STCE Newsletter

8 Dec 2025 - 14 Dec 2025

Published by the STCE - this issue : 19 Dec 2025. Available online at https://www.stce.be/newsletter/ .

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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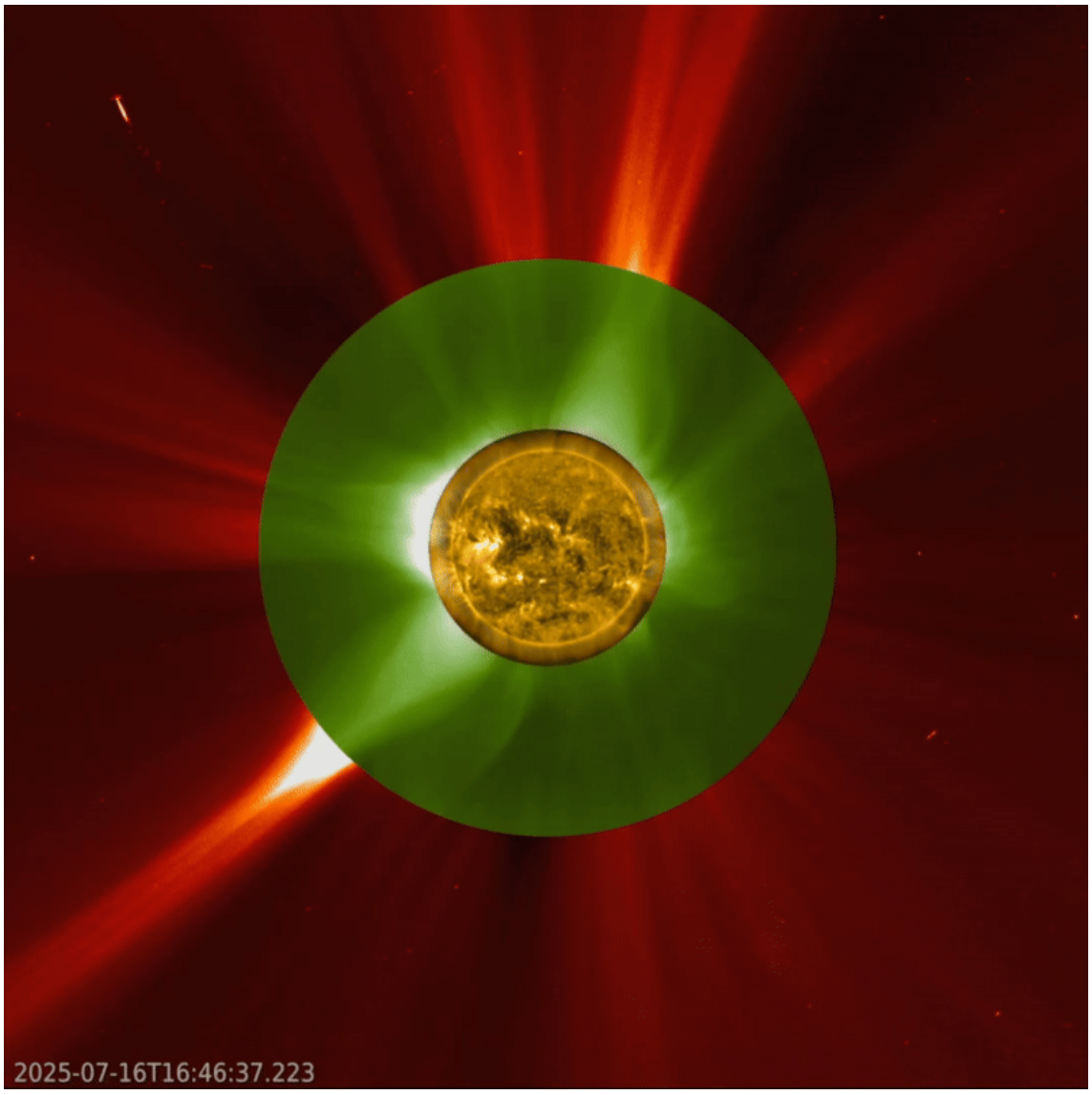
1. At the movies: Proba-3

The Proba-3 satellites are professional movie makers bringing the solar corona to the film screen. Since its launch on December 5, 2024, they made already more than 50 action movies on solar eclipses. Here is one episode in the series 'Missing solar puzzle pieces':



Read the full story on the ESA website: https://www.esa.int/Enabling_Support/Space_Engineering_Technology/Proba-3_fills_the_solar_observation_gap#msdynmkt_trackingcontext=33c74725-34f5-41de-be33-882b13dc0000

2. Review of Space Weather

Solar Active Regions (ARs) and flares

Solar flaring activity was high at the beginning of the week and gradually decreased to low levels by the end of the week.

The strongest flare was an X1.1 flare (SIDC Flare 6337), which peaked at 05:01 UTC on December 8 and was associated with SIDC Sunspot Group 713 (NOAA Active Region 4298, magnetic type beta). Several M-class flares were observed between December 8 and December 12, mainly associated with SIDC Sunspot Group 709 (NOAA Active Region 4294). Its beta-gamma-delta configuration early in the week, was the most complex, before gradually decaying.
The total number of numbered active regions decreased from nine at the beginning of the week to four by December 14.

Coronal mass ejections

Several Coronal Mass Ejections (CMEs) were observed during the week. All detected CMEs were associated with eruptions near the solar limb and were not expected to have a direct impact on Earth.
A wide CME (SIDC CME 606) was observed in LASCO/C2 and C3 coronagraph imagery starting from around 05:20 UTC on December 8, lifting off the west limb and was associated with the X1.1 flare.
Another CME (SIDC CME 607) was observed in LASCO/C2 coronagraph data starting at 22:36 UTC on December 8. The CME was directed primarily to the west from the Earth's perspective and associated with the M1.2 flare (SIDC Flare 6344), peaking at 22:28 UTC on December 08.
Later in the week, a wide CME (SIDC CME 608) was observed in LASCO/C2 and C3 coronagraph imagery starting from around 22:30 UTC on December 10, lifting off the west limb and associated with an M4.4 flare.
A slow, wide CME (SIDC CME 609), associated with a prominence eruption observed in AIA 304 data at the southeast limb on December 12, was detected in LASCO/C2 coronagraph imagery starting around 04:00 UTC.

Coronal Holes

An elongated, northern, negative polarity coronal hole (returning SIDC Coronal Hole 142) crossed the central meridian starting on December 10. The associated high-speed stream influenced the near-Earth space environment from December 12 onward and persisted through the end of the week.

Solar proton flux

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 measured by GOES 18 and GOES 19 was near or above the 1000 pfu threshold early in the week. The electron flux gradually decreased and remained below the 1000 pfu threshold from December 10 onward.
The 24-hour electron fluence was at moderate levels early in the week and returned to normal levels by midweek, remaining nominal through December 14.

Solar wind

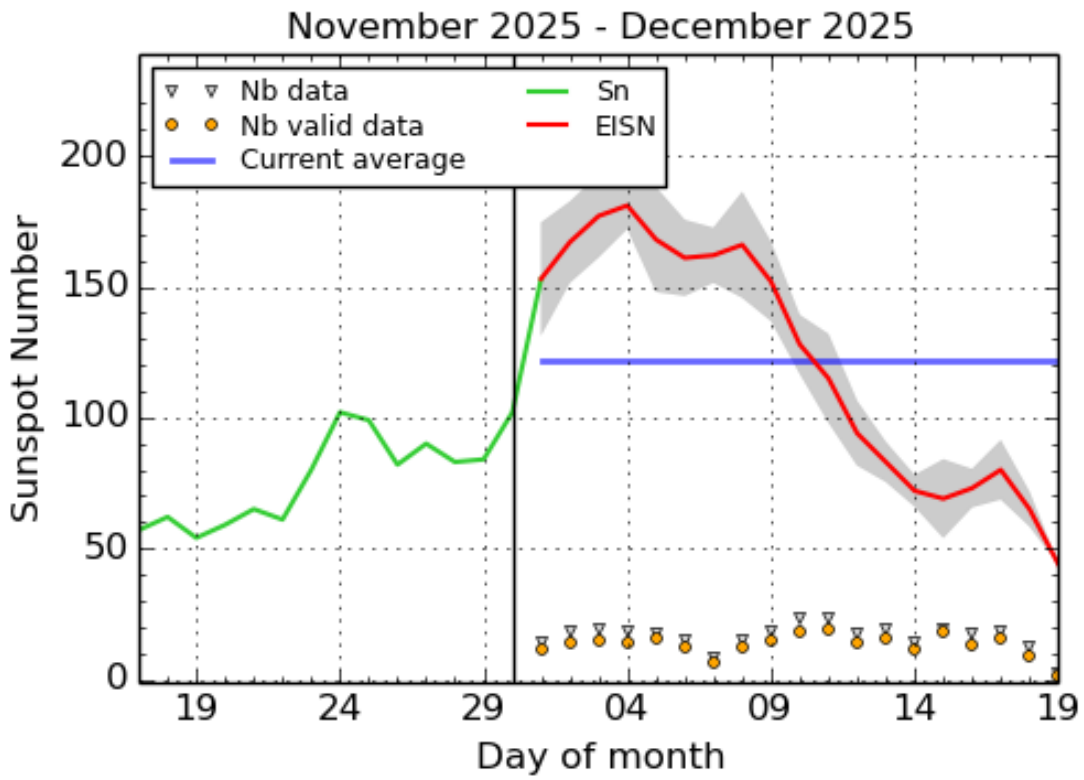
The solar wind upstream of Earth picked up speed to around 450 km/s on December 10 due to the arrival of an Interplanetary Coronal Mass Ejection (ICME). The interplanetary magnetic field values reaching up to 18 nT, and a prolonged interval of southward Bz, with minimum values down to -16 nT.
From December 12 onward, solar wind was increasingly influenced by the high-speed stream associated with the negative polarity coronal hole (SIDC Coronal Hole 142). Its speeds increased further, peaking near 690 km/s on December 14. Interplanetary magnetic field values varied between 2 nT and 16 nT, while the Bz component fluctuated between -14 nT and 16 nT.
The solar wind stayed enhanced towards the end of the week.

Geomagnetism

Geomagnetic activity reflected the combined effects of ICME and the high-speed stream resulting in a moderate global geomagnetic storm (NOAA Kp 6+) between December 10 and December 11. Above Belgium, the geomagnetic disturbance reached level 6.

The geomagnetic activity dropped to unsettled and active with recurrent minor storm intervals (NOAA Kp 5) from December 11 to December 13. This was due to the high-speed stream.
By December 14, geomagnetic conditions had relaxed to quiet to unsettled globally and locally.

3. International Sunspot Number by SILSO



SILSO graphics (http://sidc.be/silso) Royal Observatory of Belgium, 2025 December 19

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.

4. Noticeable Solar Events

DAY	BEGIN	MAX	END	LOC	XRAY	OP	10CM	TYPE	Cat	NOAA
08	0033	0036	0039	S15W30	M2.0	1			21	4294
08	0449	0501	0504	S14W52	X1.1	2B		III/3	17	4298
08	0640	0654	0704	N22W9	M1.8	1		III/1		4304
08	1242	1305	1321	S17W48	M1.0	SF			21	4294
08	2113	2117	2125	N28W7	M3.1	SF			21	4294
08	2204	2228	2245	N22W27	M1.2	SN			24	4299

09	0037	0058	0117		M2.0			24	4299
09	0134	0138	0142		M1.1		II/2	21	4294
09	0741	0747	0751	S26E45	M1.6	SF	VI/2III/2	21	4294
09	1500	1514	1520	S13W51	M1.5	1		21	4294
09	2313	2327	2336	S17W44	M1.5	SF		23	4296
10	0417	0422	0427	S14W60	M1.2	SF	III/2	21	4294
10	0731	0737	0742	S15W62	M1.9	1N		21	4294
10	0946	0955	1002		M1.0			21	4294
10	1332	1343	1349	S22W62	M1.6	SF	III/2II/2	21	4294
10	2158	2208	2214	S20W66	M4.4	2B	V/3II/3	21	4294
12	0450	0505	0514		M2.0		III/2CTM/1II/2	23	4296
12	0527	0544	0553		M1.1			21	4294

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

5. PROBA2 Observations

Solar Activity

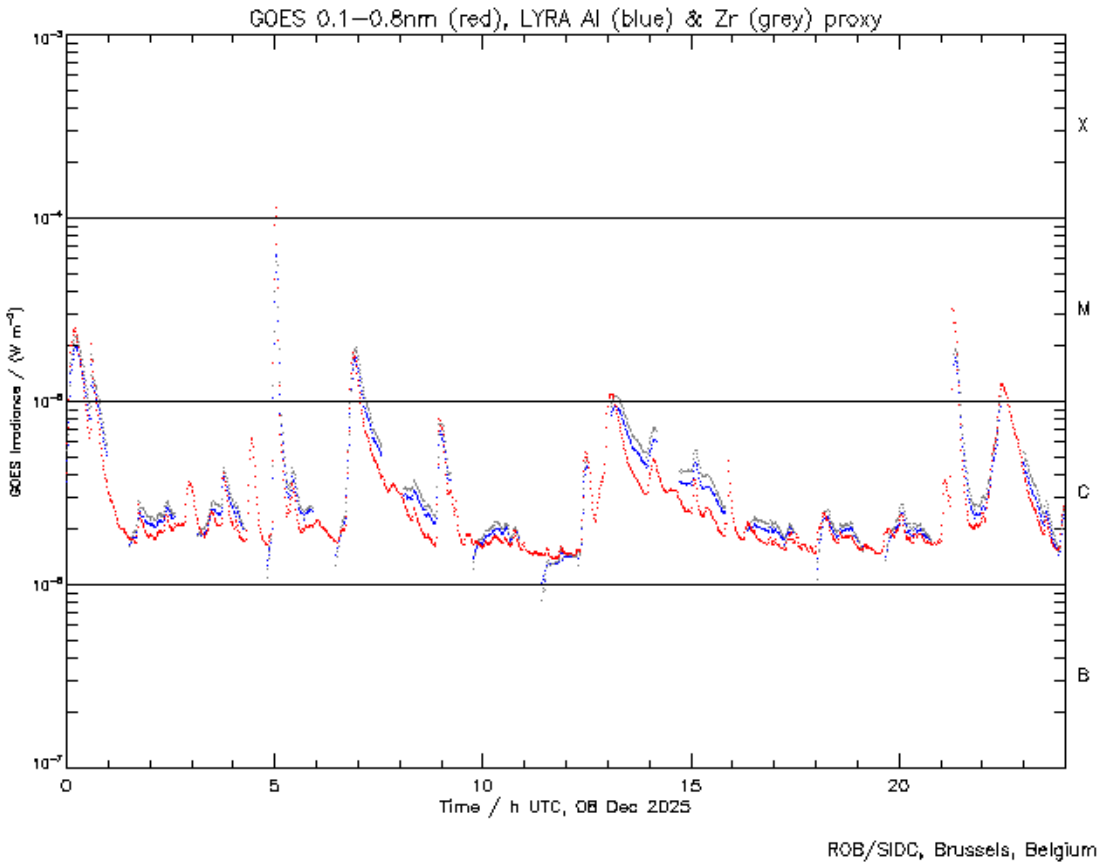
Solar flare activity fluctuated from low to high during the week.
In order to view the activity of this week in more detail, we suggest to go to the following website from which all the daily (normal and difference) movies can be accessed: https://proba2.oma.be/ssa
This page also lists the recorded flaring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

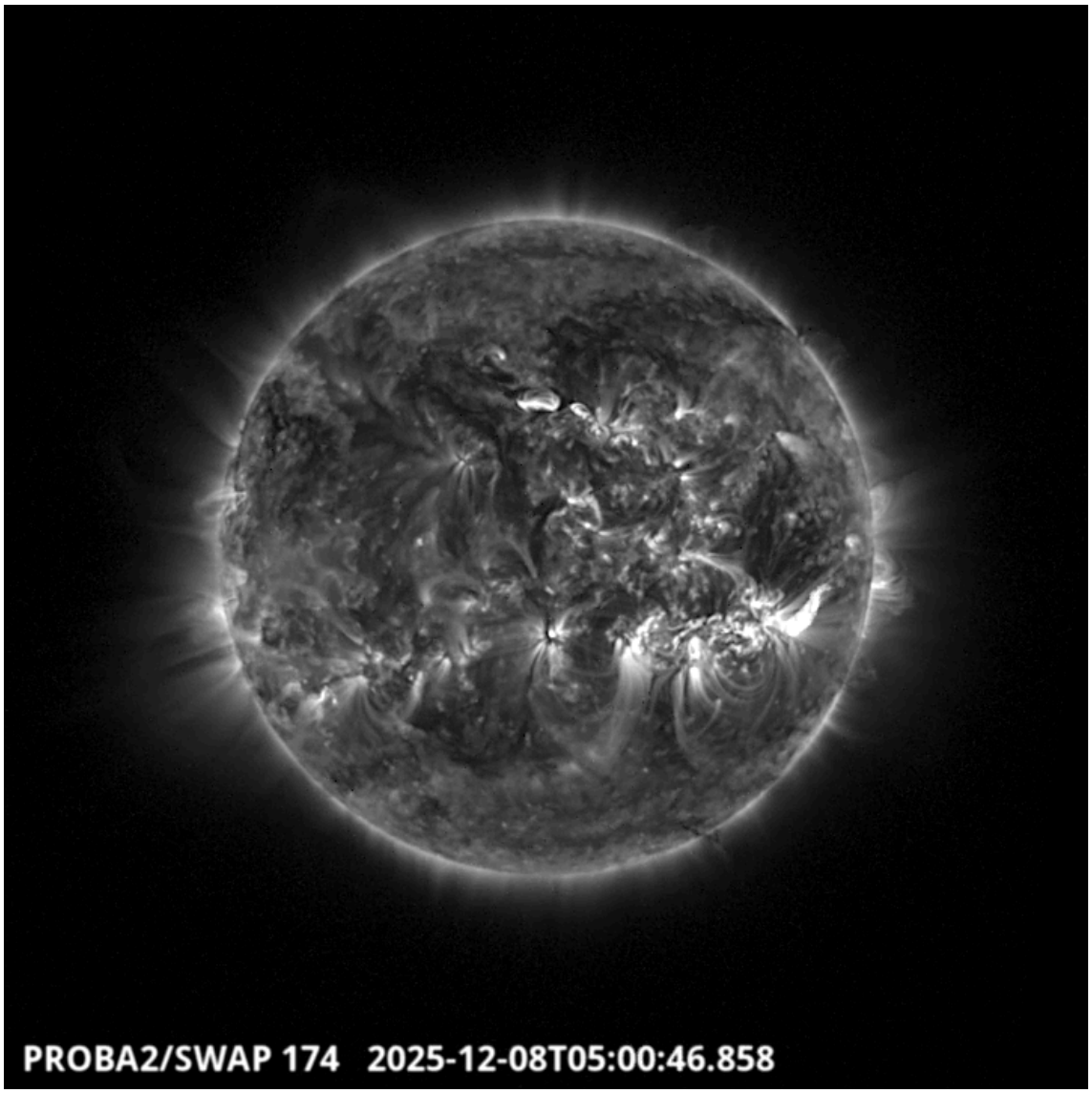
A weekly overview movie (SWAP week 820) can be found here: https://proba2.sidc.be/swap/data/mpg/movies/weekly_movies/weekly_movie_2025_12_08.mp4.

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/.

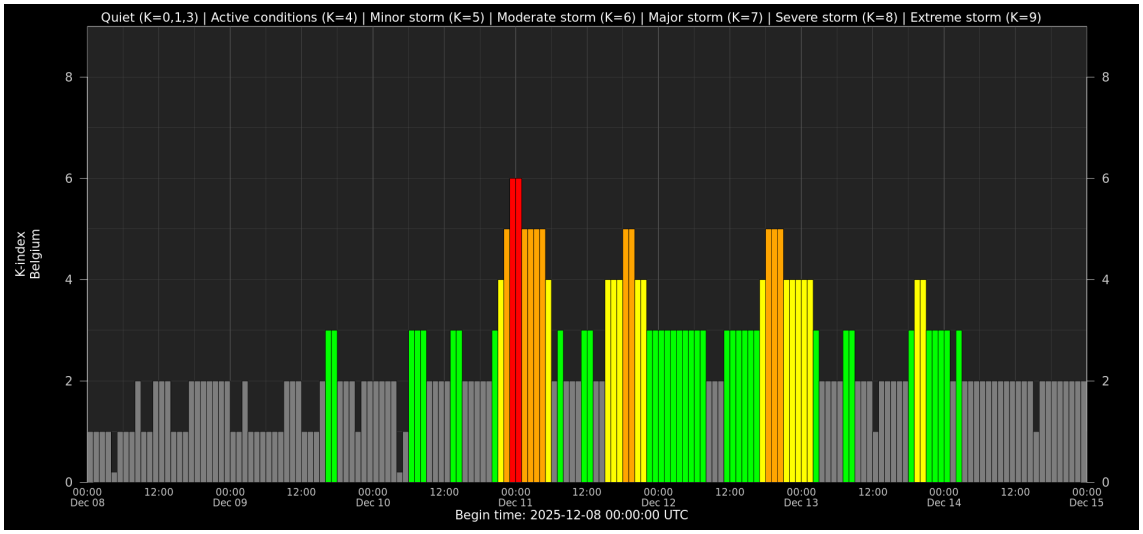
Monday December 08





The largest flare of this week was an X1.1, and it was observed by LYRA (top panel) and SWAP (bottom panel). The flare peaked on 2025-Dec-08 at 05:01 UT and occurred in the south-western quadrant of the Sun, originating from active region NOAA4298 (SIDC 713).
Find a SWAP movie of the event here: https://proba2.sidc.be/swap/movies/20251208_swap_movie.mp4.

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 forecaster on duty presented the SIDC briefing that gives an overview of space weather from December 8 to 14.
The pdf of the presentation: https://www.stce.be/briefings/20251215_SWbriefing.pdf

SIDC Space Weather Briefing

08 December 2025-14 December 2025

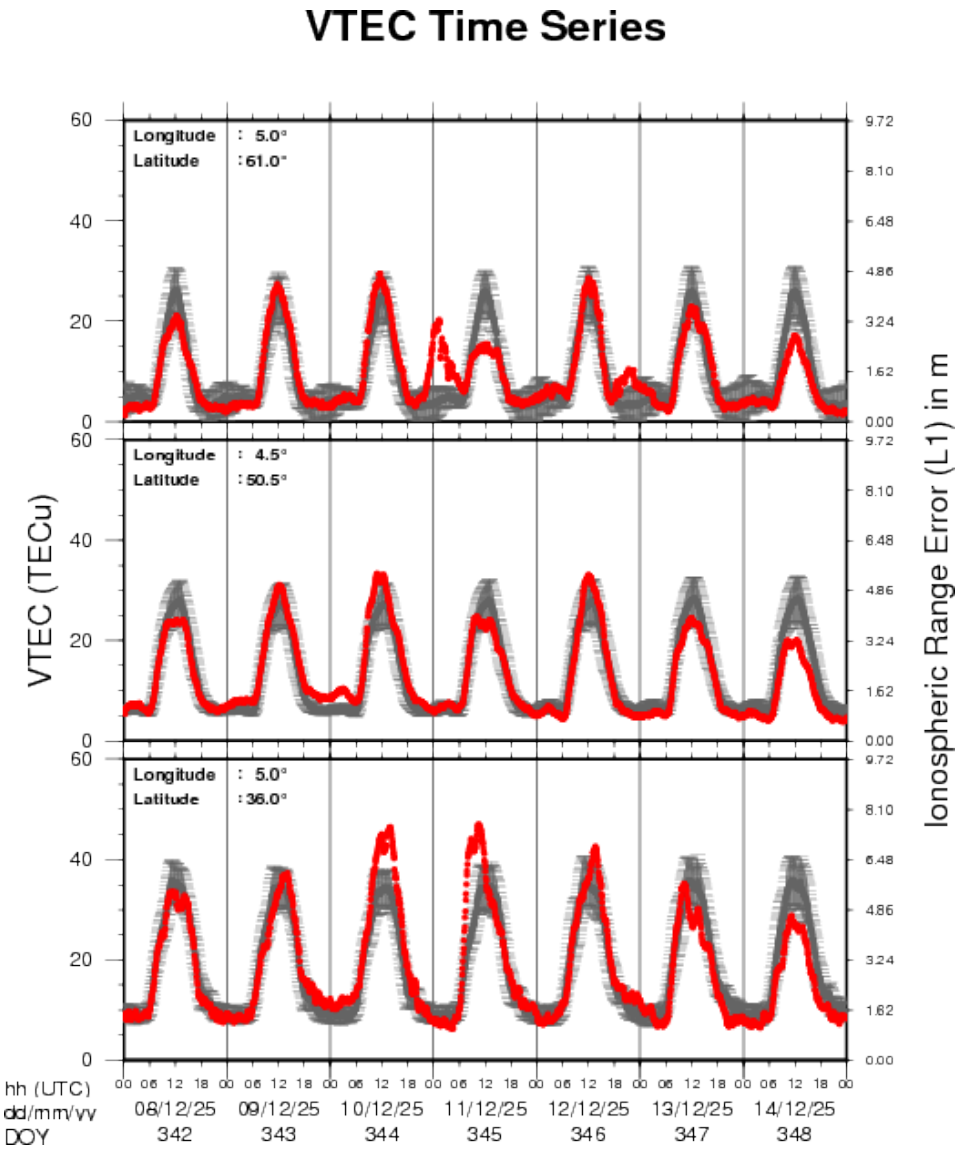
Micera Alfredo

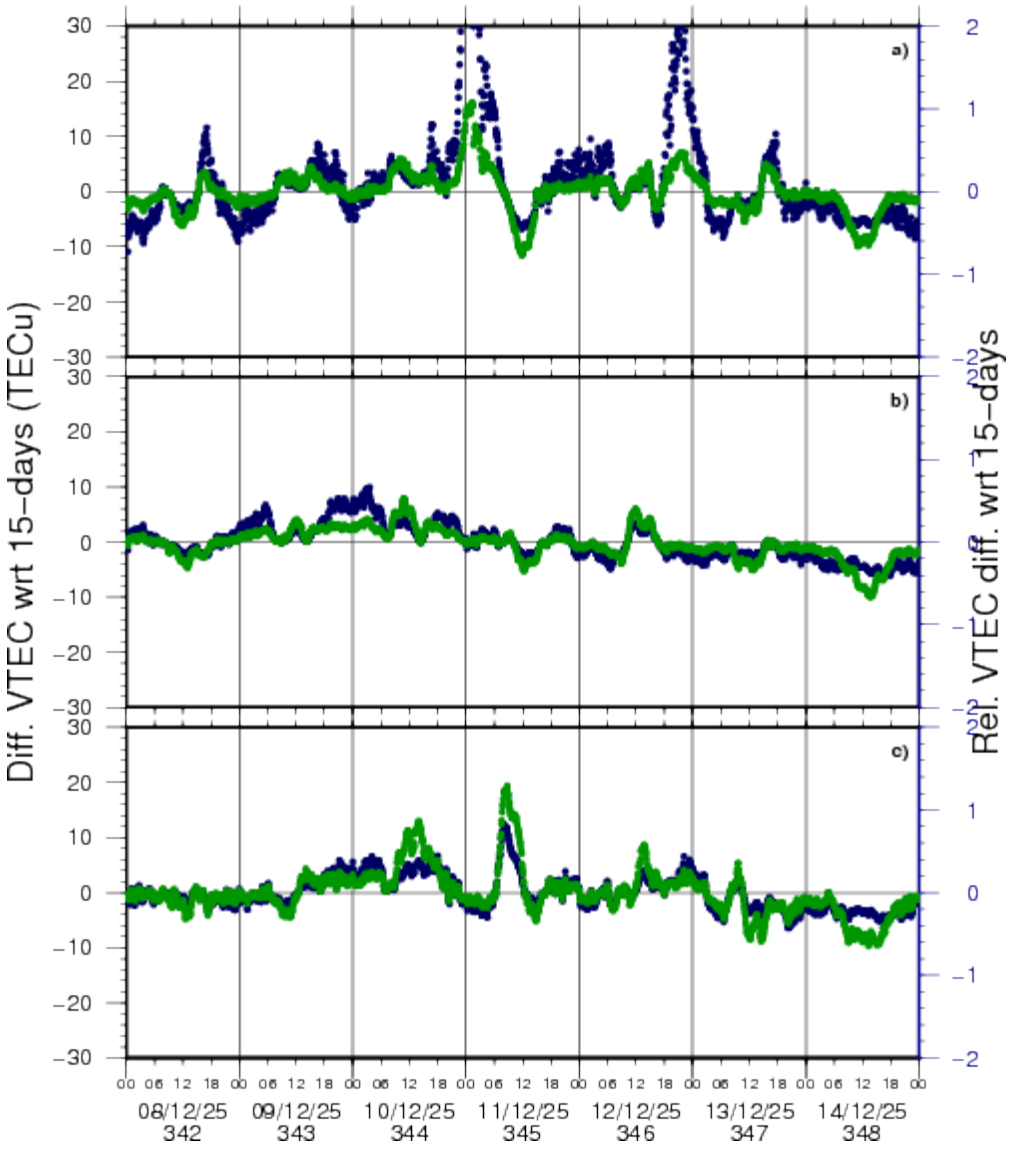
& the SIDC forecaster team

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 8 Dec 2025 till 14 Dec 2025

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. Upcoming Activities

Courses, seminars, presentations and events 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.
* Feb 9-11, 2026, STCE Space Weather Introductory Course, Brussels, Belgium - register: https://events.spacepole.be/event/255/
* Mar 16-18, 2026, STCE course: Role of the ionosphere and space weather in military communications, Brussels, Belgium - register: https://events.spacepole.be/event/258/
* Apr 20-21, 2026, STCE cursus: inleiding tot het ruimteweer, Brussels, Belgium - register: https://events.spacepole.be/event/260/
* Mar 23, 2026, STCE lecture: From physics to forecasting, Space Weather course, ESA Academy, Redu, Belgium
* Jun 15-17, 2026, STCE Space Weather Introductory Course, Brussels, Belgium - register: https://events.spacepole.be/event/256/
* Oct 12-14, 2026, STCE Space Weather Introductory Course, Brussels, Belgium - register: https://events.spacepole.be/event/257/
* Nov 23-25, 2026, STCE course: Role of the ionosphere and space weather in military communications, Brussels, Belgium - register: https://events.spacepole.be/event/259/
* Dec 7-9, 2026, STCE Space Weather Introductory Course for Aviation, Brussels, Belgium - register: https://events.spacepole.be/event/262/

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

Website: https://www.stce.be/SWEC