

STCE Newsletter

7 Apr 2025 - 13 Apr 2025



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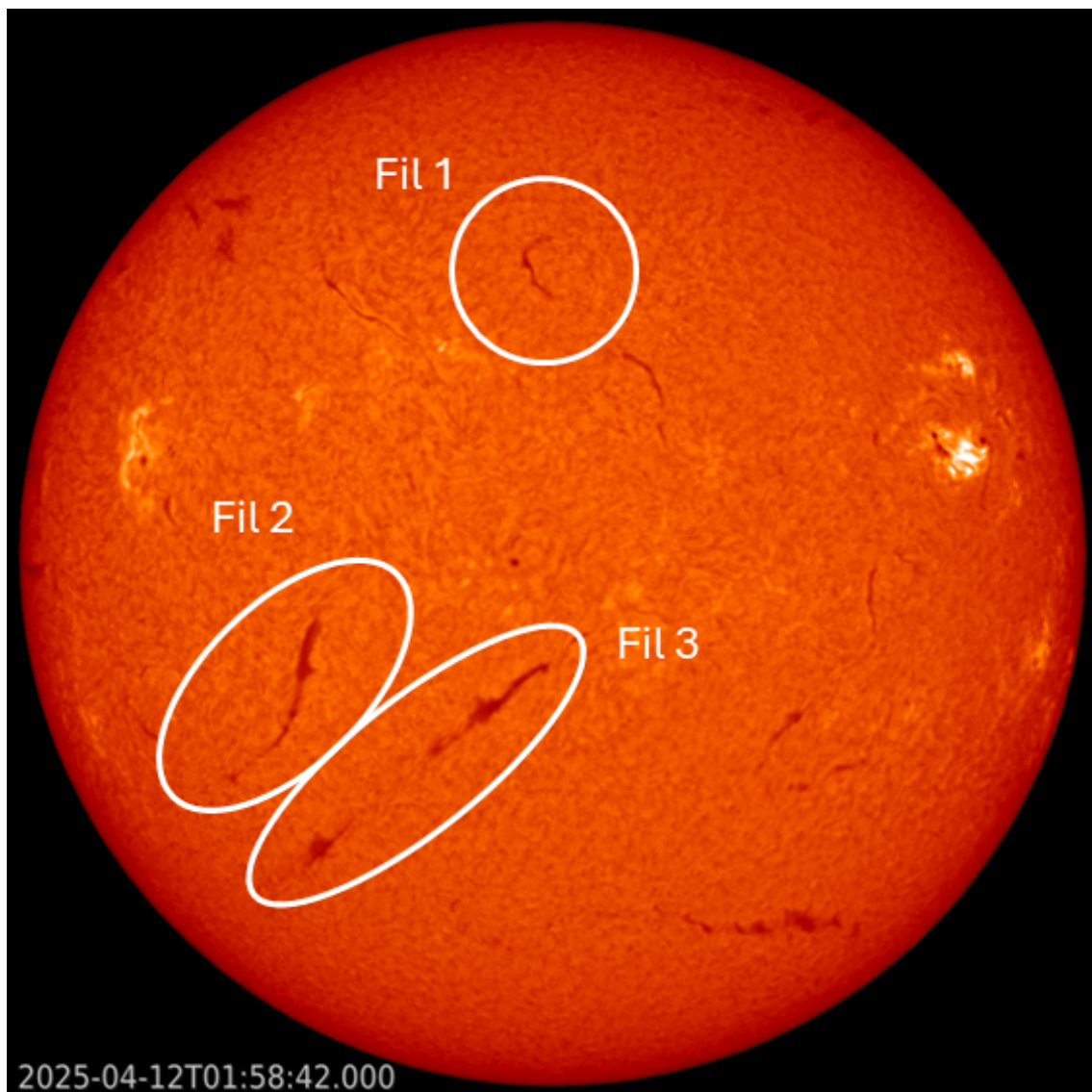
The Solar-Terrestrial Centre of Excellence (STCE) is a collaborative network of the Belgian Institute for Space Aeronomy, the Royal Observatory of Belgium and the Royal Meteorological Institute of Belgium.

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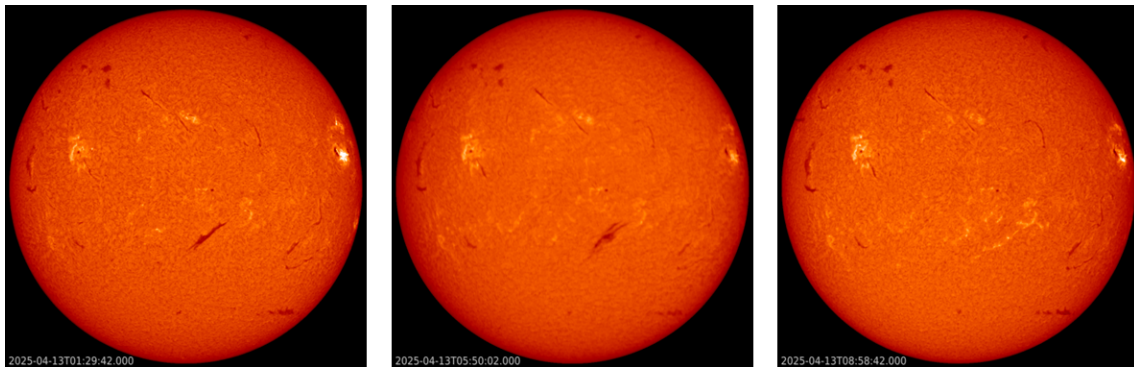
1. Filament eruptions

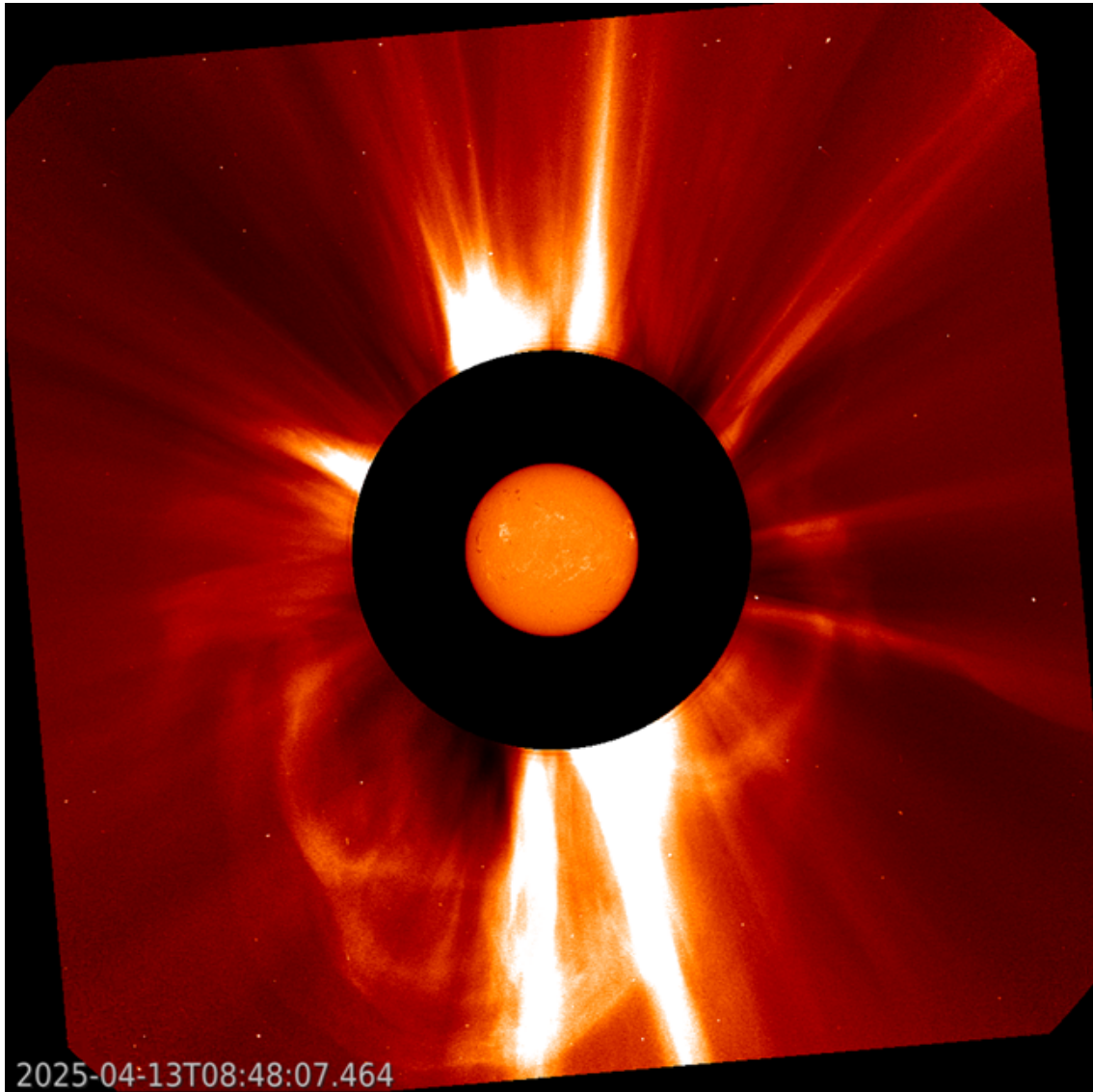
Solar prominences are clouds of charged particles ("plasma") above the solar surface squeezed between regions of opposite magnetic polarity. Being cooler and denser than the plasma underneath and their surroundings, they appear as bright blobs when seen near the solar limb and as dark lines when seen on the solar disk (then they are called "filaments"). Special filters are required to observe these features, such as in the Hydrogen-alpha (H-alpha) line in the red part of the solar spectrum (656.28 nm), or in some extreme ultraviolet (EUV) passbands such as GOES/SUVI 195. Filaments are structures that only survive by the stability of the surrounding magnetic fields. Hence, longer filaments (from about 20 degrees in length onwards) are prone to erupt. Indeed, as the magnetic regions suspending the filament may become unstable, the filament can erupt and throw a cloud of ionized particles towards the Earth where it can cause geomagnetic disturbances. These eruptions are more likely to occur as the filament grows longer, typically around 200,000 km. Such long filaments usually develop outside sunspot groups.



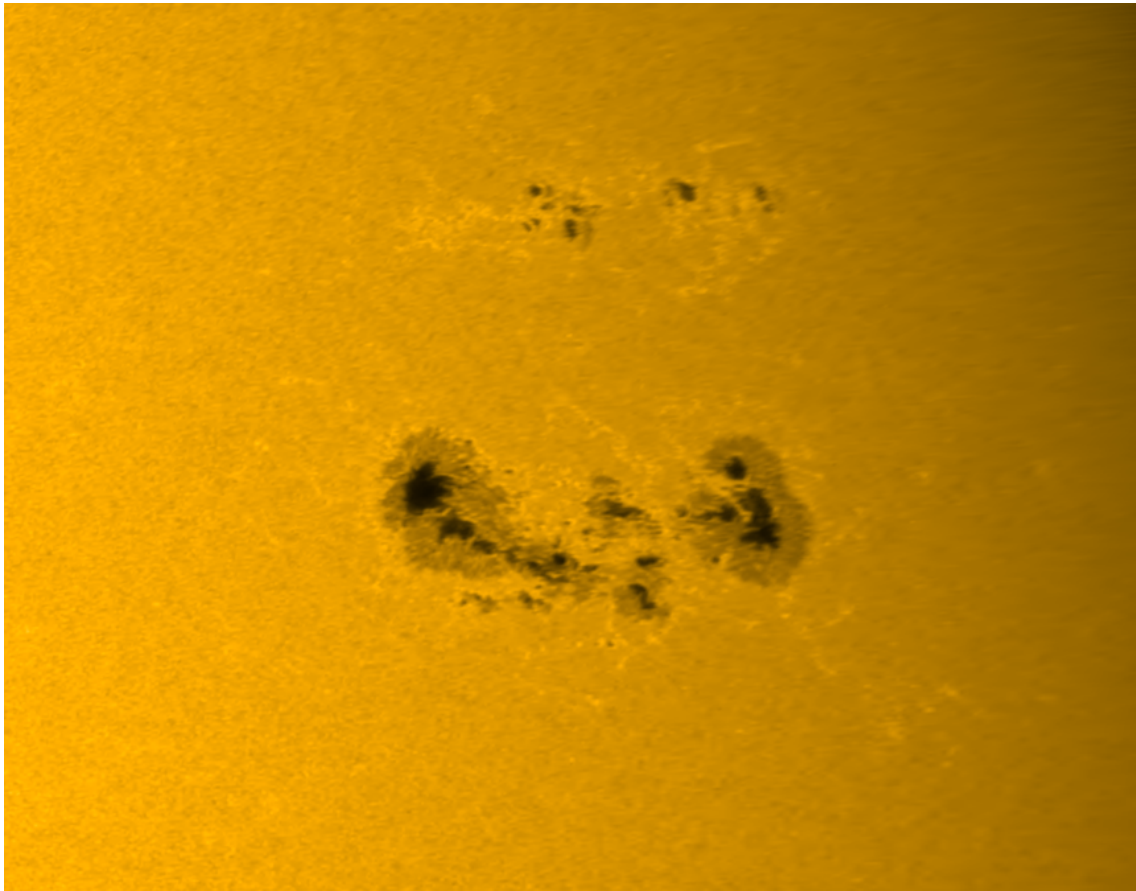
Last week, several filaments were visible in H-alpha (GONG). On 12 and 13 April, three of these filaments erupted. The smallest filament ("Fil 1" in the annotated H-alpha image above) was about 10 degrees in length and located in the northern hemisphere near the central meridian. It was the first to erupt around

11:00UTC on 12 April. The associated coronal mass ejection (CME) was narrow and directed to the north. It was quickly followed by the quiet dissipation of the southern half of a 50-degree (= more than half a million km!) long filament ("Fil 3") in the southern solar hemisphere. No obvious CME seems to have been associated with this event. Between 21:00 and 23:30UTC, another filament ("Fil 2") erupted, as shown in the H-alpha imagery underneath. It was 20 degrees in length and located to the east ("left") of the very long filament. This eruption was associated with a slow partial halo CME that was thought to have an earth-directed component. The best was saved for last, with the violent eruption of the remainder of "Fil 3" early on 13 April, between about 04:30 and 07:00UTC. It was associated with a fast partial halo CME, as shown in the combined GONG/H-alpha and SOHO/LASCO C2 coronagraphic imagery. The SIDC (<http://www.sidc.be/index.php>) space weather forecaster expects the combined arrival of these CMEs for 15 or 16 April. The online clip is available at <https://www.stce.be/news/761/welcome.html> and also shows a comet disintegrating as it approached the Sun from the southeast between 14:00 and 19:00UTC on 12 April.





As a bonus, the imagery also shows an active region close to the west limb. This is active region NOAA 4055 which started its development on 9 April, and started to produce M-class flares from late 11 April onwards. By noon on 14 April, NOAA 4055 had already been the source of 21 M-class flares, the strongest being an M4.2 flare peaking at 06:50UTC on 14 April. NOAA 4055 is also, together with NOAA 3961, the largest sunspot group to have appeared so far this year, about 5 times the total surface area of the Earth. The SDO/HMI still underneath shows this active region in white light on 13 April.



2. Solar Orbiter Workshop at the STCE

On 8, 9 and 10 April 2025, the EUI team welcomed 85 leading solar physicists, in person and online, to participate in an international workshop on the future of the ESA/NASA Solar Orbiter mission.



Through presentations and group discussions, the science of three instruments (EUI, Metis and SPICE) was reviewed in detail. A special session was held on the future science operations of the whole mission as its orbit is shifting out of the ecliptic and, for the first time ever, images of the solar poles will be taken.

Since 2020, Solar Orbiter observes the Sun at a distance that, at some moments, is within the orbit of Mercury. The Observatory manages EUI, the Extreme Ultraviolet Imager, which is one of the cornerstone instruments onboard Solar orbiter. EUI's solar images of unprecedented resolution revolutionise the understanding of our star.

More information on the Solar Orbiter Workshop: <https://sites.google.com/view/swt40/home>

More information on EUI: <https://www.sidc.be/EUI/intro>

3. Review of Solar and Geomagnetic Activity

WEEK 1267 from 2025 Apr 07

Solar Active Regions and flares

The solar flaring activity started at low levels and increased to high levels by the end of the week. A total of 20 active regions (ARs) were numbered on the visible solar disk with SIDC Sunspot Group 461 (NOAA Active Region 4048) and SIDC Sunspot Group 469 (NOAA Active Region 4055) being the most notable. These regions were the largest and most complex ones (classified as magnetic type beta-gamma-delta) contributing to most of the flaring activity throughout the week. The strongest activity registered was an M2.7 flare, SIDC flare 4099, with peak time 11:45 UTC on April 12, produced by SIDC Sunspot Group 469.

Coronal mass ejections

Multiple filaments were observed throughout the week with two major eruptions, resulting in coronal dimmings and Earth-directed coronal mass ejections (CMEs). A wide, slow, south-eastward CME was observed in the LASCO/C2 imagery around 23:36 UTC on April 12. The CME had a projected velocity around 300 km/s and is associated with a long filament crossing the central meridian to the east of the disk center, which erupted around 23:00 UTC on April 12. A faster partial halo CME with estimated

projected velocity around 550 km/s was observed in the LASCO/C2 data starting at 07:12 UTC on April 13. The CME is related to a neighbouring filament eruption to the south of SIDC Sunspot Group 398 (NOAA Active Region 4056). Both CMEs are expected to arrive at Earth in a combined shock arrival in the upcoming week.

Coronal Holes

Three negative polarity and two small and compact positive-polarity coronal holes crossed the central meridian throughout the week. High speed streams related to the negative polarity coronal holes were detected at Earth throughout the week.

Proton flux levels

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

Electron fluxes at GEO

The greater than 2 MeV electron flux as measured by GOES 18 was above the 1000 pfu threshold for prolonged periods throughout the entire week. The corresponding electron fluence started at high levels and reduced to moderate levels for the rest of the week.

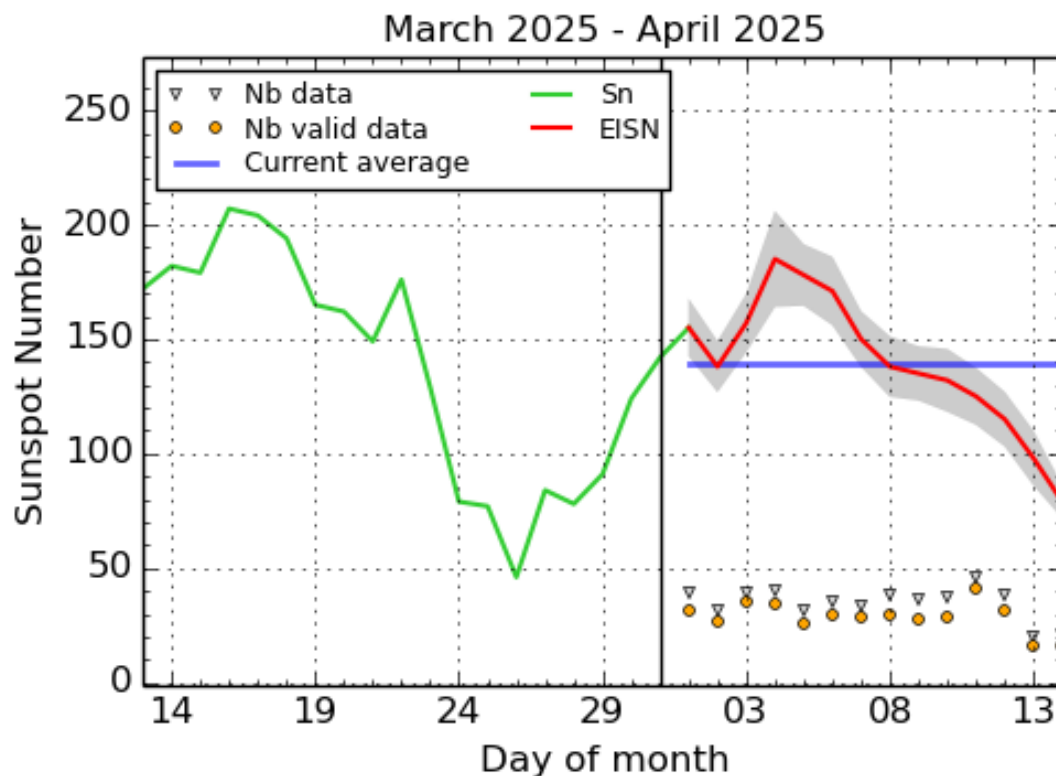
Solar wind

The solar wind conditions throughout the week reflected several high speed stream (HSS) arrivals. The magnitude of the interplanetary magnetic field (B) reached a maximum value of 11.5 nT with a minimum Bz of -11.3 nT. The B field phi angle was predominantly in the negative sector (directed towards the Sun) throughout the entire week reflecting the polarity of the geo-effective coronal holes. The solar wind speed varied in the range of 358 km/s to 724 km/s.

Geomagnetism

The geomagnetic conditions throughout the week varied between quiet and minor storm levels. Locally over Belgium, mostly quiet to active conditions were observed with a short isolated minor storm level registered late on April 08.

4. International Sunspot Number by SILSO



SILSO graphics (<http://sidc.be/silso>) Royal Observatory of Belgium, 2025 April 14

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.

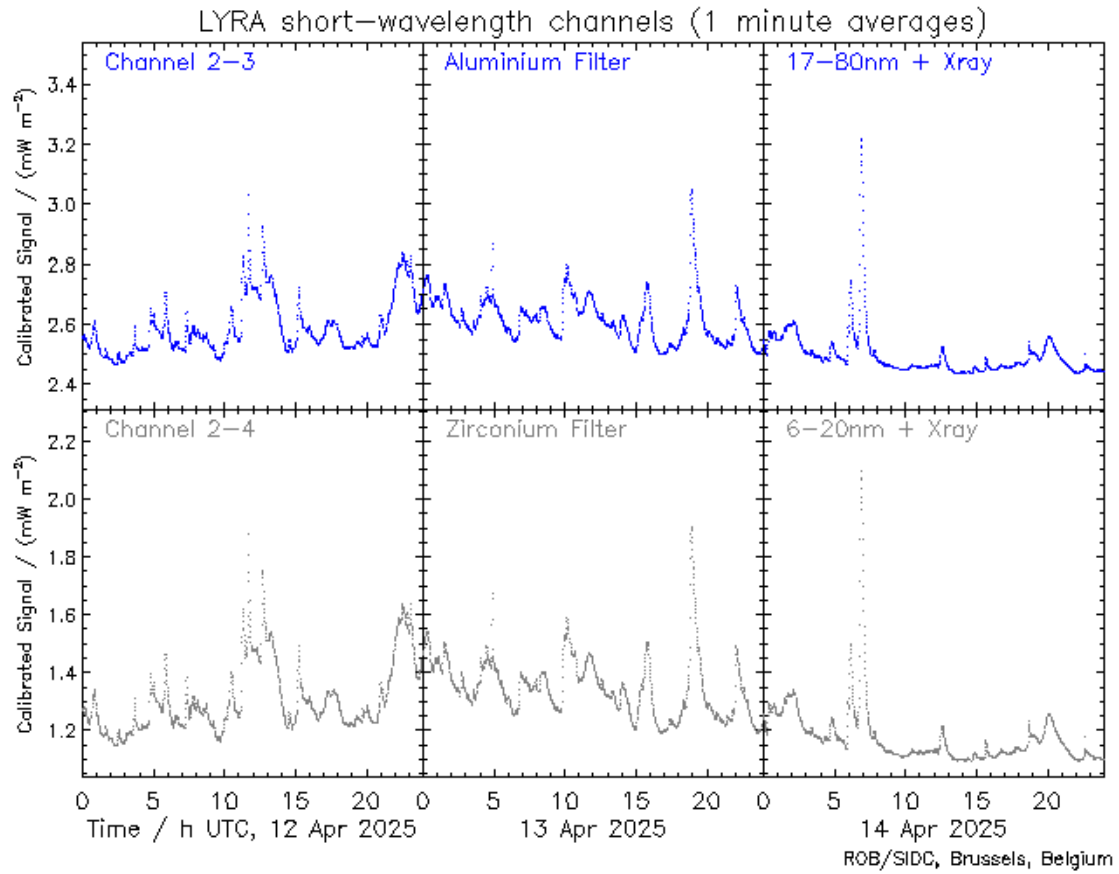
In order to view the activity of this week in more detail, we suggest to go to the following website from which all the daily (normal and difference) movies can be accessed: <https://proba2.oma.be/ssa>
This page also lists the recorded flaring events.

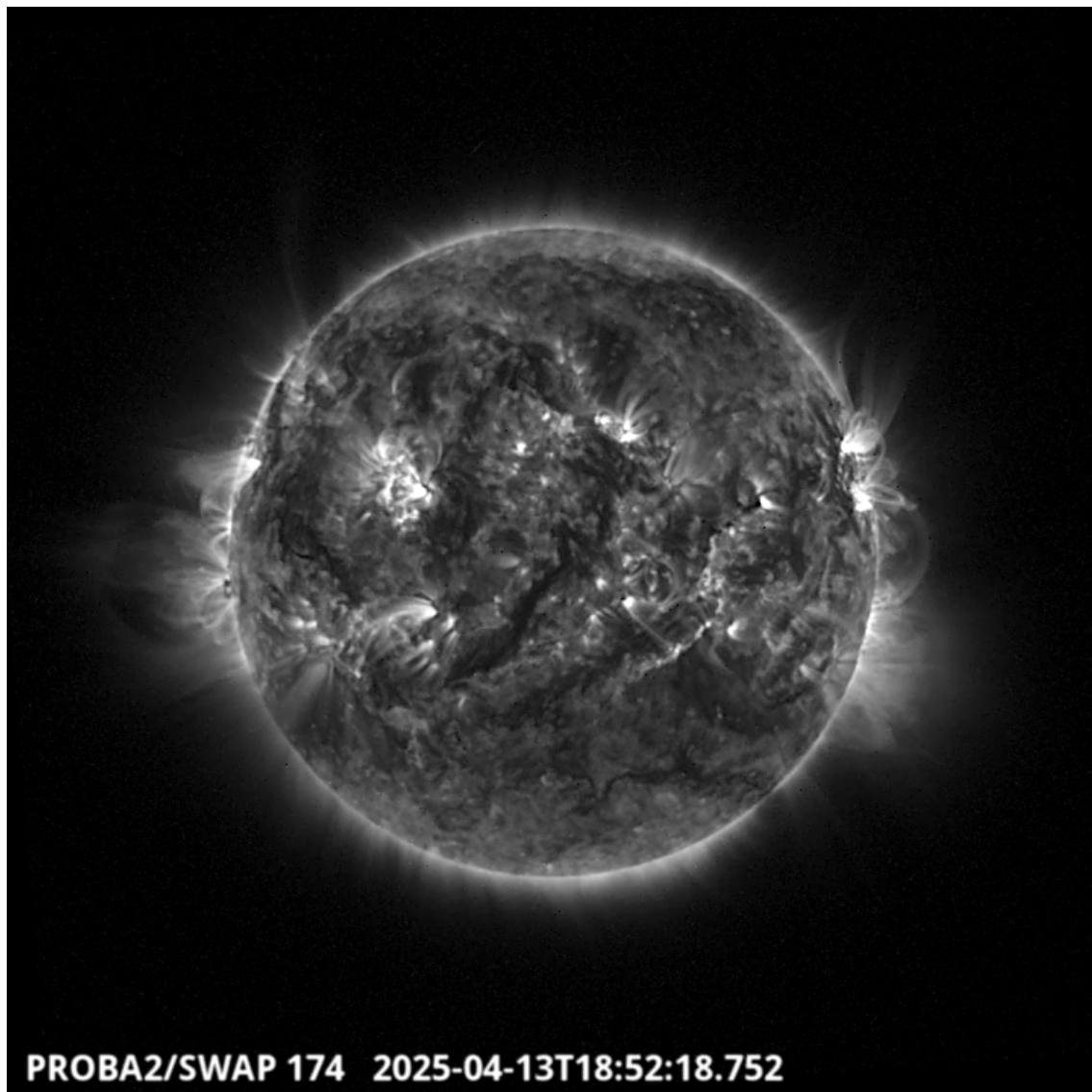
A weekly overview movie (SWAP week 785) can be found here: https://proba2.sidc.be/swap/data/mpg/movies/weekly_movies/weekly_movie_2025_04_07.mp4.

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/>.

Sunday April 13





The largest flare of this week was an M3.2, and it was observed by LYRA (top panel) and SWAP (bottom panel). The flare peaked on 2025-Apr-13 at 18:51 UT and occurred at the western limb of the Sun, originating from active region NOAA4055.

Find a SWAP movie of the event here: https://proba2.sidc.be/swap/movies/20250413_swap_movie.mp4.

6. Noticeable Solar Events

DAY	BEGIN	MAX	END	LOC	XRAY	OP	10CM	TYPE	Cat	NOAA
08	2208	2222	2236	S15W52	M1.5	1B			19	4048
11	1640	1650	1701		M1.0				26	4055
11	2208	2220	2233	N7W50	M1.0	SF			26	4055
12	0441	0445	0455		M1.1				26	4055
12	0536	0549	0555	N5W57	M1.2	SF			26	4055
12	0711	0719	0722	N6W56	M1.0	SF			26	4055
12	1105	1117	1125		M2.0				26	4055

12	1135	1143	1145		M2.7			26	4055
12	1233	1240	1252		M2.3			26	4055
12	1500	1512	1519	N7W61	M1.3	SF		26	4055
13	0121	0129	0137		M1.0			26	4055
13	0401	0405	0425		M1.1			26	4055
13	0425	0428	0431		M1.1			26	4055
13	0448	0452	0454	N7W69	M2.3	SF		26	4055
13	0638	0652	0721	N7W67	M1.0	S	III/1	26	4055
13	0943	0955	1003	N6W73	M1.4	1		26	4055
13	1003	1007	1010		M1.2			26	4055
13	1528	1542	1556		M1.2			26	4055
13	1838	1851	1900		M3.2			26	4055
13	2155	2202	2211	N9W77	M1.6	1F		26	4055

LOC: approximate heliographic location

XRAY: X-ray flare class

OP: optical flare class

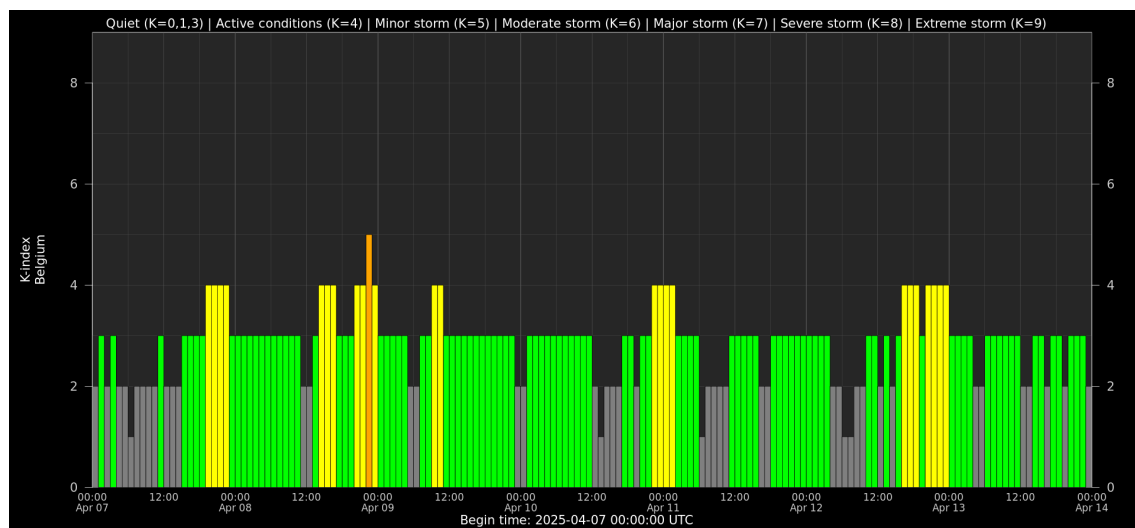
10CM: peak 10 cm radio flux

TYPE: radio burst type

Cat: Catania sunspot group number

NOAA: NOAA active region number

7. Geomagnetic Observations in Belgium

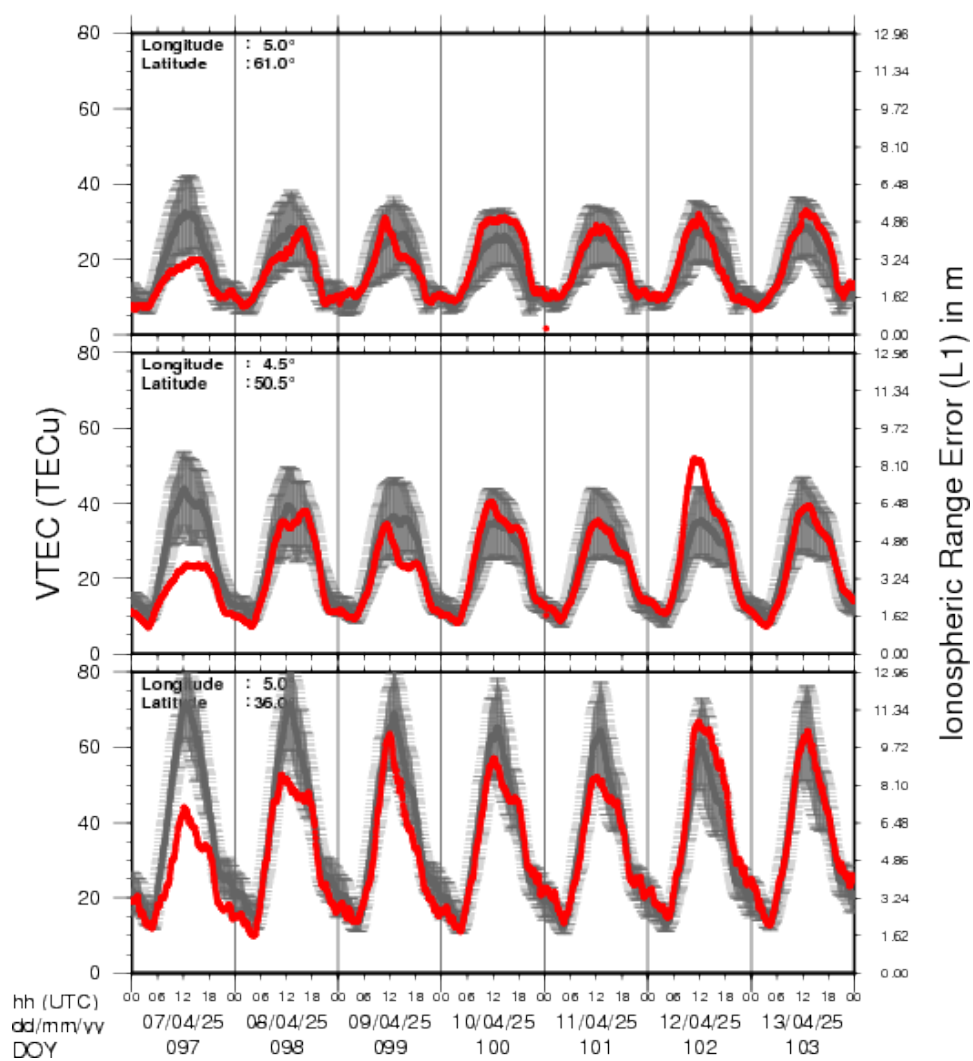


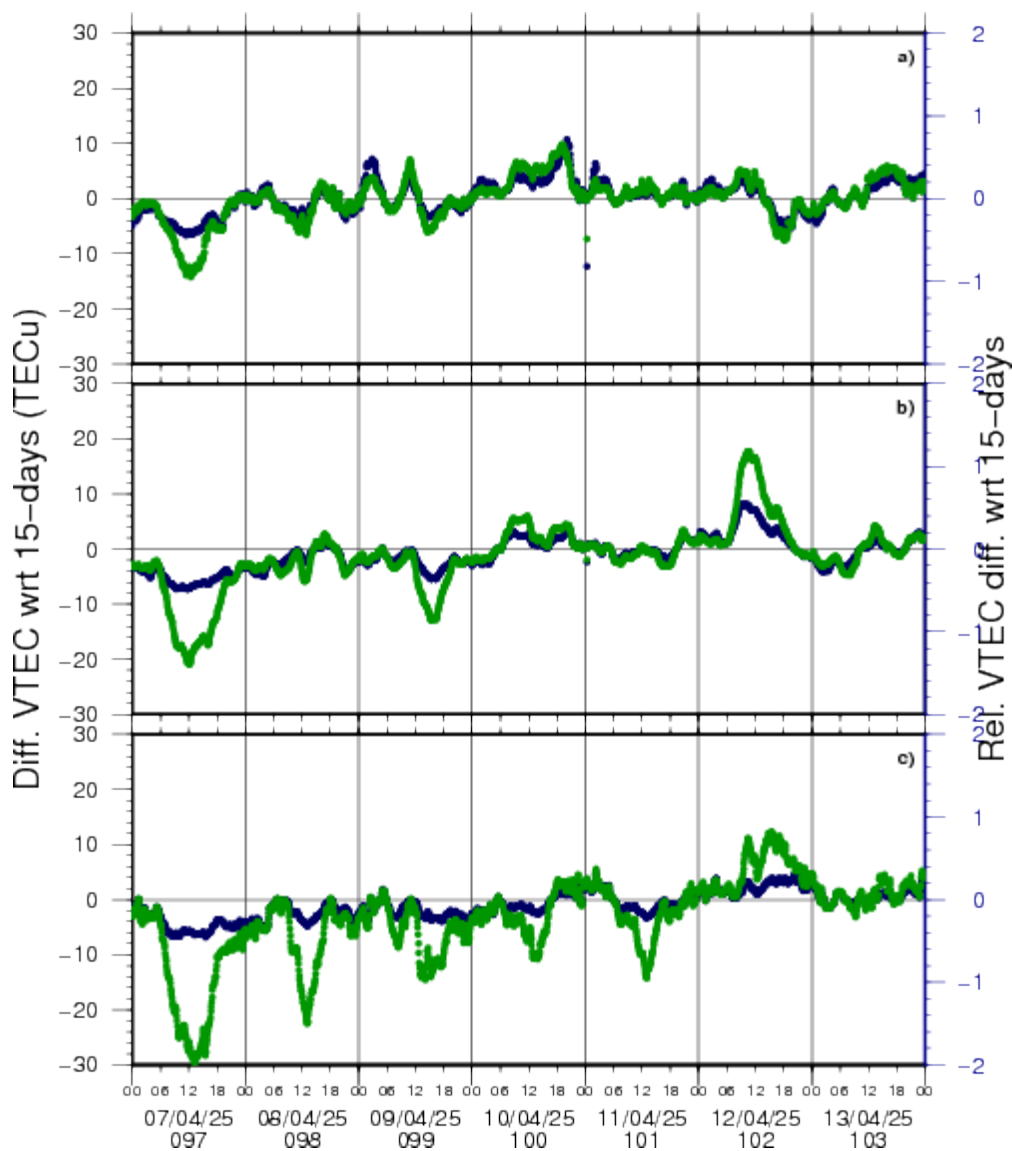
Local K-type magnetic activity index for Belgium based on data from Dourbes (DOU) and Manhay (MAB). Comparing the data from both measurement stations allows to reliably remove outliers from the magnetic data. At the same time the operational service availability is improved: whenever data from one observatory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

8. Review of Ionospheric Activity

VTEC Time Series





VTEC time series at 3 locations in Europe from 7 Apr 2025 till 13 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).

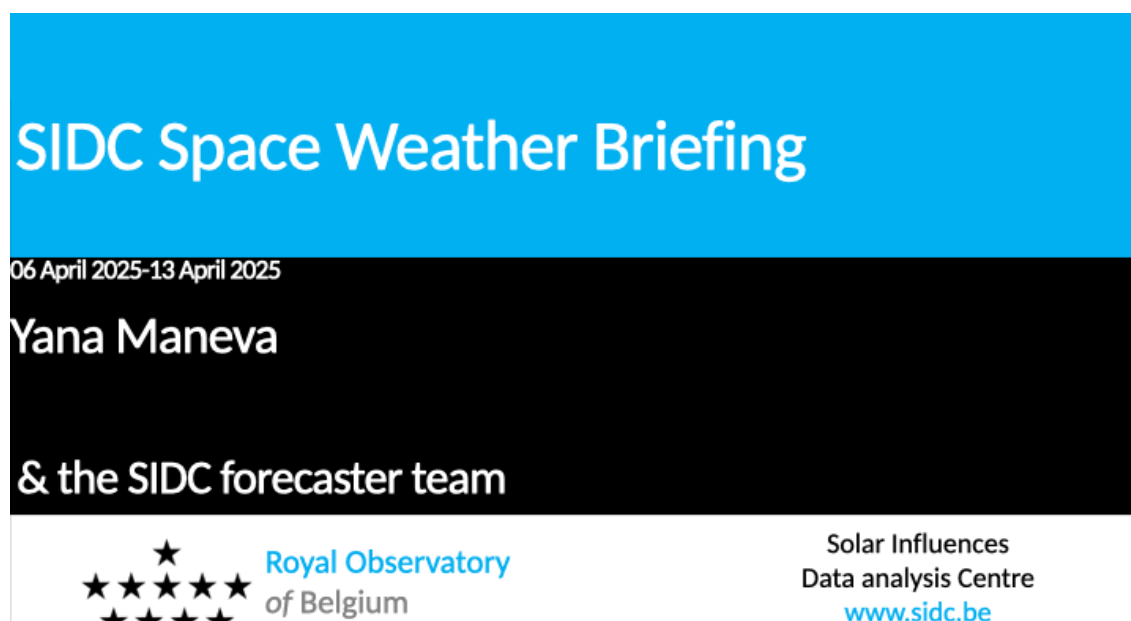
The Sun's radiation ionizes the Earth's upper atmosphere, the ionosphere, located from about 60km to 1000km above the Earth's surface. The ionization process in the ionosphere produces ions and free electrons. These electrons perturb the propagation of the GNSS (Global Navigation Satellite System) signals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

9. The SIDC Space Weather Briefing

The forecaster on duty presented the SIDC briefing that gives an overview of space weather from April 6 to 13.

The pdf of the presentation can be found here: https://www.stce.be/briefings/20250414_SWbriefing.pdf



10. STCE 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.

- * April 25, STCE Seminar: Space weather research in Defense and possible collaborations, <https://www.stce.be/content/stce-seminar-space-weather-research-defense-and-possible-collaborations>
- * 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>