15th Meeting of the International Committee on Global Navigation Satellite Systems

GNSS System Applied in Space Weather Research

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01

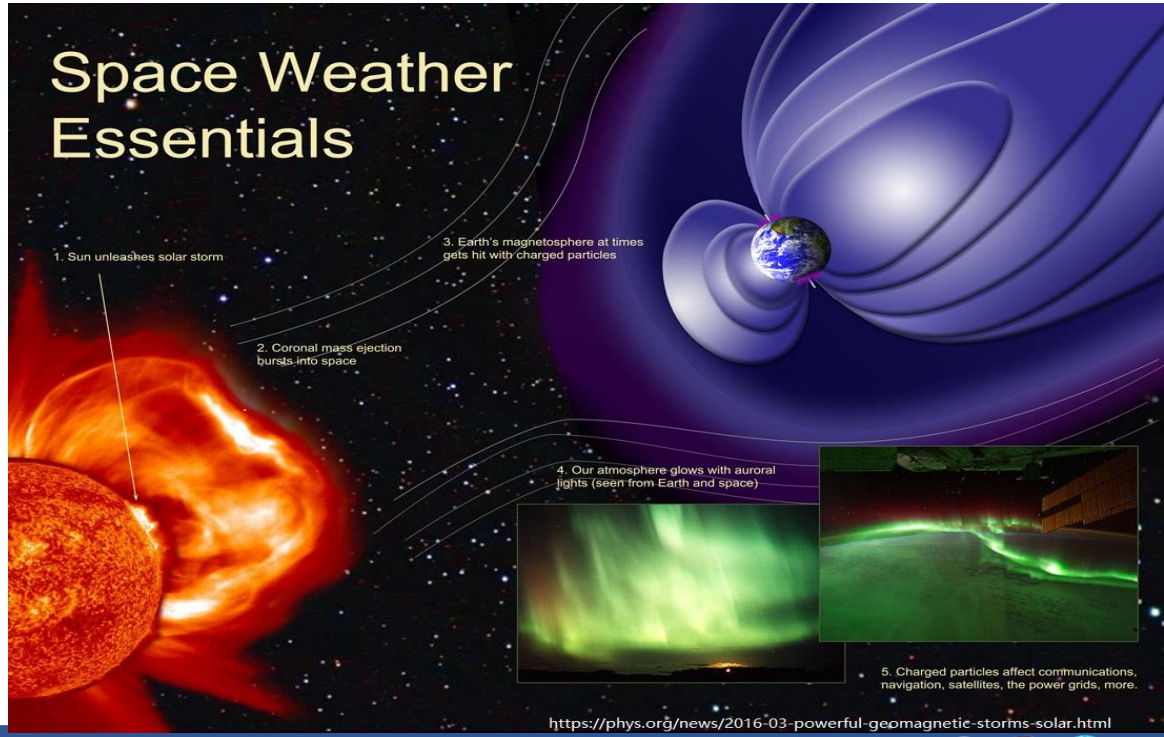
Space Weather Impact on GNSS System

01 Space Weather Impact on GNSS System

1. Space Weather Essentials

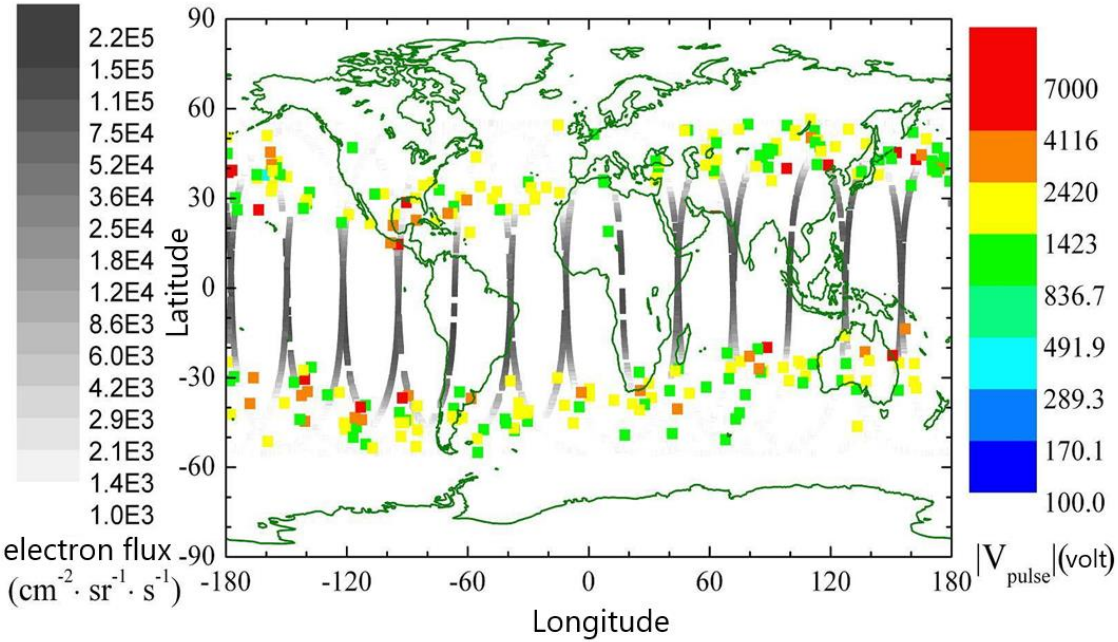
Space weather events will affect GNSS system via disturbing the navigation signals and menacing safety of the satellites.

- **Surface Charging**
- **Internal Charging**
- **Single Event Upsets**
- **Total Dose**



01 Space Weather Impact on GNSS System

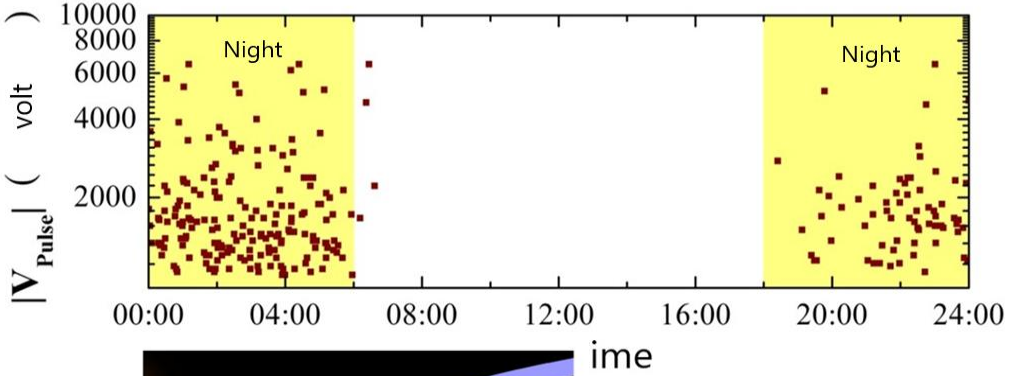
2. Observation of surface potential in MEO orbit

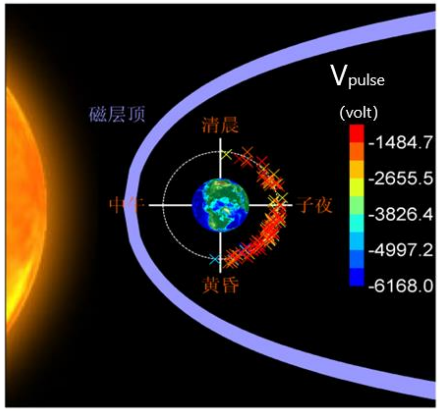


Pulse charge-discharge had been observed many times, which can charge the satellite surface to be thousands of volts in minutes.

02 Space Weather Impact on GNSS System

3. Observation of surface potential in MEO orbit





Most of the charge observations happened when the satellite locate at the night side of the magnetosphere, which indicates the charge phenomenon may be relative with the magnetotail plasma injection events.

02

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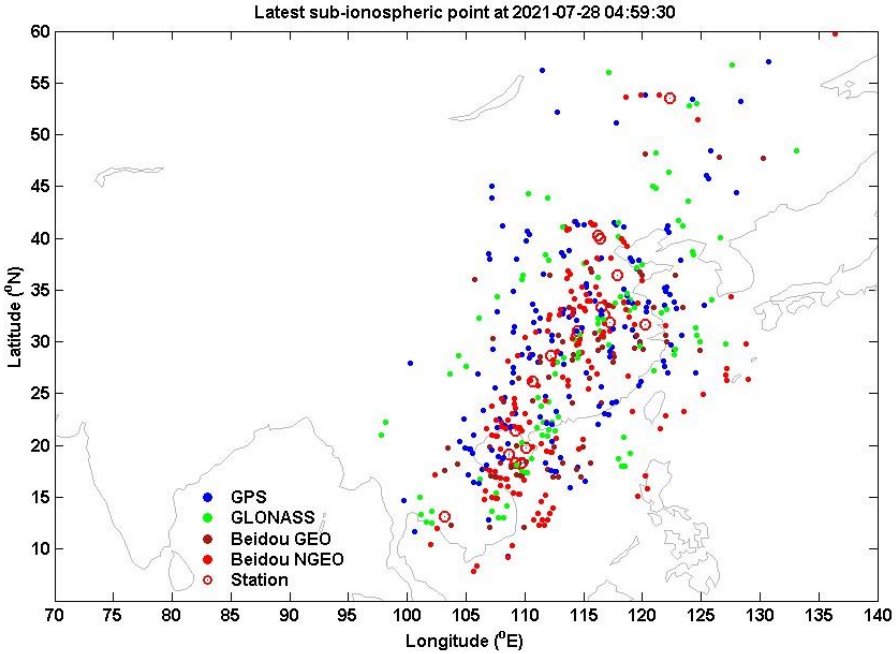
1. GNSS TEC Technique in Space Weather Monitoring



Ionosphere Monitoring

GNSS TEC technique have been new Ionosphere monitor methods.

There have been many Ionosphere monitoring networks in the world.

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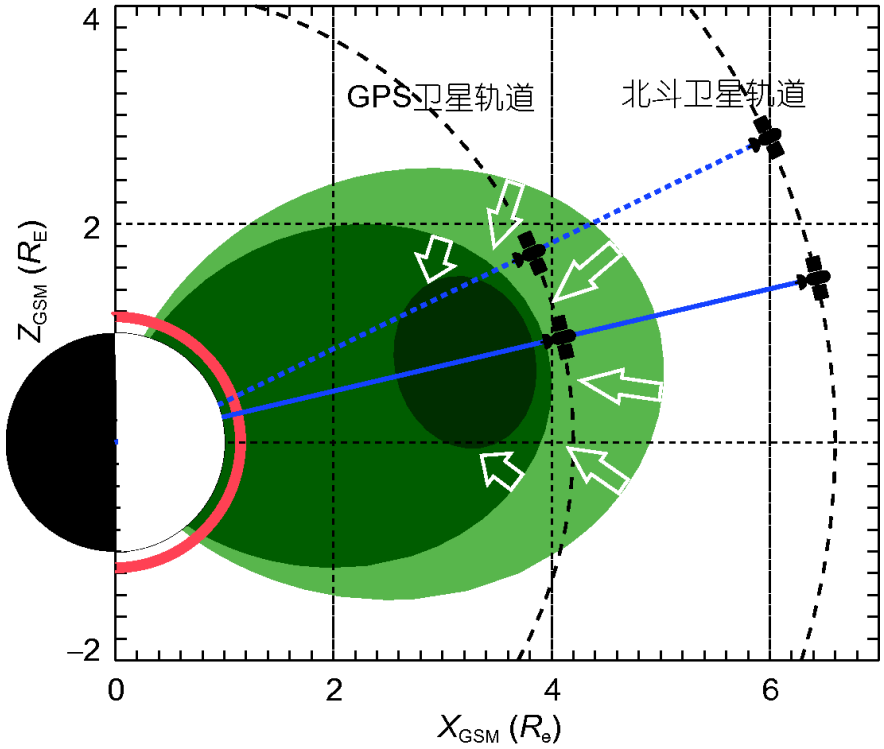
2. GNSS TEC Technique in Space Weather Monitoring



The geomagnetic storm is a major disturbance of near Earth space environment, which can be reflected from TEC signals of GPS and BeiDou.

The white arrows indicate the motion of the plasma when the geo-magnetosphere was compressed by the interplanetary shock.

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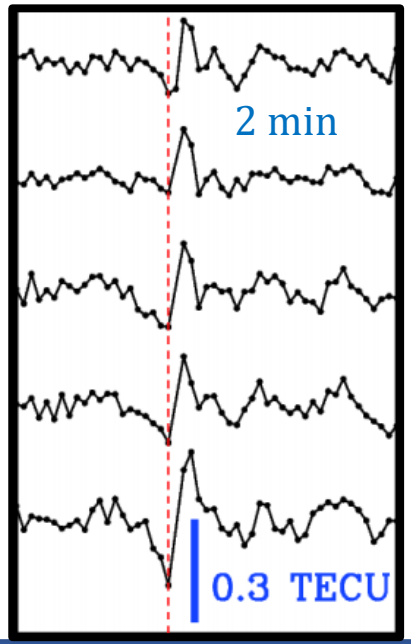
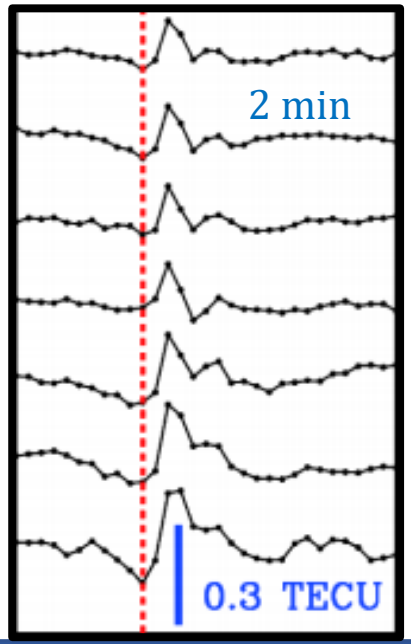
3. Observations of Storm Sudden Commencement

BeiDou



GPS



The geomagnetic storm is a major disturbance of near Earth space environment.

Intense geomagnetic storms usually start with a sudden commencement.

Total electron content (TEC) derived from navigation data can reveal features of storm sudden commencement

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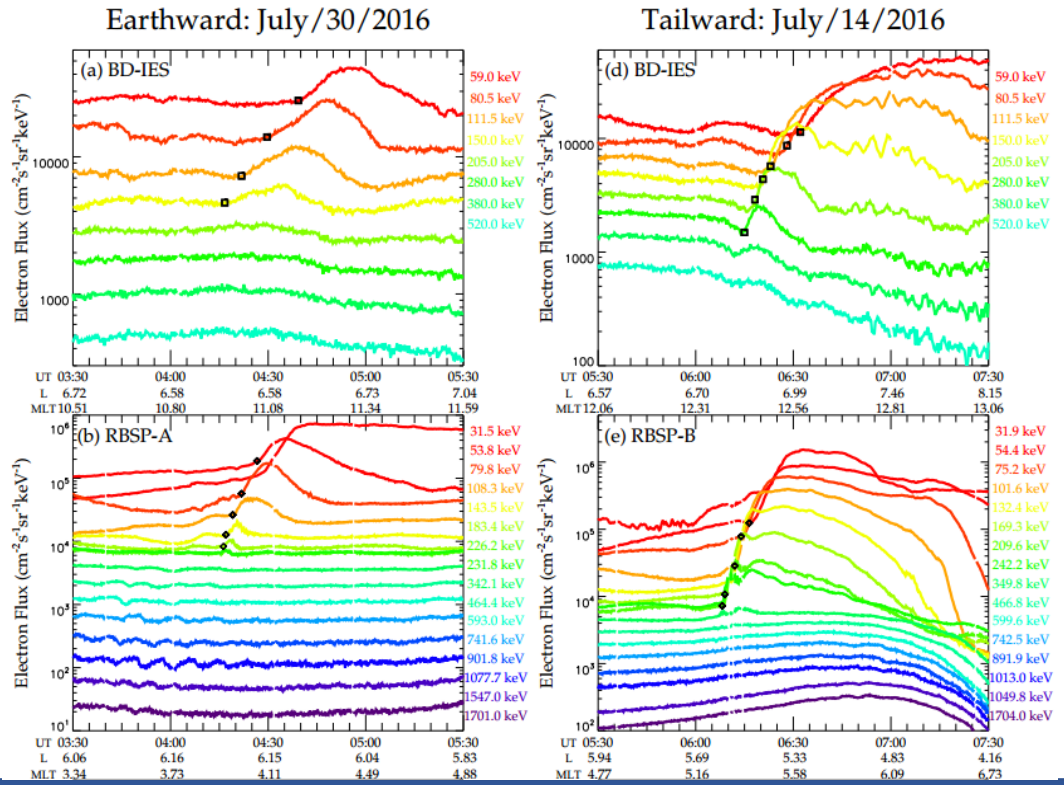
4. GNSS as Platforms for Scientific Instruments



Joint Observations of Substorm

Substorm, another major geomagnetic activity, observed by instruments onboard RBSP and BeiDou satellites

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- Space weather research can support the radiation environment prediction for the satellites, and the anomaly prediction caused by space weather events.

- Space weather research can investigate the ionosphere response to the solar events, and improve the stability of GNSS system.

- Space weather and GNSS system actually help in complementing each other.

03

Space Weather threaten to GNSS System

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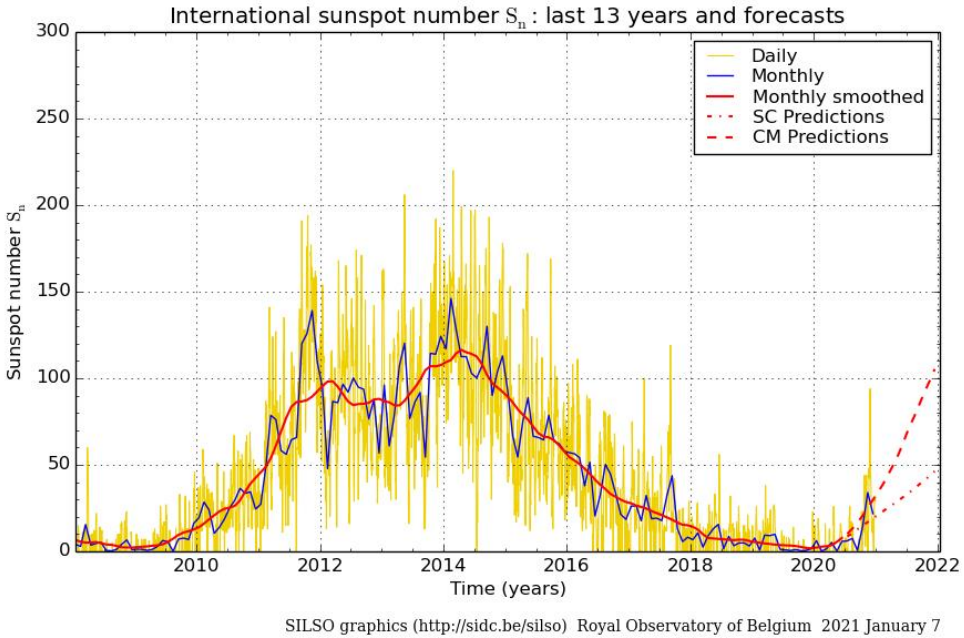
The Challenge



With the rising solar activities of the 25th solar cycle, the impacts of space weather on GNSS system will increase.

Different GNSS systems should unite together to face the threaten from the rising solar activity.

03 Space Weather threaten to GNSS System

Proposal

- Information about space weather should be exchanged, since the severe space weather events will probably be global events.
- Solid connections between different GNSS systems should be established to face the rising solar activity in next few years.
- More cooperation and openness are called by the potential natural disasters.


Thank you
http://en.beidou.gov.cn