STCE Newsletter

9 Dec 2019 - 15 Dec 2019

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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. ESWW2019 - Thank you!

Dear ESWW2019 participants

We can look back to a great ESWW edition with 417 participants from all over the world.

All of you contributed: convening a session and running after contributions, leading a topical discussion meeting, setting up a fair-booth, presenting a poster, contribute to the tutorial (on stage or from the room), giving a presentation, singing and dancing, playing, presenting a live space weather forecast, being present at the beer-tasting, visit, keynote, …

All of you deserve a medal ‘Excellent ESWW participant’. Thanks to all for your valuable contribution!

If you want to revive ESWW2019: click on ‘pictures and videos’ at http://www.stce.be/esww2019/index.php

If you are curious for the next ESWW2020, check http://esww17.iopconfs.org/Home

Enjoy the holidays!

Petra, Mario, Ronald, Alexi, Anna, Daniel, Dave, David, Ellen, Gareth, Jean, Jussi, Luke, Nicole, Peter, Piers, Stefaan, Volker

2. Spotless!

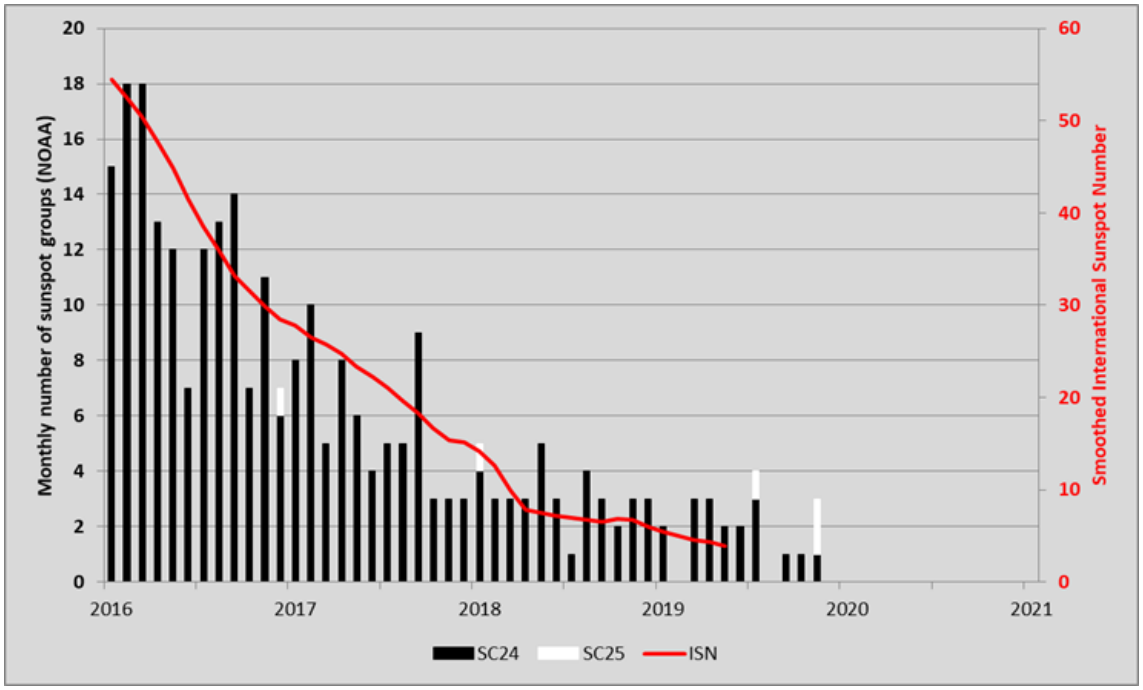
Based on the *provisional* sunspot numbers as provided by SILSO (http://sidc.be/silso/), the Sun has been spotless since 14 November. Said otherwise, no sunspots have appeared for at least 33 consecutive days. This is longer than the longest spotless stretch of the previous solar cycle minimum, when the Sun was spotless from 31 July till 31 August 2009. The next "target" (in recent history) is the

42 days stretch from the solar cycle 22-23 minimum, when there were no sunspots observed from 13 September till 24 October 1996. That would propel the currently ongoing spotless stretch into the Top 10 of periods with spotless days since 1849, as shown in the table underneath (http://sidc.be/silso/spotless).

Periods with spotless days (≥ 30 days) since 1849

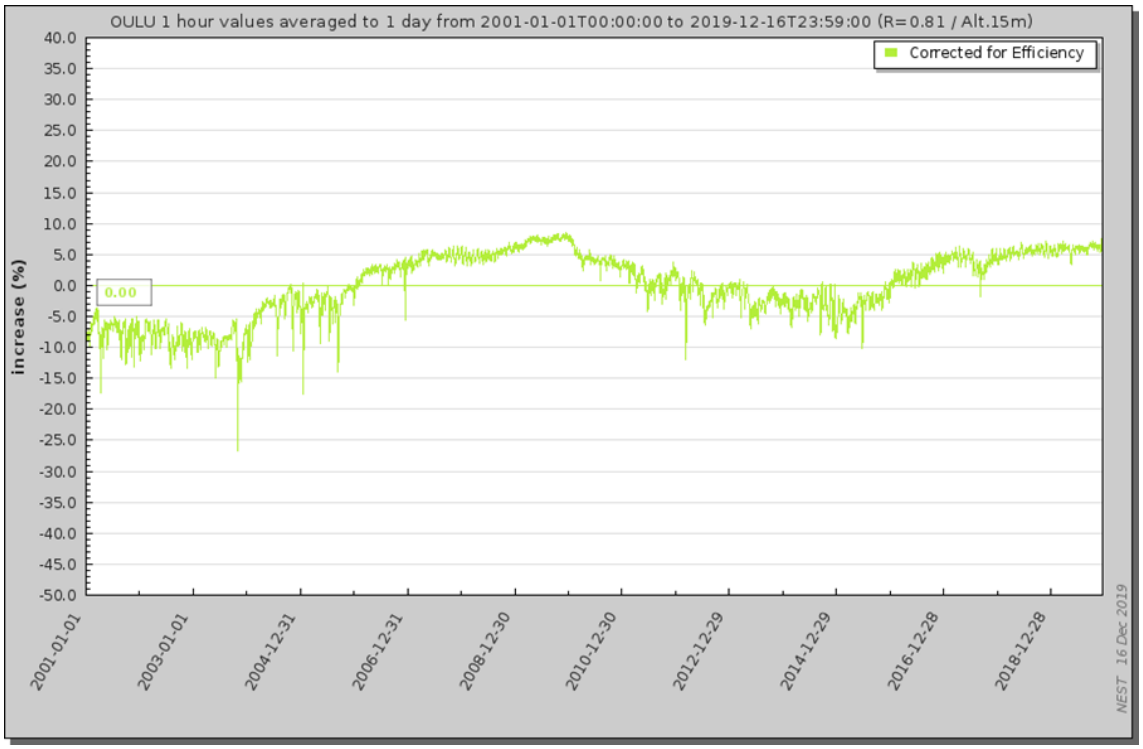
Rank	SC	Begin	End	Days	Rank	SC	Begin	End	Days	Rank	SC	Begin	End	Days
1	15	08 Apr 1913	08 Jul 1913	*92*	9	10	22 Apr 1856	01 Jun 1856	*41*	15	11	20 Apr 1867	24 May 1867	*35*
2	14	11 Mar 1901	18 May 1901	*69*	10	14	26 Nov 1901	04 Jan 1902	*40*	16	24	31Jul 2009	31 Aug 2009	*32*
3	12	16 Feb 1879	10 Apr 1879	*54*	11	16	06 Jan 1924	13 Feb 1924	*39*	17	24	21 Jul 2008	20 Aug 2008	*31*
4	14	17 Mar 1902	04 May 1902	*49*	11	15	15 Jul 1913	22 Aug 1913	*39*	17	17	12 Dec 1933	11 Jan 1934	*31*
4	10	14 Aug 1855	01 Oct 1855	*49*	12	11	29 Dec 1866	04 Feb 1867	*38*	17	15	12 Jul 1912	11 Aug 1912	*31*
5	12	04 Apr 1878	20 May 1878	*47*	12	10	12 Dec 1855	18 Jan 1856	*38*	17	14	25 Nov 1900	25 Dec 1900	*31*
6	14	16 Jan 1902	01 Mar 1902	*45*	13	12	17 May 1876	22 Jun 1876	*37*	18	19	03 Jun 1954	02 Jul 1954	*30*
6	12	14 Sep 1878	28 Oct 1878	*45*	13	12	27 Jul 1878	01 Sep 1878	*37*	18	17	13 Jul 1933	11 Aug 1933	*30*
7	15	21 Jan 1912	03 Mar 1912	*43*	14	18	18 Apr 1944	23 May 1944	*36*	18	14	08 Jul 1902	06 Aug 1902	*30*
8	23	13 Sep 1996	24 Oct 1996	*42*	14	17	05 Nov 1933	10 Dec 1933	*36*					

Gradually, more and more sunspot groups from the new solar cycle (SC25) are showing. The graph below shows the monthly number of sunspot groups (having received a NOAA number) from SC24 (black) and from SC25 (white) since 2016. The red curve represents the smoothed monthly international sunspot number (SILSO). While the number of regions is low so close to the solar minimum, SC25 sunspot regions will gradually become more numerous than the SC24 regions eventually outnumbering those from the "old" cycle. The cycle minimum usually occurs within just a few months of this "break-even".



In view of the decreasing solar activity, the earth environment is exposed again to more high-energetic particles coming from outside our solar system, the so-called galactic cosmic rays (GCR - see the STCE newsitem at http://www.stce.be/news/433/welcome.html). When entering the heliosphere, cosmic rays encounter a turbulent solar wind with an embedded heliospheric magnetic field. The higher the solar activity, the more intense and complex this magnetic field, and the more difficult it is for a particle to make it all the way to the Earth. When some finally arrive, they collide with particles in the Earth's atmosphere, creating a shower of secondary particles such as neutrons. These neutrons are detected by

neutron monitors such as in Dourbes (http://ionosphere.meteo.be/instruments/neutron.php) or various other sites around the world (Moscow, Oulu,...). The graph underneath shows the monthly Oulu neutron count relative to the average of the last 20 years. The neutron count is 6 percent above this average, almost as high as during the previous solar cycle minimum (8 percent). The GCRs are the cause of increased radiation and so the monitoring is important for aviation and astronauts.



Acknowledgements to the NMDB database (www.nmdb.eu), founded under the European Union's FP7 programme (contract no. 213007) for providing data, as well as to the Oulu neutron monitor webpage at http://cosmicrays.oulu.fi and the Sodankyla Geophysical Observatory.

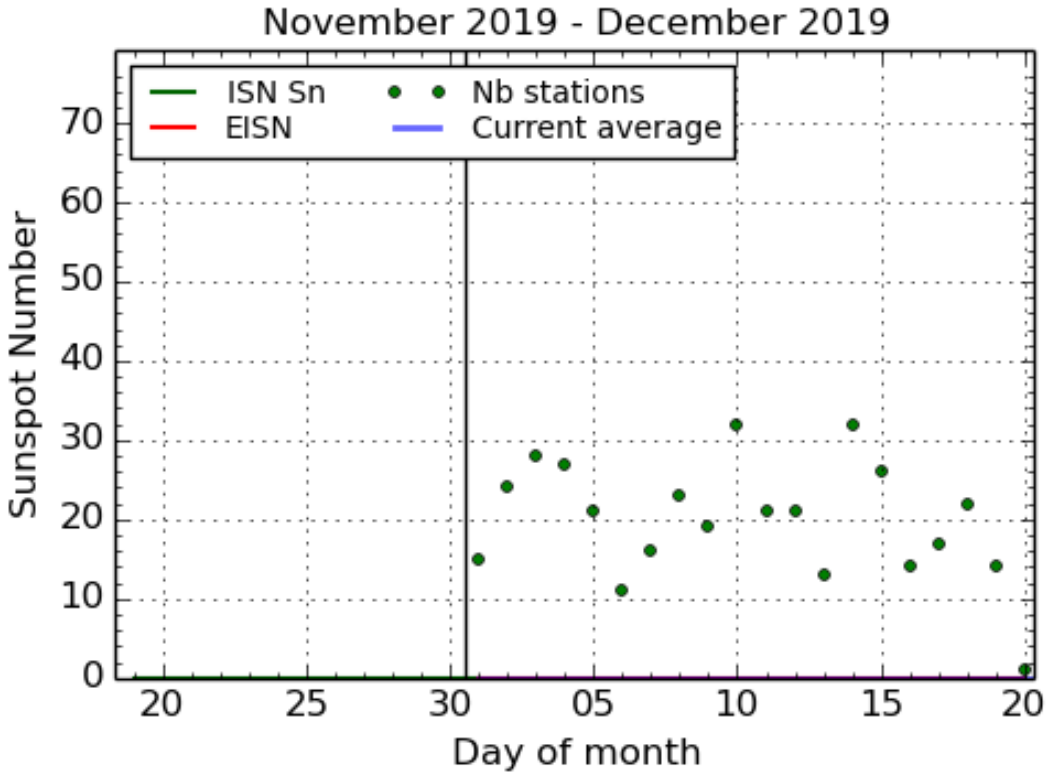
3. Review of solar activity

Solar flaring activity was very low, without C-class, or even B-class flares reported. No numbered active regions were observed on the visible side of the Sun. No wide CMEs reported and the solar protons remained at the background level.

Two coronal holes were observed on the visible side of the Sun. The coronal hole that reached the central meridian on December 10, was situated near the equator, narrow, and had a negative polarity. The coronal hole that reached the central meridian on December 14, was also situated near the equator, but with a positive polarity.

4. The International Sunspot Number by SILSO - all equal to zero

It happened: the first Sunspot Number graph of this solar minimum in the STCE Newsletter with all numbers equal to zero!



SILSO graphics (http://sidc.be/silso) Royal Observatory of Belgium, 2019 December 20

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). The plot shows the last 30 days (about one solar rotation). The horizontal blue line shows the current monthly average, while the green dots give the number of stations included in the calculation of the EISN for each day.

5. PROBA2 Observations (9 Dec 2019 - 15 Dec 2019)

Solar Activity

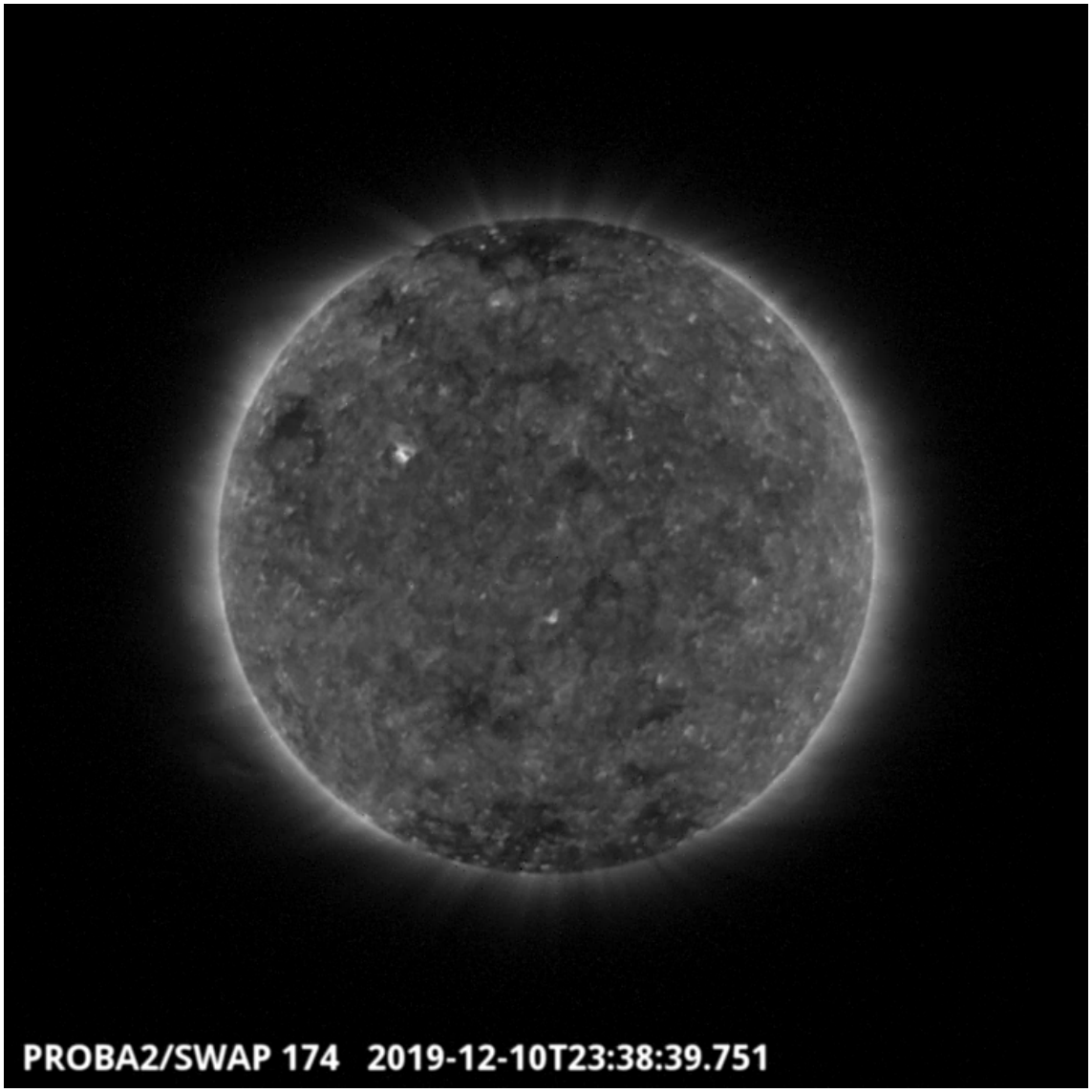
Solar flare activity was very low during the week.
In order to view the activity of this week in more detail, we suggest to go to the following website from which all the daily (normal and difference) movies can be accessed: https://proba2.oma.be/ssa
This page also lists the recorded flaring events.

A weekly overview movie can be found here (SWAP week 507). http://proba2.oma.be/swap/data/mpg/movies/weekly_movies/weekly_movie_2019_12_09.mp4

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

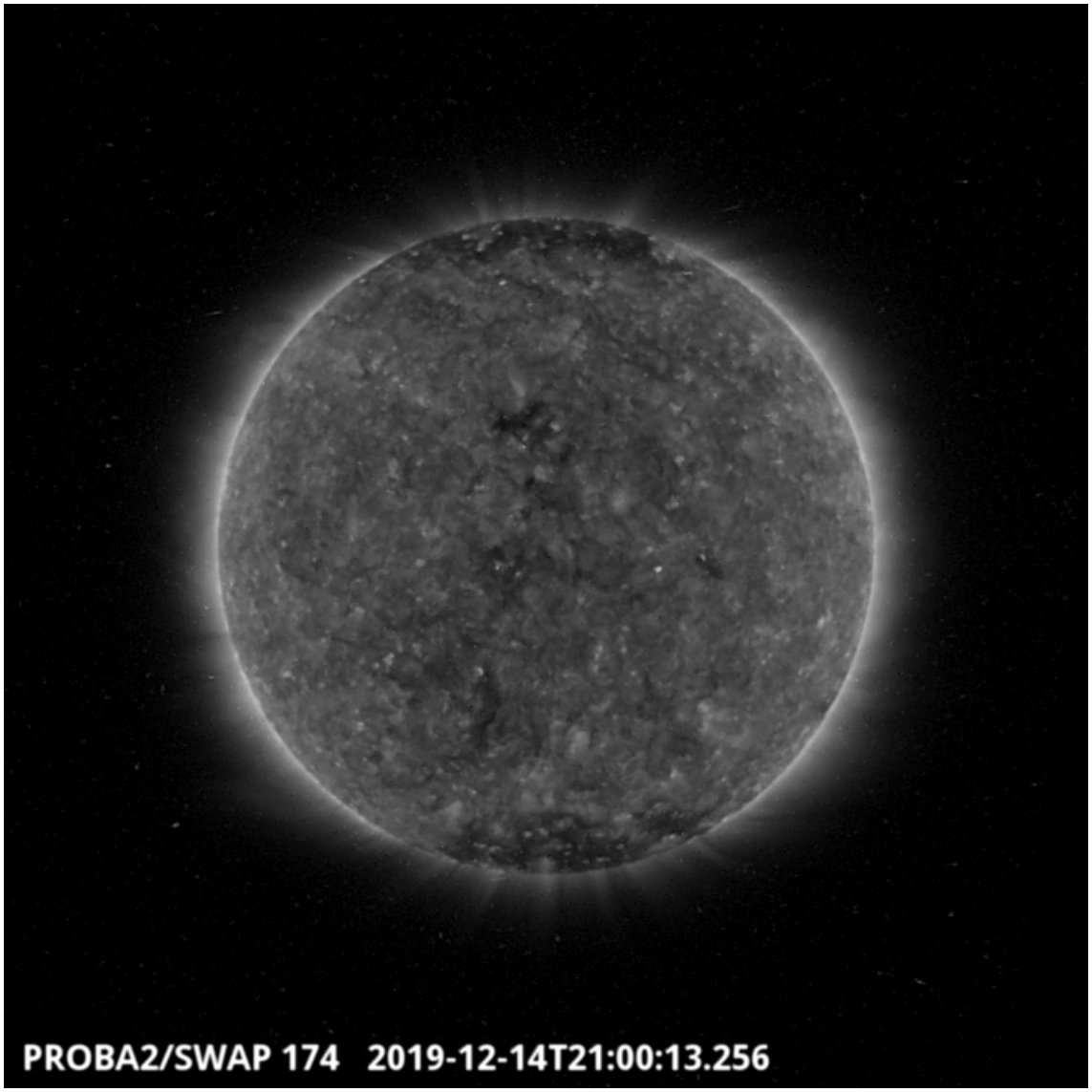
If any of the linked movies are unavailable they can be found in the P2SC movie repository here https://proba2.oma.be/swap/data/mpg/movies/

Tuesday Dec 10



A southern elongated coronal hole transited the central meridian on 2019-Dec-10 and is visible on the SWAP image above. Find a movie of the day here (SWAP movie) http://proba2.oma.be/swap/data/mpg/movies/2019/11/20191210_swap_movie.mp4

Saturday Dec 14



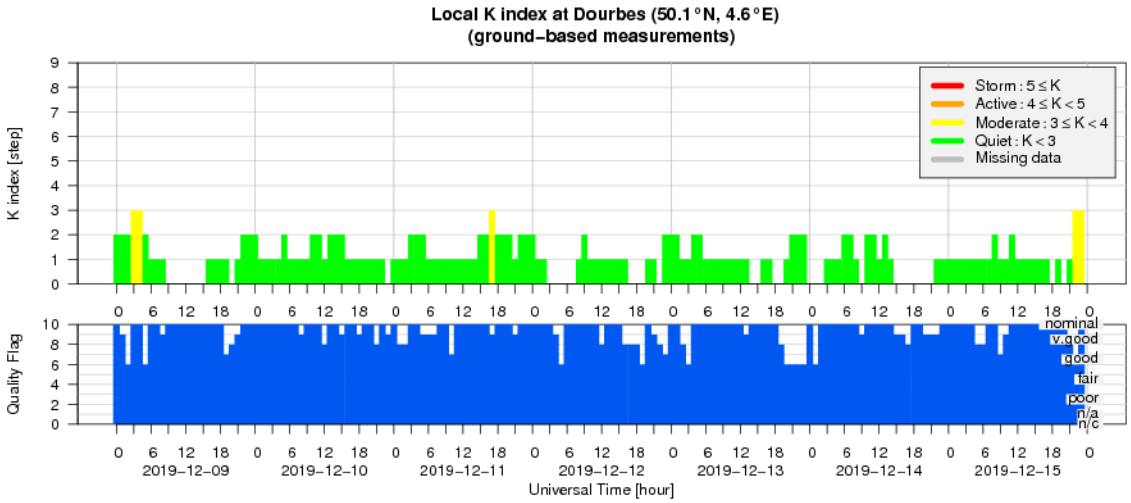
An extended central coronal hole transited the central meridian on 2019-Dec-14 is visible on the SWAP image above. Find a movie of the day here (SWAP movie) http://proba2.oma.be/swap/data/mpg/movies/2019/11/20191214_swap_movie.mp4

6. Review of geomagnetic activity

At the beginning of the week, the solar wind at L1 had a speed around 350 km/s. The interplanetary magnetic field strength was 5 nT. The in situ observations indicated the passage of an ICME (of unclear solar origin) at L1 early in the morning of December 10. The ICME was followed by the solar wind from the patchy, negative polarity coronal hole (which reached central meridian on December 05). The solar wind speed reached maximum value of about 480 km/s and the interplanetary magnetic field magnitude was up to 9 nT.
Another interval of slightly enhanced solar wind speed (up to 430 km/s) and the interplanetary magnetic field magnitude (up to 7 nT) was observed in the afternoon of December 15. This was possibly associated with the negative polarity coronal hole that crossed central meridian on December 10.

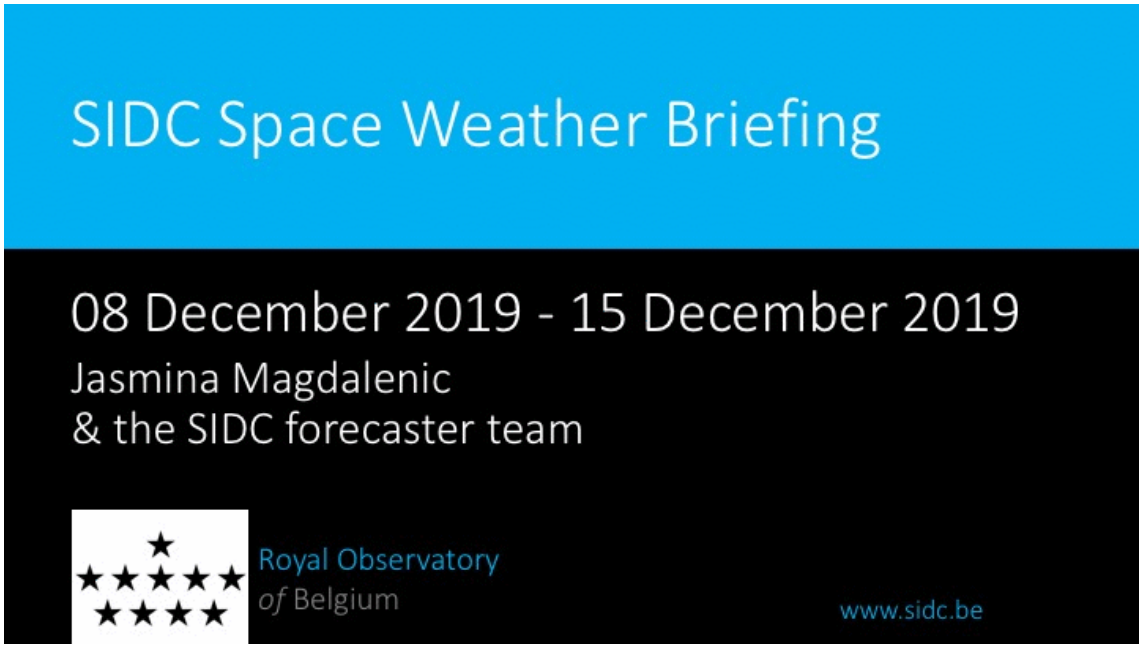
Geomagnetic conditions were quiet with a few intervals of unsettled conditions, both locally (Dourbes) and on the planetary level. The 'All quiet alert' was on during the whole week.

7. Geomagnetic Observations at Dourbes (9 Dec 2019 - 15 Dec 2019)



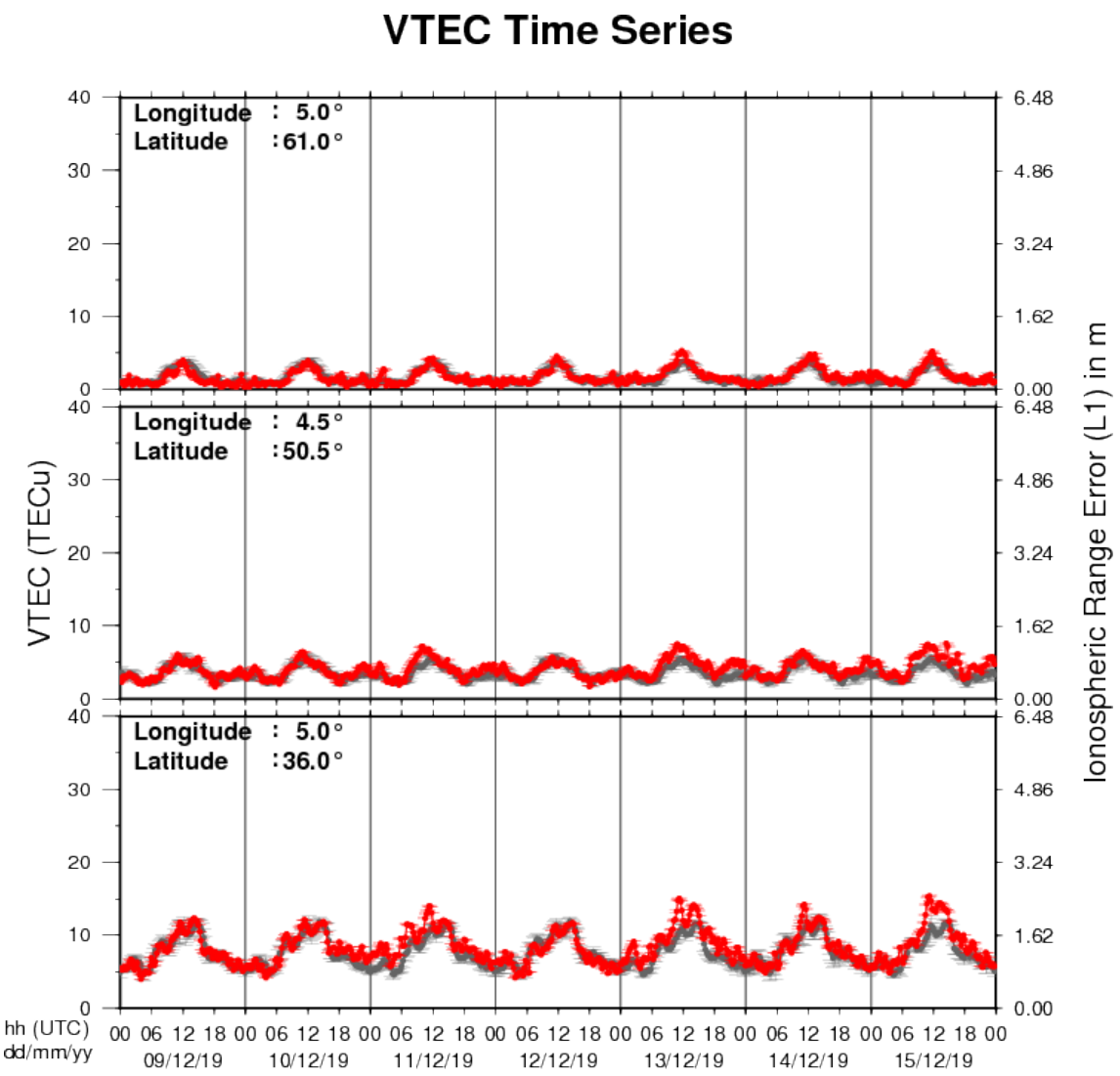
8. The SIDC space weather Briefing

The Space Weather Briefing presented by the forecaster on duty from December 8 to 15. It reflects in images and graphs what is written in the Solar and Geomagnetic Activity report.



The pdf-version: http://www.stce.be/briefings/20191216_SWbriefing.pdf
The automatically running presentation: http://www.stce.be/briefings/20191216_SWbriefing.ppsm

9. Review of ionospheric activity (9 Dec 2019 - 15 Dec 2019)



The 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(N61°, 5°E)
b) above Brussels(N50.5°, 4.5°E)
c) in the southern part of Europe(N36°, 5°E)
This figure also shows (in grey) the normal ionospheric behaviour expected based on the median VTEC from the 15 previous days.

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 detailed information, see http://gnss.be/ionosphere_tutorial.php