



Differential BDS in China and the Research of DBDS standard in the Framework of RTCM

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- About Differential BDS (DBDS)
- Performance of DBDS
- Research of DBDS standard



About DBDS

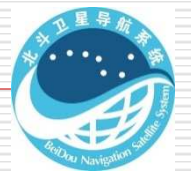


About Differential BDS

- ❑ Differential GNSS techniques to improve the accuracy of real time positioning
- ❑ Differential GNSS classified by the data sources
 - ❑ Code differential(CDBDS), 0.3m~2m
 - ❑ Phase differential(RTK),0.02m~0.10m
 - ❑ State Space Representation (SSR),0.1m~1.0m
- ❑ CORS, GBAS, RBN-DGNSS, etc. are used
- ❑ RTCM SC104 protocols are to support the DGNSS applications



Performance of DBDS

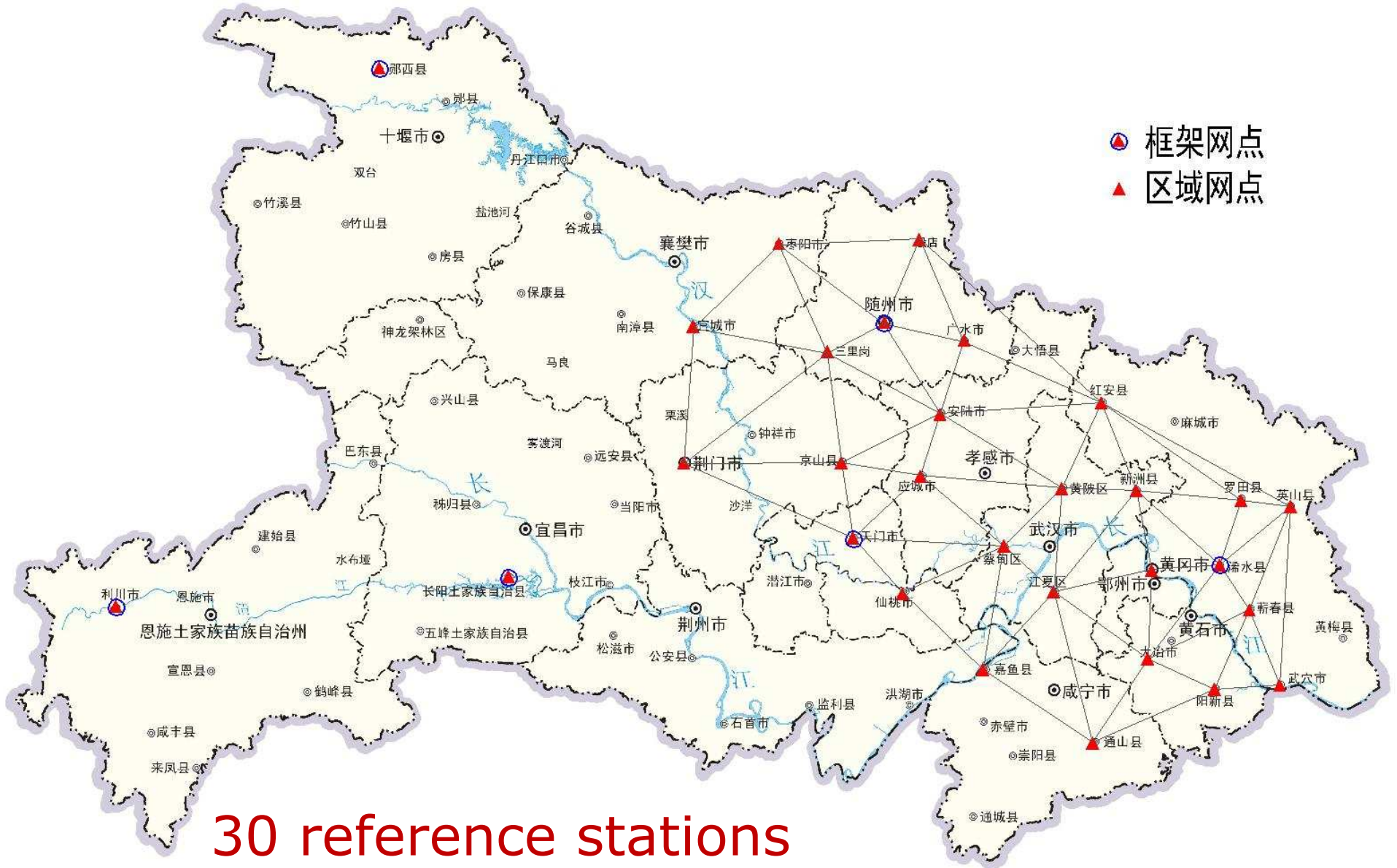


DBDS Test network

- 30+ reference stations
- Hubei Province BDS Network RTK System
- BDS/GPS/GLONASS



HuBei BDS Network RTK system

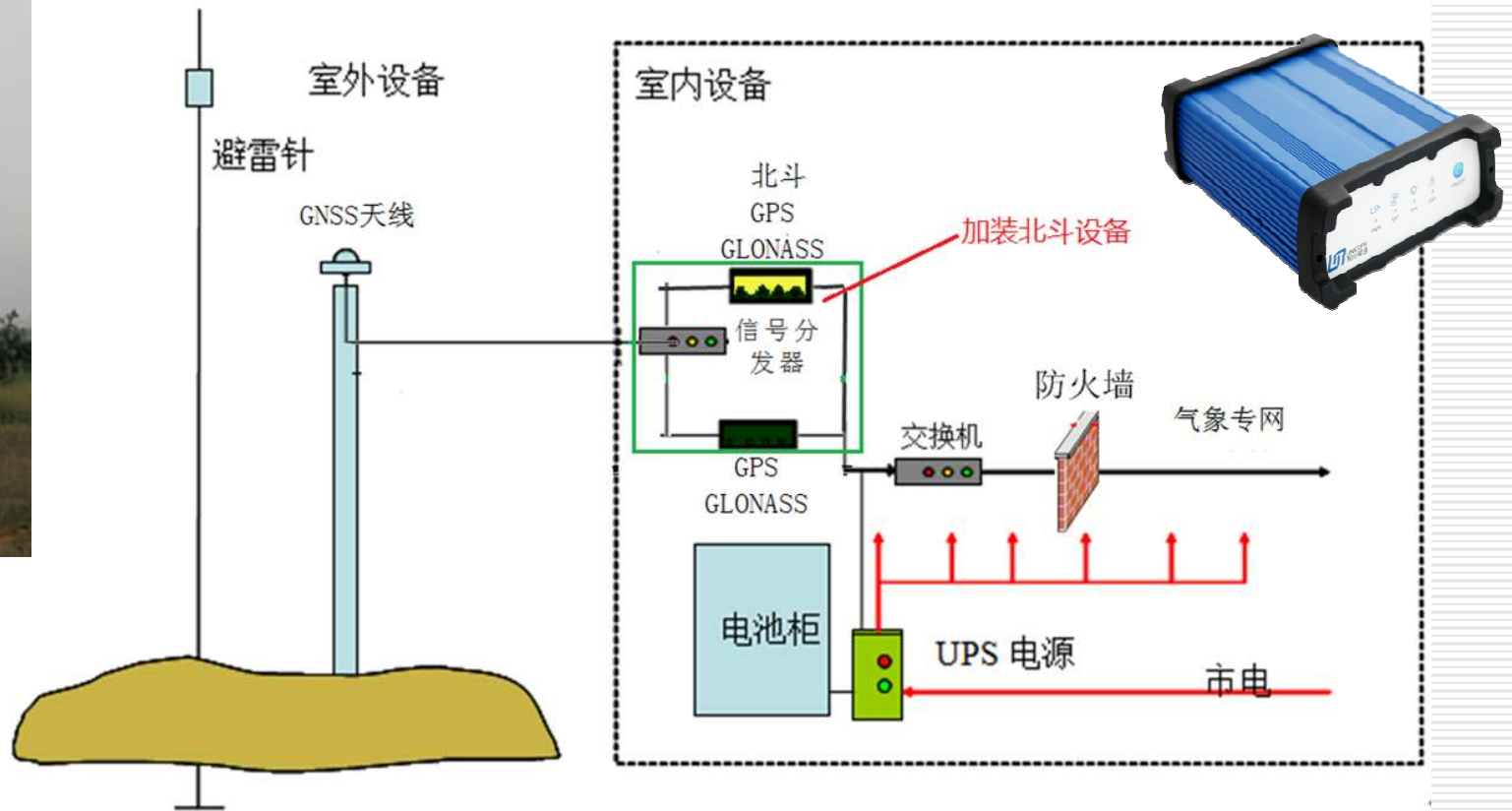


Reference stations

- BDS/GPS Receiver, UPS, Route, Switch etc.



tower:
high 3.5m



Data center

- Located at Hubei Surveying & Mapping Bureau



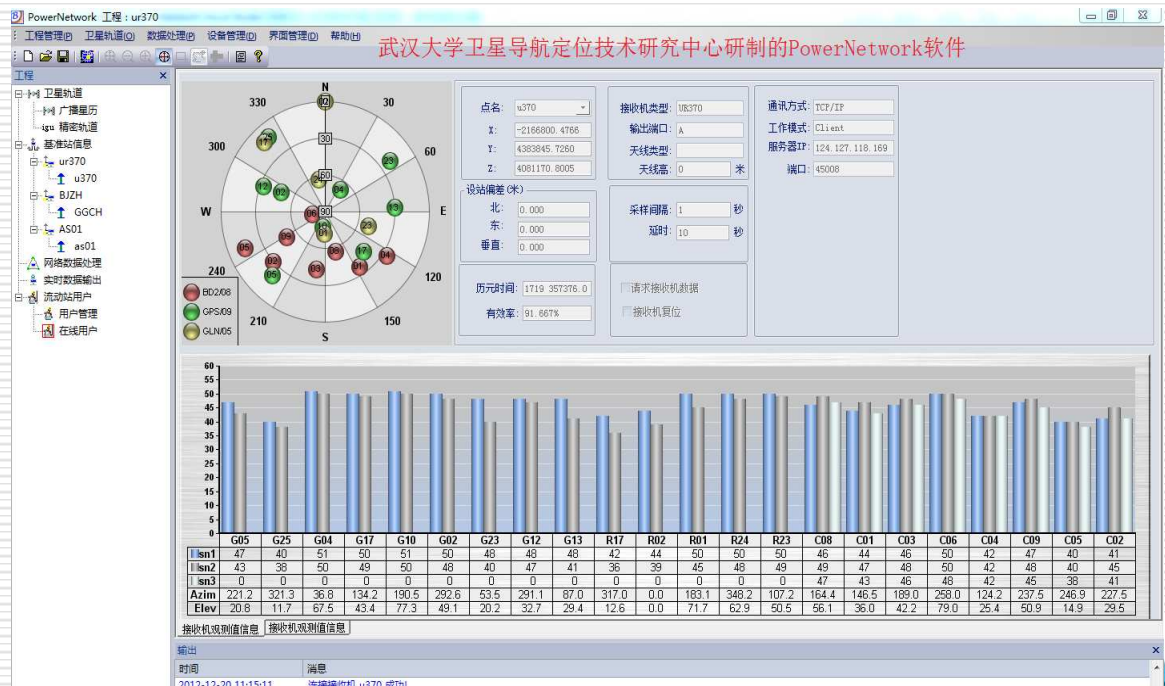
Software

□ Functions

- RS management
- Data process
- User management

□ Systems

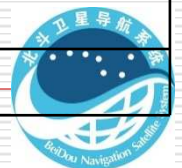
- BDS B1, B2, B3
- GPS L1, L2
- GLONASS L1, L2



User receiver—BDS/GPS OEM



	Specification
Freq	Beidou B1/B2 + GPS L1/L2
Positioning Mode	Support point positioning using Beidou only, GPS only, and Beidou/GPS
BDS	Support Beidou B1/B2, Support Beidou point positioning, differential Beidou, and high precision relative positioning
Differential Corrections	CMR,CMR+,RTCM2.x,RTCM3.x
RTK Positioning	Support instant RTK and long range RTK
RTK accuracy	Horizontal: 1 cm+1 ppm Vertical: 2cm+1 ppm
Power	1.6W
WAAS	Support WAAS and PPP



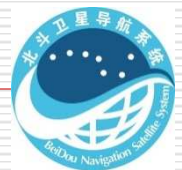
User receiver

- RTK Rover
- GIS data collector
-



Testing items

- Reference Station Coordinates
- Static post-processing
- Network RTK
- Code Differential
- Precision Point Positioning

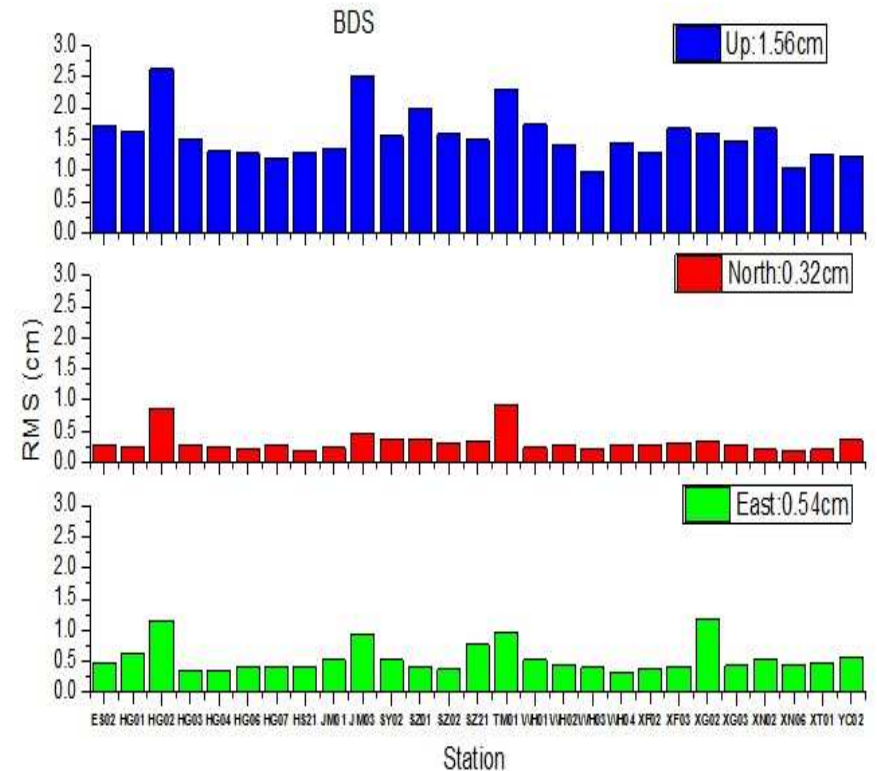


Experiments and Results

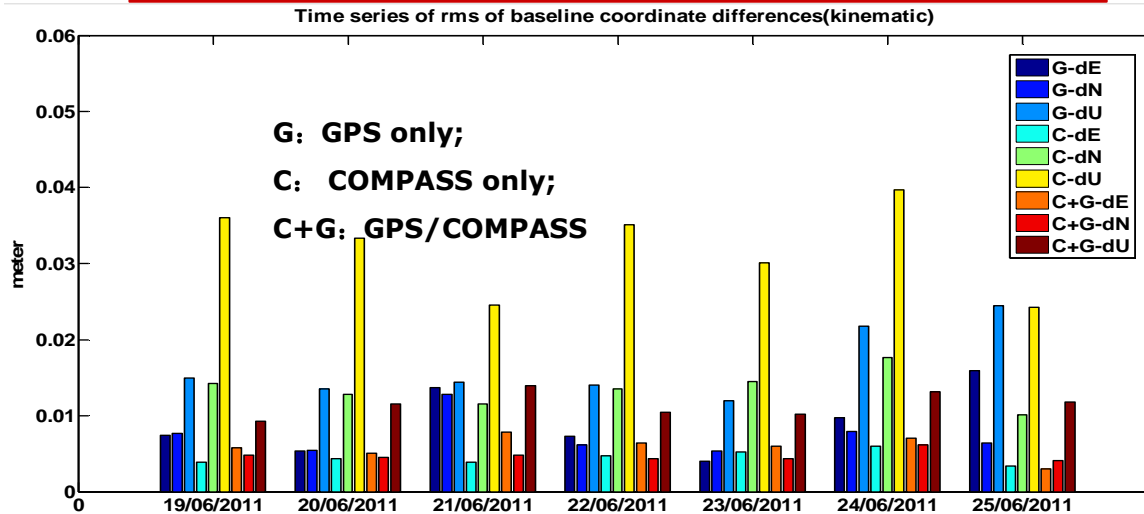
- Reference Station Coordinates—CGCS2000(BDS data only)

RMS H:0.006m、RMS V: 0.015m

ECEF RMS		Baseline Repeative
	RMS	Fixed +Scale
X	0.007m	6.7mm+ 2.8×10^{-8}
Y	0.010m	10.0 mm + 1.6×10^{-8}
Z	0.006m	5.8mm + 3.0×10^{-8}

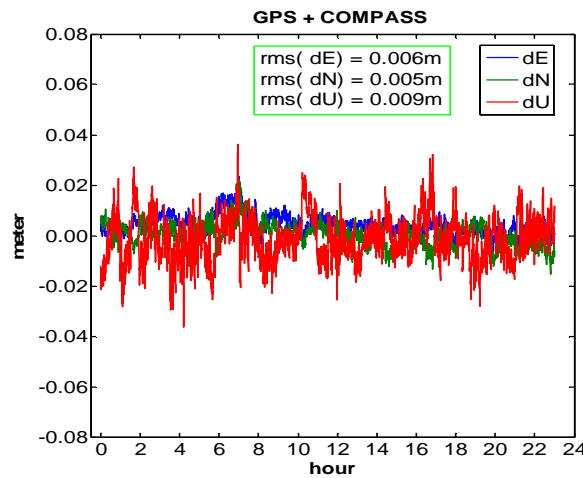
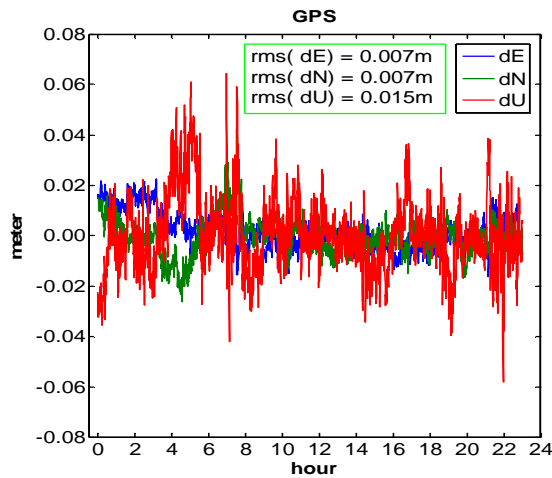


Experiments and Results-Static post-processing



**7Days Positioning Result Vs. GPS
(Dynamic, epoch by epoch)**

	<i>dE</i> (mm)	<i>dN</i> (mm)	<i>dU</i> (mm)
GPS	9	7	17
Beidou	5	13	32
GPS + Beidou	6	5	12



DOY170 (Dynamic) Vs. GPS

**20% precision improved
using BDS+GPS than
single GPS (Dynamic)**



Experiments and Results—NETRTK

□ Network RTK Positioning

■ BDS B1/B2 + GPS L1/L2

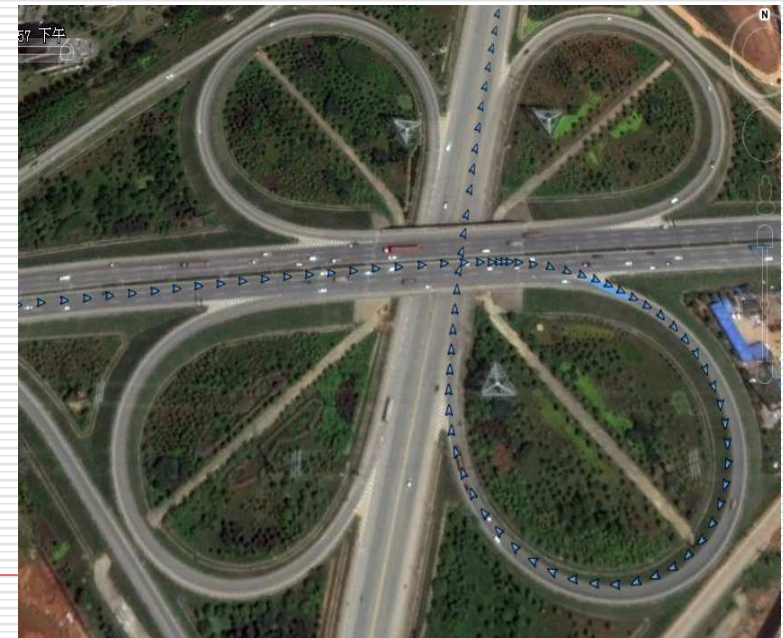
<i>Mode</i>	<i>Fixed</i>	<i>Initial Time (s)</i>	<i>STD/m (Average)</i>		<i>RMS/m (Average)</i>	
			<i>H</i>	<i>V</i>	<i>H</i>	<i>V</i>
<i>GPS+BDS3</i>	100%	5.76	0.004	0.018	0.010	0.036
<i>GPS+BDS2</i>	80%	27.46	0.003	0.015	0.011	0.042
<i>BDS3</i>	83%	16.40	0.007	0.020	0.013	0.052
<i>BDS2</i>	40%	50.78	0.003	0.015	0.014	0.045
<i>GPS</i>	44%	40.28	0.006	0.021	0.012	0.048



Experiments and Results—CDBDS

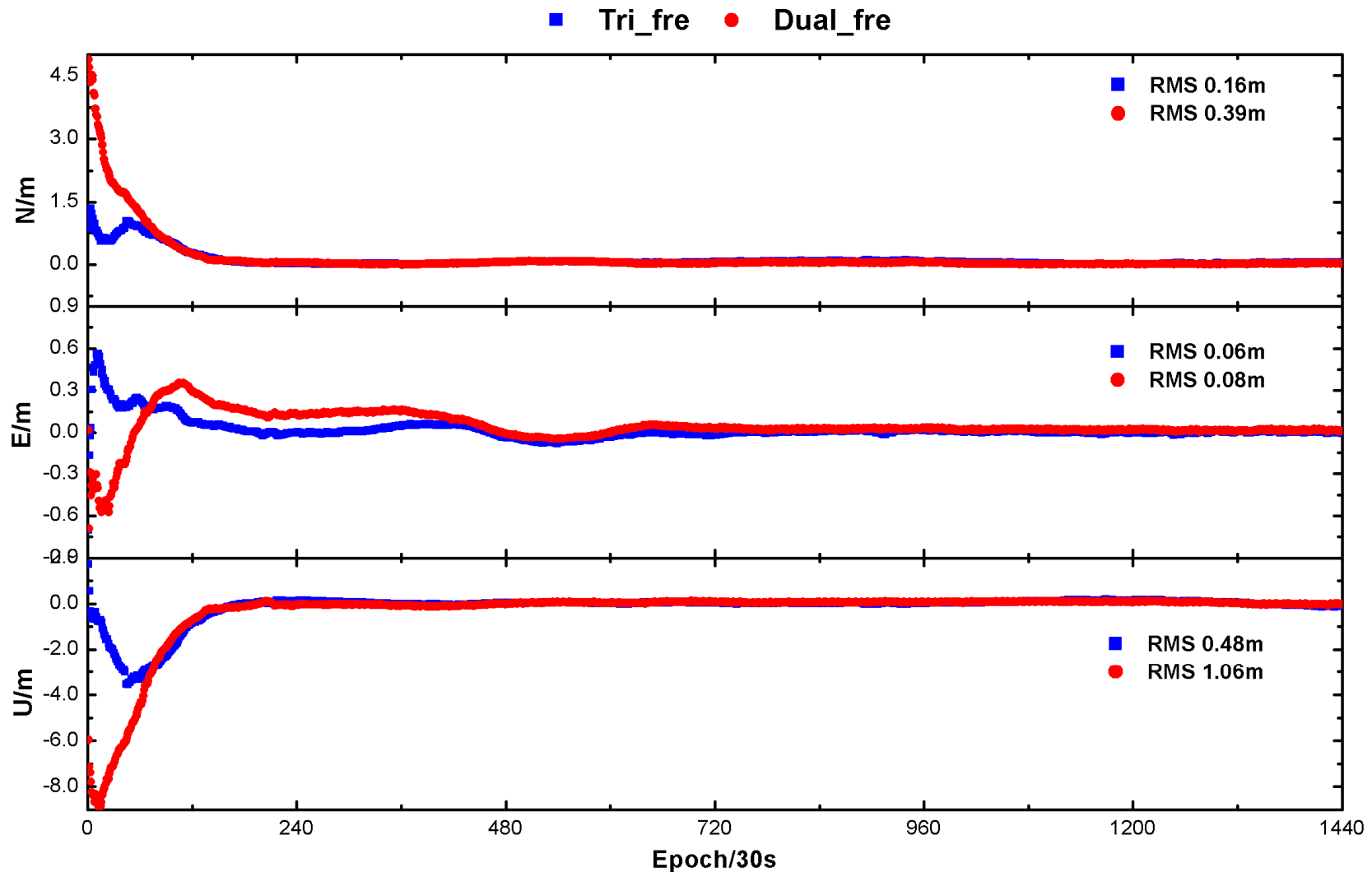
- Dynamic testing
- 1Hz position output
- RMS:0.67m, 1.5m(95%)

Mode	BDS L1
Points number	1344
1Sigma	0.67m
95%	1.44m



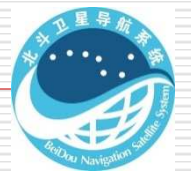
Experiments and Results—PPP

□ PPP B1/B2 and B1/B2/B3



Research of DBDS standard in the framework of RTCM SC104

2013-11-21



RTCM SC104 DGNSS Service

- Radio Technical Commission for Maritime services Special Committee No.104 (RTCM SC104) provides to DGNSS standard
- Using for manufactory, R&D, Service provider etc.
- Versions:
 - RTCM SC10402.3 for DGNSS applications
 - RTCM SC10403.2 for high precision applications



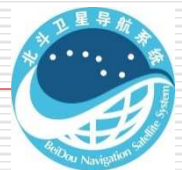
The thoughts of adding BDS Messages

- For RTCM SC10402.X
 - Add: B1 Code differential messages
 - Modified: Some messages
- For RTCM SC10403.X
 - Add: BDS Network RTK Corrections
 - Add: BDS Satellite Ephemeris
 - Add: BDS SSR
 - Comments: MSM messages etc.



The progress in 2013

- Attend the RTCM SC104 conference in Nashville, Sept 2013
- Wuhan Navigation & LBS Inc. suggested to form BDS Working Group to provide BDS support to RTCM committee.
- Dr. Shaowei Han was elected as RTCM SC104 the BDS WG chair. Dr. HuiLiu is the secretary.
- There were 15+ organizations apply to attend the BDS WG
 - Trimble、Novatel、Geo++、Navcomm、etc.



RTCM SC104 WebSite

Upcoming Meetings:

30-31 January 2014

Bahia Hotel

San Diego, CA, USA

[Transport and Lodging Information](#)

21-22 May 2014

European Space Operations Centre

Darmstadt, Germany

8-9 September 2014 (to be confirmed)

Tampa, FL, USA



Reference Materials
RTCM Bylaws
RTCM Standards Development Policies
Galileo ICD
BeiDou ICD
RTCM 3.2 Message Sample/Template

Active Working Groups	Chair
RTK Network MSG	Frank Takac
Internet Protocol	Georg Weber
GALILEO	Hans-Jürgen Euler
GLONASS	Alexei Zinoviev
DGNSS Beacon Services	Al Cleveland
Private Services	Ivo Milev
State Space	Gerhard Wübbena
Version 3	Paul Alves
Coordinate Transformation	Martin Schmitz
RINEX	Ken MacLeod
BeiDou	ShaoWei Han



Conclusions

- ❑ BDS is in operation. The performance of DBDS in China is satisfied to the most user's requirements
- ❑ It is necessary to define the DBDS unified interface between service provider and end users.
- ❑ The full BDS messages in RTCM SC-104 standards are needed as quick as possible so that worldwide GNSS manufacturers can participate those campaigns.
- ❑ BDS WG will push it to happen faster.





Thanks you very much for
the attention!

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