

# STCE Newsletter

27 Jan 2025 - 2 Feb 2025



*Published by the STCE - this issue : 6 Feb 2025. Available online at <https://www.stce.be/newsletter/>.*

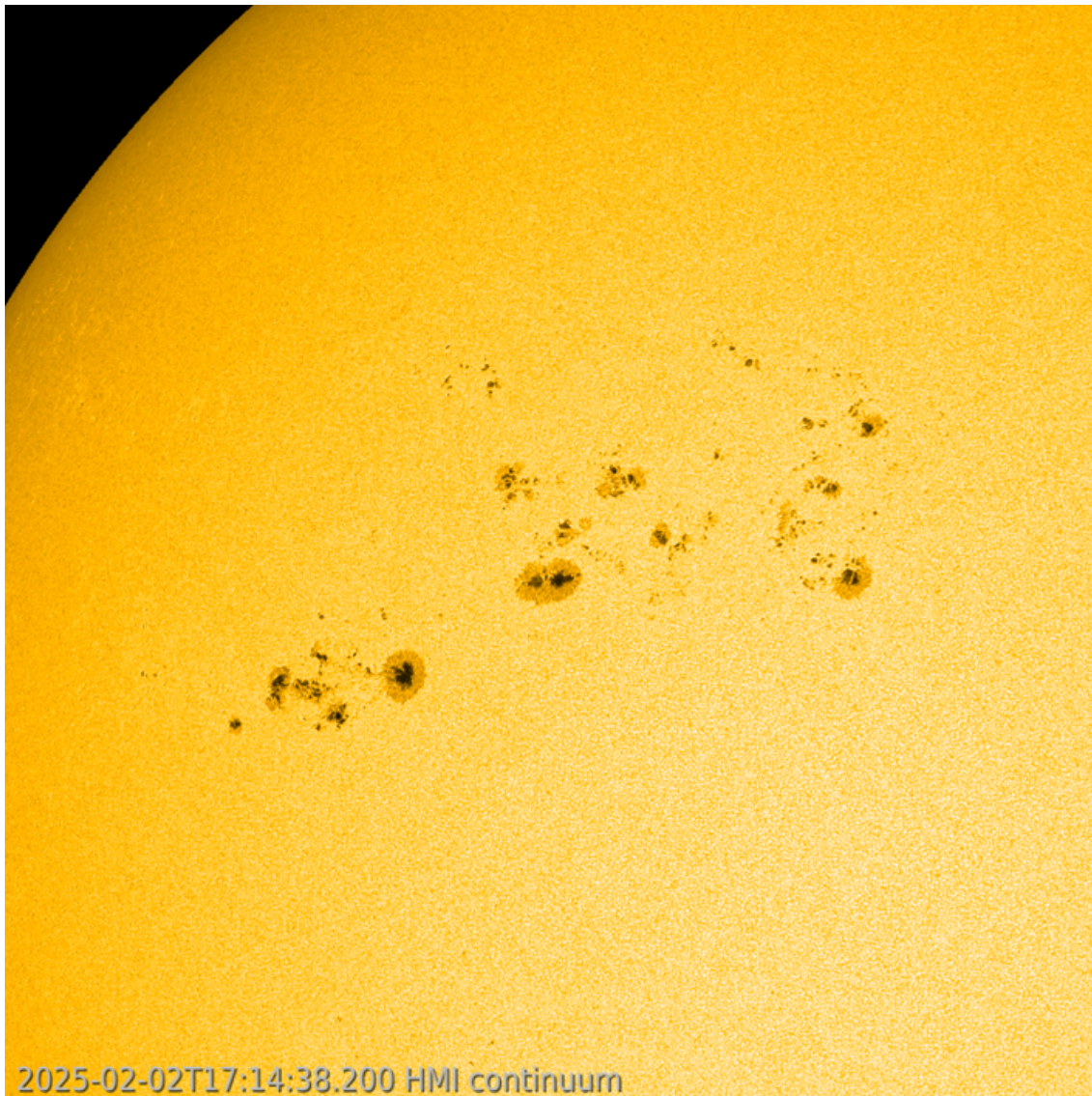
The Solar-Terrestrial Centre of Excellence (STCE) is a collaborative network of the Belgian Institute for Space Aeronomy, the Royal Observatory of Belgium and the Royal Meteorological Institute of Belgium.

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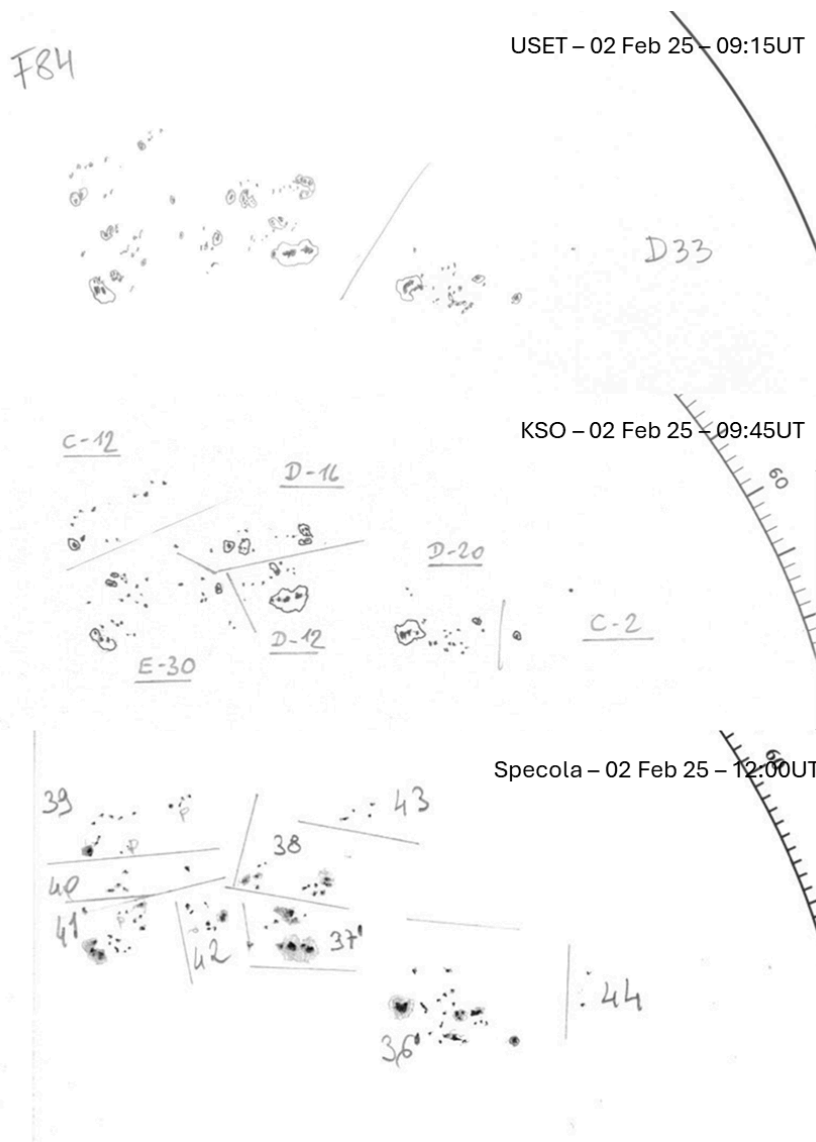
## 1. A flock of sunspots

Once again, a swarm of sunspots is rotating over the solar disk. This time, the sunspot hive started to rotate over the northern solar hemisphere from 28 January onwards, and so -at the time of this writing (3 February)- it is close to the Sun's central meridian. Dozens of sunspots of varying sizes are squeezed together in an area of about 12 by 20 degrees. Then, late on 1 February, additional, isolated sunspot groups started to develop to the northeast ("upper left") and southeast ("lower left") of this cluster, adding even more to the size of this already very complex area. The SDO/HMI image underneath shows the entire sunspot cluster a day later, with a clip covering the period from 1 to early 3 February available in the online version of this newsitem at <https://www.stce.be/news/747/welcome.html>



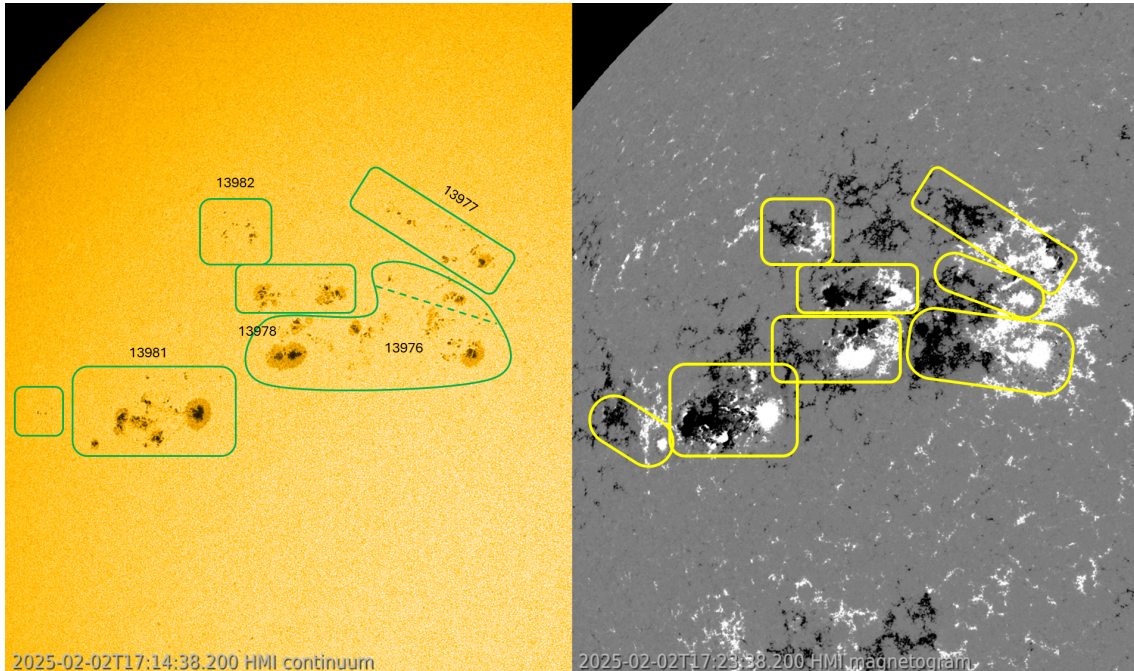
To the solar observers, this kind of sunspot clusters is also known as the "sunspots from hell" (that's a little joke...). Indeed, it is downright difficult to determine how many sunspot groups are actually present in such a cluster, as can be gauged from the solar drawings underneath. They were all made by reputable solar observatories such as USET (Royal Observatory of Belgium <https://www.sidc.be/uset/>), The Kanzelhöhe Observatory for Solar and Environmental Research (KSO, Austria - <http://www.kso.ac.at/>)

cesar.kso.ac.at/ ), and the Specola Observatory in Locarno (Specola Solare Ticinese, Switzerland - <https://www.specola.ch/en/home-english/> ). For 2 February, they count respectively 2, 6, and 9 sunspot groups, as shown in the drawing cuts underneath. Note the reversed image orientation compared to the SDO imagery, i.e. in the east-west direction, and that the Specola observation contains at least one group that was not visible yet a few hours earlier in the USET and KSO observations (Specola nr 43 ; NOAA 13982). The NOAA/USAF observers reported 5 active regions (<https://www.solarmonitor.org/index.php> ).

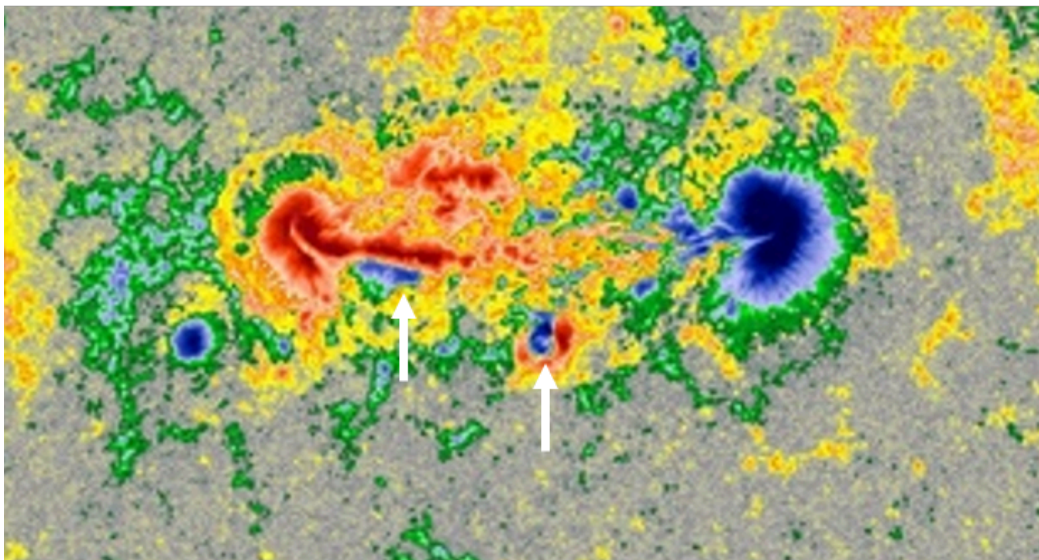
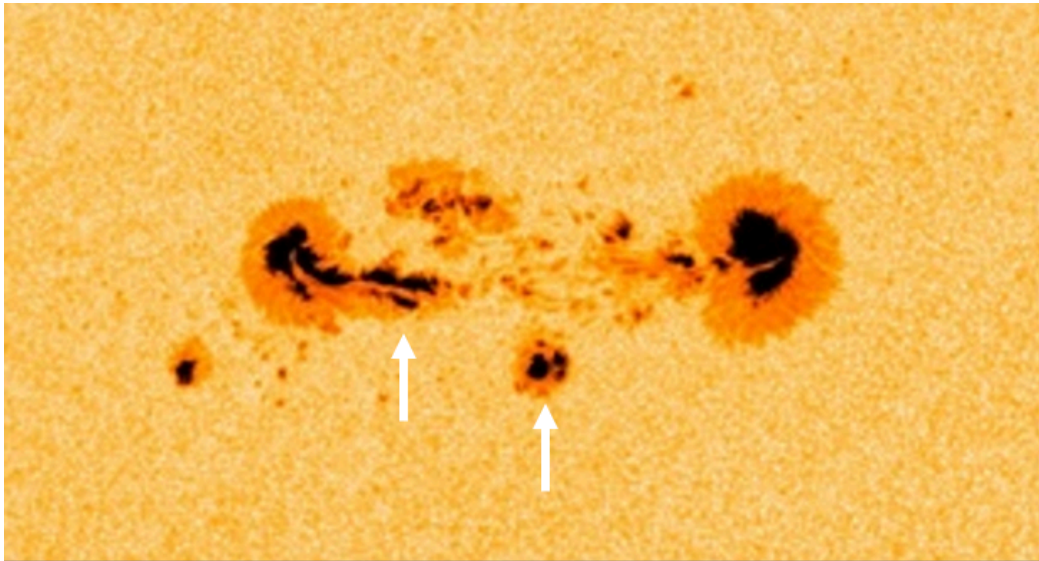


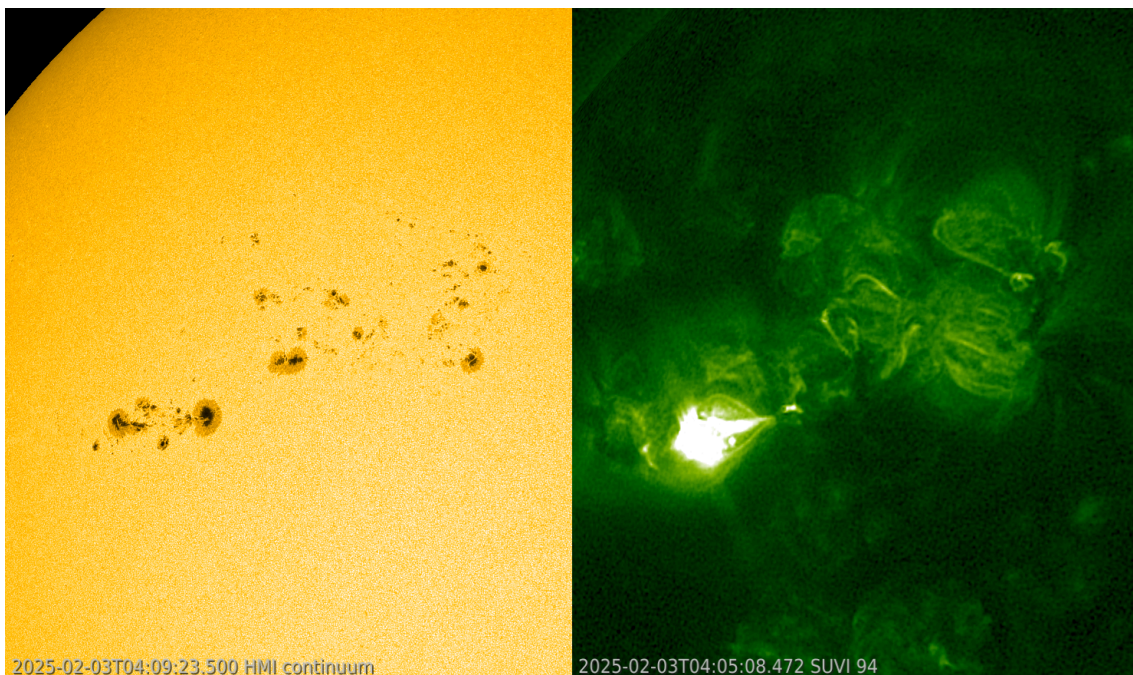
Claiming that there's a single, correct solution to this problem is a bit exaggerated, certainly in view of the rapidly evolving number, size and location of the various sunspots. For splitting up sunspot groups, one has to keep in mind that a solar observer -in order to keep consistency with the old observations when no magnetic imagery was available- is only allowed to use white light imagery. He can use "rules" such as e.g. that the leading spot usually is larger and more inclined to the solar equator than the trailing spot. Independent active regions evolve by themselves, without much interaction with their neighbours. Also, in case there's still doubt, sunspots and sunspot groups less than 5 degrees in latitude and/or 10 degrees in longitude are usually taken together. The annotated SDO/HMI white light image (underneath left) shows a possible solution of 6 sunspot regions (green boxes), with a debatable 7th group possible

(above the dashed line). The numbers in black are the active regions as reported by NOAA. On the right is the corresponding SDO/HMI magnetogram. Here, the simplest way forward is to look for bipolar regions, with in this case "white" being the magnetic polarity of the leading region (magnetic field lines coming out of the solar surface), and "black" being the magnetic polarity of the trailing region. Here, 8 regions can be quite easily identified (yellow boxes).



Correctly separating the sunspot groups (as much as possible) is important, as it is the first step in the classification of the groups: usually according to the McIntosh scheme in white light, and according to the Mount Wilson scheme when using a magnetogram (see the STCE SWx classification page at <https://www.stce.be/educational/classification>). At least here, there's one certainty: if there's a magnetic delta structure present in an active region, then the chance on (strong) flares is significantly higher than if there's no delta present. A sunspot group is said to contain a delta structure when it has at least one mature spot that contains umbrae of opposite magnetic polarities separated by less than 2 degrees and situated within the common penumbra. The imagery underneath shows a white light image and a magnetogram of NOAA 13981 early on 3 February. The region clearly contains 2 delta structures, as indicated by the white arrows. From 2 February onwards, it was the source of several M-class flares, the strongest being an M8.8 flare peaking on 3 February at 03:58UTC. A combo of a SDO/HMI white light image and a GOES/SUVI extreme ultraviolet image can be found underneath (the online clip covers 2-3 February). Notice also how some of the spots are stretched, another sign of the powerful magnetic field strengths that are present there. It's obvious that an X-class flare is possible from this region as long as the magnetic delta structures persist.





## 2. Eight PITHIA-NRF TNA Call is open

The Eight TNA Call is open from 2 February 2025 until 2 March 2025 .

PITHIA-NRF launches its eight call. This is an extra call within the frame of PITHIA-NRF project goal to provide effective and convenient access to the best European research facilities for observations of the upper atmosphere, including the plasmasphere, ionosphere and thermosphere. This access is organised through the Trans-National Access (TNA) programme, and it provides an opportunity for researcher and other users to execute and carry out their own projects at one of the PITHIA-NRF research facilities.

The call opens from 2 February 2025. It is an Open Call, and applications are handled as they arrive with typical evaluation times of 2 to 3 weeks. If accepted the projects can commence for organisation and realisation from mid-February 2025, with the extra condition that the final project report must be submitted at the latest by the end of May 2025. This call closes on 2 March 2025.

More information can be found on the PITHIA-NRF website: <https://pithia-nrf.eu/pithia-nrf-users/tna/tna-calls/eight-tna-call>



### 3. Review of solar and geomagnetic activity

WEEK 1257 from 2025 Jan 27

#### Solar Active Regions and flares

The solar flaring activity was at low to moderate levels throughout the week, with 40 C-class flares and 11 M-class flares observed. There were 14 active regions (ARs) observed on the visible solar disk. SIDC 368 (NOAA AR 3977), SIDC 388 (NOAA AR 3976) and SIDC 360 (NOAA AR 3978) produced most of the flaring activity. These regions rotated on disk at the start of the week and increased in size and magnetic complexity.

SIDC 391 (NOAA AR 3981) rotated on disk at the end of the week and produced several M-class flares. The largest flare was a M6.7-flare, with peak time 14:00 UTC on January 31 and was associated with SIDC 388 (NOAA AR 3976).

#### Coronal mass ejections

Throughout the week 3 Coronal Mass Ejections (CMEs) with an Earth directed component were observed. The first CME was observed in LASCO data at 13:25 UTC on the 28th of January and was associated with SIDC sunspot group 388 (NOAA Active Region 3976). This CME had a glancing blow arrival at Earth on January 30.

The second CME was observed in LASCO data at 16:12 UTC on the 30th of January and was associated with a filament eruption in the southeast quadrant of the Sun. A third CME was observed in LASCO data at 14:24 UTC on January 31 and was associated with an M6.7 flare.

## **Coronal Holes**

Returning SIDC Coronal Hole 82 (equatorial coronal hole with a positive polarity) and returning SIDC Coronal Hole 60 (mid-latitude coronal hole with a positive polarity) both crossed the central meridian between January 28 and February 01.

## **Proton flux levels**

The greater than 10 MeV GOES proton flux remained at nominal levels throughout the week.

## **Electron fluxes at GEO**

The greater than 2 MeV electron flux, as measured by the GOES-16 satellite, was below the 1000 pfu threshold level over the past week. The greater than 2 MeV electron flux, as measured by GOES-18, passed the 1000 pfu threshold during brief periods on January 26 and January 27.

## **Solar wind**

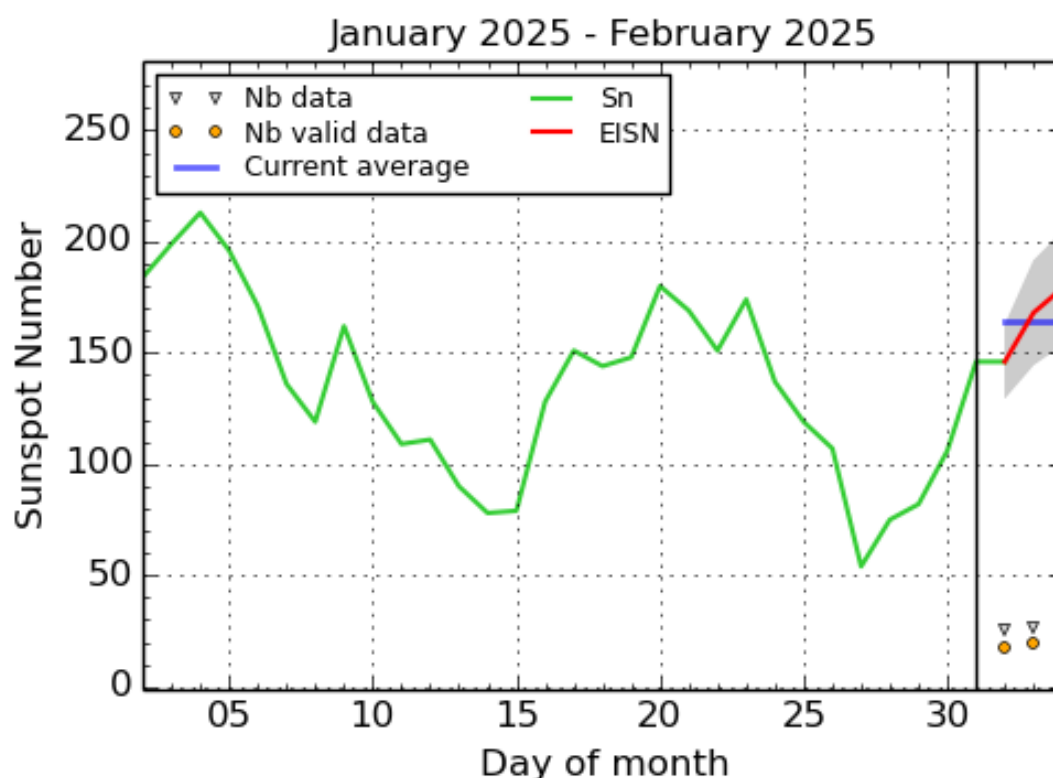
At the beginning of the week, the Earth was under a slow solar wind regime. The solar wind became disturbed with the arrival of an ICME on January 30, followed by the arrival of a high-speed stream on January 31. The solar wind speed ranged between 258 km/s and 712 km/s. The total interplanetary magnetic field ranged between 0.8 nT and 18 nT, with the Bz reaching a minimum of -16 nT.

## **Geomagnetism**

The geomagnetic conditions were globally and locally quiet to unsettled (Kp 1-3 and K BEL 1-3) at the start of the week and at the end of the week reached active conditions globally (Kp 4) and minor storm conditions locally (K BEL 5).



## 4. International Sunspot Number by SILSO



SILSO graphics (<http://sidc.be/silso>) Royal Observatory of Belgium, 2025 February 3

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. PROBA2 Observations

### Solar Activity

Solar flare activity fluctuated from low to moderate during the week.

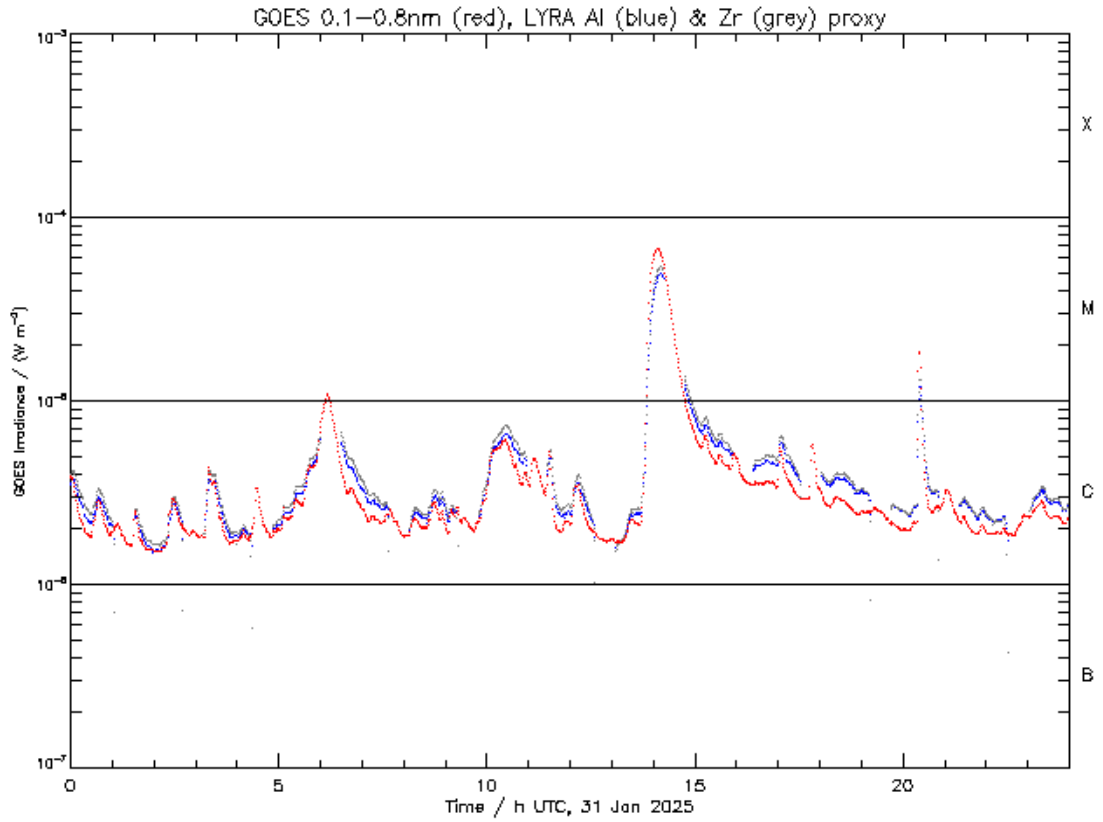
In order to view the activity of this week in more detail, we suggest to go to the following website from which all the daily (normal and difference) movies can be accessed: <https://proba2.oma.be/ssa>  
This page also lists the recorded flaring events.

A weekly overview movie (SWAP week 775) can be found here: [https://proba2.sidc.be/swap/data/mpg/movies/weekly\\_movies/weekly\\_movie\\_2025\\_01\\_27.mp4](https://proba2.sidc.be/swap/data/mpg/movies/weekly_movies/weekly_movie_2025_01_27.mp4).

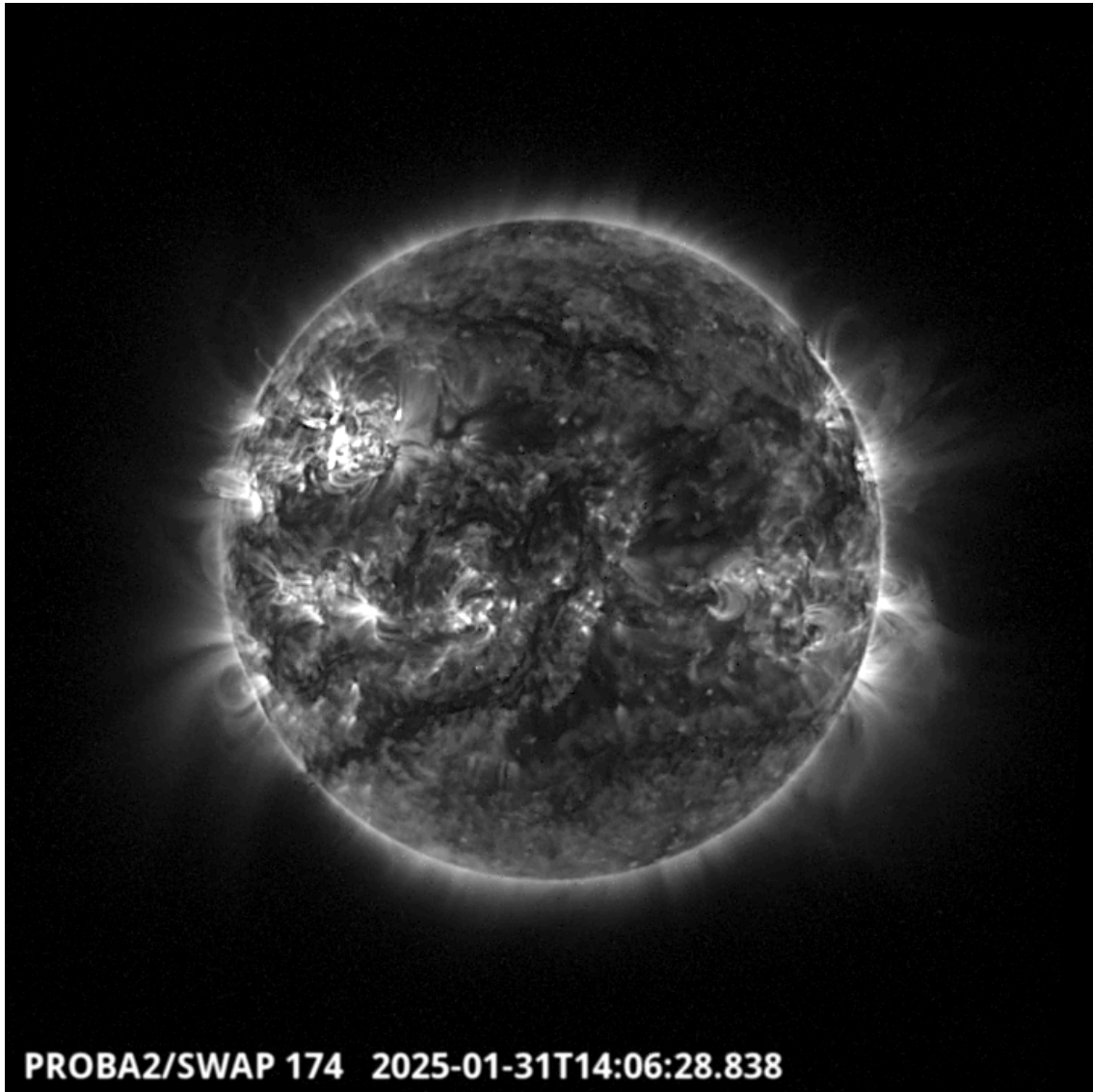
Details about some of this week's events can be found further below.

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/>.

## Friday January 31



ROB/SIDC, Brussels, Belgium



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 2025-Jan-31 at 14:06 UT. It occurred in the north-eastern quadrant of the Sun, originating from active region NOAA3978.

Find a SWAP movie of the event here: [https://proba2.sidc.be/swap/movies/20250131\\_swap\\_movie.mp4](https://proba2.sidc.be/swap/movies/20250131_swap_movie.mp4).

## 6. Noticeable Solar Events

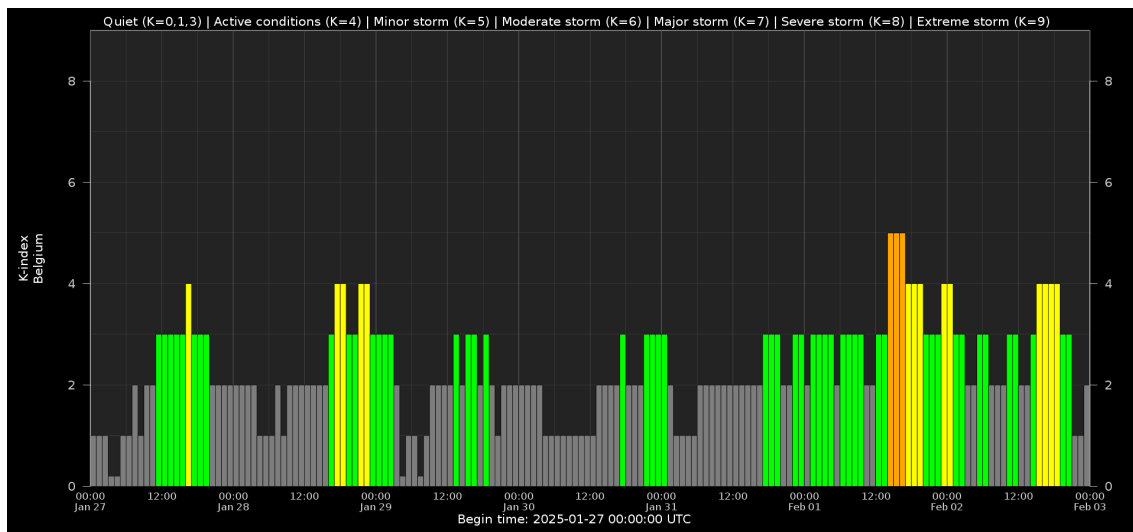
DAY	BEGIN	MAX	END	LOC	XRAY	OP	10CM	TYPE	Cat	NOAA
27	0752	0812	0833		M2.6					3976
28	1941	1945	1949		M1.7			III/1	21	3977
29	0336	0408	0421		M1.0			III/1	21	3977
31	0548	0610	0620		M1.0			III/2	20	3976
31	1340	1406	1425	N11E43	M6.7	1N		VI/2	22	3978
31	2014	2023	2028	N23E28	M1.8	SF		III/3	21	3977
01	1314	1319	1323		M2.4			II/2	21	3977

02	1001	1012	1021	M3.0	I/1 6	24	3981
02	1241	1250	1300	M1.4		24	3981
02	1358	1404	1408	M5.1	/3	21	3977
02	1508	1513	1517	M1.2		21	3977
02	1521	1533	1543	M2.7		24	3981
02	2309	2324	2342	M4.1		24	3981

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

## 7. Geomagnetic Observations in Belgium

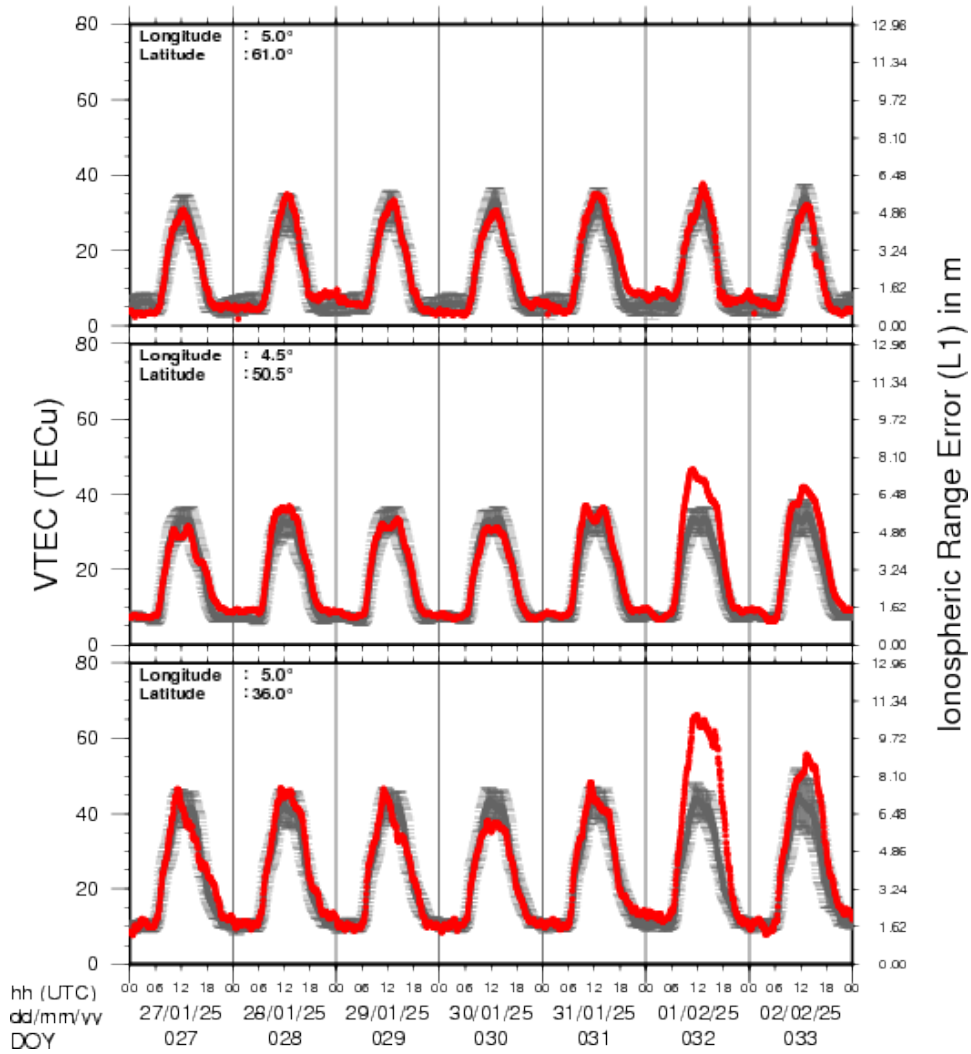


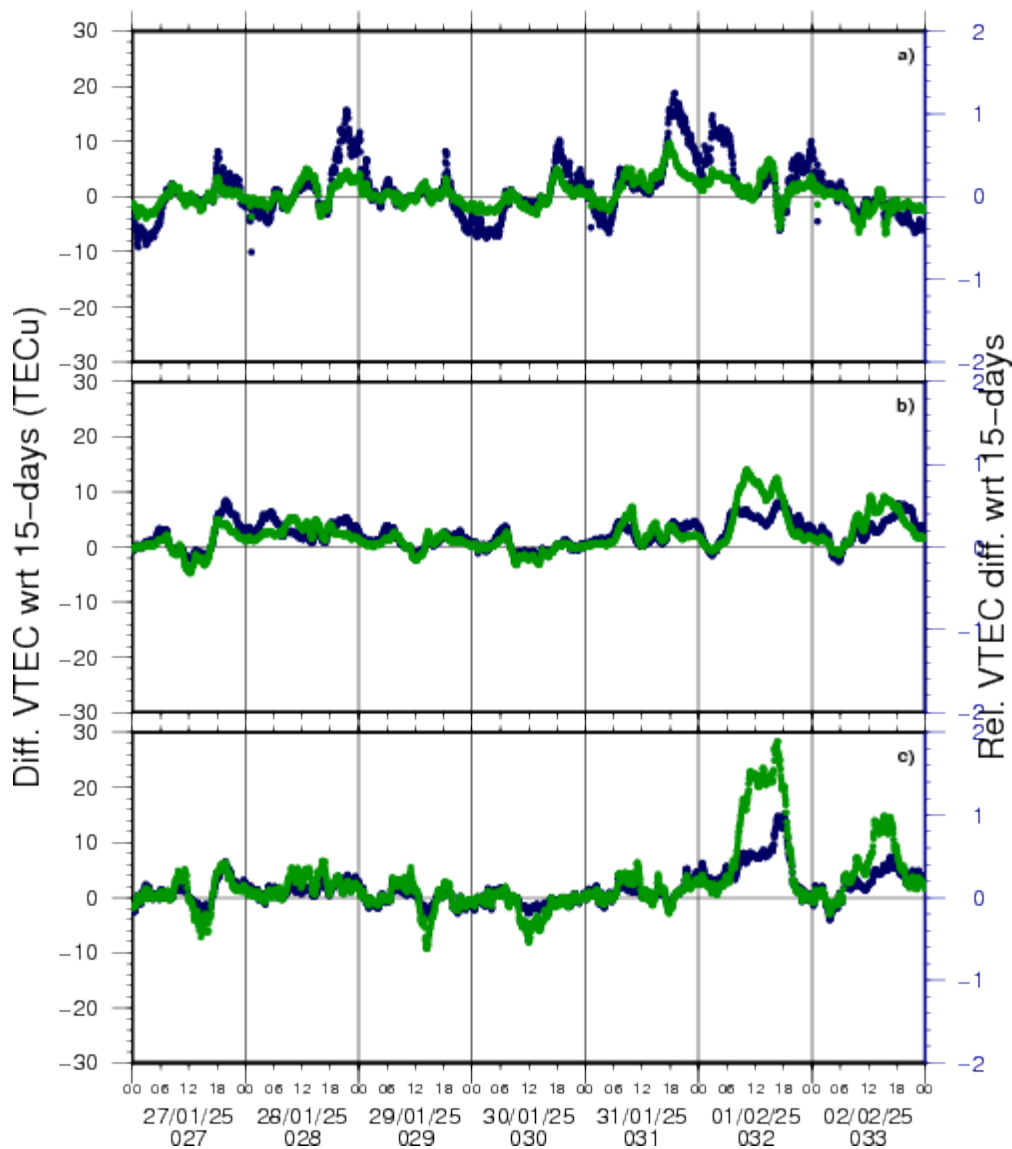
Local K-type magnetic activity index for Belgium based on data from Dourbes (DOU) and Manhay (MAB). Comparing the data from both measurement stations allows to reliably remove outliers from the magnetic data. At the same time the operational service availability is improved: whenever data from one observatory 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/](http://ionosphere.meteo.be/geomagnetism/K_BEL/)

## 8. Review of Ionospheric Activity

### VTEC Time Series





VTEC time series at 3 locations in Europe from 27 Jan 2025 till 2 Feb 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  $1\text{TECu}=10^{16}$  electrons per square meter) and is directly related to the signal propagation delay due to the ionosphere (in figure: delay on GPS L1 frequency).

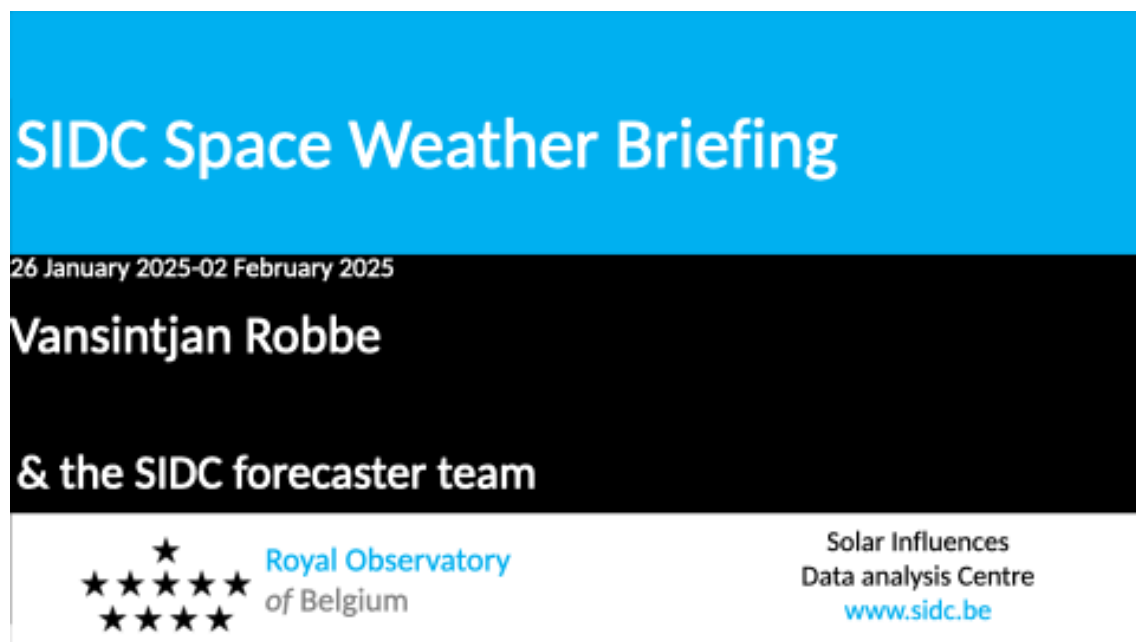
The Sun's radiation ionizes the Earth's upper atmosphere, the ionosphere, located from about 60km to 1000km above the Earth's surface. The ionization process in the ionosphere produces ions and free electrons. These electrons perturb the propagation of the GNSS (Global Navigation Satellite System) signals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

See [http://stce.be/newsletter/GNSS\\_final.pdf](http://stce.be/newsletter/GNSS_final.pdf) for some more explanations; for more information, see <https://gnss.be/SpaceWeather>

## 9. The SIDC Space Weather Briefing

The forecaster on duty presented the SIDC briefing that gives an overview of space weather from January 27 to February 2.

The pdf of the presentation can be found here: [https://www.stce.be/briefings/20250203\\_SWbriefing.pdf](https://www.stce.be/briefings/20250203_SWbriefing.pdf)



## 10. Upcoming Activities

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.

\* 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](mailto:stce_coordination@stce.be) at [stce.be](https://www.stce.be)



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