

STCE Newsletter

31 Mar 2025 - 6 Apr 2025



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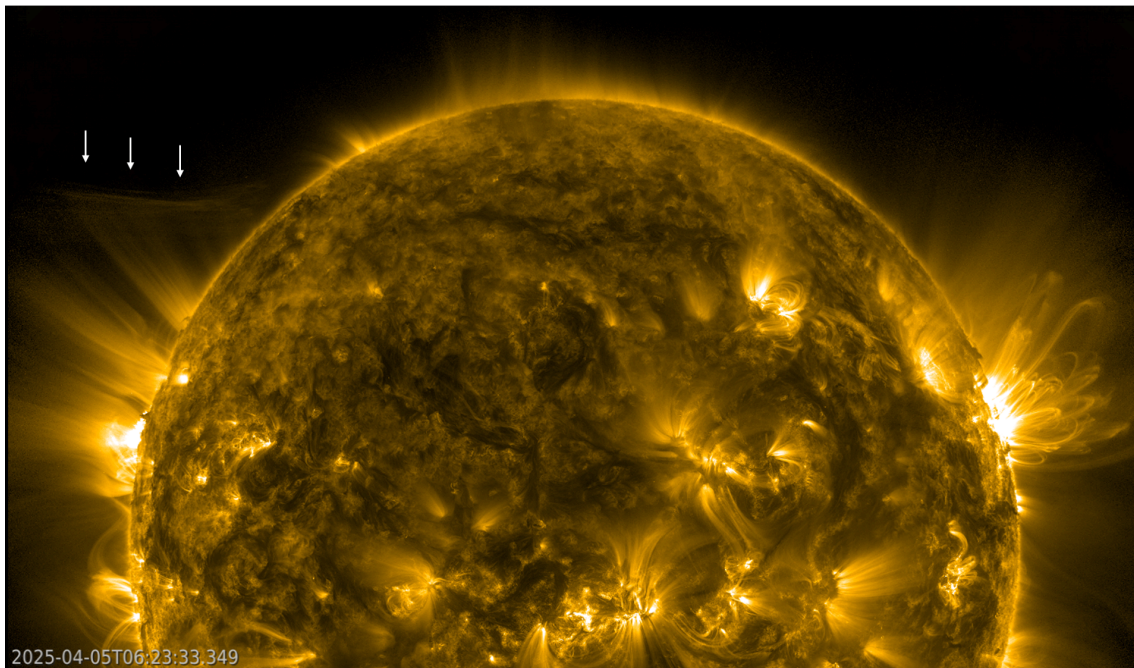
The Solar-Terrestrial Centre of Excellence (STCE) is a collaborative network of the Belgian Institute for Space Aeronomy, the Royal Observatory of Belgium and the Royal Meteorological Institute of Belgium.

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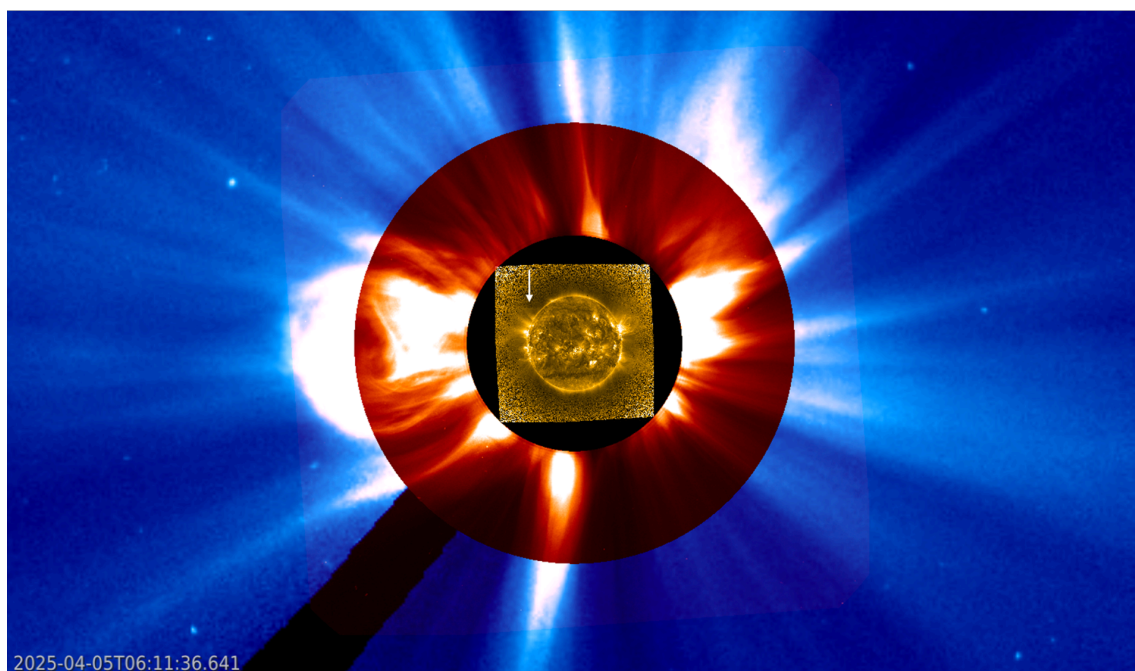
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1. Far side solar eruptions

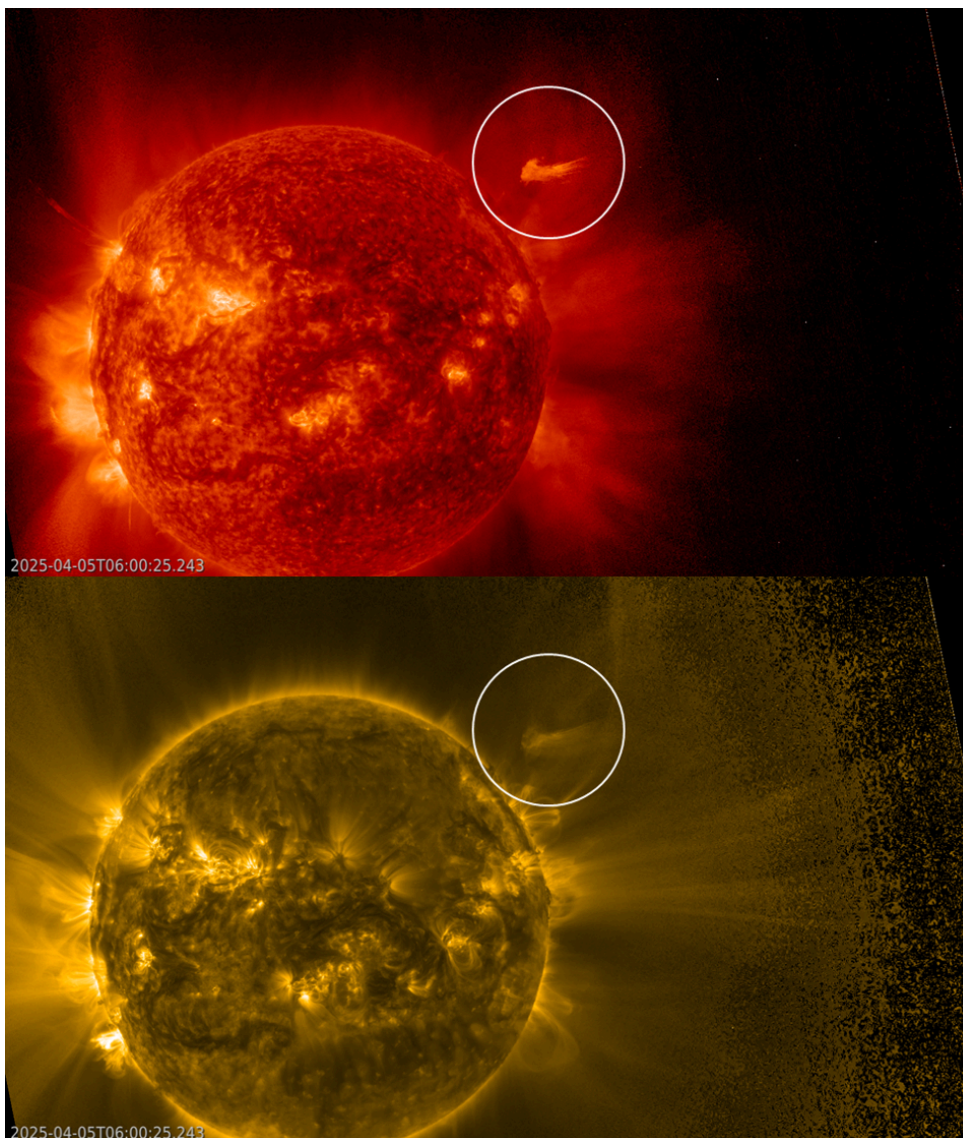
Coronagraphic images from SOHO revealed a partial halo coronal mass ejection (CME with a width greater than 120 degrees) leaving the Sun on 5 April. Closer examination by the SIDC space weather forecaster (<https://www.sidc.be/>) revealed this eruption had a far side origin, with no obvious signatures of the eruption on the Sun's earth-facing side. The SDO imagery underneath shows the Sun at temperatures of 700.000 degrees (AIA 171). Around 04:00UTC on 5 April, it shows a violent eruption in the solar outer atmosphere (the "corona") near its east limb, followed about an hour later by an apparently much slower eruption with -as seen from Earth- a horizontal, wide slab of plasma gradually moving northward starting from around 45 degrees north (see annotated image underneath). The post-eruption coronal loops appear about an hour later, from a location about halfway between the first eruption and the lift-off of the second eruption. Clips of the eruptions are available in the online version of this STCE newsitem at <https://www.stce.be/news/760/welcome.html>



That there are at least 2 CMEs at work seems also evident from the SOHO/LASCO coronagraphic imagery. The main CME is directed to the east and related to the first, rather violent eruption. It's becoming first visible at 04:12UTC in LASCO C2 imagery and has a plane-of-the-sky speed near 400 km/s. The second CME has a fuzzier outline and becomes visible around 08:00UTC. Related to the much slower eruption, it has a plane-of-the-sky speed near 250 km/s and is directed to the north-north-east. In the annotated imagery underneath, the wide-field EUV image obtained by PROBA2/SWAP has been overlaid on the coronagraphic images by SOHO/LASCO. SWAP's off-disk corona has been enhanced.



One of the possible scenarios is that the first, more violent eruption destabilized the magnetic environment of a filament, that subsequently got ejected into space. STEREO-A is preceding the Earth by 32 degrees, while Solar Orbiter was located - as seen from Earth- 12 degrees beyond the west limb, so there's basically a blank area of 78 degrees in longitude that is not covered by any of the satellites capable of EUV-imaging, precisely the area of our current interest. Nonetheless, the first image available from Solar Orbiter for 5 April shows a plasma feature over the northwest limb -as seen from SoLO- around 06:00UTC (upper image SoLO/FSI 304, lower image SoLO/FSI 174; both off-disk enhanced). This is very likely corresponding to the wide slab of plasma as observed by e.g. SDO and PROBA2 around that time. The first eruption took indeed place almost on the opposite side of the Sun as seen from SoLO, and so most of the features seen around 06:00UTC are likely related to the second eruption. Note the different shapes of the feature are due to line-of-sight effects. As further SoLO/EUI images become available in the coming days, it may become clearer what happened on the Sun's far side early on 5 April.



2. ESWW2025 - call for abstracts and live space weather forecasts

The European Space Weather Week is an annual space weather conference in Europe and is being organised since 2004. It has evolved to an event where the content is mainly defined by space weather stakeholders and the community.

Recently, the sessions have been defined and now, they are open for contributions.

During the week, space weather service centres are also invited to present their space weather forecast.

Info on how to submit an abstract for a contribution to a session or a live space weather forecast can be found on the website: <https://esww.eu>

List of the sessions

Parallel: Space Weather Research (SWR), Community-Driven (CD), Open (OPS), Application PipeLine (APL)

SWR1 - Magnetic sources of Space Weather Across Solar Atmospheric Layers. Conveners: Paolo PAGANO; Clementina SASSO; Ioannis KONTOGIANNIS; Hanna STRECKER

SWR2 - Interdisciplinary Insights into Space Weather Events of Solar Cycle 25: From Solar Origins to Planetary Impacts. Conveners: Karmen Martinic; Manuella Temmer; Guram Kervalishvili; Rute Santos

SWR3 - Inner Magnetospheric Dynamics and Coupling Processes. Conveners: Ravindra DESAI; Sarah Glauert; Adnane Osmane; Alex Lozinski

SWR4 - Interactions in the Earth's Magnetosphere-Ionosphere-Thermosphere System and their Space Weather Impact. Conveners: Daria KOTOVA; Lucilla ALFONSI; Guram KERVALISHVILI; Alan WOOD

SWR5 - Space Climate. Conveners: Claudio CORTI; Kalevi MURSULA; Barbara PERRI; Ilya USOSKIN

CD1 - Combination of physics-based and data-driven methods for space weather forecasting. Conveners: Sabrina GUASTAVINO; Dario DEL MORO; Filipa S. BARROS

CD2 - All about the solar wind. Conveners: Stephan G. HEINEMANN, Eleanna ASVESTARI

CD3 - Refining the Sunspot Number Series : challenges and benefits for the Space Climate Community. Conveners: Theodosios Chatzistergos, Laure Lefèvre, Ilya Usoskin

CD4 - Space Weather Impacts on Transportation Systems. Conveners: Cameron PATTERSON; Juliane HÜBERT; David BOTELER; Magnus WIK

CD5 - Open Validation in Space Weather Modeling. Conveners: Martin REISS; Barbara PERRI; Karin MUGLACH; Evangelia SAMARA

CD6 - Radiation for exploration beyond LEO. Conveners: Giovanni SANTIN; Aiko NAGAMATSU; Thomas BERGER

CD7 - Space weather at unmagnetized or weakly magnetized solar system objects. Conveners: Gabriella STENBERG WIESER; Sofia BERGMAN; Charlotte GOETZ

CD8 - The Vigil Mission: Advancing Space Weather Operations and Science. Conveners: Matthew West; Jeffrey Newmark; Steph Yardley; Hannah Schunker

CD9 - Communicating Science Through Aurora: Engaging the Public in Space Weather. Conveners: Lenka ZYCHOVA; Christine VERBEKE; Laure LEFEVRE

OPS - Open parallel session. Conveners: Adur Pastor Yabar, Kseniia Golubenko, David Themens, Anna Morozova

APL1 - Space Weather Services and Alerts for End-Users: Bridging Forecasting, Infrastructure, and Communication. Conveners: Judith DE PATOUL; Francois-Xavier BOCQUET; Mpho TSHISAPHUNGO; Kasper VAN DAM

APL2 - Bridging the Gap: Reproducibility, Deployment, Operation, Updates, and Monitoring of Machine Learning-Based Solar Flare Forecast Models. Conveners: Shane Maloney; Sophie Murray; Paul Wright; Anna Massone

Plenary (P)

P1 - Space Weather Challenges in the Arctic: A Round Table Discussion. Conveners: Magnus Wik; Andrew Dimmock

P2 - Space Weather at the Moon, Mars, and Beyond: Recent Advancements, Observations, and Future Opportunities for Exploration. Conveners: Gina DIBRACCIO; Beatriz SANCHEZ-CANO; Fabrice CIPRIANI



3. Review of space weather

Solar Active Regions (ARs) and flares

Solar flaring activity went from high, moderate, low and picked up again to moderate by the end of the week.

Fifteen numbered active regions were observed on the visible solar disk. SIDC Sunspot Group 461 (NOAA Active Region 4048) was the largest and most complex region. It had first a beta-gamma-delta configuration and simplified to beta-gamma. This region was the primary driver of the flaring activity and produced eight out of the nine M-class flares this week. The largest flare from this region was an M2.5 flare (SIDC Flare 4005), peaking at 22:31 UTC on April 1. The largest flare overall was an M5.6 flare (SIDC Flare 3994), peaking at 06:46 UTC on April 1, and was associated with SIDC Sunspot Group 459 (NOAA Active Region 4046; beta-gamma).

Coronal mass ejections

No Earth-directed coronal mass ejections (CMEs) were detected in the available coronagraph images.

Coronal Holes

A returning low-latitude negative polarity coronal hole (SIDC Coronal Hole 99) began to cross the central meridian on April 01. The associated high-speed stream arrived at Earth late on April 03.

Proton flux levels

The greater than 10 MeV GOES proton flux exceeded the 10 pfu threshold early in the week, reaching a maximum of 147 pfu as measured by GOES-18 at 04:25 UTC on April 1.

The proton flux decreased below the 10 pfu threshold by 08:30 UTC on April 2, remaining slightly elevated for the rest of the week.

Electron fluxes at GEO

The greater than 2-MeV electron flux, as measured by the GOES-18 satellite, exceeded the 1000 pfu threshold on multiple occasions at the start and the end of the week.

The 24-hour electron fluence remained normal to moderate.

Solar wind

At the beginning of the week, solar wind parameters reflected the arrival of two interplanetary coronal mass ejections (ICMEs). The first ICME arrived at 10:16 UTC on March 31, marked by a sudden increase in solar wind speed (from about 420 km/s to 445 km/s) and a jump in the interplanetary magnetic field from 8 nT to 11 nT. The second ICME arrived at 17:29 UTC on April 1, causing further enhancements in the magnetic field and solar wind parameters. These ICMEs are possibly associated with CMEs that lifted off the Sun on March 28 at 15:24 UTC and March 27 at 04:23 UTC, respectively.

Solar wind parameters became slightly disturbed again from late on April 3, due to the arrival of a high-speed stream from a negative polarity coronal hole (SIDC Coronal Hole 99). The interplanetary magnetic field reached values up to 15 nT, and the solar wind speed increased to values about 750 km/s. The southward component of the interplanetary magnetic field fluctuated between -11 nT and +10 nT. Solar wind conditions remained slightly elevated through the end of the week under the continued influence of the high-speed stream.

Geomagnetism

At the start of the week, geomagnetic conditions were quiet to unsettled both globally and locally over Belgium. Active levels were reached globally (NOAA Kp: 4;4+) on April 2-3, likely due to an ICME arrival. Late on April 3, minor storm periods were observed both globally and locally (NOAA Kp: 5-; K-Bel: 5), associated with the onset of a high-speed stream. On April 5, conditions briefly reached moderate storm levels globally (Kp: 6-), while minor storm levels (K-Bel: 5) were observed locally.

4. Noticeable Solar Events

DAY	BEGIN	MAX	END	LOC	XRAY	OP	10CM	TYPE	Cat	NOAA
31	1016	1024	1037		M1.2					4048
01	0637	0646	0653		M5.6					4046
01	2218	2231	2241		M2.5					4048
05	1954	2005	2012		M1.0				19	4048

LOC: approximate heliographic location

XRAY: X-ray flare class

OP: optical flare class

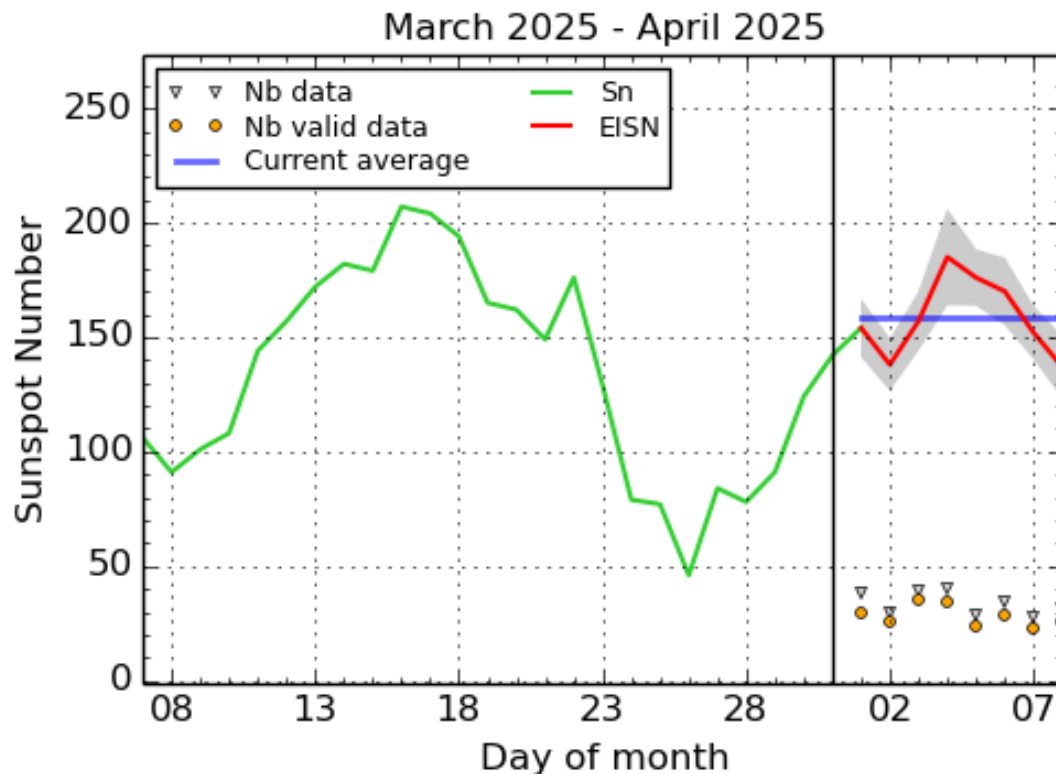
10CM: peak 10 cm radio flux

TYPE: radio burst type

Cat: Catania sunspot group number

NOAA: NOAA active region number

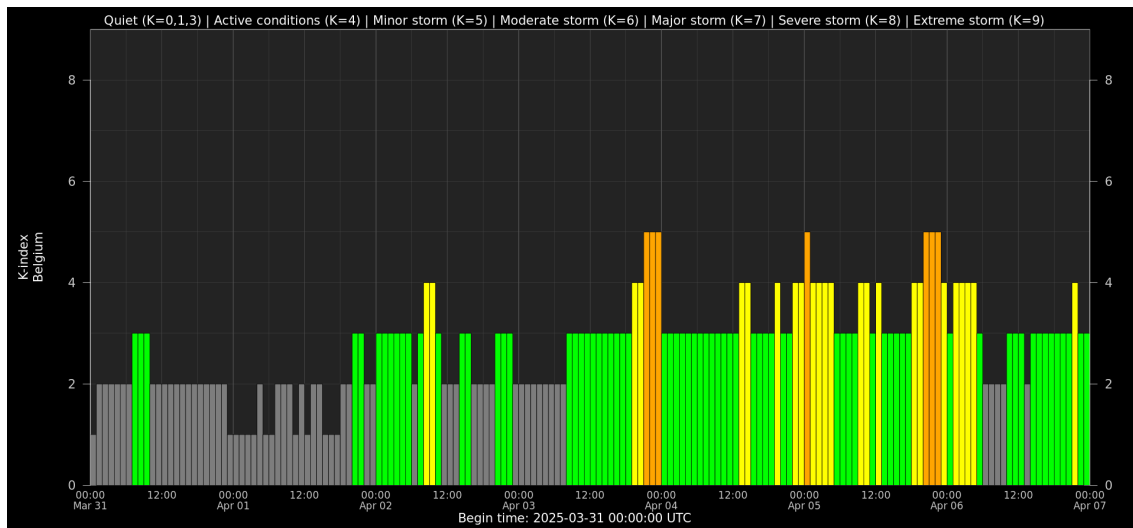
5. International Sunspot Number by SILSO



SILSO graphics (<http://sidc.be/silso>) Royal Observatory of Belgium, 2025 April 8

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.

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. PROBA2 Observations

Solar Activity

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

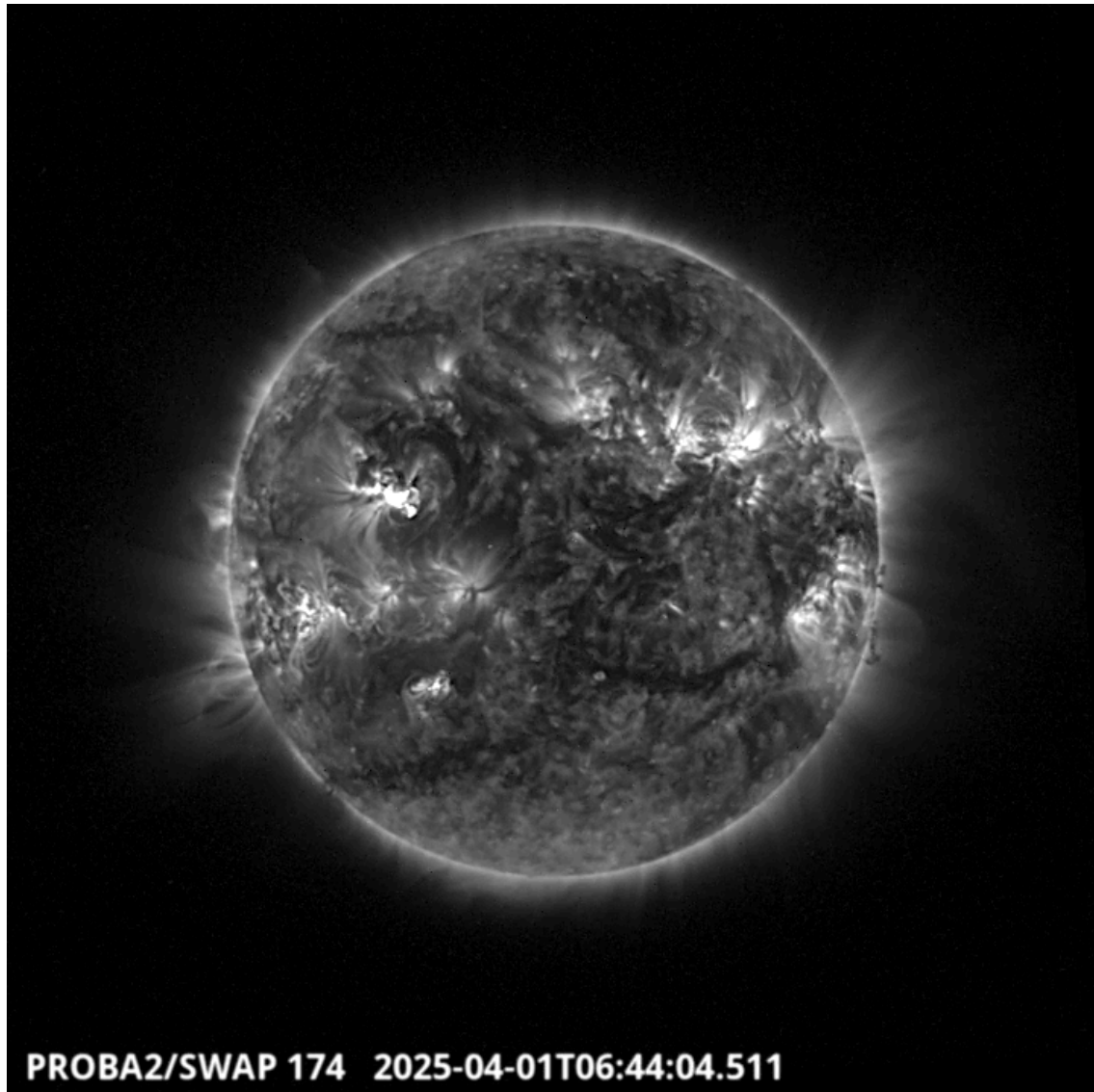
In order to view the activity of this week in more detail, we suggest to go to the following website from which all the daily (normal and difference) movies can be accessed: <https://proba2.oma.be/ssa>
This page also lists the recorded flaring events.

A weekly overview movie can be found here (SWAP week 784). http://proba2.oma.be/swap/data/mpg/movies/weekly_movies/weekly_movie_2025_03_31.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.sidc.be/swap/data/mpg/movies/>

Tuesday Apr 01



The largest flare of the week, a M5.6 peaking around 6:44 UT, has been produced by the active region NOAA 4046 located on the North-East part of the solar disk. Find a SWAP movie of the event here. https://proba2.sidc.be/swap/movies/20250401_swap_movie.mp4

8. The SIDC space weather briefing

The forecaster on duty presented the SIDC briefing that gives an overview of space weather from March 30 to April 6 .

The pdf of the presentation: https://www.stce.be/briefings/20250407_SWbriefing.pdf

SIDC Space Weather Briefing

30 March-06 April 2025

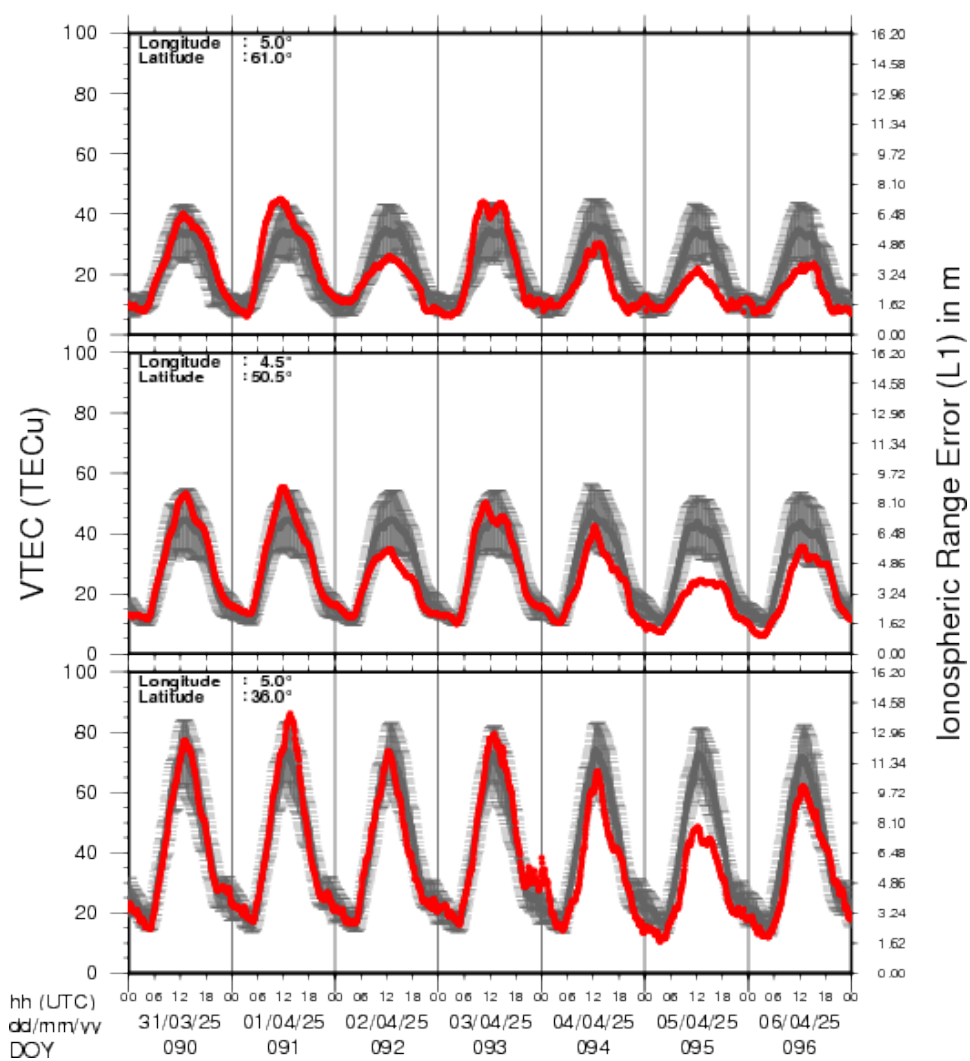
Daria Shukhobodskaia
& the SIDC forecaster team

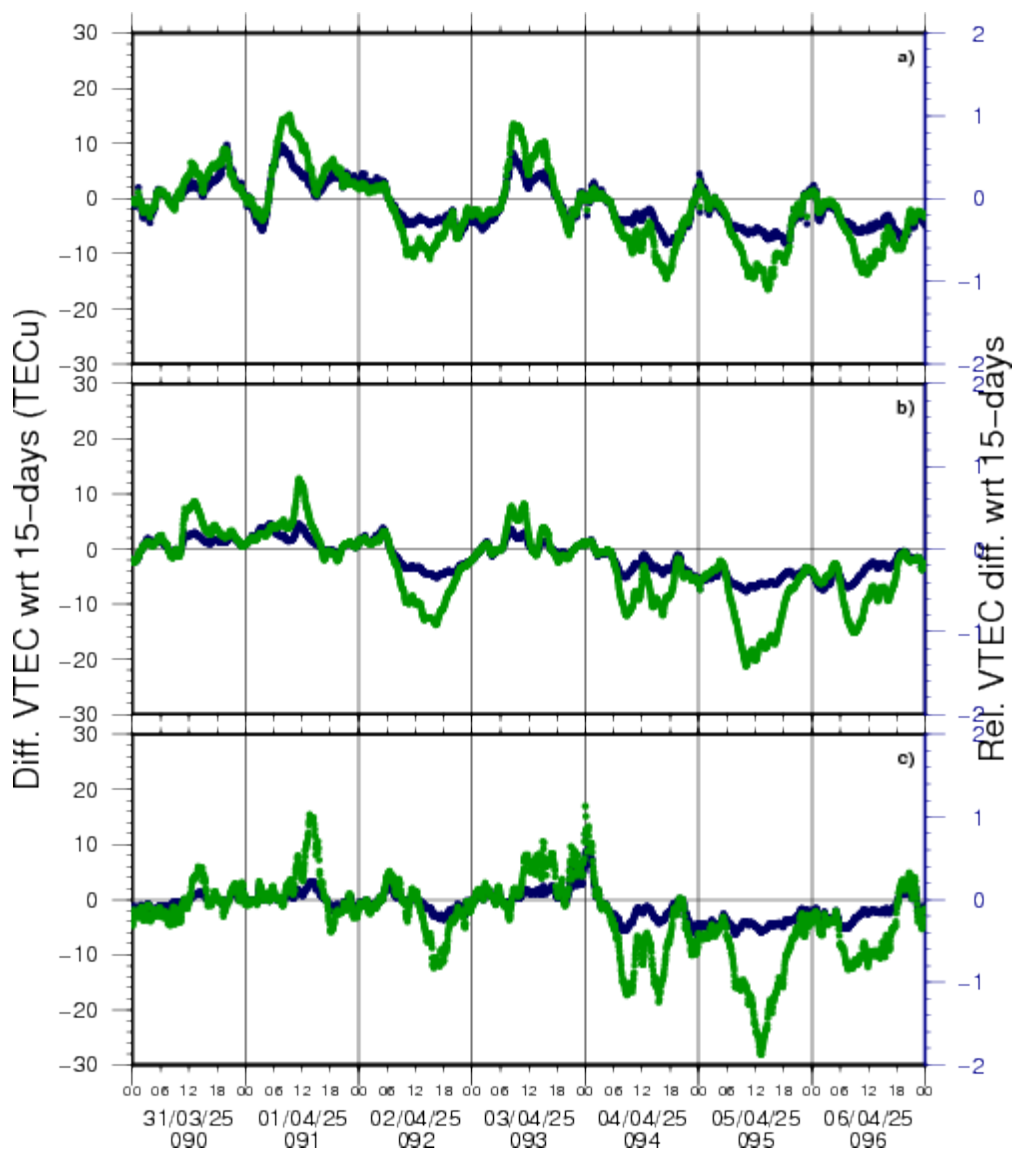


Solar Influences
Data analysis Centre
www.sidc.be

9. Review of Ionospheric Activity

VTEC Time Series





VTEC time series at 3 locations in Europe from 31 Mar 2025 till 6 Apr 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 $\text{TECu} = 10^{16}$ 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 for some more explanations; for more information, see <https://gnss.be/SpaceWeather>

10. Courses, seminars, events

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.

* 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 7-9, STCE stand: Dichtbij de Zon, Nerdland Festival, Wachtebeke, Belgium, <https://www.nerdlandfestival.be/nl/>

* Jun 20, 2025, STCE seminar: The Vigil mission to L5

* 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](mailto:stce_coordination@stce.be)



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