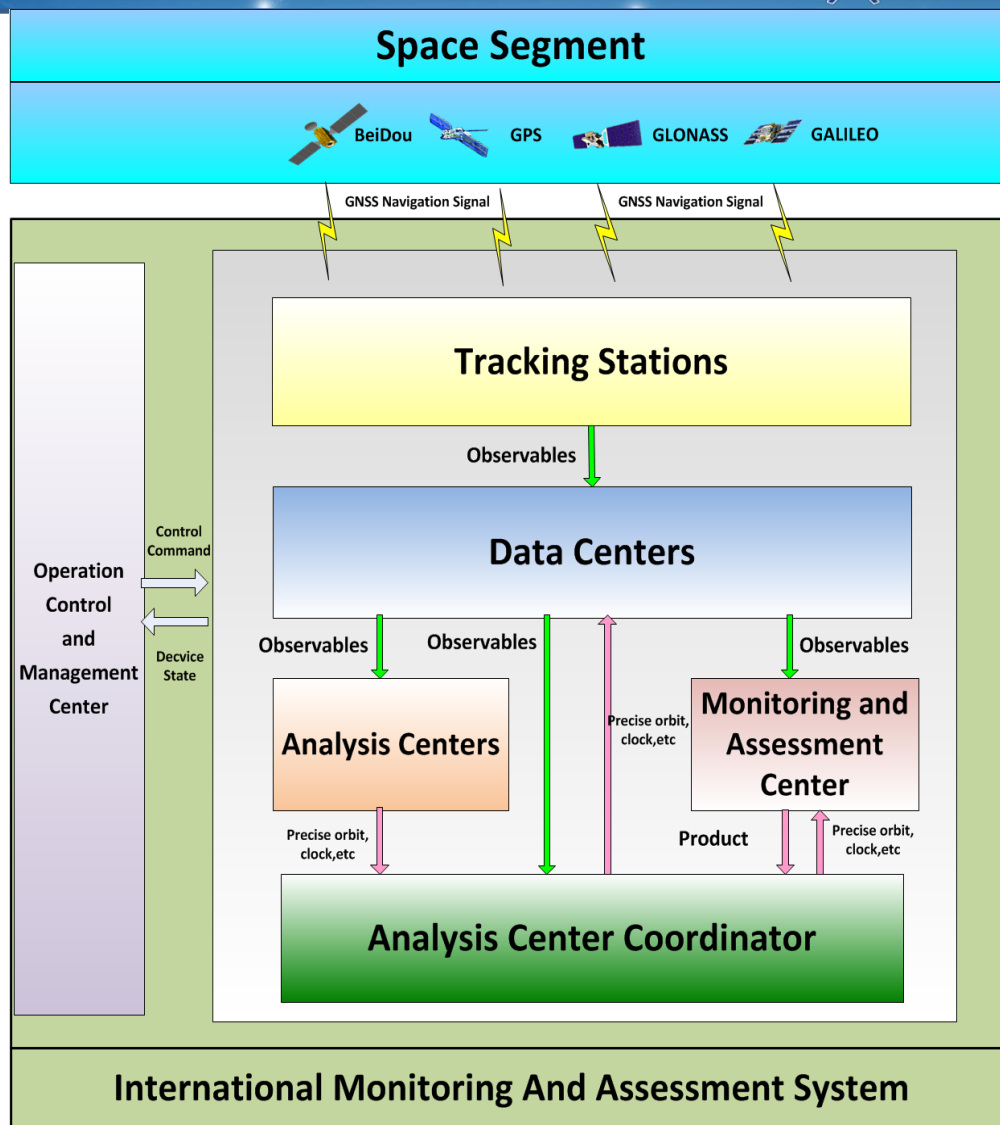


iGMAS Construction



System Components

- 34+ monitoring/tracking stations;
- 3 data centers;
- 8 analysis centers;
- 1 monitoring and assessment center;
- 1 product integration and service center;
- 1 operational control and management center.



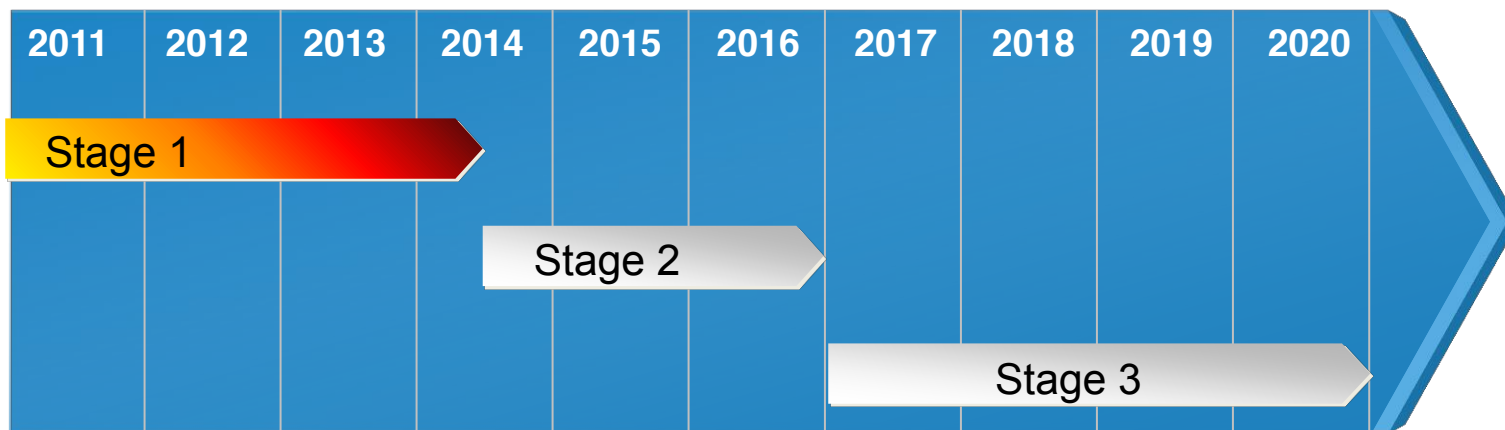


iGMAS Construction



Procedure

- Stage 1: During 2011-2014, 20 monitoring stations, 2 data centers, 5 analysis centers, 1 monitoring and assessment center, 1 product integration and service center, 1 operational control and management center have been established.

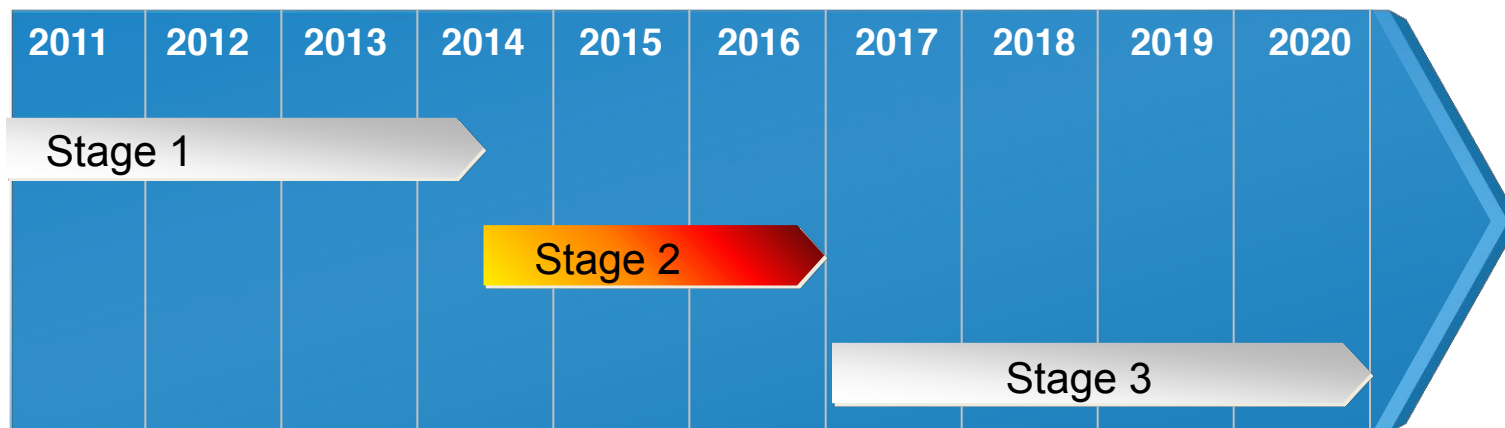




iGMAS Construction



- Stage 2: in 2014-2016, add more system components including 10 monitoring stations, 1 data center, 2 analysis centers, and update the system for enhanced processing capability.

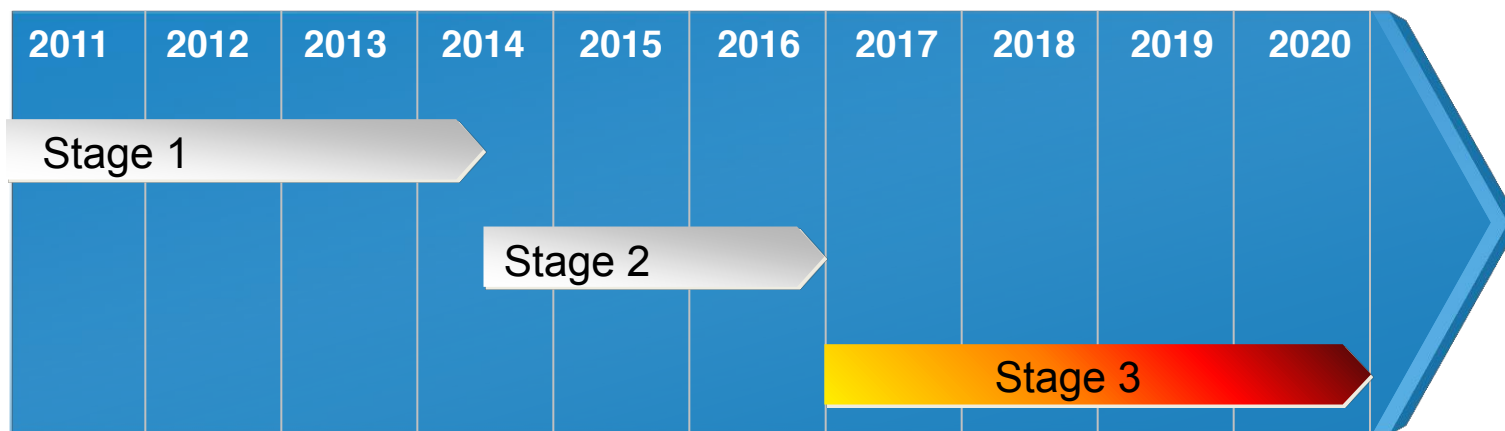




iGMAS Construction



- Stage 3: 2016-2020, update system to possess processing capability for the next generation of BDS and other GNSS systems.





iGMAS Construction



Milestones

- 2007/09, initial concept study of iGMAS;
- 2010/08, requirements analysis;
- 2011/03, iGMAS formal proposal;
- 2012/12, iGMAS project approval;
- 2013/05, start of iGMAS construction;
- 2014/01, start of integration testing;
- 2014/07, start of trial operation.

✚ GNSS Receivers

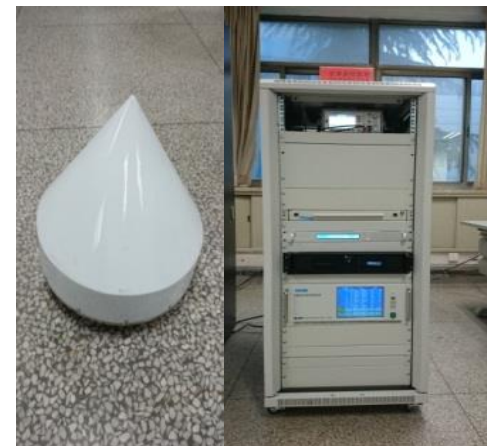
- R&D and production of multi-GNSS receivers by Unicore, CETC 54 and CETC 20 was finished.



Unicore



CETC54



CETC20

Monitoring Stations

- Construction of 8 domestic stations have been completed, receiver equipments have been installed.



Beijing



LASA



Urumqi



Changchun



Kunming



Shanghai



Wuhan



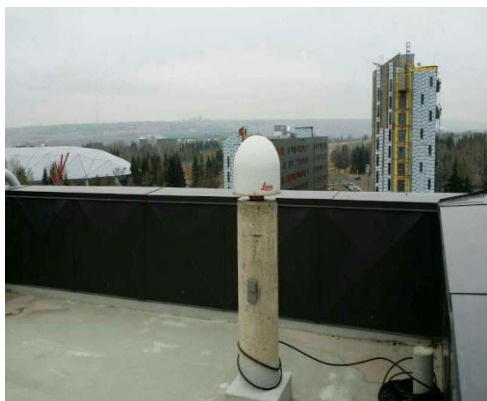
Xi'an



iGMAS Construction



- Constructions of the Arctic and Antarctic stations have been completed.
- Stations in Pakistan, Brazil, Argentina and Canada have been equipped with receiver and network equipment.



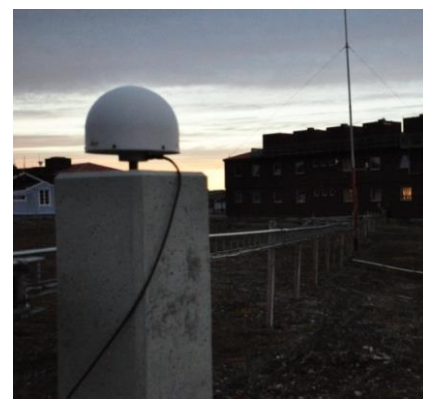
Canada



Argentina



Pakistan



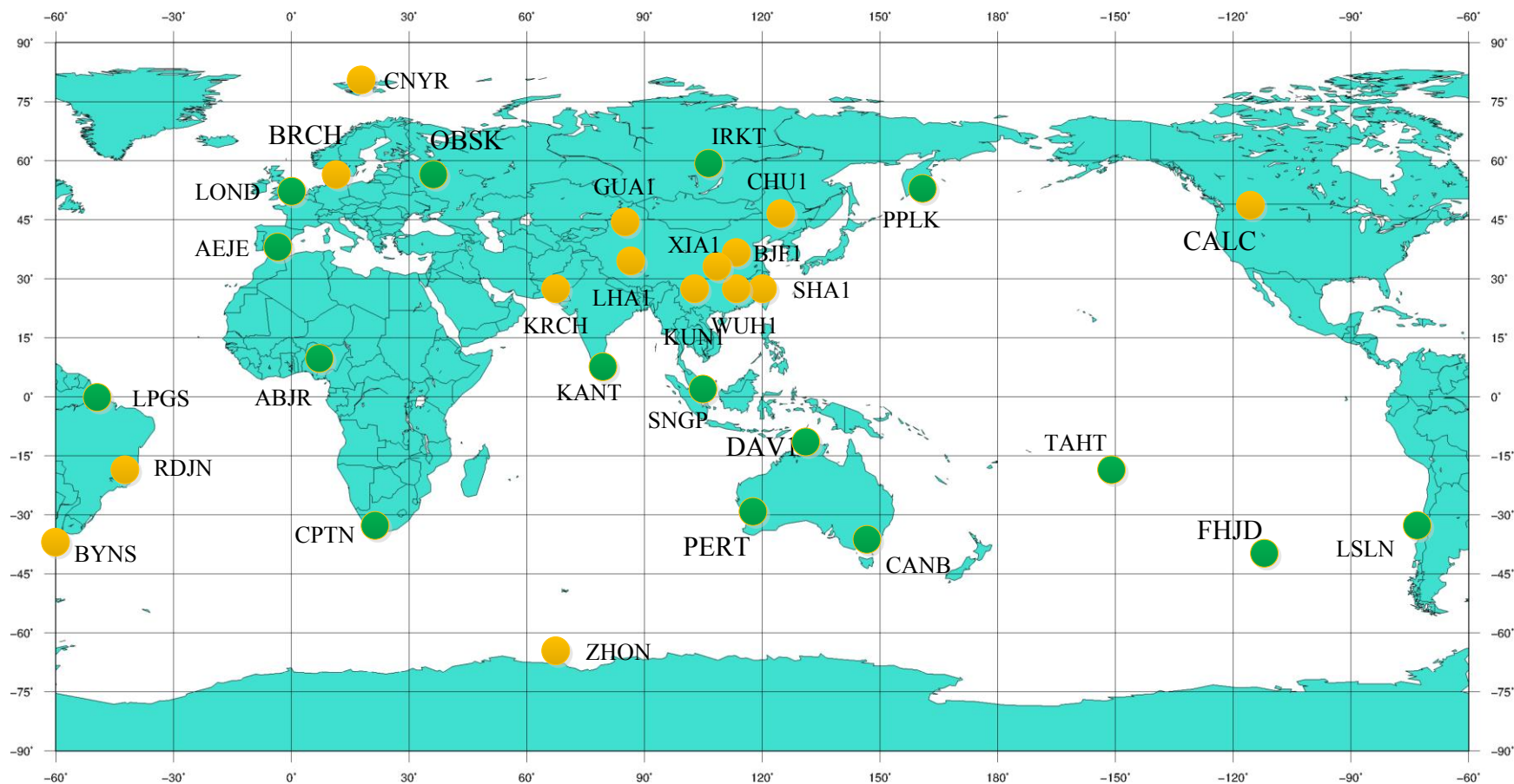
Brazil



iGMAS Construction



- Stations in Russia, Australia, England and South Africa are in progress.





iGMAS Construction



Signal monitoring stations

- In April 2009, a 7.3m antenna started to work in Xi'an;
- In October 2014, a 40m antenna was put into service in Xi'an;
- International cooperation with Canada, Malaysia and Argentina for signal quality monitoring and assessment has been established.







iGMAS Construction



Center Construction

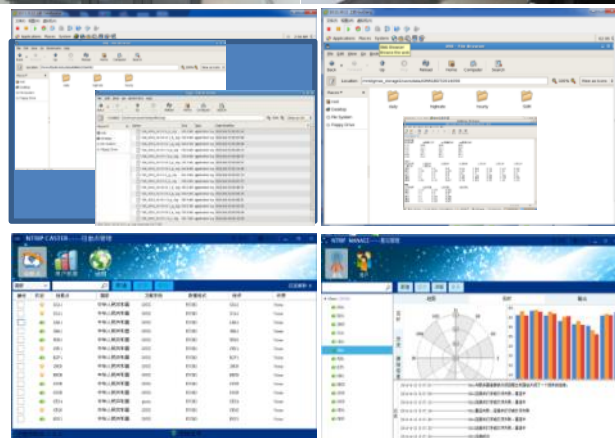
- 3 data centers have finished the internal integration testing;
- 10 analysis centers have finished internal integration testing;
- Monitoring and assessment center, operational control and management center, product integration and service center have finished internal integration testing;
- iGMAS has started trial running since July, 2014.



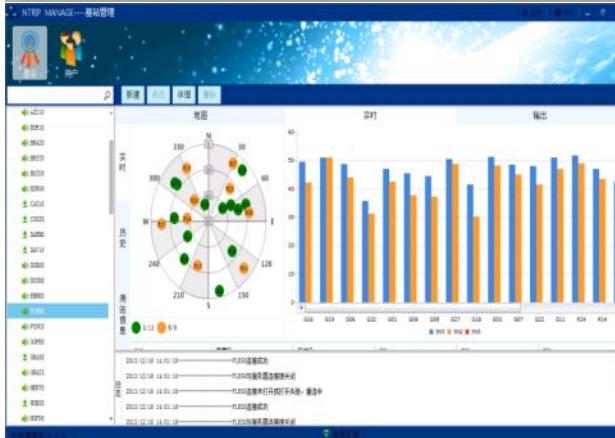
iGMAS Construction



- Data Center



NUDT



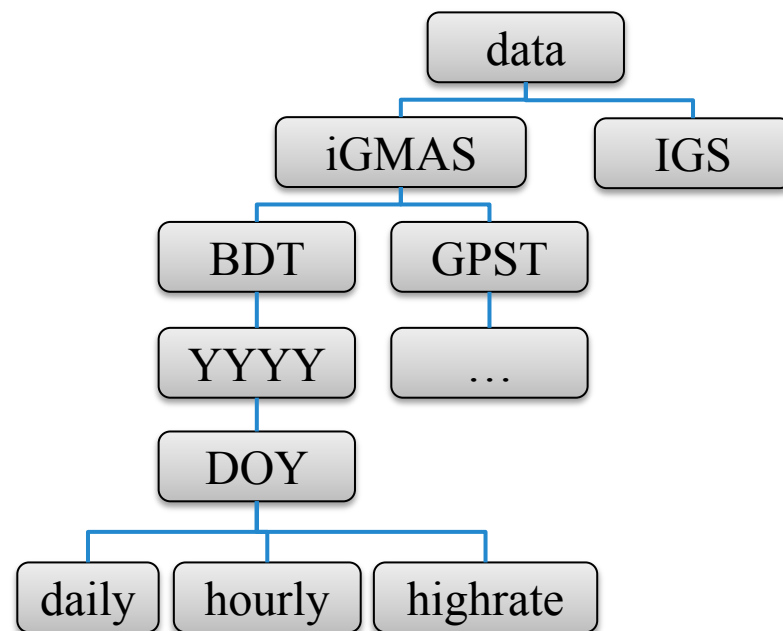
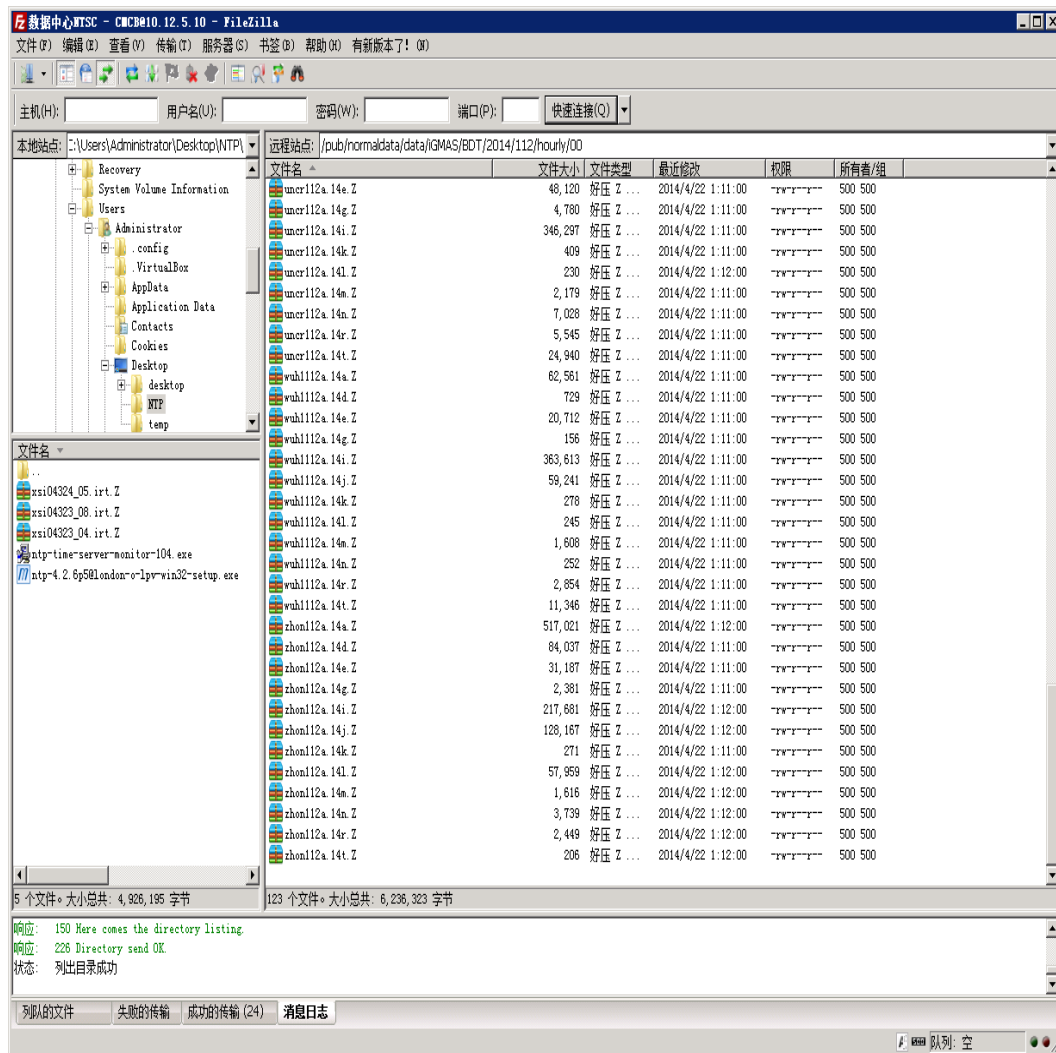
WHU



NTSC



iGMAS Construction



Data directory



iGMAS Construction



- Analysis Centers



Xi'an Satellite Control Center



Shanghai Astronomical Observatory



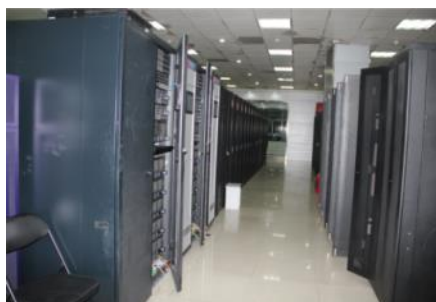
Information Engineering University



Chang'an University



Space Information Relay and Transmission Technology Research Center



Beijing Aerospace Control Center

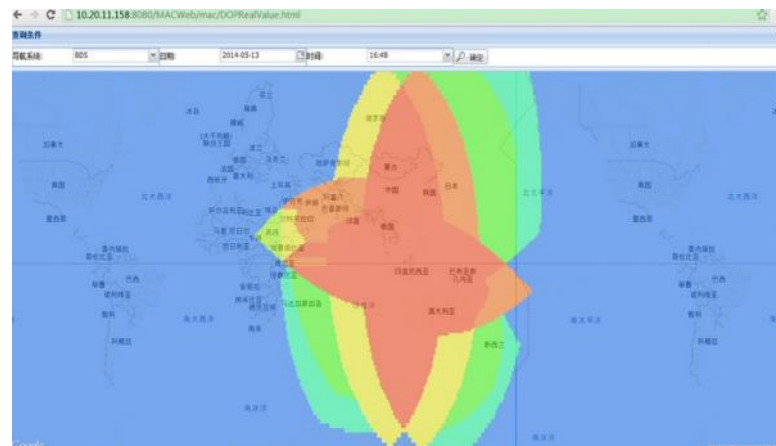
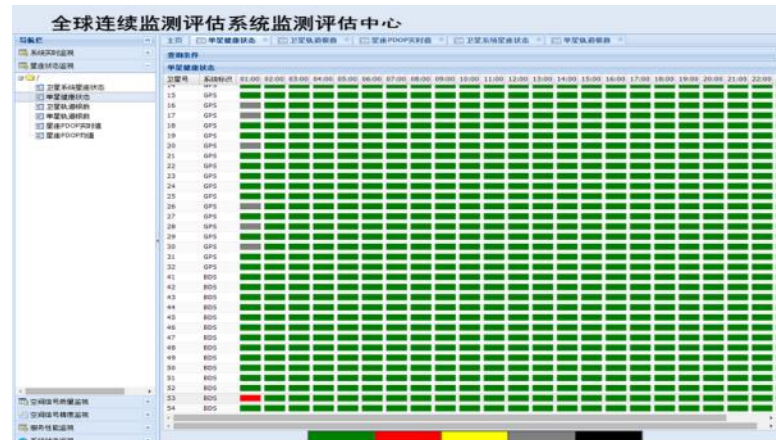


Chinese Academy of Surveying & Mapping



Institute of Geodesy and Geophysics

- The Monitoring and Assessment Center

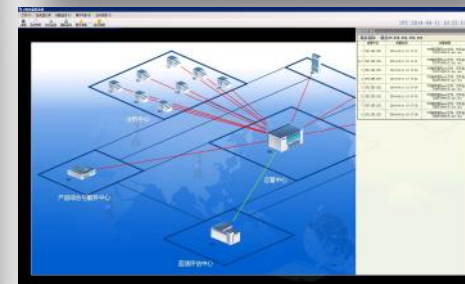




iGMAS Construction



- Operational Control and Management Center



- Product Integration and Service Center



业务数据监视

开始时间	结束时间	开始日期	结束日期	开始时间	结束时间	开始日期	结束日期	开始时间	结束时间	开始日期	结束日期	开始时间	结束时间	开始日期	结束日期	开始时间	结束时间	开始日期	结束日期	
2014-01-01 00:00:00	2014-01-01 00:00:00	2014-01-01 00:00:00	2014-01-01 00:00:00	2014-01-01 00:00:00	2014-01-01 00:00:00	2014-01-01 00:00:00	2014-01-01 00:00:00	2014-01-01 00:00:00	2014-01-01 00:00:00	2014-01-01 00:00:00	2014-01-01 00:00:00	2014-01-01 00:00:00	2014-01-01 00:00:00	2014-01-01 00:00:00	2014-01-01 00:00:00	2014-01-01 00:00:00	2014-01-01 00:00:00	2014-01-01 00:00:00	2014-01-01 00:00:00	2014-01-01 00:00:00



OUTLINE

I iGMAS Construction

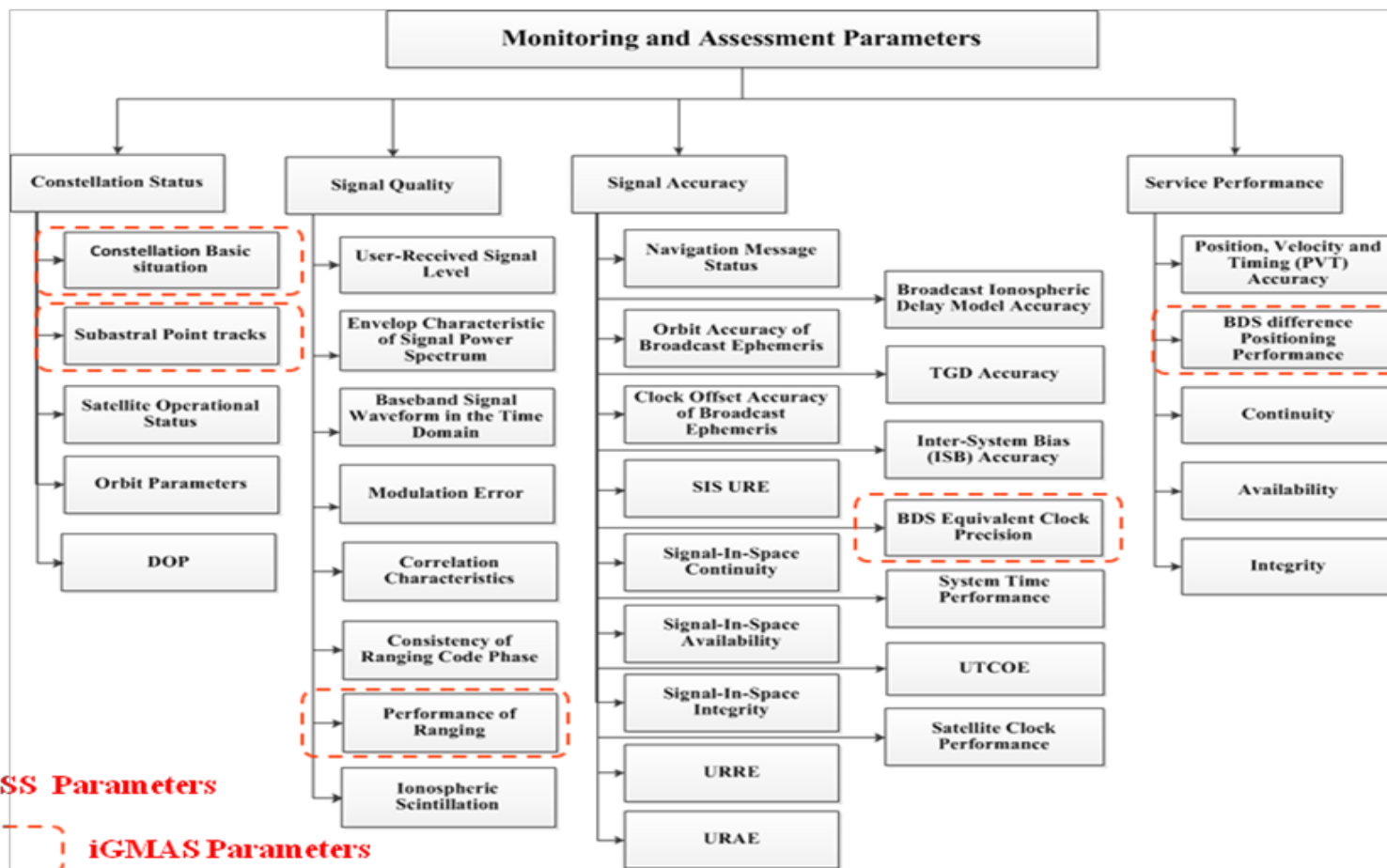
**II iGMAS Monitoring &
Assessment Results**



iGMAS Monitoring and Assessment Results



Core Products

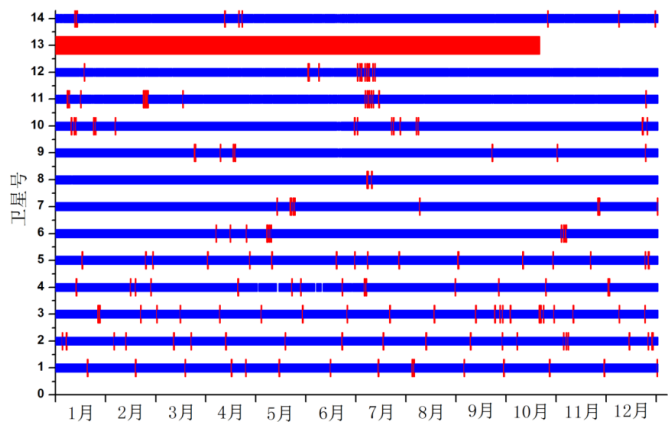




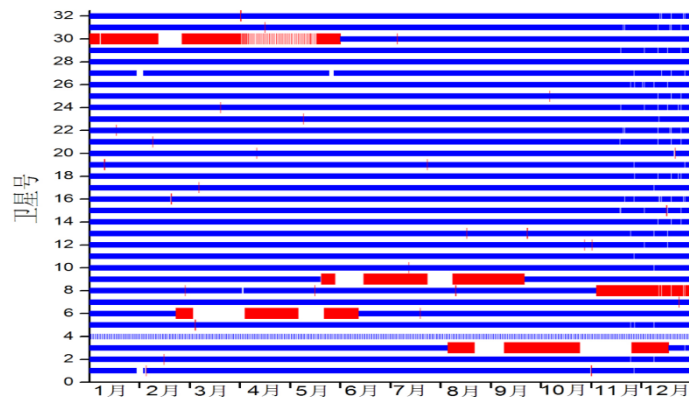
iGMAS Monitoring and Assessment Results



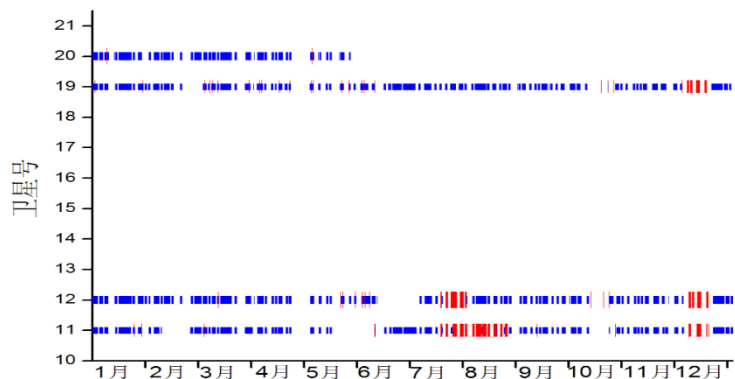
Constellation Status (2014)



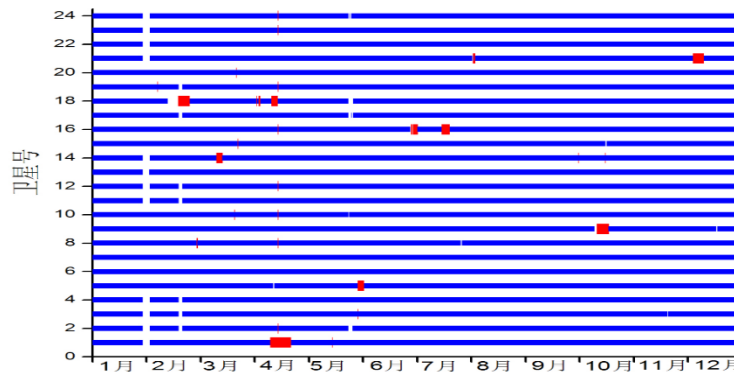
BDS Satellite Availability



GPS Satellite Availability



GALILEO Satellite Availability



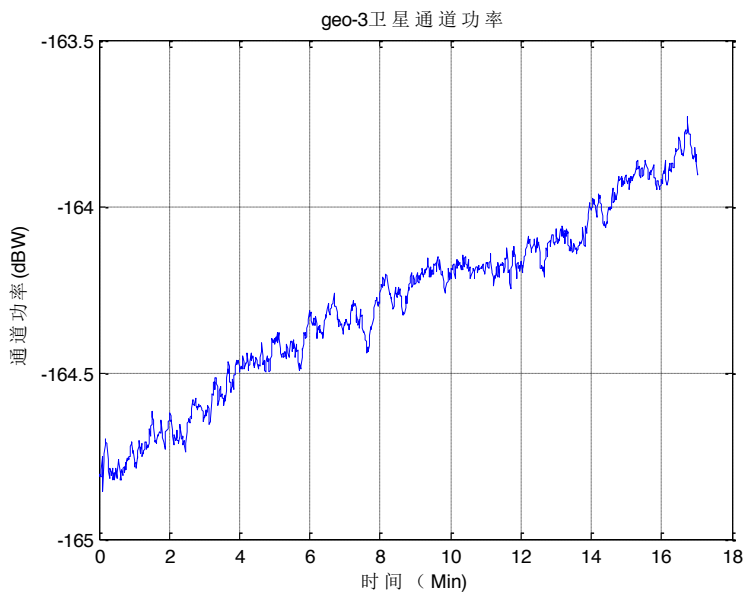
GLONASS Satellite Availability



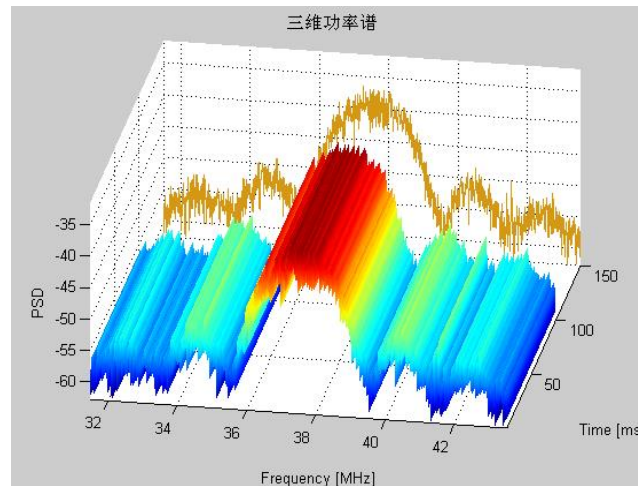
iGMAS Monitoring and Assessment Results



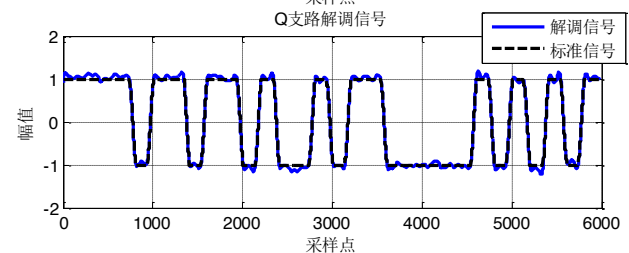
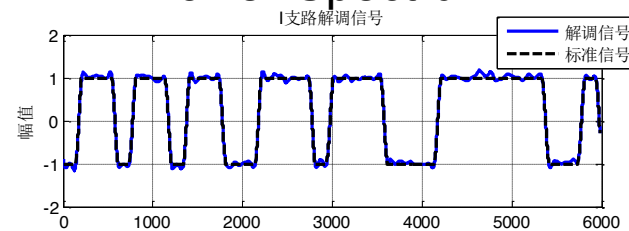
Quality of Signal-in-space(2014)



User-Received Signal Level



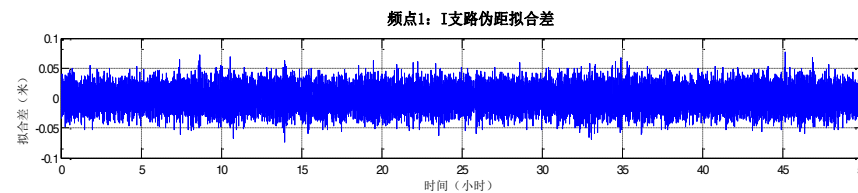
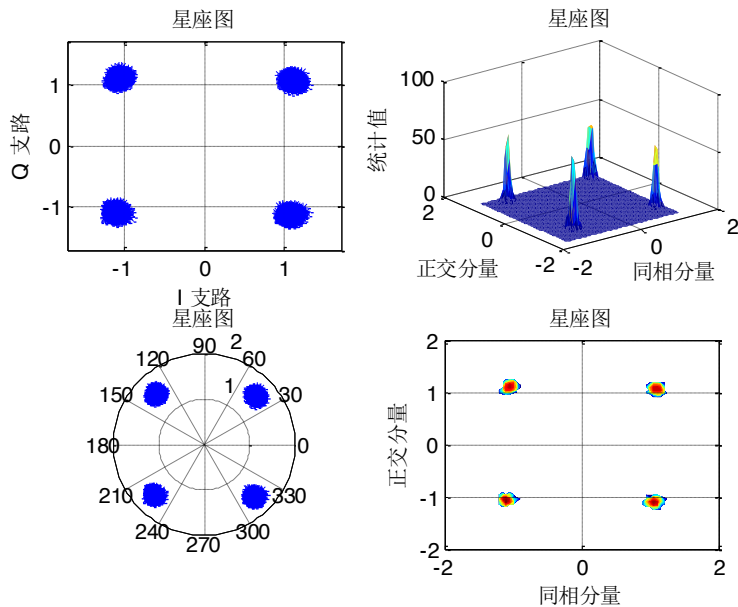
Power Spectrum



waveform of baseband signal



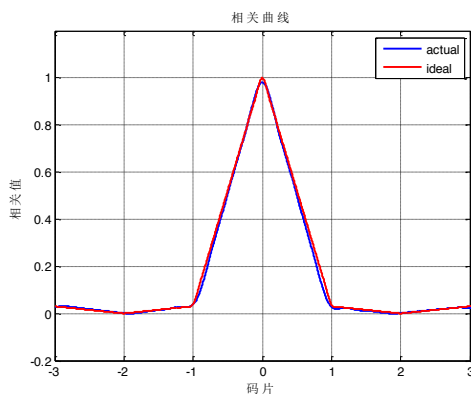
iGMAS Monitoring & Assessment Results



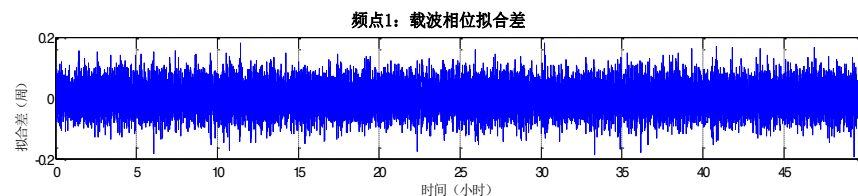
signal ranging value stability

Year 2014

modulation error of carrier phase(April)



signal correlation(August)



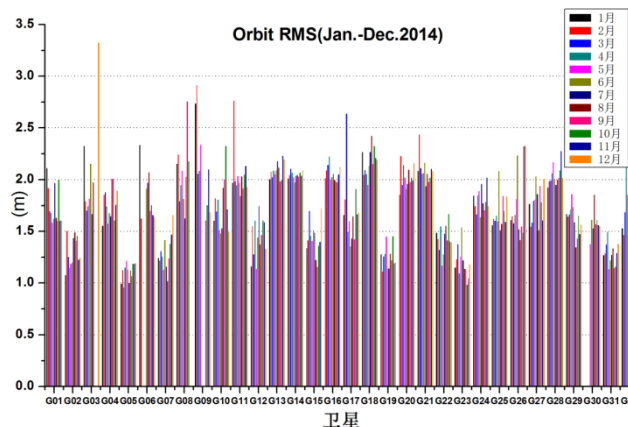
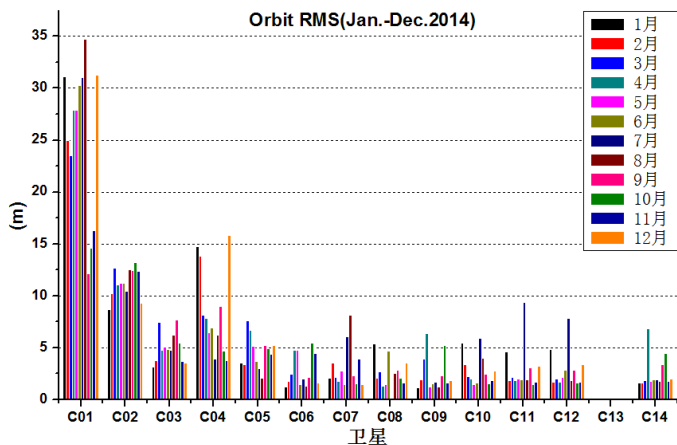
Carrier phase value stability



iGMAS Monitoring & Assessment Results

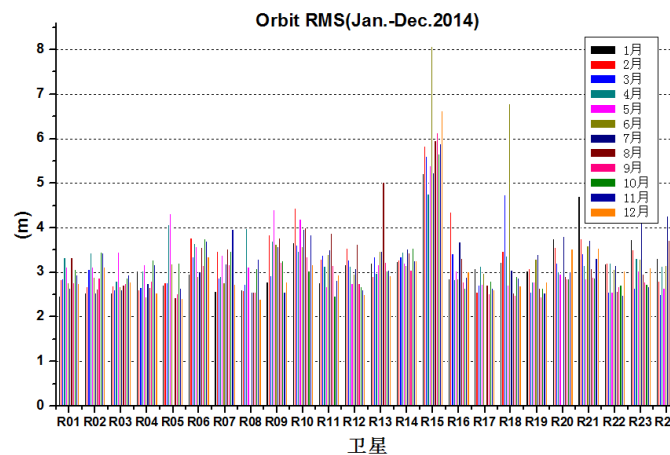
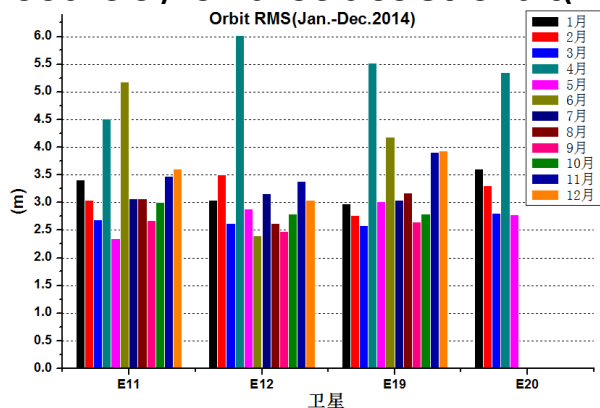


Accuracy of Signal-in-space(2014)



Accuracy of broadcast orbit(GPS)

Accuracy of broadcast orbit(BDS)

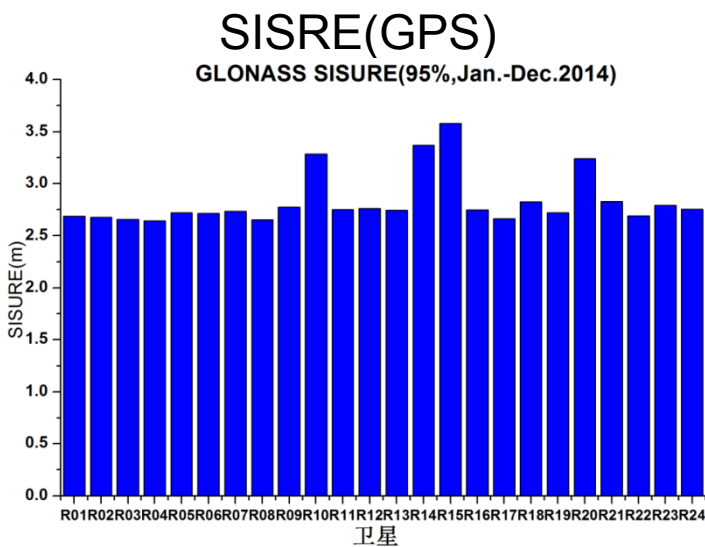
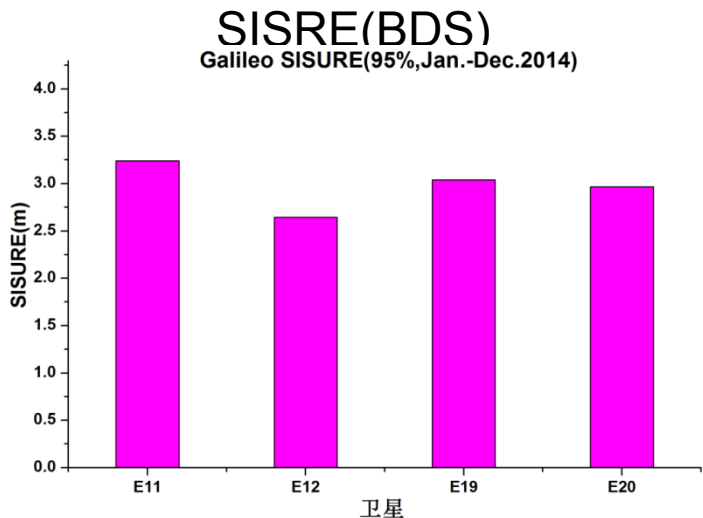
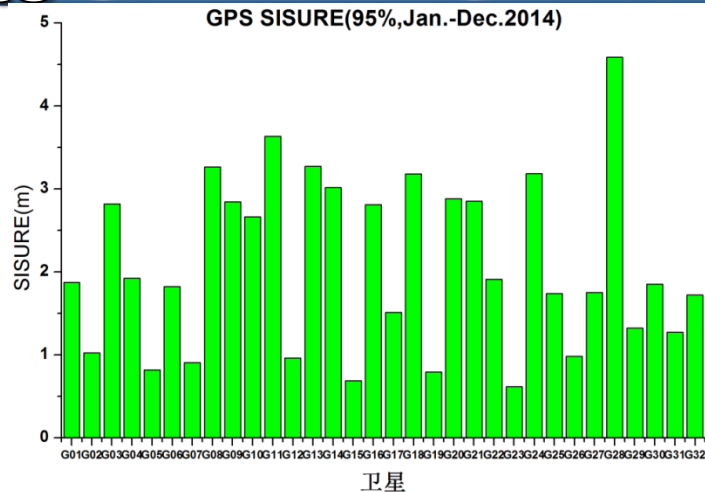
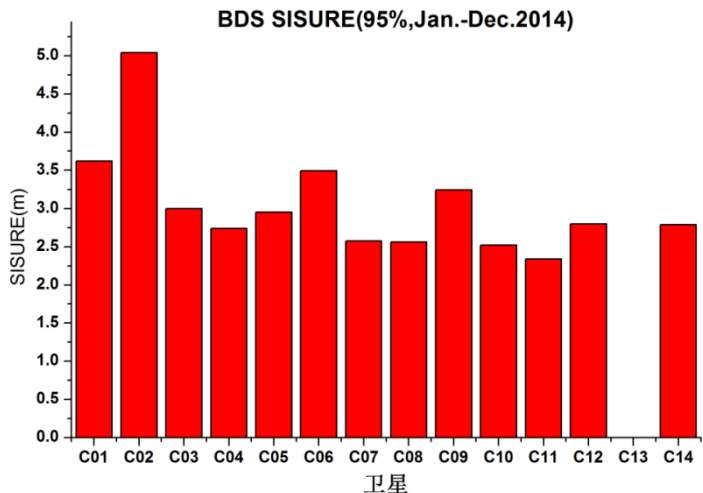


Accuracy of broadcast orbit(Galileo)

Accuracy of broadcast orbit(GLONASS)



iGMAS Monitoring & Assessment Results



SISRE(Galileo)

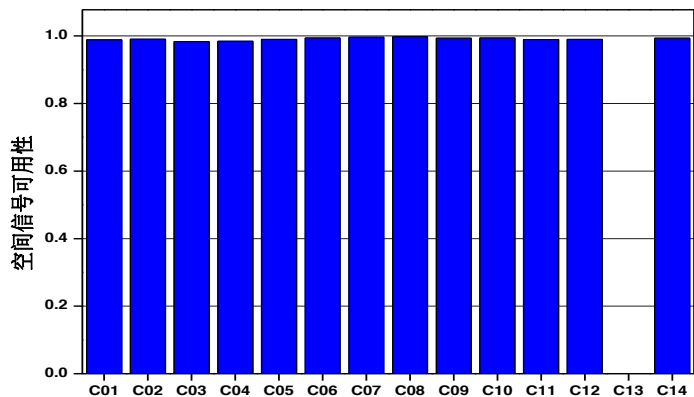
SISRE(GLONASS)



iGMAS Monitoring & Assessment Results

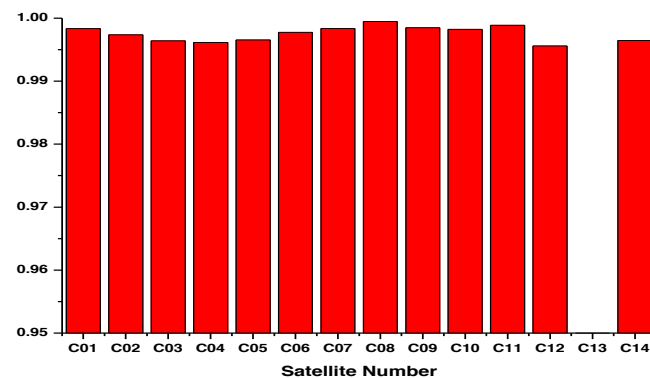


各卫星1-12月可用性



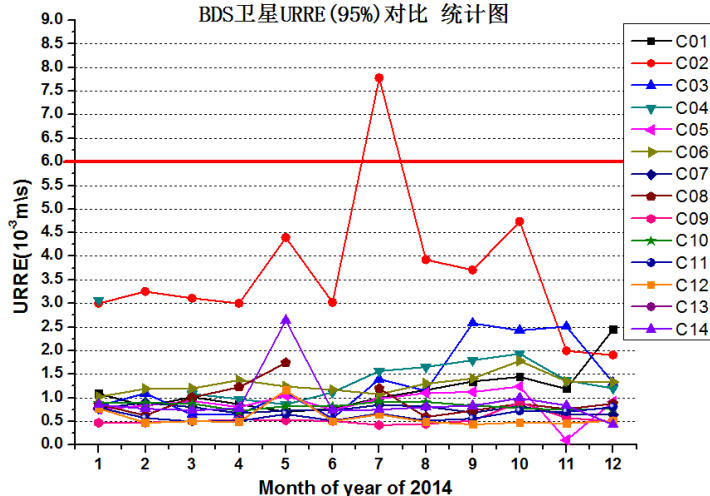
SIS availability

BDS Continuity(Jan-Dec.2014)



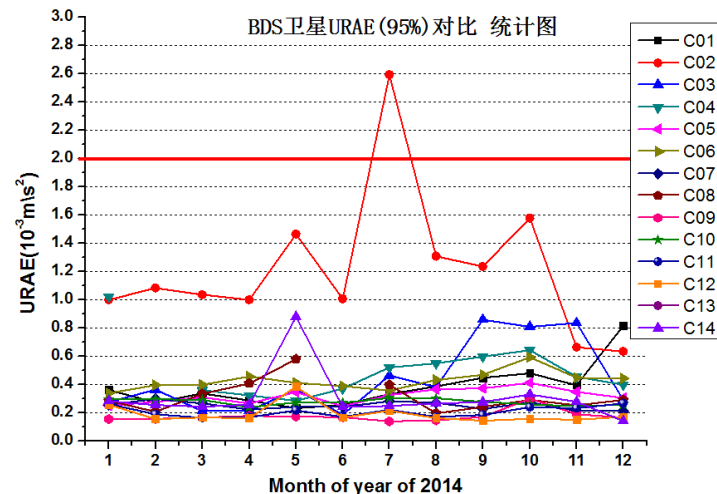
SIS continuity

BDS卫星URRE (95%)对比 统计图



URRE

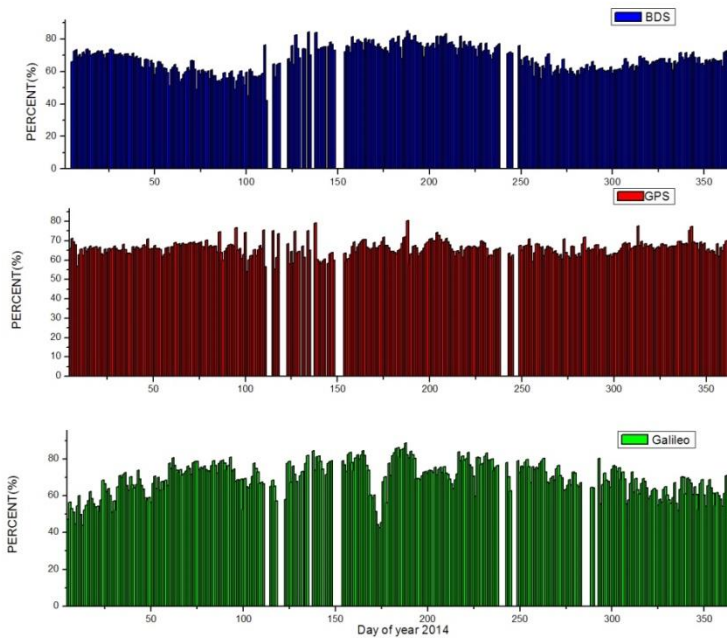
BDS卫星URAE (95%)对比 统计图



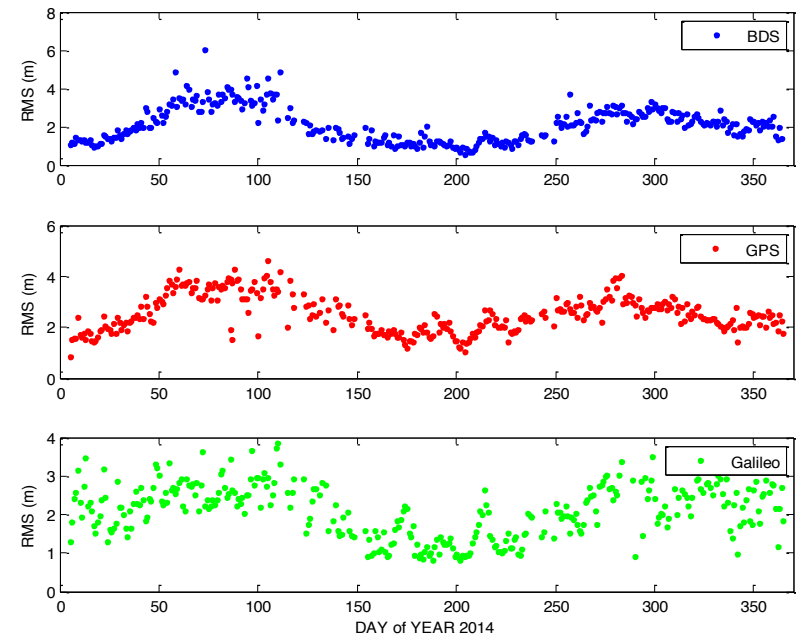
URAE



iGMAS Monitoring & Assessment Results



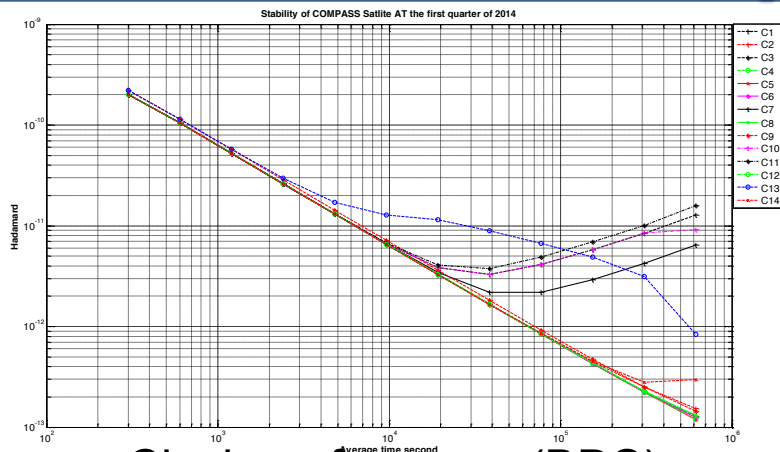
Correction Percentage
of Broadcast
Ionospheric model



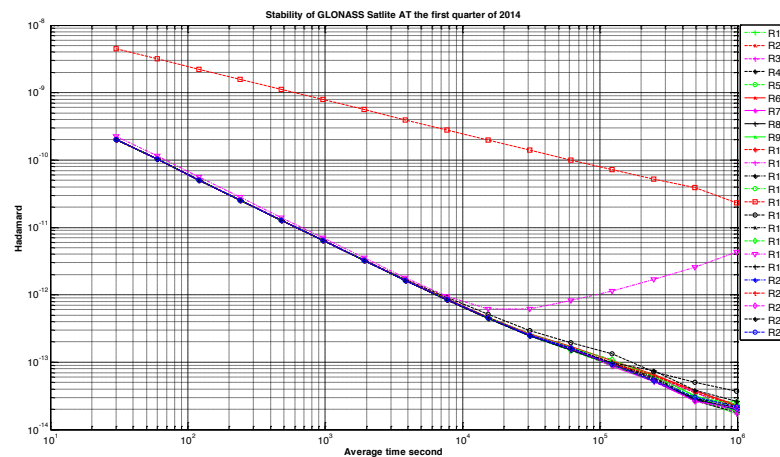
Error of Broadcast
Ionospheric model



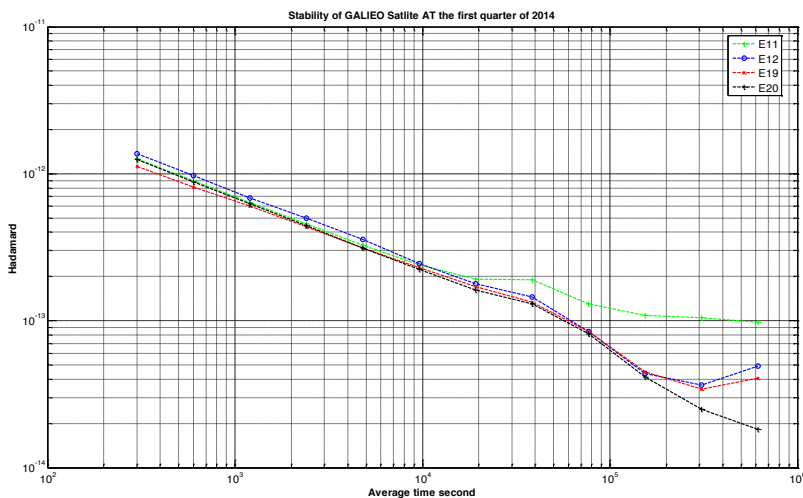
iGMAS Monitoring & Assessment Results



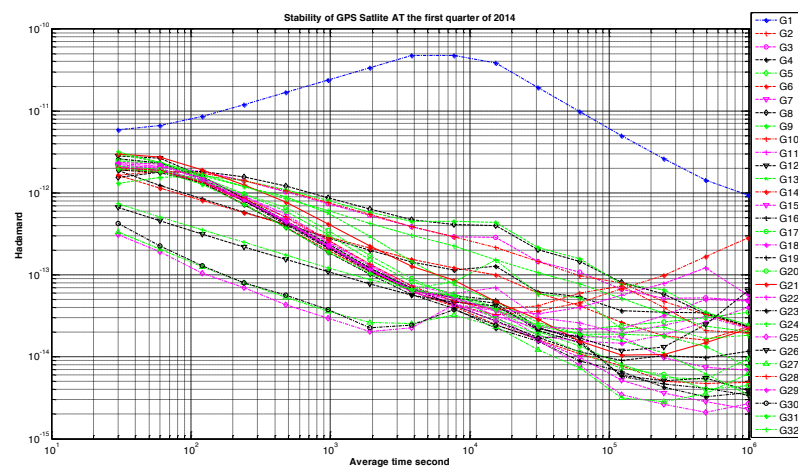
Clock performance(BDS)



Clock performance(GPS)



Clock performance(Galileo)



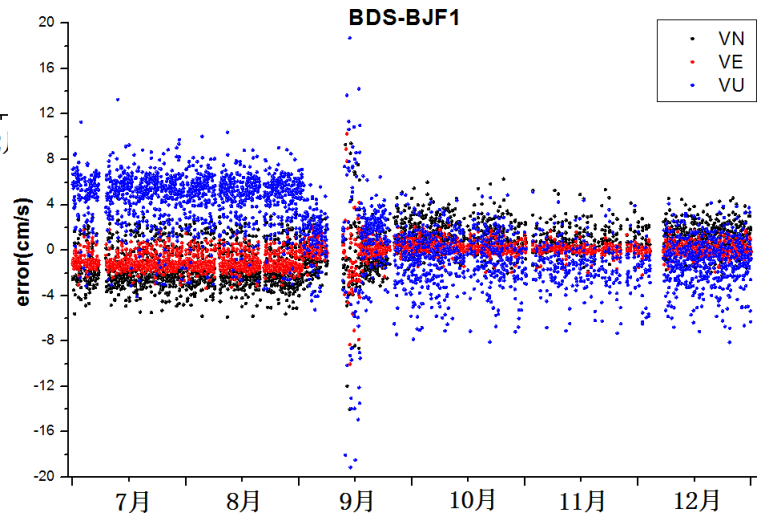
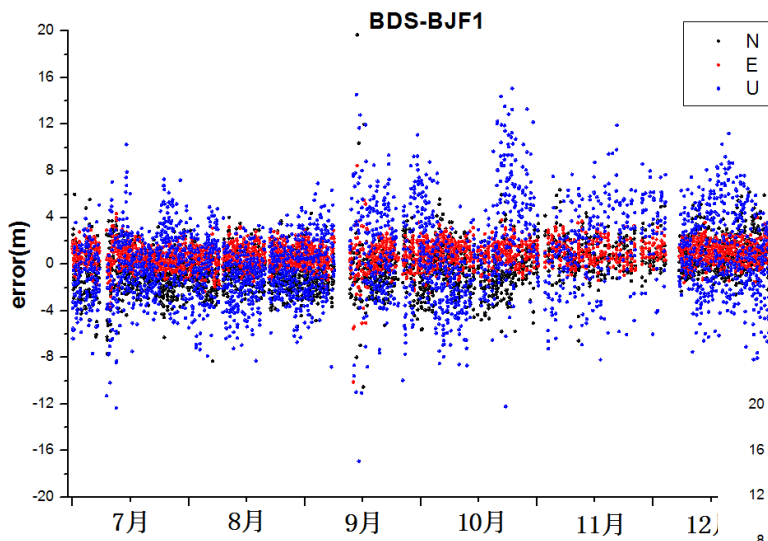
Clock performance(GLONASS)



iGMAS Monitoring & Assessment Results



Service Performance



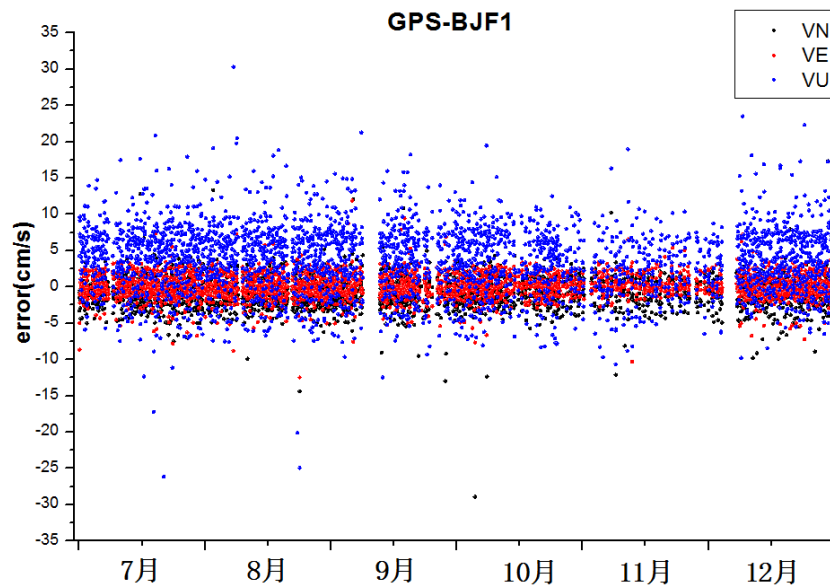
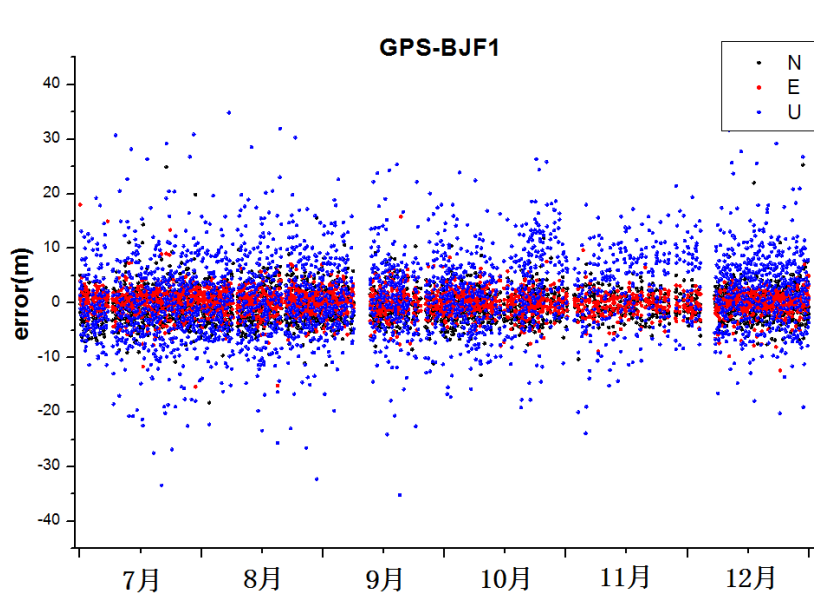
Positioning and Velocity Result of Station BJF1 based on BDS observations for the year 2014 (Unit: m)



iGMAS Monitoring & Assessment Results



Service Performance



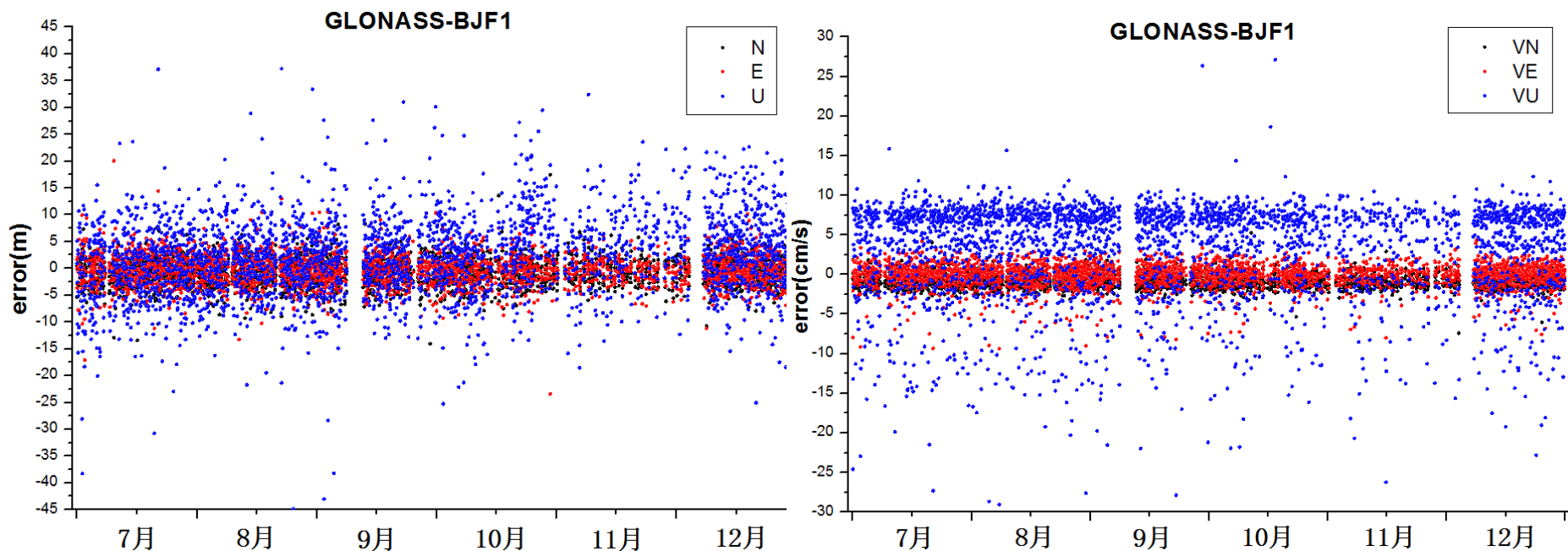
Positioning and Velocity Result of Station BJF1 based on GPS observations for the year 2014 (Unit: m)



iGMAS Monitoring & Assessment Results

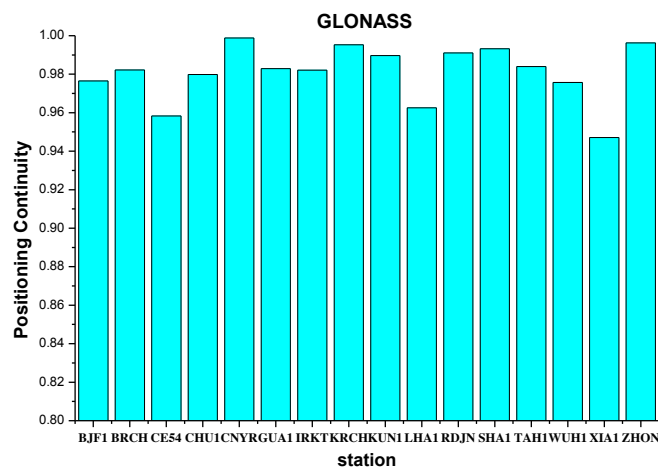
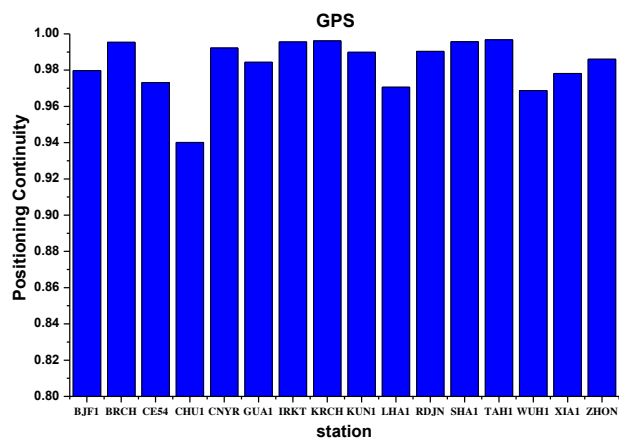
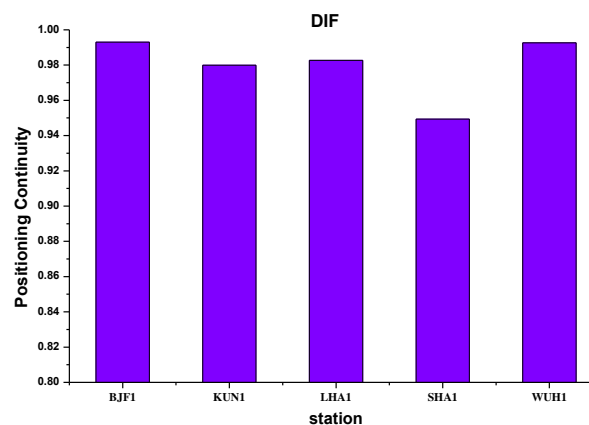
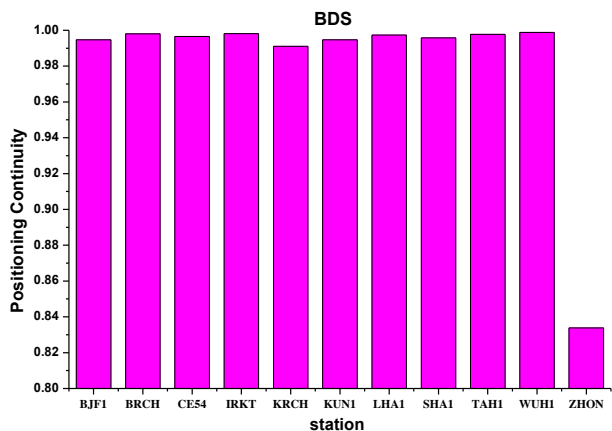


Service Performance

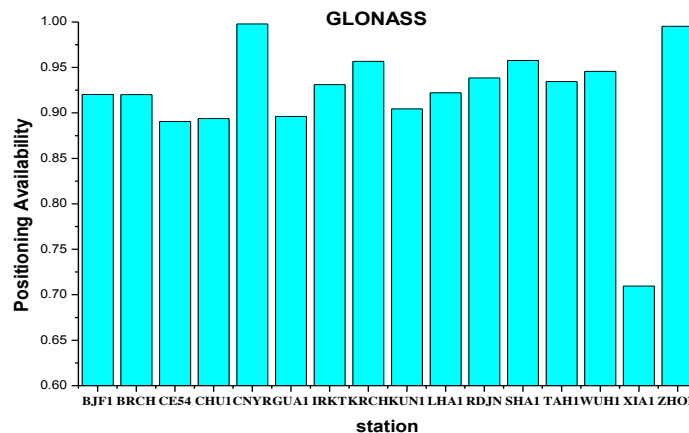
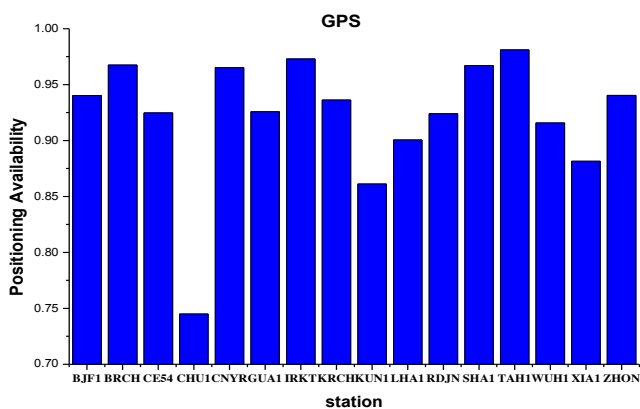
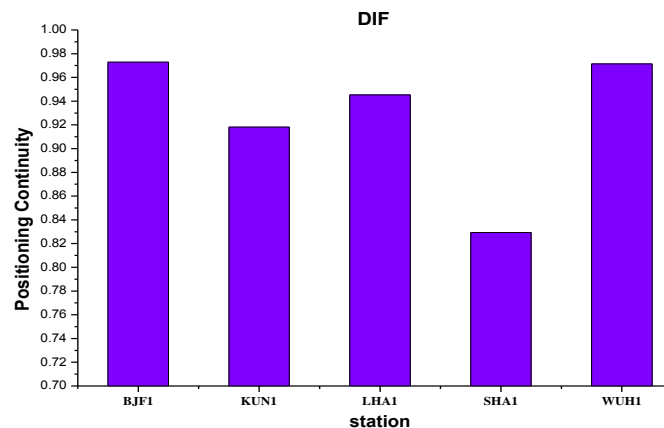
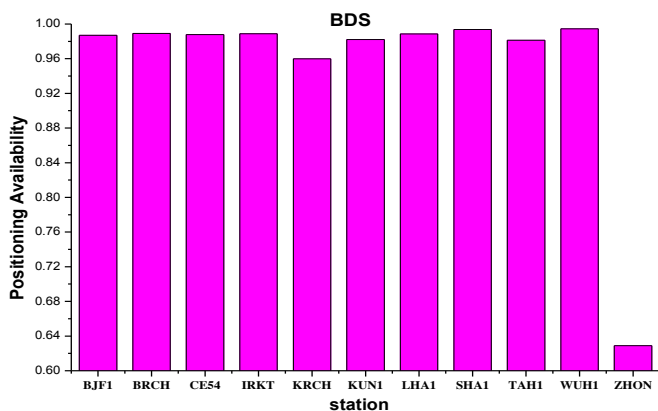


Positioning and Velocity Result of Station BJF1 based on GLONASS observations for the year 2014 (Unit: m)

Positioning Continuity



Positioning Availability





iGMAS Monitoring & Assessment Results



Monitoring and Assessment Reports of GNSS Services

GNSS 服务
监测评估报告

2013 年第 4 期 (总第 16 期)
中国卫星导航系统管理办公室测试评估研究中心 2013 年 5 月 3 日

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**Monitoring and Assessment of
Parameters on GNSS**
Draft

Test and Assessment Research Center, CSNO
September, 2012

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Summary



- iGMAS is an international GNSS monitoring and assessment system built by China under the ICG IGMA initiative.
- iGMAS has been operational on trial basis since July 2014, providing the users with raw observation data, basic products as well as monitoring and assessment information.
- iGMAS welcomes the participation from the international GNSS society.



Thanks!

谢谢!

Dr. Jun Shen (shenjun@beidou.gov.cn)

Deputy Director

International Cooperation Center

China Satellite Navigation Office (CSNO)

<http://en.beidou.gov.cn>