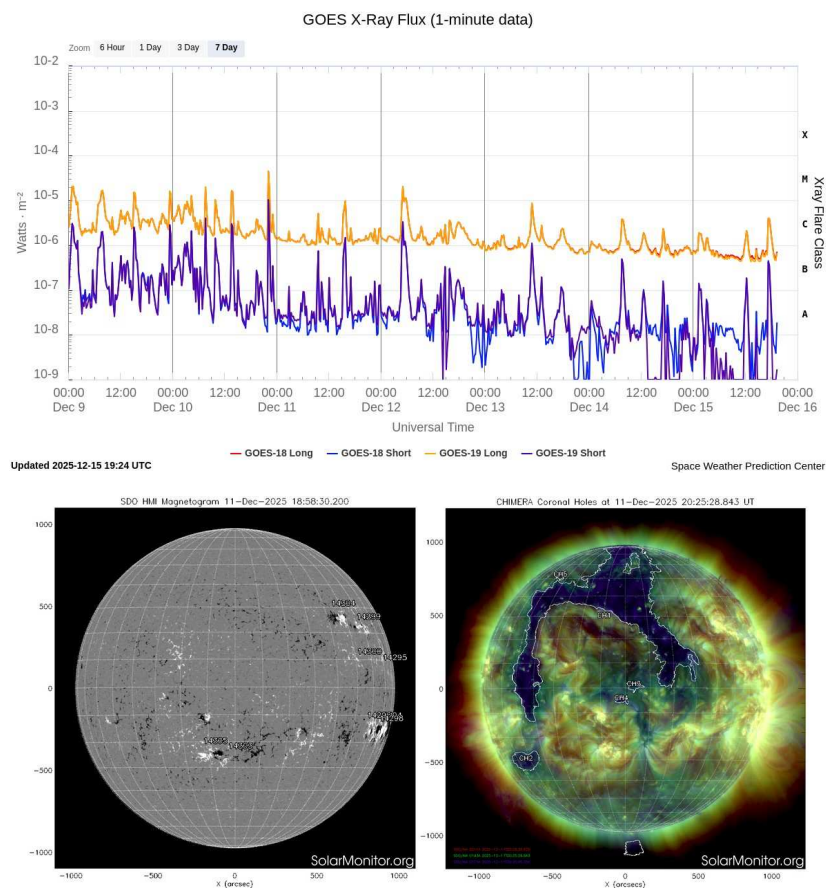


## Sun – Solar Activity (Jean C. Santos)

### Summary

This week the Sun began with a group of active regions of high magnetic complexity. These active regions gave rise to several M-class flares and one X-class flare. Throughout the week, the magnetic complexity of these regions decreased, as did the number of flares. During this period, two coronal holes with significant area and reaching low latitudes were present, which may have influenced the occurrence of fast beams in the solar wind. There were also two halo-type flares, identified in the data from the LASCO C2 and C3 coronagraphs.



**Figure 1** – X-ray flux measured by GOES (top panel) for the period of December 9th to 15th, magnetic field in the line of sight (bottom left panel) and image at 193 angstroms (bottom right panel) measured on December 11th, 2025, showing, respectively, active regions and coronal holes present in the solar disk.



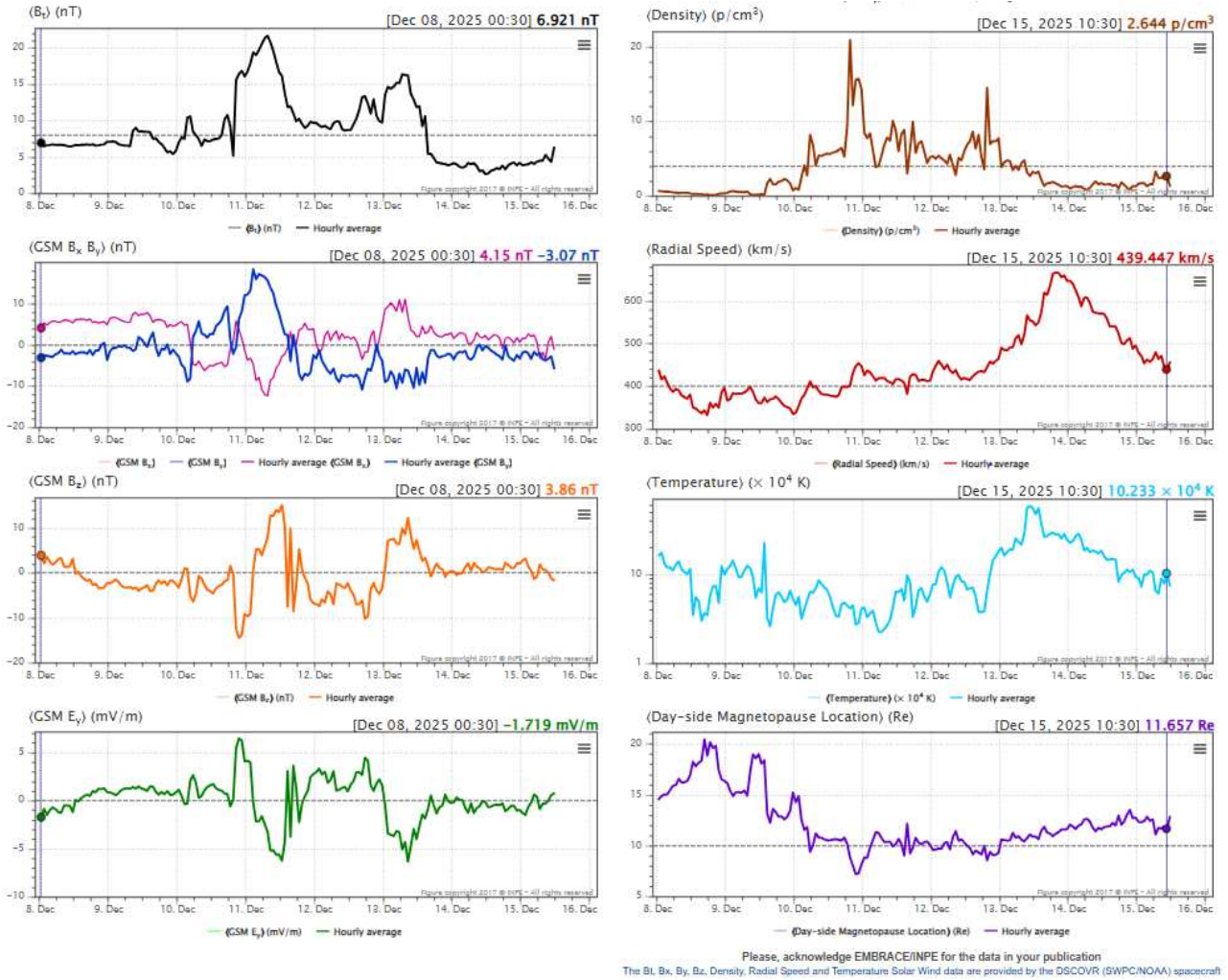
**Interplanetary Medium – IM – Daniele da S. F. Medeiros and Paulo R. Jauer**  
**Period: December 8th to December 15th.**

**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 and HSS identified by the DSCOVR satellite in the interplanetary medium. The Kp index obtained by NOAA/SWPC and the modeling.

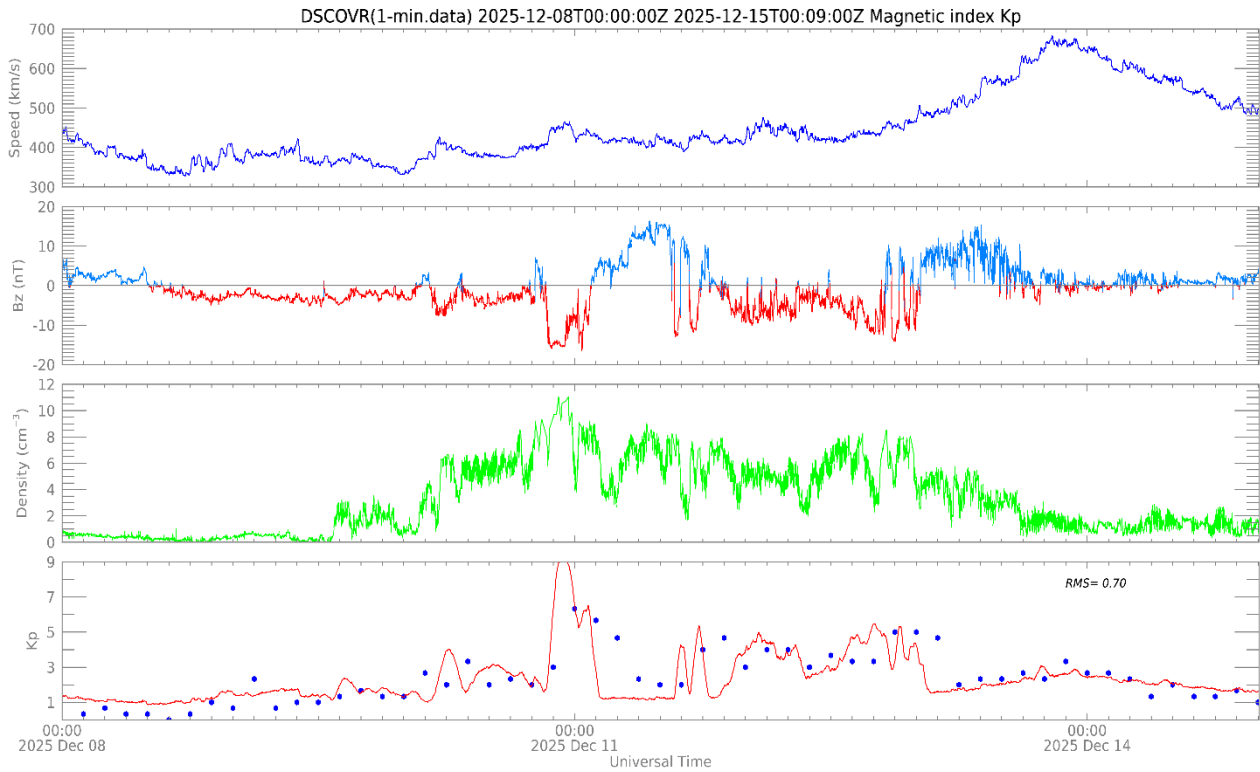
- The magnitude of the interplanetary magnetic field component peaked on December 11th at 07:30 UT at +21.66 nT due CME.
- The BxBy components presented variations in the analyzed period, keeping both oscillating within the interval [-12.36, +18.40] nT. Showing seven rotations of the By component.
- The Bz component presents negative values for most of the week with a maximum negative -14.49 nT at 21:30 UT on December 10th. It presented positive value of +15.05 nT on December 11th at 12:30 UT.
- The solar wind density maximum peaked on December 10th at 19:30 UT, reaching 20.92 protons/cm<sup>3</sup>.
- The solar wind speed fluctuated between 332 to 667 km/s, with a increase on December 12th starting at 13:30 UT and a decrease on December 13th starting at 21:30 UT due to CME and HSS.
- The magnetopause position remained relaxed almost throughout the analyzed period, reaching maximum compression (7.20 RE) at 21:30 UT on December 10th.
- The measured interplanetary Kp reached a peak above 6 on December 11th, and the modeled Kp exceeded the limit of 9 on December 10th, due to CME.

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.



**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

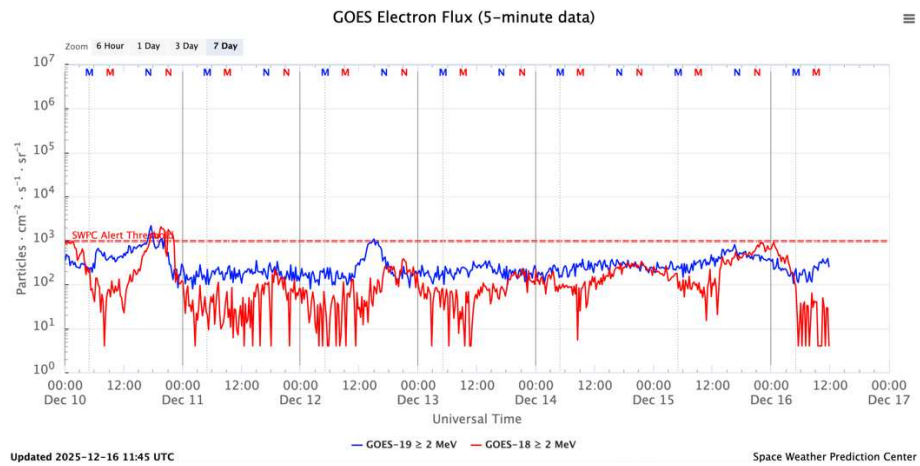


Figure 1: High-energy electron flux (> 2MeV) obtained from GOES-18 and GOES-19 satellite. Source: <https://www.swpc.noaa.gov/products/goes-electron-flux>

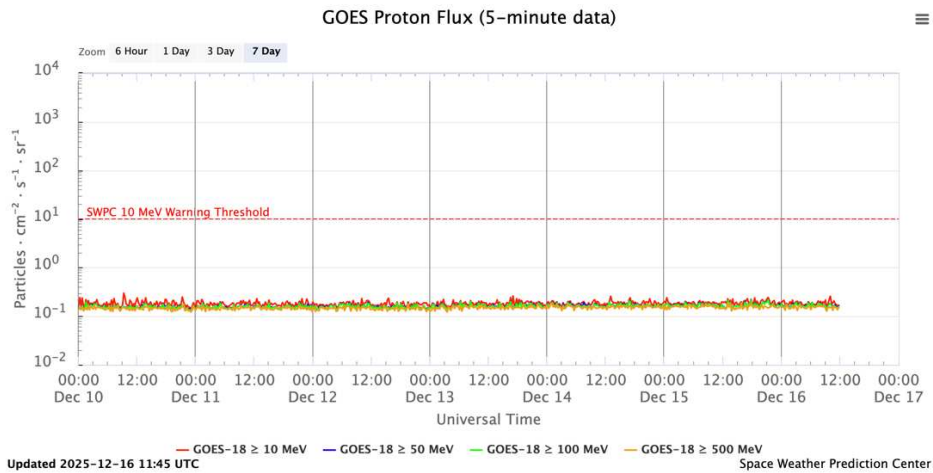


Figure 2: High-energy proton flux (≥ 10MeV, ≥ 50M, ≥ 100M, ≥ 500M) obtained from GOES-18 satellites. Source: <https://www.swpc.noaa.gov/products/goes-proton-flux>



## Summary

The high-energy electron flux ( $\geq 2$  MeV) at the outer boundary of the outer radiation belt obtained from the GOES-19 geostationary satellite (Figure 1) shows a "dropout" at the end of the day on December 10th. The flux remains below the minimum threshold of  $10^3$  particles/(cm<sup>2</sup> s sr) until today, December 16th.

The high-energy proton flux ( $\geq 10$ MeV,  $\geq 50$ M,  $\geq 100$ M,  $\geq 500$ M) obtained from the GOES-18 satellites is very low, indicating that there is no arrival of SEPs (Solar energetic particles), which are damage to circuits on board space platforms.



## Geomagnetic Field

**Responsible: Karen Sarmiento/ Livia Alves/ Sony Su Chen**

### Summary

Between December 9 and 15, geomagnetic activity ranged from moderate geomagnetic storm conditions (G2 level) on December 10 and 11, to minor storm conditions (G1 level) and episodes of instability on December 14, evolving to quiet conditions on December 15. The northward component ( $H_p$ ) of the geomagnetic field monitored by the GOES satellites showed a significant increase on December 10, reaching a maximum value of 213 nT (GOES-18) at 21:00 UT on the dayside. Between December 10 and 11, rapid fluctuations were recorded in the northward component of the geomagnetic field on both the dayside and nightside. A minimum value of approximately 13.1 nT (GOES-18) was observed at 08:15 UT on December 12 on the dayside, coincident with the rotation of the  $B_z$  component of the interplanetary magnetic field, which turned southward after 18:30 UT on December 11, reaching values near  $-10$  nT at 17:30 UT on December 12. A minimum value close to 35 nT (GOES-19) was also recorded at 06:45 UT on the nightside of December 4. The AE index exhibited variations typical of substorm activity, with a peak exceeding 1500 nT on December 10 between 22 and 24 UT, coincident with increases in solar wind speed, density, and temperature, following the rotation of the interplanetary magnetic field components, magnetospheric compression, and a sudden enhancement of the geomagnetic field. On December 11, the AE index showed peaks around 1000 nT during the 00–02 UT and 02–04 UT intervals, reaching values close to 1500 nT between 17 and 20 UT. On December 12, the AE index remained predominantly above 500 nT, displaying clear substorm signatures and patterns consistent with high-intensity, long-duration continuous auroral activity (HILDCAA). This behavior was likely favored by the combination of a southward  $B_z$  component ( $-5$  to  $0$  nT) and high-speed solar wind, resulting in prolonged substorm activity. The planetary  $K_p$  index reached a maximum value of 6+ late on December 10, between 21 and 24 UT, characterizing strong geomagnetic disturbance conditions typical of a moderate geomagnetic storm (G2 level). These conditions persisted through December 11 and 12, subsequently evolving to minor storm conditions (G1 level), instability on December 14, and quiet conditions on December 15. The Dst index fluctuated between positive and negative values, reaching a minimum of approximately  $-73$  nT at 04 UT on December 11, indicating a moderate geomagnetic storm. Throughout the remainder of the week, the index remained predominantly negative and did not return to that level of intensity. Magnetometers from the Embrace-Magnet network recorded a slight initial increase in the H component, associated with the passage of an interplanetary shock around 20:14 UT on December 10, marking the onset of the geomagnetic storm. This was followed by a decrease in the H component, reaching a minimum of approximately  $-117$  nT at 00:43 UT at the São Luís (SLZ) and Porto Velho (PVE) stations, with variations amplified during the daytime by the Equatorial Electrojet effect, as both stations are located within its region of influence. The H component exhibited rapid fluctuations late on December 11 and throughout December 12, in response to oscillations of the  $B_z$  component of the interplanetary magnetic field, which remained southward until early December 13. The observed disturbances are associated with the passage of an interplanetary shock recorded at 20:00 UT on December 10, detected at the L1 Lagrangian point by the ACE satellite, which caused a rotation of the three interplanetary magnetic field components, with the

Bz component reaching a minimum of approximately  $-16$  nT. This event marked the arrival of two interplanetary coronal mass ejections, associated with solar eruptions recorded on December 8. Additionally, the observed fluctuations may also be related to the action of a high-speed solar wind stream on December 13, resulting from the passage of a corotating interaction region (CIR).

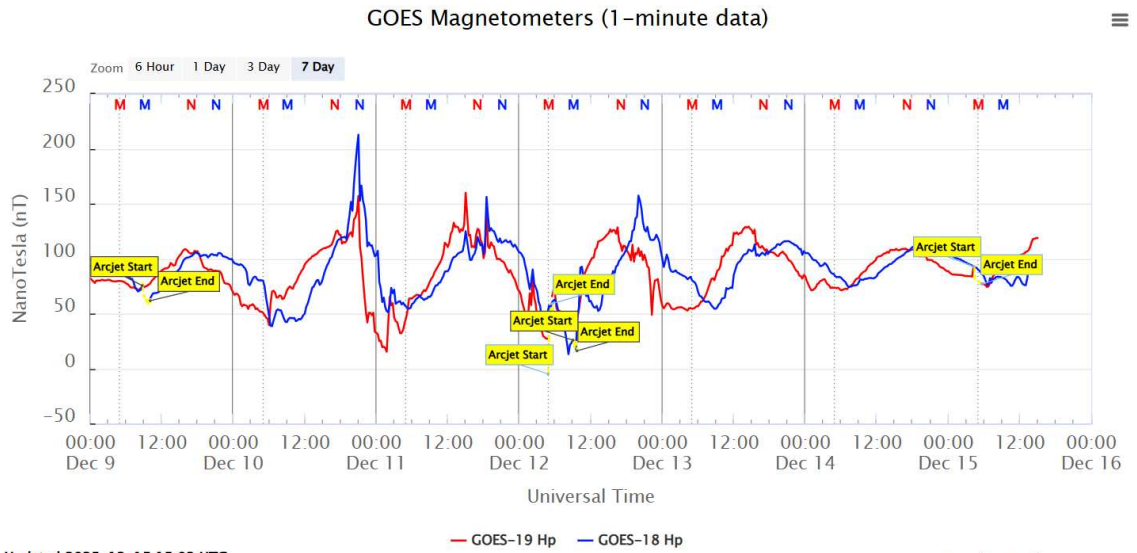


Figure 1- Magnetic field horizontal component at the GOES satellite orbit through.

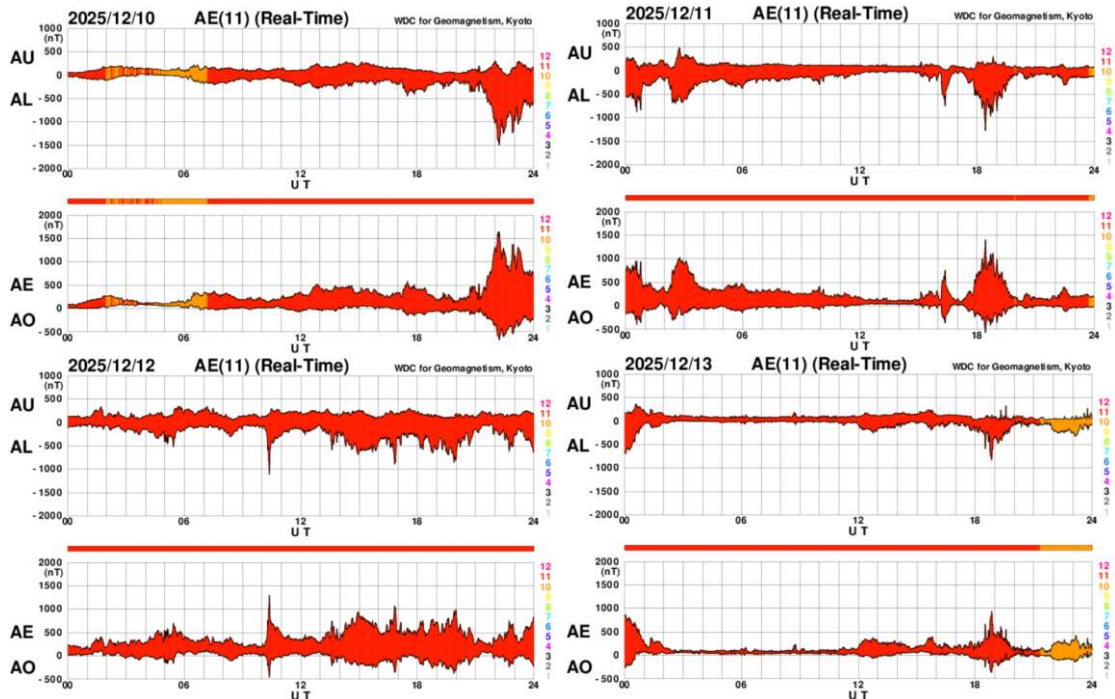


Figure 2- AE index.

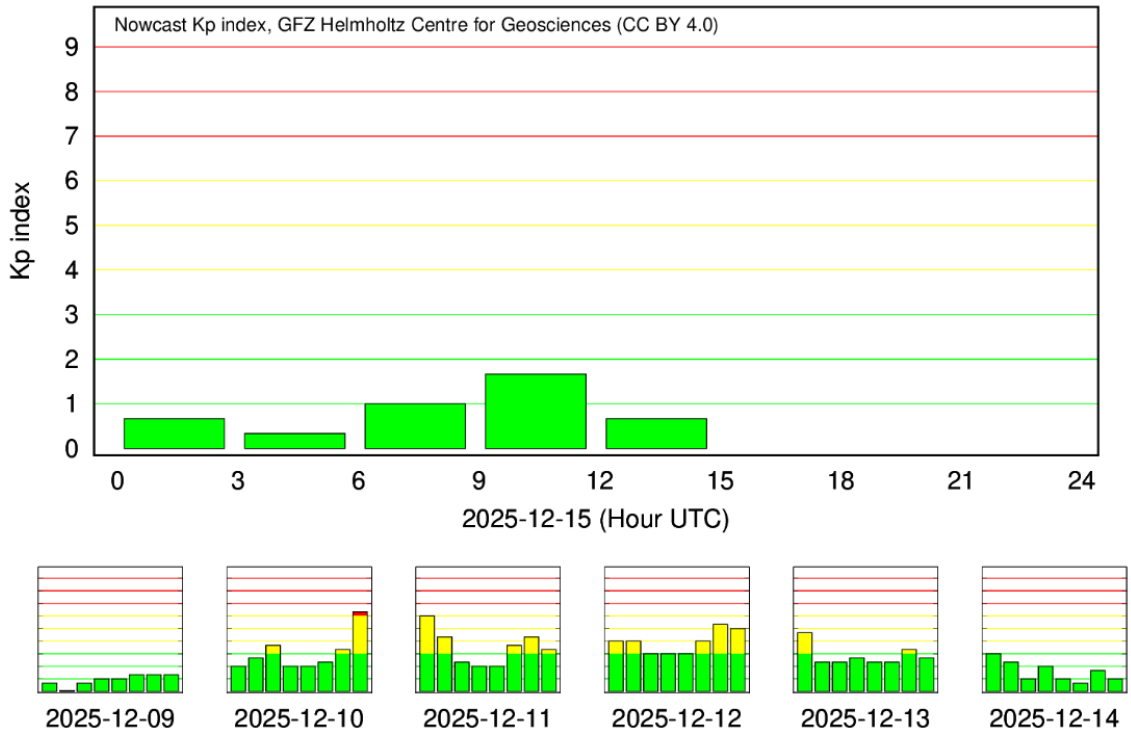
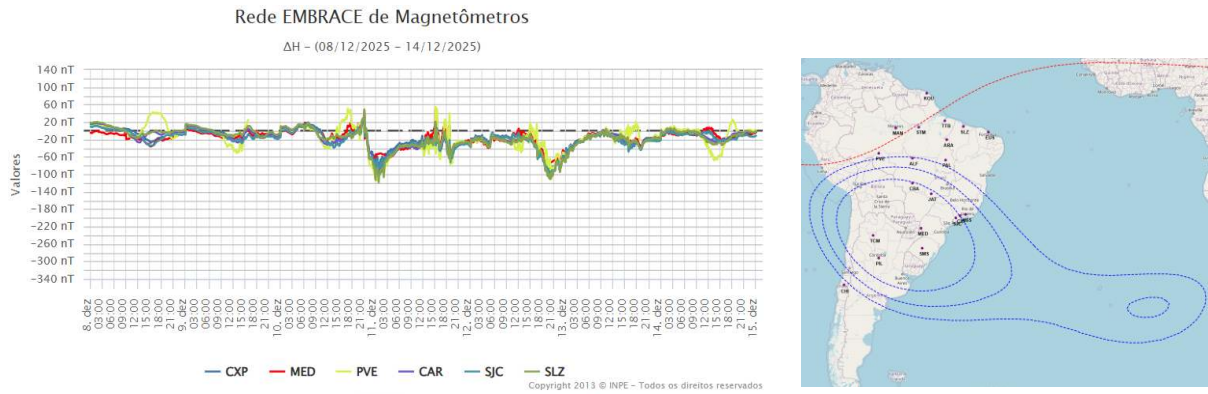


Figure 3- Kp index in logarithmic scale.



Figure 4- Dst Index



### Rede EMBRACE de Magnetômetros

$\Delta H - (10/12/2025 - 11/12/2025)$

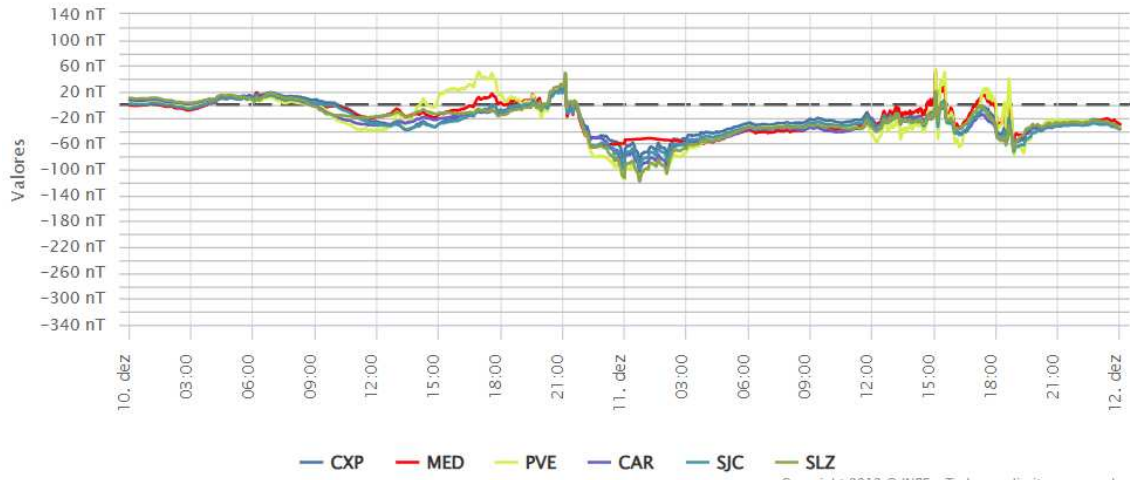
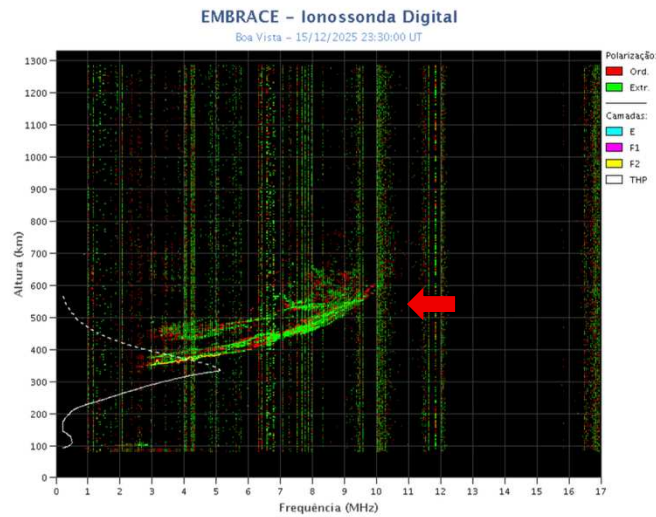


Figure 5- Daily variation of the geomagnetic field from  $H(nT)$  measured at EMBRACE MagNet.

## Ionosfera – Digisonda (Laysa Resende)

### Summary

This week, spread-F was observed at Cachoeira Paulista, Boa Vista, and São Luís. At Boa Vista, the spread-F displayed atypical characteristics (Figure 1). On December 12, the Es layer at Boa Vista intensified, reaching a scale of 5 (Figure 1). However, the variation in the MUF did not exceed the threshold for a moderate index.

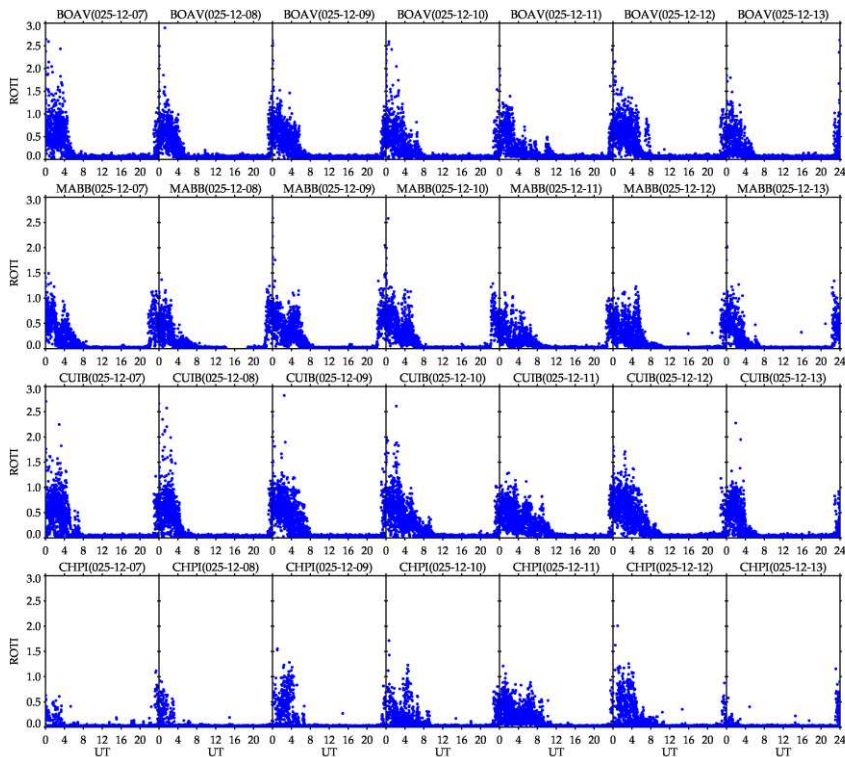


**Figure 1** – Ionogram over São Luís, showing the spread F.

## Ionosphere - ROTI Summary for Week 2396 (December 7-13, 2025)

Carolina de Sousa do Carmo

In the week 2396 (December 6-13, 2025) there were ionospheric irregularities (plasma bubble), on all analyzed days. Figure 1 shows the ROTI time series for four stations in the Brazilian sector (Boa Vista (BOAV), Bacabal (MABB), Cuiabá (CUIB) and Cachoeira Paulista (CHPI)).



**Figure 1** – ROTI time series for four stations in the Brazilian sector (Boa Vista (BOAV), Bacabal (MABB), Cuiabá (CUIB) and Cachoeira Paulista (CHPI)), from December 07 to 13, 2025.