



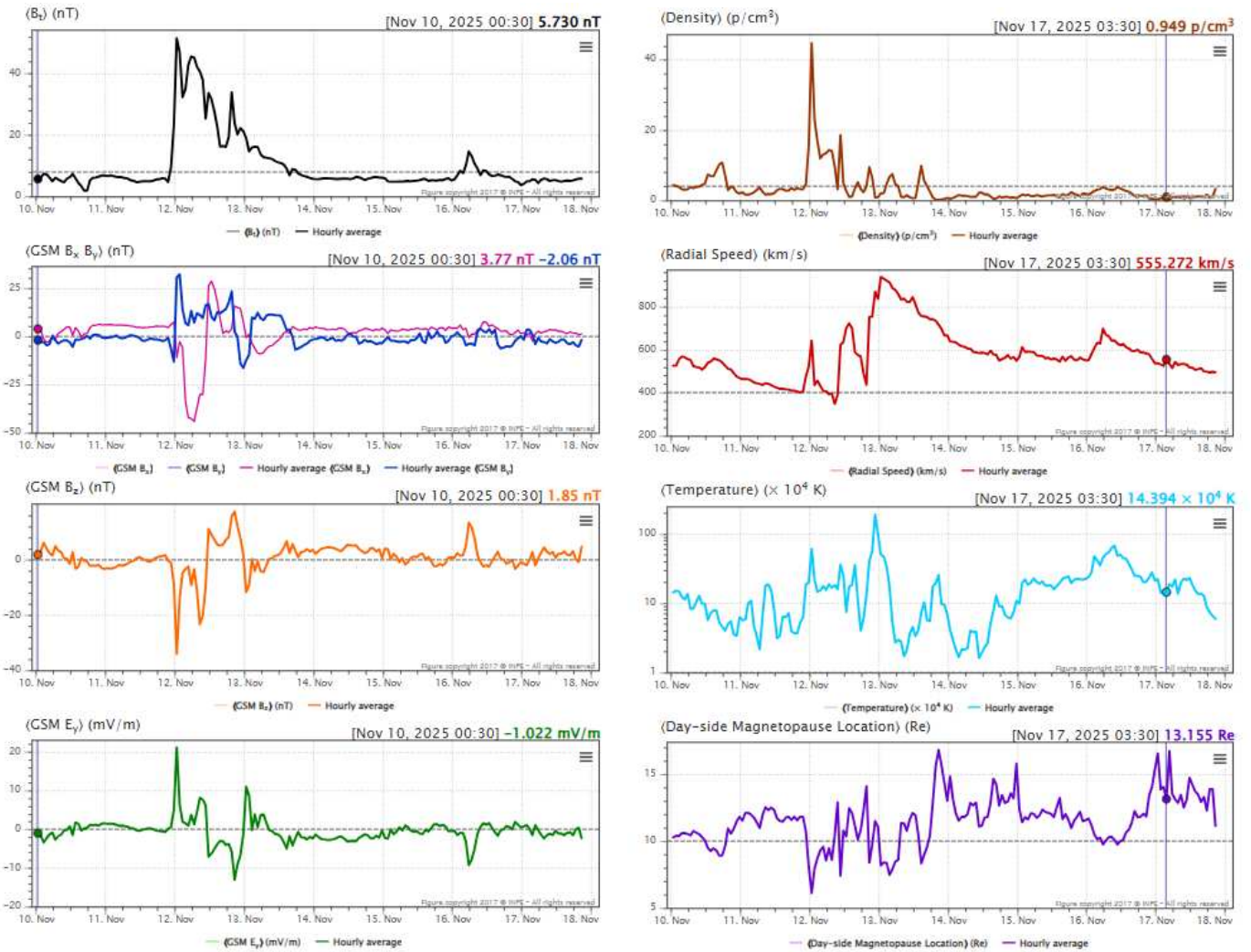
Interplanetary Medium – IM – Daniele da S. F. Medeiros and Paulo R. Jauer
Period: November 10th to November 17th.

Summary

Summary of IM conditions for the last week. The interplanetary medium region in the last week showed a moderate level of plasma disturbances due to the possible interaction with CME identified by the DSCOVR satellite in the interplanetary medium. The Kp index obtained by NOAA/SWPC and the modeling.

- The magnitude of the interplanetary magnetic field component peaked on November 12th at 00:30 UT at +51.51 nT due CME.
- The BxBy components presented variations in the analyzed period, keeping both oscillating within the interval [-44.10, +32.03] nT. Showing eight rotations of the By component.
- The Bz component presents negative values for most of the week with a maximum negative -34.07 nT at 00:30 UT on November 12th. It presented positive value of +17.36 nT on November 12th at 20:30 UT.
- The solar wind density maximum peaked on November 12th at 00:30 UT at 44.82 protons/cm³.
- The solar wind speed fluctuated between 348 to 939 km/s, with four increases: on November 11th starting at 21:30 UT, November 12th starting at 08:30 UT and 19:30 UT, and on November 16th starting at 00:30 UT due to CMEs.
- The magnetopause position remained relaxed almost throughout the analyzed period, reaching maximum compression (6.12 RE) at 00:30 UT on November 12th.
- The measured interplanetary Kp reached a peak of approximately 9, while the modeled Kp exceeded the limit of 9 on November 11th.

Figure 1 illustrates a set of parameters observed in the solar wind by the DSCVR satellite. The measured solar wind parameters can be identified in the following order starting in column 1: Interplanetary magnetic field modulus (IMF), the Bx and By components, Bz component, convection electric field Ey. Column 2: Solar wind density, speed, temperature and the last graph represents the position of the subsolar magnetopause.



Please, acknowledge EMBRACE/INPE for the data in your publication
The B_x , B_y , B_z , Density, Radial Speed and Temperature Solar Wind data are provided by the DSCOVR (SWPC/NOAA) spacecraft

Figure 1: Illustrates a set of parameters observed in the solar wind by the DSCVR satellite.

Figure 2 illustrates a set of parameters observed in the solar wind by the DSCOVR satellite. The measured solar wind parameters can be identified in the following order, starting with the panels below: solar wind speed, Bz component of the interplanetary magnetic field (IMF), solar wind density, and the last graph represents the Kp index obtained by NOAA/SWPC and the modeling.

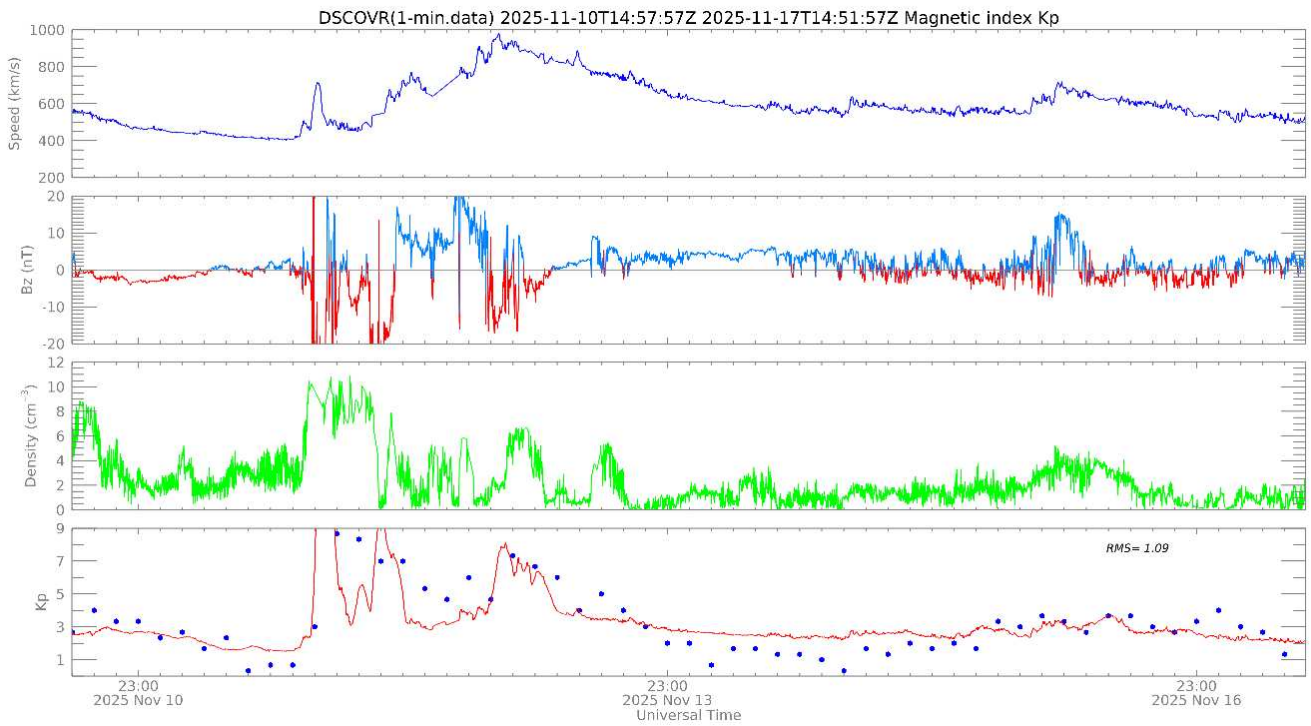


Figure 2: Illustrates a set of parameters observed in the solar wind by the DSCVR satellite and the Kp index by NOAA/SWPC, blue dot, and the modeling, red line.

EARTH'S RADIATION BELT

Responsible: Ligia Da Silva

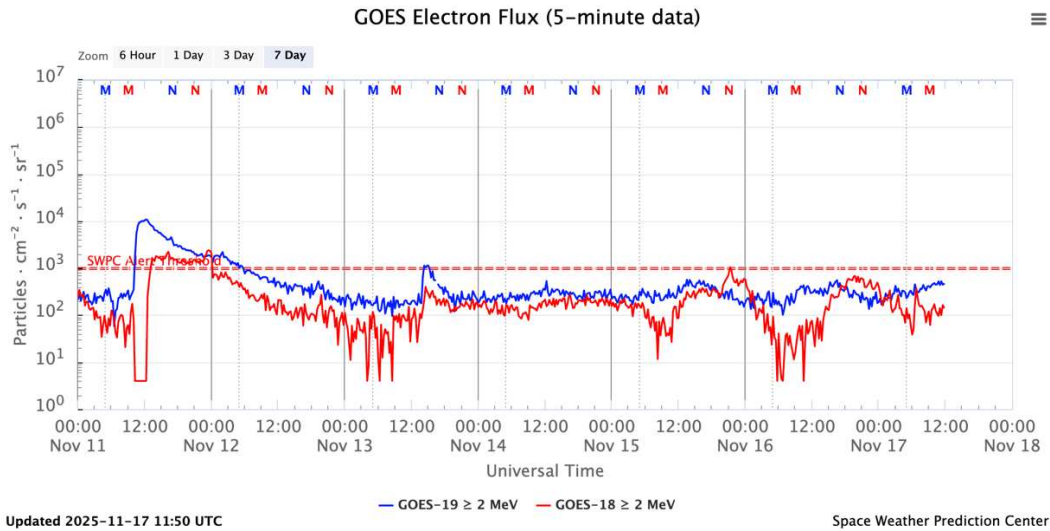


Figure 1: High-energy electron flux (> 2MeV) obtained from GOES-18 and GOES-19 satellite. Source: <https://www.swpc.noaa.gov/products/goes-electron-flux>.

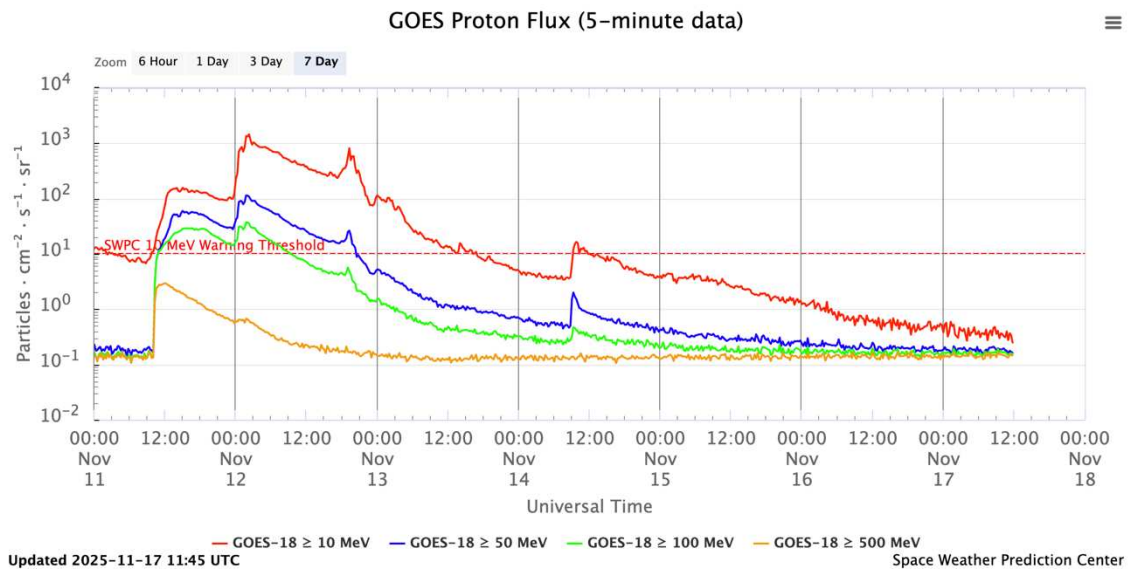


Figure 2: Proton flux ($\geq 10\text{MeV}$, $\geq 50\text{Me}$, $\geq 100\text{Me}$, $\geq 500\text{Me}$) obtained from the GOES-18 satellites. Source: <https://www.swpc.noaa.gov/products/goes-proton-flux>.



Summary

The high-energy electron flux (>2 MeV) in the outer boundary of the outer radiation belt obtained from geostationary satellite data GOES-19 (Figure 1) exhibited a rapid dropout, followed by a flux increase that exceeded the alert threshold starting at 10:00 UT on November 11th. This variability in high-energy electron flux occurred due to influences from a coronal mass injection (ICME). From the beginning of November 12th, the flux remained slightly below the alert threshold.

The flux of solar energetic protons (SEPs ≥ 10 MeV, ≥ 50 Me, ≥ 100 Me, ≥ 500 Me), at the outer boundary of the outer radiation belt obtained from the GOES-18 geostationary satellite (Figure 2), increased significantly, exceeding the alert threshold, from 10:00 UT on November 11th, associated with the arrival of an x-class flare and an ICME. A second increase in energetic proton flux occurred after 00:00 UT on November 12th, reaching two orders of magnitude above the alert threshold, associated with the arrival of another ICME. Although the SEPs showed a decreasing trend, two other peaks were observed at the end of the day on November 12th and in the middle of the day on November 14th, also associated with the arrival of solar wind structures.

IONOSPHERIC CONDITIONS REPORT

Laysa Resende

Period: 09–14 November

Locations analyzed:

- **São Luís (SLZ)** – Near the magnetic equator
 - **Cachoeira Paulista (CP)** – Region influenced by the South American Magnetic Anomaly (SAMA)
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1. São Luís (SLZ)

1.1 – 09 November – Before the CME arrival

- Typical ionospheric behavior.
- **Spread-F** observed in the F region, associated with **equatorial plasma bubbles**.

1.2 – 10 November – Arrival of an X-class flare

- **Partial HF blackout.**
- Layers **E, Es, and part of F** (especially at low frequencies) experienced strong attenuation.
- Signals stopped being detected.
- **HF impact:** 09:20–13:40 UT (06:20–10:40 LT).

Nighttime:

- Persistent F-region spread → sustained **plasma bubble activity**.

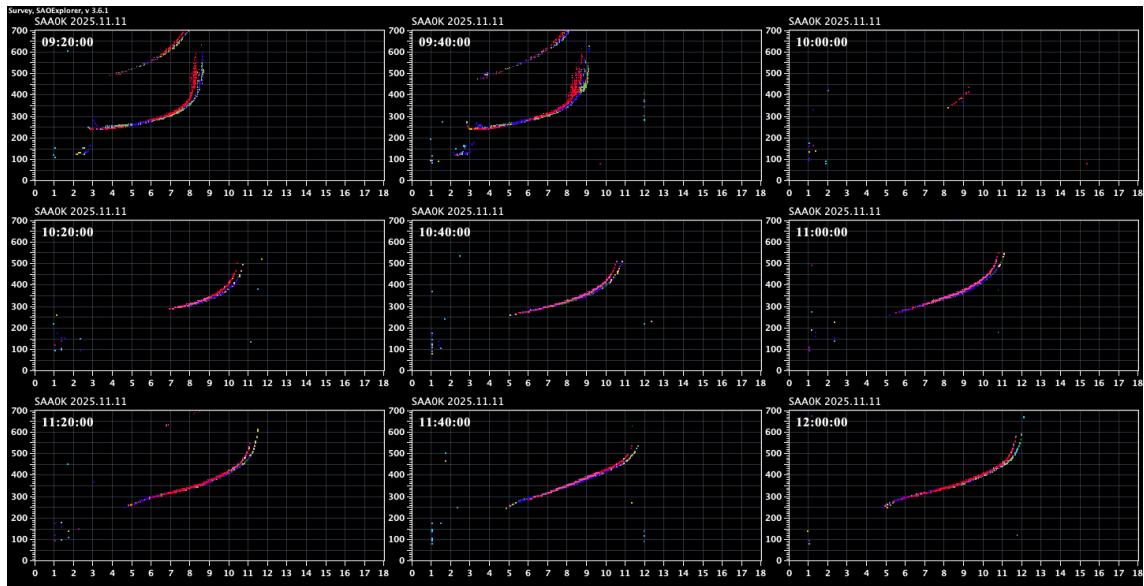
1.3 – 11 November – New X-class flare + CME arrival

- **Total HF blackout.**
- Layers **E, Es, and F at low frequencies** fully attenuated.

HF impact: 10:00–10:20 UT (07:00–07:20 LT).

Subsequent partial blackout:

- F-region began recovering after 10:20 UT.
- Full recovery at **13:20 UT (10:20 LT)**.
- HF degradation persisted throughout the recovery phase.



Nighttime:

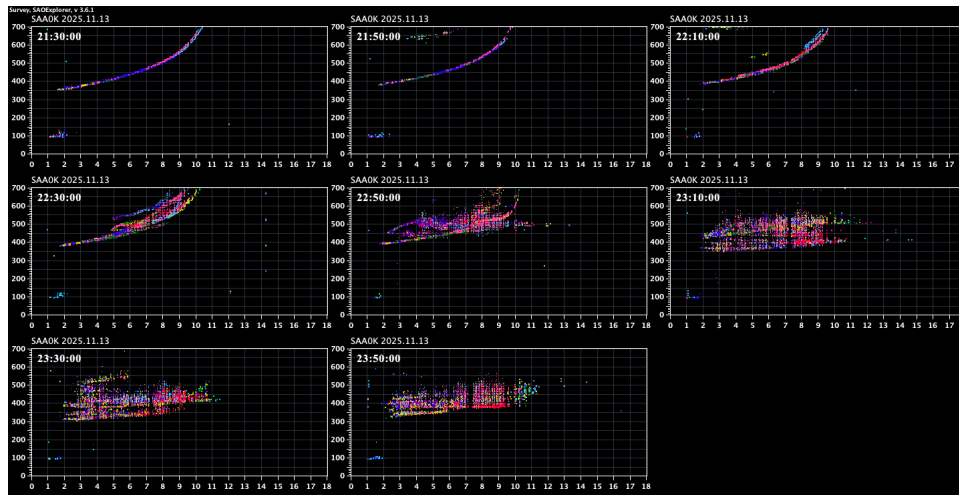
- Continued F-region spread → ongoing **plasma irregularities**.

1.4 – 12 November – CME effects

- **04:00 UT (03:00 LT):** abrupt rise of the F layer + persistent spread → strong plasma irregularities.
- **05:00 UT (02:00 LT):** additional F-layer uplift accompanied by a sharp decrease in electron density → intensification of irregularities.
- **09:00–09:20 UT (06:00–06:20 LT):** an **atypical trace** was observed at the edge of the F region.

1.5 – 13 November – Beginning of Dst recovery

- **22:10–22:50 UT (19:10–19:50 LT):** anomalous ionospheric behavior suggesting intensified irregularities.
- Potential **impact on sensitive systems, especially GNSS**.



1.6 – 14 November – Real-time observations

- Ionospheric irregularities still present.
- Expected to persist throughout the day.

2. Cachoeira Paulista (CP)

(Region directly influenced by SAMA)

2.1 – 09 November – Before CME

- Typical ionospheric behavior.
- Weak F-region spread → presence of **plasma bubbles**.

2.2 – 10 November – Arrival of the X-class flare

- **Partial HF blackout.**
- Layers **E, Es, and part of F** (low frequencies) strongly attenuated.
- **HF impact:** 09:20–11:40 UT (06:20–08:40 LT).

Nighttime:

- Typical F-region spread → plasma bubbles present.

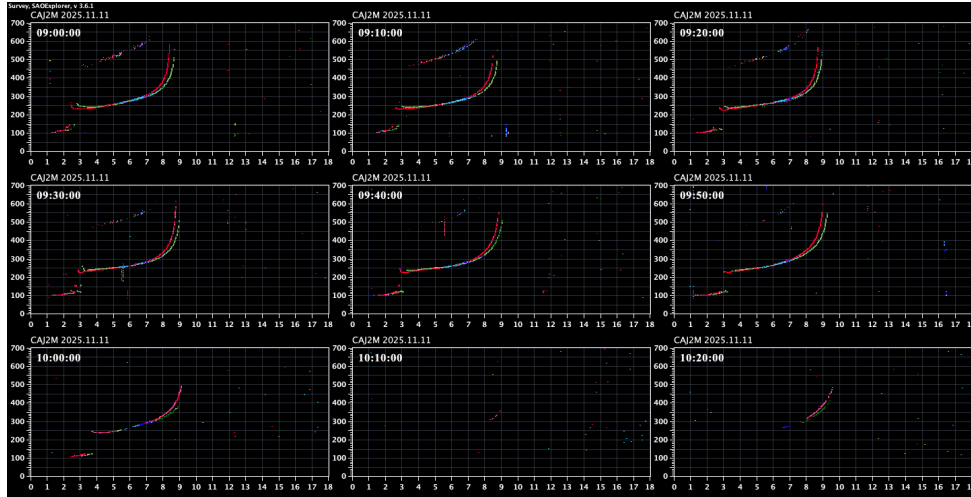
2.3 – 11 November – New X-class flare + CME arrival

- **Complete HF blackout.**
- Layers **E, Es, and low-frequency F** entirely attenuated.

HF impact: 10:10–10:20 UT (07:10–07:20 LT).

Partial recovery:

- Gradual reestablishment after 10:20 UT.
- Full recovery at **12:40 UT (09:40 LT)**.
- HF remained degraded during recovery.



Nighttime:

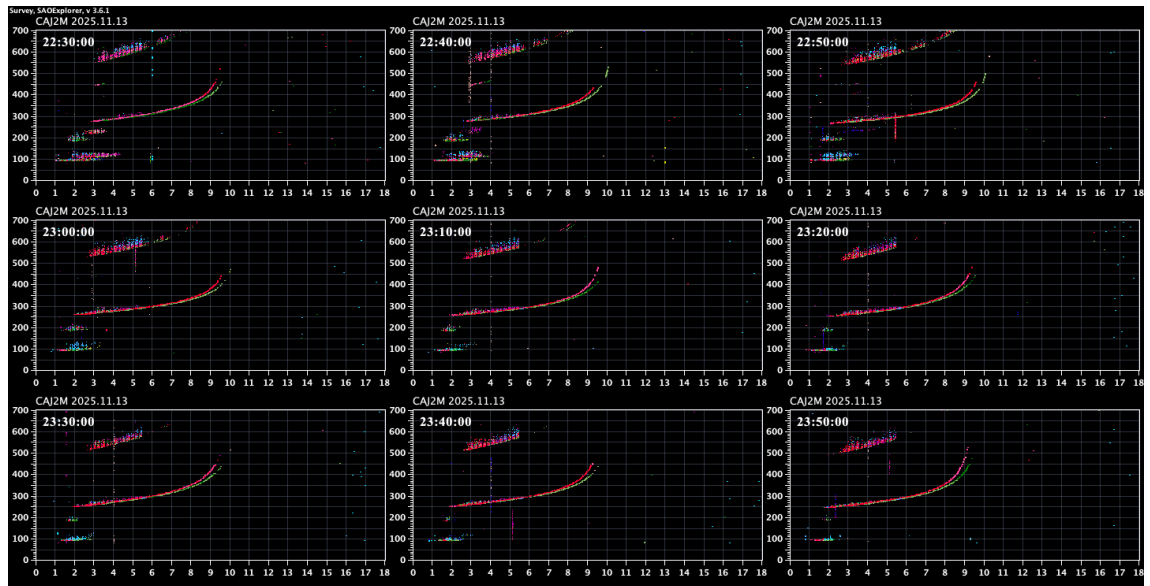
- F-region spread maintained → plasma bubbles present.
- **Auroral-like Es layer**
 - Onset: **21:40 UT (18:40 LT)**
 - Indicates **particle precipitation in SAMA**.

2.4 – 12 November – Main phase of the geomagnetic storm

- **Abrupt F-region uplift** at 04:00 UT (03:00 LT) + intense spread.
- **05:00 UT (02:00 LT):** further uplift + sharp electron density decrease → strong irregularities.
- **Atypical ionosonde trace** observed between 11:50–12:10 UT (05:50–06:10 LT).
- **Auroral-type Es layer**
 - Present from **00:00 to 03:40 UT**, indicating intense precipitation in SAMA.
- **Suppression of plasma bubbles**
 - After 23:00 UT, no spread observed → absence of bubbles.

2.5 – 13 November – Beginning of Dst recovery

- No F-region spread → continued **suppression of plasma bubbles**.
- **Auroral-type Es layer** present overnight → ongoing precipitation in SAMA.



2.6 – 14 November – Real-time observations

- Ionospheric irregularities reappeared and are expected to persist.
- Particle precipitation remains evident → radiation belt disturbance ongoing.

3. Summary

- **São Luís:**
 - Strong equatorial influence.
 - Continuous occurrence of **plasma bubbles**, intensified during the geomagnetic storm's main phase.
- **Cachoeira Paulista:**
 - Direct influence of **SAMA**.
 - Frequent **auroral-type Es layers**, bubble suppression during certain intervals, and strong response to particle precipitation.