Sol – Cecatto
Period: May 06 – May 13, 2024

Summary

05/06 – M1.6, M1.3, X4.5, M1.5, M1.2, M4.3 flares; Fast (=< 550 km/s) wind stream; 3 CME can have component toward the Earth;
05/07 – M2.6, M5.1, M1.3, M2.4, M1.5, M1.0, M1.0, M8.2, M2.1, M3.3, M3.2 flares; Fast (=< 600 km/s) wind stream; 3 CME can have component toward the Earth;
05/08 – X1.0, M3.4, M1.8, X1.0,M4.5, M1.8, M2.1,M4,1, M7.9, M2.9, M2.0, M1.7, X1.0, M9.8.flares; Fast (=< 500 km/s) wind stream; 13 CME can have component toward the Earth;
05/09 – M4.0, M4.5, M1.7, M2.3, X2.2, M3.1, M2.9, M3.7, X1.1, M1.0, M1.0, M2.6, M1.2, M1.5 flares; Fast (=< 500 km/s) wind stream; 7 CME can have component toward the Earth;
05/10 – M1.3, M1.4, X3.9, M2.2, M5.9, M1.1, M1.7, M2.0, M1.1, M1.9, M3.8 flares; Fast (=< 800 km/s) wind stream; 11 CME can have component toward the Earth;
05/11 – X5.8, M3.1, M1.6, X1.5, M1.7, M8.8, M1.2 flares; Fast (=< 950 km/s) wind stream; 13 CME can have component toward the Earth;
05/12 – M3.2, M2.4, M1.6, M1.0, M1.5, X1.0, M4.8, M1.1, M1.0 flares; Fast (=< 1000 km/s) wind stream; 9 CME can have component toward the Earth;
05/13 – M1.2, M1.2, M1.4, M6.6 flares; Fast (=< 800 km/s) wind stream; 1 CME can have component toward the Earth;
For.: Fast wind stream for today and next 1-2 days; for while (95% M, 75% X) probability of M / X flares next 2 days; also, occasionally some other CME can present a component toward the Earth.

Resumo

06/05 – "Flares" M1.6, M1.3, X4.5, M1.5, M1.2, M4.3; Vento rápido (=< 550 km/s); 3 CMEs podem ter componente para a Terra;
06/05 – "Flares" M2.6, M5.1, M1.3, M2.4, M1.5, M1.0, M1.0, M8.2, M2.1, M3.3, M3.2; Vento rápido (=< 600 km/s); 3 CME podem ter componente para a Terra *;
08/05 – "Flares" X1.0, M3.4, M1.8, X1.0,M4.5, M1.8, M2.1,M4,1, M7.9, M2.9, M2.0, M1.7, X1.0, M9.8; Vento rápido (=< 500 km/s); 13 CME podem ter componente para a Terra *;
09/05 – "Flares" M4.0, M4.5, M1.7, M2.3, X2.2, M3.1, M2.9, M3.7, X1.1, M1.0, M1.0, M2.6, M1.2, M1.5; Vento rápido (=< 500 km/s); 7 CME podem ter componente para a Terra;
10/05 – "Flares" M1.3, M1.4, X3.9, M2.2, M5.9, M1.1, M1.7, M2.0, M1.1, M1.9, M3.8; Vento rápido (=< 800 km/s); 11 CME podem componente para a Terra;
11/05 – "Flares" X5.8, M3.1, M1.6, X1.5, M1.7, M8.8, M1.2; Vento rápido (=< 950 km/s); 13 CME podem ter componente para a Terra **;
12/05 – "Flares" M3.2, M2.4, M1.6, M1.0, M1.5, X1.0, M4.8, M1.1, M1.0; Vento rápido (=< 1000 km/s); 9 CME podem ter componente p/ a Terra;

13/05 – "Flares" M1.2, M1.2, M1.4, M6.6; Vento rápido (=< 800 km/s); 1 CME podem ter componente para a Terra
Prev.: Vento rápido para hoje e próximo(s) 1-2 dia(s); probabilidade de “flares” M/X (95% M, 75% X) nos próximos 02 dias; eventualmente alguma(s) outra(s) CME pode(m) apresentar componente dirigida para a Terra.

Geomagnetic Field / Campo Geomagnético

Summary

In the week of May 06-12, the Embrace magnetometer network data recorded the most intense geomagnetic storm in the later 20 years, with emphasis on:

- May 10-12: The magnet Embrace Magnetometers recorded several SI's, with the most intense reaching ~ 100 nT in PVE, and a drop of -600 nT in JAT.
- May 10-12: AE index was active, above 2000 nT. The minimum Dst index was -413 nT. The highest Kp of the week was 9o.

Resumo

Na semana de 06 a 12/05, os dados provenientes da rede de magnetômetros Embrace registraram a tempestade mais intensa dos últimos 20 anos, com destaque para:

- 10-12/05: Os magnetometros da rede Embrace MagNet registraram vários SI's, sendo que o mais intenso atingiu ~100 nT na estação PVE, e queda na componente H de até - 600 nT em JAT
- 10-12/05: índice AE esteve ativo, acima de 2000 nT. O índice Dst mínimo foi -413 nT. O Kp mais alto da semana foi 9o.

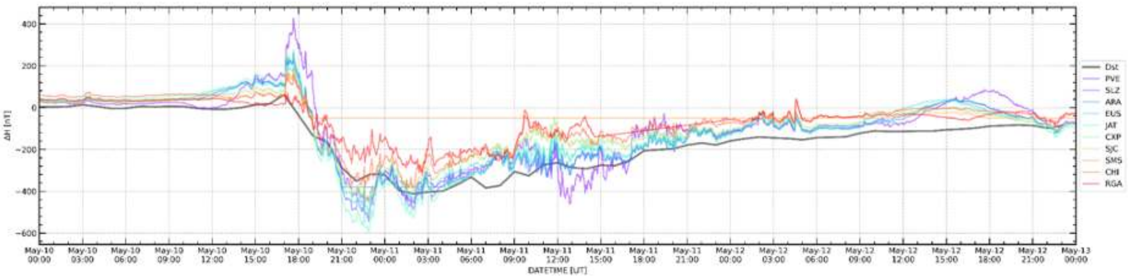

Figura 1.: Variação diurna da componente geomagnética H (nT) das estações da rede Embrace

Figure 1.: Daily variation of the geomagnetic field from H (nT) measured at Embrace MagNet

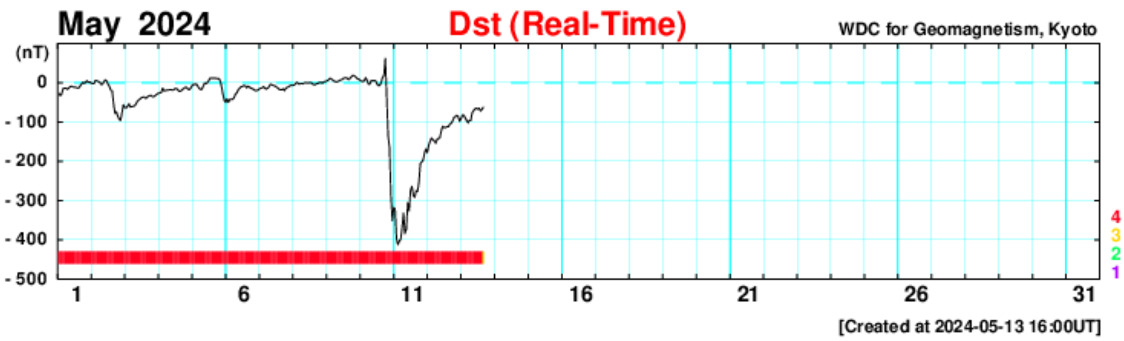

Figura 2.: Índice Dst.

Figure 2: Dst index

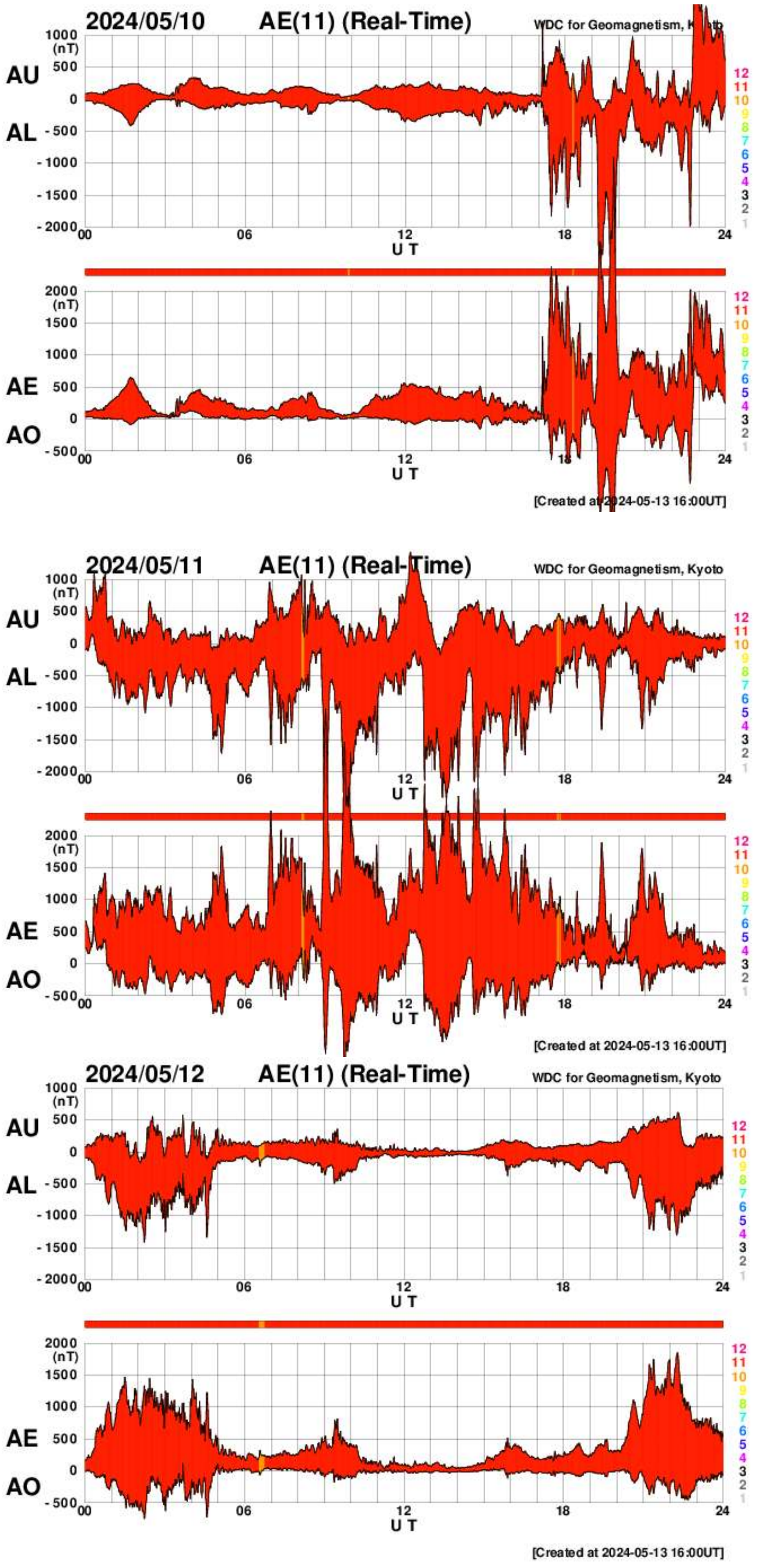

Figura 3.: Índice AE para os dias mais perturbados da semana.
Figure 3.: AE index for the most disturbed days in the current week.

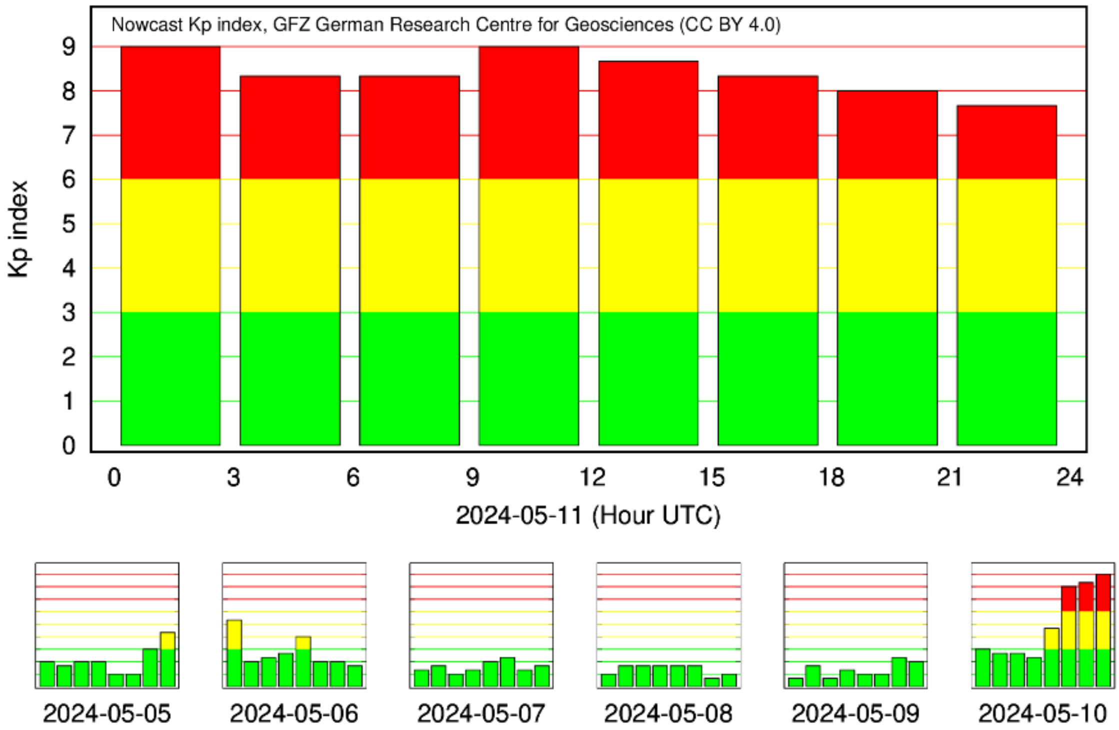

Figura 4.: Índice Kp.
Figure 4: Kp index for the current week

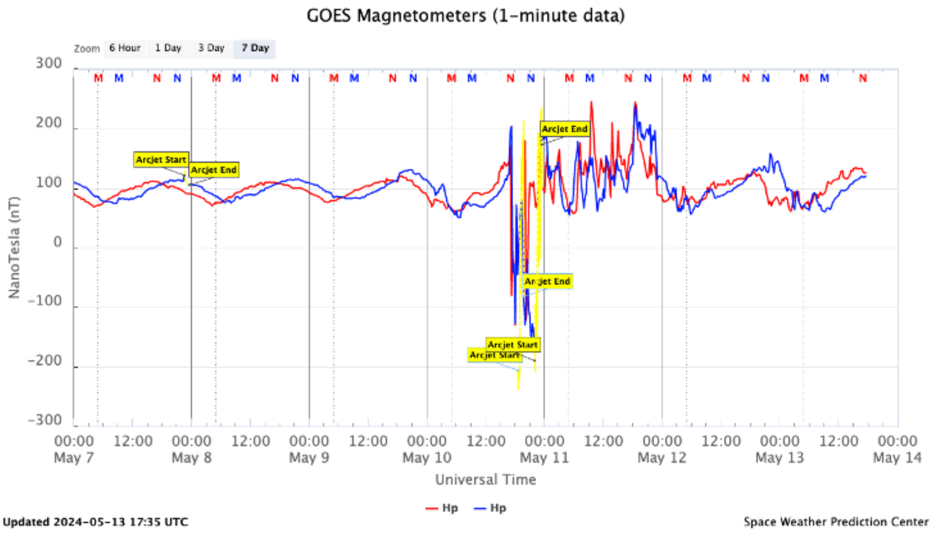

Figura5. Medida de Campo magnético na posição do satélite GOES
Figure 5.: Magnetic field horizontal component at the GOES satellite orbit.

EARTH'S RADIATION BELT

Responsible: Ligia Da Silva

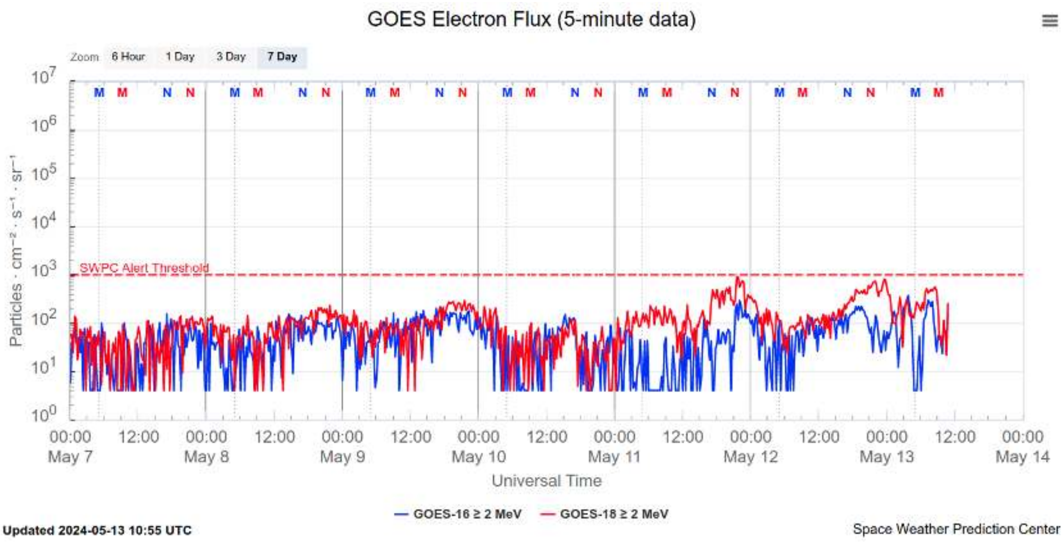

Figure 1: High-energy electron flux (> 2MeV) obtained from GOES-16 and GOES-18 satellite. Source: https://www.swpc.noaa.gov/products/goes-electron-flux

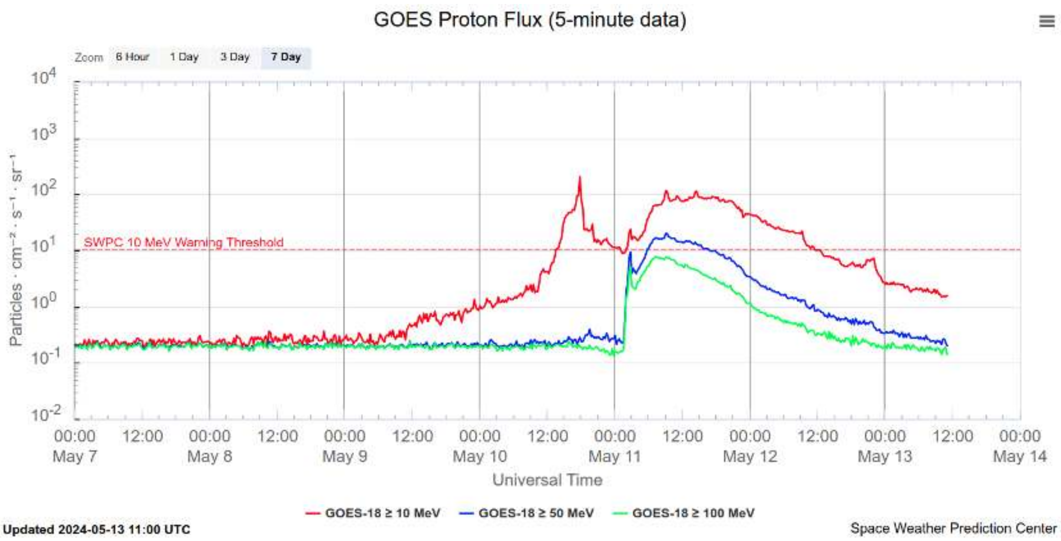

Figura 2: Fluxo de prótons (≥ 10MeV, ≥ 50MeV, ≥ 100MeV) obtido a partir dos satélites GOES-18. Fonte: https://www.swpc.noaa.gov/products/goes-proton-flux

Summary

The high-energy electron flux (>2 MeV) in the outer boundary of the outer radiation belt obtained from geostationary satellite data GOES-16 and GOES-18 (Figure 1) is confined below 10^3 particles/(cm^2 s sr) throughout analyzed period, showing a decrease on May 11th (GOES-16), associated with the arrival of coronal mass ejections that caused a storm at the G5 level. After this, the electron flux increases slightly at the outer boundary, not exceeding 10^3 particles/(cm^2 sr) until May 13th.

The proton flux ≥ 10 MeV (Figure 2) increases from 6:00 UT on May 9th associated with solar wind structures that were towards Earth. A maximum and abrupt peak was observed at 17:45 UT on May 10th, followed by a decrease of approximately 1 order of magnitude at the beginning of May 11th. From 2:45 UT onwards, the proton flux ≥ 10MeV, ≥ 50MeV and ≥ 100MeV increased significantly, with the proton flux ≥ 10MeV persisting above 10^1 particles/(cm^2 s sr) until 11:30 UT on the 12th/ May, ≥ 50MeV and ≥ 100MeV persisted above 10^0 and 10^{-1} particles/(cm2 s sr) most of May 11, respectively.

Ionosfera – Digissonda (Laysa Resende)

Summary

The ionosphere in the Brazilian region showed a modified behavior due to the magnetic storm occurrence on May 10th. In São Luís, the F region rose abruptly, reaching an Apex much higher than expected and causing the super fountain effect. After the pre-reversal enhancement (PRE), the nighttime E region appeared in Cachoeira Paulista (Figure 1), causing the coupling in the E-F region system again. This fact generated changes in the plasma and the ionosphere in Cachoeira Paulista had a diurnal behavior. This behavior occurred due to particle precipitation that continued after the main phase of the magnetic storm. The spread F was observed in the days during the magnetic storm in Cachoeira Paulista. Furthermore, there have been daytime blackout events due to X-class solar flares.

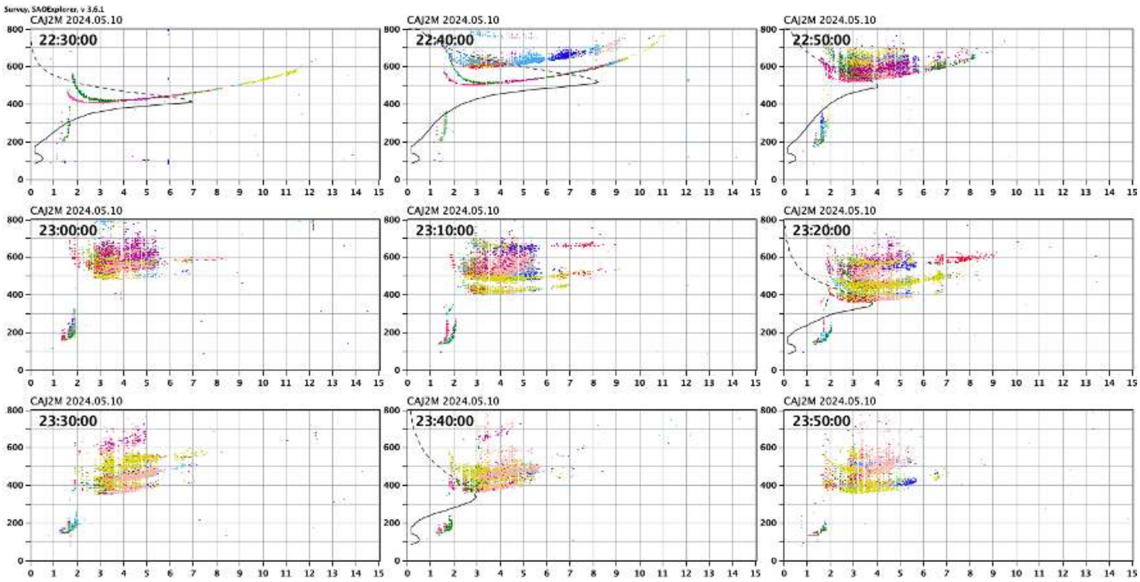

Figure 1 – Sequence of the ionograms over Cachoeira Paulista, showing the nighttime E region trace on May 10, 2024.

Ionosfera –S4 (Cintilação receptores GNSS)

Summary

In this report on the S4 scintillation index, data from SLMA in São Luiz/MA, UFBA in Salvador/BA, STSN in Natal/RN, STCB in Cuiabá/MT, SJCE in São José dos Campos/SP, STCP in Cachoeira Paulista/SP, POAL in Porto Alegre/RS and STBR in Balneario Rincão/SC are presented. The S4 index tracks the presence of irregularities in the ionosphere having a spatial scale ~ 400 m.

The observation period for this report is between May 9th and 12th, covering the beginning and main phase of the largest geomagnetic storm (GS) recorded so far in solar cycle 25. Figure 1 shows the S4 index for low latitude stations of STNT and SLMA. During the main phase of the GS, no scintillation was recorded at the station closest to the magnetic equator (SLMA) and only few satellites evidence scintillation > 0.3 at STNT. May is not a typical plasma bubble season month, despite this, some plasma bubbles presence could be expected due to GS.

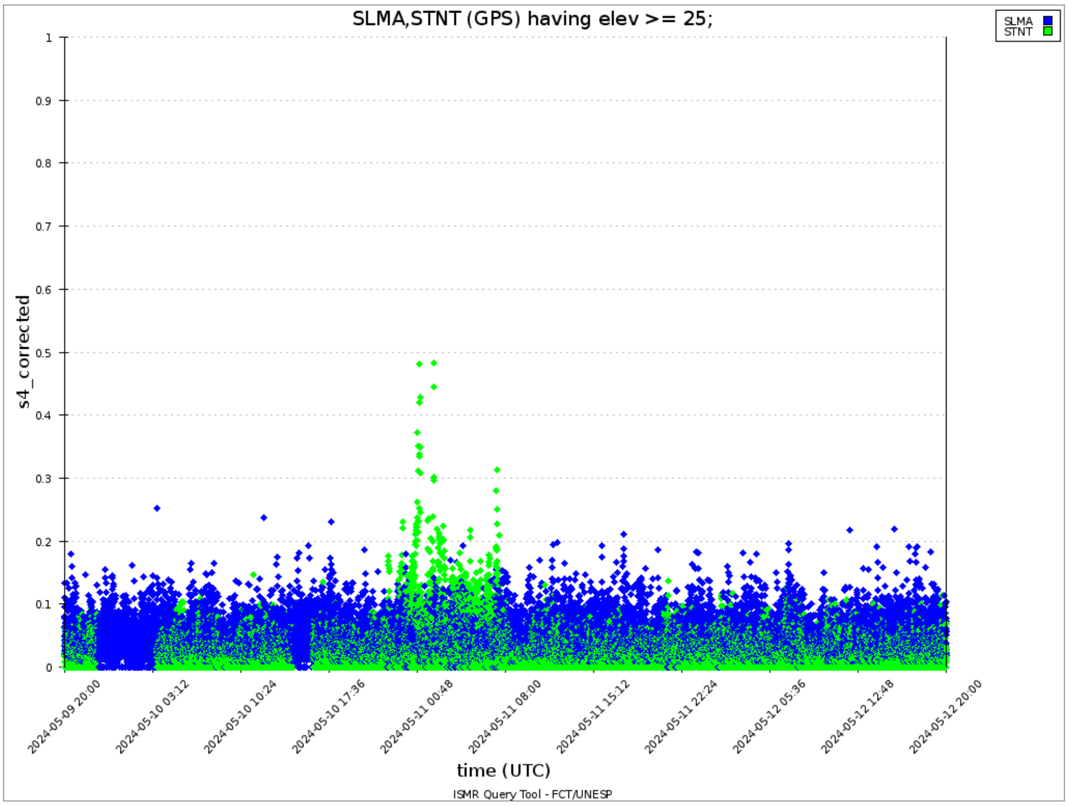

Figure 1 – S4 index values for the GPS constellation measured at SLMA (blue) and STNT (green), during the period 05/02-12.

Figure 2 shows the low latitude stations of STCB and UFBA. STCB manifests the typical seasonal behavior of bubbles absence as if the GS in full development did not exist at that time. UFBA however, report strong scintillation in several satellite, despite being located merely 2.5° north of STCB. This suggest that large electronic concentration gradient could be located further east in Brazilian territory. This is confirmed in the Ionospheric Piercing Point (IPP) map of SJCE and STCP receivers.

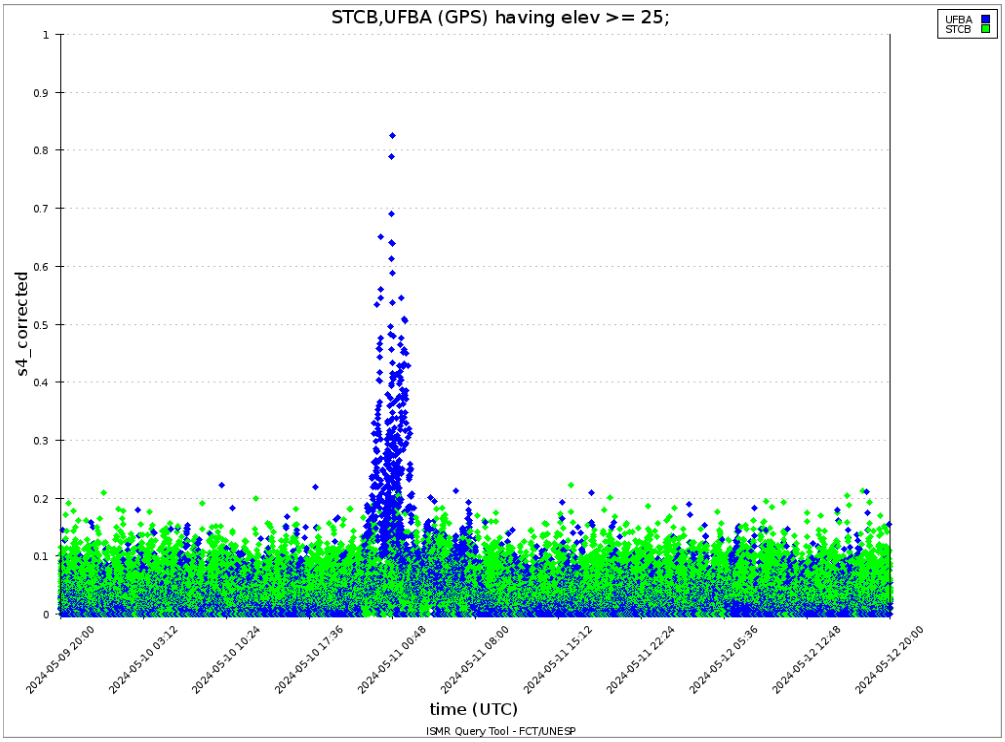

Figure 2 – S4 index values for the GPS constellation measured at UFBA (blue) and STCB (green), during the period 05/02-12.

Figure 3 and 4 show the S4 behavior and IPP map for SJCE and STCP stations, located around 23° S.

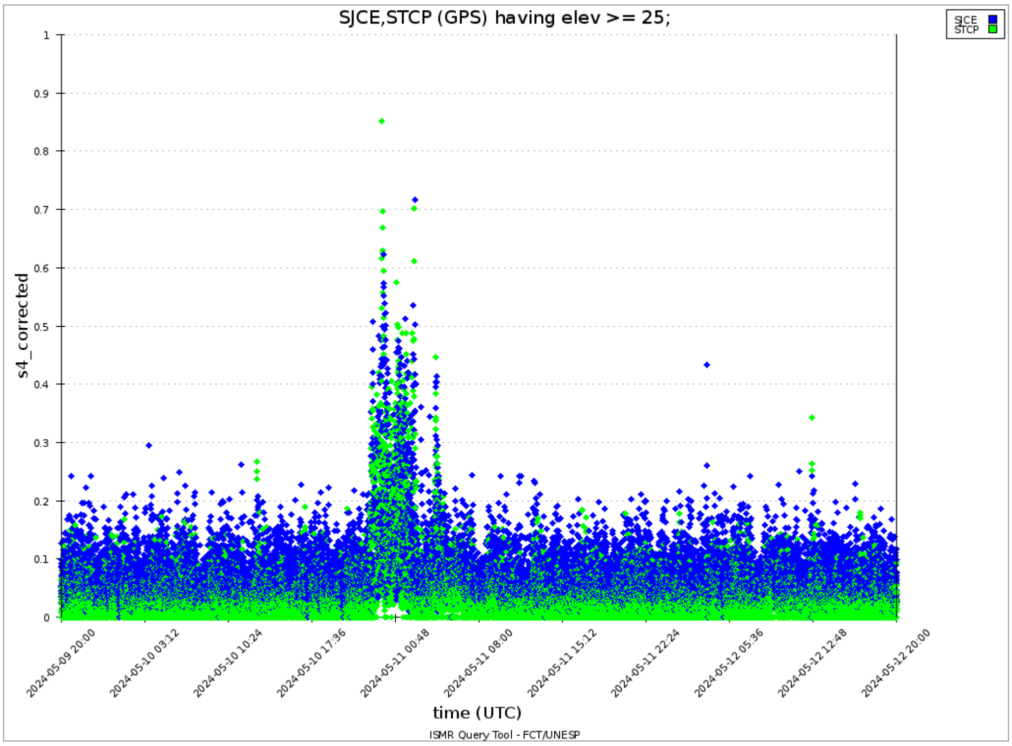

Figure 3 – S4 index values for the GPS constellation measured at SJCE (blue) and STCP (green), during the period 05/02-12

Moderate to strong scintillation was measured in both stations. The IPP for 05/10 2100 to 05/11 0700 UT map for this receivers are shown in figure 4.

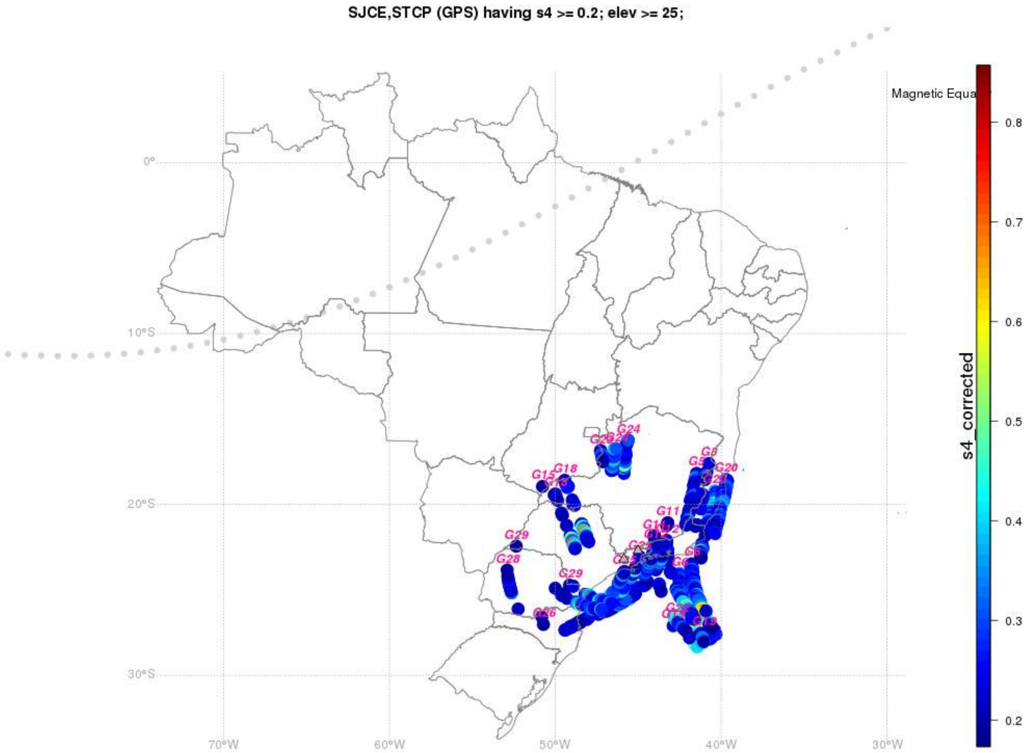

Figure 4 – Ionospheric Piercing Point (IPP) map of the satellites from GPS constellation with S4 > 0.2 and elevation > 25° measured at SJCE and STCP, during the period 05/10 2100 to 05/11 0700 UT.

IPP of S4 values > 0.2 are concentrate south and southeast of SJCE and STCP. This could indicate that the most probable source of the electronic concentration gradient that could cause this scintillation, that is, the Equatorial Ionization Anomaly (EIA) has displaced to higher latitudes than it normally appears. To confirm this last statement, Figure 5 shows the behavior of the S4 index for the receivers located further south in the INCT GNSS NavAer network, namely STBR and POAL. Values of S4 as exceeding 0.7 was measured at both stations in May a month typically without presence of scintillations as can be seem from data corresponding to 05/09 and 05/11 in this Figure.

Finally Figure 6 (IPP map for STBR and POAL) confirm the EIA displacement further south of the anomaly´s normal location. The most plausible source of the scenario represented in Figure 6 is the interception of a great latitudinal mapping of an equatorial plasma bubble with a EIA abnormally located at latitudes greater than 30°. This could only occur under severe GS conditions like the one recorded on the May 10th. It remains to discuss in more depth the reason that a possible bubble signature appears at latitudes > 15° and does not appear any scintillation at stations close to the magnetic equator.

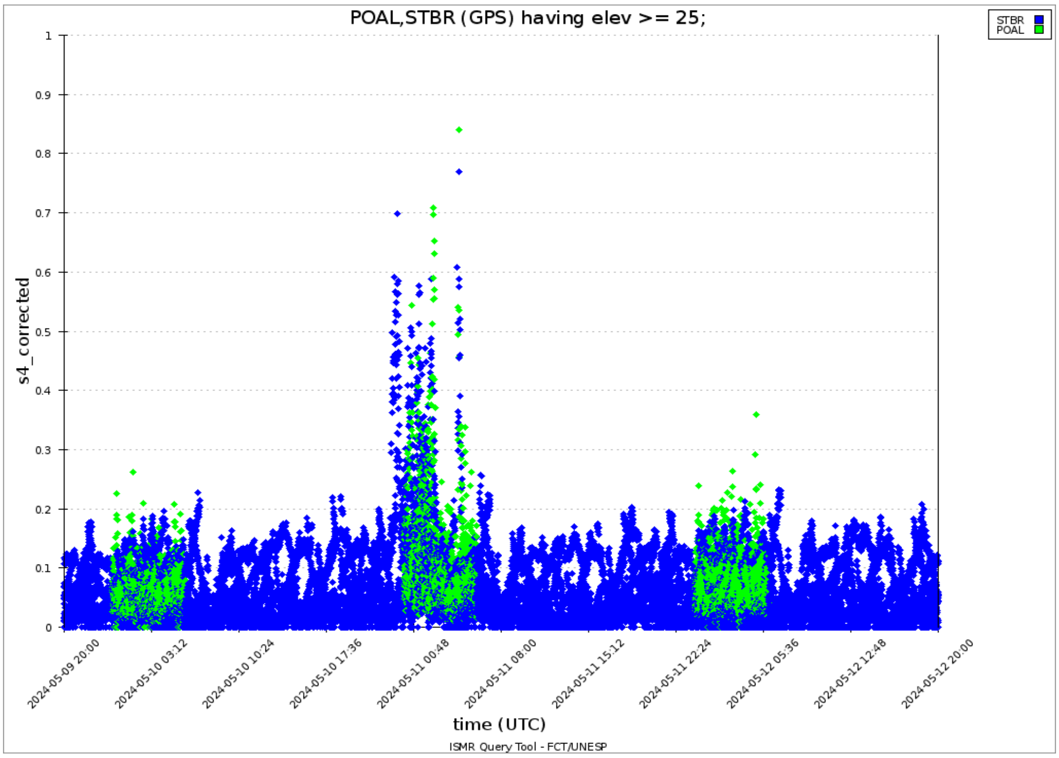

Figure 5 – S4 index values for the GPS constellation measured at STBR (blue) and POAL (green), during the period 05/02-12

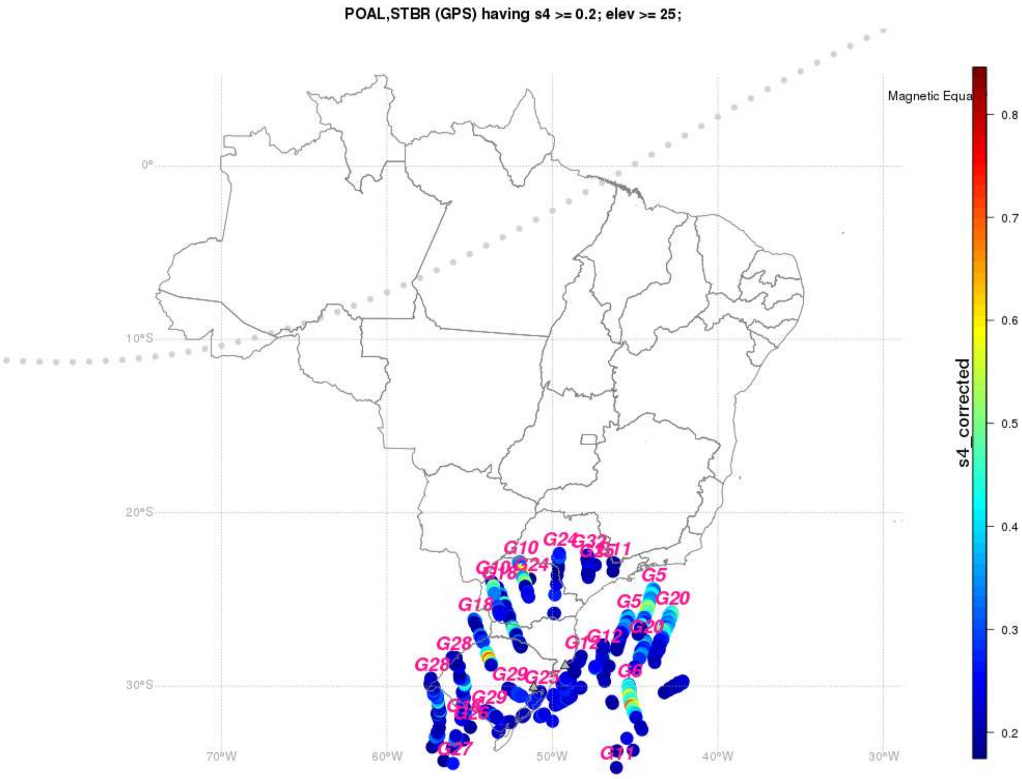

Figure 6 – Ionospheric Piercing Point (IPP) map of the satellites from GPS constellation with S4 > 2 and elevation > 25º measured at STBR and POAL during the period 05/10 2100 to 05/11 0700 UT.

Ionosphere - ROTI
Summary for Week 2313 (May 05 to 11, 2024)

Carolina de Sousa do Carmo

In the week 2313 (May 05 to 11, 2024), ionospheric irregularities (plasma bubbles) were observed on the night of May 10 to 11. The Figure below shows the ROTI time series for four stations in the Brazilian sector (Natal (RNNA), Bacabal (MABB), Cuiabá (CUIB) and São José dos Campos (SJSP)).

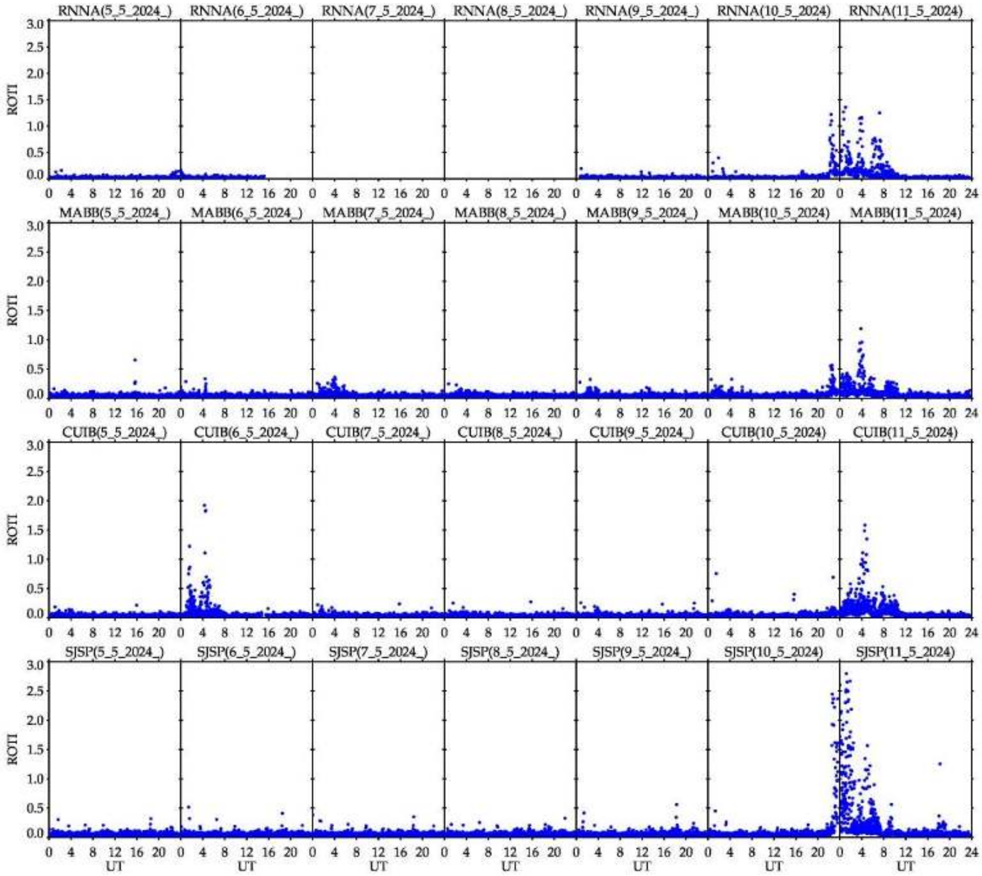

Figure – ROTI time series for four stations in the Brazilian sector (Natal (RNNA), Bacabal (MABB), Cuiabá (CUIB) and São José dos Campos (SJSP)), from May 05 to 11, 2024.

The following figure shows the TEC map (on the left), the ROTI map (in the center), and the All-Sky Imagers (ASI) (on the right) in Cachoeira Paulista and Santa Maria at 0 UT on May 11, 2024. Plasma bubbles are observed in the TEC and ROTI maps and in the ASI in Cachoeira Paulista. In Santa Maria, it was cloudy, making observation difficult. Additionally, a southward shift of the equatorial ionization anomaly (EIA) crest to ~30°S of geographic latitudes was observed. This was one of the effects derived from the geomagnetic storm that began on May 10.

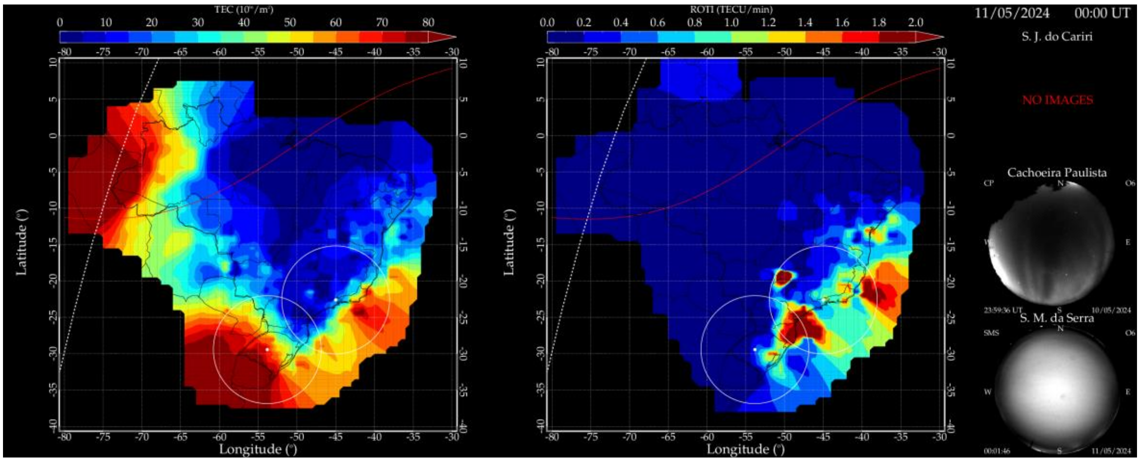

Figure – TEC map (on the left), the ROTI map (in the center), and the All-Sky Imagers (ASI) (on the right) in Cachoeira Paulista and Santa Maria at 0 UT on May 11, 2021