STCE Newsletter

3 Nov 2014 - 9 Nov 2014

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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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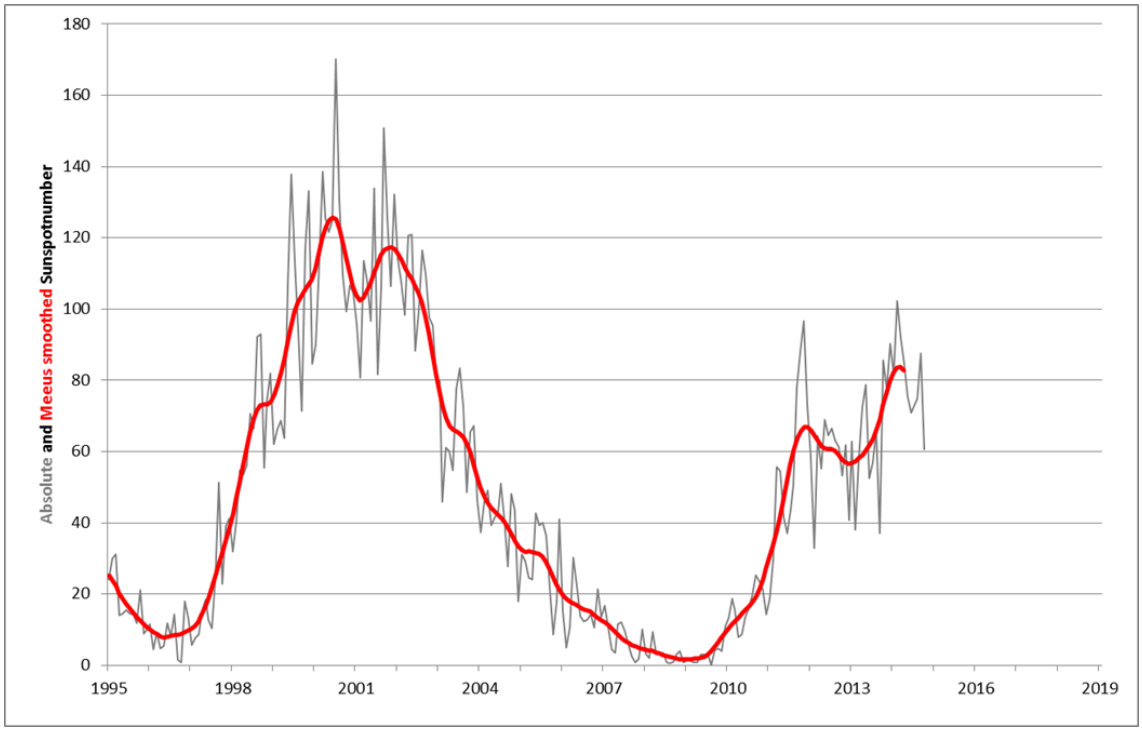
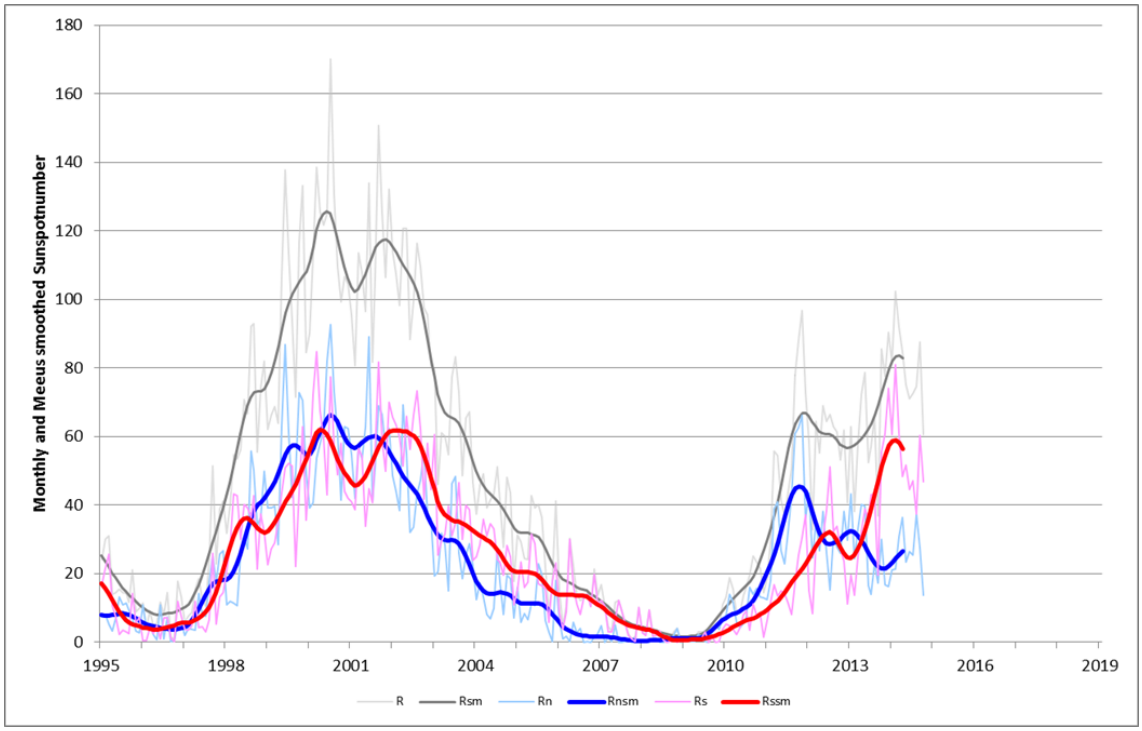
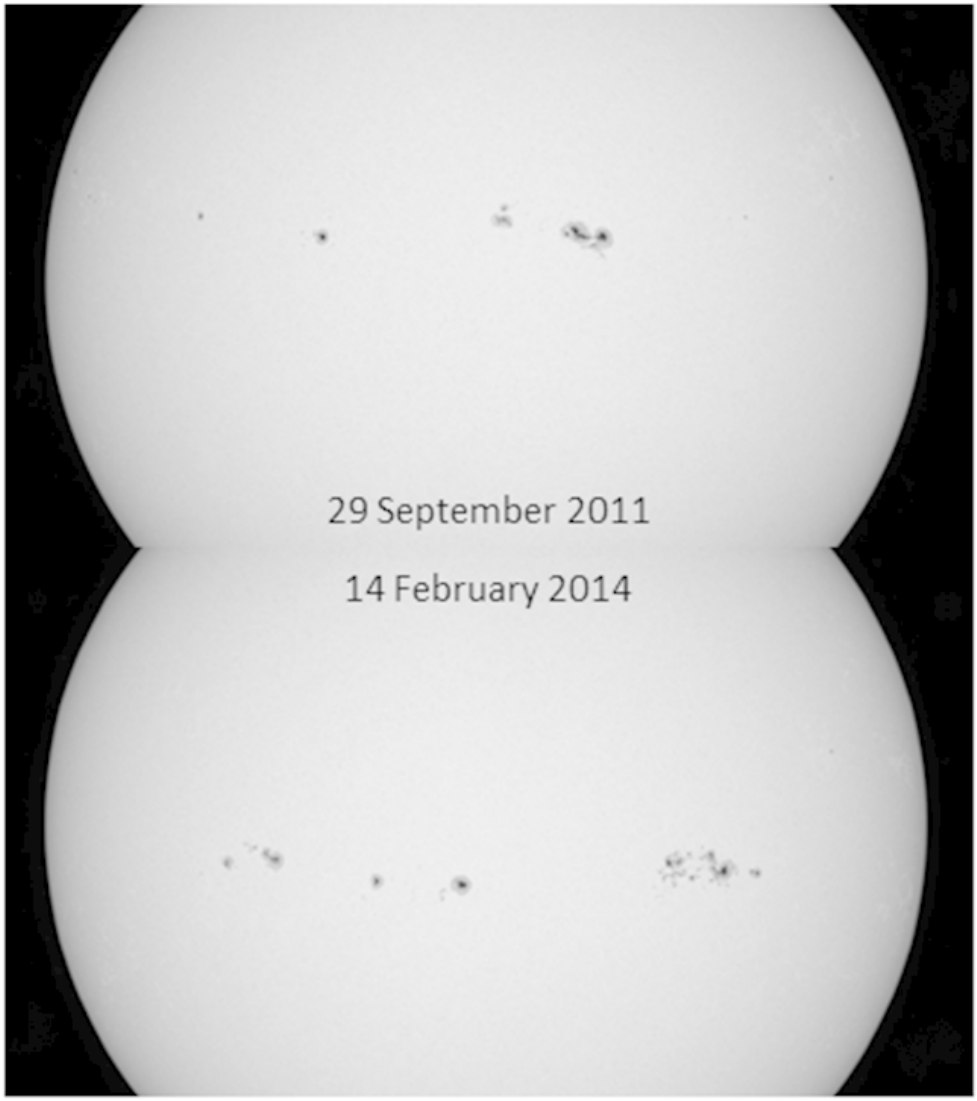
1. How's SC24 doing?

We are now close to 6 years since solar cycle 24 (SC24) started the gradual climb towards its solar cycle maximum. Over the last year, solar activity was mostly elevated, with several X-class flares and large sunspot groups. As the sunspot activity varies from month to month, the monthly sunspot numbers are smoothed to get an idea of the overall evolution. It then appears, pending the smoothing formula used, that a solar cycle maximum occurred during the early spring months of 2014 (red curve in graph underneath).

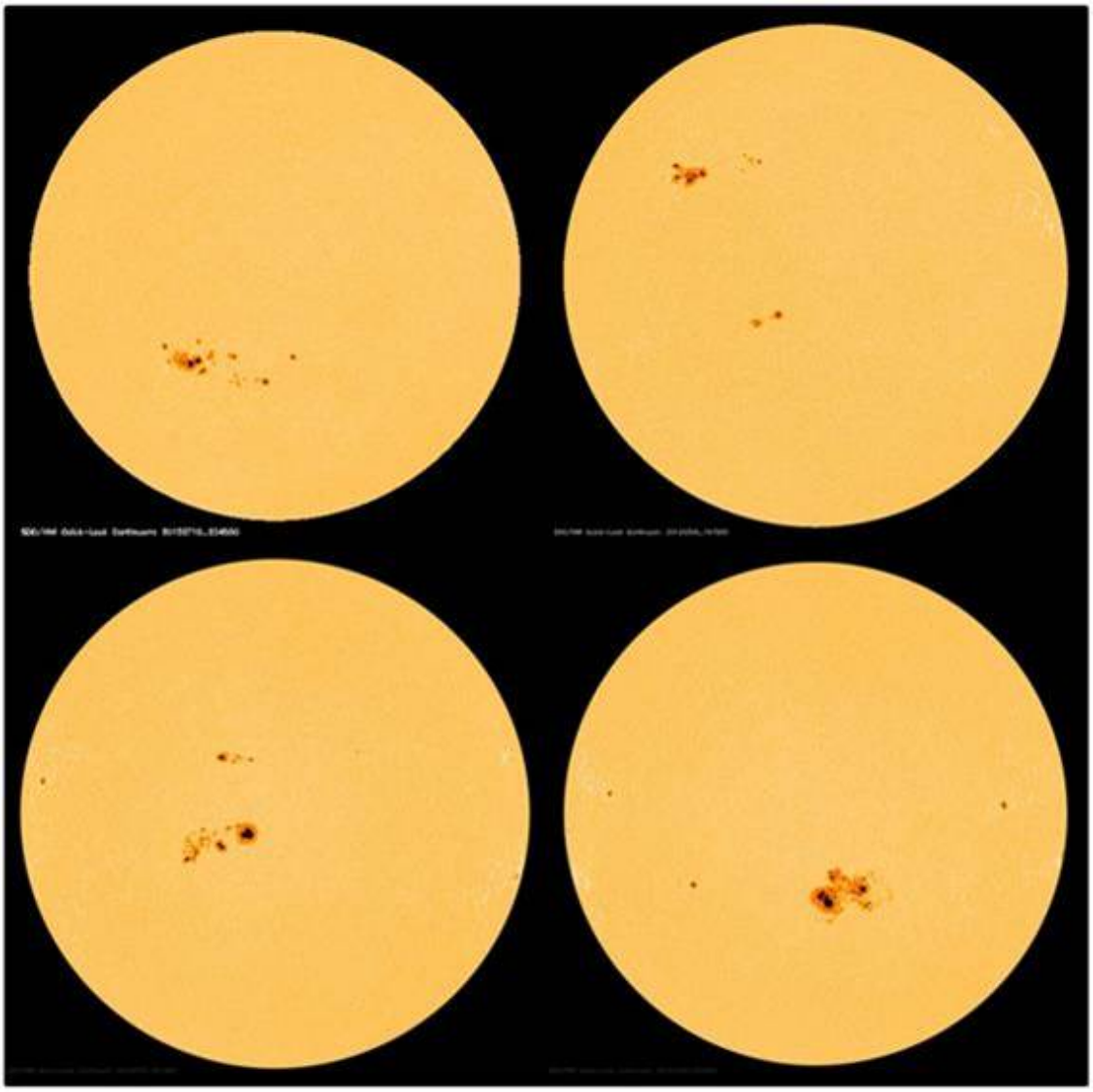


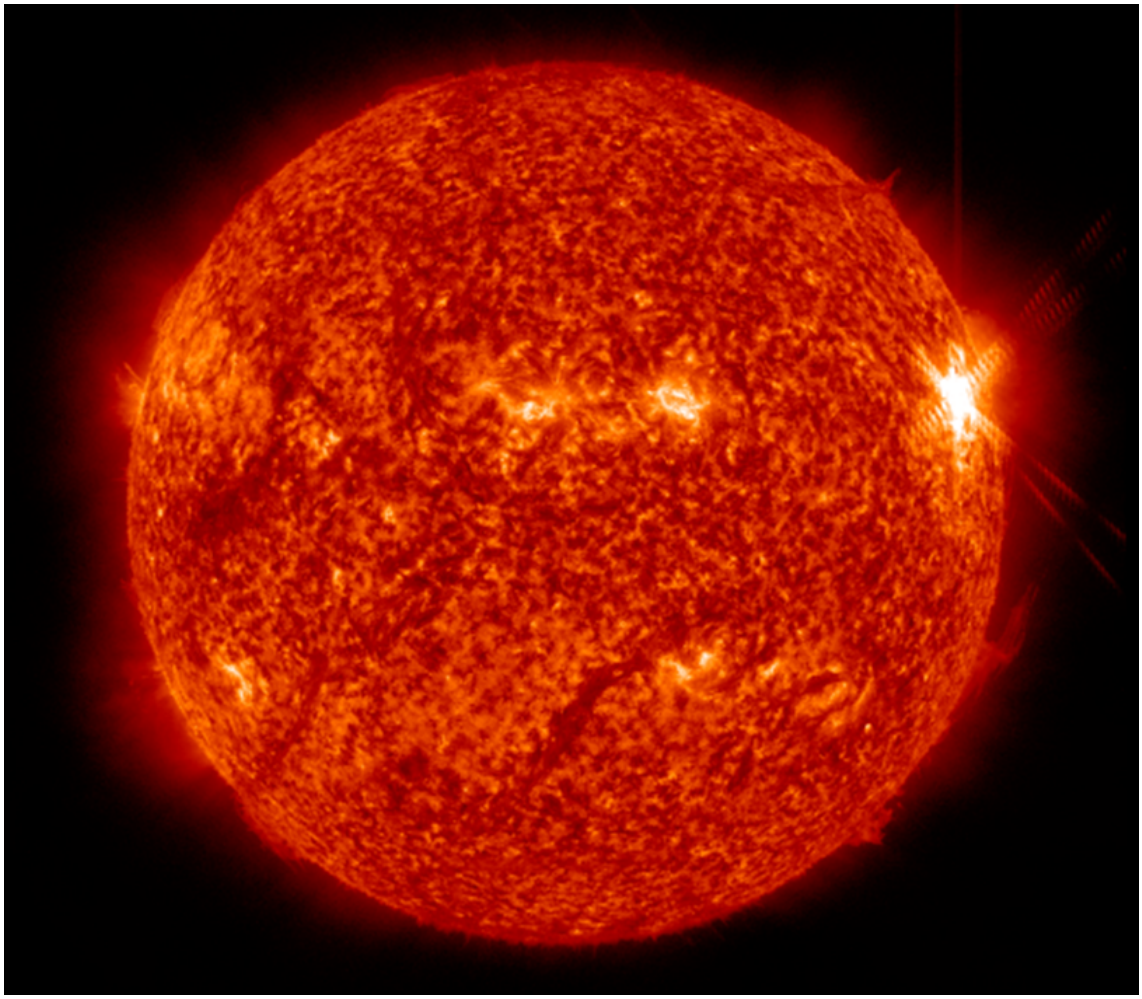
This maximum is quite a bit higher than the one recorded late 2011, as many solar observers will certainly confirm. The 2014 smoothed maximum seems to be about 83, whereas the one in 2011 only reached 66. This figure of "83" is very close to the maximum sunspot number predicted by the international team back in 2008-2009 (see this page at http://www.swpc.noaa.gov/SolarCycle/SC24/). The recent maximum was mainly due to increased activity on the southern solar hemisphere (red curve in graph underneath), whereas high activity on the northern hemisphere (blue curve) was the cause of the 2011 maximum.


Monthly and Meeus smoothed Sunspotnumber
180
160
140
120
100
80
60
40
20
0
1995
1998
2001
2004
2007
2010
2013
2016
2019
R
Rsm
Rn
Rnsm
Rs
Rssm

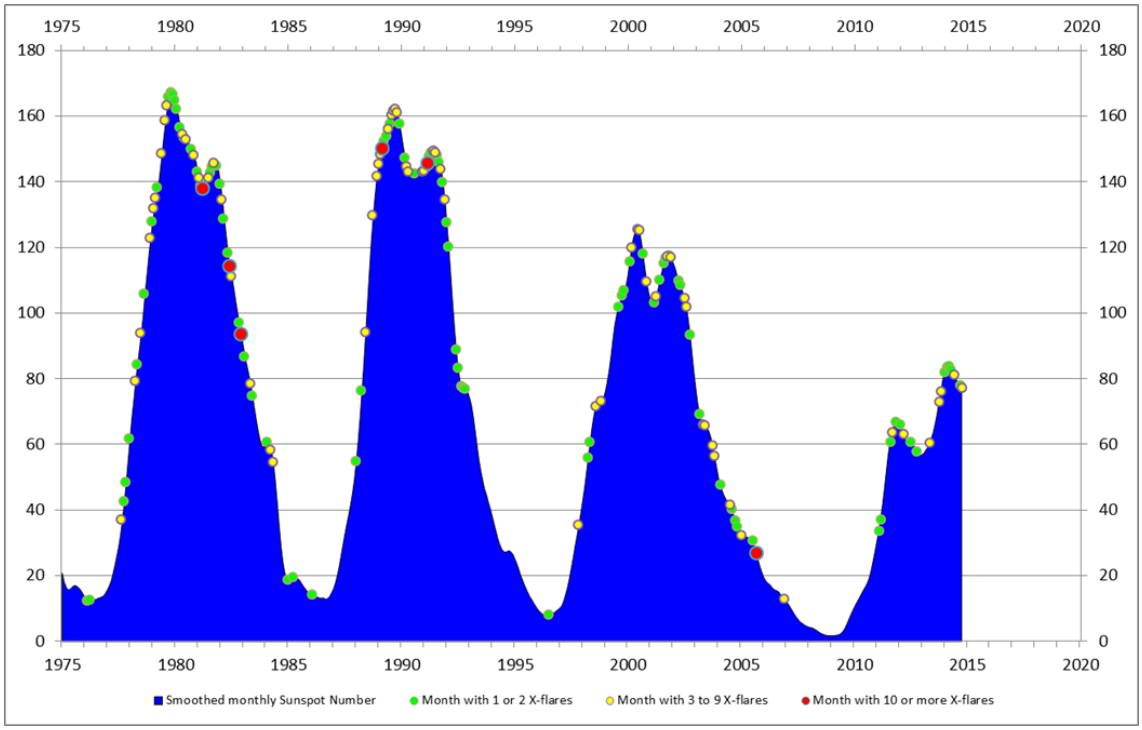


Many large sunspot groups have appeared during this cycle maximum, and –of course- the solar cycle is not finished yet! Underneath a few examples of big groups in SC24 producing at least one X-class ("eXtreme") flare. From left to right and from top to bottom: NOAA 1522 (July 2012), NOAA 1429 (March 2012), NOAA 1944 (January 2014), and of course NOAA 2192 (October 2014). So far, the largest X-class flare (X6.9 - image underneath) occurred on 9 August 2011 and was produced by NOAA 1263.





It does not happen very often that in a single month, the Sun produces more than 3 X-class flares. In fact, since measurements started in 1976, there have been only about 70 such months - as can be seen from the yellow and red dots superposed on the smoothed sunspot number in graph underneath. Seven of those have occurred during the ongoing SC24, with the latest in October due to famous NOAA 2192 flaring activity (6 X-class flares). However, as one can see from graph underneath, no month with 10 or more X-class flares (red dots) has occurred so far this SC. The red dots in the graph underneath show that SC21 had 3 such months, SC22 two, and SC23 only one. Amazingly, that one was not related to one of the Halloween groups, but to sunspot group NOAA 0808 that appeared in September 2005.



Credits - SILSO (http://sidc.oma.be/silso/), SDO (http://sdo.gsfc.nasa.gov/data/aiahmi/)

2. European Space Weather Week - high mass for space weather

From 17 to 21 November, more than 350 scientists from all over the world will gather in Liège, Belgium to discuss the newest insights in space weather. They try to predict solar storms and understand how these storms travel through space and can impact the Earth. Space weather is not only of interest to scientists, but it is also important for companies that, for example, depend on GPS navigation and accurate timings.

Just this week, a very big sunspot is visible again. At the end of October, this spot, which was visible with the naked eye, caused commotion because it produced many extreme solar flares. Satellite operators were alarmed and prepared for potentially large particle storms that luckily did not materialize. This super sunspot group, which they hope to watch live, will certainly be a hot topic of discussion.

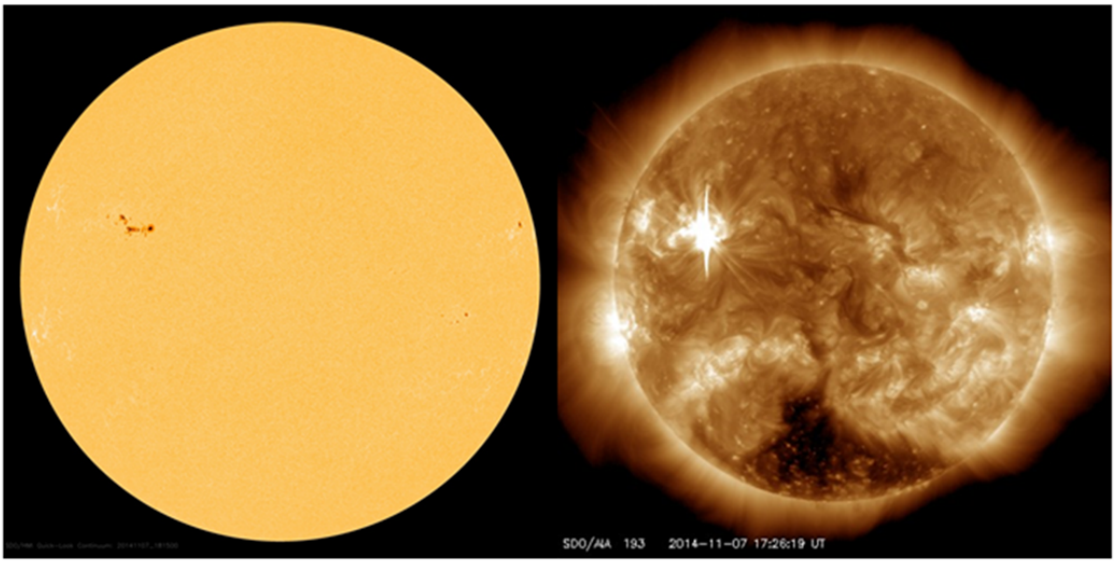
Please have a look at
http://www.stce.be/esww11

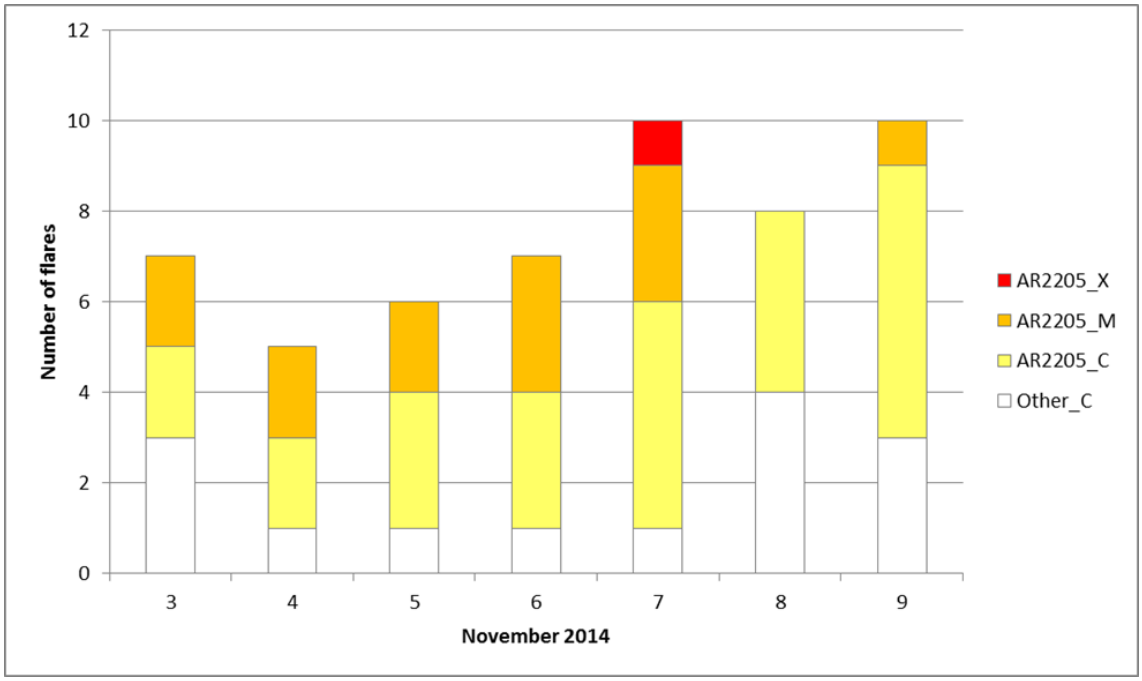
November 17 - 21, 2014
Liège, BELGIUM

SPACECRAFT - IONOSPHERE & GNSS - PLANETARY SYSTEMS - NUMERICAL SW PREDICTIONS - GEOSPACE - SOLAR PARTICLES - ENTERPRISES - SW SCIENCE, ENGINEERING AND APPLICATIONS - SPACE BASED OBSERVATIONS - SPACE CLIMATE

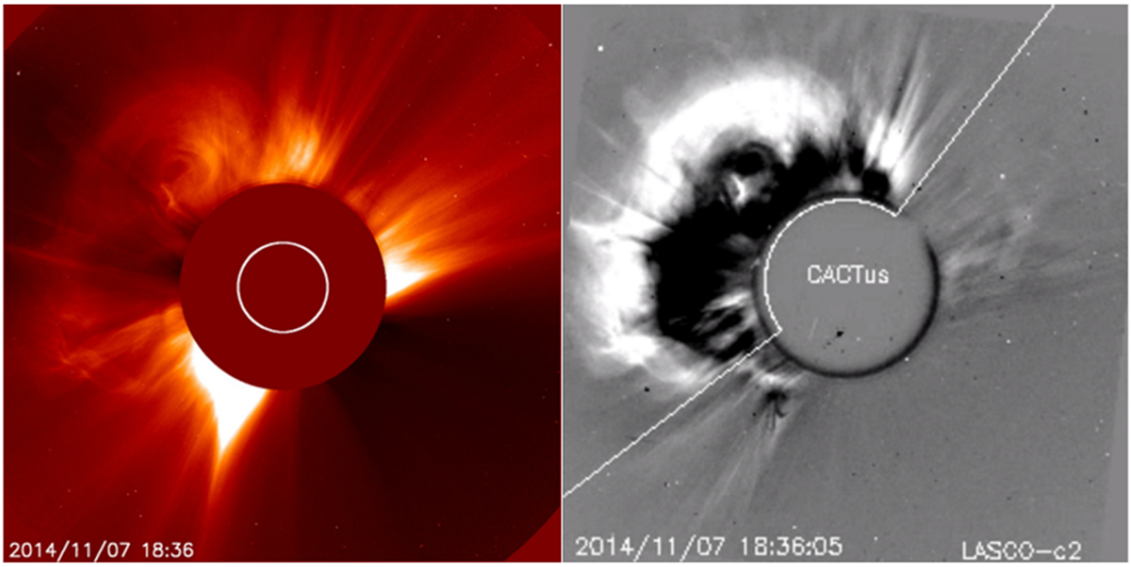
3. Review of solar activity (3 Nov 2014 - 9 Nov 2014)

The week was dominated by NOAA active region NOAA 2205 which over the course of the week moved to its current position near the central meridian. It produced 13 M-class flares scattered over that period and an X1.6 flare peaking at 17:26UT on 7 November. More details and a movie of this event can be found at http://stce.be/news/282/welcome.html The other groups produced only a few low-level C-class flares.





Multiple coronal mass ejections (CMEs) were associated to NOAA 2205's flaring activity, though mostly not very powerful and propagating well eastward of the Sun-Earth line.
Only the CME from 7 November associated to the X-class flare is believed to have an Earth directed component. Its first appearance in SOHO/LASCO C2 coronagraph is at 18:08UT, but the actual onset was missed due to a 30 minute data gap just before. This partial halo CME was directed to the northeast and had an angular width of at least 180 degrees. CACTus initially reported this as a full halo, because it erroneously included high speed components in the southwestern direction from a different event.



The projected speed of the CME was determined to be around 600 km/s. Though the bulk of the mass was expelled in northeastern direction (off the Sun-Earth line), an Earth directed component was expected to arrive during the afternoon of 10 November. Current solar wind parameters indicate a slightly earlier than expected arrival.

4. Noticeable Solar Events (3 Nov 2014 - 9 Nov 2014)

DAY	BEGIN	MAX	END	LOC	XRAY	OP	10CM	TYPE	Cat	NOAA
03	1123	1153	1217		M2.2			II/2		2205
03	2215	2240	2253		M6.5		180	III/1II/1		2205
04	0759	0838	0851	N15E82	M2.6	SF		CTM/1VI/1		2205
04	0852	0904	0913	N15E82	M2.3	1F				2205
05	0926	0947	0955	N20E68	M7.9	1N	240	II/2		2205
05	1850	1944	2015	N17E65	M2.9	1N		VI/1II/1		2205
06	0129	0139	0154	N15E58	M3.2	2N		III/1		2205
06	0332	0346	0402	N17E58	M5.4	1N		II/1IV/1		2205
06	2153	2216	2234	N14E45	M2.5	1N	200	III/2		2205
07	0205	0249	0332	N17E50	M2.7	2N		VI/1		2205
07	0412	0425	0438		M2.0					2205
07	1013	1022	1030	N15E43	M1.0	SF				2205
07	1653	1726	1734		X1.6		72	II/2IV/1		2205
09	1524	1532	1538	N18E14	M2.3	1B				2205

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. PROBA2 Observations (3 Nov 2014 - 9 Nov 2014)

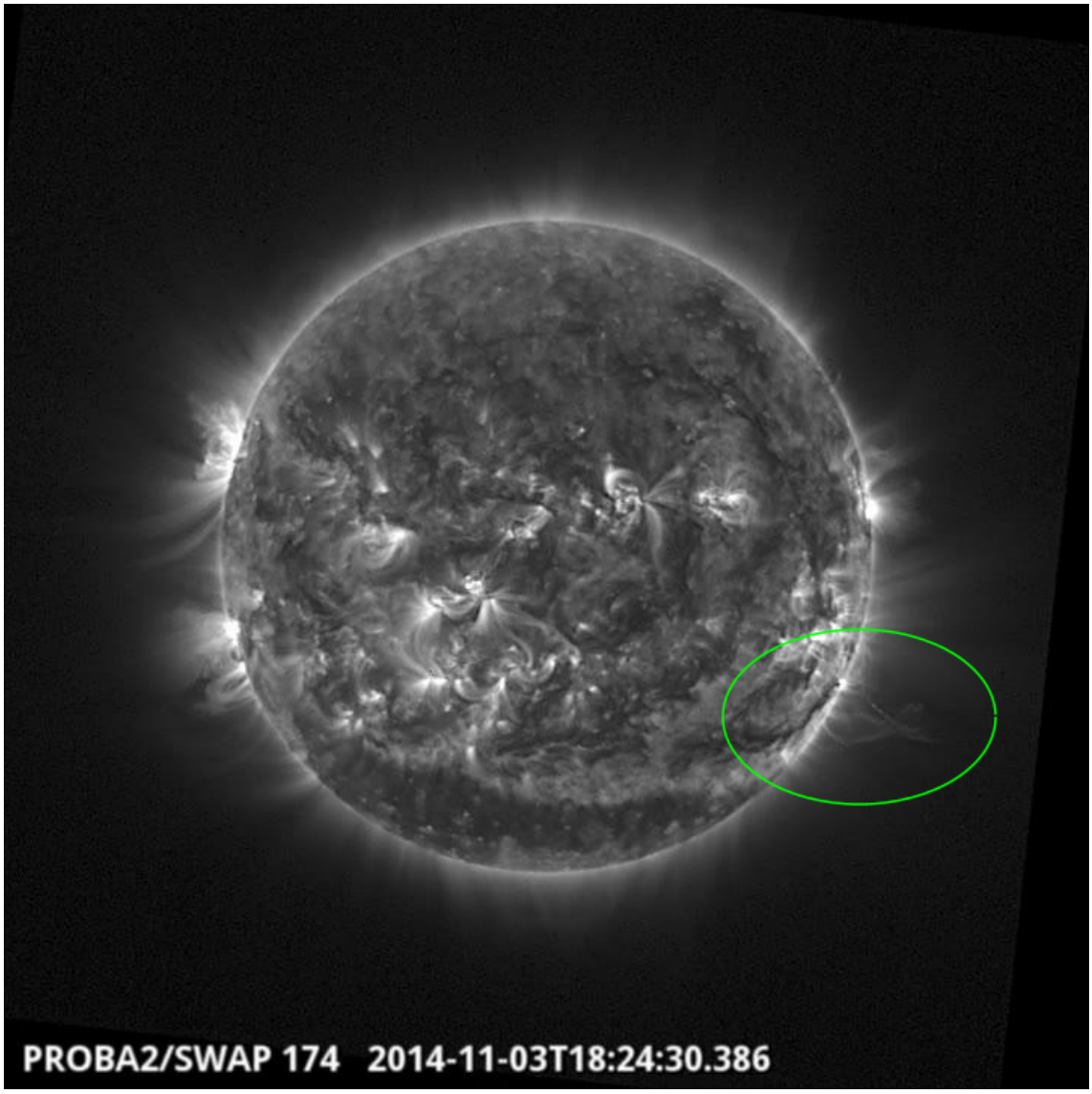
Solar Activity

Solar flare activity fluctuated between low and high 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: http://proba2.oma.be/ssa
This page also lists the recorded flaring events.
A weekly overview movie can be found here (SWAP week 241).
http://proba2.oma.be/swap/data/mpg/movies/WeeklyReportMovies/WR241_Nov03_Nov09/weekly_movie_2014_11_03.mp4
Details about some of this week's events, can be found further below.

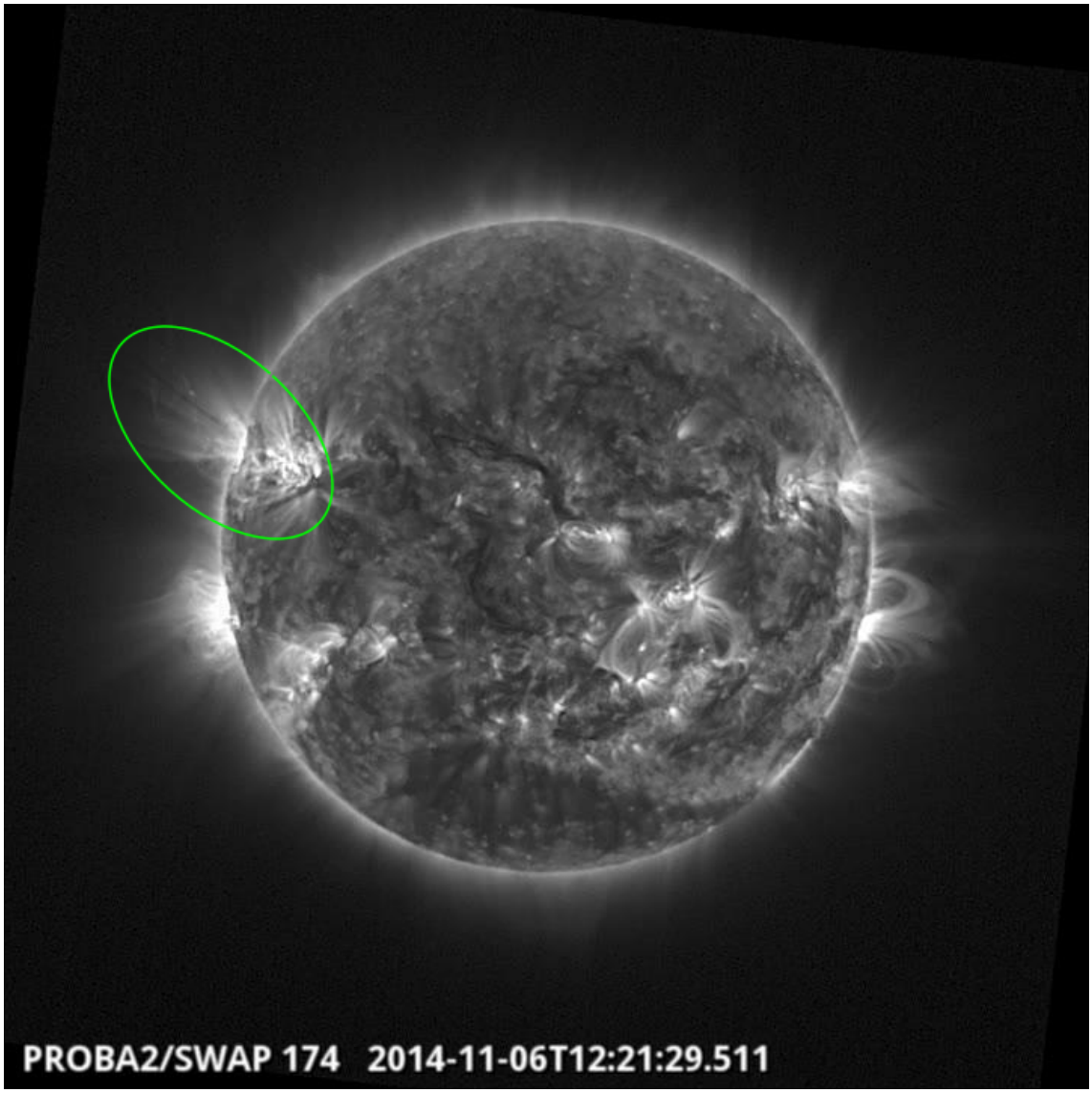
Monday Nov 03

Eruption on the north east quad @ 11:42 SWAP difference image
Find a movie of the events here (SWAP difference movie)
http://proba2.oma.be/swap/data/mpg/movies/20141103_swap_diff.mp4



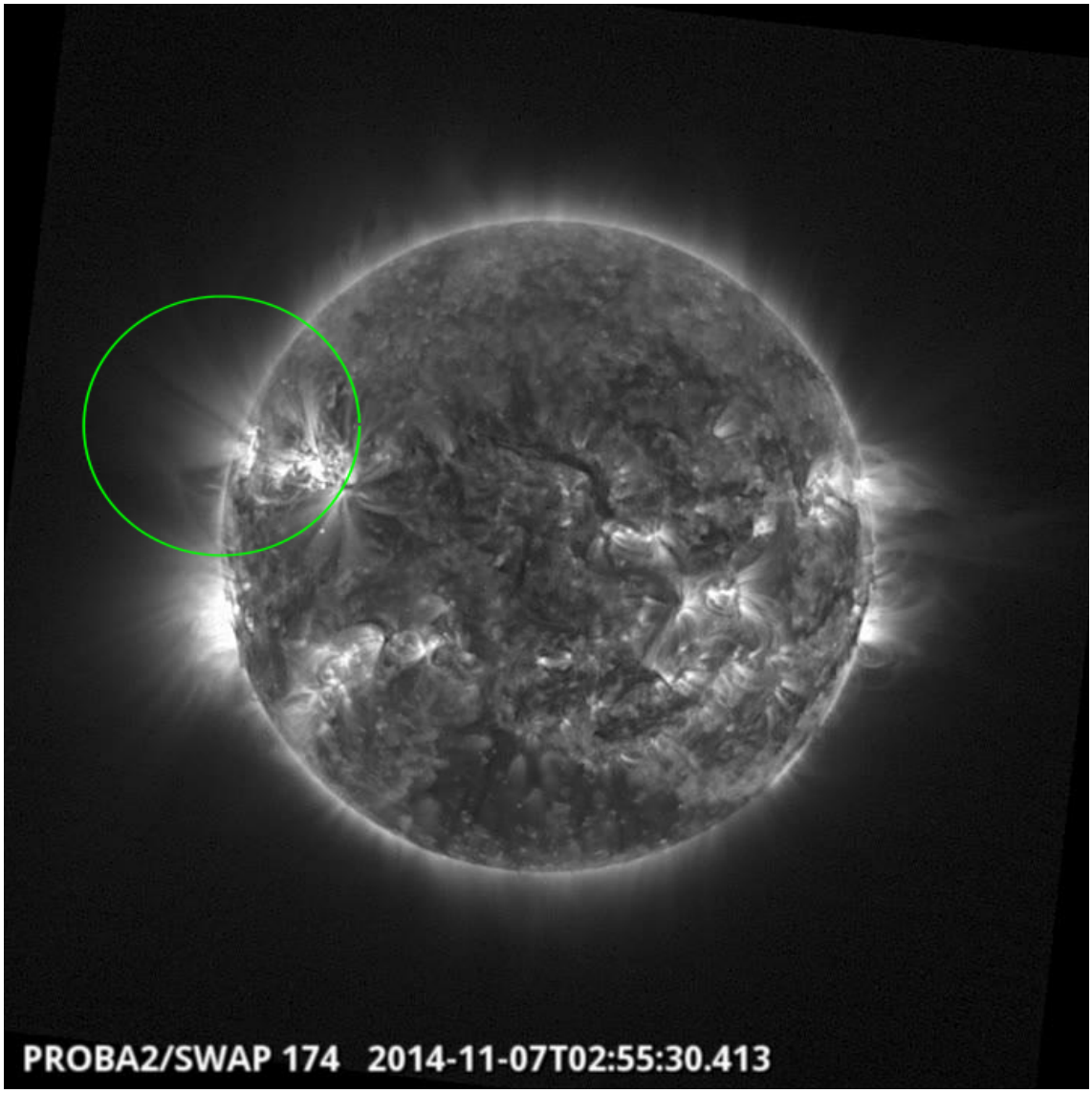
Failed eruption on the west quad @ 18:24 SWAP image
Find a movie of the events here (SWAP movie)
http://proba2.oma.be/swap/data/mpg/movies/20141103_swap_movie.mp4

Thursday Nov 06



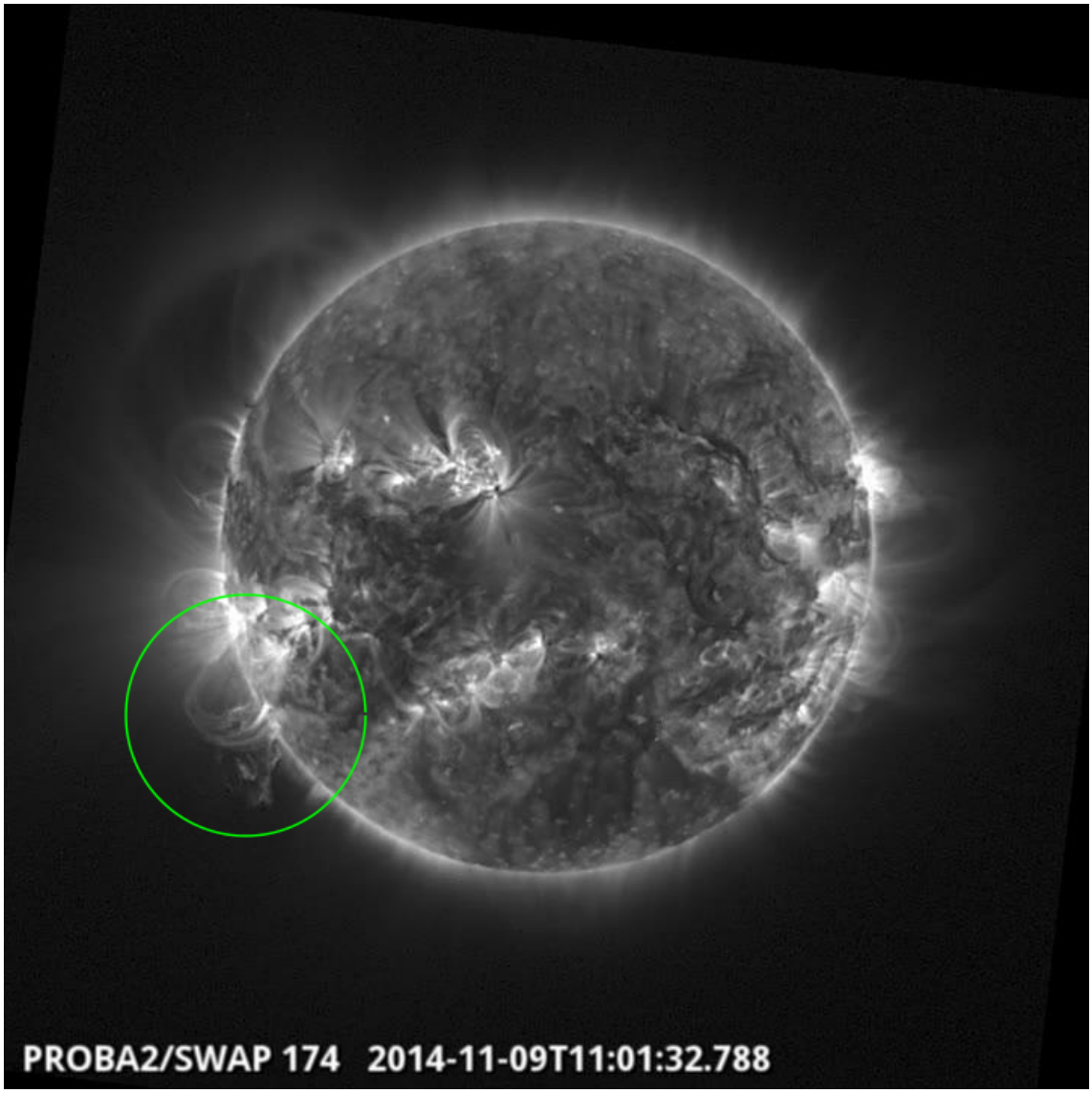
Eruption in the north east quad @ 12:21 SWAP image
Find a movie of the event here (SWAP movie)
http://proba2.oma.be/swap/data/mpg/movies/20141106_swap_movie.mp4

Friday Nov 07



Eruption in the north west quad @ 02:55 SWAP image
Find a movie of the event here (SWAP movie)
http://proba2.oma.be/swap/data/mpg/movies/20141107_swap_movie.mp4

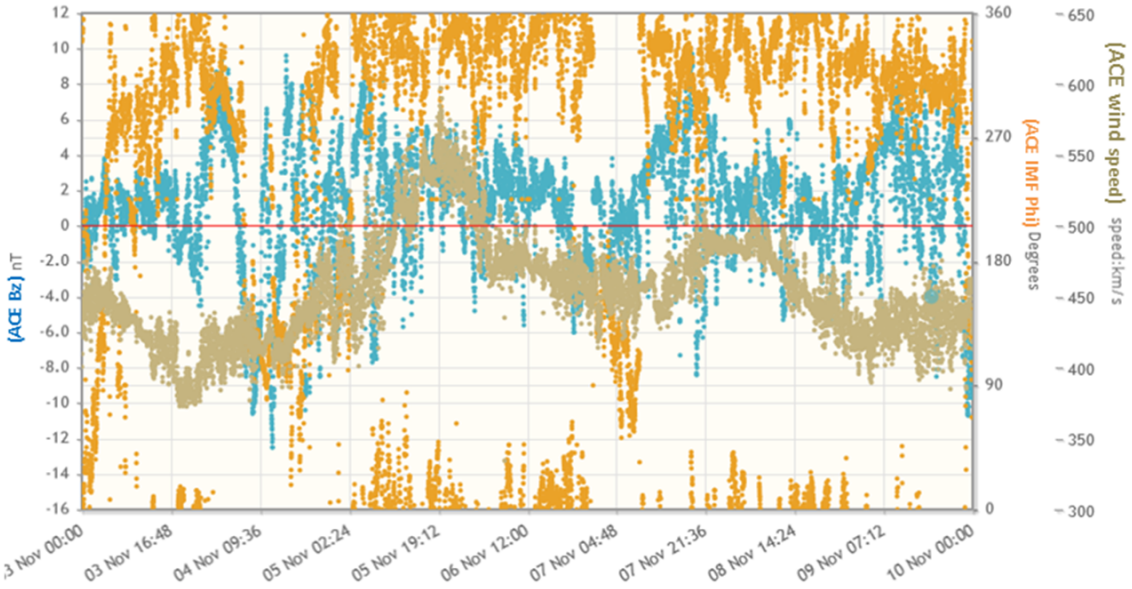
Sunday Nov 09



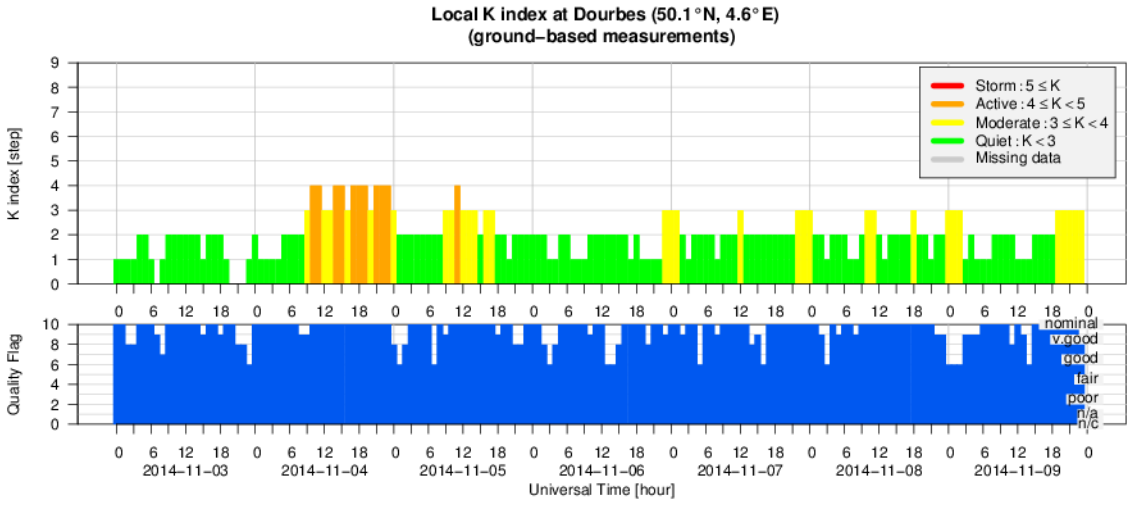
Failed eruption in the south west quad @ 11:01 SWAP image
Find a movie of the event here (SWAP movie)
http://proba2.oma.be/swap/data/mpg/movies/20141109_swap_movie.mp4

6. Review of geomagnetic activity (3 Nov 2014 - 9 Nov 2014)

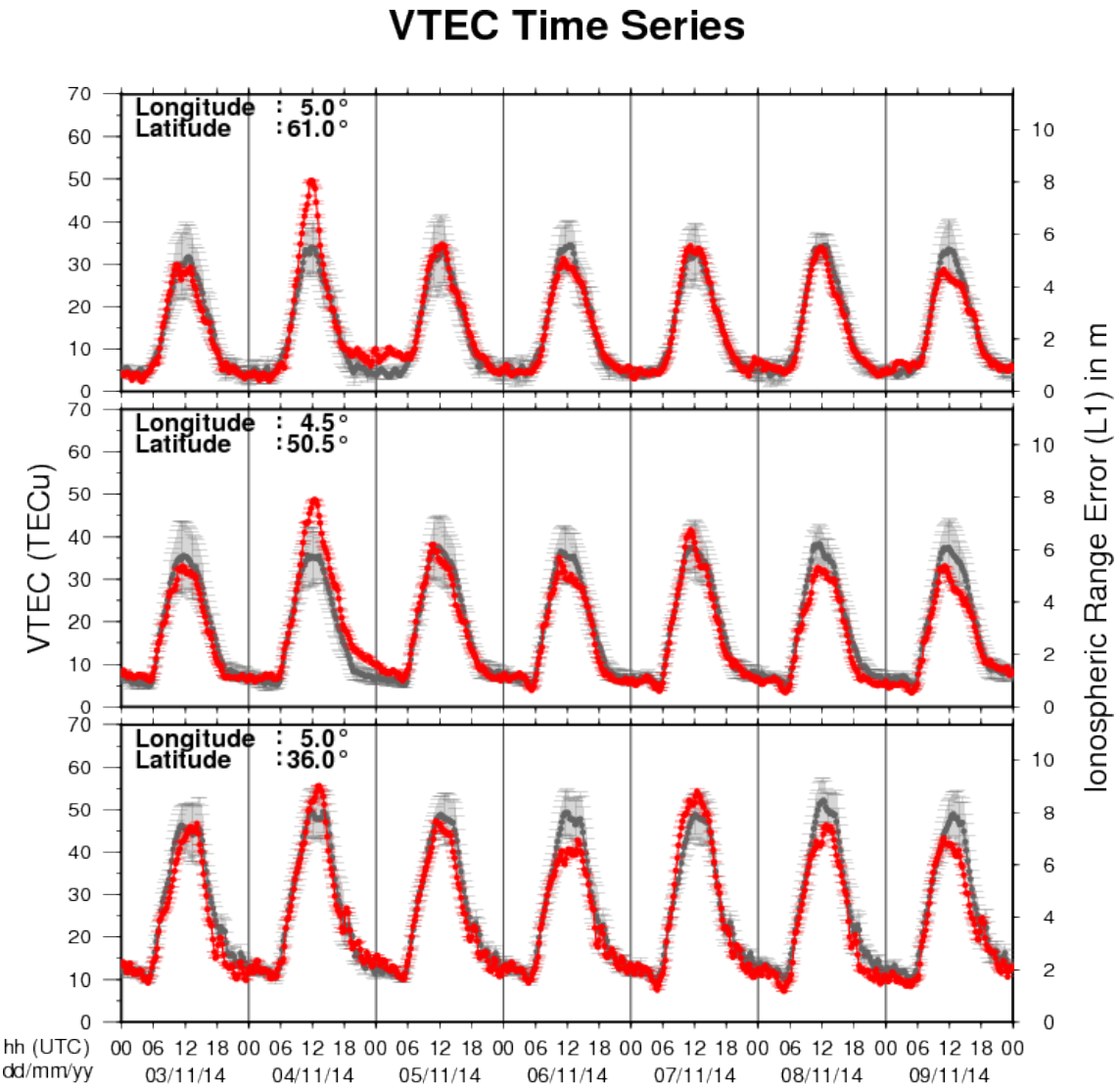
Except for some minor coronal hole high speed influences, solar wind was mostly at nominal values with some transients starting late on 3 November, possibly marking the impact of the 1 November eruption. Geomagnetic conditions were mostly quiet to unsettled (both NOAA Kp and local K Dourbes between 0 and 3), with an active period (both NOAA Kp and local K Dourbes values at 4) on 4 November associated to the aforementioned transient from the 1 November CME.



7. Geomagnetic Observations at Dourbes (3 Nov 2014 - 9 Nov 2014)



8. Review of ionospheric activity (3 Nov 2014 - 9 Nov 2014)



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

9. New documents in the European Space Weather Portal Repository

See http://www.spaceweather.eu/en/repository

STCE - Seismologie in België

Presentation, in Dutch given at the open doors of the Space Pole, Brussels, Belgium, 2014
http://www.spaceweather.eu/en/repository/show?id=548

STCE - Ruimteweer: de impact van zonnestormen op aarde

Presentation, in Dutch given at the open doors of the Space Pole, Brussels, Belgium, 2014
http://www.spaceweather.eu/en/repository/show?id=550

STCE - Seismologie in België

Presentation, in Dutch, given at the open doors of the Space Pole, Belgium, 2014
http://www.spaceweather.eu/en/repository/show?id=551

STCE - Les éruptions solaires: quand notre astre se fâche

Presentation, in Dutch, given at the open doors of the Space Pole, Belgium, 2014
http://www.spaceweather.eu/en/repository/show?id=552

Panel on Space Weather: report 2014

http://www.spaceweather.eu/en/repository/show?id=553

10. Future Events

For more details, see http://www.spaceweather.eu/en/event/future

41st COSPAR Scientific Assembly in Istanbul, Turkey

Start : 2016-07-30 - End : 2016-08-07
The 41st COSPAR Scientific Assembly will be held in Istanbul, Turkey from 30 July - 7 August 2016. This Assembly is open to all bona fide scientists.
Website:
https://www.cospar-assembly.org/