APSCO IGMA Network

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www.apsco.int

Outline

- Background
- Current Status
- Monitoring & Assessment Results
- Conclusions

Multi-Lateral Cooperation in the Asia-Pacific Region

Vast Geographical Area

Large Population

Mostly Developing Countries

Prone to Natural Disasters

Exploiting Space Needs High Technology, Risk and Investment

Background

- Asia-Pacific Space Cooperation Organization (APSCO) is an inter-governmental organization, pursuing space cooperative activities to improve socio-economic development among its Member States.
- 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.
- Several GNSS cooperative projects have been carried out, such as, demonstration of application in emergency management and disaster rescue, development of GNSS software receiver and IGMA projects.

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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 Status

- 7 Member States (China, Mongolia, Pakistan, Thailand, Turkey, Bangladesh and Peru) have completed station construction and installation work, as well as integration test and technician training.
- 1 Member State (Iran) has finished installation, the under testing and acquisitioning - expected to finish by the end of 2019.
- The overall APSCO-IGMA network is expected to be completed in the 1st quarters of 2020.

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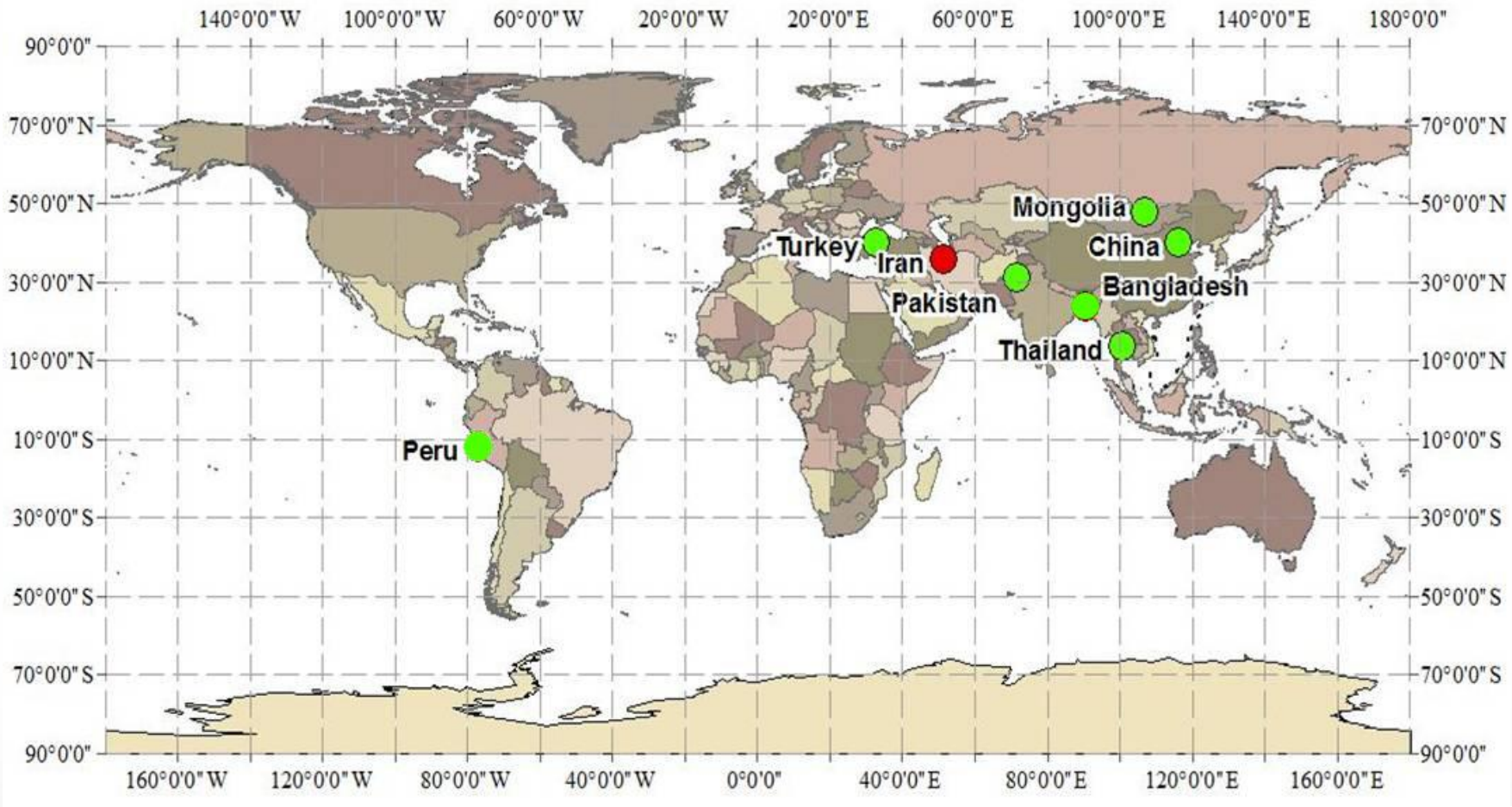
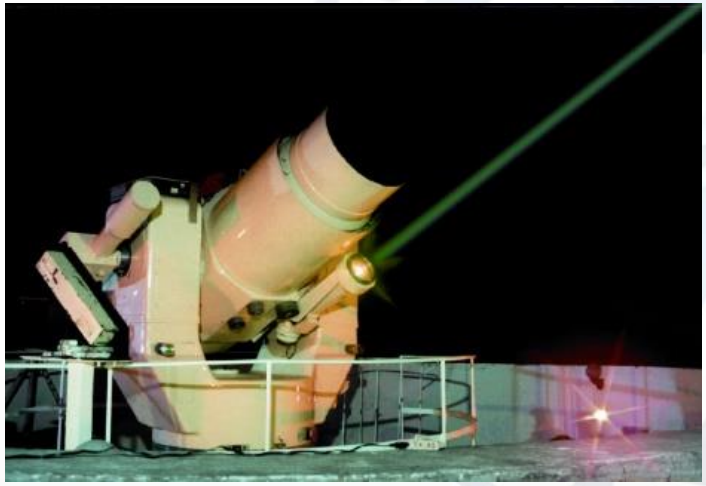
The Distribution of 8 APSCO Stations



Current Progress

China (bjf1)

- Location: Fangshan District, Beijing



Current Progress

Mongolia (ulbt)

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

Current Progress

Pakistan (mult)

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

Current Progress

Thailand (csrs)

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

Current Progress

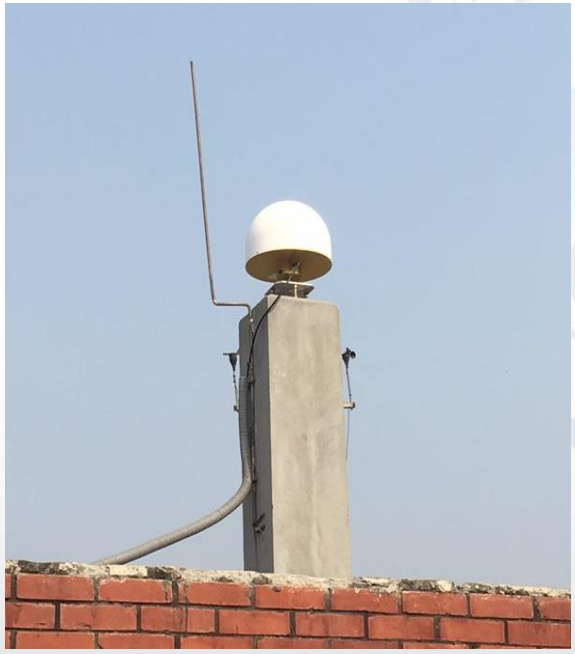
Turkey (metu)

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

Current Progress

Bangladesh (srrs)

- Started in November,2018
- Location: Space Research and Remote Sening Organization, Bangladesh



Current Progress

Peru (hucy)

- Started in November,2019
- Location: Observatorio de Huancayo, Huancayo

Current Progress

Iran

- Finished site investigation and construction, now under testing and acquisition.

Monitoring & Assessment Results

GPAK Software

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

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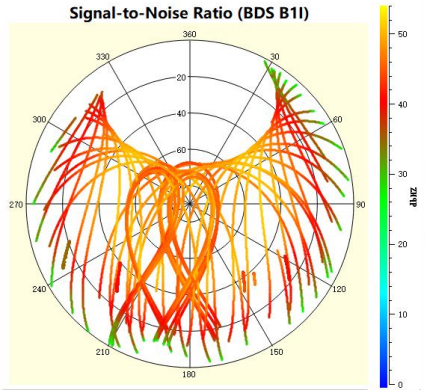
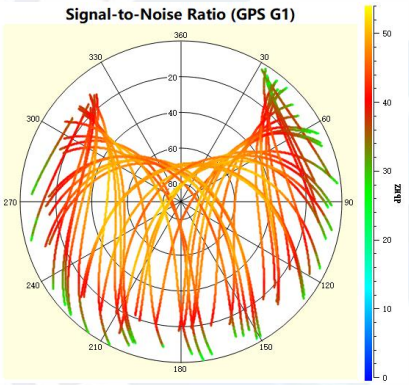
Monitoring & Assessment Results

China (bjf1)

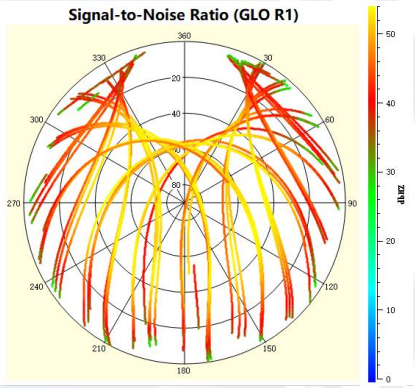
BDS



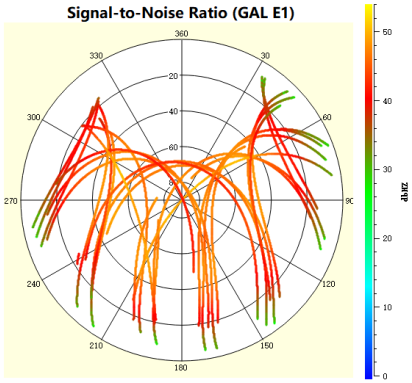
GPS



GLONASS



Galileo



Skyplot：signal-to-noise ratio

Test Date: July.8, 2019

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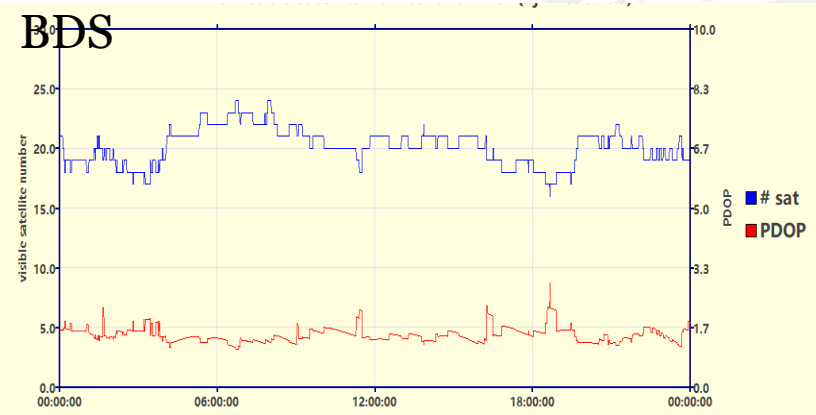
Monitoring & Assessment Results

China (bjf1) **Number of Visible Satellites and PDOP**

BDS



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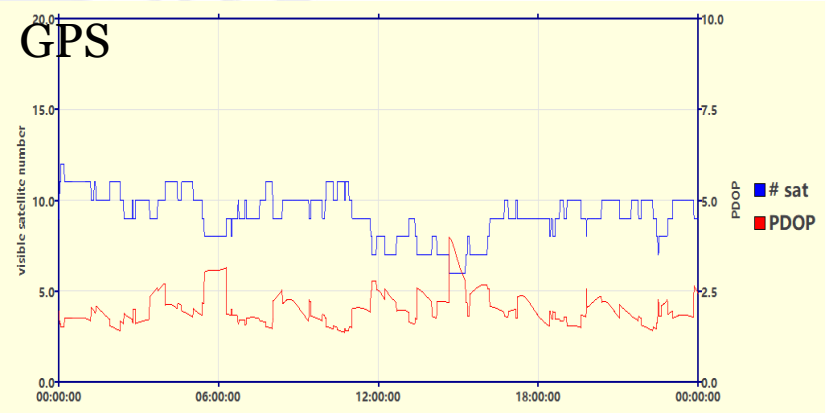

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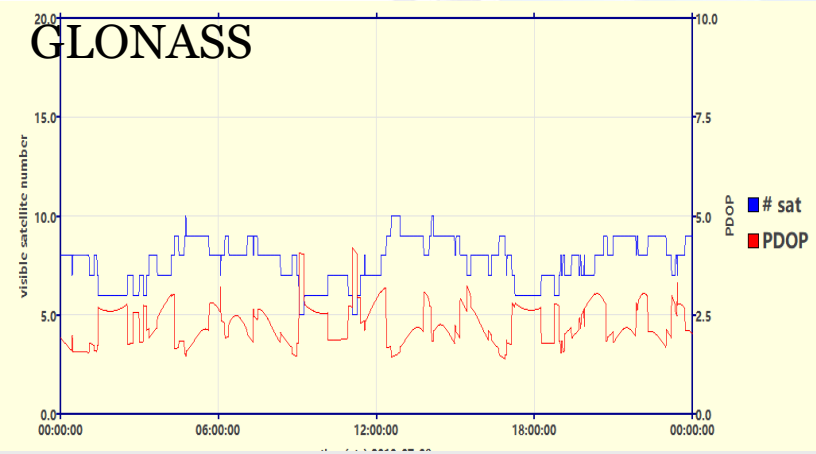

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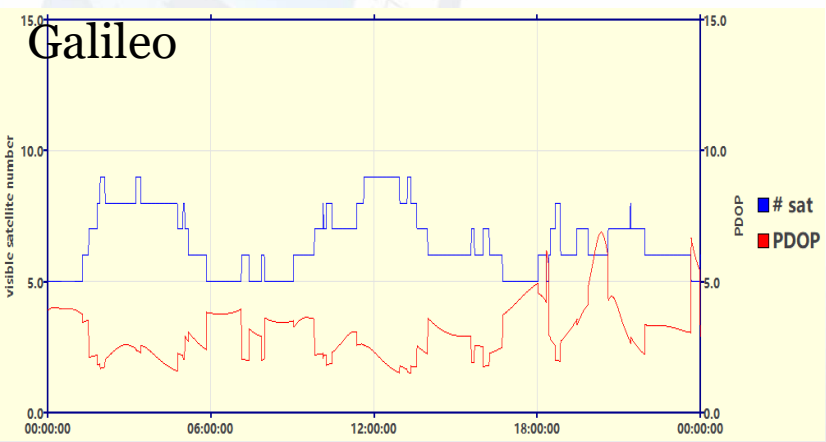

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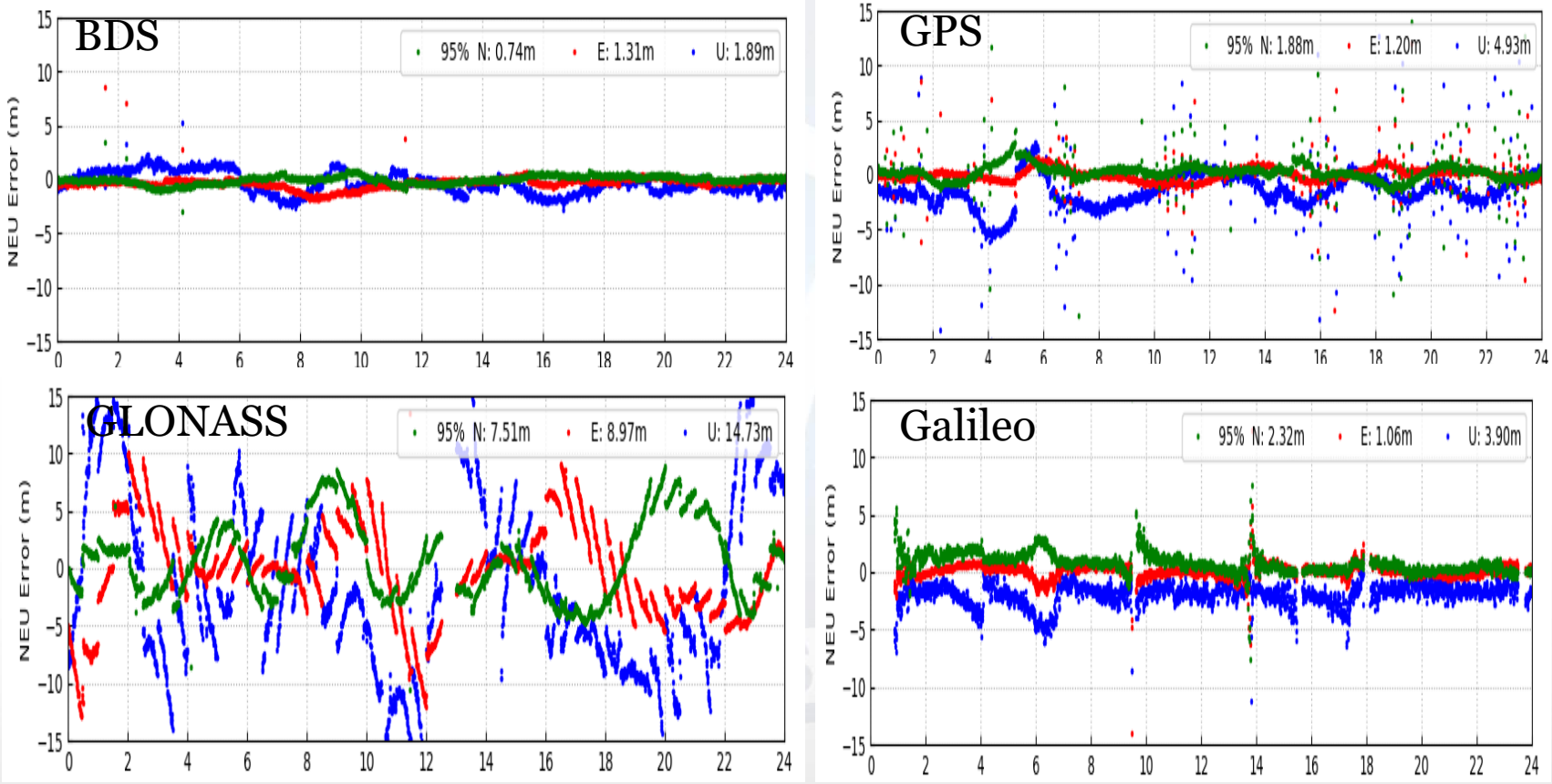
Monitoring & Assessment Results

China (bjf1) **Positioning Error** N E U



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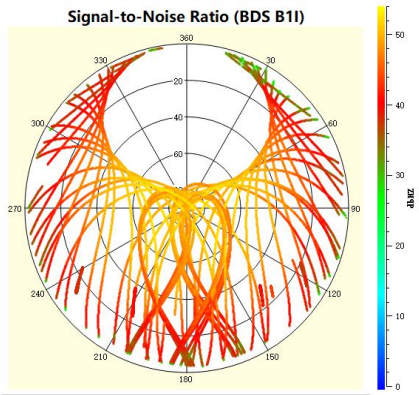
Monitoring & Assessment Results

Mongolia (ulbt)

BDS



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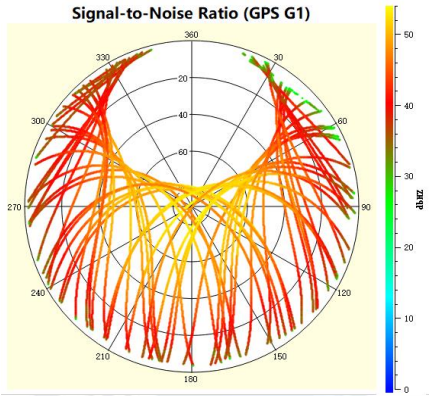

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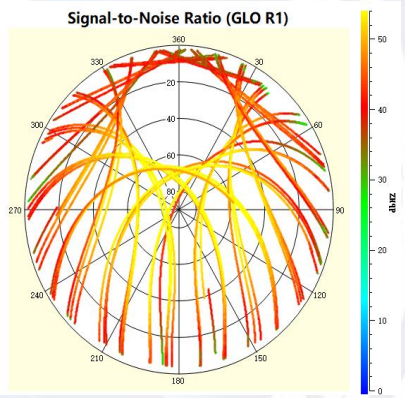

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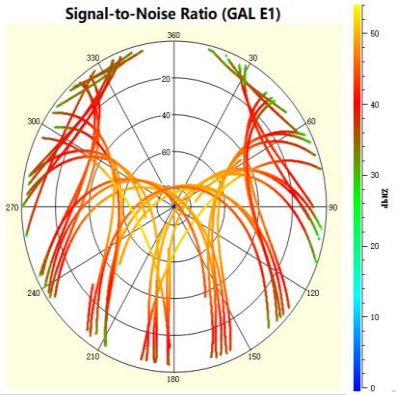

Skyplot：signal-to-noise ratio

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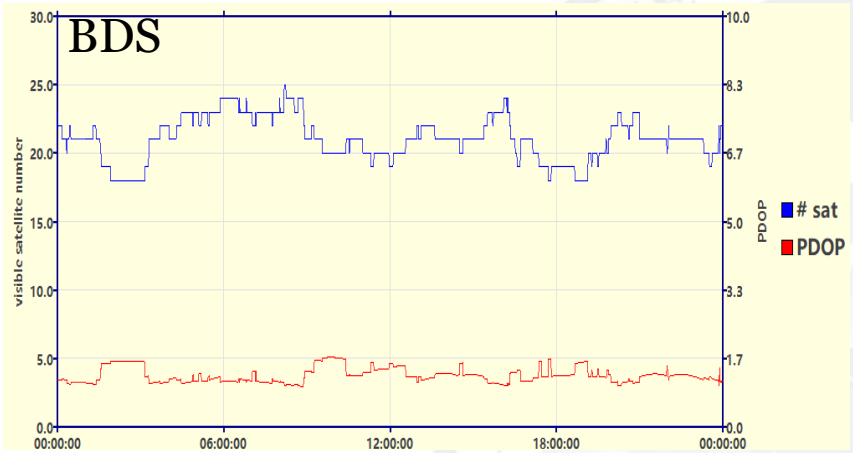
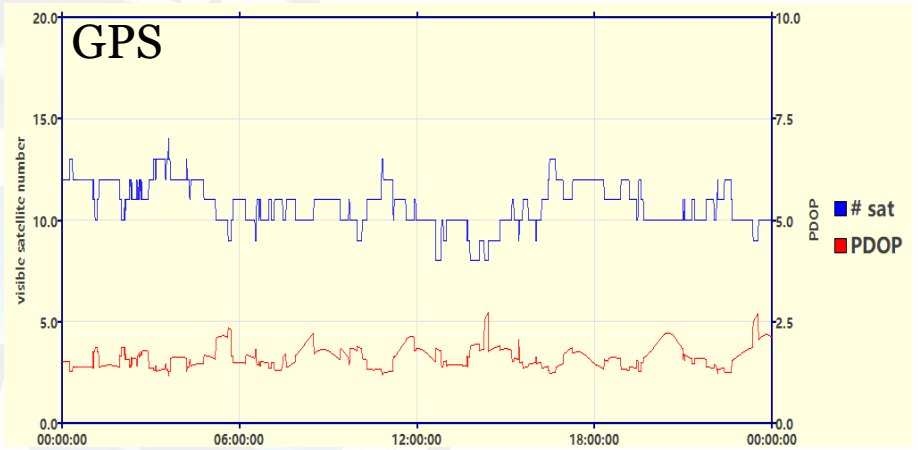
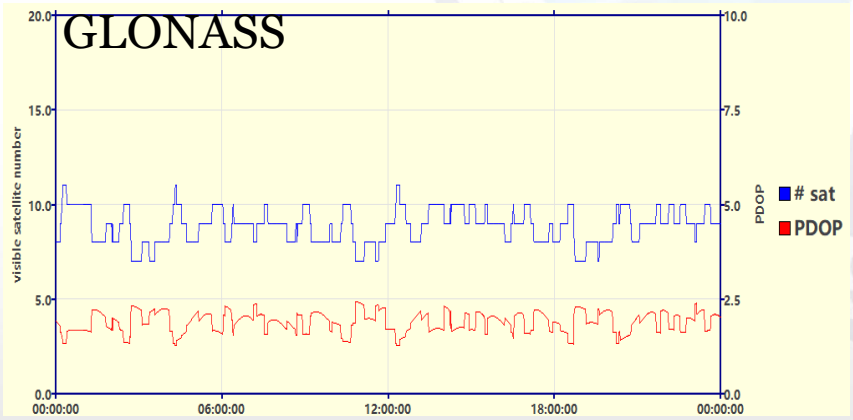
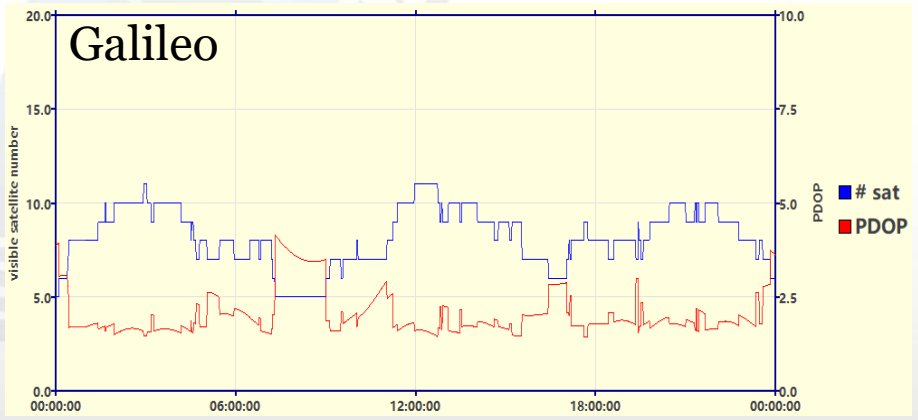
Monitoring & Assessment Results

Mongolia (ulbt) **Number of Visible Satellites and PDOP**









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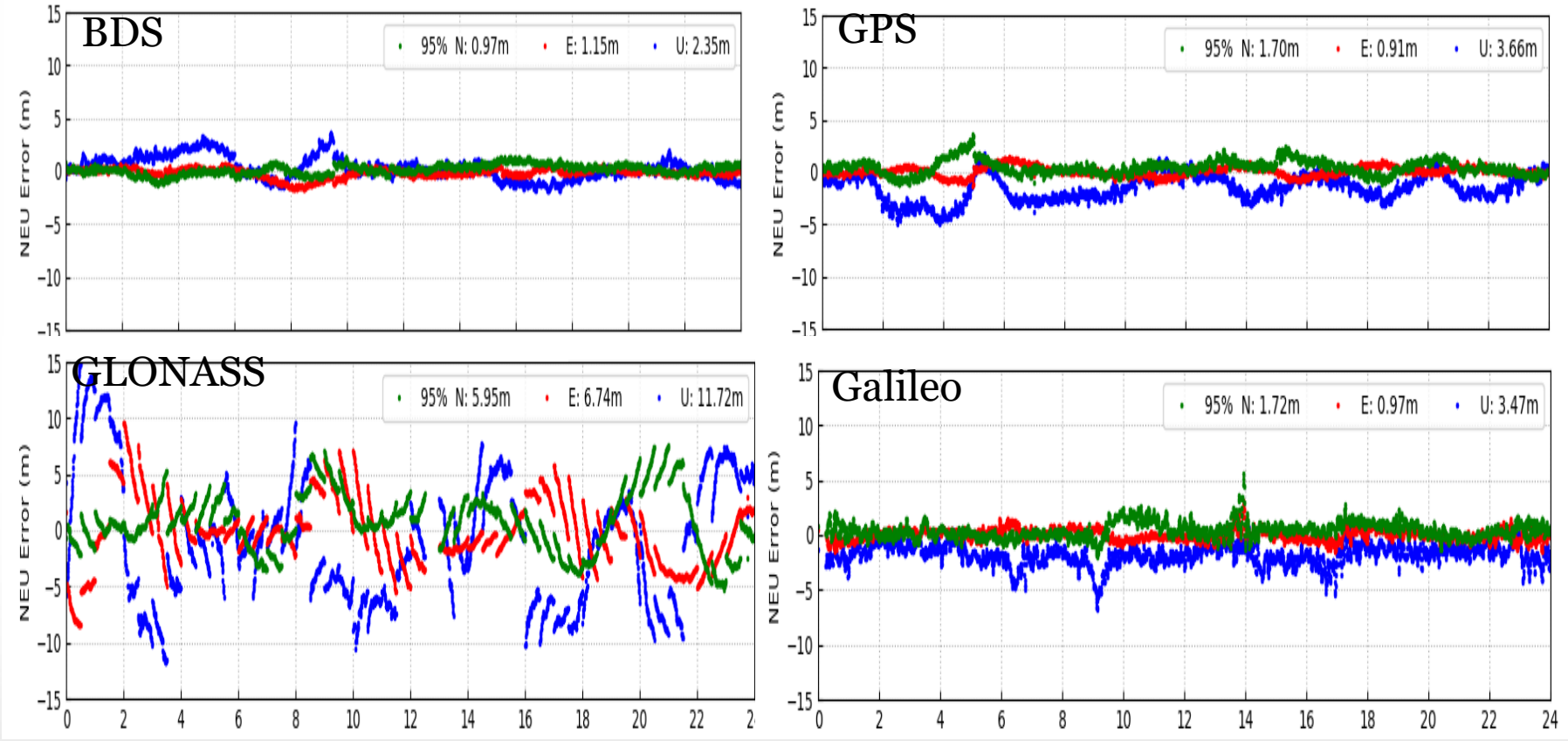
Monitoring & Assessment Results

Mongolia (ulbt) **Positioning Error** N E U



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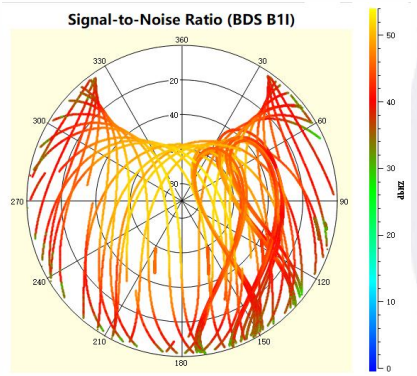
Monitoring & Assessment Results

Pakistan (mult)

BDS



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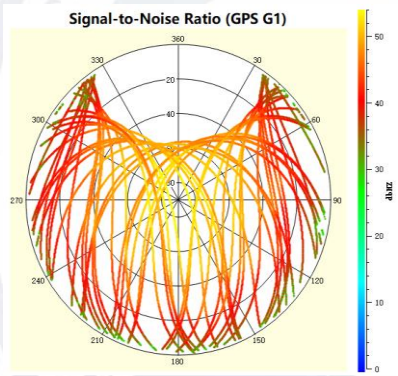
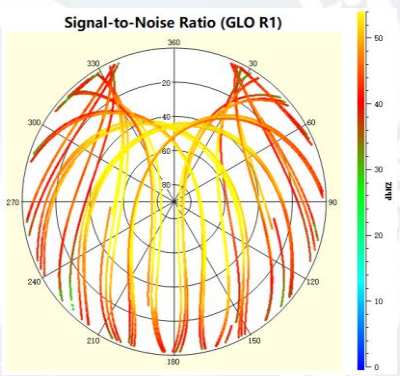
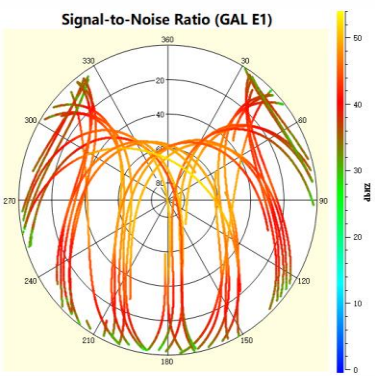


GLONASS



Galileo



Skyplot：signal-to-noise ratio

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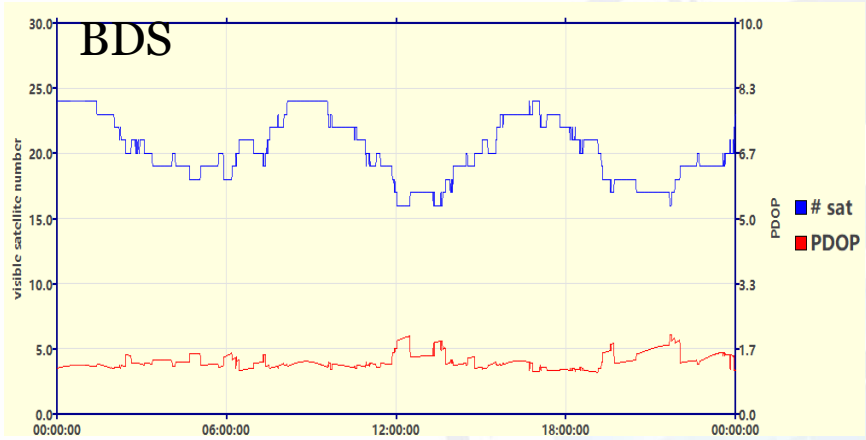
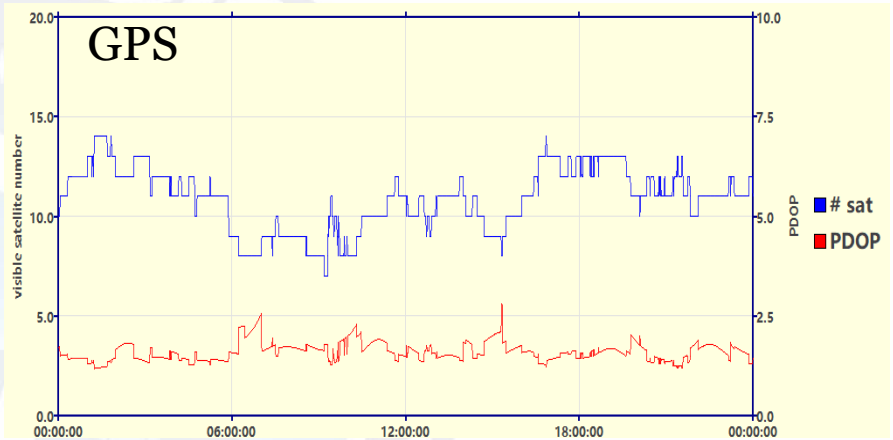
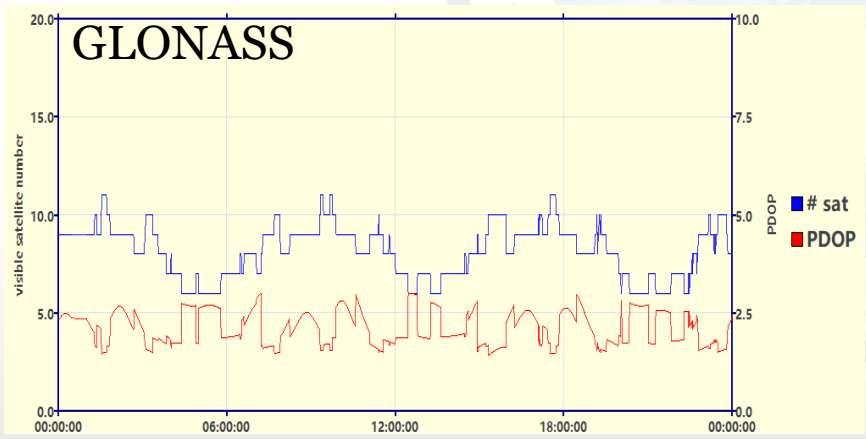
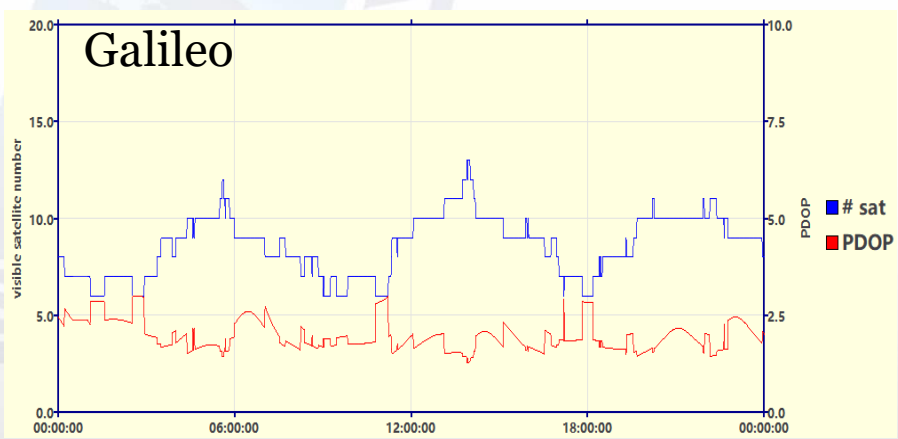
Monitoring & Assessment Results

Pakistan (mult) **Number of Visible Satellites and PDOP**









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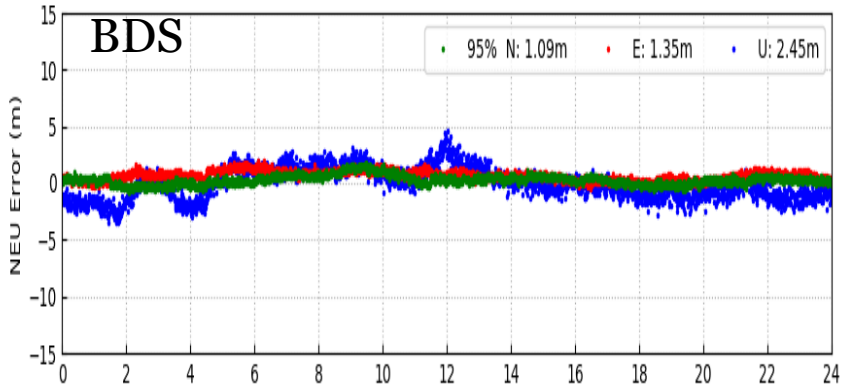
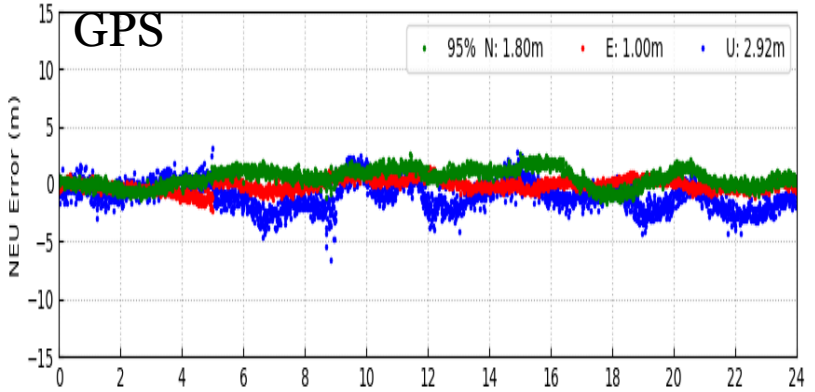
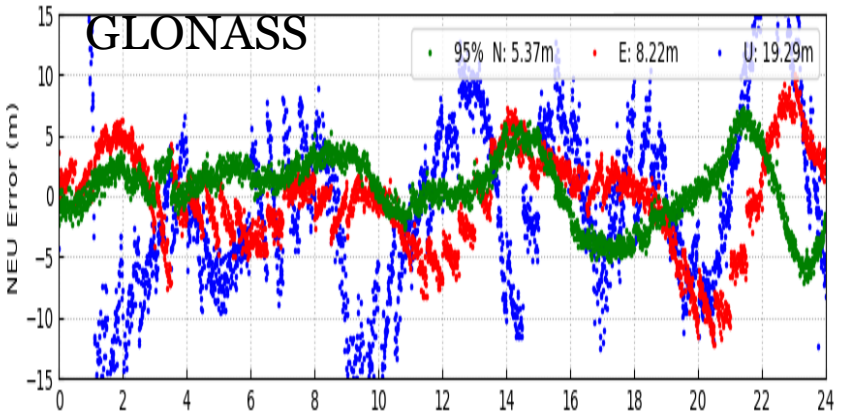
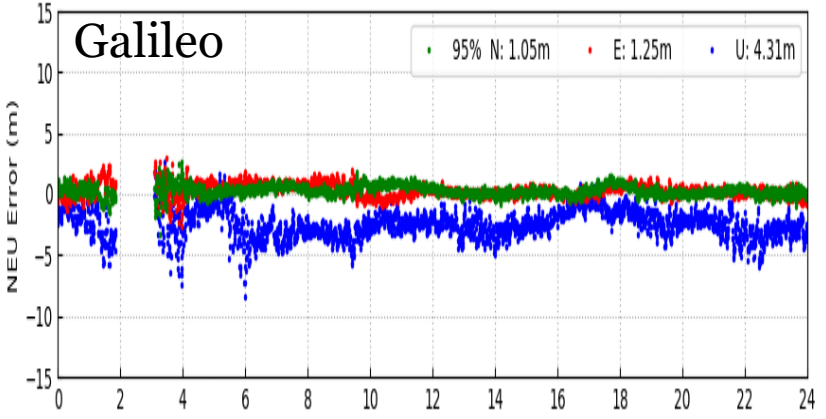
Monitoring & Assessment Results

Pakistan (mult) **Positioning Error** N E U









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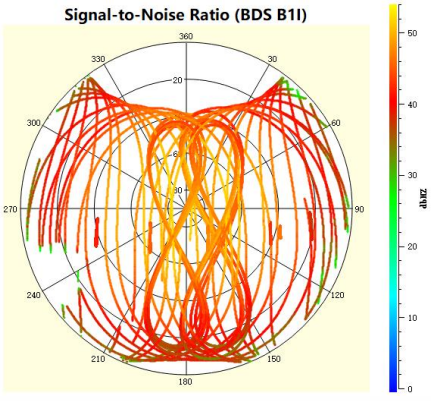
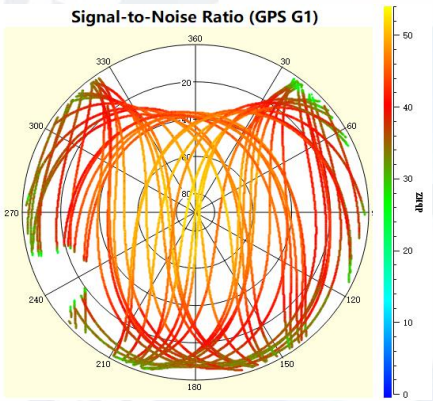
Monitoring & Assessment Results

Thailand (csrs)

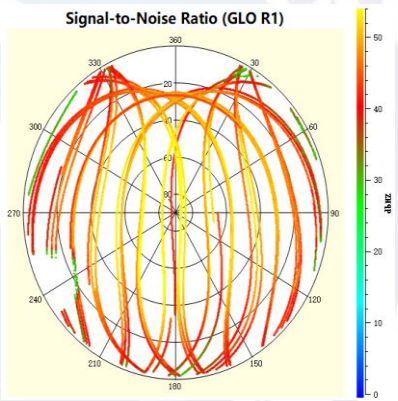
BDS



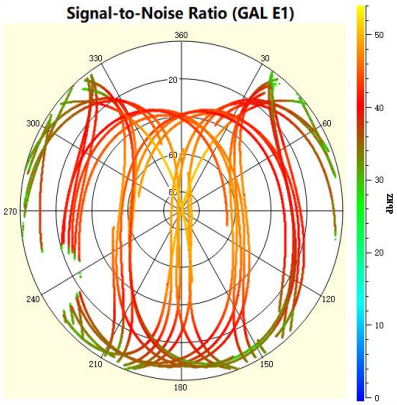
GPS



GLONASS



Galileo



Skyplot：signal-to-noise ratio

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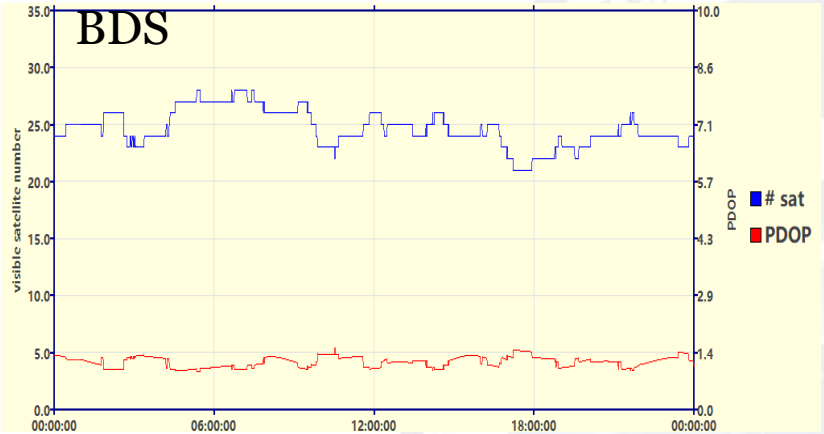
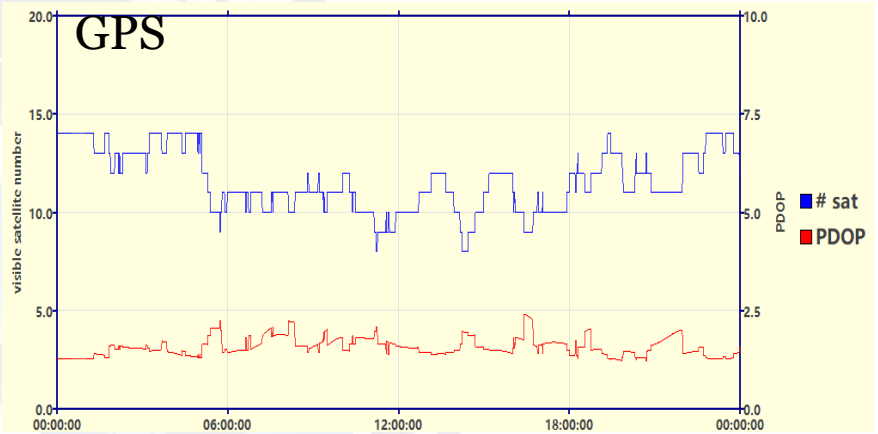
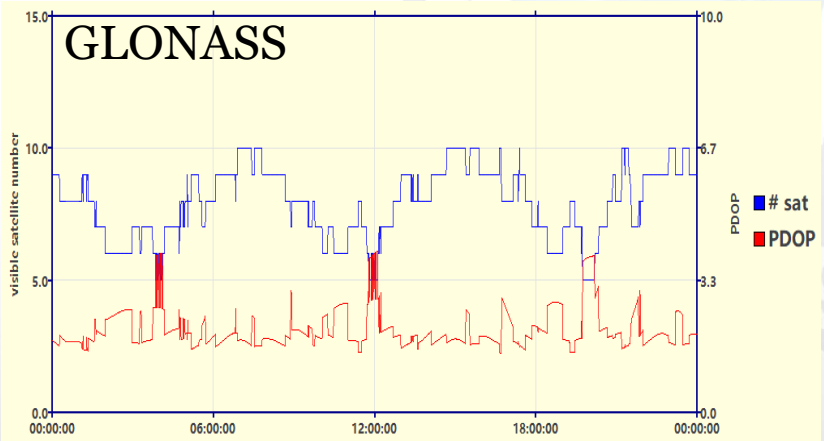
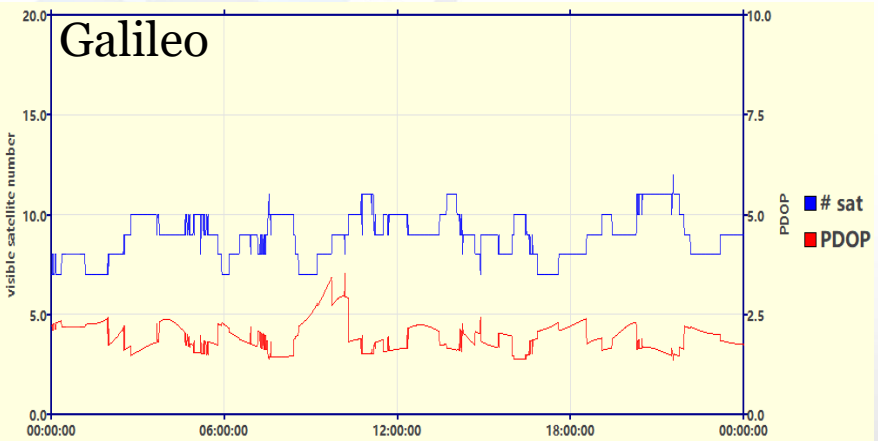
Monitoring & Assessment Results

Thailand (csrs) **Number of Visible Satellites and PDOP**









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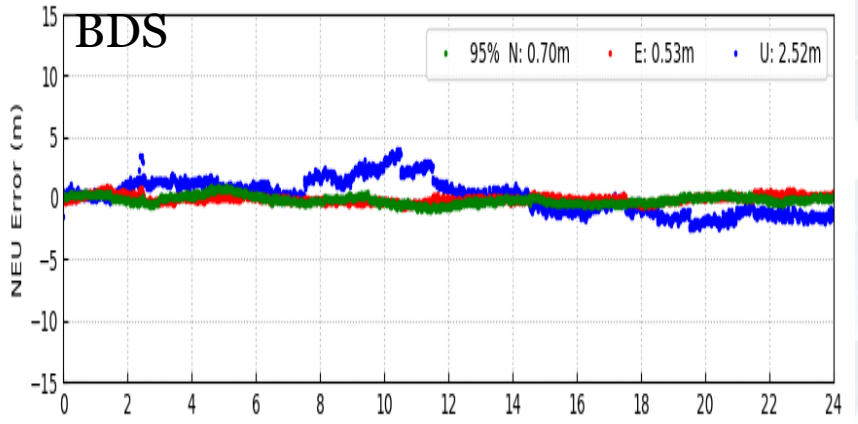
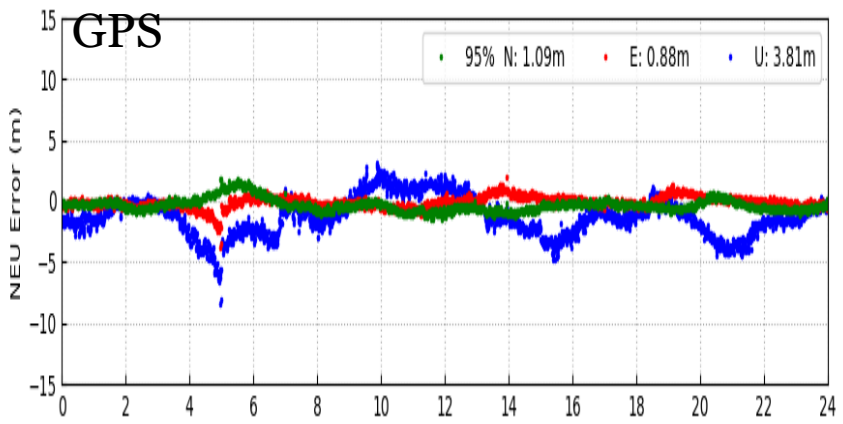
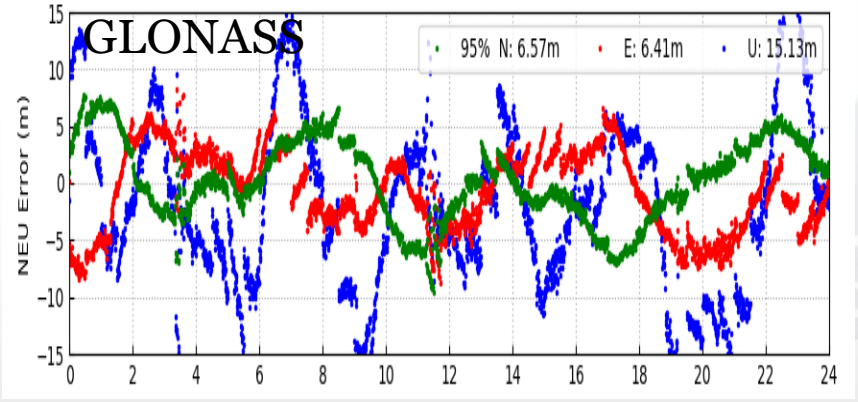
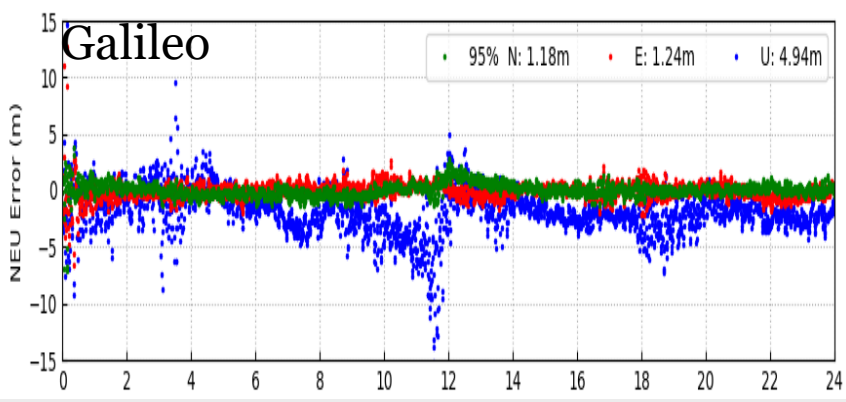
Monitoring & Assessment Results

Thailand (csrs) **Positioning Error** N E U









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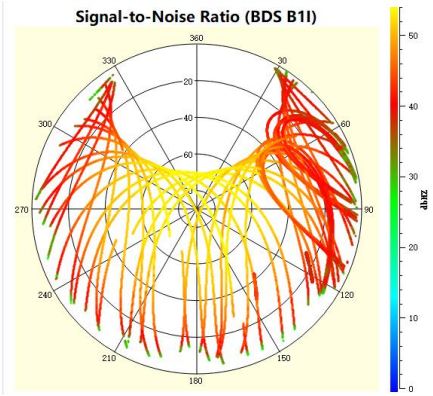
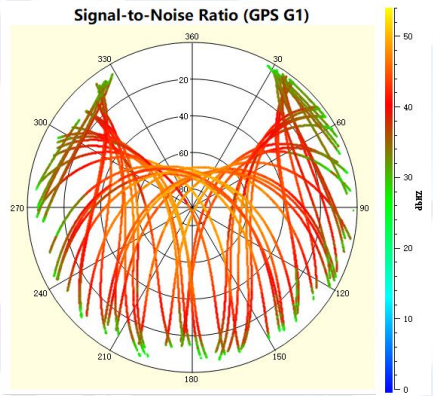
Monitoring & Assessment Results

Turkey (metu)

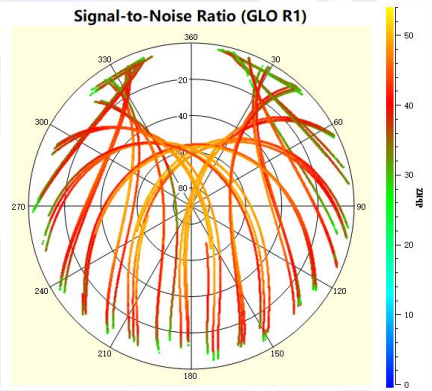
BDS



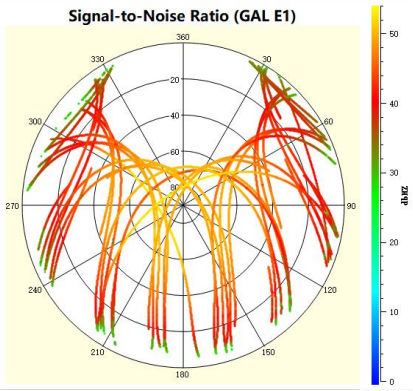
GPS



GLONASS



Galileo



Skyplot：signal-to-noise ratio

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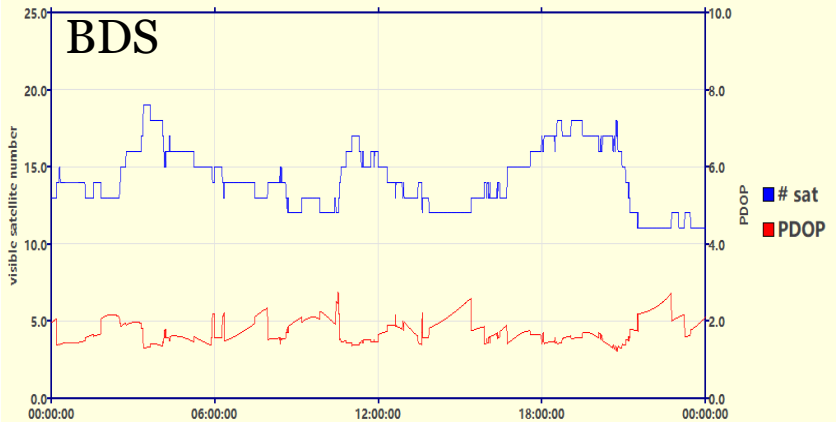
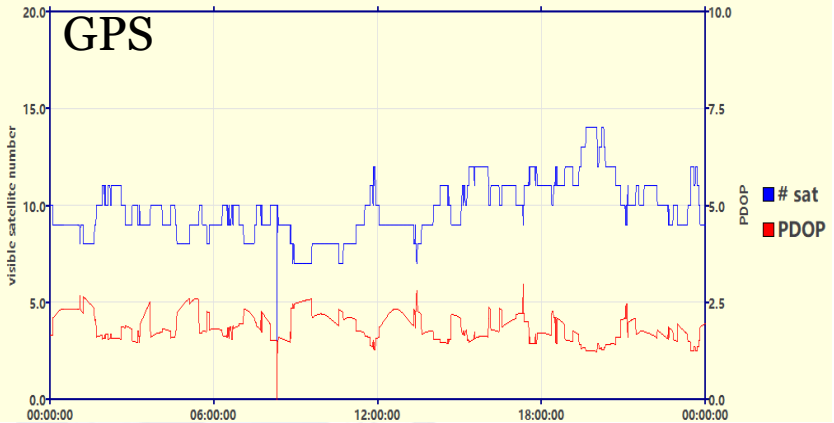
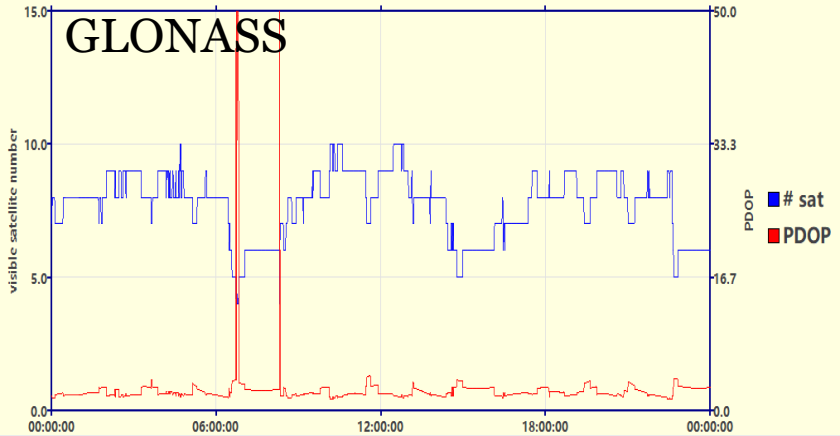
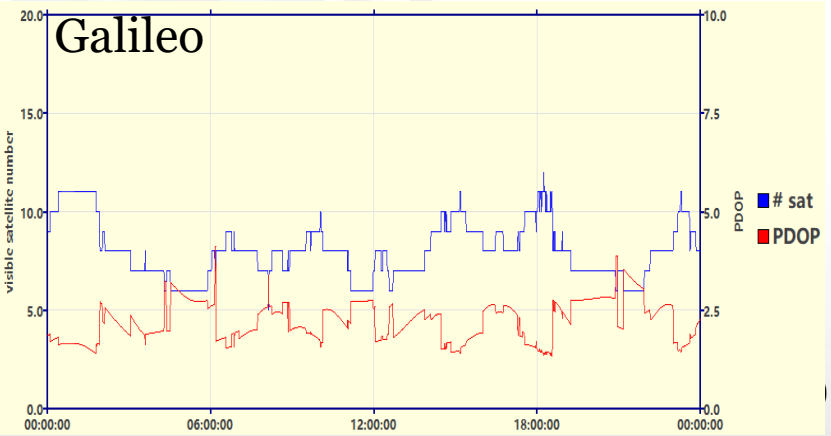
Monitoring & Assessment Results

Turkey (metu) **Number of Visible Satellites and PDOP**









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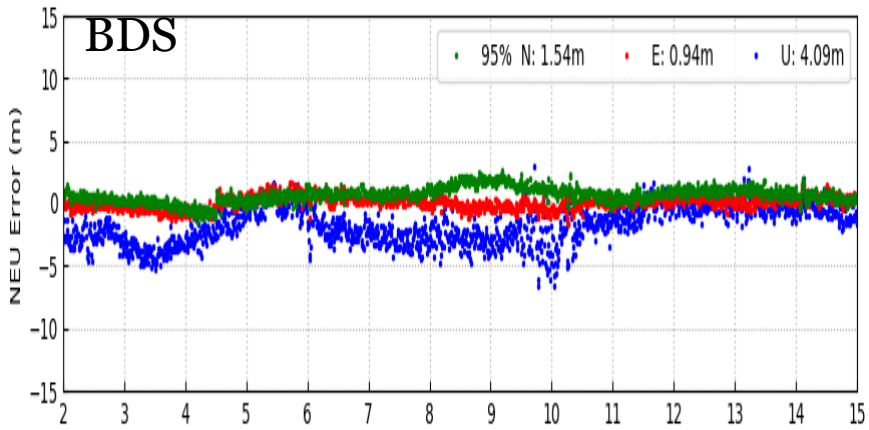
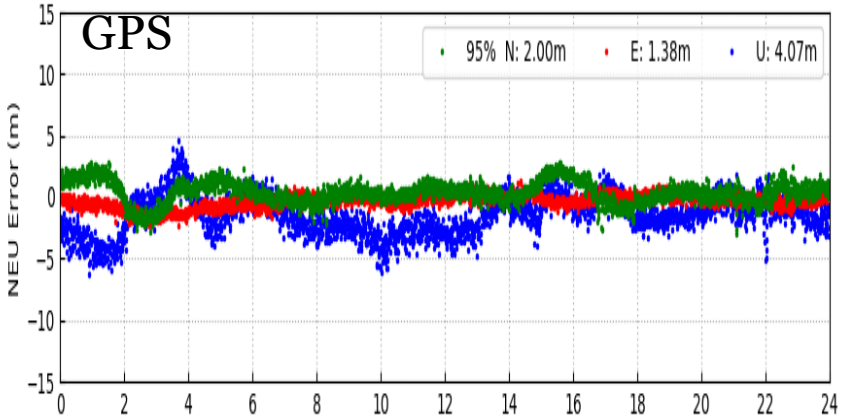
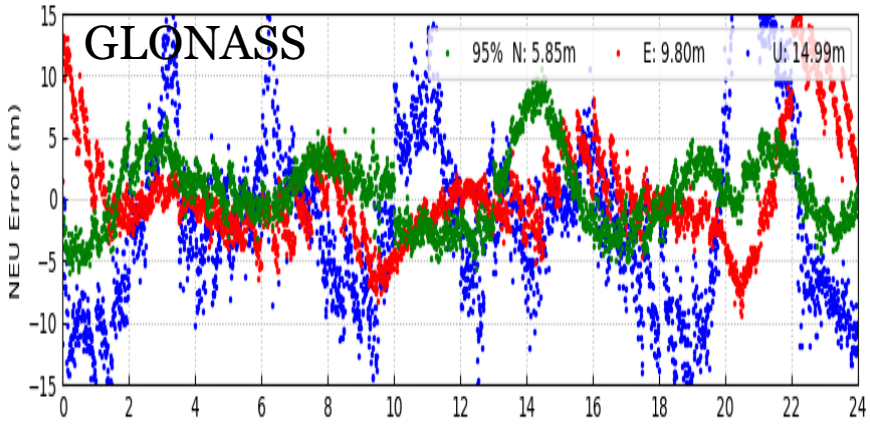
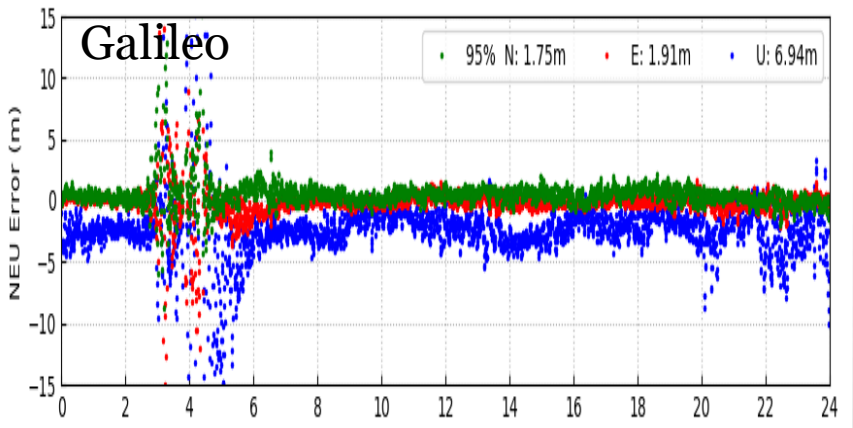
Monitoring & Assessment Results

Turkey (metu) **Positioning Error** N E U









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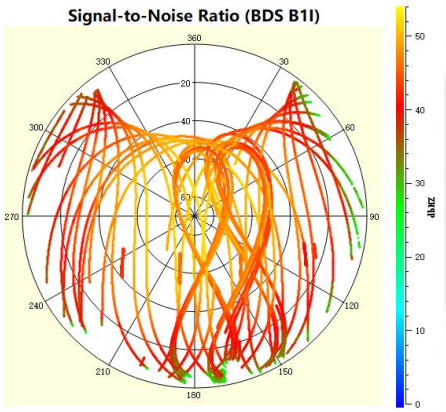
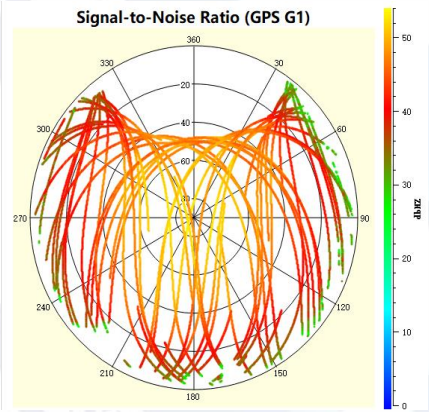
Bangladesh (srrs)

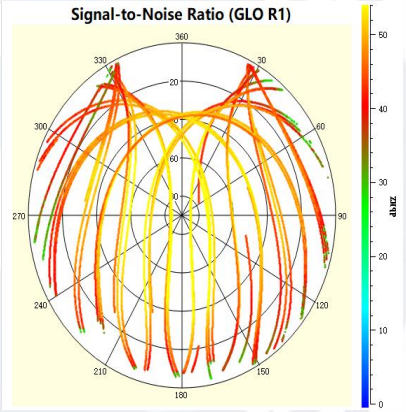
BDS



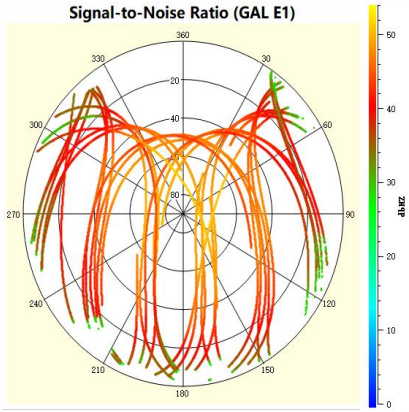
GPS



GLONASS



Galileo



Skyplot：signal-to-noise ratio

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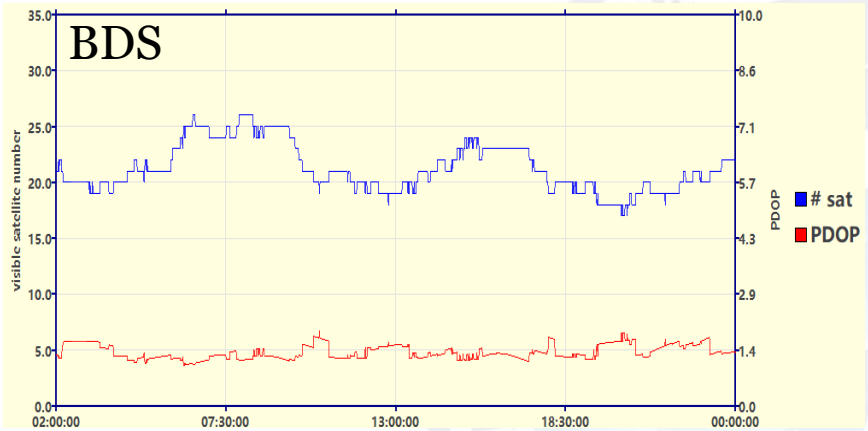
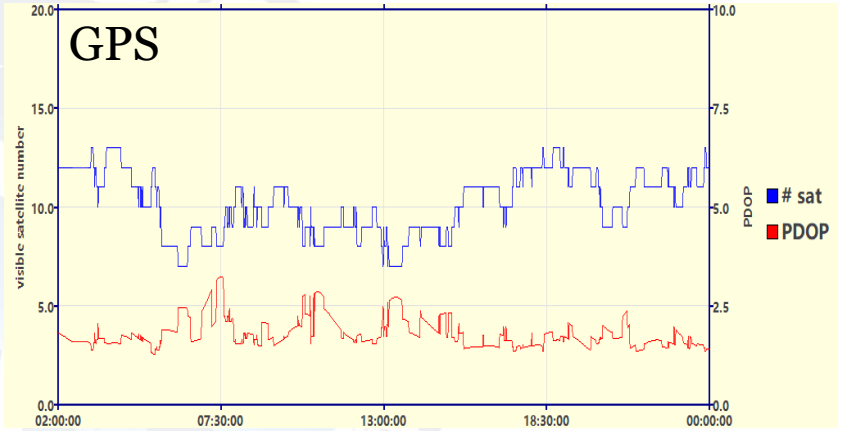
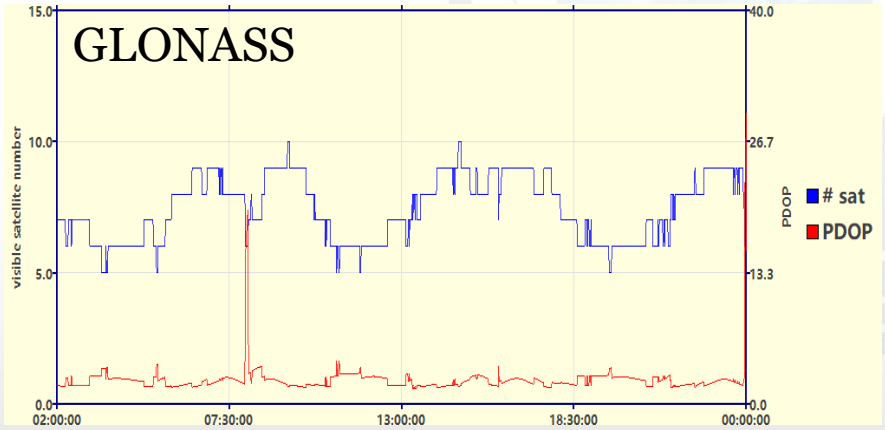
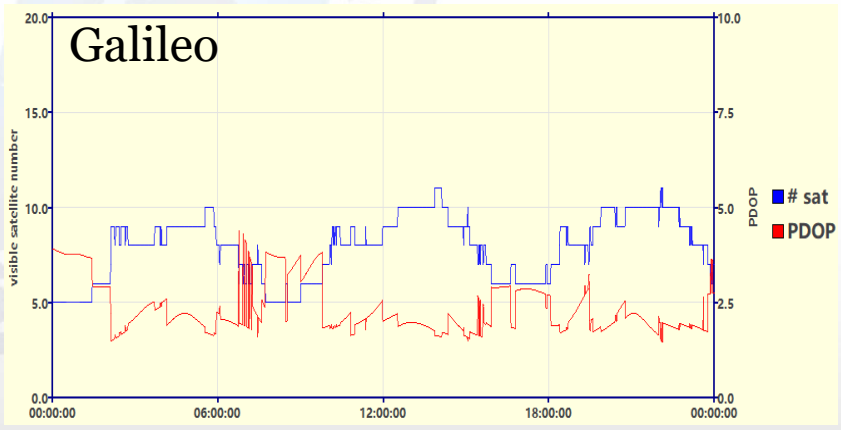
Monitoring & Assessment Results

Bangladesh (srrs) **Number of Visible Satellites and PDOP**









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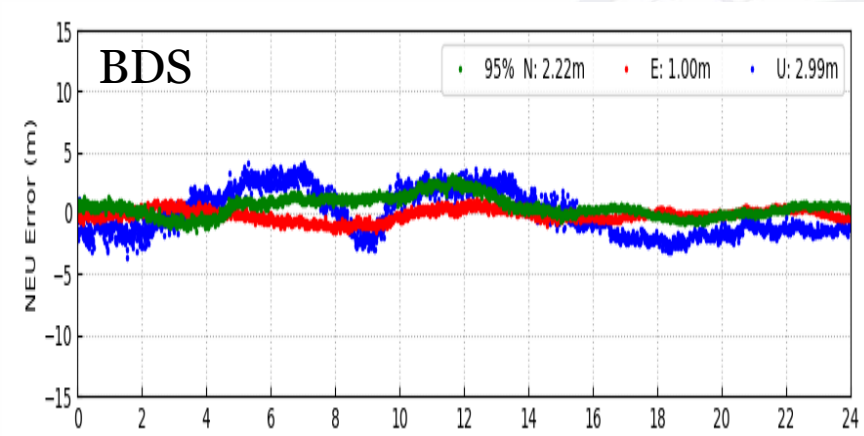
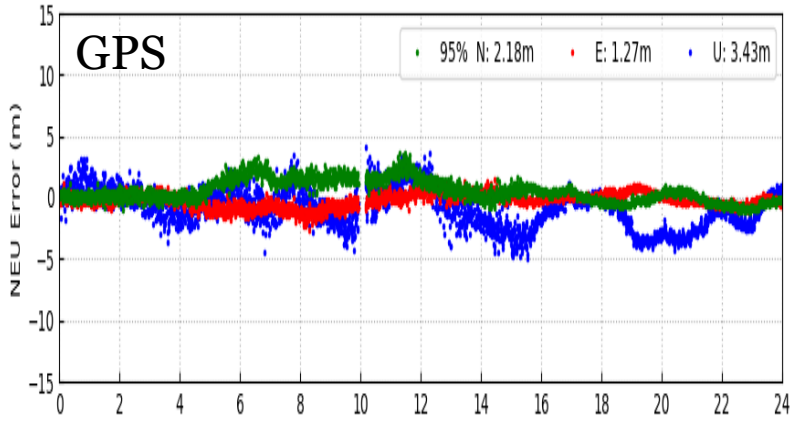
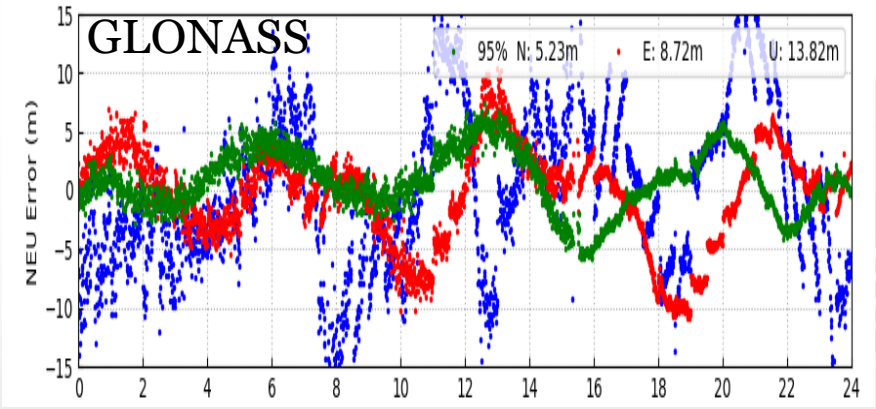
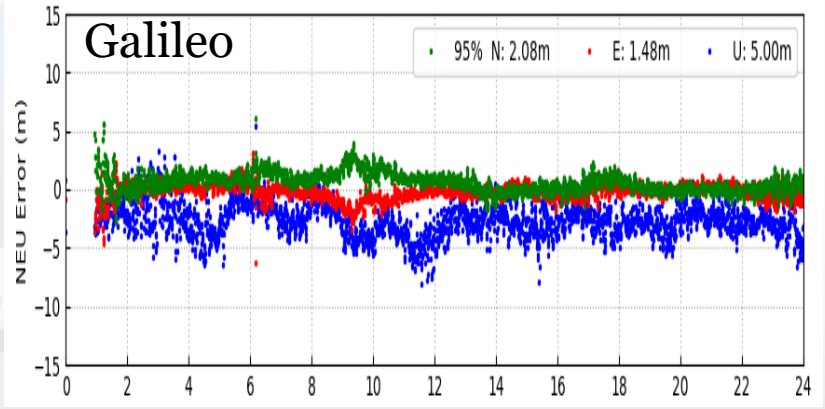
Monitoring & Assessment Results

Bangladesh (srrs) **Positioning Error** N E U









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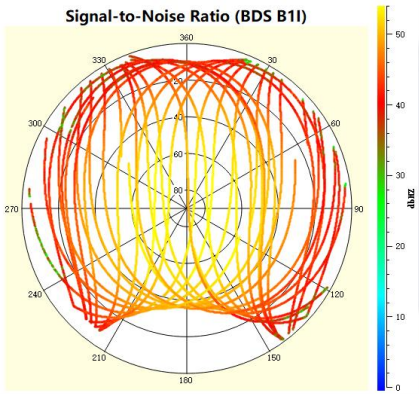
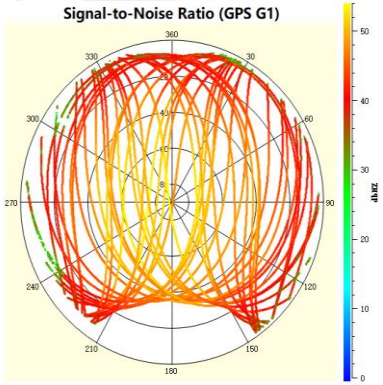
Monitoring & Assessment Results

Peru (hucy)

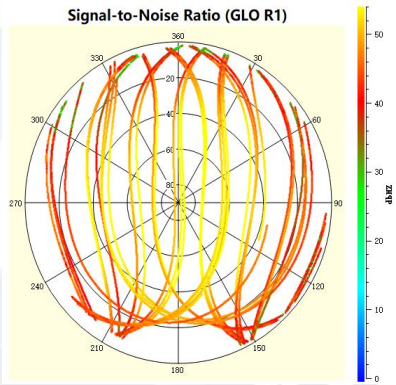
BDS



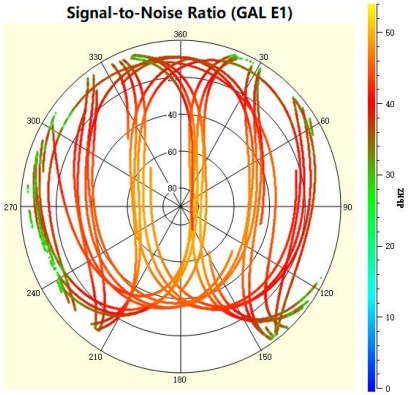
GPS



GLONASS



Galileo



Skyplot：signal-to-noise ratio

Test Date: December 5, 2019

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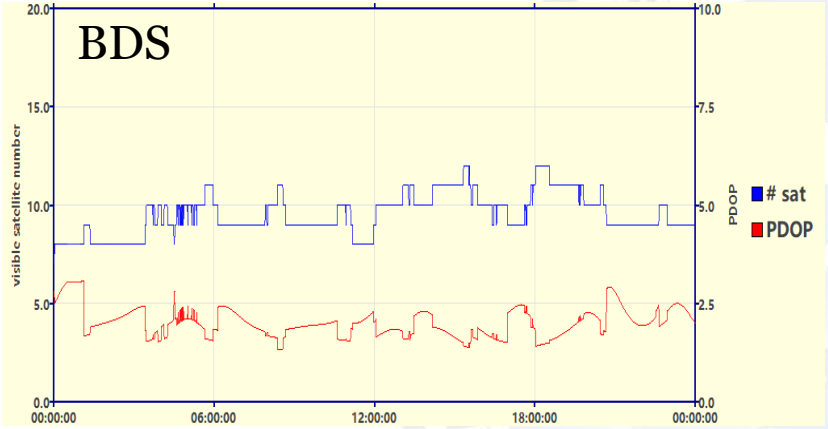
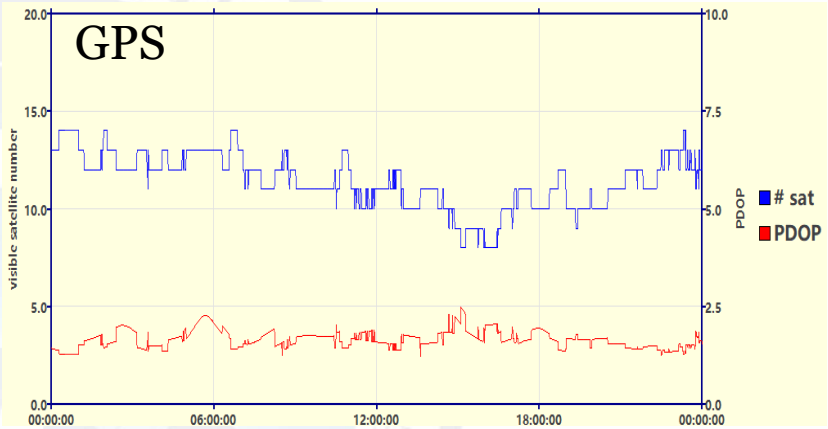
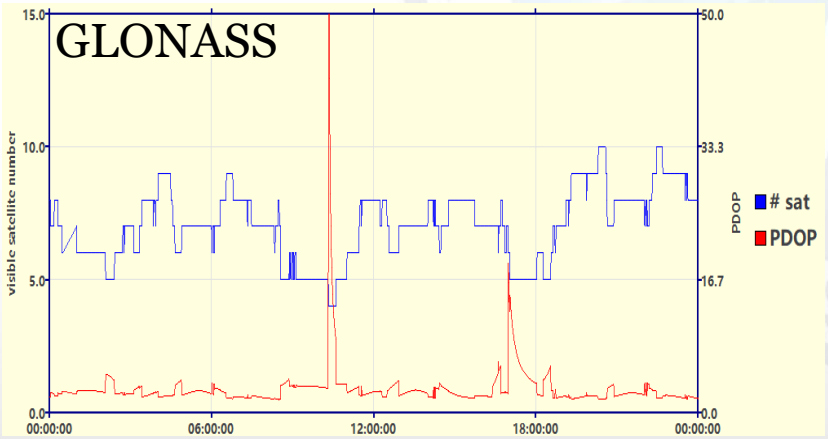
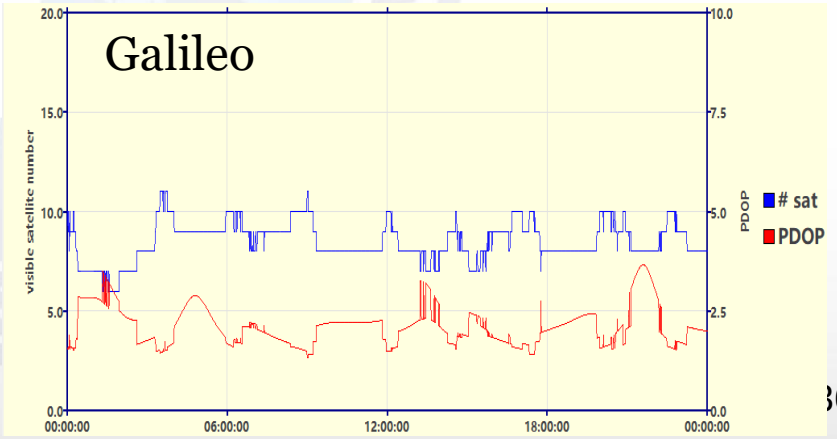
Monitoring & Assessment Results

Peru (hucy) **Number of Visible Satellites and PDOP**









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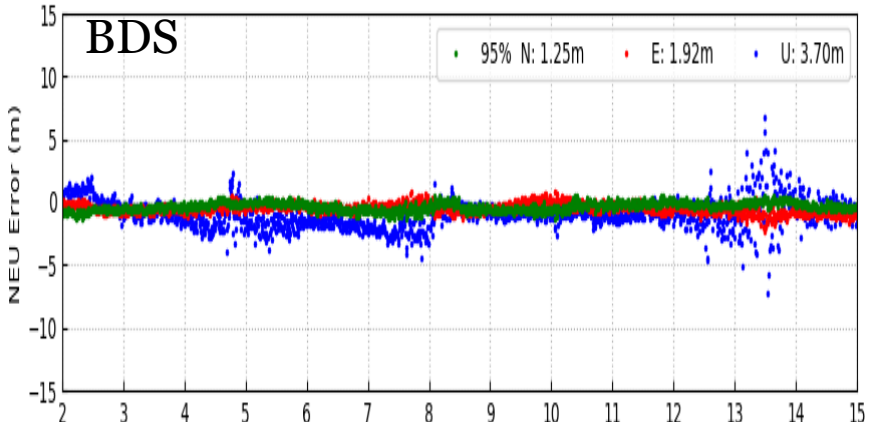
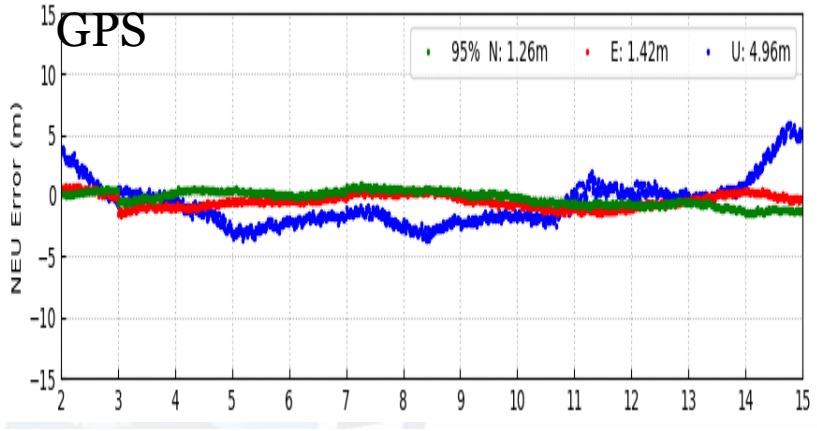
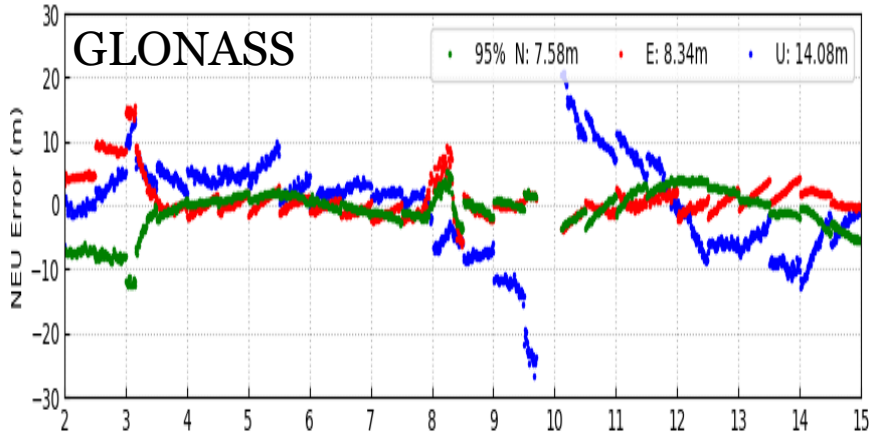
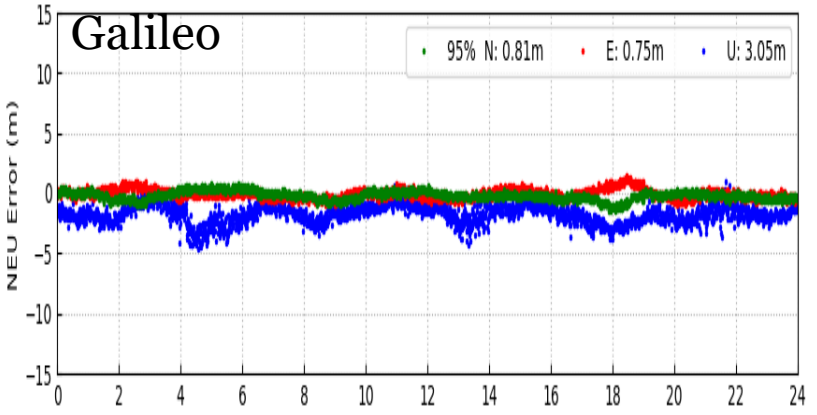
Monitoring & Assessment Results

Peru (hucy) **Positioning Error** N E U









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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: 8-28 satellites, PDOP ranges from 1-3
  - GPS: 6-14 satellites, PDOP ranges from 1.5-4.5
  - GLONASS: 4-10 satellites, PDOP ranges from 2-5
  - Galileo: 5-12 satellites, PDOP ranges from 2-6
- From the positioning results,
  - BDS (B1I): horizontal accuracy (95%) 1-3m, vertical accuracy 1-5m
  - GPS (L1): horizontal accuracy (95%) 1-3m, vertical accuracy 2-6m
  - GLONASS (R1): horizontal accuracy (95%) 8-11m, vertical accuracy 12-19m
  - Galileo (E1): horizontal accuracy (95%) 1-3m, vertical accuracy 3-7m

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Conclusions

- Through multilateral cooperation among APSCO Members, IGMA Network has been established;
- APSCO-IGMA stations can well serve GNSS monitoring & assessment, with all defined requirements have been achieved:
  - ✓ To acquire GPS, GLONASS, Galileo, BDS navigation satellites
  - ✓ To provide GNSS data with good quality
  - ✓ To analyze of the GNSS service performance by GPAK
  - ✓ To provide technical reference for GNSS applications

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THANK YOU !