Recent Progress of iGMAS

iGMAS TEAM

Wenhai Jiao, Shuli Song, Xiaolin Jia,Hongliang Cai,……

2018-11-06

CONTENT

01

Introduction

01 Introduction

- **Multi-GNSS era has been coming and more navigation systems will provide services for users.**
- **To ensure the service quality, consistent with common OS performance parameters, and realize the goal of interoperable GNSS OS signals, it is desirable to carry out GNSS monitoring and assessment.**
- **In March 2011, China proposed the concept of international GNSS Monitoring and Assessment System(iGMAS). The construction of iGMAS started in 2012,the trial running and service started in 2014.**

01 Introduction

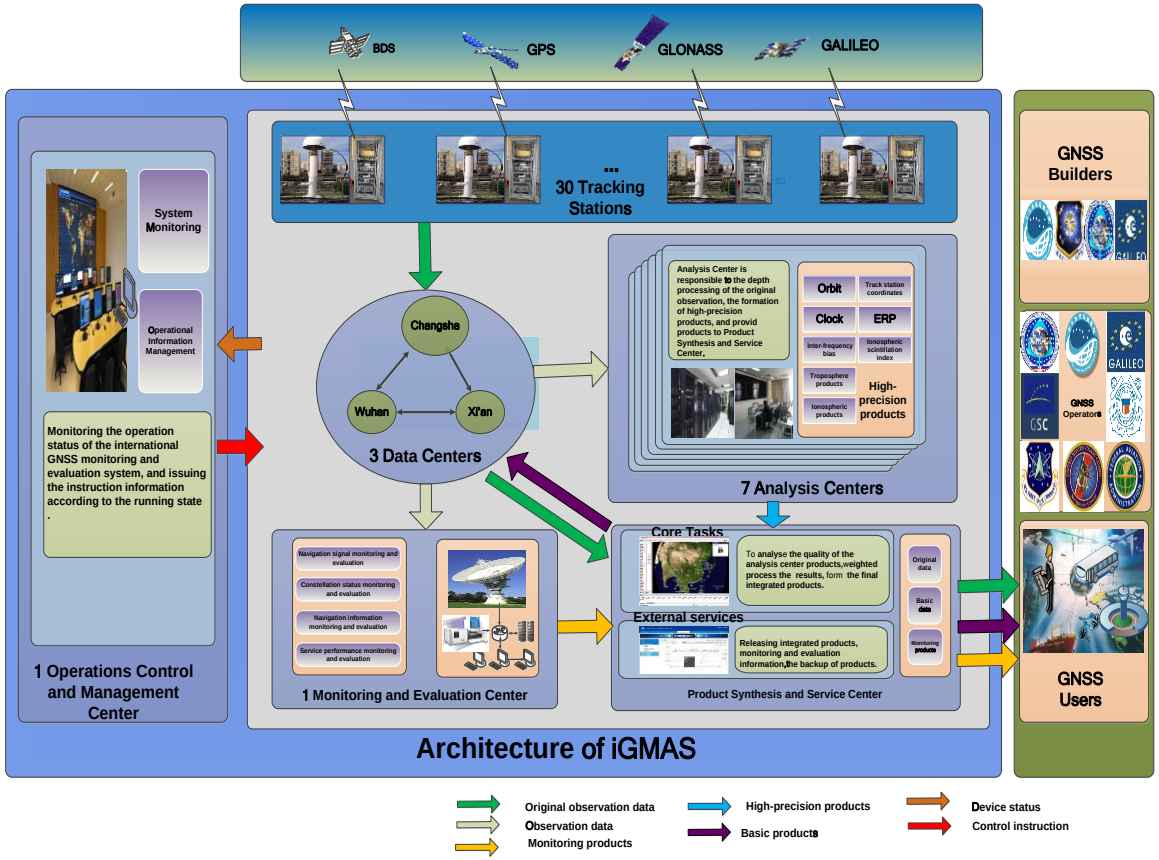
➢ Objective of iGMAS

Establish global real-time GNSS tracking network which could track the whole orbits of GNSS satellites; and a complete infrastructure with data collection, storage, analysis, management, publishing capabilities. The infrastructure would monitor and assess the GNSS operational status and key indicators, and also generate GNSS reference products(precise ephemeris, Earth Rotation Parameters, station coordinates, global ionospheric delay and other products) to support satellite navigation technology test, performance monitoring and assessment, service in scientific research and various applications.

01 Introduction

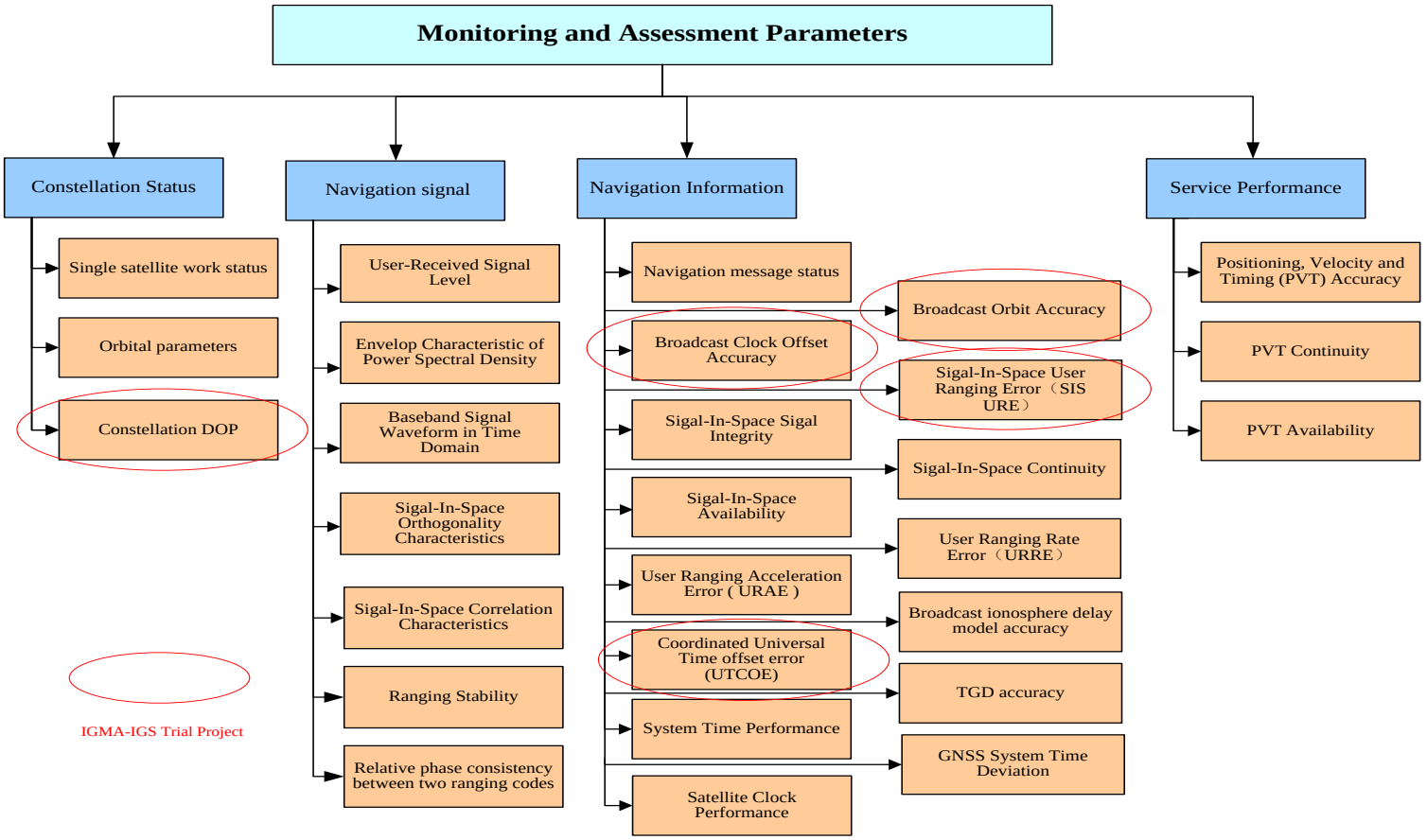
➢ Construction of iGMAS

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



01 Introduction

➢ Products of iGMAS

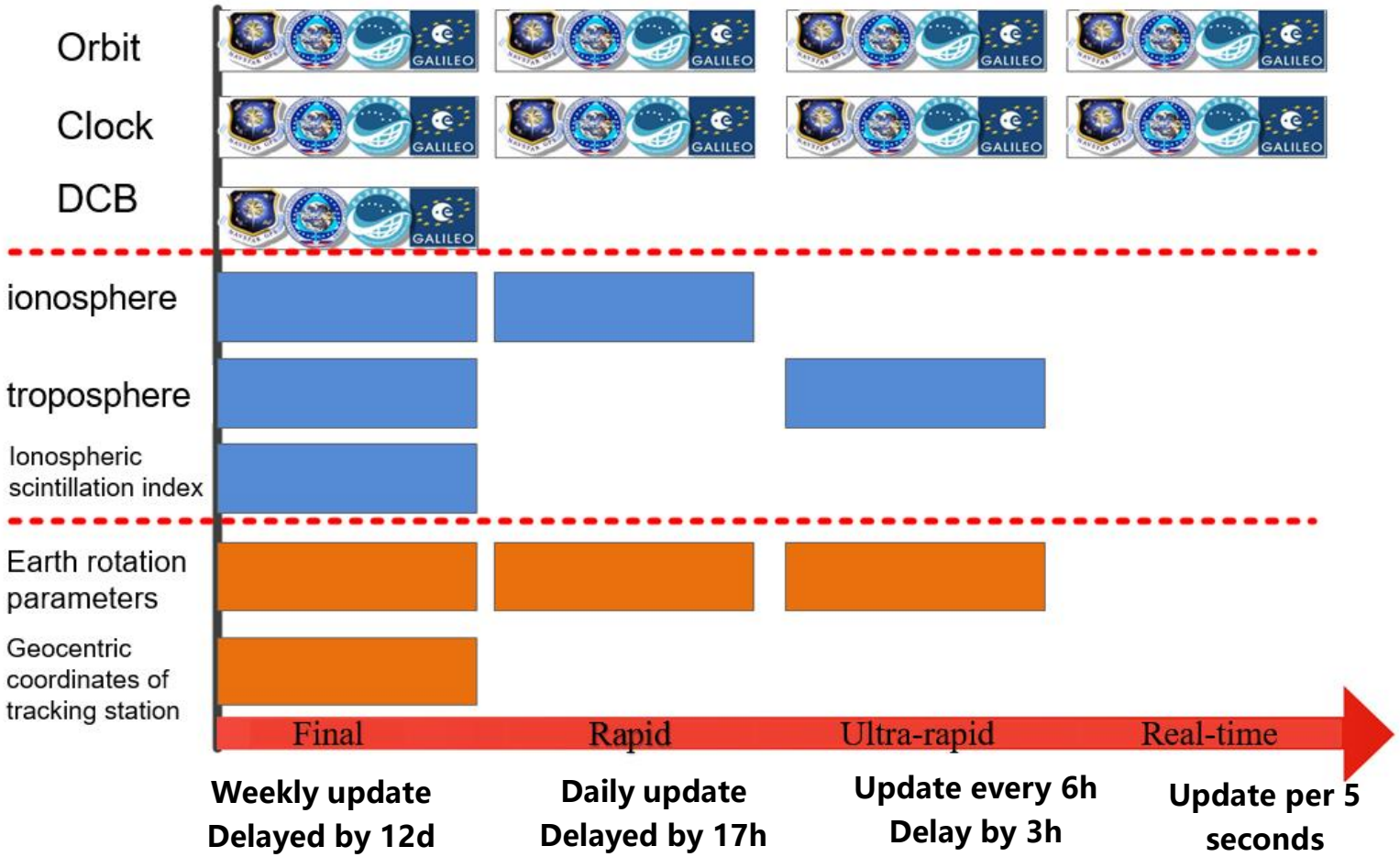


Most parameters have been calculated operationally in MAC of iGMAS.

The monitoring and assessment reports have been published routinely.

01 Introduction

➢ Products of iGMAS



iGMAS has been providing these reference products routinely from 2014,which can be downloaded from www.igmas.org.

02

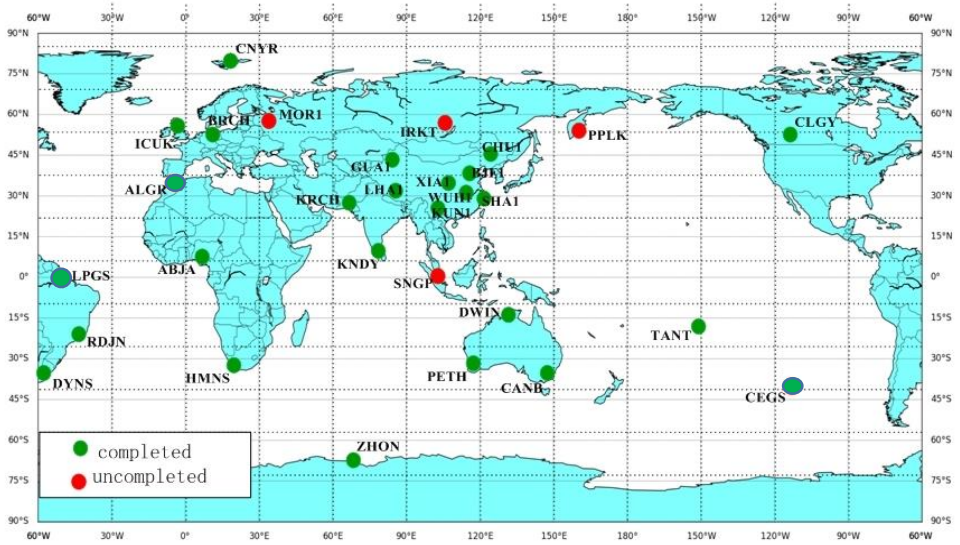
Progress of iGMAS

- iGMAS Construction Update
- iGMAS MAC Update
- iGMAS Reference Products Update

2.1 iGMAS Construction Update

Up to now,26 tracking stations have been built:8 in China,2 in polar regions,18 abroad stations. This Year:

(1)ALGR and CEGS stations were built.(2) All the receivers are upgraded for receiving all frequencies signals of GNSS, including the new signals of BDS3.



Tracking signals:

GPS:L1,L2P,L2C,L5

BDS:B1I,B2I,B3I,B1C,B2a

GLO:G1,G2

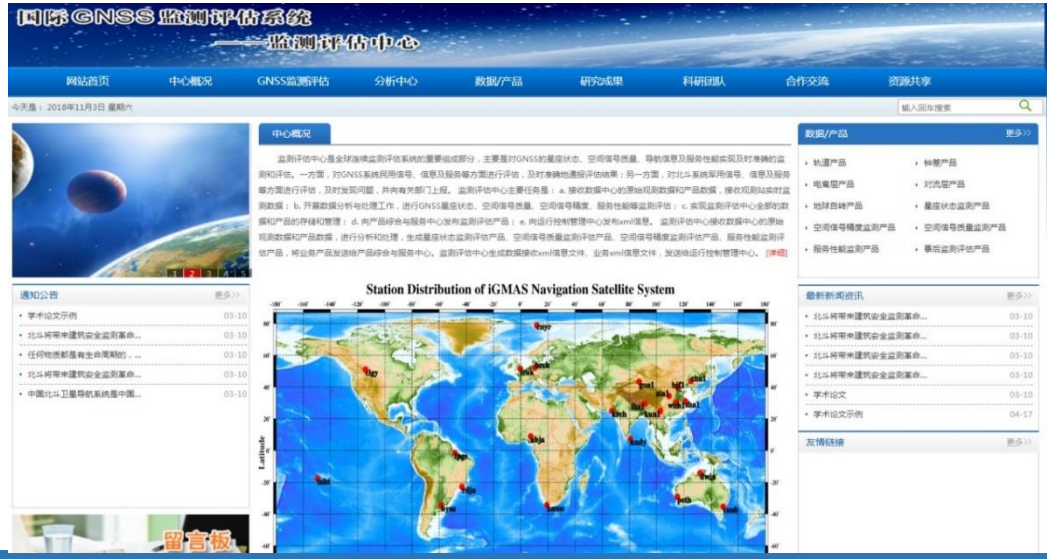
GAL:E1,E5A,E5B

(3)One new Monitoring and Assessment Center was built.

(4) All the data centers and analysis centers were upgraded to receive, storage and process all new signals of GNSS, including BDS-3 and provide products.

2.2 iGMAS MAC Update

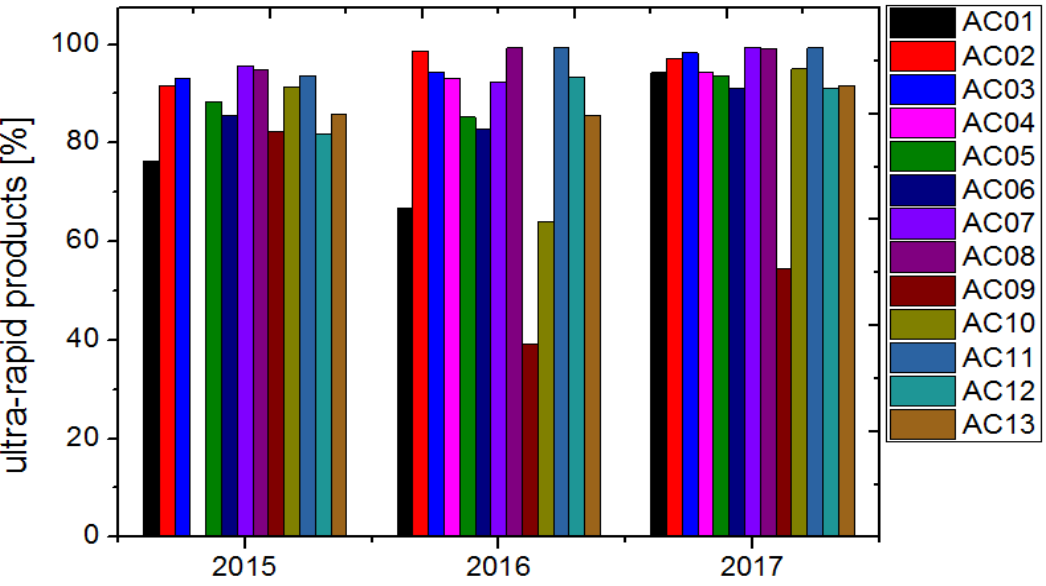
- Upgrade for near real-time monitoring and capability of processing Beidou-3 new signals.
- Upgrade for supporting the assessment by daily, weekly, monthly, quarterly, yearly, and non-fixed intervals.
- Develop the function of alarming, such as UERE.
- Working on the upgrade of the website and visualization.
- Next presentation will provide more details.



2.3 iGMAS Reference Products Update

➢ Timeliness

iGMAS has been making good progress at the continuity and stability of reference products. The timeliness of most the analysis centers have been improved with 6.7%,1.3% and 3.5% of Ultra, Rapid and Final products.

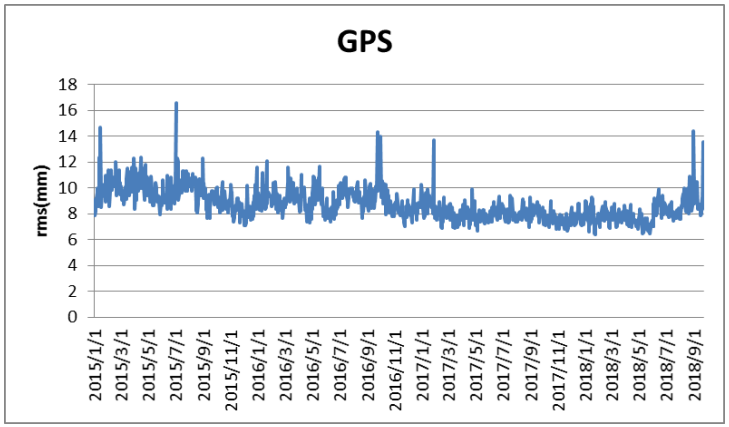


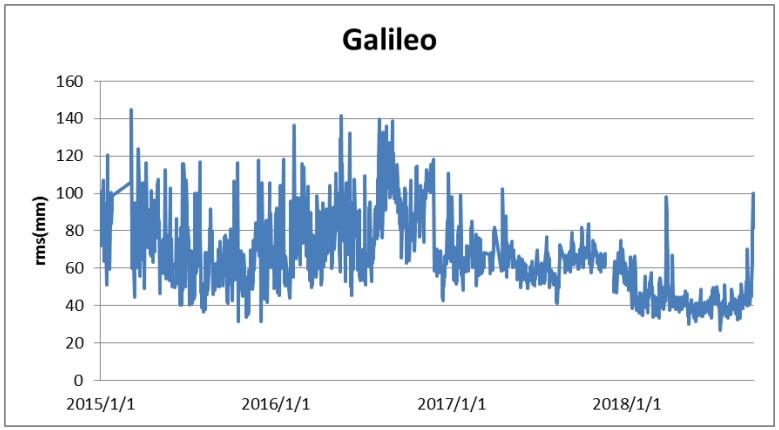
Timeliness of ISC Products

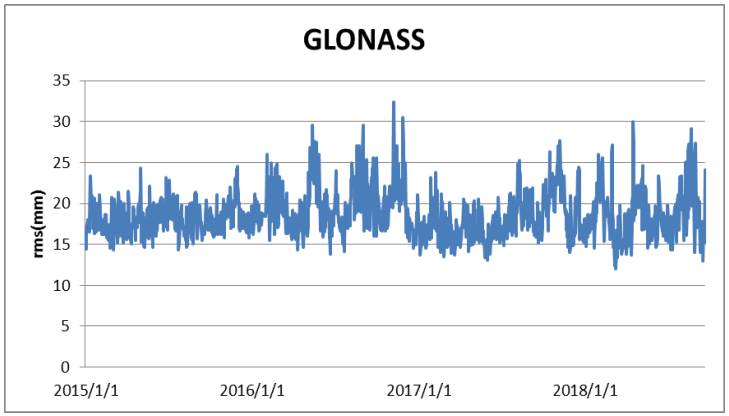
Year	Ultra	Rapid	Final
2015	96.43	94.94	98.25
2016	99.67	99.95	100.00
2017	99.77	100.00	100.00
	3.3%	5.1%	1.7%

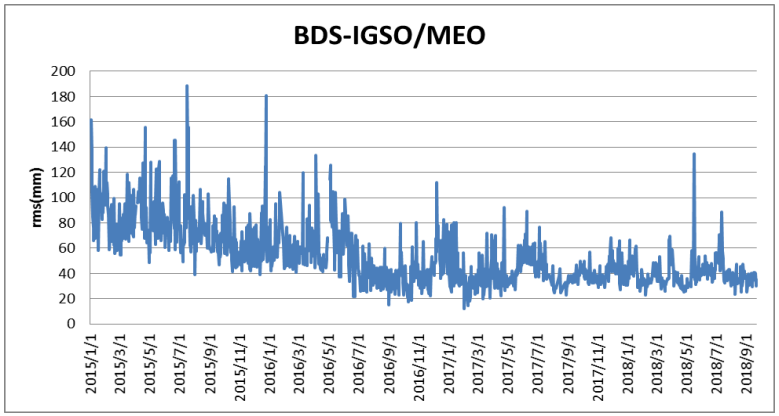
2.3 iGMAS Reference Products Update

➢ Final ISC Orbit







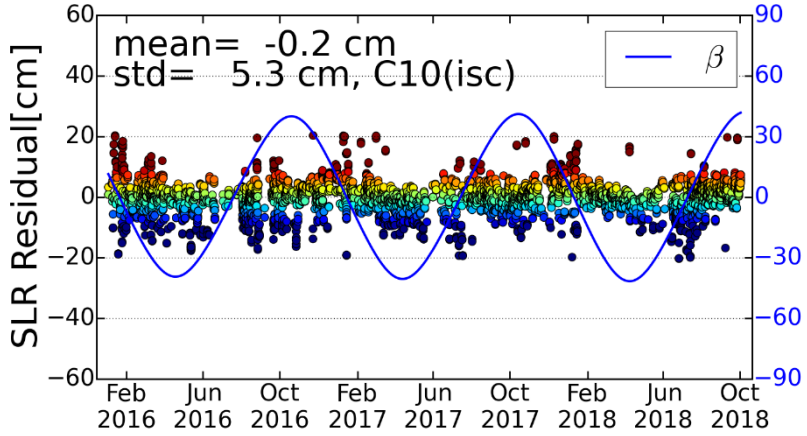


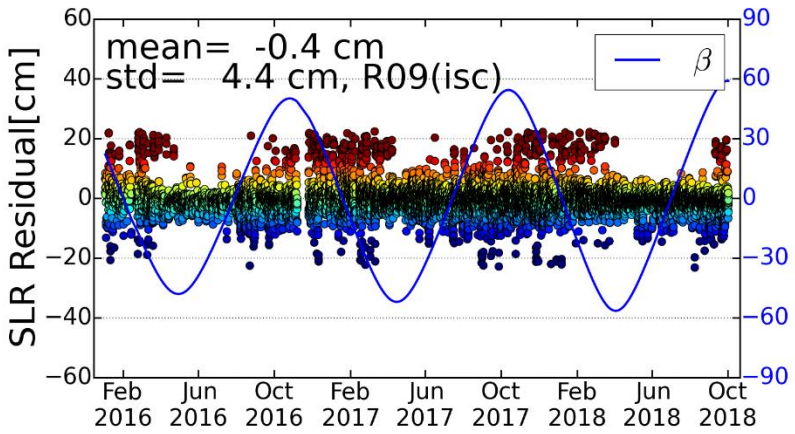
From 2015, the orbits of GPS and Glonass are more stable and improved gradually. For BDS and Galileo, the orbits are improved very distinctly in 2017 and 2018.

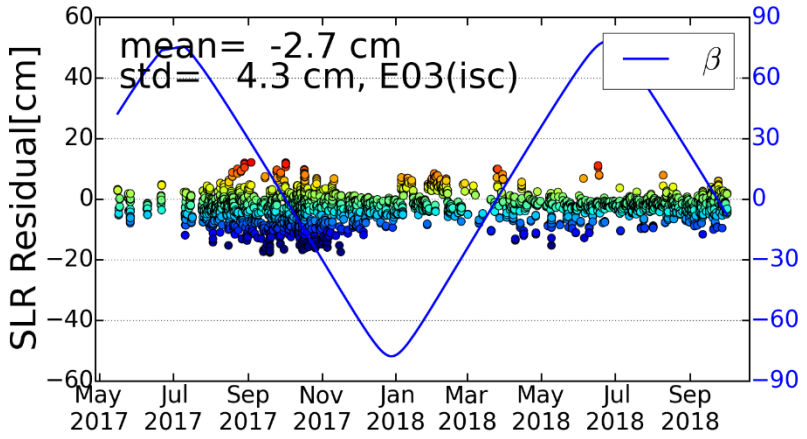
2.3 iGMAS Reference Products Update

➢ Check of Final ISC Orbit with SLR from 2016-

From 2016,the SLR tracking data for 4 BDS,16 GALILEO and 24 GLONASS have been analyzed routinely to check the ISC orbit in iGMAS.



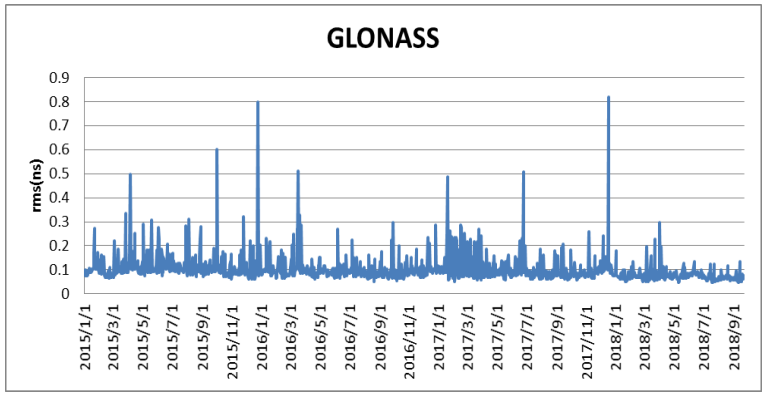


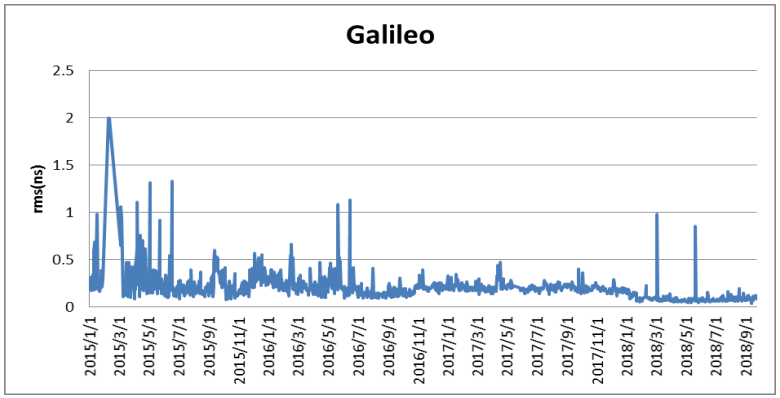


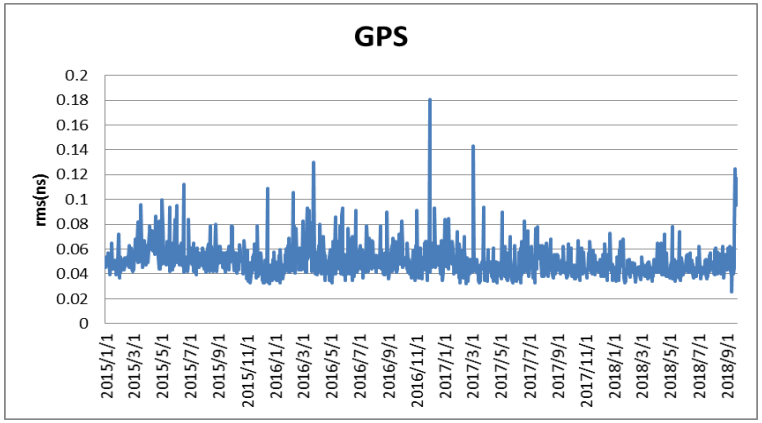
2.3 iGMAS Reference Products Update

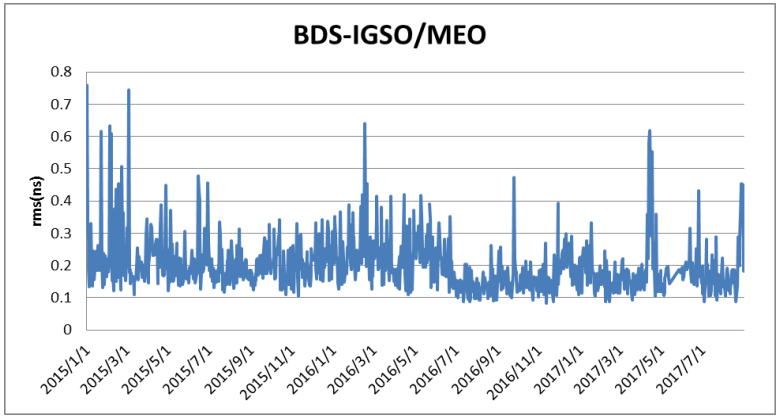
➢ Final ISC Clock

The statistics of iGMAS final ISC clock products from 2015 show that, the mean accuracy of GPS clock and GLONASS are more stable.









The accuracy of BDS and Galileo clock is improving gradually from 2015,BDS-GEO keep at 0.5ns,BDS-IGSO/MEO and Galileo at 0.2ns with respect to GFZ.

03

iGMAS Activities

- iGMAS Workshops
- Preliminary Performance Analysis of BDS-3

3.1 iGMAS Activities

From 2014 to 218,six iGMAS Workshops have been held which have brought lots of contributions to the development of iGMAS.

3.1 iGMAS Activities

2018 iGMAS Workshop was held during 3-4th,Nov. in XuZhou.There're more than 180 participants from 15 countries including German,Australia,Switzerland,Poland,Sweden,Brazil,etc.The main topic of this workshop is the improvement of iGMAS and the performance of BDS-3.

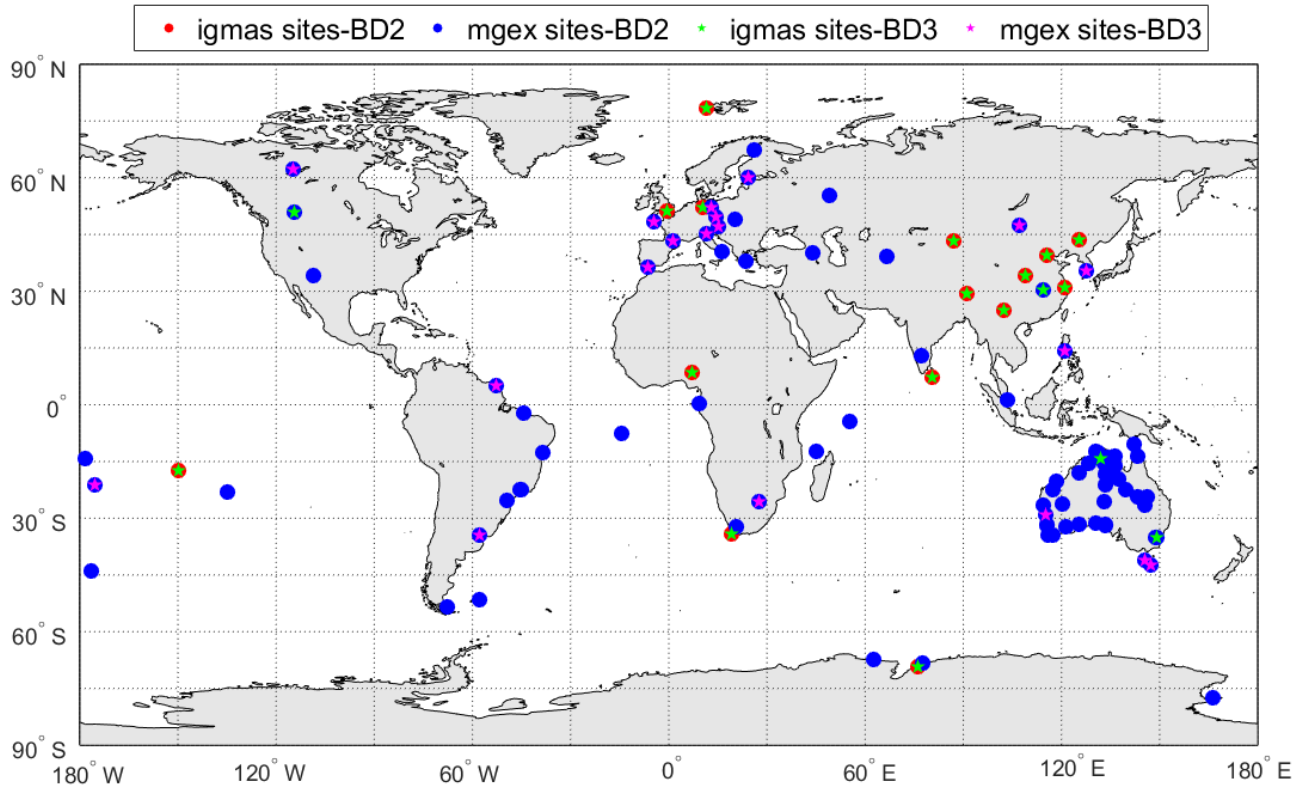
03

iGMAS Activities

- iGMAS Workshops
- Preliminary Performance Analysis of BDS-3

3.2 BDS Tracking Data

In this preliminary analysis activity, we have used the tracking data from iGMAS and MGEX for BDS POD,BDS-3 new signal quality and SIS accuracy analysis, precise point positioning.



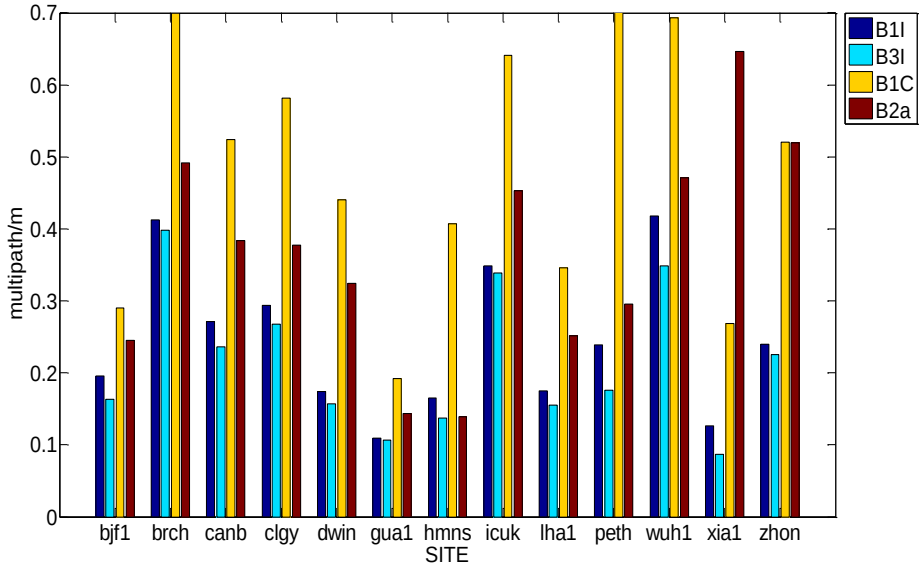
There're about 60 stations with BDS-2 tracking data and 39 stations with BDS-3 tracking data used during Aug. and Sept. 2018.

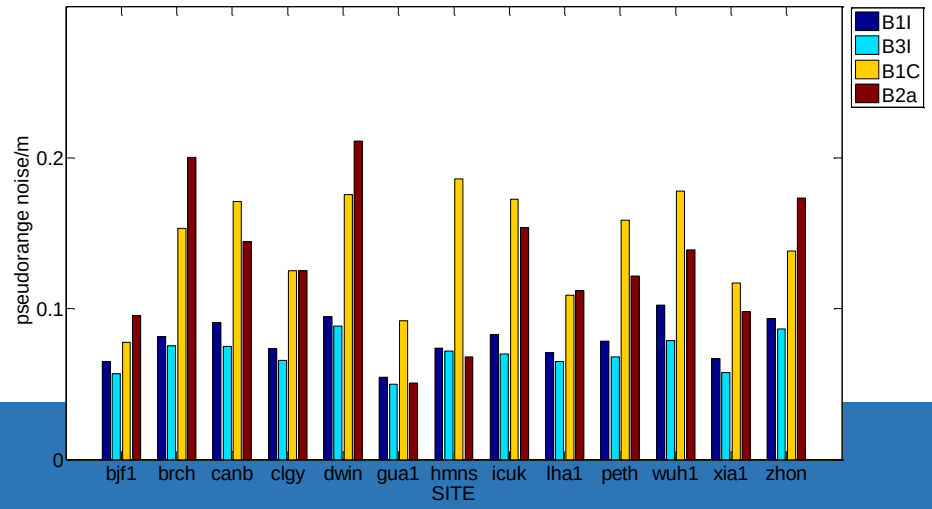
3.2 BDS-3 Data Quality

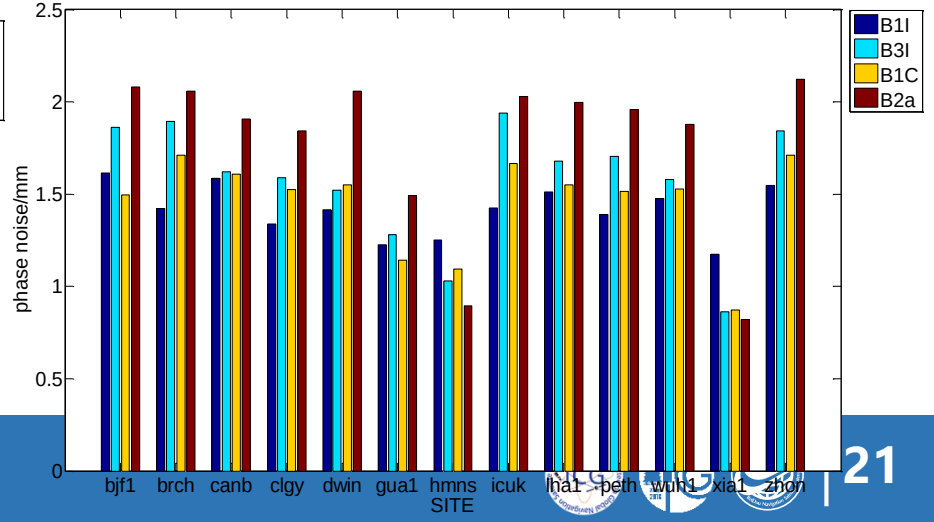
The multipath, pseudorange and phase noise of BDS-3 B1I,B3I,B1C and B2a have been analyzed at iGMAS stations.

For multipath and pseudorange noise, B1C and B2a are comparable at a few stations, but exhibit larger than B1I/B3I at most stations.

For phase noise, these four signals are in close range, only B2a exhibits a little larger than other three signals.

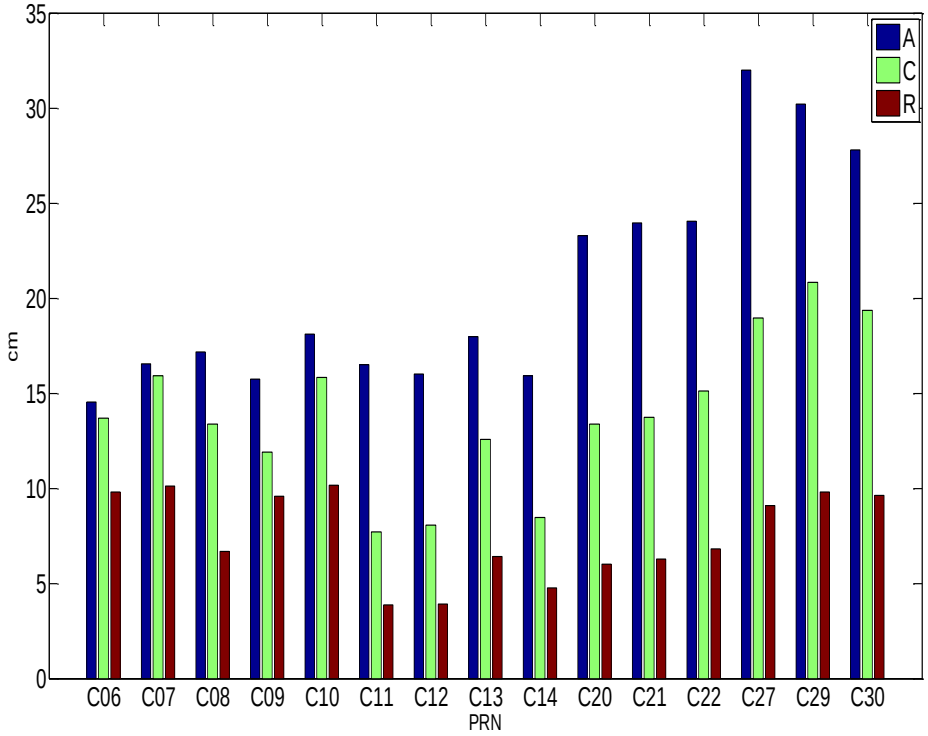


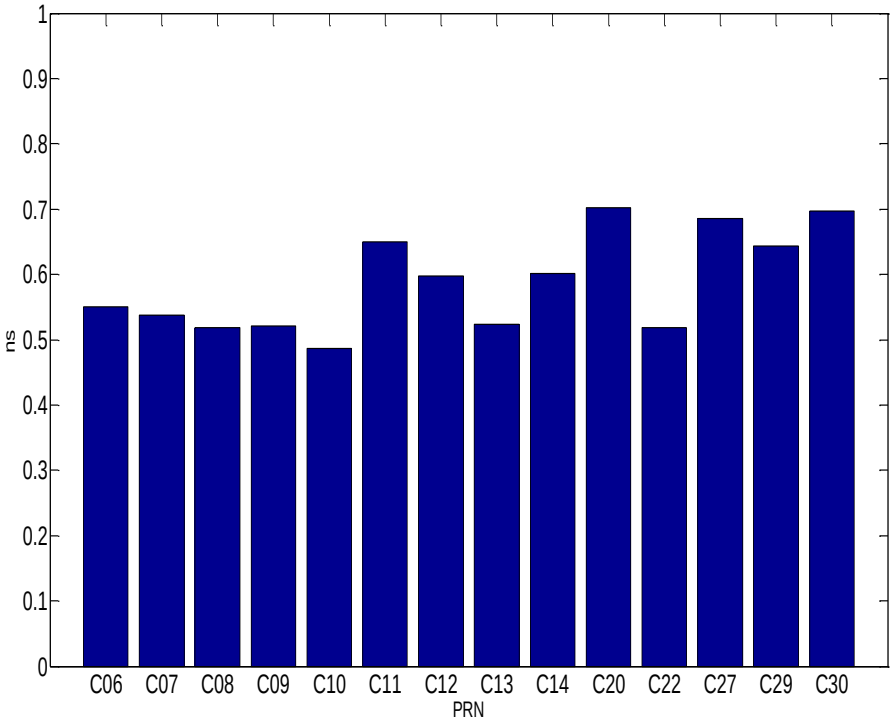




3.3 BDS Precise Orbit and Clock

With the B1I and B3I data for BDS-2 and BDS-3 from iGMAS and MGEX, the precise orbit and clock have been estimated during Aug. and Sept. 2018.

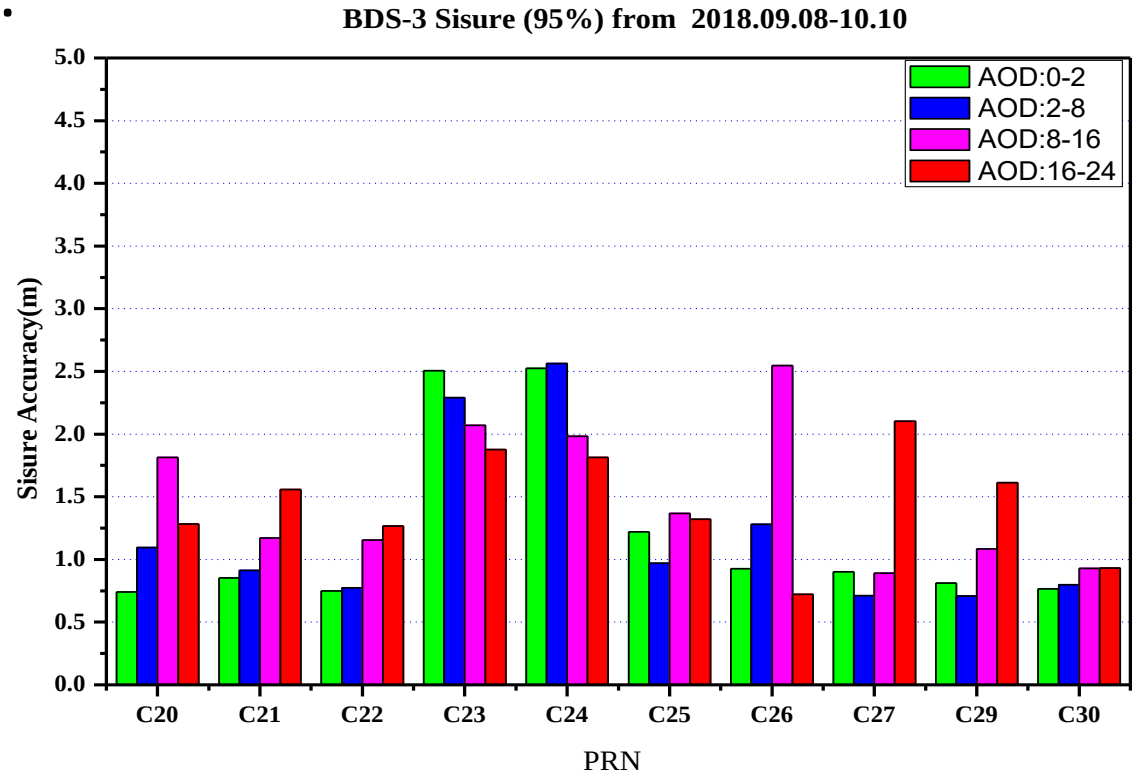




The overlap orbit and clock accuracy are analyzed preliminarily. Considering the number of tracking stations, BDS-2 and BDS-3 are comparable.

3.4 BDS SIS Assessment

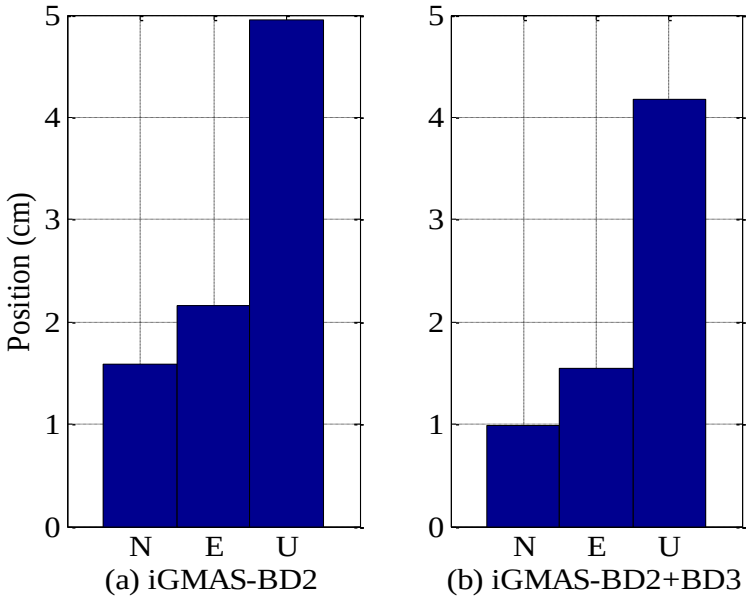
The parameters of navigation message of Sept. 2018 were analyzed according to different age of data.



For most satellites, the URE increase with the AOD except two new satellites C23 and C24 with less test time. More data will be used in further study.

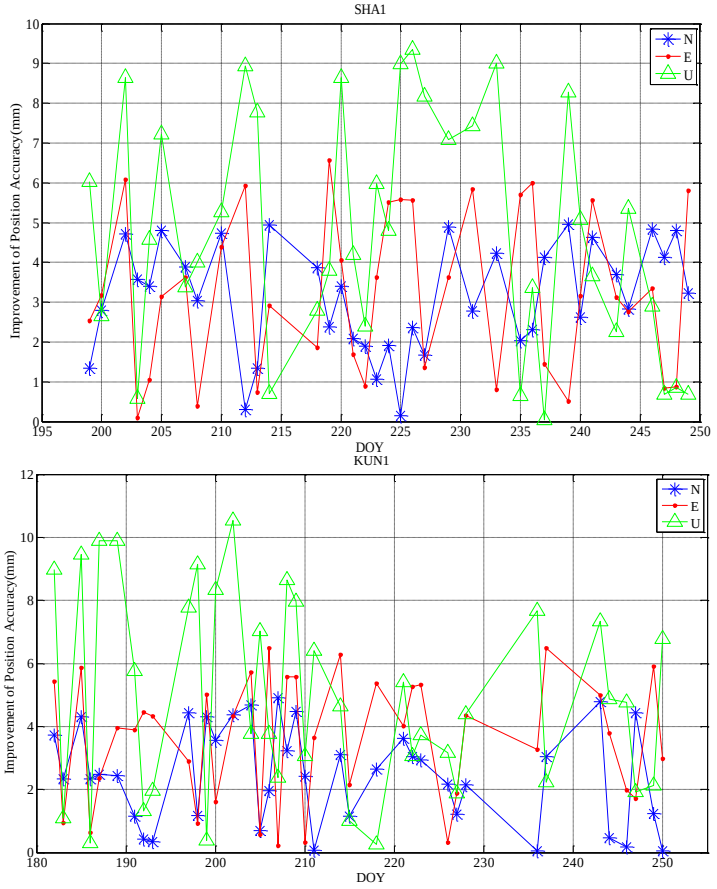
3.5 BDS Precise Point Positioning

The precise point positioning accuracy of BDS-2 in China and surrounding areas is about 5cm (rms) at some iGMAS stations, and the joint positioning accuracy of BDS-2 and BDS-3 is improved 37.70%,28.24%, 15.75% respectively at N E U direction.



(a) iGMAS-BD2

(b) iGMAS-BD2+BD3



04

Summary and Suggestion

04 Summary and Suggestion

- iGMAS has been making good process steadily and started providing valuable services including observations, reference products, monitoring and assessment reports.
- BDS3 new signals are being routinely processed and related products are available from iGMAS facilities. More information is on the Website: www.igmas.org
- Suggest strengthening international cooperation in terms of upgrading full GNSS tracking stations and participating full GNSS data analysis.

THANK YOU!

13th Meeting of the International Committee on Global Navigation Satellite Systems