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ASIA-PACIFIC SPACE COOPERATION ORGANIZATION

APSCO-IGMA Project Update

Presenter: Byambasuren Erdenee, Senior Official

November, 2018

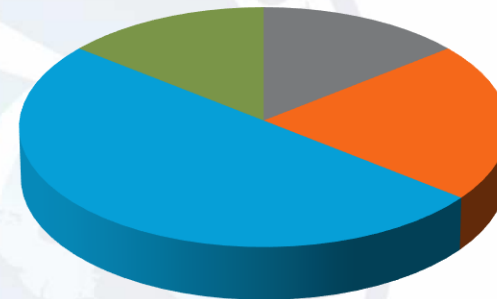


Outline

- Background
- Current Progress
- Monitoring & Assessment Results
- Summary



- Asia-Pacific Space Cooperation Organization (APSCO) is an inter-governmental organization, actively involved to promote space cooperation within Member States to achieve maximum benefits from space resources.
- In 2012, APSCO Secretariat and China Satellite Navigation Office (CSNO) signed a Letter of Intent for joint promotion of exchange, cooperation and application of Global Navigation Satellite System. And carried out several cooperated application projects. Including demonstration of application in emergency management and disaster rescue, development of software receiver and etc.



- Space Technology
- Space Science
- Space Technology Application
- Education and Training



Background

- At ICG-6 meeting (2011), “International GNSS Monitoring and Assessment” (IGMA), co-chaired by China, Japan and IGS, was initiated and established under WG-A scheme to promote International GNSS Monitoring and Assessment (IGMA) implementation.
- In year 2015, based on IGMA proposal, China proposed the APSCO-IGMA Project aims at promoting the understanding of GNSS monitoring and assessment technology, as well as deepening the technological cooperation on GNSS among APSCO Member States.
- 2017, the APSCO-IGMA project start to implementation.



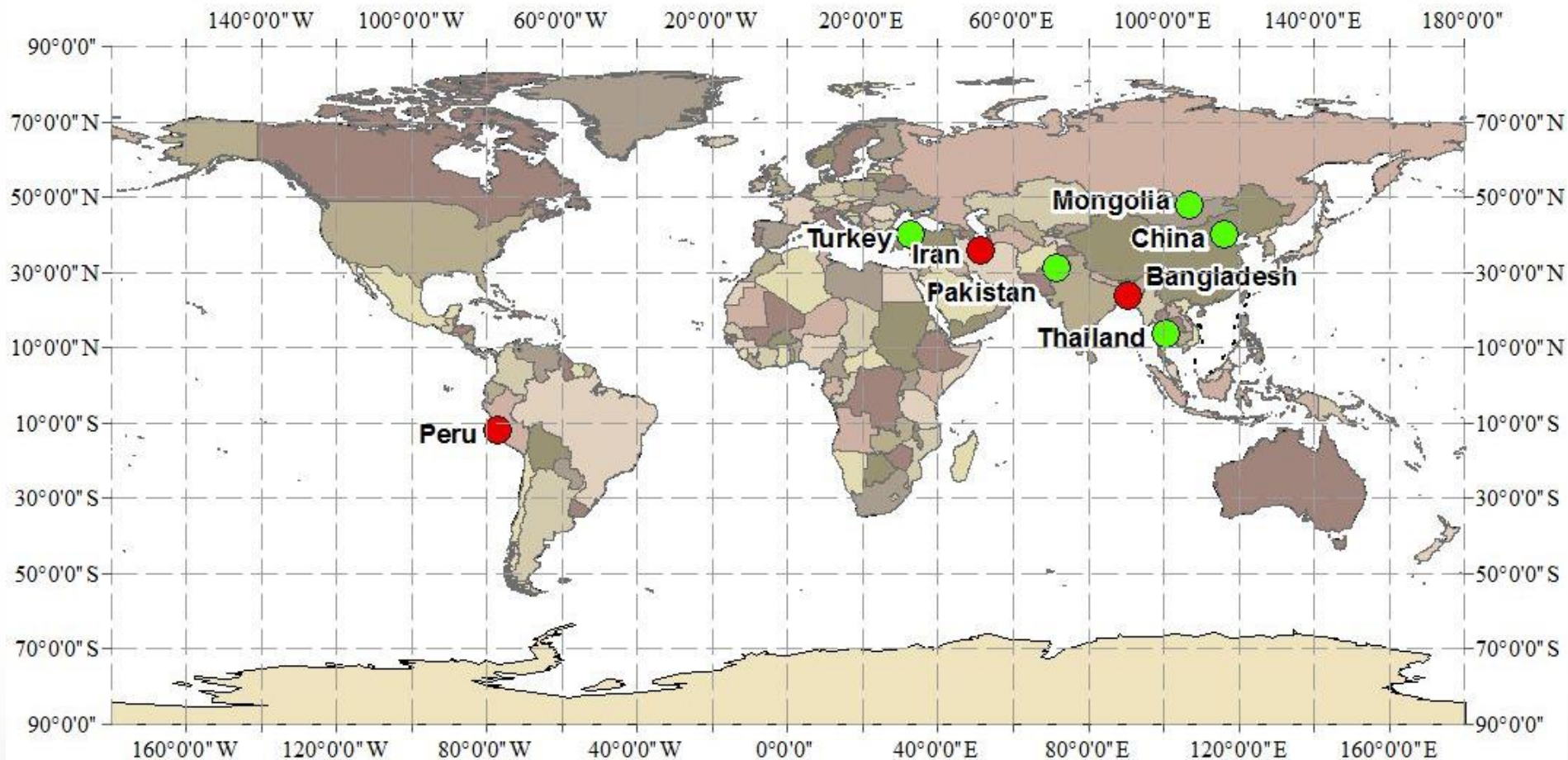
Current Progress

- 5 Member States (China, Mongolia, Pakistan, Thailand and Turkey) have completed station construction and installation work, as well as integration test and technician training.
- 3 Member States (Bangladesh, Iran and Peru) have finished site investigation work such as evaluating proposed sites, on site survey and test. The construction and installation will be finished by the end of year 2018.
- The APSCO-IGMA project is expected to be completed at the beginning of year 2019.



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The Distribution of 8 APSCO Stations



Legend

- Site investigation finished
- Station construction finished

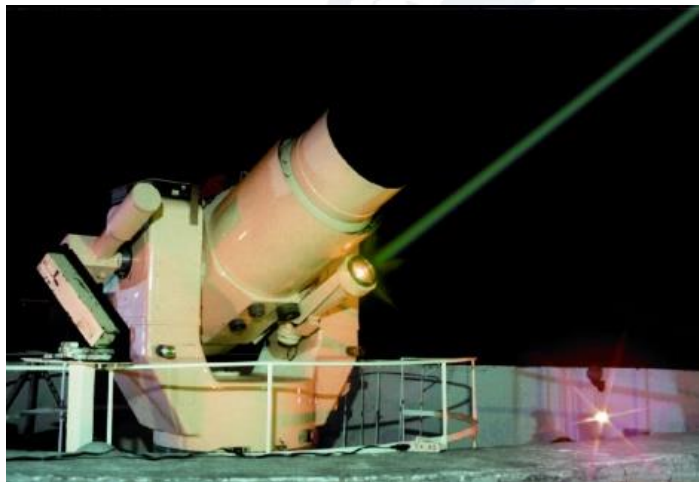


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Current Progress

China (bjf1)

- Location: Fangshan District, Beijing





Current Progress

Mongolia (ulbt)

- Started in September, 2018
- Location: New Mongol Institute of Technology, Ulaanbaatar





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Current Progress

Pakistan (mult)

- Started in September, 2018
- Location: Bahauddin Zakariya University (BZU), Multan;





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Current Progress

Thailand (csrs)

- Started in July, 2018
- Location: Kasetsart University of Bangkok, Bangkok





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Current Progress

Turkey (metu)

- Started in August, 2018
- Location: Middle East Technical University, Ankara





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Current Progress

Bangladesh, Iran & Peru

- Has finished site investigation, the station construction work is underway



Bangladesh



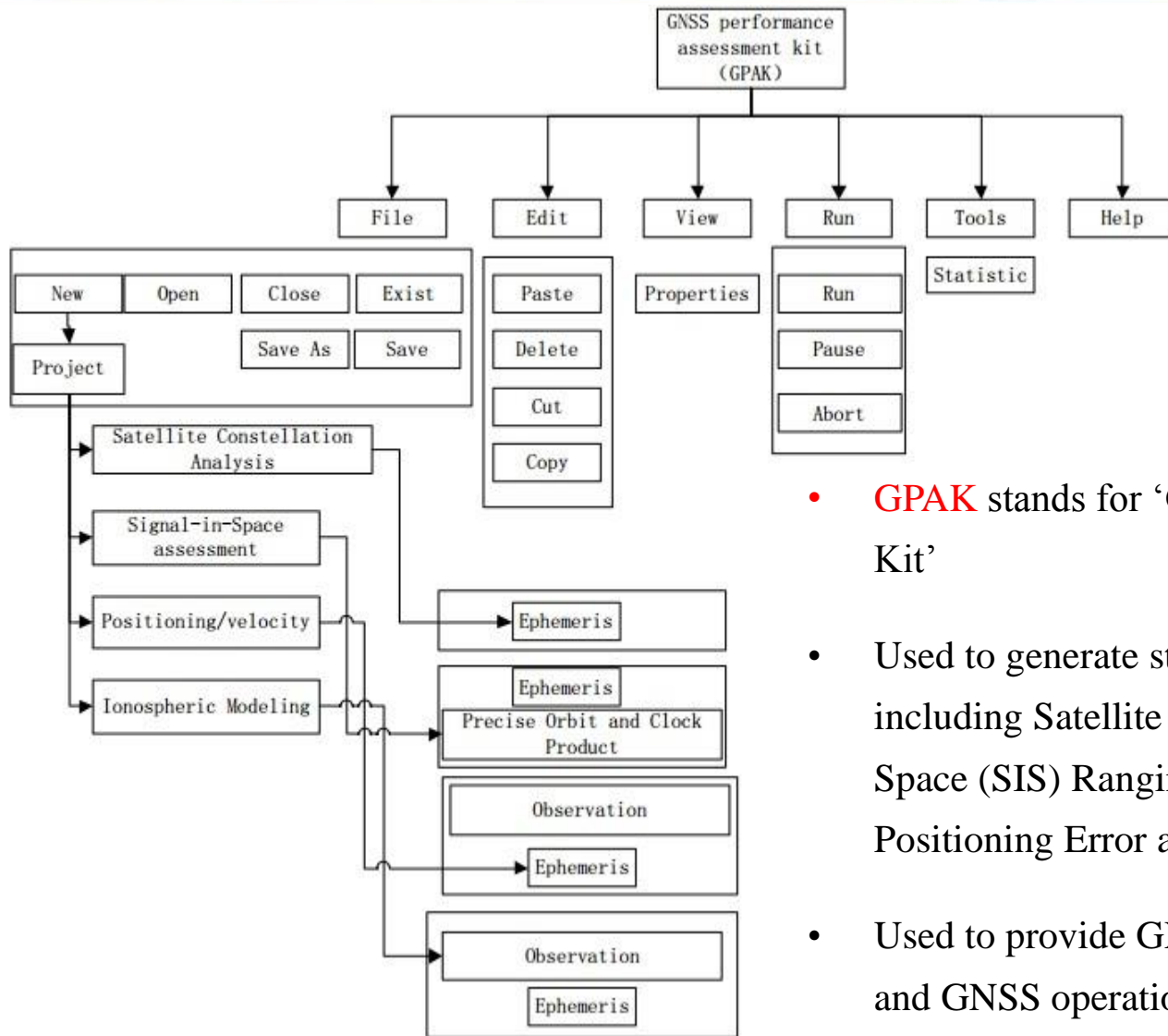
Peru



Iran



Monitoring & Assessment Results



- **GPAK** stands for ‘GNSS Performance Analysis Kit’
- Used to generate statistical and visual products, including Satellite Constellation, Signal-In-Space (SIS) Ranging Error, Data Quality, Positioning Error and Ionosphere Delay
- Used to provide GNSS performance simulation and GNSS operation status comparison

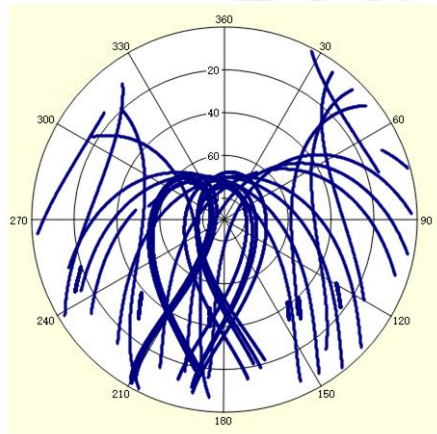


Monitoring & Assessment Results

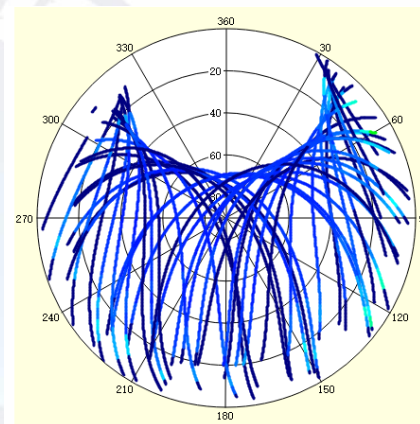
China (bjf1)

Skyplot

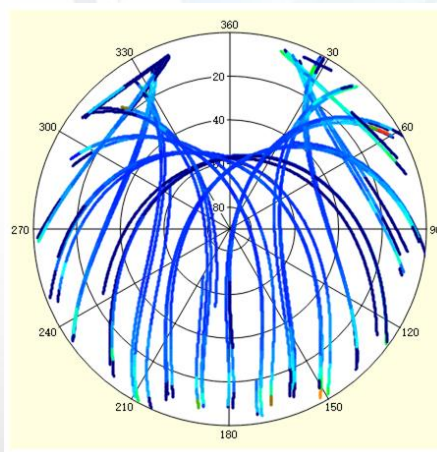
BDS



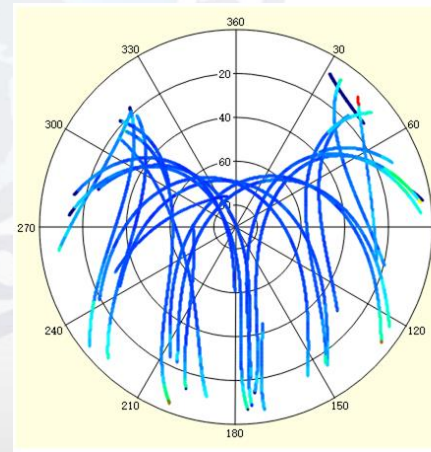
GPS



GLONASS



Galileo



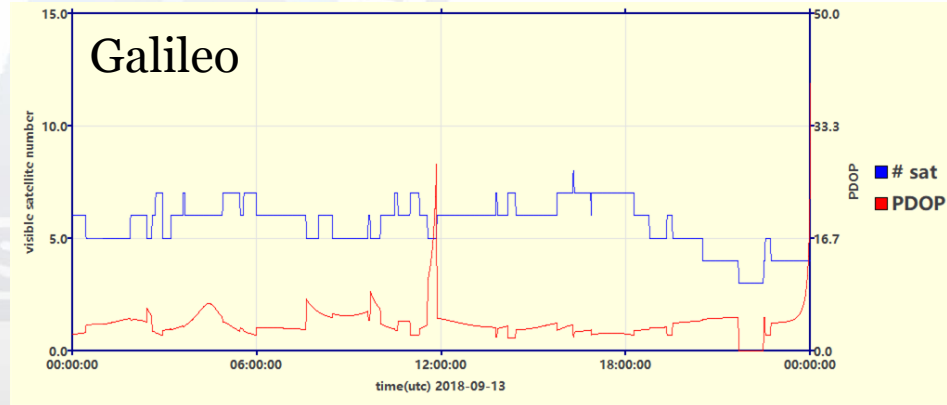
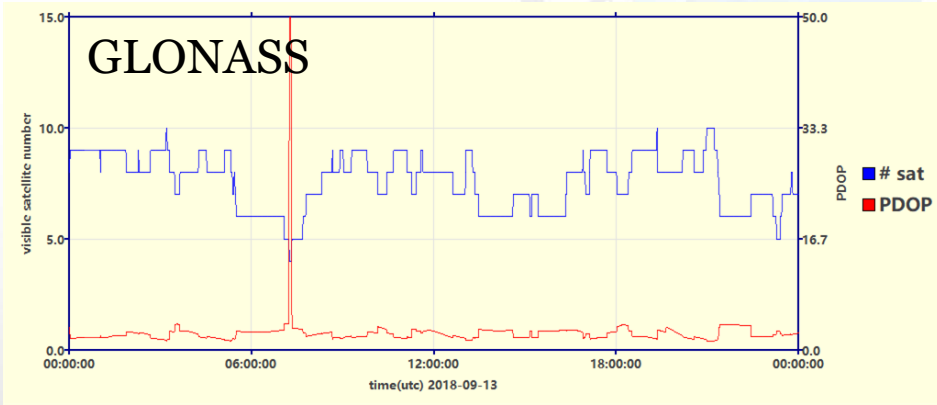
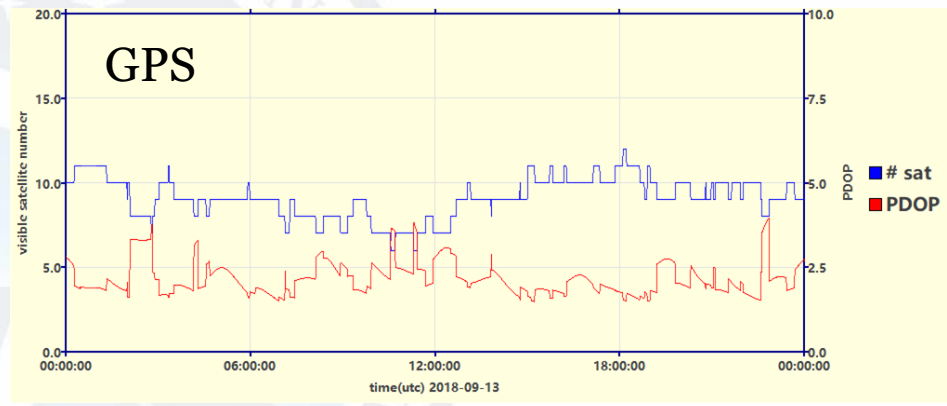
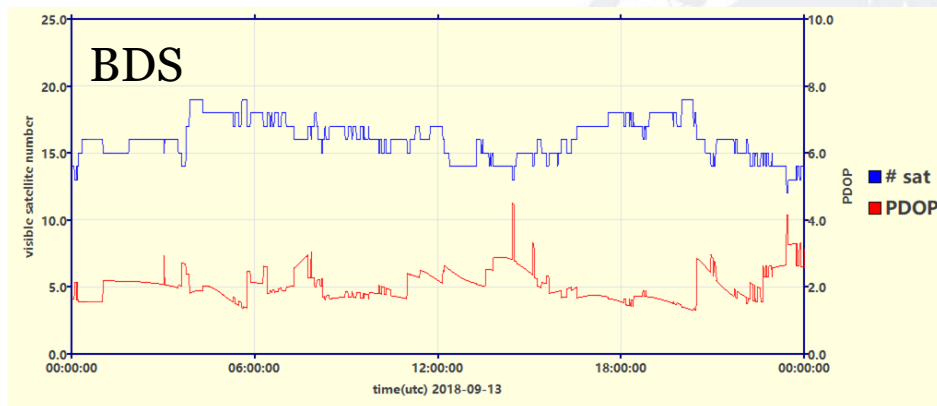
Test Date: Sep.13, 2018



Monitoring & Assessment Results

China (bjf1)

Number of Visible Satellites and PDOP



Test Date: Sep.13, 2018

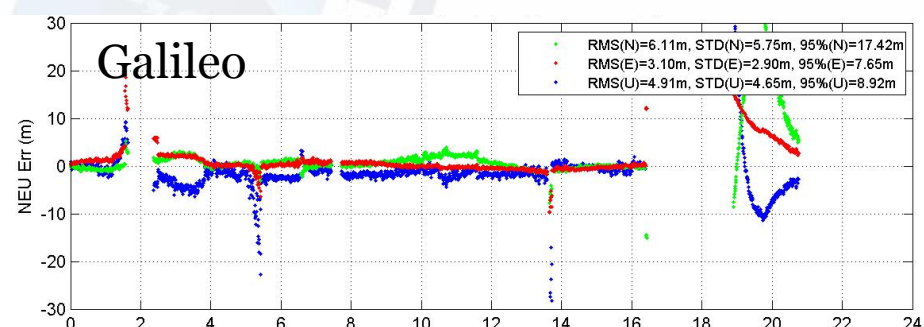
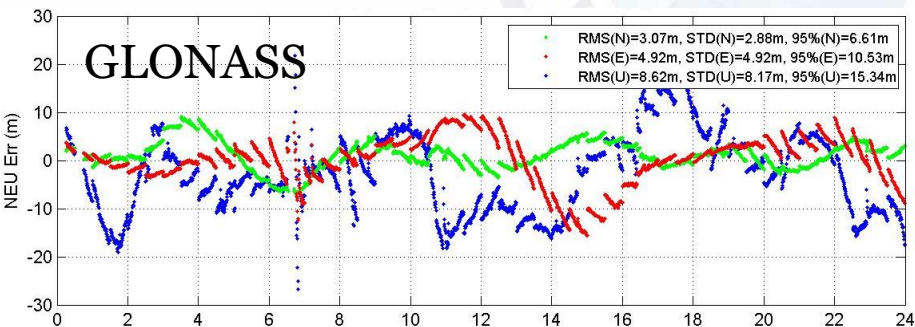
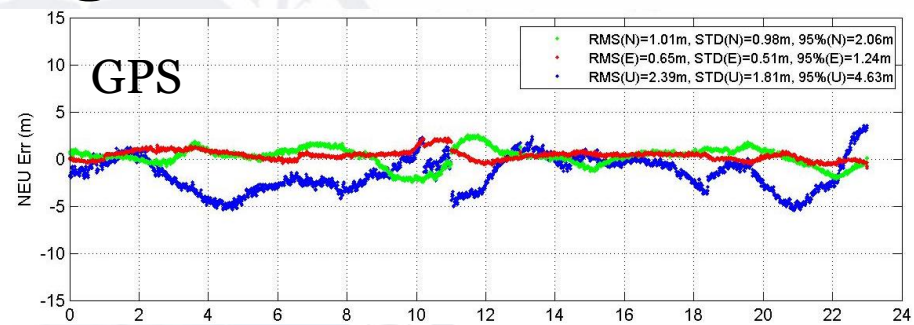
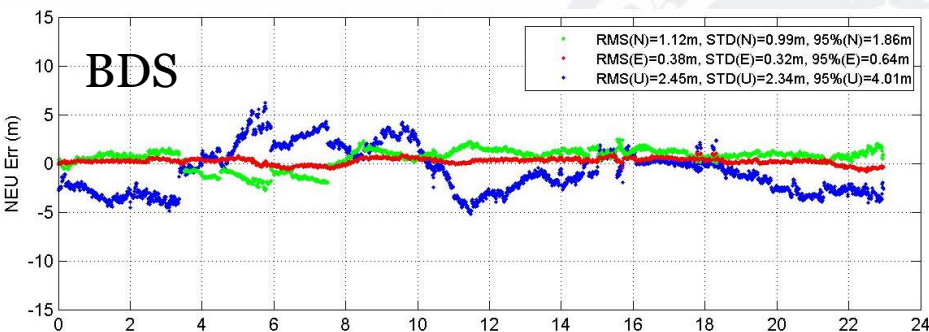


Monitoring & Assessment Results

China (bjf1)

Positioning Error

— N — E — U



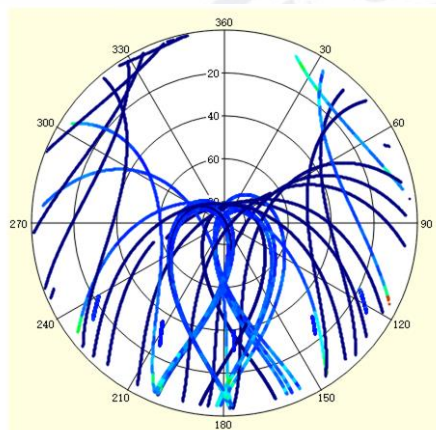


Monitoring & Assessment Results

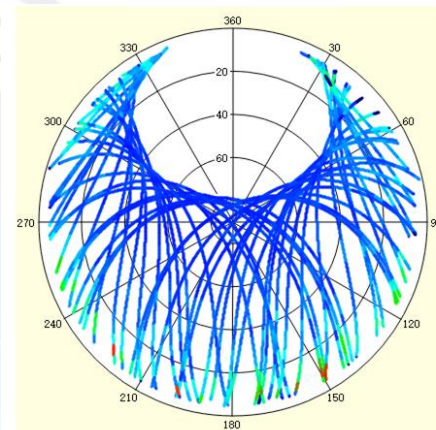
Mongolia (ulbt)

Skyplot

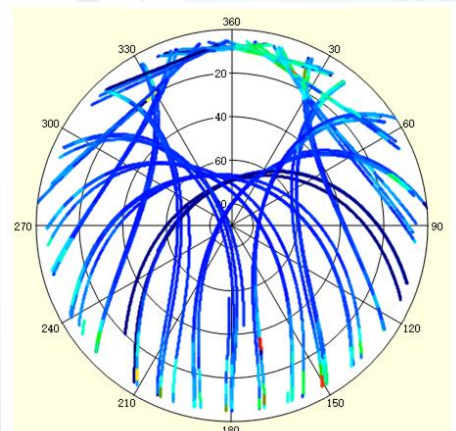
BDS



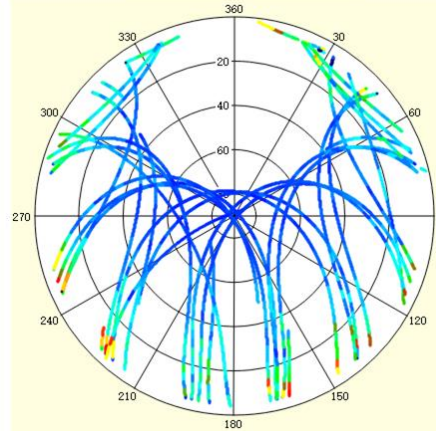
GPS



GLONASS



Galileo



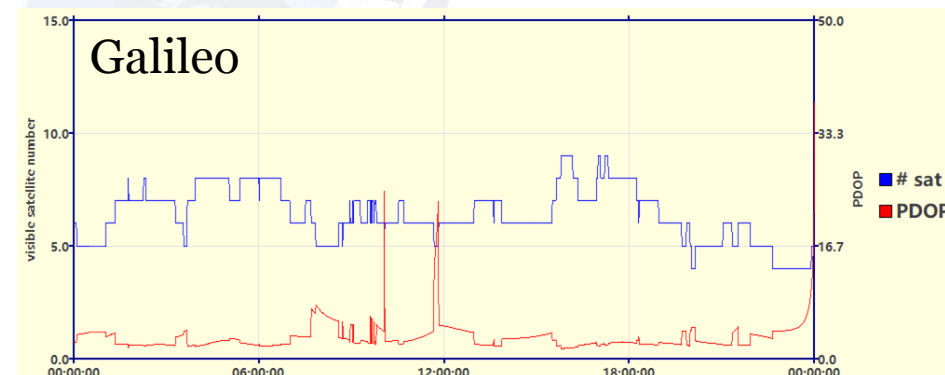
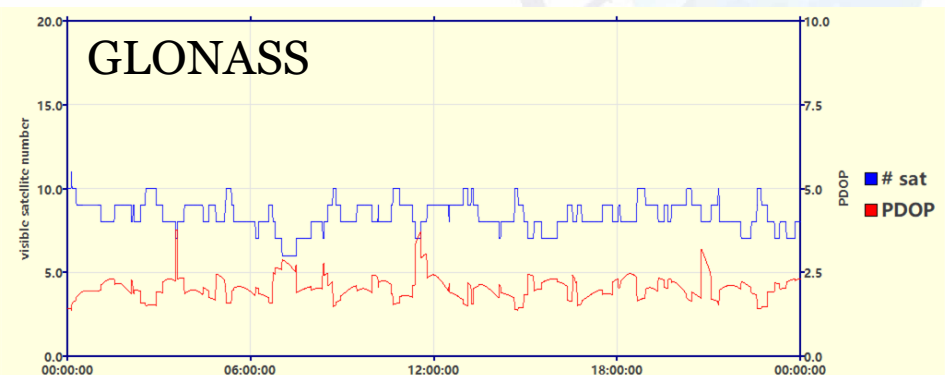
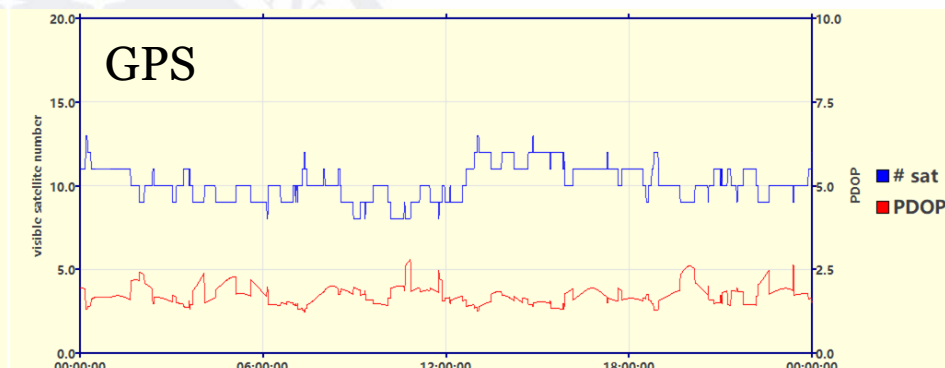
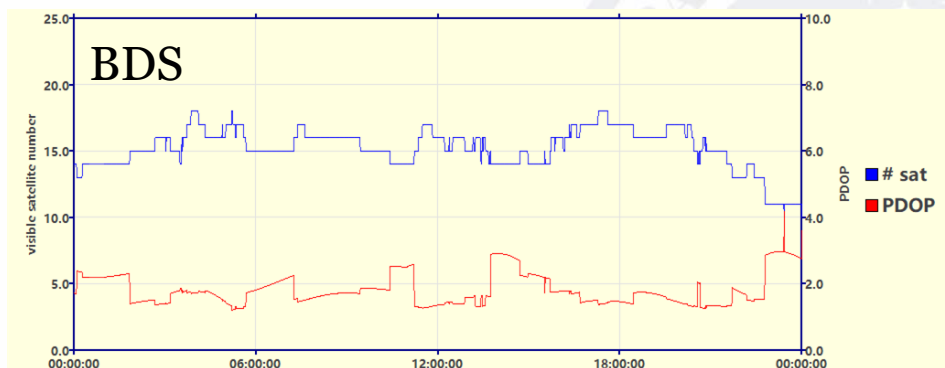
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Monitoring & Assessment Results

Mongolia (ulbt)

Number of Visible Satellites and PDOP



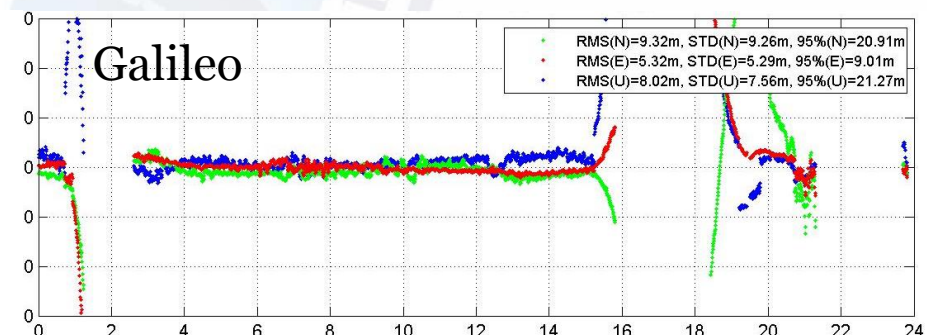
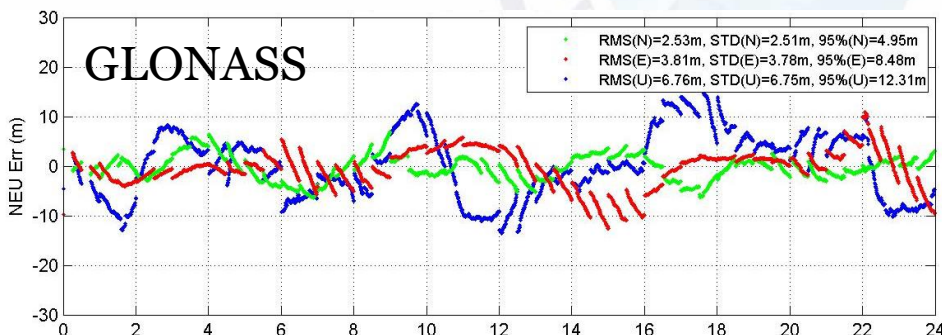
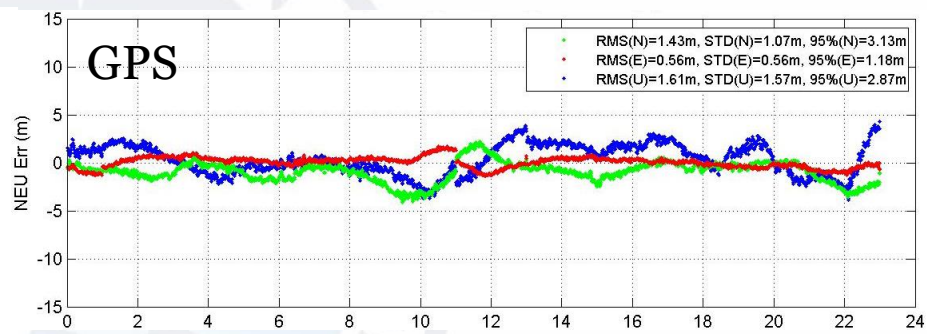
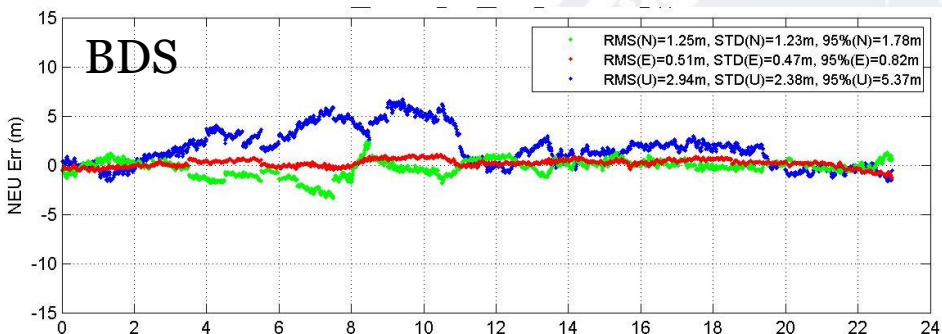


Monitoring & Assessment Results

Mongolia (ulbt)

Positioning Error

— N — E — U



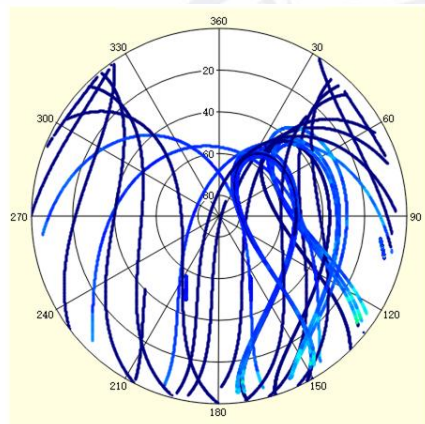


Monitoring & Assessment Results

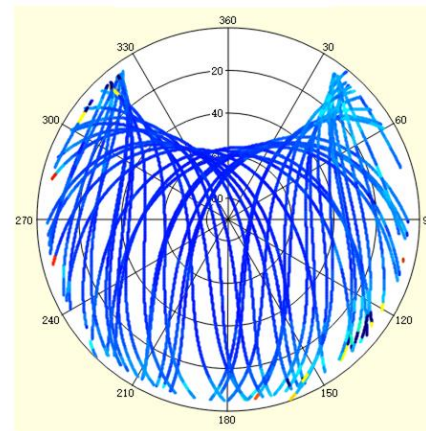
Pakistan (mult)

Skyplot

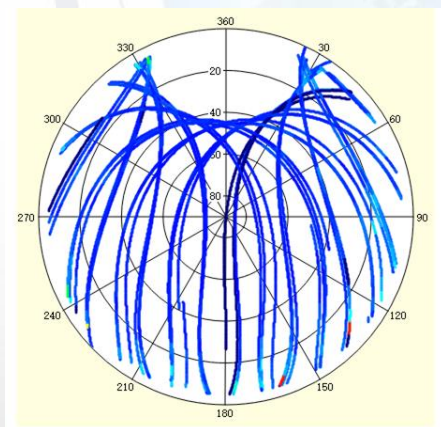
BDS



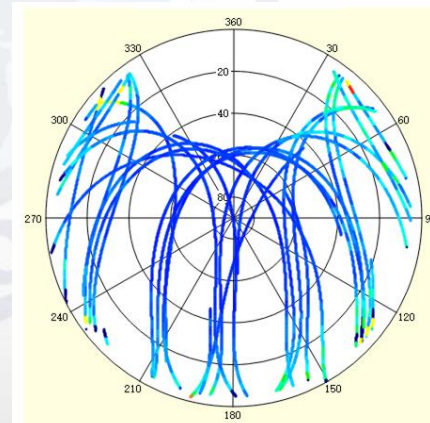
GPS



GLONASS



Galileo



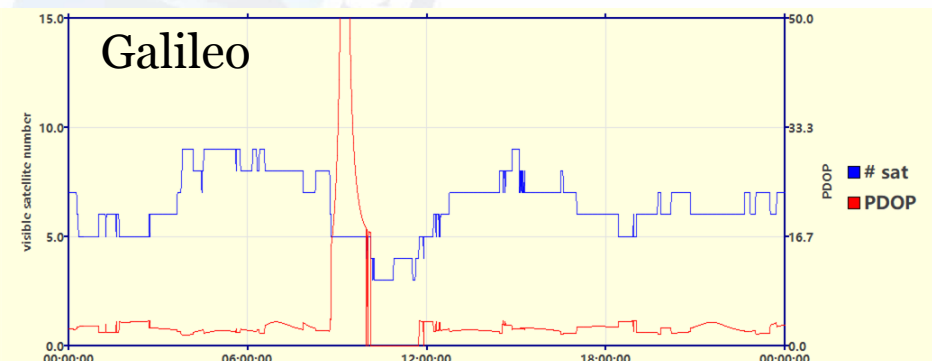
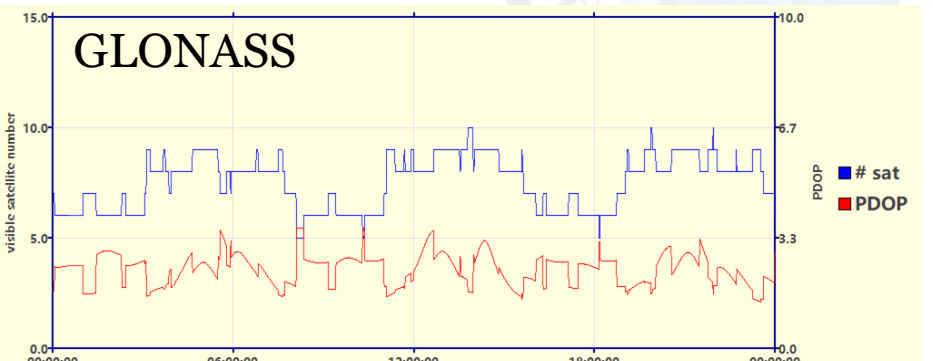
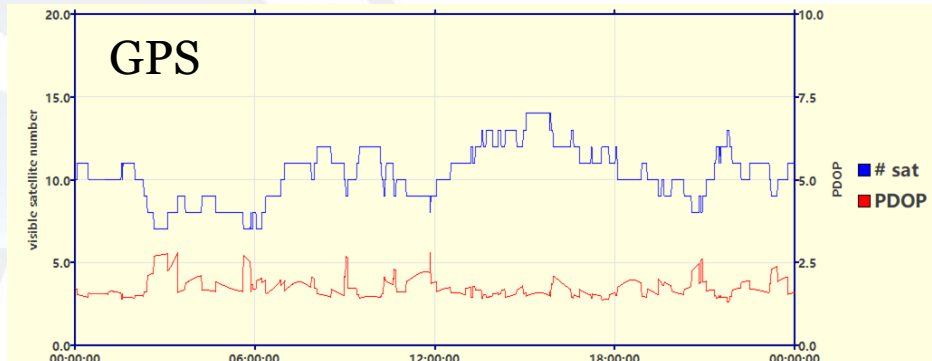
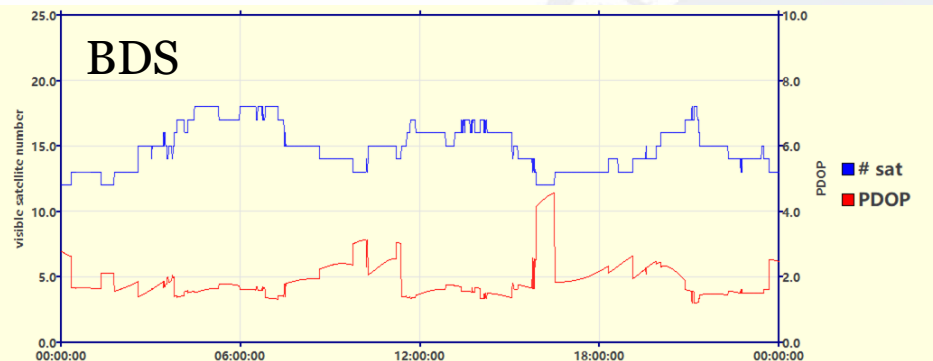
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Monitoring & Assessment Results

Pakistan (mult)

Number of Visible Satellites and PDOP



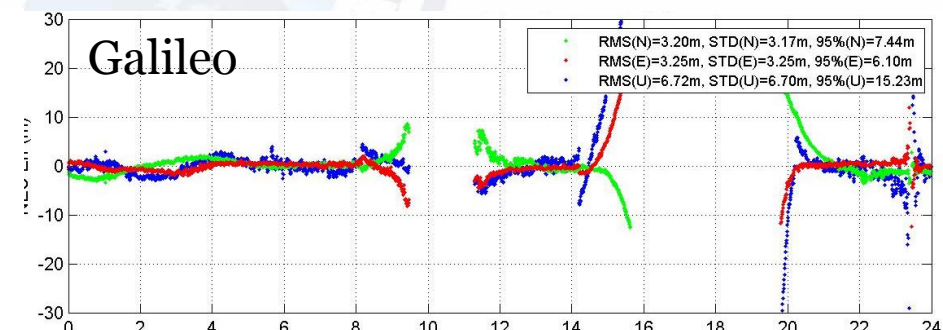
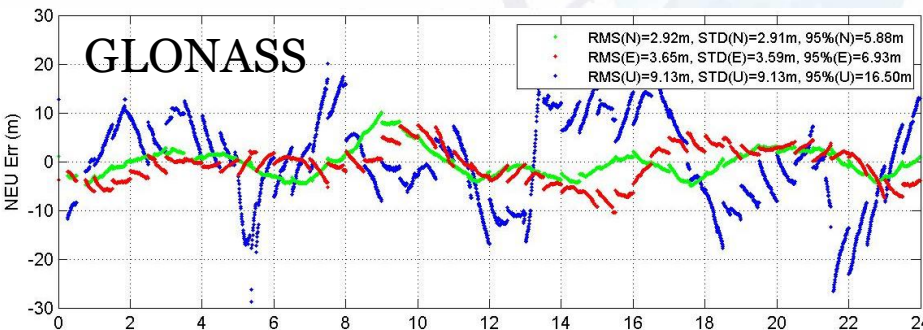
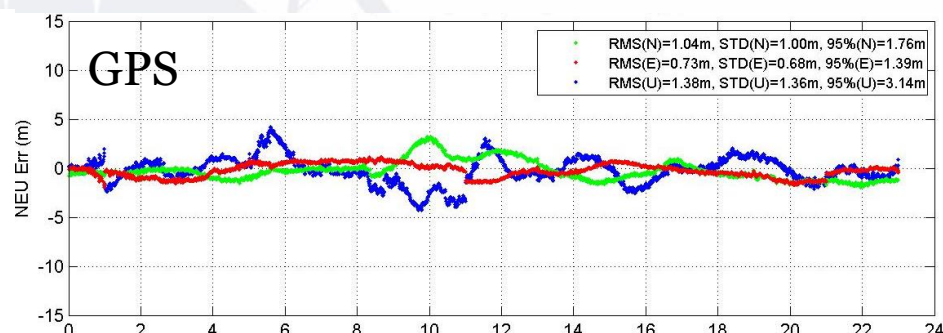
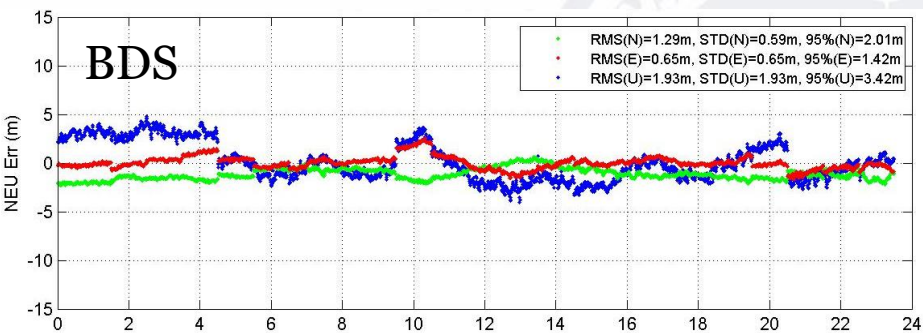


Monitoring & Assessment Results

Pakistan (mult)

Positioning Error

— N — E — U



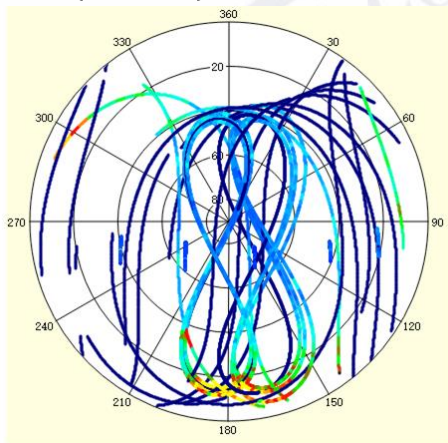


Monitoring & Assessment Results

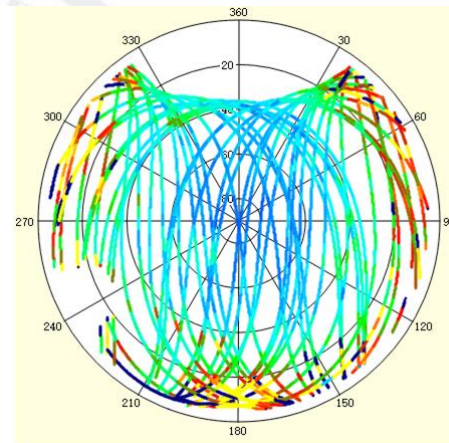
Thailand (csrs)

Skyplot

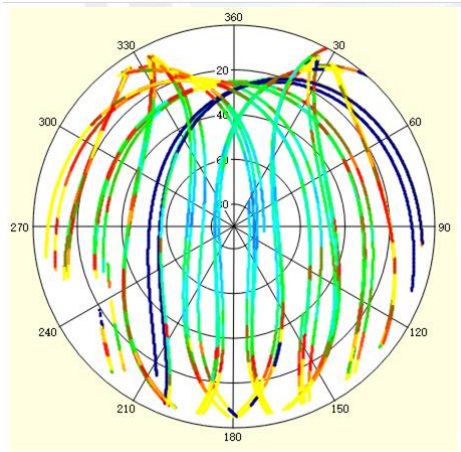
BDS



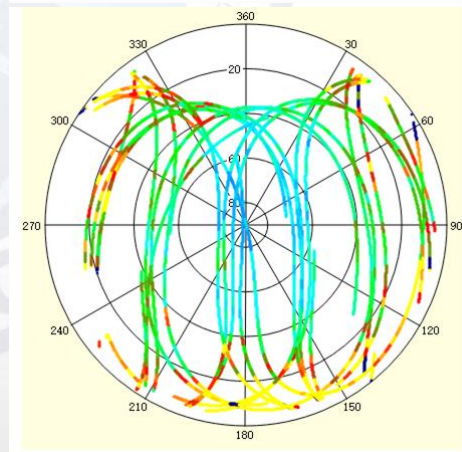
GPS



GLONASS



Galileo

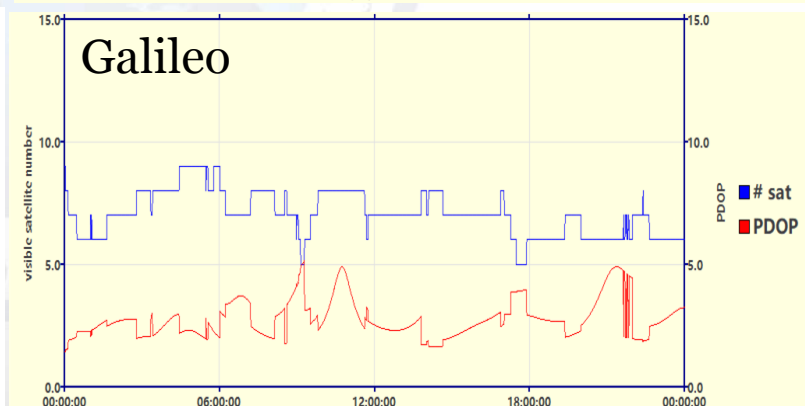
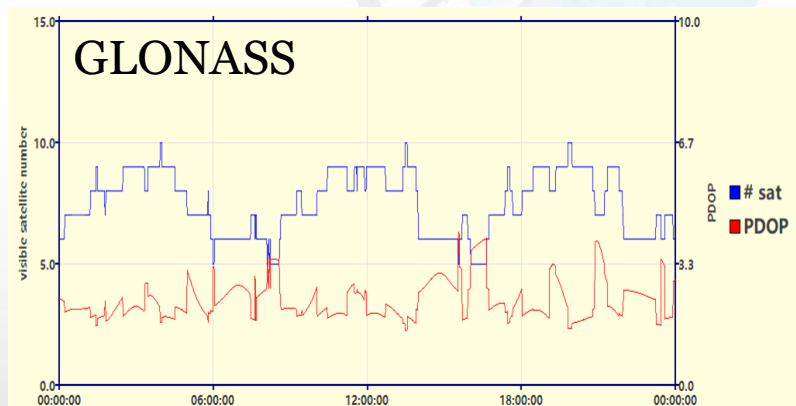
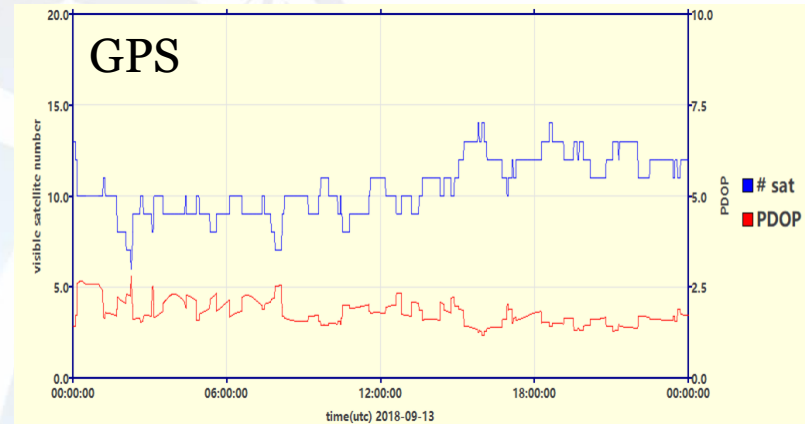
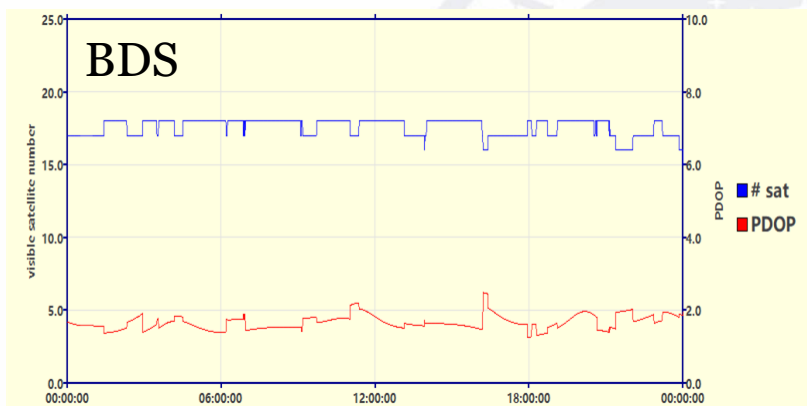




Monitoring & Assessment Results

Thailand (csrs)

Number of Visible Satellites and PDOP



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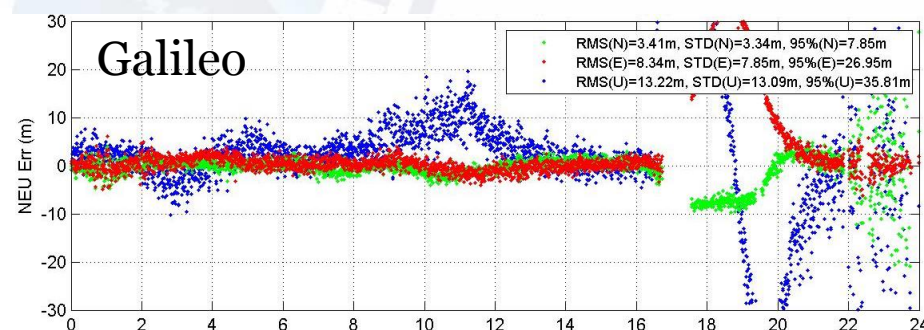
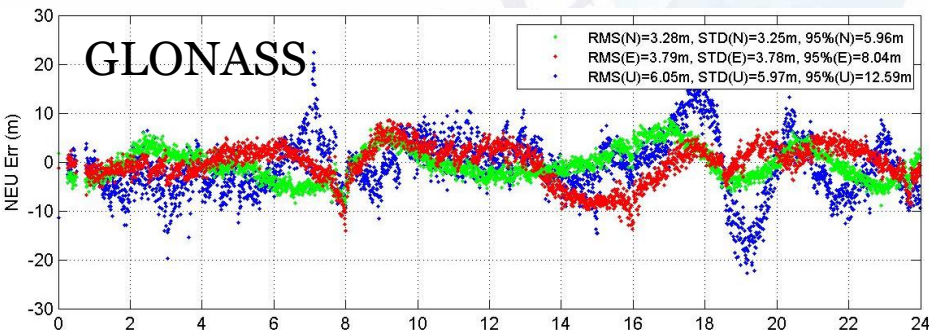
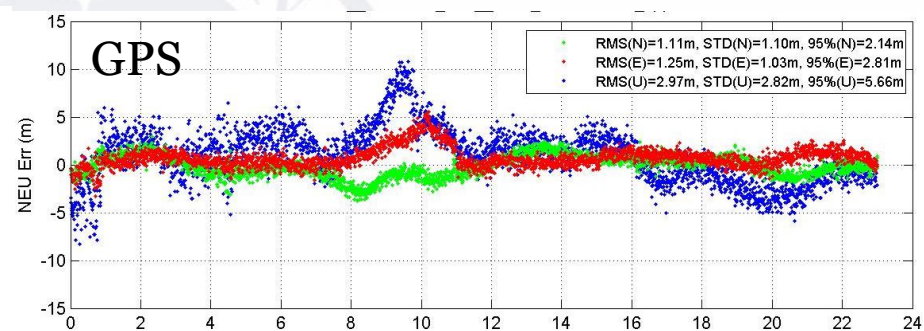
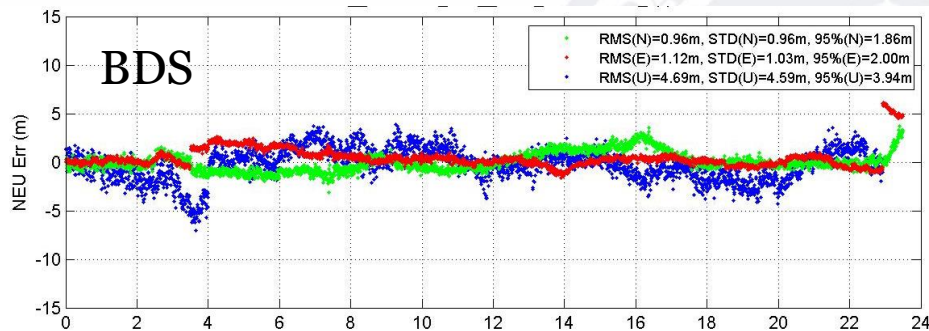


Monitoring & Assessment Results

Thailand (csrs)

Positioning Error

— N — E — U



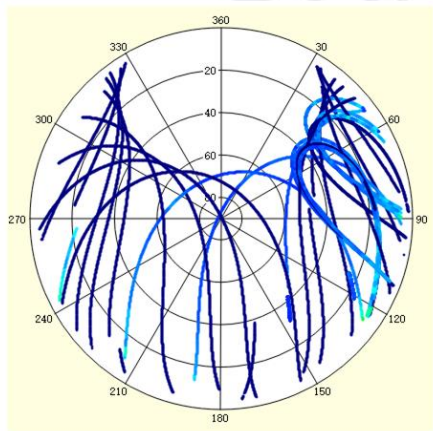


Monitoring & Assessment Results

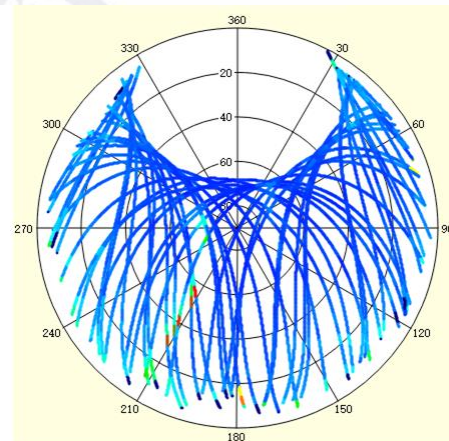
Turkey (metu)

Skyplot

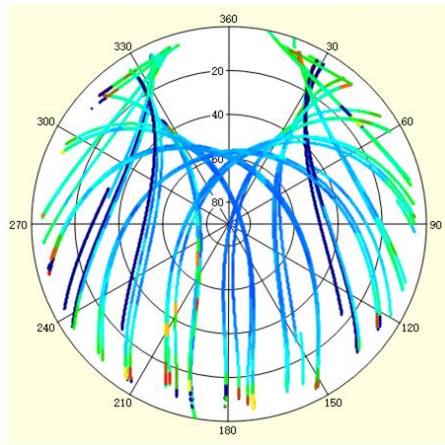
BDS



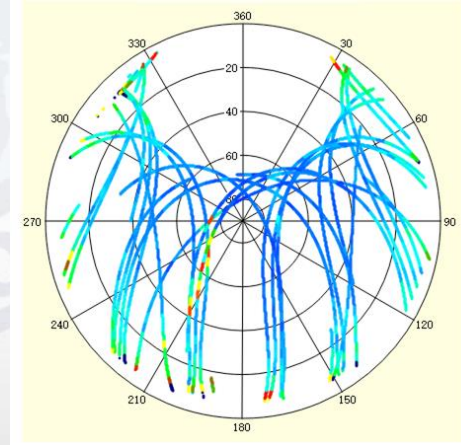
GPS



GLONASS



Galileo



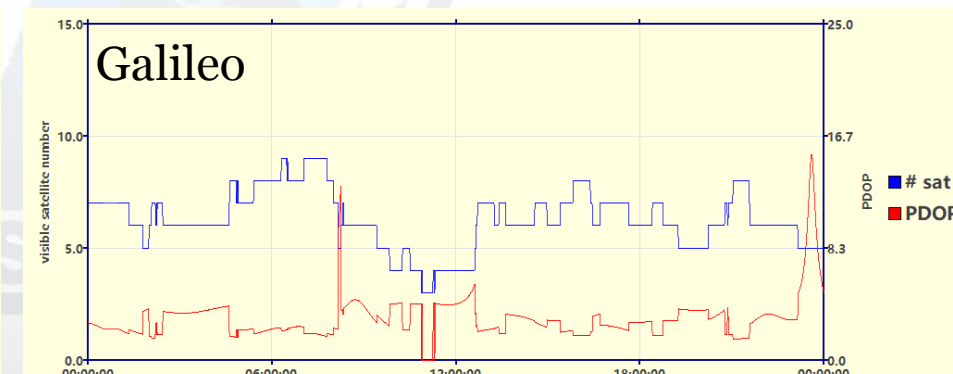
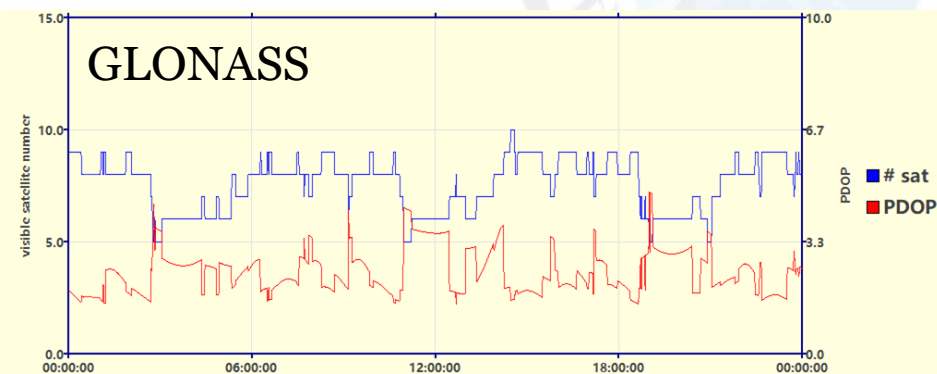
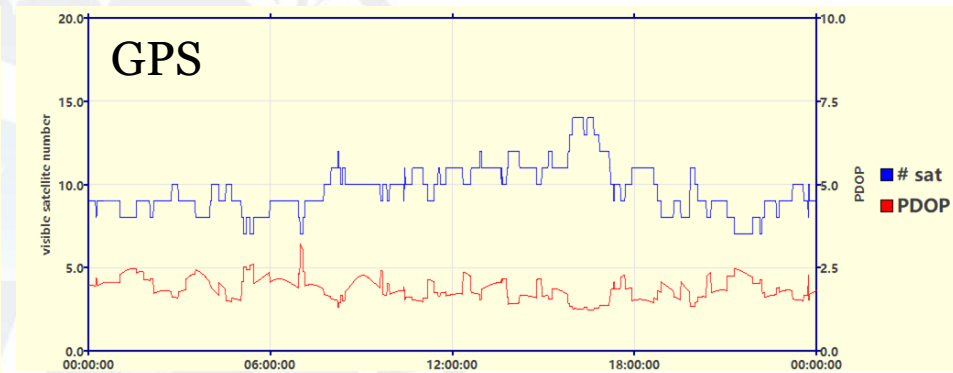
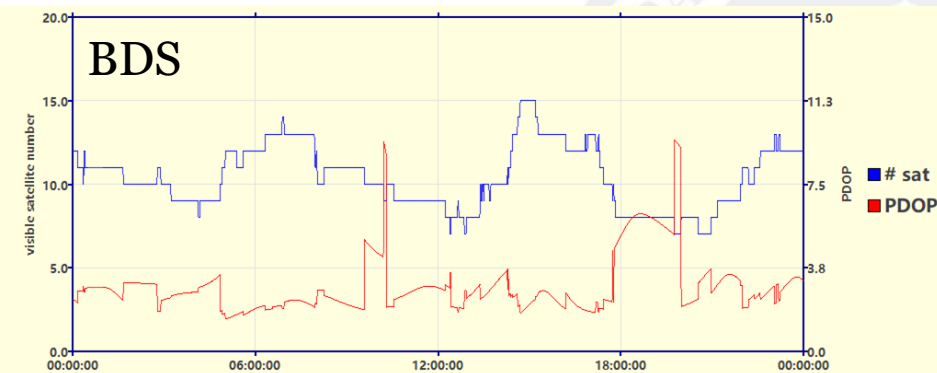
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Monitoring & Assessment Results

Turkey (metu)

Number of Visible Satellites and PDOP



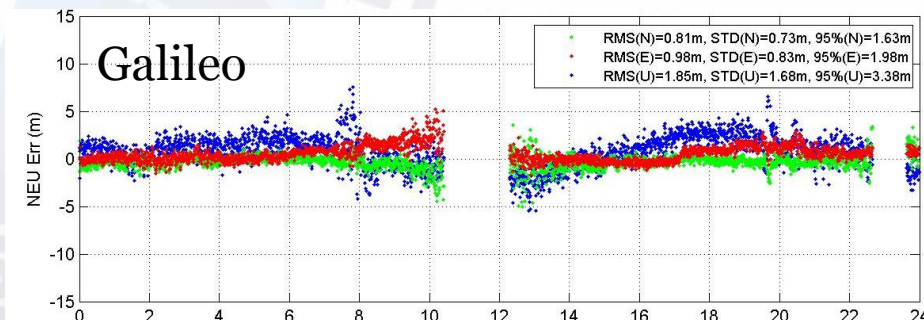
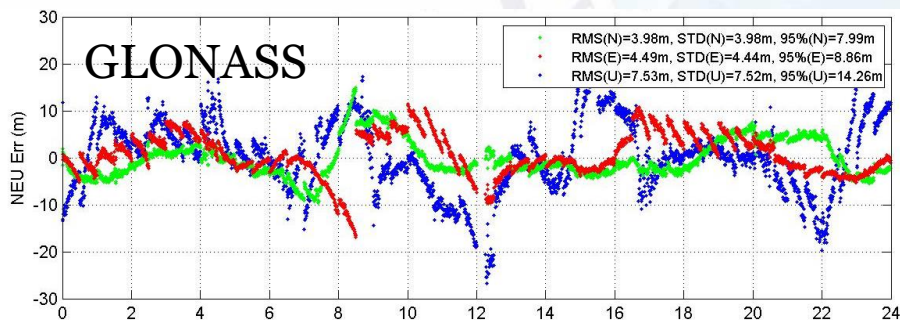
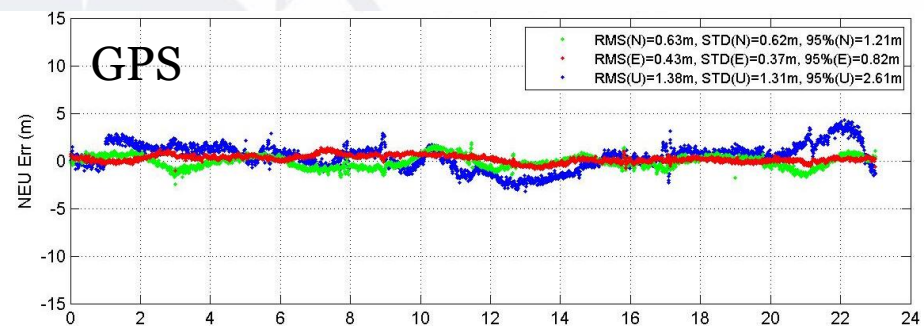
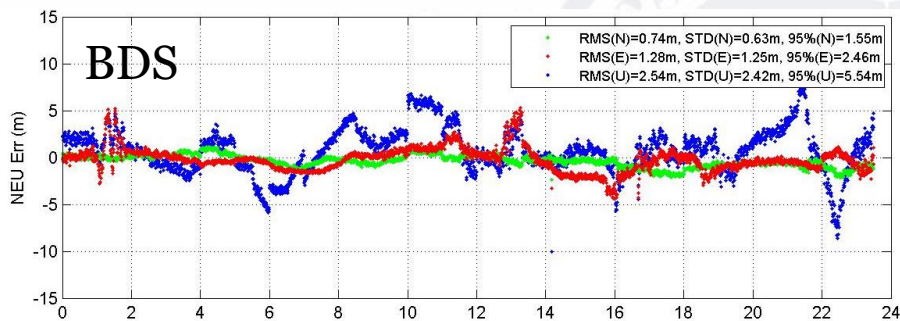


Monitoring & Assessment Results

Turkey (metu)

Positioning Error

— N — E — U





Monitoring & Assessment Results

- From skymaps, the satellite ground tracks of four GNSS systems (BDS/GPS/GLONASS/Galileo) over one day is in regular distribution
- From the number of visible satellites and PDOP value,
 - BDS: 10-18 satellites, PDOP ranges from 1-4
 - GPS: 6-14 satellites, PDOP ranges from 1.5-4.5
 - GLONASS: 4-10 satellites, PDOP ranges from 2-5
 - Galileo: 3-9 satellites, PDOP ranges from 2-6
- From the positioning results,
 - BDS (B1I): horizontal accuracy (95%) 2-3m, vertical accuracy 4-6m
 - GPS (L1): horizontal accuracy (95%) 2-4m, vertical accuracy 2-6m
 - GLONASS (R1): horizontal accuracy (95%) 8-11m, vertical accuracy 12-16m
 - Galileo (E1): at best, horizontal accuracy (95%) can reach 2m, vertical accuracy can reach 3-4m; positioning results vary among stations, with a little lower stability and continuity than other GNSS systems
- To sum up, APSCO IGMA stations could serve a satisfying GNSS monitoring & assessment results, achieving the initial expectations and requirements



Summary

- Those 5 stations
 - can acquire GPS, GLONASS, BDS, Galileo navigation satellites
 - can provide GNSS data with good quality
 - can analyze the GNSS service performance by GPAK
 - can provide technical reference for GNSS application



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ASIA-PACIFIC SPACE COOPERATION ORGANIZATION

***THANK YOU
FOR YOUR ATTENTION!***