STCE Newsletter

27 Apr 2026 - 3 May 2026

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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.

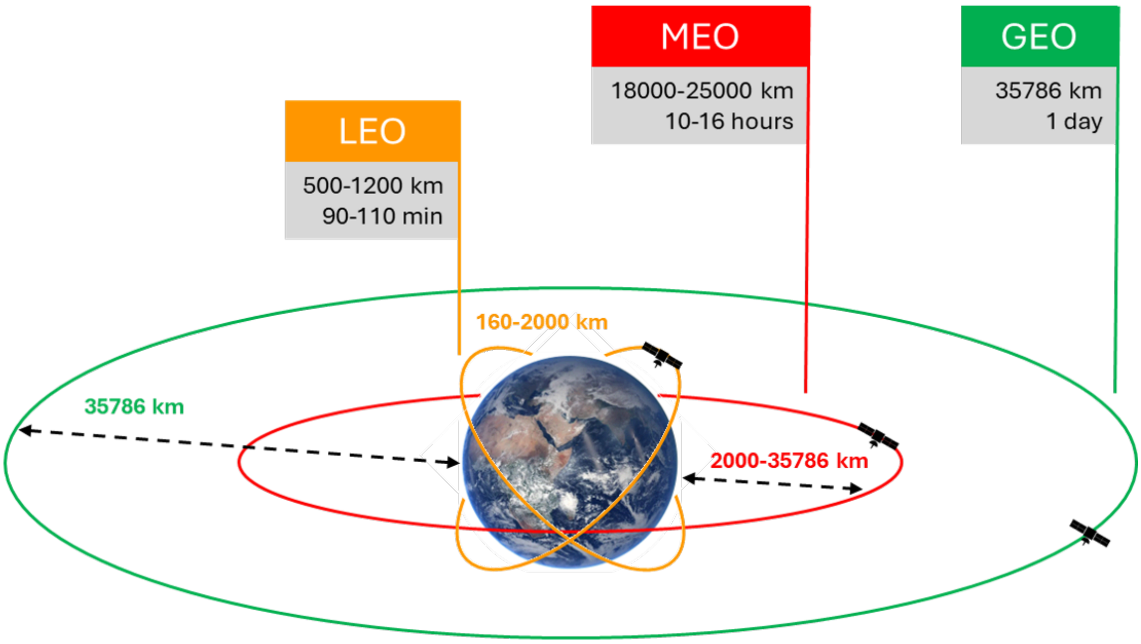
Final Editor : Petra Vanlommel
Contact : R. Van der Linden, General Coordinator STCE, Ringlaan - 3 - Avenue Circulaire, 1180 Brussels, Belgium

1. What floats around, comes around

Recent statistics from e.g. ESA (annual Space Environment Report ; https://www.esa.int/Space_Safety/Space_Debris/ESA_Space_Environment_Report_2025) have shown that there are more than 30.0000 tracked objects in a Low Earth Orbit (LEO), and that this number is quickly growing. LEO is a region of space close to Earth typically ranging from 160 to 2000 km in altitude, with the majority of the LEO satellites located between 500 and 1200 km.

These boundaries are very specific. Below an altitude of about 160 km, the density of the Earth's atmosphere quickly increases. As a result, the atmospheric friction with the satellite results in unrecoverable drag effects and eventually the burn-up of the satellite in the atmosphere. Above an altitude of about 2000 km, the satellite would be exposed to the effects of the inner radiation belt where the presence of highly energetic particles poses a direct threat to the satellite's electronics. The sketch underneath shows typical parameters for the 3 main orbits: Low Earth Orbit (LEO), Medium Earth Orbit (MEO), and Geostationary Orbit (GEO). This sketch is not to scale, and the radiation belts have been omitted for clarity.

So, the room for satellites in LEO is not infinite. In fact, a study by Bongers and Torres (2023 - https://doi.org/10.1016/j.ecolecon.2023.107831) indicated there's room for about 72.000 satellites in outer space, before the Kessler Syndrome might kick in. The Kessler Syndrome is a theoretical, cascading scenario where the density of space debris in LEO becomes so high that collisions between objects cause a chain reaction, generating even more debris and making space operations nearly impossible (Kessler and Cour-Pailais ; 1978 , https://doi.org/10.1029/JA083iA06p02637).

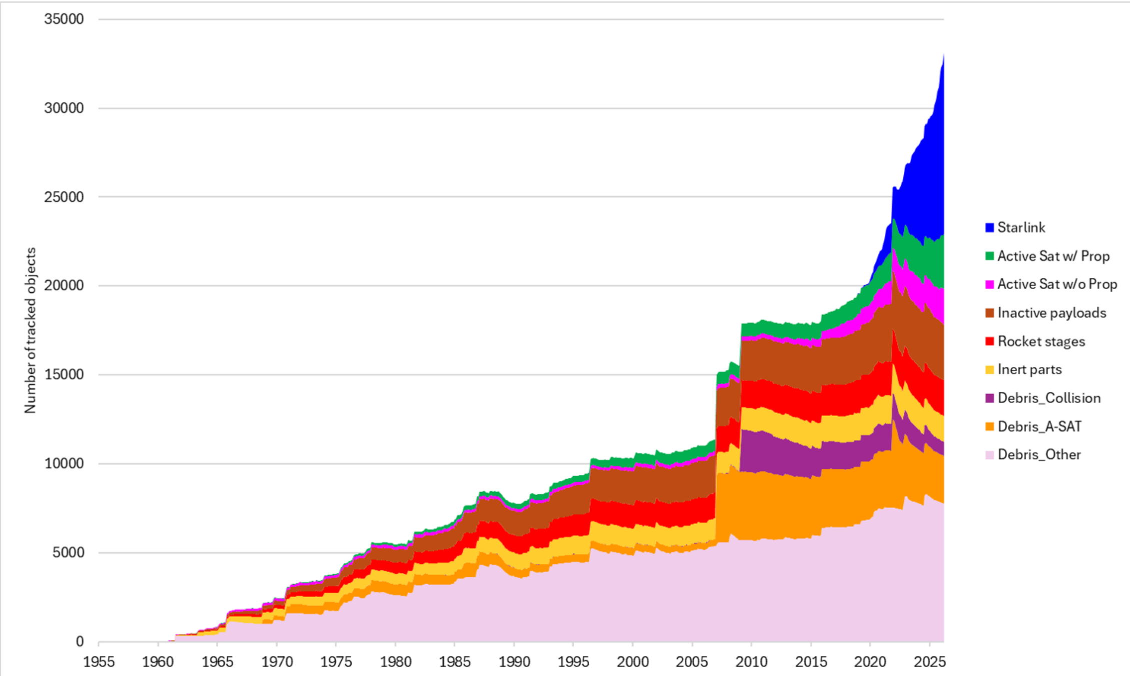


The graph below was based on recent data (April 2026) compiled by Jonathan McDowell (https://planet4589.org/space/stats/active.html), retired astrophysicist and an honorary professor at Durham University. It shows, since the start of the space age, the evolution of the number of operational satellites and all space debris that can be tracked in LEO. The top 3 data series involve operational satellites, binned as follows:

- "Starlink" are obviously the Starlink satellites, of which the number drastically started to rise from 2019 onwards, and currently totals over 10.000 satellites. So about a third of all the "stuff" that is currently being tracked, and about two thirds of all the operational satellites are Starlinks!

- "Active Sat w/ Prop" are operational satellites equipped with propulsion systems. This is not only important to counter drag effects, but also for collision avoidance with other satellites and space debris, and for the end-of-life scenario (burn-up in atmosphere (LEO), "grave-yard orbit" (GEO),...). Typical examples are the International Space Station (ISS), the Starlinks,...

- "Active Sat w/o Prop" are the non-manoeuvrable operational satellites, i.e. satellites without a propulsion system. They eventually will burn up in the atmosphere, but the time range varies from months to decades, depending on their altitude and on coditions in the upper atmosphere. Typical examples are the first generation satellites and cubesats, such as SIMBA (see the STCE Annual Reports of 2020 (launch), 2022 (end-of-operations), and 2024 (re-entry) - https://www.stce.be/annualReport). Satellite systems must now comply with international and national regulations focusing on swift de-orbiting using one of several possible propulision systems, usually within 5 years of mission completion for LEO.



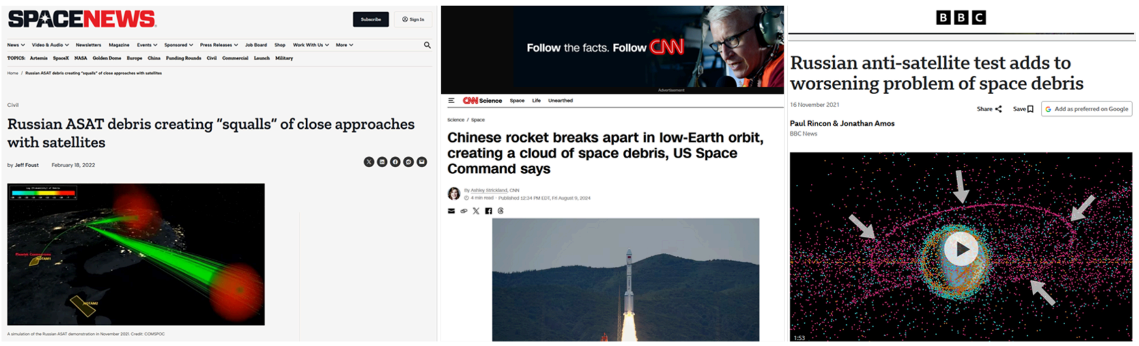
Everything else in the graph represents space debris:
- "Inactive payloads" refer to satellites that are no longer operational and are awaiting to burn up in the atmosphere. Just as the non-manoeuvrable operational satellites, they may stay in LEO for years to decades.

- "Inert parts" are non-functional, non-operating components of satellites or "rocket stages". Unlike active payloads, they do not communicate with Earth, perform manoeuvres, or carry out missions. They are simply objects drifting or orbiting after being discarded during launch or mission operations. Typical examples of "Inert parts" are launch vehicle adapters, instruments caps and covers, despin systems, dead instruments,... "Rocket stages" constitute over 50% of this group, hence they are displayed separately from the "Inert parts".

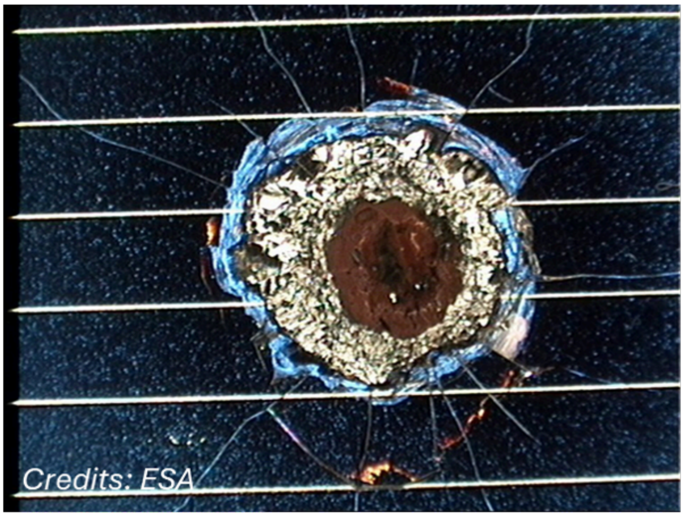
- "Debris_Collision" is the debris following the unintentional collision between 2 satellites. A prime example, and prominently displayed in the graph above, took place on 10 February 2009 when the active commercial satellite Iridium 33 accidentally collided with the derelict Russian satellite Kosmos 2251 at an altitude of 789 km above Siberia. This was the first-ever accidental, high-speed collision between two intact satellites, creating more than 2.300 large trackable fragments, along with thousands of smaller pieces and posing a significant long-term risk to low-Earth orbit (LEO) operations. Now, more than 17 years later, there's still a significant portion of the larger debris floating around, with expectations they can remain in orbit -and pose a threat- for decades to come.

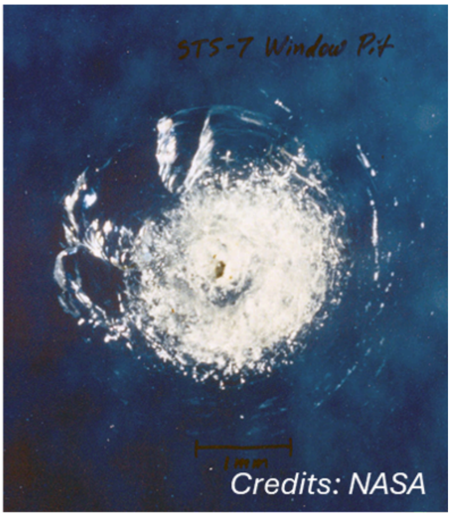
- "Debris_A-SAT" refers to the debris following the intentional destruction of a satellite by an antisatellite (ASAT) weapon.
= On January 11, 2007, China successfully tested an antisatellite (ASAT) weapon by destroying its own inactive Fengyun-1C (FY-1C) weather satellite, orbiting at 865 km. A ground-launched kinetic kill vehicle shattered the satellite, creating over 3000 trackable pieces of debris -the largest debris event in history at that time- posing long-term hazards to satellites. The destruction generated more than 35.000 pieces of debris (down to 1 cm), which was described as the "worst satellite breakup" in terms of creating long-lasting space debris in the LEO. The test, which was not confirmed by China until nearly two weeks later, caused major international concern regarding space security.
= Despite these concerns, Russia basically did the same thing on 15 November 2021 when it conducted a destructive antisatellite test involving a missile striking its own defunct satellite COSMOS 1408. The destruction generated over 1500 pieces of trackable, long-lived orbital debris in LEO, as well as hundreds of thousands of smaller, non-trackable pieces. The test was widely condemned by the international community due to the danger it posed to orbital safety. According to NASA, the debris field posed an immediate danger to the ISS, forcing the crew -which included American, Russian, and German astronauts- to shelter in their docked capsules for two hours as a precaution.

- "Debris_Other" concerns all the tracked debris not covered by the above sections. Prime examples here are the fragmentation events that took place on 12 November 2022 and 6-7 August 2024, involving in both cases the breakup of a Chinese Long March 6A (CZ-6A) rocket upper stage shortly after launching its payload at an altitude of around 800 km. Each time, the incident created a cloud of several hundreds of pieces of trackable debris in LEO. According to several news sources, the debris was orbiting in a "high-traffic" area posing risks to over 1000 satellites as well as the ISS.



Note that only the number of large fragments, i.e. with sizes of about 10 cm or larger, are shown in the graph above. ESA estimates that, on top of these, there are over 1.2 million objects with sizes between 1 and 10 cm. These cover small items from the usual nuts and bolts over pieces of insulation to frozen fuel and coolant droplets. They also include the smaller fragments from collisions, fragmentations or anti-satellite tests. Space debris between 1 and 10 cm in size is often referred to as the "lethal non-trackable" population and considered to be one of the greatest threats to operational satellites and spacecraft because they are too small to be tracked accurately from the ground, but large enough to cause catastrophic damage (ESA). Traveling with speeds of 7-8 km/s (25.000-29.000 km/h), these marble- and tennisball-sized objects can still pack enough energy to penetrate the shielding of the ISS or destroy a satellite. Due to the Russian antisatellite event in 2021, a new term was coined: "squall". A "conjunction squall" is a term used in space situational awareness to describe a period when a large amount of debris creates a "squall" or sudden surge of close approaches (conjunctions) with active satellites in LEO. Events such as the Russian ASAT incident can produce thousands of close approaches between debris and active satellites over just a few days. The images underneath show the impact of much smaller debris on a solar panel of the Hubble Space Telescope and on the window of a space shuttle.



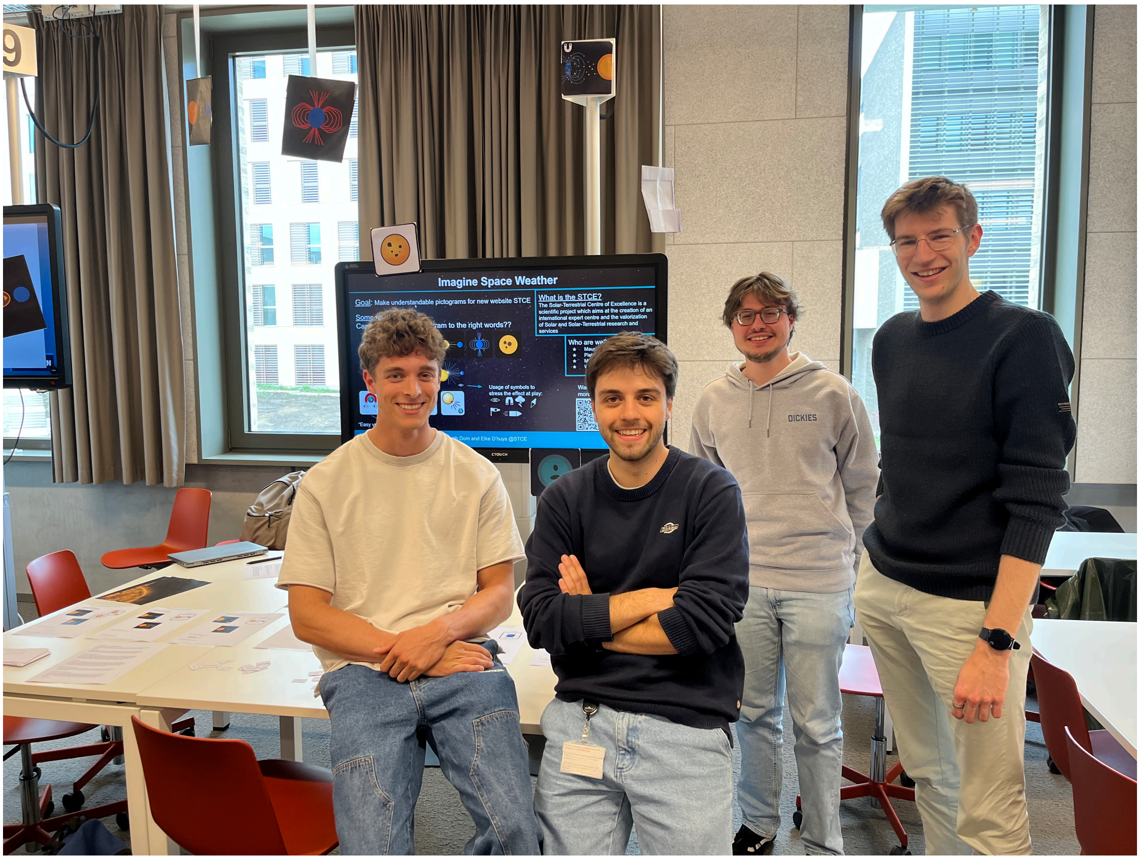


Solar activity and space weather in general can help in decreasing the amount of space junk in LEO. Increased x-ray and extreme ultraviolet radiation from solar flares, as well as the energy and particles dumped in the atmosphere during geomagnetic storms, make the upper atmosphere expand. This increases the drag with the space debris present, and allows a faster eliminiation of this space junk. This can be seen very well in the graph when during the maximum of solar cycle 22 in 1989-1991, there there was a clear dip in the amount of tracked space debris. Also the ongoing solar cycle 25, which experienced a higher-than-predicted maximum in 2024-2025, had a significant, measurable effect on the amount of space debris in LEO. The increased solar activity (see the STCE SC25 tracking page at https://www.stce.be/content/sc25-tracking) has led to a notable reduction in debris at lower altitudes, especially in the 200-400 km altitude range, due to faster orbital decay. Other effects that have been observed, are faster-than-anticipated Starlink re-entries, debris from the Cosmos 1408 breakup following the 2021 Russian ASAT test is reentering faster than originally estimated, and the space debris re-entry rate in 2023 was roughly 5 times higher than that in 2022, directly correlating with the ramp-up in solar activity. However, while solar maximum helps clear low-altitude debris, it also poses challenges, as it increases orbital drag on operational satellites, requiring more fuel for station-keeping and complicating collision avoidance as debris trajectories become less predictable.

Unfortunately, according to the ESA 2025 Space Environment Report ; https://www.esa.int/Space_Safety/Space_Debris/ESA_Space_Environment_Report_2025), not enough satellites leave the already heavily congested orbits at the end of their lives, creating a collision risk. The adherence to space debris mitigation standards is slowly improving over the years, especially in the commercial sector, but it is not enough to stop the increase of the number and amount of space debris. Even without any additional launches, the number of space debris would keep growing, because fragmentation events add new debris objects faster than debris can naturally re-enter the atmosphere. To prevent this runaway chain reaction (Kessler syndrome) from escalating and making certain orbits unusable, active debris removal is required.

2. Imagine Space Weather

Space Weather is a natural hazard.
Space Weather impacts communication, navigation, surveillance and radio controlled systems. These systems are critical for our society. Think of aviation, unmanned aircrafts, positioning systems.
The STCE wants to broadcast a daily online Space Weather Bulletin. This bulletin needs to correctly inform people with support of visuals.
So, the STCE asked students of the KULeuven, Belgium to develop pictograms which visualise in a straightforward and simple way the space weather phenomena and their impacts on the Earth environment.
The result was presented at a Science Communication Fair.
The group of 4 did a splendid job on which the STCE can build further. More on the pictograms will follow in a next edition of the STCE Newsletter.



Well done, Michiel, Wout, Mauro and Pieter!

3. ESWW2026 - call for abstracts

CALL FOR ABSTRACTS
ESWW2026 Session OTH4: Space Weather Education and Outreach

Dear Colleagues,

We are pleased to invite you to submit your abstracts for the upcoming European Space Weather Week 2026 (Florence, 2-6 November 2026).

Specifically, we welcome contributions to the Parallel Session OTH4: "Education and Outreach in Space Weather: Engaging Communities and Shaping the Next Generation".

Education and outreach play an important role in the space weather community. They help turn scientific discoveries into awareness, skills, and real-world impact. As space weather increasingly impacts modern technology and society, we need better ways to communicate, train, and engage different audiences.

This session welcomes contributions from researchers, educators, communicators, and service providers to share their experiences, tools, and ideas for space weather education and outreach. Topics of interest include training schools, innovative teaching methods, citizen science, engagement with stakeholders and end-users, and new communication formats—from digital tools to hands-on activities.

We also aim to discuss how to make Education and Outreach more inclusive, impactful, and sustainable. We will also look at how to better integrate space weather into broader STEM education. The session will encourage an open and interactive exchange of ideas, with the aim of inspiring collaboration across communities and sparking new ways to engage society while supporting the next generation of space weather scientists and practitioners.

Submission Deadline: May 15, 2026
Submission Guidelines: https://esww.aeronomie.be/info-guidelines/guidelines-for-abstract-submission
General Info: https://esww.aeronomie.be/
We look forward to seeing you in Florence and hearing about your initiatives!

Best regards,

The Session Conveners
Domenico Di Mauro (domenico.dimauro at ingv.it)
Stefania Lepidi (stefania.lepidi at ingv.it)

4. Review of space weather

Solar Active Regions (ARs) and flares

Over the week, the solar flaring activity decreased from moderate to low. Eight (8) M-class flare were identified. The largest flare was a M6.0 flare (SIDC Flare 7519) peaking on Apr 26 at 22:57 UTC and was produced by SIDC Sunspot Group 847 (NOAA Active Region (AR) 4420). During the flare, the source region had a beta-gamma-delta magnetic configuration. There were 12 numbered active regions on the visible solar disk throughout the week. NOAA AR 4425 and 4420 (SIDC Sunspot Groups 805 and 847) had both a beta-gamma-delta magnetic configuration and produced all the M-class flares and around 80 C-class flares.

Coronal mass ejections

Two subsequent coronal mass ejections (CMEs) were observed in the SOHO/LASCO C2 and STEREO-A/COR2 field of view around 12:30 UTC and 18:30 UTC on Apr 30 in the S-SW part. These CMEs were faint, wide, and slow (around 250 km/s), and were possibly associated with eruptions closer to SIDC Sunspot Group 853 (NOAA Active Region 4428). ICMEs were not expected, but they did arrive in L1 at 14:55 UTC on May 04.
Another CME was observed in SOHO/LASCO-C2 images at 11:12 UTC on May 02. The plasma cloud was associated to a filament eruption next to SIDC Sunspot Group 851 (NOAA Active Region 4424). Type II radio emissions were detected at 10:51 UTC on May 02. With an angular width of about 90 deg and a projected speed of about 425 km/s (as detected and measured by the Cactus tool), this CME was not considered Earth-directed.
An elongated filament erupted in the S hemisphere around 20:00 UTC on May 02, but no associated CME was seen.

Coronal Holes

SIDC Coronal Hole (CH) 149 (recurrent, negative polarity) crossed the central meridian during Apr 26-28. The high speed streams (HSSs) related to this CH enhanced the solar wind parameters near Earth during Apr 30 - May 02. Another SIDC CH 142 (recurrent, negative polarity) crossed the central meridian during Apr 29 - May 02.

Proton flux levels

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

Electron fluxes at GEO

The greater than 2 MeV electron flux measured by GOES-18 satellite, remained below the 1000 pfu threshold, except for a short interval on April 26. The greater than 2 MeV electron flux measured by GOES-19 satellite, remained below the 1000 pfu threshold level throughout the past week. The 24h electron fluence was normal to moderate.

Solar wind

Until Apr 27, the solar wind parameters reflected the waning influence of high speed streams (HSSs) from two recurrent, positive polarity coronal holes (SIDC Coronal Holes (CH) 156 and 157). During this period, the solar wind speed reached 500 km/s, while the interplanetary magnetic field (IMF) reached 9 nT and the North-South component (Bz) decreased to -4 nT.
From Apr 27, Earth remained inside the slow solar wind regime from then until Apr 30. Thereafter, solar wind was disturbed due to HSSs from the negative polarity, recurrent coronal hole (SIDC Coronal Hole 149) which crossed the central meridian on Apr 26-28. The solar wind speed was as high as 560 km/s, the IMF reached 14 nT, and Bz decreased to -12 nT.

Geomagnetism

Geomagnetic conditions were quiet to active at the start of the week, and then decreased to quiet until Apr 30.
With the arrival of high speed streams (HSSs) associated to the recurrent, negative polarity coronal hole (SIDC Coronal Hole 149) that crossed the central meridian during Apr 26-28, geomagnetic conditions was globally active, reaching minor storm level (NOAA Kp 4 to 5) during Apr 30 - May 01. Above Belgium, the conditions were active (K_BEL 4) on May 01. At the end of the week, geomagnetic conditions were quiet to unsettled (NOAA Kp and K_BEL 1 to 3) both globally and locally.

5. PROBA2 Observations

Solar Activity

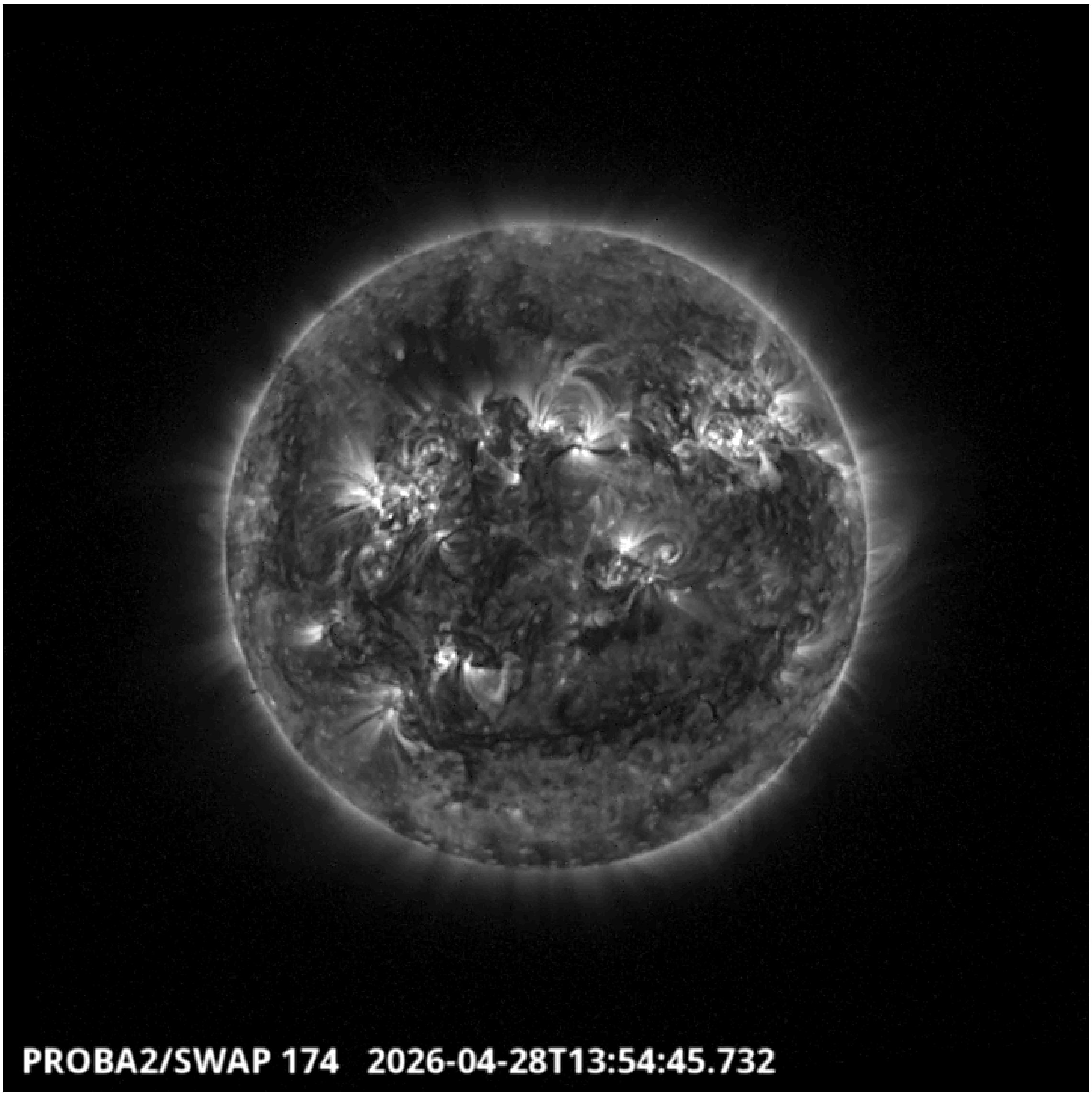
Solar flare activity fluctuated from low to moderate during the week.
In order to view the activity of this week in more detail, we suggest to go to the following website from which all the daily (normal and difference) movies can be accessed: https://proba2.oma.be/ssa

This page also lists the recorded flaring events.

A weekly overview movie can be found here (SWAP week 840). https://proba2.sidc.be/swap/data/mpg/movies/weekly_movies/weekly_movie_2026_04_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.sidc.be/swap/data/mpg/movies/

Tuesday Apr 28



The largest flare of this week was an M1.5, and it was observed by SWAP. The flare peaked on 2026-Apr-28 at 13:53 UT and occurred on the North West part of the solar disk, originating from active region NOAA4420 (SIDC 847). Find a SWAP movie of the event here. https://proba2.sidc.be/swap/movies/20260428_swap_movie.mp4

6. Noticeable Solar Events

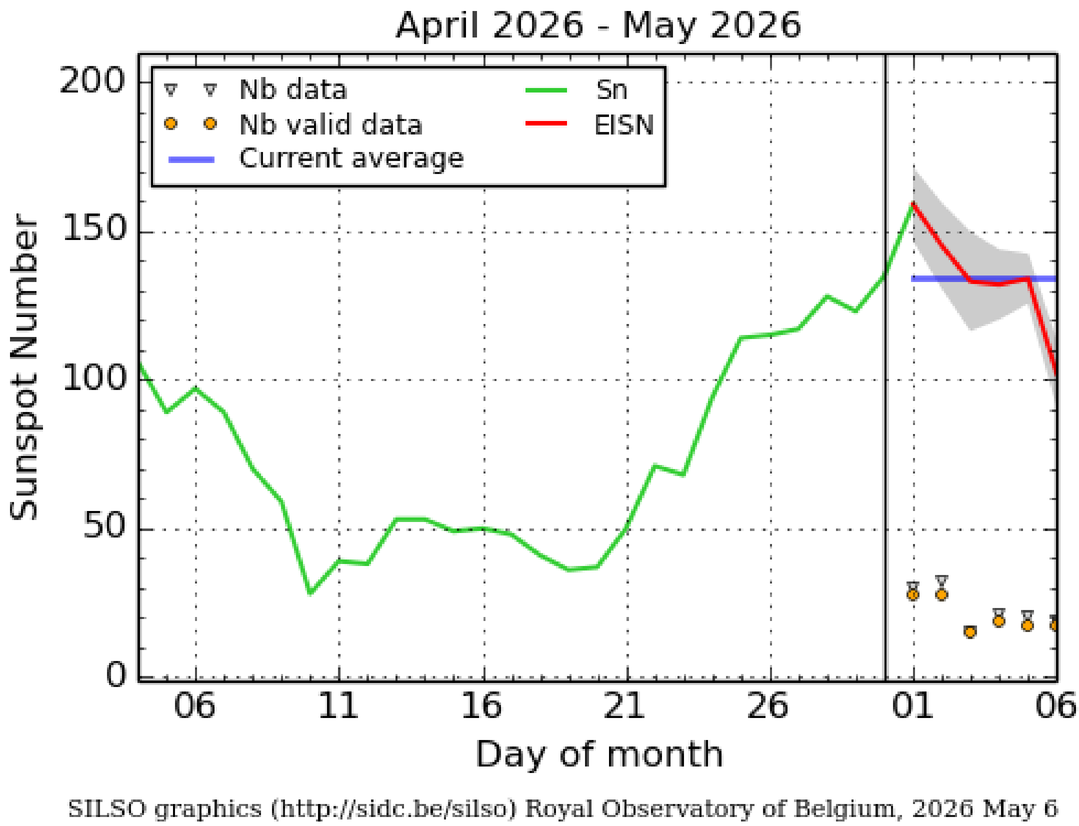
DAY	BEGIN	MAX	END	LOC	XRAY	OP	10CM	TYPE	Cat	NOAA
27	0639	0645	0650	N6E44	M1.0	SF			90	4425
28	1217	1223	1229	N15W38	M1.0	S		III/1	85	4420
28	1349	1353	1355	N17W38	M1.5	SN			85	4420
28	1403	1407	1409	N17W39	M1.1	S			85	4420

LOC: approximate heliographic location
XRAY: X-ray flare class
TYPE: radio burst type
Cat: Catania sunspot group number

OP: optical flare class
10CM: peak 10 cm radio flux

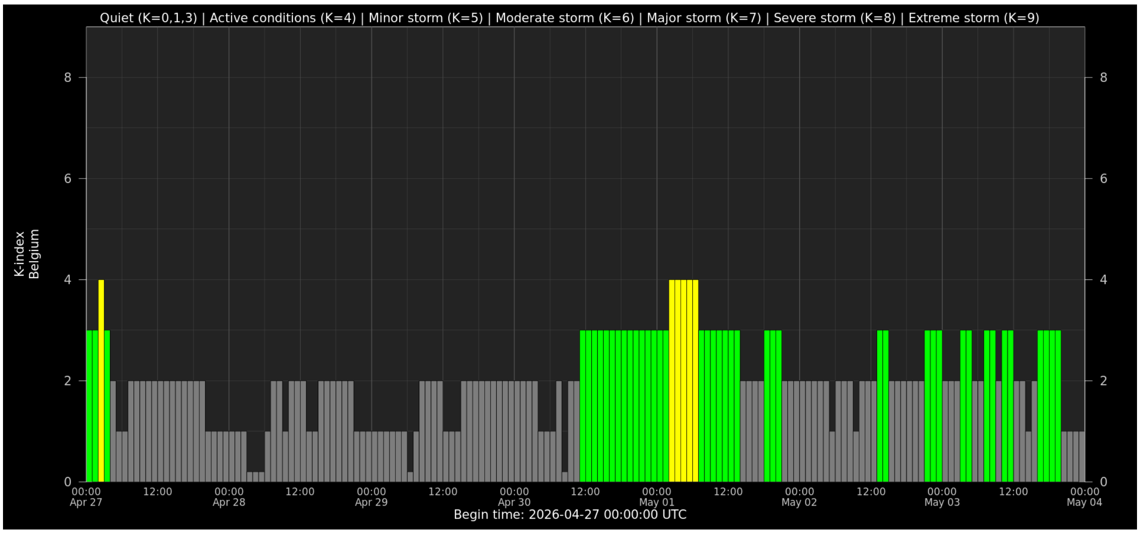
NOAA: NOAA active region number

7. International Sunspot Number by SILSO



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.

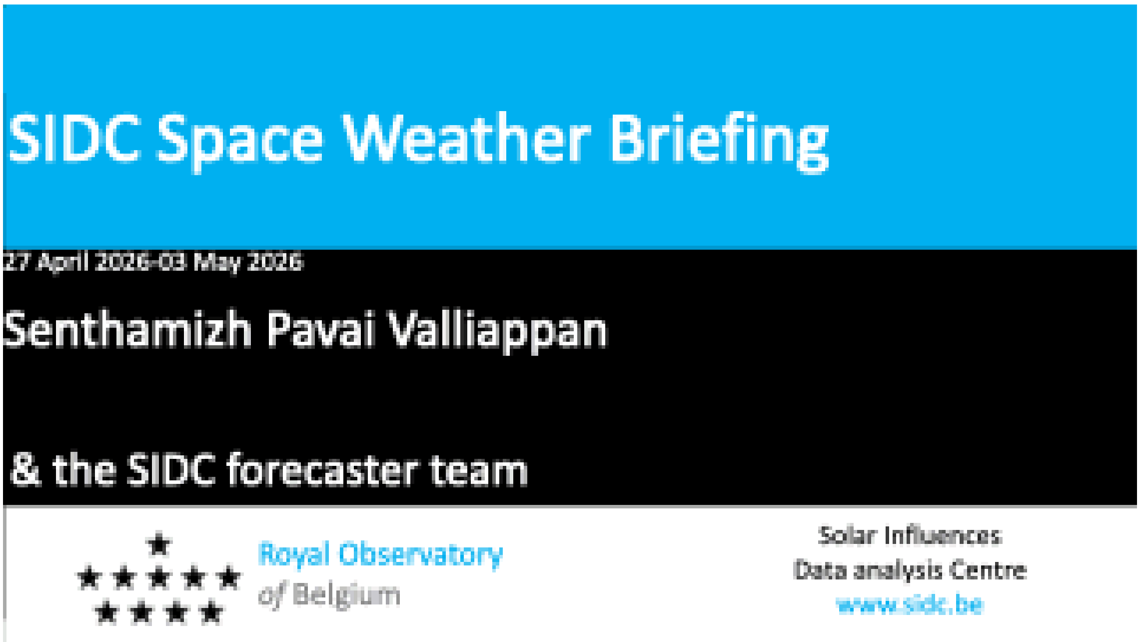
8. Geomagnetic Observations in Belgium



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/

9. The SIDC Space Weather Briefing

The forecaster on duty presented the SIDC briefing that gives an overview of space weather from April 27 to May 3.
The pdf of the presentation: https://www.stce.be/briefings/20260504_SWbriefing.pdf



10. Events and Training courses

Courses, seminars 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.

* May 22-25, 2026, STCE show at Nerdland- In the eye of a solar storm (Dutch) - https://www.nerdlandfestival.be/nl/programma-overzicht/in-het-oog-van-een-ruimtestorm
* May 25, 2026, Public presentation at Nerdland - Een duikvlucht over de zon (Dutch) - https://www.nerdlandfestival.be/nl/programma-overzicht/een-duikvlucht-over-de-zon
* Jun 15-17, 2026, STCE Space Weather Introductory Course, Brussels, Belgium - register: https://events.spacepole.be/event/256/ - Fully booked
* Oct 12-14, 2026, STCE Space Weather Introductory Course, Brussels, Belgium - register: https://events.spacepole.be/event/257/ - Reserved
* Oct 29- Nov 1, 2026, Prior to ESWW2026 - Space Weather Training Course in Firenze, Italy - Apply: https://events.spacepole.be/event/278/
* Nov 2-6, 2026, European Space Weather Week, Florence, Italy, https://esww2026.eswan.eu/
* 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

SWEC

Space Weather Education Centre

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