STCE Newsletter

11 Nov 2024 - 17 Nov 2024

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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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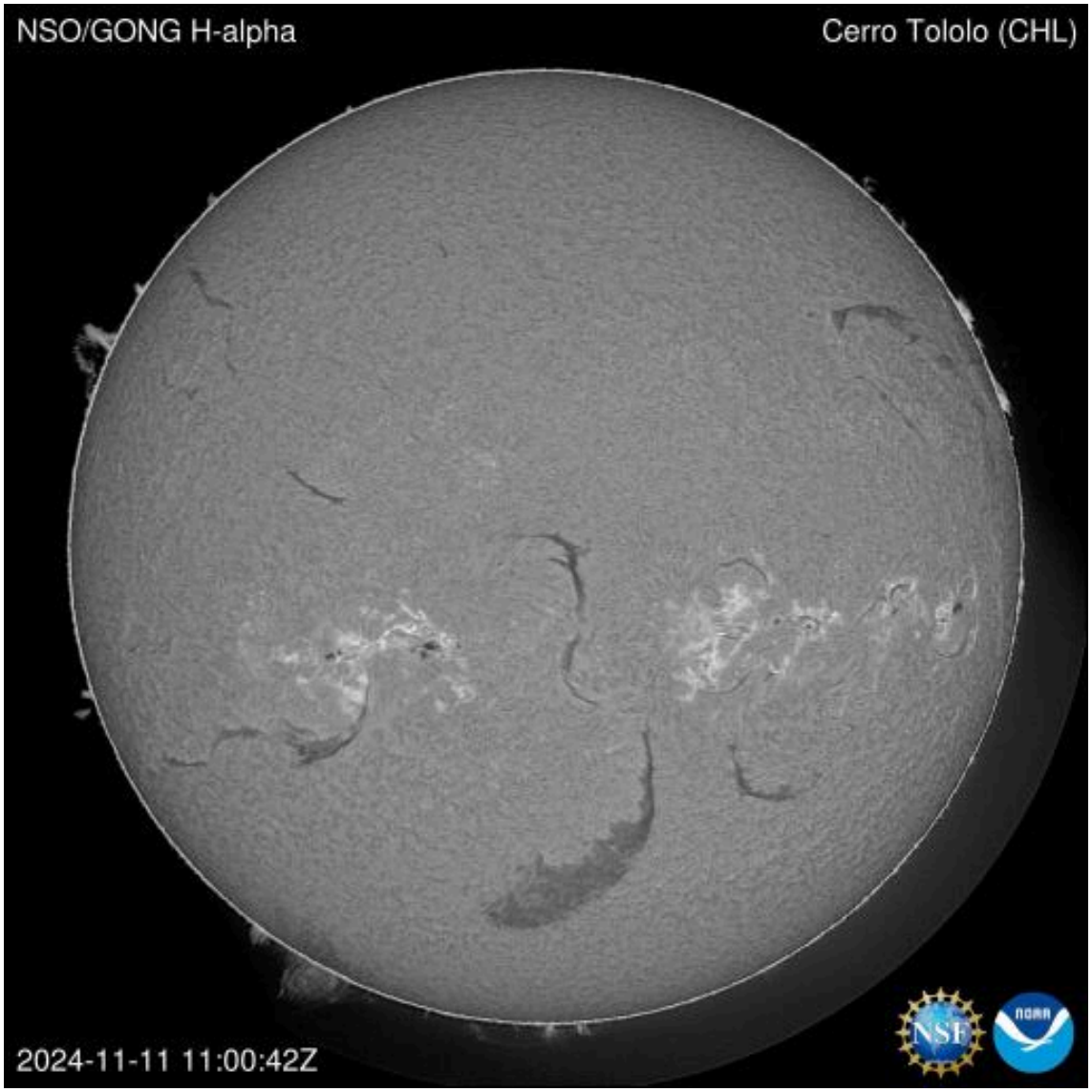
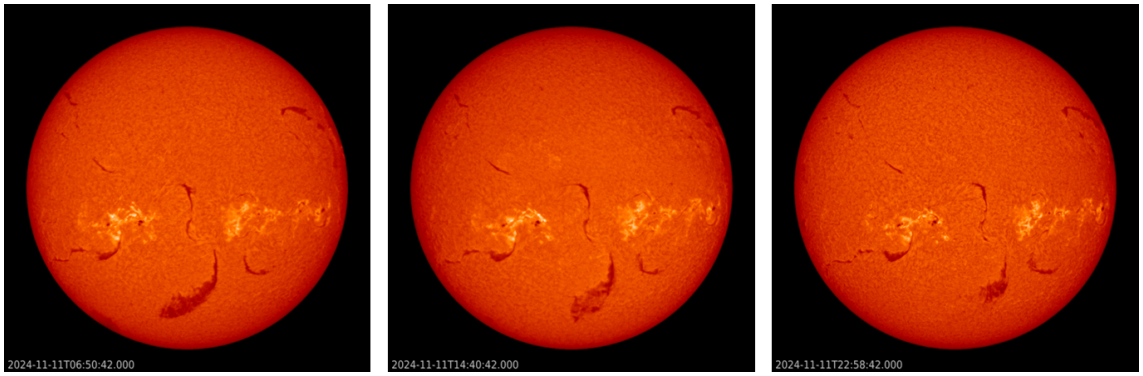
1. Filament eruption

Cerro Tololo (Chile) is one of the 6 observing sites of the GONG network (Global Oscillation Network Group ; https://gong.nso.edu/). These stations are distributed over the Erth in such way that the Sun can continuously be observed. Originally created to do helioseismic observations (see this STCE newsitem at https://www.stce.be/news/635/welcome.html for more info on helioseismology), the stations were also equipped with other instruments to do solar observations, amongst them an H-alpha telescope. H-alpha ("Hydrogen - alpha") is a line in the red part of the solar spectrum near 656.28 nm. It allows a good view on features in the lower chromosphere, the inner atmosphere of the Sun. Typical features that are observed are solar filaments, which are clouds of charged particles ("plasma") above the solar surface squeezed between magnetic regions of opposite magnetic polarity. Being cooler and denser than the plasma underneath and their surroundings, they appear as dark lines when seen on the solar disk and as bright blobs when seen near the solar limb (then they are called "prominences").

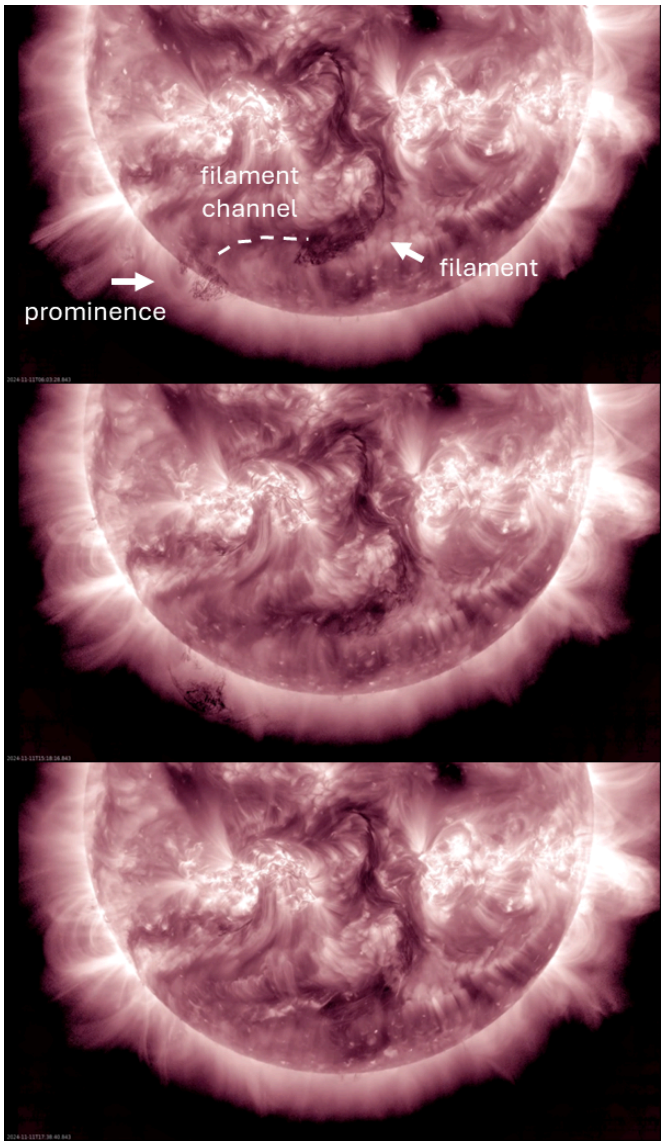


On 11 November shortly after UTC-noon, Cerro Tololo was able to observe an impressive filament eruption from the Sun's southern hemisphere. In H-alpha, the filament had a length of nearly 500.000

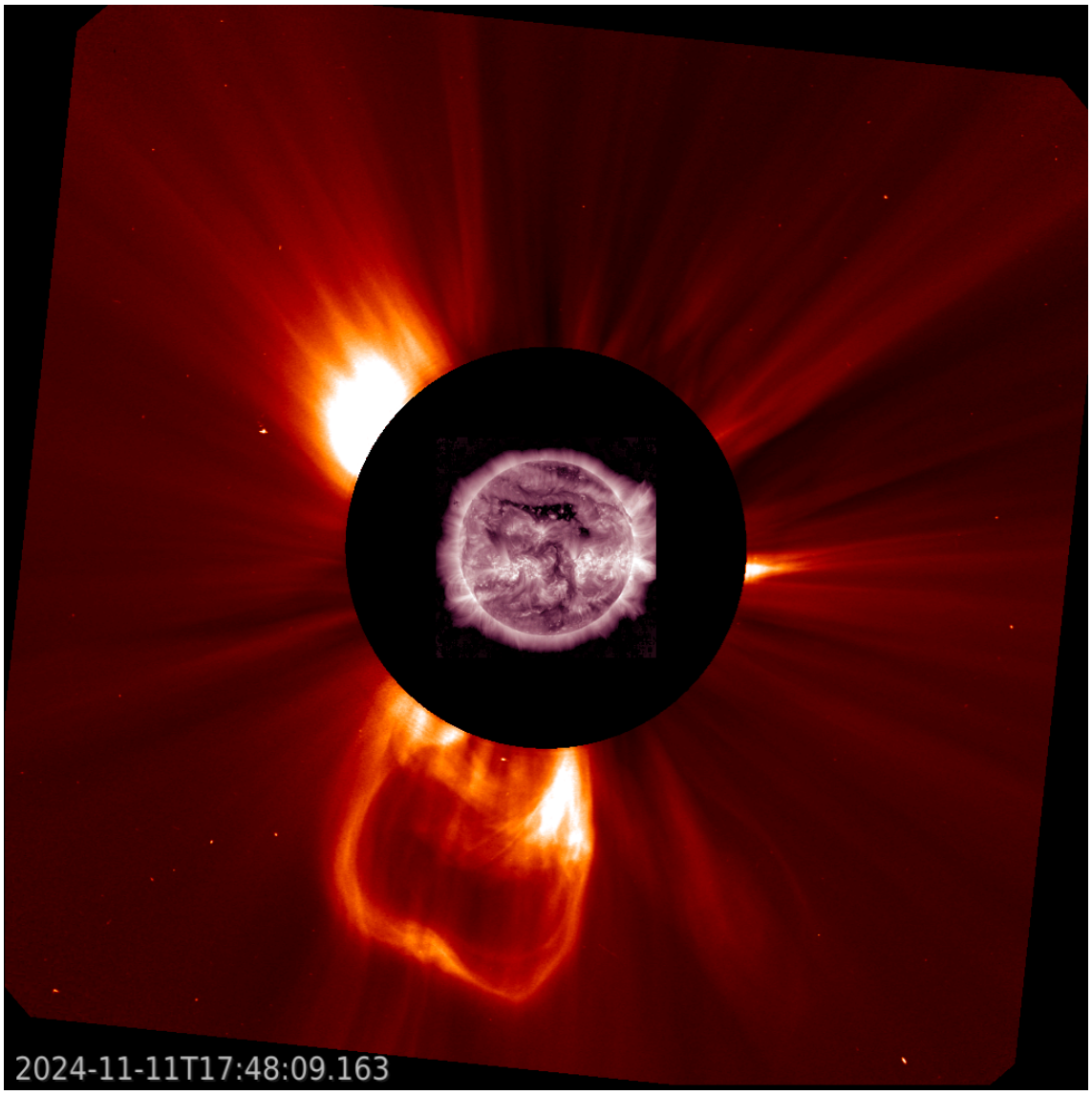
km, significantly longer than the typical Earth-Moon distance. The eruption started around 14:00UTC and lasted for several hours. The eruption can be seen in the H-alpha movie above. A clip is available in the online version of this article at https://www.stce.be/news/738/welcome.html



Not all of the filament was gone, as can be seen in the compilation above. Also, around the same time, another filament/prominence near the southeast solar limb erupted. SDO's extreme ultraviolet (EUV ; SDO/AIA 211, see annotated image and the clip underneath) images suggest that the prominence at the limb was connected with the big filament by a filament channel. A filament channel is thought to be the magnetic structure within which usually lies the filament plasma. However, not all filament channels are filled with filament plasma. In the case of the 11 November eruption, the presence of the filament channel can be seen when it gets activated (brightens a little bit) during the eruption.

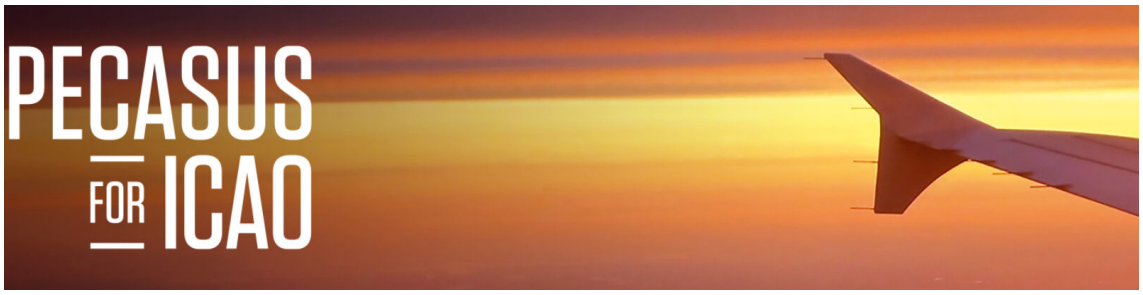


As a result, there was only a single coronal mass ejection (CME) associated with this eruption, and deemed not earth-directed by the SIDC space weather forecaster (http://www.sidc.be/index.php). It is shown in the imagery underneath, combining the SOHO/LASCO C2 coronagraph white light images with the EUV images from SDO/AIA 211.



2. PECASUS celebrates its fifth anniversary

November 7, 2019: The Solar-Terrestrial Centre of Excellence (STCE) launches an unprecedented service that alerts pilots and air traffic controllers when navigation and communication systems may experience problems, or when the health of passengers and crew is at risk due to space weather. This was the very first time such messages have been sent out.

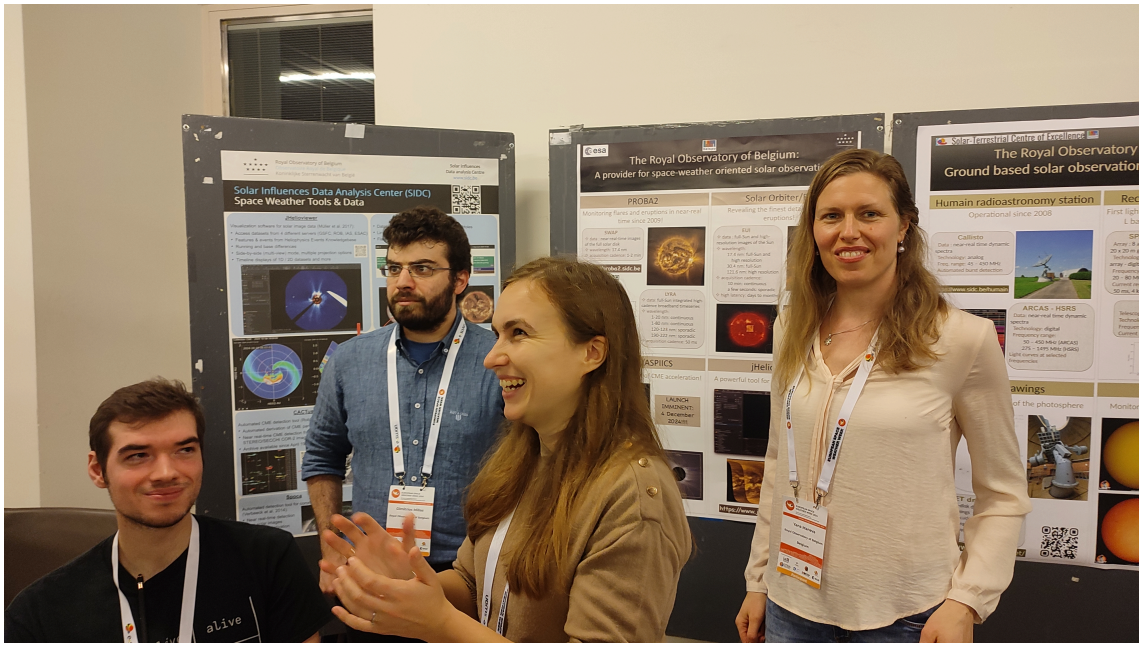


PECASUS is a global civil aviation service drawing on the expertise of the STCE, the Belgian Space Weather Centre.

STCE staff have worked hard over the past 5 years to collect the necessary data and models, to put these data into a form that allows experts and scientists to asses the state of space weather and its impacts, to ensure proper coordination with countries that are part of PECASUS and with the other 3 world centres, to enable a 24/7 service.

The STCE is the Belgian Space Weather Centre that closely monitors solar storms. As expected, the number and strength of solar storms is currently increasing. As a consequence, STCE's PECASUS operators have their hands full estimating the impact on pilot’s navigation systems and radio communications and sending out warnings.

It was a huge task and the future promises to be challenging. Therefore, STCE does not wish to just let the 5th anniversary of PECASUS go by, instead we celebrate it together with colleagues and partners.



Lukas, Dimitrios, Daria and Yana, members of the big STCE PECASUS team at ESWW2024.

Background

PECASUS (https://pecasus.eu) stands for ‘Pan-European Consortium for Aviation Space Weather User Services' and brings together several European institutes possessing leading expertise in the space weather impact domain. PECASUS is led by the FMI, the Finnish Meteorological Institute under the regulations of ICAO (International Civil Aviation Organisation).

The STCE (Belgium) provides expertise in the domain of solar physics and particle radiation expertise, and is responsible for collecting, formatting and analyzing the data and to write the bulletins.

The alerts are available on the website of FMI, the Finnish Meteorological Institute.

3. Join the ESWW2025 Design Contest!

We are excited to announce the European Space Weather Week 2025 Banner and Poster Design Contest! As with previous editions of the European Space Weather Week (ESWW), we invite you to showcase your creativity by designing a banner and poster for the conference.

The 2025 ESWW will be held 27th to 31st of October in Umeå, Sweden and the contest theme is "Technological Expansion of the Arctic: The New Frontiers of Space Weather".

The winning design will be featured on the ESWW2025 website banner, poster, announcements, and document of the conference.

How to Participate:
* Submit your design by December 16, 17:00 CET to the LOC.
* We only need a picture/image/cartoon—no text required.
* Include your name(s) and affiliation(s) with your submission.

Competition Details:
* Open to all participants.
* Multiple submissions are allowed.
* The winner will receive a free registration to ESWW2025.
* Team submissions are welcome, but only one free ticket will be awarded per team.

Technical Requirements for Winning Design:
* Minimum resolution of 150dpi.
* Formats suitable for use as both a banner and a poster (portrait).

We look forward to seeing your innovative designs and exploring the new frontiers of Space Weather in the Arctic through your artistic contributions.

The full announcement can be found here: https://esww.eu/calls/banner-and-poster-competition

4. Review of space weather

Solar Active Regions (ARs) and flares

Solar activity over the past week ranged from low to moderate, with several M-class flares observed. The SIDC Sunspot Group 288 (NOAA Active Region 3889) exhibited a Beta-Gamma-Delta magnetic configuration and was particularly active. It produced multiple M-class flares, including the largest, an M1.7 flare (SIDC Flare 2599), which peaked on November 13 at 17:08 UTC.

Coronal mass ejections

A significant number of large filaments were facing Earth. On November 12, one of the largest filaments in the northwest quadrant erupted, potentially associated with or triggering the C8.2 flare (SIDC Flare 2599), which peaked at 14:01 UTC. This flare was produced by SIDC Sunspot Group 302 (NOAA Active Region 3879), located near the western limb. Due to the filament's source location and the northwest direction of the associated ejection, no Earth-directed impact was expected. Throughout the week, no additional Earth-directed CMEs have been observed in the available coronagraph imagery.

Coronal Holes

Several coronal holes have been identified, with some crossing the central meridian. The recurrent SIDC Coronal Hole 68, a mid-latitude northern coronal hole with positive polarity, crossed the central meridian on November 7. The Earth was embedded in the solar wind coming from this coronal hole from November

11 to 16. SIDC Coronal Hole 78, an equatorial coronal hole with positive polarity, crossed the central meridian on November 14.

Proton flux levels

The greater-than-10 MeV GOES proton flux has been below the 10 pfu threshold.

Electron fluxes at GEO

The greater than 2 MeV electron flux measured by GOES 16 was below the 1000 pfu threshold and the 24-hour electron fluence was at nominal level over the past week.

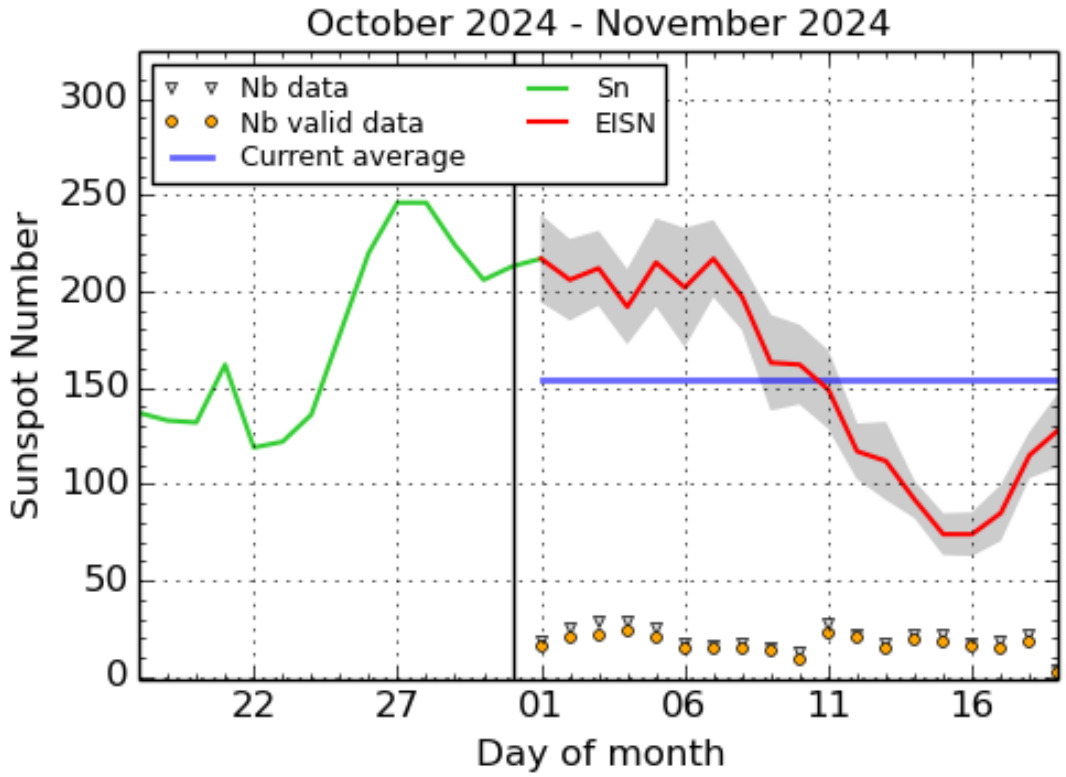
Solar wind

A high speed solar wind linked to SIDC Coronal Hole 68, a mid-latitude northern coronal hole with positive polarity impacted the magnetosphere of Earth. The solar wind peaked at 500 km/s. The interplanetary magnetic field (IMF) measured in the L1 point, ranged from 7 nT to 14 nT, with the Bz component predominantly negative, fluctuating between -12.7 nT and 6 nT. From November 17, the solar wind gradually decreased to approximately 325 km/s, the IMF dropped below 7 nT, and the Bz component fluctuated between -7 nT and 5 nT. On November 17, around 10:45 UTC, the IMF shifted from "away from the Sun" (phi-angle positive) to "towards the Sun" (phi-angle negative), likely due to the crossing of a sector boundary. Following this rotation, the total interplanetary magnetic field slightly increased, ranging between 7 nT and 8 nT, while the southward component, Bz, remained predominantly negative, fluctuating between -7 nT and 0 nT.

Geomagnetism

Geomagnetic activity was influenced by high-speed solar wind streams associated with the SIDC Coronal Hole 68, a mid-latitude northern coronal hole with positive polarity. The conditions were active, both local (K BEL 4) and global (NOAA Kp 4) between November 11 and 16. By November 17, as the influence of SIDC Coronal Hole 68 diminished, geomagnetic activity returned to quieter levels, with NOAA Kp values ranging from 1 to 2 and K BEL values between 1 and 3.

5. International Sunspot Number by SILSO



SILSO graphics (http://sidc.be/silso) Royal Observatory of Belgium, 2024 November 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.

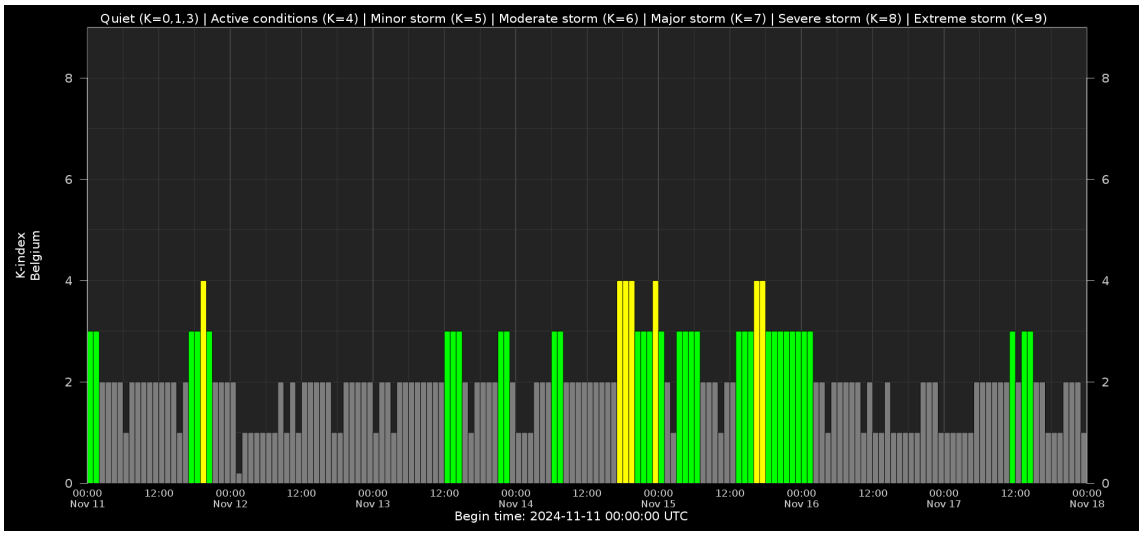
6. Noticeable Solar Events

DAY	BEGIN	MAX	END	LOC	XRAY	OP	10CM	TYPE	Cat	NOAA
11	0507	0526	0536	S8E17	M1.1	1				3889
11	0536	0543	0552	S13W18	M1.4	SF				3889
13	0011	0022	0032	S12E2	M1.0	1F				3889
13	1657	1708	1717		M1.7					3889
15	0138	0146	0208		M1.1				97	3893
15	1205	1218	1226	S20E43	M1.0	SF			97	3893
16	0126	0137	0141	S10W39	M1.6	1N			93	3889

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

10CM: peak 10 cm radio flux

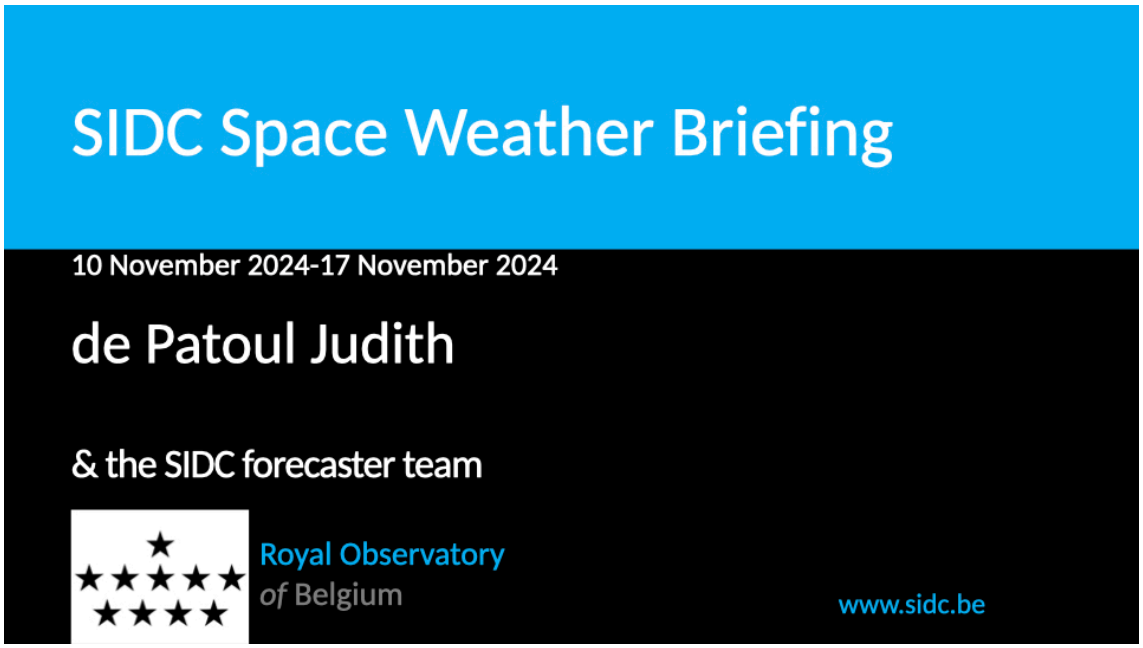
7. Geomagnetic Observations in Belgium



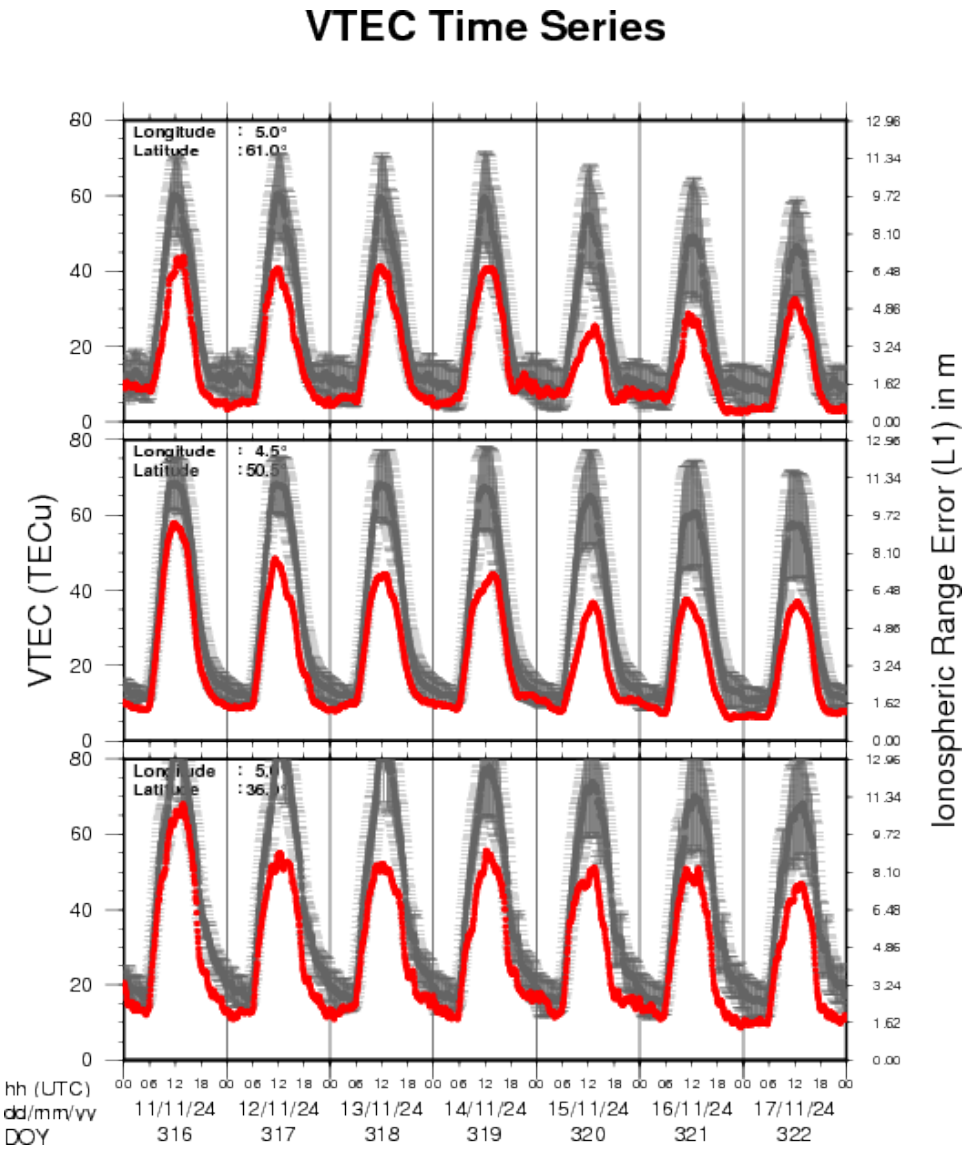
Local K-type magnetic activity index for Belgium based on data from Dourbes (DOU) and Manhay (MAB). Comparing the data from both measurement stations allows to reliably remove outliers from the magnetic data. At the same time the operational service availability is improved: whenever data from one observatory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

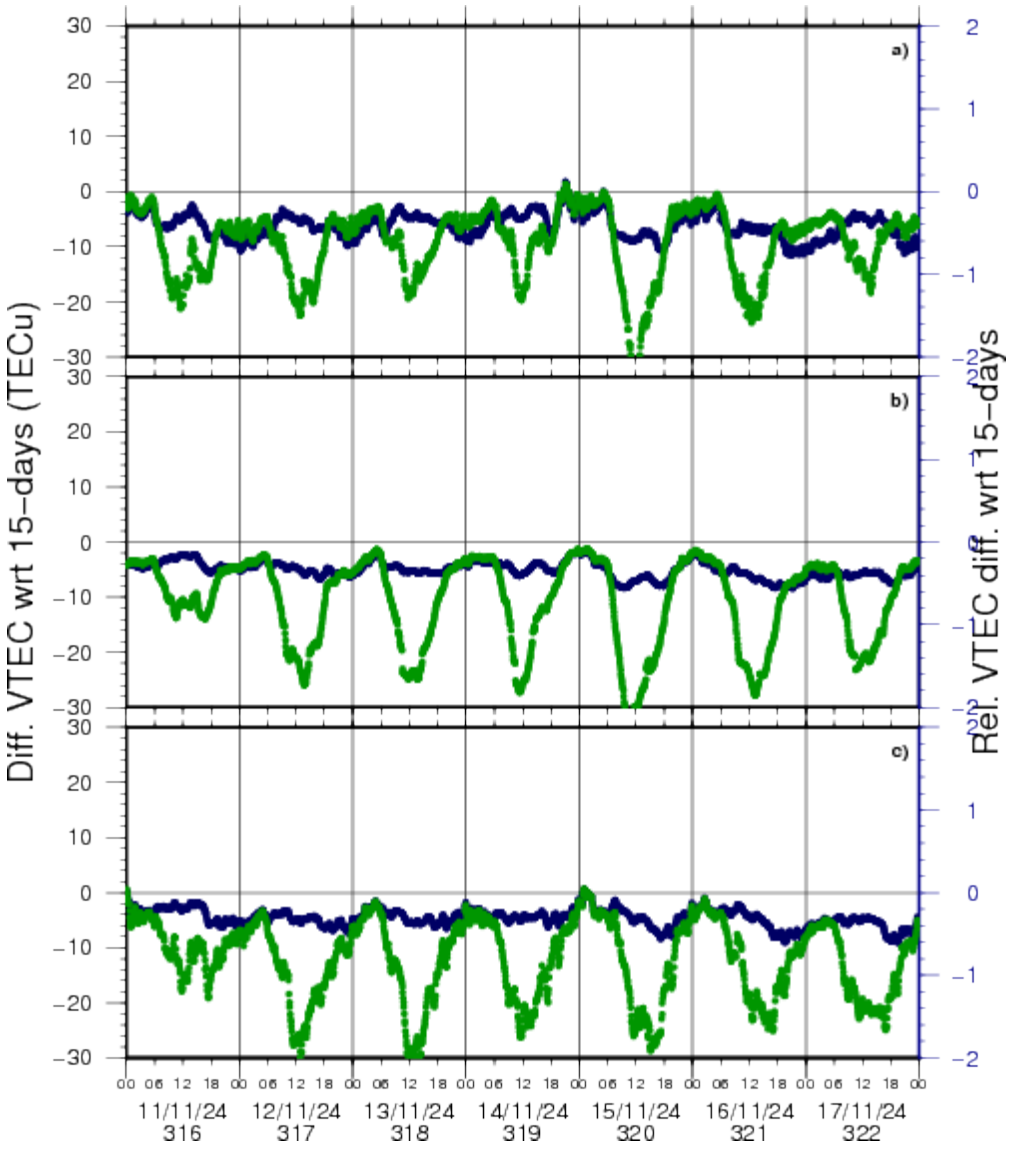
8. The SIDC space weather briefing

The Space Weather Briefing presented by the forecaster on duty from Nov 11 to 17.
The pdf of the presentation can be found here: https://www.stce.be/briefings/20241118_SWbriefing.pdf


SIDC Space Weather Briefing
10 November 2024-17 November 2024
de Patoul Judith
& the SIDC forecaster team
Royal Observatory
of Belgium
www.sidc.be

9. Review of Ionospheric Activity





VTEC time series at 3 locations in Europe from 11 Nov 2024 till 17 Nov 2024

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

10. STCE courses and trainings

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.
* Dec 5-6, 2024, STCE Course Space Weather impacts on aviation, online - full
* Jan 28-30, 2025, Role of the ionosphere and space weather in military communications, Brussels, Belgium - register: https://events.spacepole.be/event/208/
* 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, surf 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