STCE Newsletter

9 Dec 2024 - 15 Dec 2024

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The Solar-Terrestrial Centre of Excellence (STCE) is a collaborative network of the Belgian Institute for Space Aeronomy, the Royal Observatory of Belgium and the Royal Meteorological Institute of Belgium.

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1. Happy Christmas and a happy new year

This newsletter will take a 2 week break. The STCE space weather and PECASUS services will continue. Enjoy the holidays!

2. Review of space weather

Solar Active Regions (ARs) and flares

Solar flaring activity has been mostly at moderate levels throughout the week, with 13 M-class flares recorded. The two strongest flares were an M6.4 and an M6.7 flare. The first one peaked at 06:48UTC on December 10 and was produced by SIDC Sunspot Group 335 (NOAA Active Region 3922). The second peaked at 15:49 UTC on December 11, probably produced by SIDC Sunspot Group 305 (NOAA Active Region 3912) from beyond the west limb. There was a total of 11 numbered active regions on the visible disk, with two of them developing to a complex magnetic type. SIDC Sunspot Group 332 (NOAA 3920) had a magnetic type beta-delta (December 12-13) and SIDC Sunspot Group 288 (NOAA 3917) had a magnetic type beta-gamma-delta (December 13-14).

Coronal mass ejections

Numerous Coronal Mass Ejections (CMEs) were detected during the week, with two halo CMEs being the most important events. The first was detected around 21:50 UTC on December 11 in LASCO/C2 and LASCO/C3 coronagraph imagery. The second was detected in LASCO/C2 and LASCO/C3 coronagraph imagery, starting from 14:30 UTC on December 15. In both cases, no clear source region was identified on the visible disk, suggesting that both were backsided events. In addition, a wide coronal mass ejection (CME) was observed in LASCO/C2 coronagraph imagery around 00:45 UTC on December 15, lifting off the southwest quadrant. It was most likely associated with a large filament eruption around 23:40 UTC on December 14, west of SIDC Sunspot Group 337 (NOAA Active Region 3924).

Coronal Holes

Two northern coronal holes have crossed the central meridian, both equatorial and with positive polarity. The first coronal hole (SIDC Coronal Hole 82) was elongated, which fully crossed the central meridian on December 10. The second (SIDC Coronal Hole 78), crossed the central meridian on December 12.

Proton flux levels

The greater than 10 MeV proton flux was below the 10 pfu threshold throughout the week.

Electron fluxes at GEO

The greater than 2 MeV electron flux as measured by GOES 16 and GOES 18 was below the threshold at the beginning of the week. Starting from December 10, the 2 MeV electron flux was enhanced, periodically crossing the threshold (as measured by GOES18) on December 11-13 before returning to background levels. The 24-hour electron fluence was mostly at nominal levels throughout the week.

Solar wind

The solar wind conditions were enhanced at the beginning of the week, under the influence of the northern, elongated, positive polarity coronal hole (SIDC Coronal Hole 82). The speed reached 515 km/s, the interplanetary magnetic field was around 10 nT and the Bz component varied between -9 nT and 6 nT. Between December 11-14, the solar wind speed ranged between 310 and 350 km/s. In the UTC morning of December 14, enhancements in the magnetic field were observed, with values up to 13 nT and the Bz component reaching -10 nT. Small speed enhancements were observed early on December 15 due to a mild high-speed stream from SIDC Coronal Hole 78, with values increasing from 340 km/s up to 450 km/s. After this, the solar wind returned to the slow regime.

Geomagnetism

Geomagnetic conditions globally and locally were unsettled to active (NOAA Kp 3-4, K BEL 3-4) at the beginning of the week, as a consequence of the arrival of the high-speed stream from SIDC Coronal Hole 82. Geomagnetic conditions became then quiet, globally and locally (NOAA Kp 1-2, K BEL 1-2). Active geomagnetic conditions were observed locally on December 14-15 and unsettled globally.

3. PROBA2 Observations (9 Dec 2024 - 15 Dec 2024)

Solar Activity

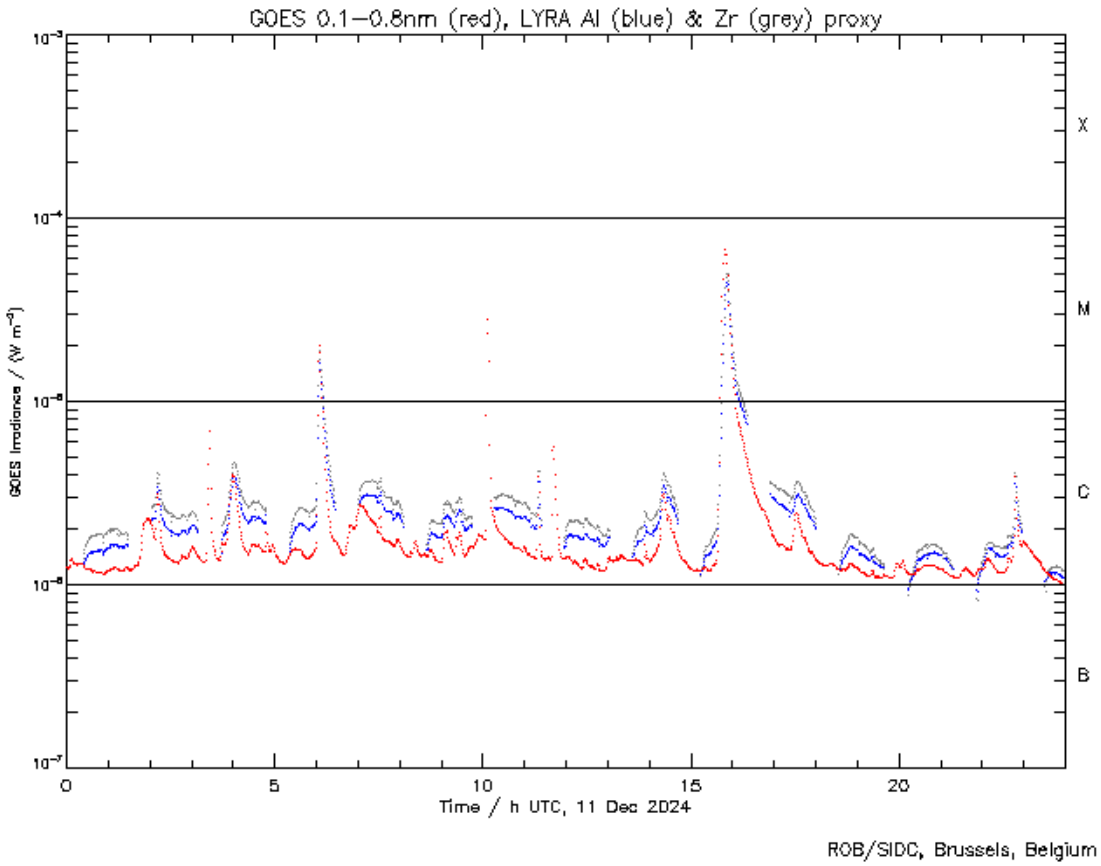
Solar flare activity fluctuated from low to moderate during the week.
In order to view the activity of this week in more detail, we suggest to go to the following website from which all the daily (normal and difference) movies can be accessed: https://proba2.oma.be/ssa
This page also lists the recorded flaring events.

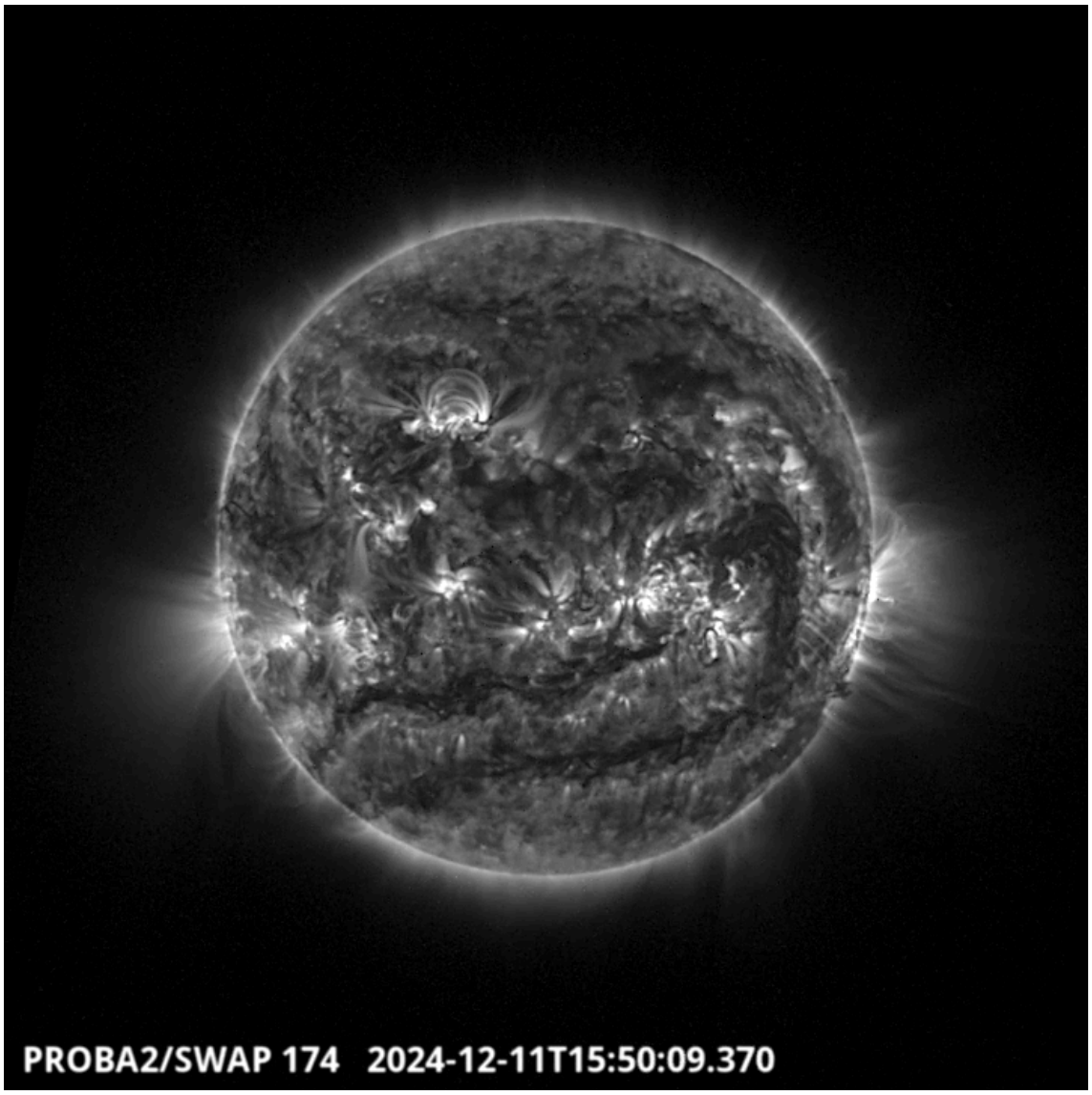
A weekly overview movie (SWAP week 768) can be found here: https://proba2.sidc.be/swap/data/mpg/movies/weekly_movies/weekly_movie_2024_12_09.mp4.

Details about some of this week's events can be found further below.

If any of the linked movies are unavailable they can be found in the P2SC movie repository here: https://proba2.oma.be/swap/data/mpg/movies/.

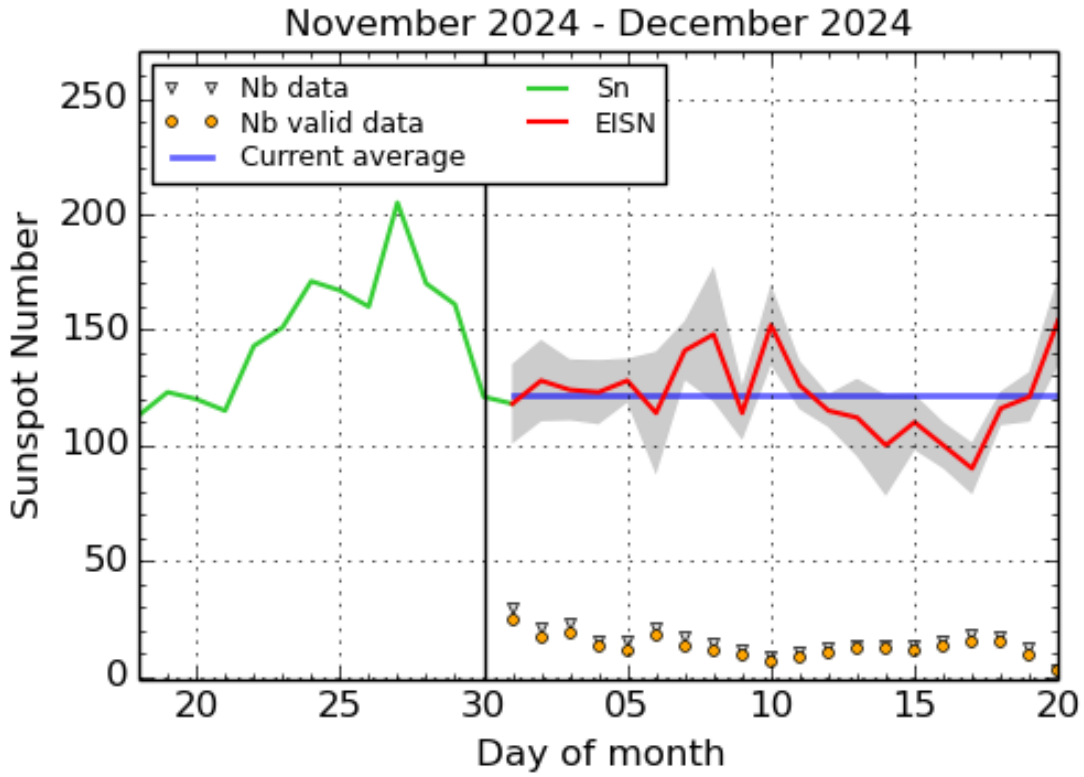
Wednesday December 11





The largest flare of this week was an M6.7, and it was observed by LYRA (top panel) and SWAP (bottom panel). The flare peaked on 2024-Dec-11 at 15:49 UT. It occurred close to the equator at the western limb, originating from active region NOAA3912.
Find a SWAP movie of the event here: https://proba2.sidc.be/swap/movies/20241211_swap_movie.mp4.

4. International Sunspot Number by SILSO



SILSO graphics (http://sidc.be/silso) Royal Observatory of Belgium, 2024 December 20

The daily Estimated International Sunspot Number (EISN, red curve with shaded error) derived by a simplified method from real-time data from the worldwide SILSO network. It extends the official Sunspot Number from the full processing of the preceding month (green line), a few days more than one solar rotation. The horizontal blue line shows the current monthly average. The yellow dots give the number of stations that provided valid data. Valid data are used to calculate the EISN. The triangle gives the number of stations providing data. When a triangle and a yellow dot coincide, it means that all the data is used to calculate the EISN of that day.

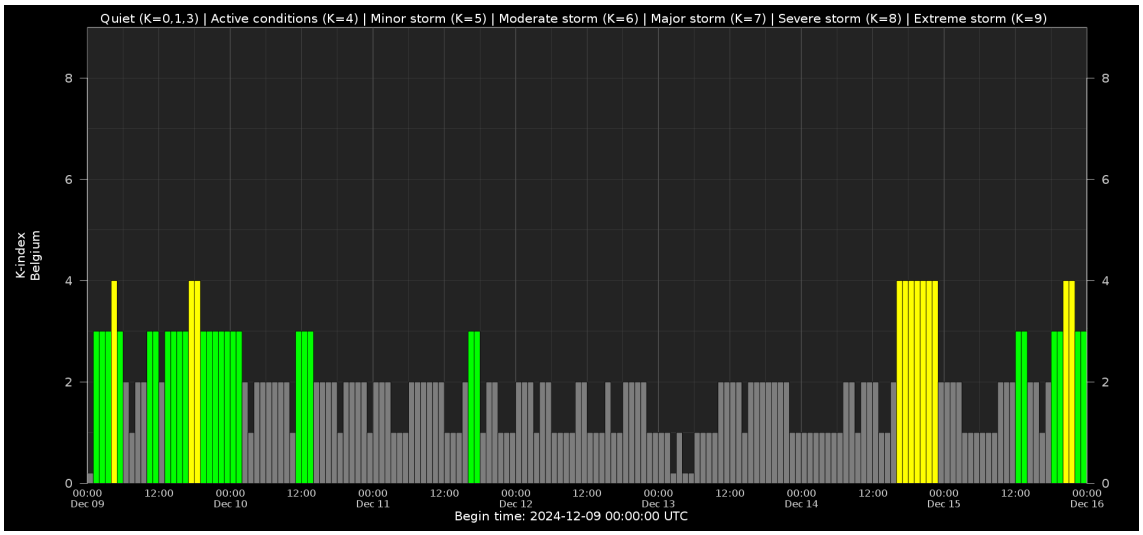
5. Noticeable Solar Events

DAY	BEGIN	MAX	END	LOC	XRAY	OP	10CM	TYPE	Cat	NOAA
10	0703	0709	0714		M1.4			III/2		3922
10	1055	1102	1109		M1.5			III/2VI/2		3922
10	1754	1758	1803		M1.6			III/2VI/1		3922
11	0554	0604	0609		M1.9			III/2	47	3922
11	1003	1006	1010	N19E16	M2.7	1F			43	3920
11	1532	1549	1556		M6.7					3912
12	1731	1743	1750		M2.2			III/2	47	3922
12	2058	2107	2112		M1.6				47	3922
13	0311	0318	0322	S18E37	M1.0	SF		III/2	47	3922
13	1113	1124	1130	S8W49	M2.0	SF			33	3917

13	1415	1424	1431	M1.0	V/2III/2	47	3922
15	2015	2024	2028	M3.1		43	3920

LOC: approximate heliographic location
XRAY: X-ray flare class
OP: optical flare class
10CM: peak 10 cm radio flux
TYPE: radio burst type
Cat: Catania sunspot group number
NOAA: NOAA active region number

6. Geomagnetic Observations in Belgium



Local K-type magnetic activity index for Belgium based on data from Dourbes (DOU) and Manhay (MAB). Comparing the data from both measurement stations allows to reliably remove outliers from the magnetic data. At the same time the operational service availability is improved: whenever data from one observatory is not available, the single-station index obtained from the other can be used as a fallback system.
Both the two-station index and the single station indices are available here: http://ionosphere.meteo.be/geomagnetism/K_BEL/

7. The SIDC space weather briefing

The Space Weather Briefing presented by the forecaster on duty from Dec 8 to 15, 2024.
The pdf of the presentation: https://www.stce.be/briefings/20241216_SWbriefing.pdf

SIDC Space Weather Briefing

08 December 2024-15 December 2024

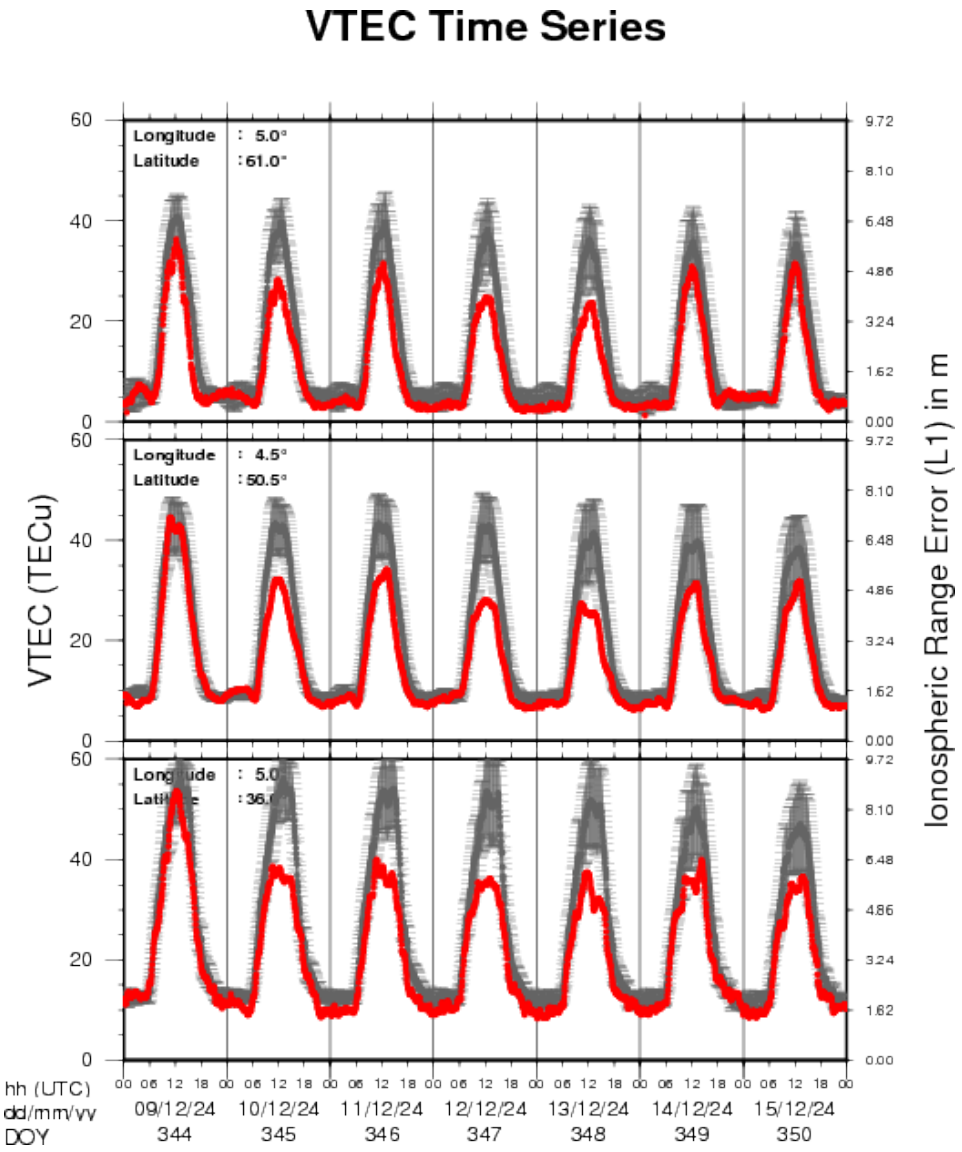
Dimitrios Millas

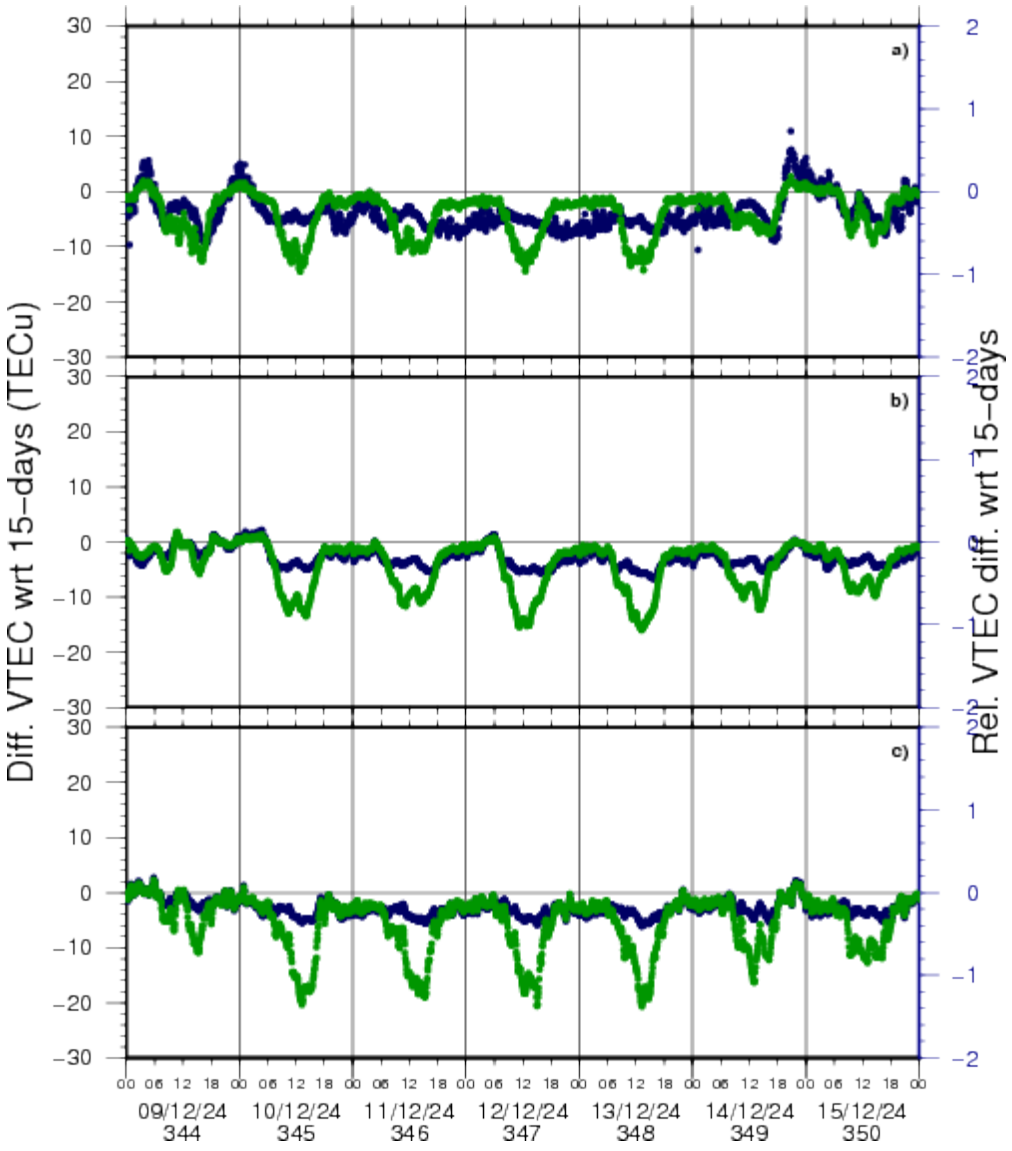
& the SIDC forecaster team

Royal Observatory of Belgium

Solar Influences Data analysis Centre
www.sidc.be

8. Review of Ionospheric Activity





VTEC time series at 3 locations in Europe from 9 Dec 2024 till 15 Dec 2024

The top figure shows the time evolution of the Vertical Total Electron Content (VTEC) (in red) during the last week at three locations:
a) in the northern part of Europe(N 61deg E 5deg)
b) above Brussels(N 50.5deg, E 4.5 deg)
c) in the southern part of Europe(N 36 deg, E 5deg)
This top figure also shows (in grey) the normal ionospheric behaviour expected based on the median VTEC from the 15 previous days.

The time series below shows the VTEC difference (in green) and relative difference (in blue) with respect to the median of the last 15 days in the North, Mid (above Brussels) and South of Europe. It thus illustrates the VTEC deviation from normal quiet behaviour.

The VTEC is expressed in TECu (with TECu=10^16 electrons per square meter) and is directly related to the signal propagation delay due to the ionosphere (in figure: delay on GPS L1 frequency).

The Sun's radiation ionizes the Earth's upper atmosphere, the ionosphere, located from about 60km to 1000km above the Earth's surface.The ionization process in the ionosphere produces ions and free electrons. These electrons perturb the propagation of the GNSS (Global Navigation Satellite System) signals by inducing a so-called ionospheric delay.

See http://stce.be/newsletter/GNSS_final.pdf for some more explanations; for more information, see https://gnss.be/SpaceWeather

9. STCE courses and trainings

Courses, seminars and presentations with the Sun-Space-Earth system and Space Weather as the main theme. We provide occasions to get submerged in our world through educational, informative and instructive activities.
* Jan 28-30, 2025, Role of the ionosphere and space weather in military communications, Brussels, Belgium - full - register for the waiting list: https://events.spacepole.be/event/208/
* Feb 5, 2025, 14h, STCE Seminar: Tropospheric ozone trends from harmonized ground-based measurements, RMI Conference Room
* Mar 17-18, 2025, Inleiding tot het ruimteweer, enkel voor leden van volkssterrenwachten, Brussels, Belgium - register: https://events.spacepole.be/event/213/
* Mar 24, 2025, STCE Lecture From Physics to Forecasting, ESA Academy's Space Weather Training Course
* April 28-30, 2025, STCE Space Weather Introductory Course, Brussels, Belgium - register: https://events.spacepole.be/event/214/
* May 26-27, 2025, STCE Course Space Weather impacts on aviation, online - register: https://events.spacepole.be/event/215/
* Jun 23-25, 2025, STCE Space Weather Introductory Course, Brussels, Belgium - register: https://events.spacepole.be/event/216/
* Sep 15-16, 2025, STCE Course Space Weather impacts on aviation, online - register: https://events.spacepole.be/event/218/
* Nov 17-19, 2025, STCE Space Weather Introductory Course, Brussels, Belgium - register: https://events.spacepole.be/event/217/

To register for a course and check the seminar details, navigate to the STCE Space Weather Education Center: https://www.stce.be/SWEC
If you want your event in the STCE newsletter, contact us: stce_coordination at stce.be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