Data and Applications of Space Weather Payloads onboard of BDS Satellites

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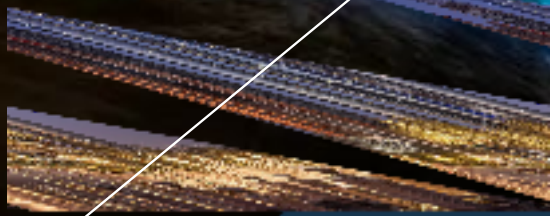

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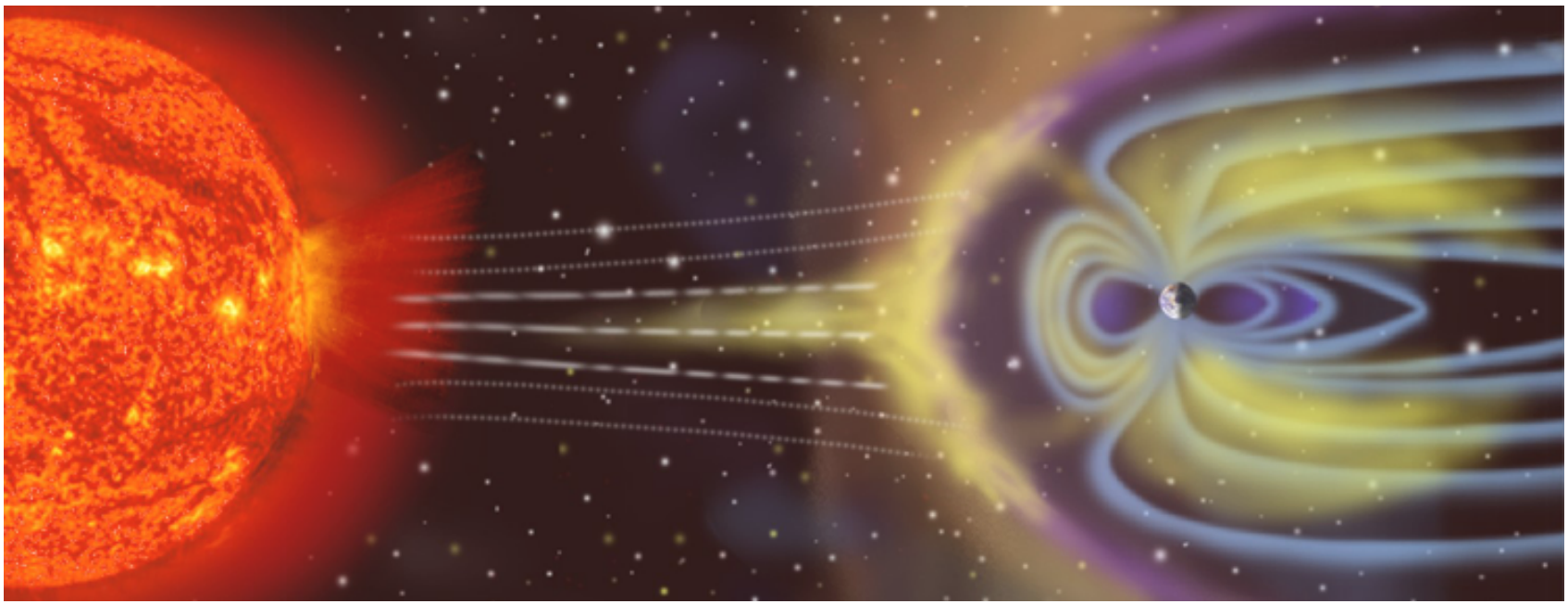
Space Weather and GNSS

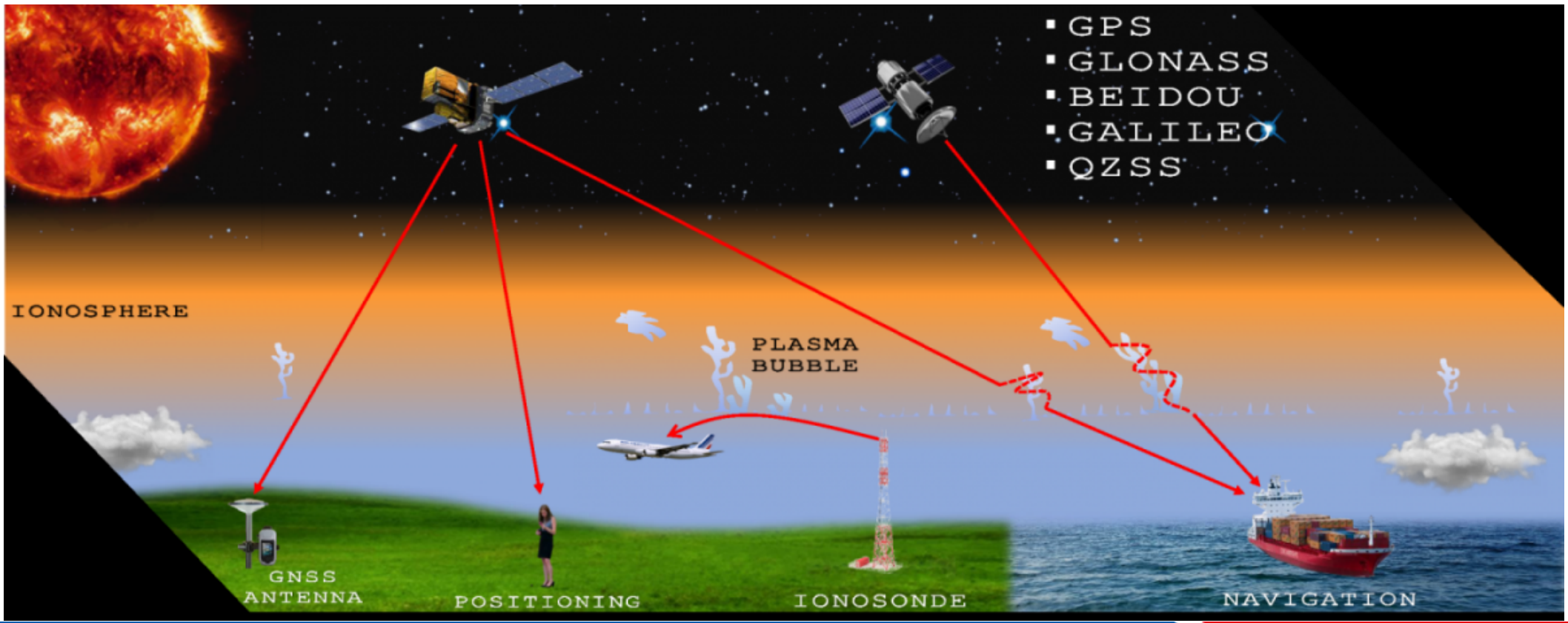
Space Weather and GNSS

1. Space environment disruptions near Earth, caused by solar activities.



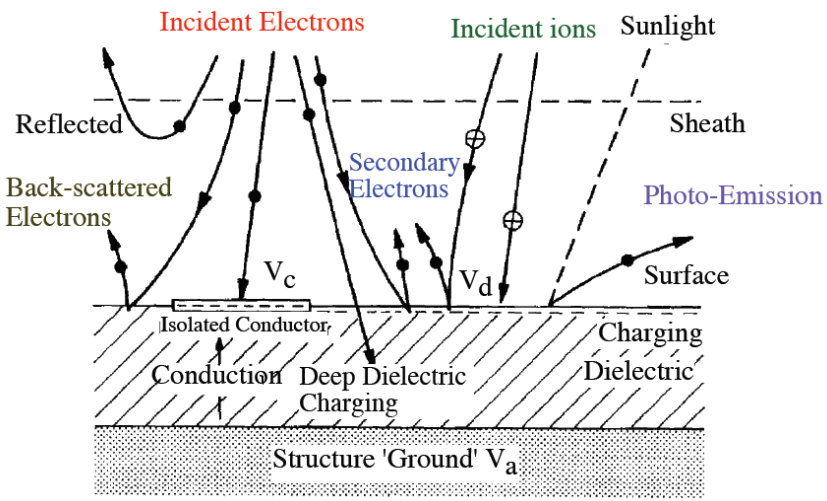
Space Weather and GNSS

2. Possible consequences of space weather events for GNSS

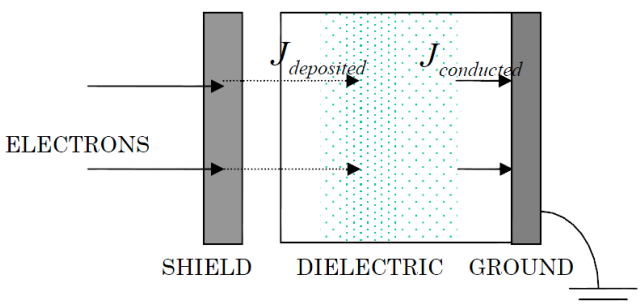


Space Weather and GNSS

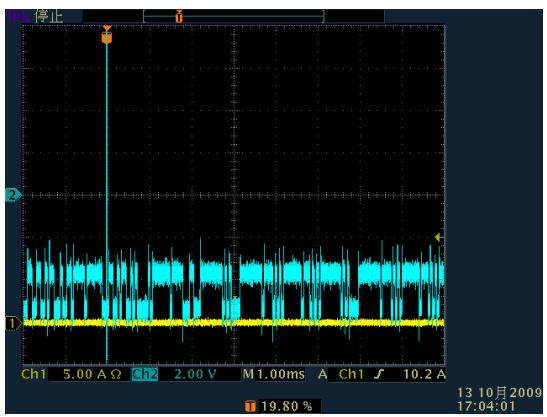
3. Incident Electrons and Charging Events



Surface Charging



Inner Charging



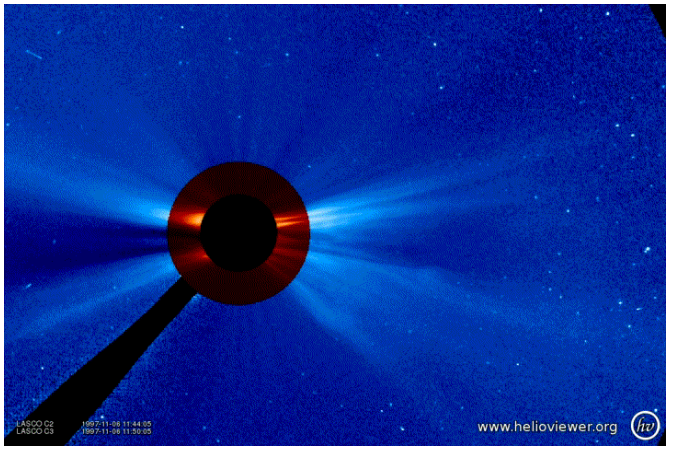
Interference

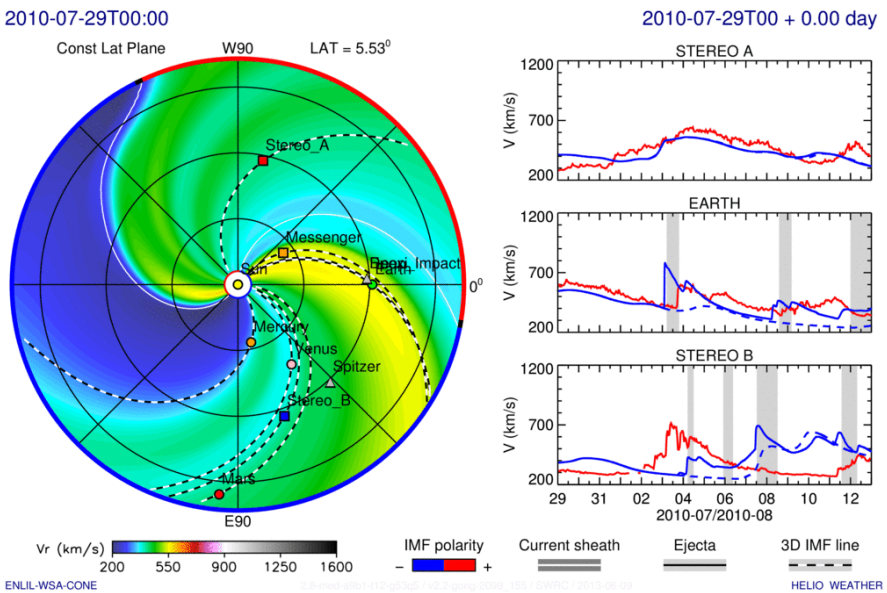
Space Weather and GNSS

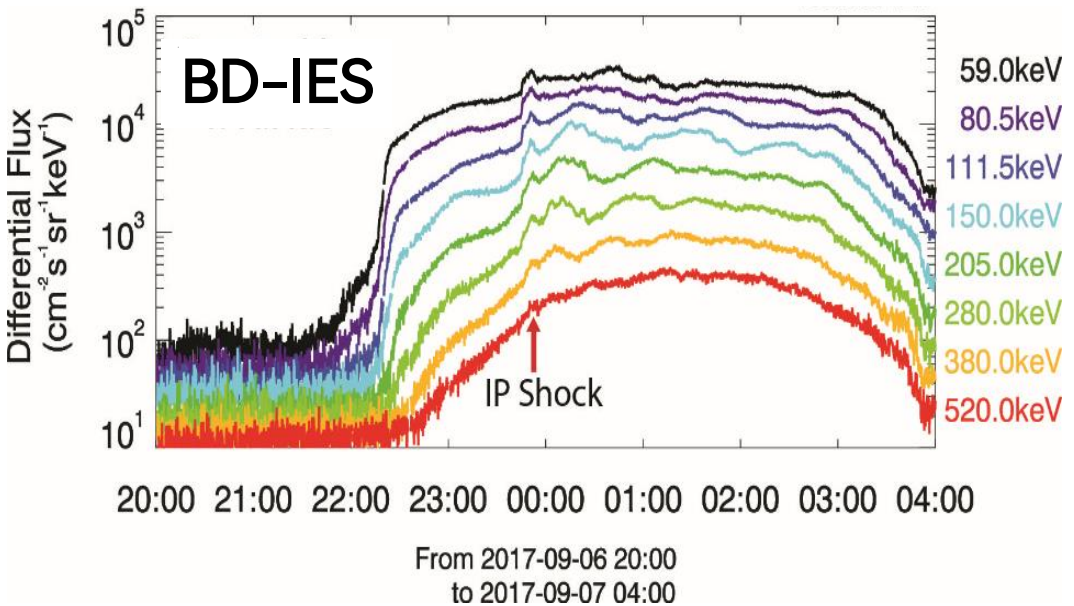
4. Research and Forecasting

Methods:

- Observations analysis
- Simulations
- Model predictions







02

Space Weather Payloads on BDS

Space Weather Payloads on BDS

1. Energetic Electron Detection Packages

Payload	Characteristic Parameter	Function
Medium-energy Electron Spectrometer (MES)	Energy: 50~600keV FOV: 30°×180° Geometric factor: < ~2.0×10^{-3}	Measure the energy spectra and flux changes of medium electrons in the outer radiation belt.
High-energy Electron Detector (HED)	Energy: 0.5~3.0MeV FOV: 30° cone-angle Geometric factor: < ~1.0×10^{-2}	Measure the energy spectra and flux changes of high electrons in the outer radiation belt.
Deep Dielectric Charging Monitor (DDCM)	Charging Voltage: -2.5 kV to 0 V Charging Current: 0.01-50 pA	Measure the deep dielectric charging current and voltage.

Space Weather Payloads on BDS

2. Space Plasma and Satellite Surface Charging Monitor

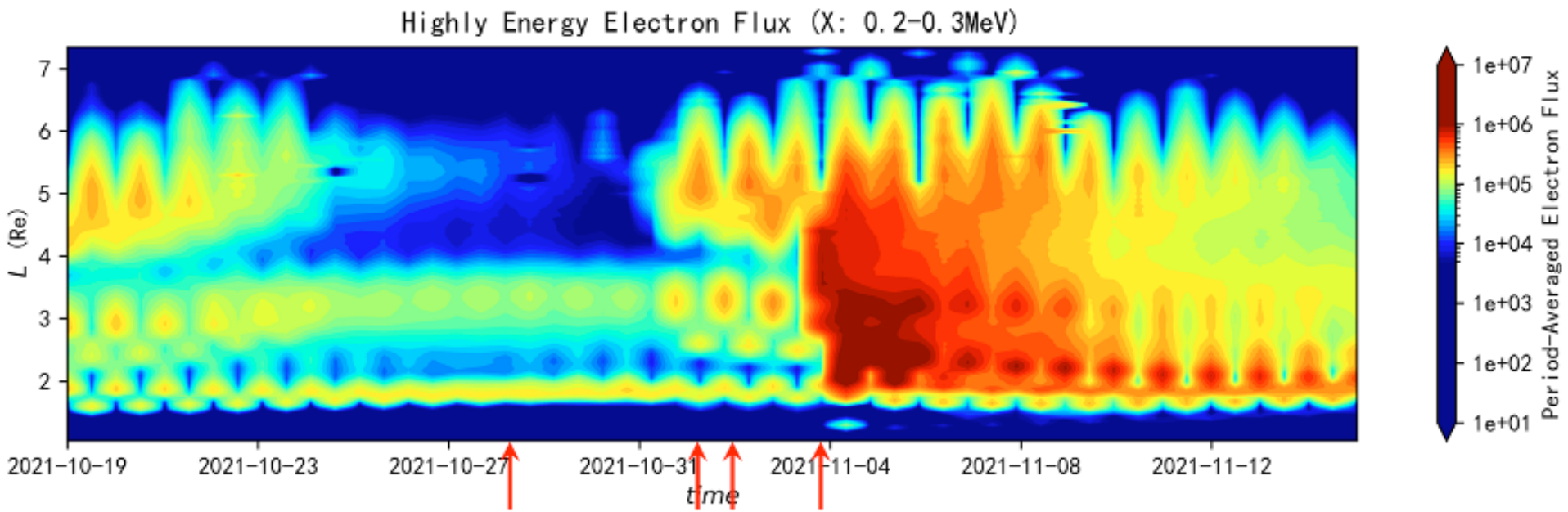
Payload	Characteristic Parameter	Function
Low Energy Electron/Ion Spectrometer	Energy: 0.1~15 keV FOV: 2π Resolution: ＜15%±2%	Detect parameters of in-situ electrons and ions, such as energy, flux, density and velocity.
Magnetometer	Range: -65000 nT ~ +65000 nT Noise: 10 nT	Measure the environmental magnetic field around the satellites.
Radiation dosimeter	Radiation dosage: 0～10^7rad	Measure total radiation dose to evaluate the lifetime of satellite.
Surface potential detector	Surface potential : 0.1 ~10 kV	Monitor the satellite' s surface potential.

Data and Results

03

Data and Results

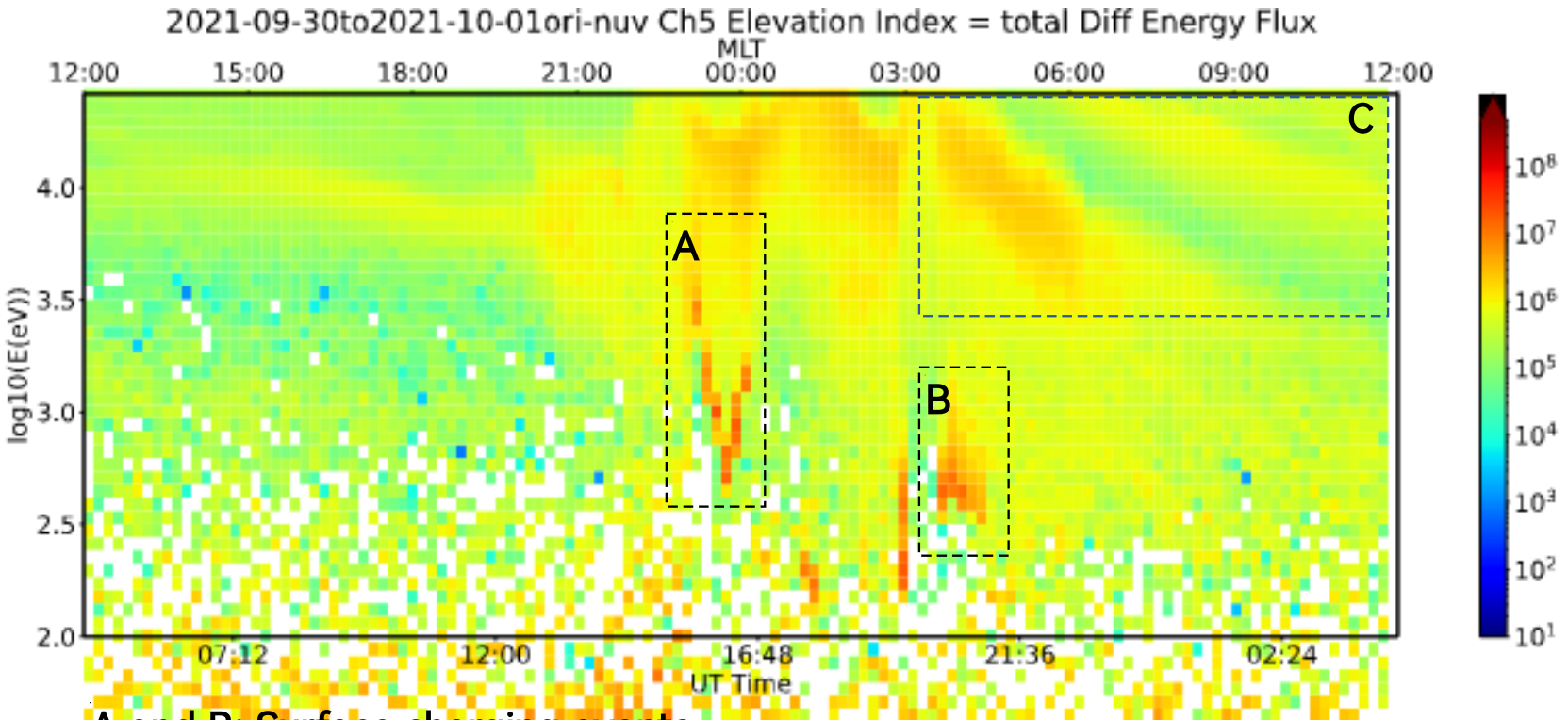
1. Data of HED (High-energy Electron Detector)



The red arrows indicate times of four CME (Coronal Mass Ejection) events

Data and Results

2. Data of LEIS (Low Energy Ion Spectrometer)



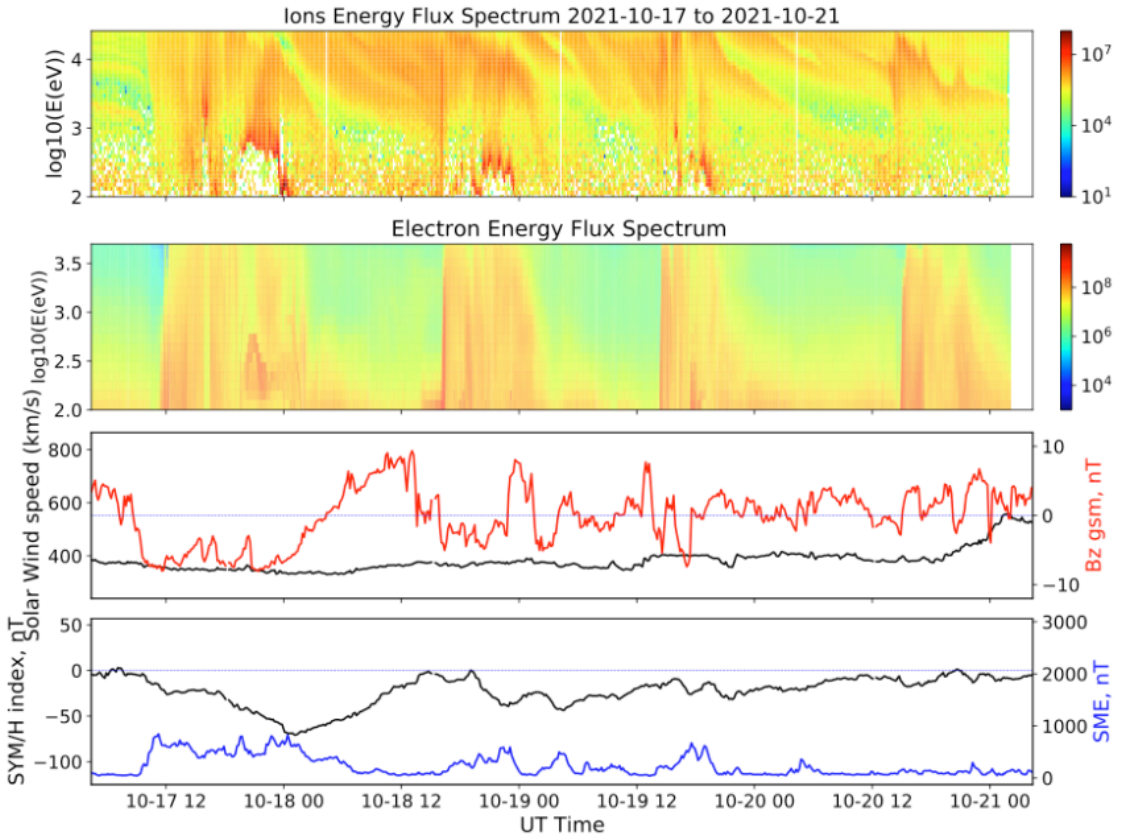
A and B: Surface charging events

C: Characteristic for injection of charged particles

Data and Results

3. Analysis of Surface Charging Events

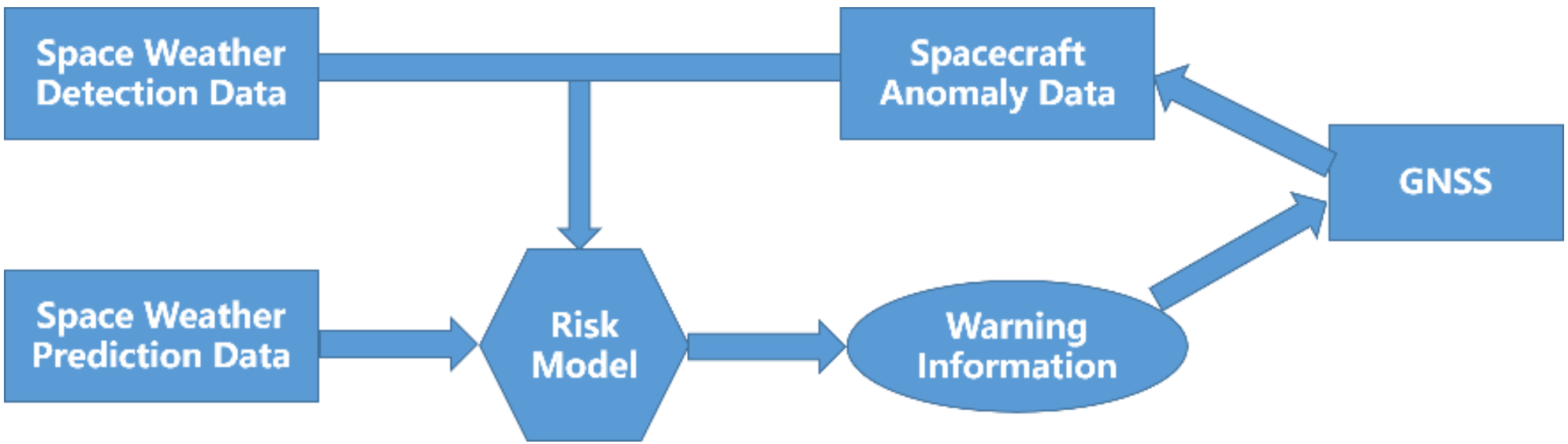
- Spectrum data of both Ions and Electrons are from the same satellite;
- The higher electron fluxes appear from the midnight to the dawn side, which may indicate that the electron injection from the magnetotail mainly occurs at the dawn side;
- The weakening of the substorm and the weakening of the electron flux observed by the electron detector on the dawn side may indicate a correlation in-betweens.



Data and Results

4. GNSS Anomaly Warning Strategy

- According to the risk model, the space environment risk probability of the GNSS satellites are predicted, and the space environment risk early warning evaluation indexes with appropriate satellite thresholds are issued.



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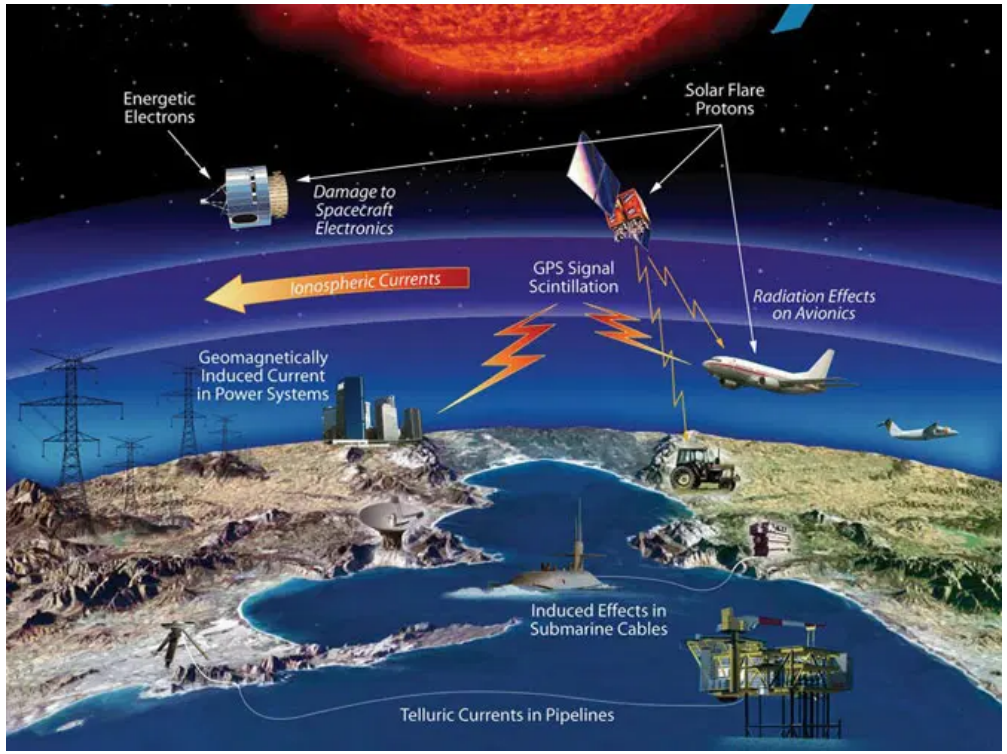
Recommendation

Recommendation: Conduct Workshops for Space Weather

Background and Brief Description of the Issue:

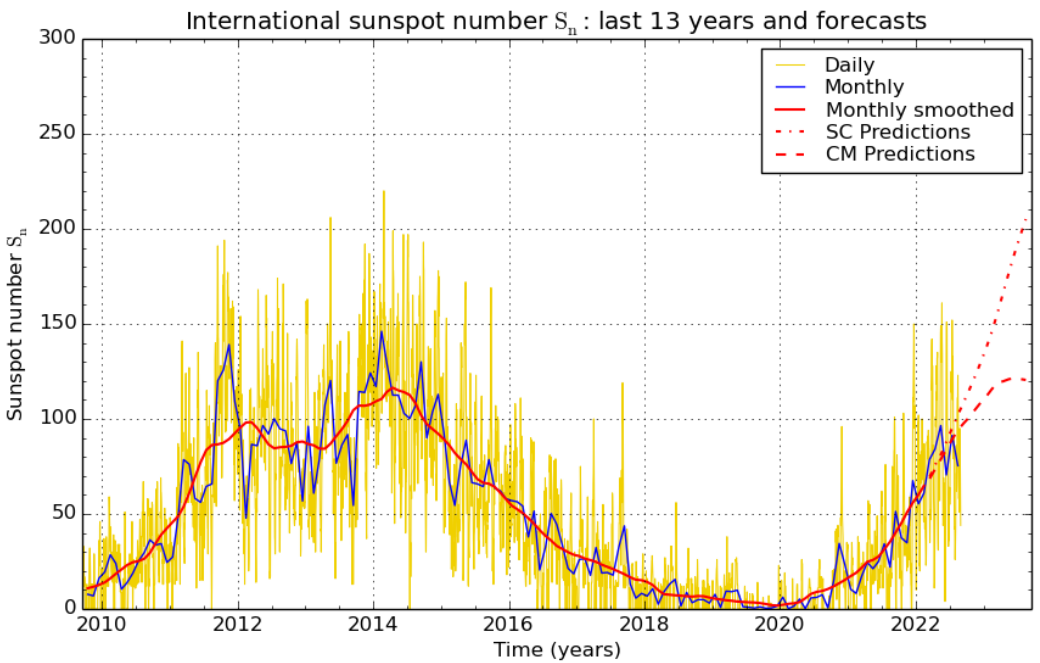
- Space weather is essential to the safety and stability of the GNSS system;
- Information about the space environment payloads onboard different GNSS satellites should be introduced in ICG;
- If space weather data sets obtained by GNSS satellites can be shared and discussed, the accuracy of the forecast and nowcast models would have a tremendous improvement.



Recommendation: Conduct Workshops for Space Weather

Discussions and Analyses:

- We are at the rising phase of the 25th solar cycle now;
- Rising solar activities would lead to more space weather events ;
- We should work together to prevent possible damages from severe space weather events to our GNSS satellites.



Recommendation: Conduct Workshops for Space Weather

Recommendation of Committee Action:

- The workshops for space weather could be conducted in ICG.
- The space environment payloads onboard GNSS satellites and their date sets could be introduced in workshops.
- The space weather models and forecast outputs could be shared and discussed in workshops.
- Severe space weather events and their impact to GNSS systems could be studied through the workshops.


Thank you
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