STCE Newsletter

24 Feb 2014 - 2 Mar 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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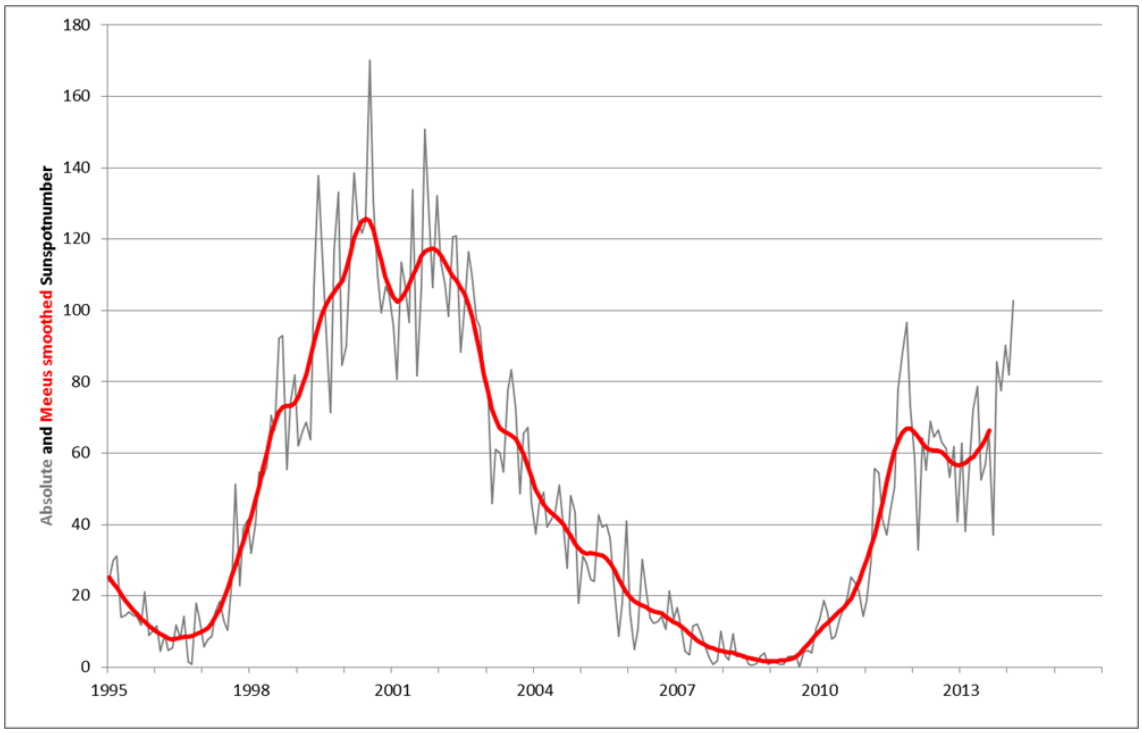
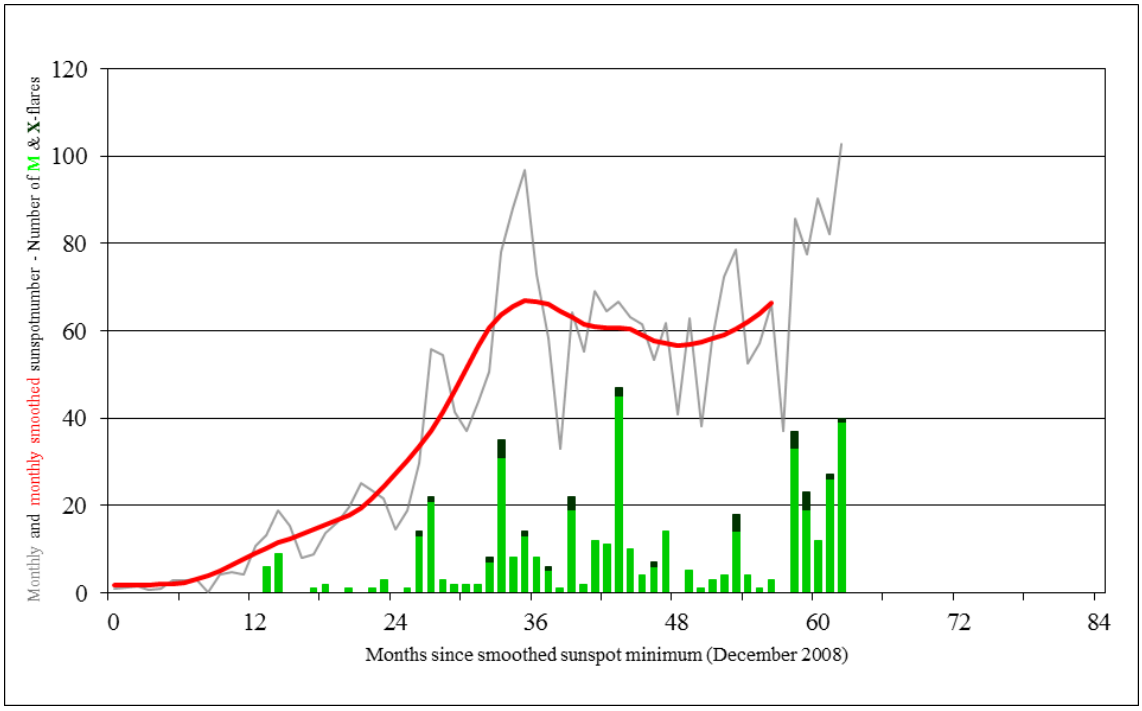
1. The long way to solar maximum (24 Feb 2014 - 2 Mar 2014)

Everybody has noticed it: Over the last few months, solar activity has shifted into a higher gear.

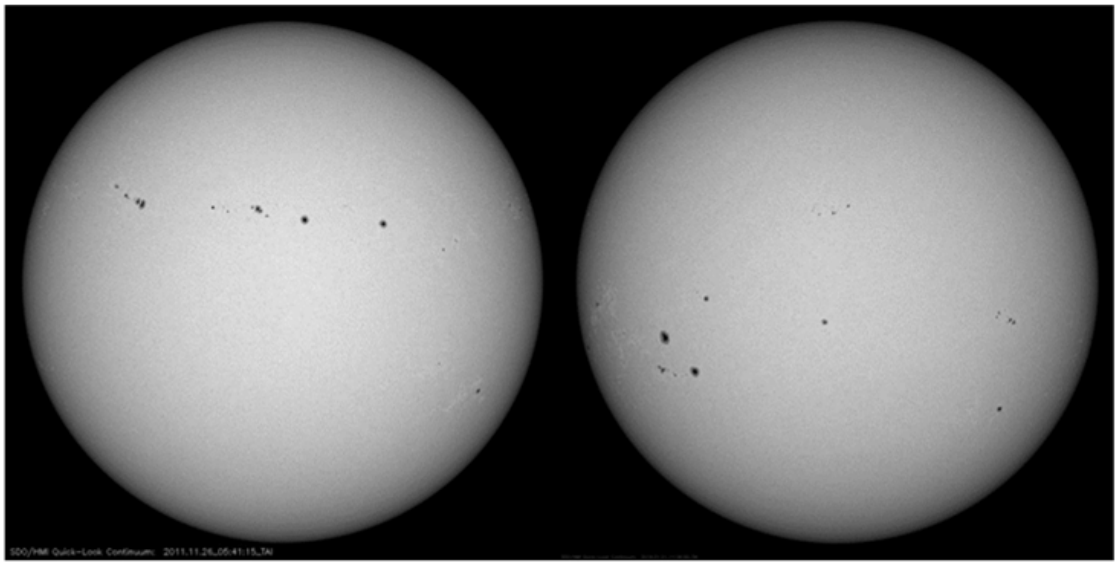
Since October last year, more and bigger sunspot groups have appeared on the solar disk, gradually driving the monthly sunspot number to new heights. Indeed, in February, preliminary values (SILSO at http://www.sidc.be/silso/) for the international sunspot number reached 102.8, the highest so far this solar cycle. Also the smoothed sunspot number is on the rise and easily surpasses the previous "maximum" that occurred late 2011-early 2012. Five years after its start in December 2008, Solar Cycle 24 (SC24) seems finally to have arrived at its maximum.



This upswing in solar activity is also noticeable in other parameters, such as the radio-flux or the number of solar flares. As can be seen in the chart underneath (data from NOAA/NGDC), the number of medium (M) and extreme (X) flares has been at a relatively high level. So far this solar cycle, there have been 8 months with more than 20 M- and X-class flares, and half of those have occurred over the last 5 months. Over the same time period, one third of all M/X-flares in SC24 were produced.



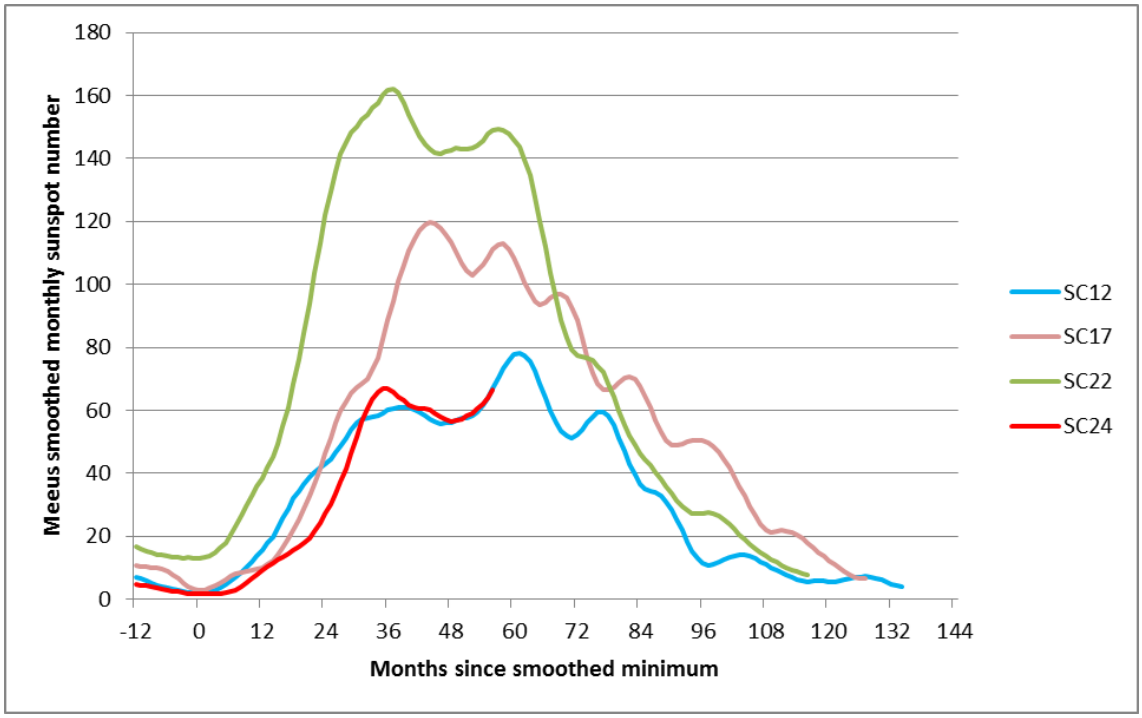
This ongoing maximum of SC24 seems to be on the account of the southern hemisphere, contrary to the 2011-2012 bump which happened mostly on the northern hemisphere. These timings are in line with the onset of solar activity as well as with the reversals of the polar magnetic fields of the Sun (see this STCE news item at http://stce.be/news/211/welcome.html). Double peaked maxima are by no means exceptional, they happened for example also during the previous 2 solar cycles. Nonetheless, cycles with lower amplitudes such as SC24 have a longer and more complex maximum phase, quite different from a "classical" single or double sharp peak. These are actual manifestations of the solar dynamo, which are not encompassed by most solar cycle models which only show a smooth, asymmetric cycle shape.



26 November 2011 21 January 2014

Pending the further evolution of the solar activity, the (smoothed) maximum is expected to occur late 2013 or in 2014. That means the time of rise would be around 5 years, which is relatively long compared

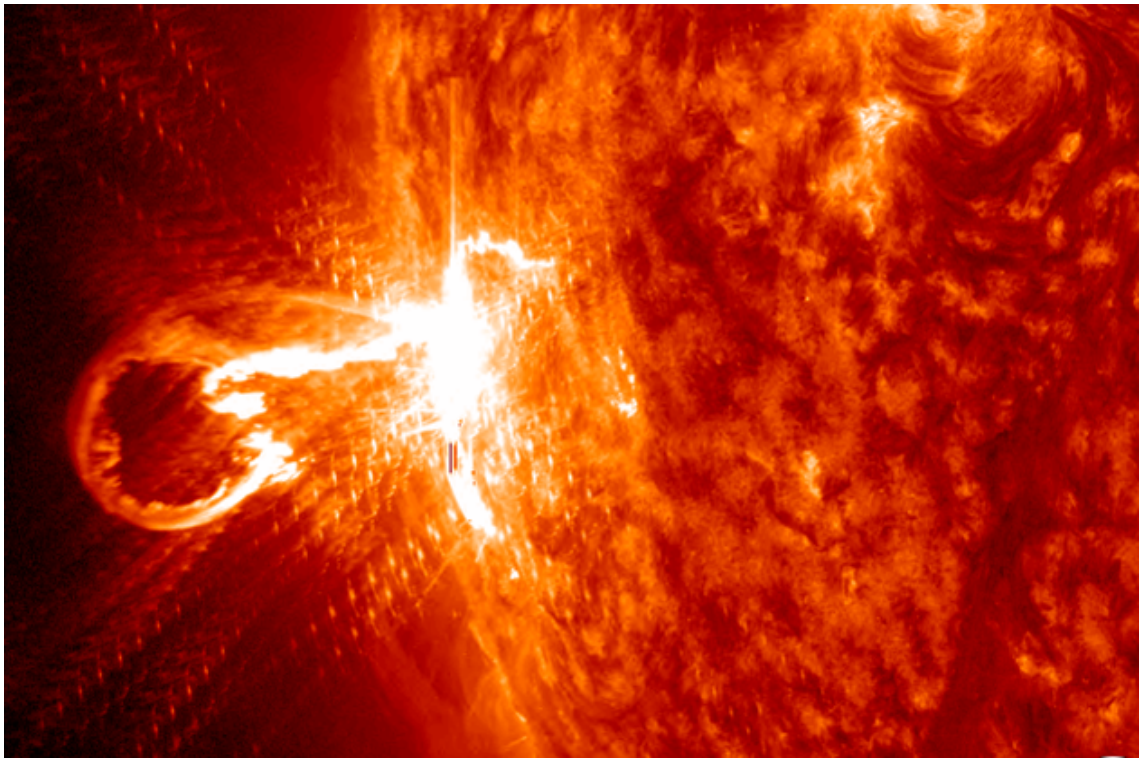
to the "average" solar cycle. However, as the maximum is forecast to be relatively low too, these timings are perfectly similar to previous solar cycles with comparable amplitude (e.g. SC12). It is also possible that another "bump" occurs during the declining phase of the solar cycle, as has been observed in various other solar cycles such as SC17. It is clear we're not done yet with this solar cycle!



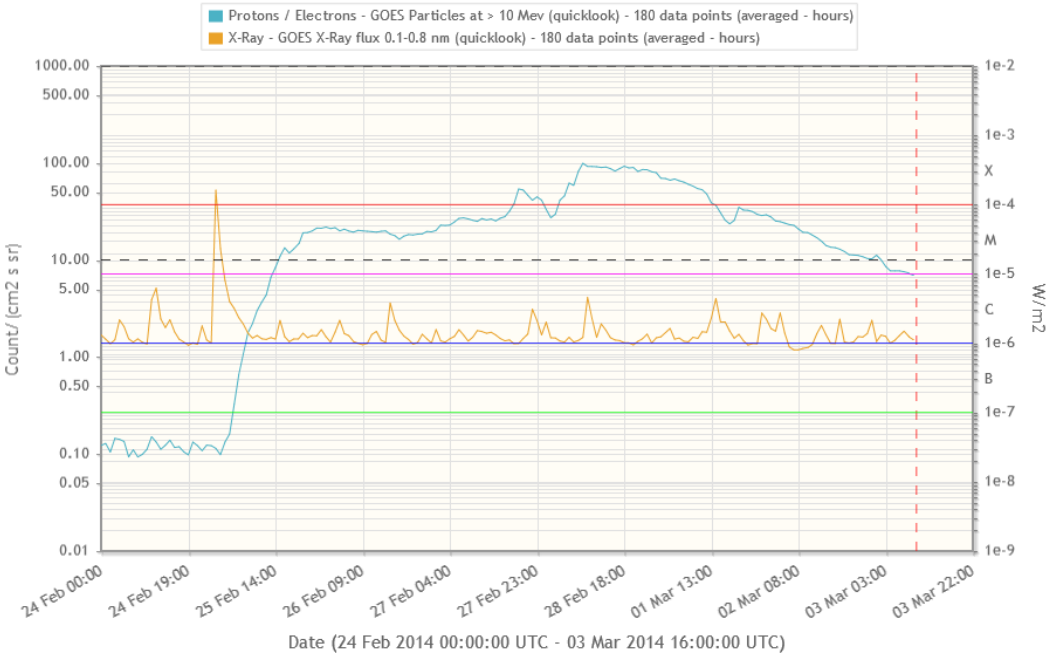
Credits - Sunspot data are available at SILSO (http://www.sidc.be/silso/), and the flare data at NOAA/NGDC (ftp://ftp.ngdc.noaa.gov/STP/space-weather/solar-data/solar-features/solar-flares/x-rays/goes/). Imagery was taken from SDO (http://sdo.gsfc.nasa.gov/data/aiahmi/browse/).

2. Review of solar activity (24 Feb 2014 - 2 Mar 2014)

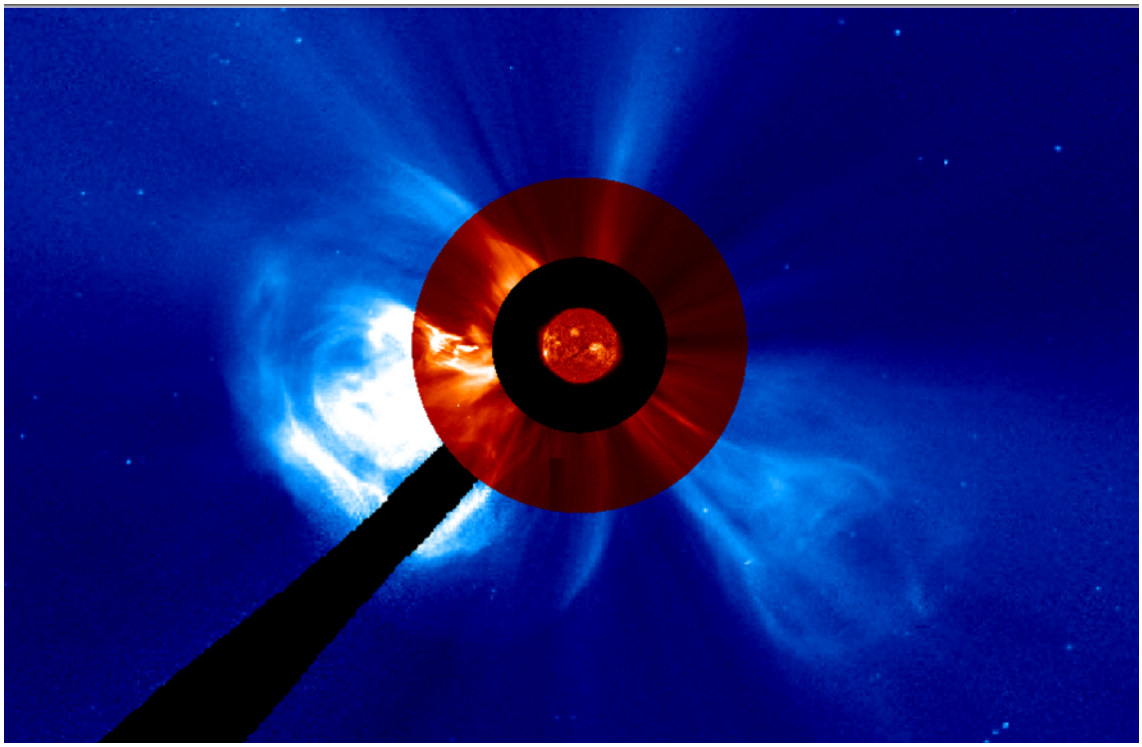
The highlight of the week was the X4.9 flare peaking at 00:49UT on 25 February. It took place in NOAA 1990 while it was still close to the solar east limb. This was a recurrent active region (AR), previously known as AR NOAA 1967 and AR NOAA 1944.



The flare was associated with a gradual solar proton event that crossed the event threshold (for particles having energies greater than 10 MeV) around 14:00UT on the same day. This moderate proton event remained above the threshold until early 3 March.



The X4.9 flare was also associated with a CME that expanded to a full halo CME with propagation speeds above 1500 km/s. Radio bursts were observed by the e-Callisto receivers in Malaysia and Alaska. Culgoora Observatory observed type II radio bursts with speeds of 2000 km/s and 700 km/s.



Many other active regions were present on the solar disc during the period, many with complex magnetic configuration but none of these produced more than M1 class flares. However, collectively they pushed the X-ray background nearly up to the C1 level.

3. Noticeable Solar Events (24 Feb 2014 - 2 Mar 2014)

DAY	BEGIN	MAX	END	LOC	XRAY	OP	10CM	TYPE	Cat	NOAA
24	1103	1117	1142		M1.2	F				1990
24	1200	1205	1210		M1.3			II/2		1990
25	0039	0049	0103		X4.9	B	3700	II/1V/2I/3	52	1990
26	1452	1501	1510	S13W44	M1.1	1N		III/2	46	1982
28	0044	0048	0050	S24E53	M1.1	SN			59	1991
01	1318	1333	1340		M1.1				46	1982
02	2311	2319	2326	N15W74	M1.1	SF				1986

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

4. PROBA2 Observations (24 Feb 2014 - 2 Mar 2014)

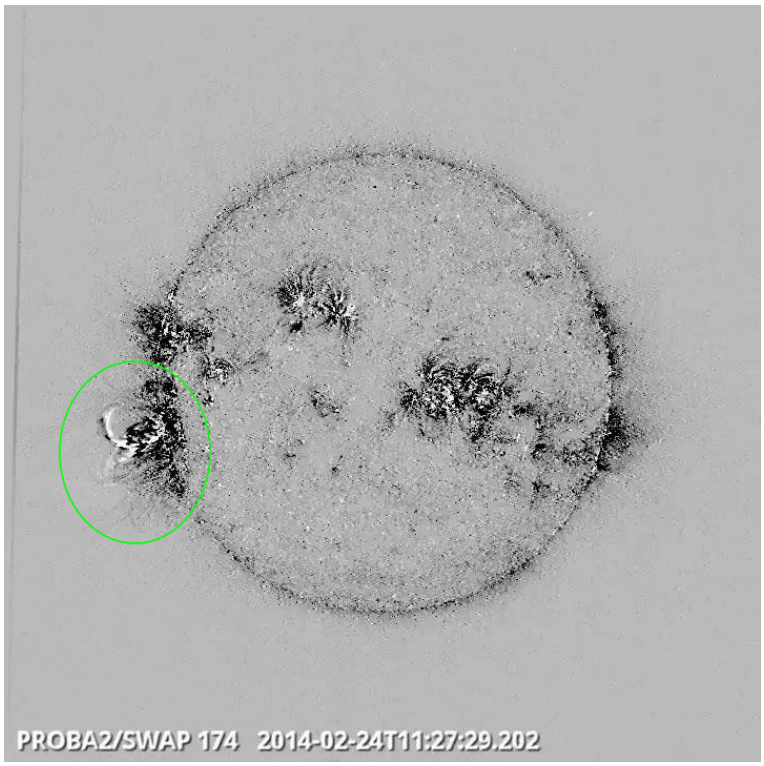
Solar Activity

Solar flare activity fluctuated between low and 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: http://proba2.oma.be/ssa
This page also lists the recorded flaring events.
A weekly overview movie can be found here (SWAP week 205).
http://proba2.oma.be/swap/data/mpg/movies/WeeklyReportMovies/WR205_Feb24_Mar02/weekly_movie_2014_02_24.mp4

Because of a science campaign with proba2 a part of the weekly movie doesn't have the Sun centered.
Details about some of this week's events, can be found further below.

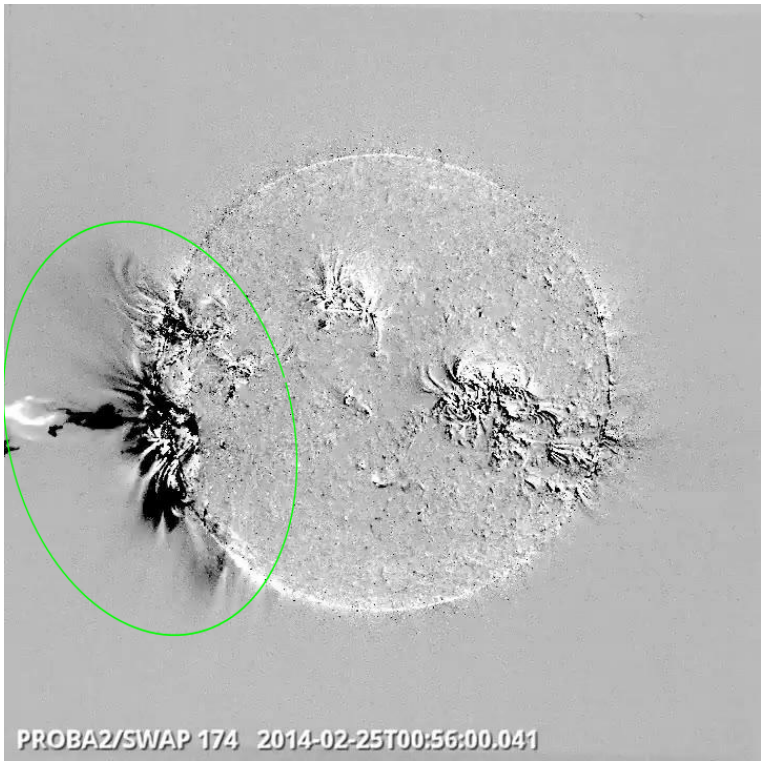
Monday Feb 24:



Failed eruption on the east limb @ 11:27 SWAP difference image
Find a movie of the events here (SWAP difference movie)
http://proba2.oma.be/swap/data/mpg/movies/WeeklyReportMovies/WR205_Feb24_Mar02/Events/20140224_FailedEruption_EastLimb_1127_swap_diff.mp4
Find a movie of the events here (SWAP movie)
http://proba2.oma.be/swap/data/mpg/movies/WeeklyReportMovies/WR205_Feb24_Mar02/Events/20140224_FailedEruption_EastLimb_1127_swap_movie.mp4

Eruptions on the west limb @ 23:02 SWAP difference image
Find a movie of the events here (SWAP difference movie)
http://proba2.oma.be/swap/data/mpg/movies/WeeklyReportMovies/WR205_Feb24_Mar02/Events/20140224_Eruptions_WestLimb_2302_swap_diff.mp4

Tuesday Feb 25:

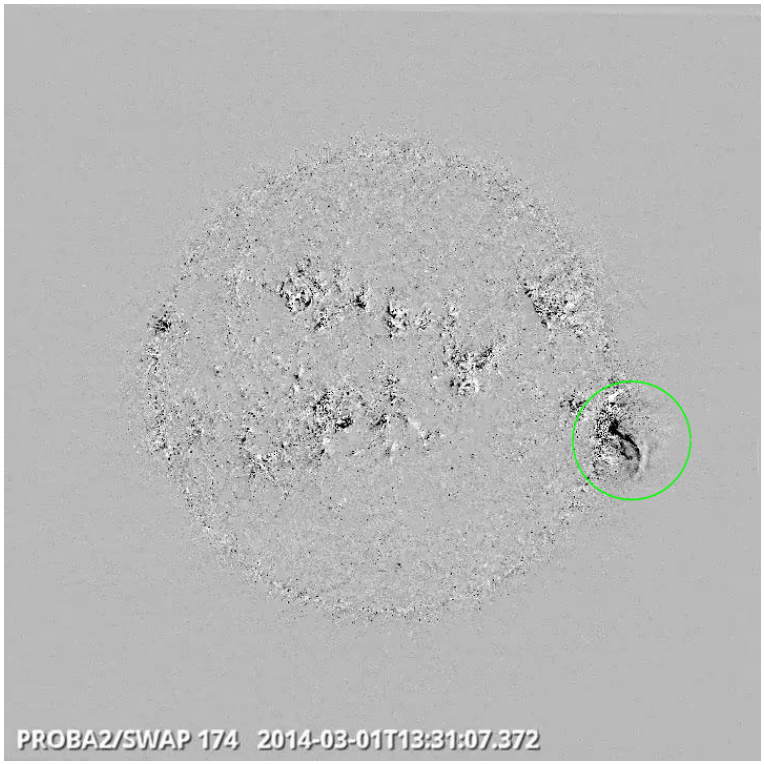


Eruptions and X flare on the west limb @ 00:56 SWAP difference image
Find a movie of the events here (SWAP difference movie)
http://proba2.oma.be/swap/data/mpg/movies/WeeklyReportMovies/WR205_Feb24_Mar02/Events/20140225_Eruption_EastLimb_0056_swap_diff.mp4
Find a movie of the events here (SWAP movie)
http://proba2.oma.be/swap/data/mpg/movies/WeeklyReportMovies/WR205_Feb24_Mar02/Events/20140225_Eruption_EastLimb_0056_swap_movie.mp4

Friday Feb 28:

Slow eruptions on the east limb @ 21:57 SWAP difference image
Find a movie of the events here (SWAP difference movie)
http://proba2.oma.be/swap/data/mpg/movies/WeeklyReportMovies/WR205_Feb24_Mar02/Events/20140228_SlowEruption_EastLimb_2157_swap_diff.mp4
Find a movie of the events here (SWAP movie)
http://proba2.oma.be/swap/data/mpg/movies/WeeklyReportMovies/WR205_Feb24_Mar02/Events/20140228_SlowEruption_EastLimb_2157_swap_movie.mp4

Saturday Feb 01:



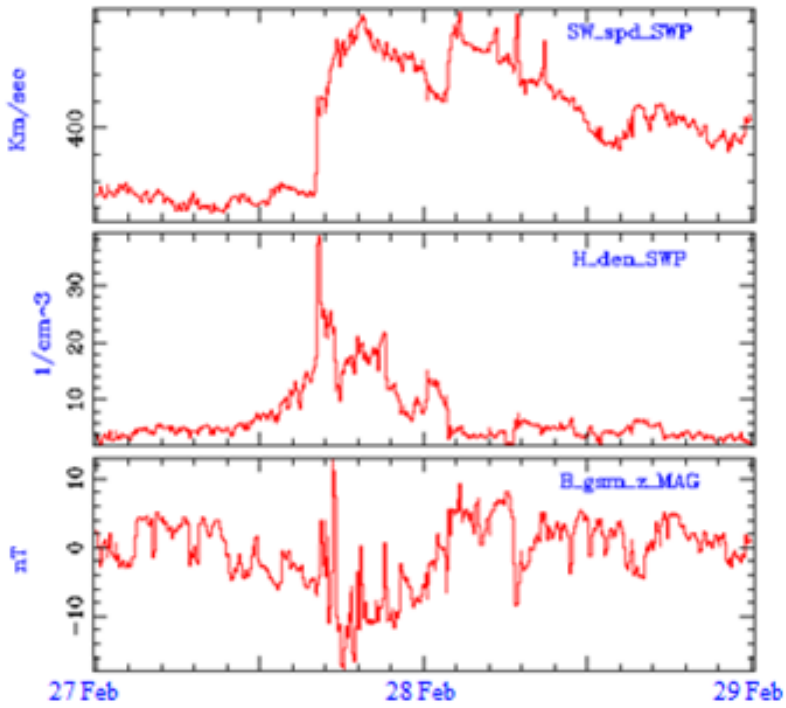
Eruptions on the west limb @ 11:31 SWAP difference image
Find a movie of the events here (SWAP difference movie)
http://proba2.oma.be/swap/data/mpg/movies/WeeklyReportMovies/WR205_Feb24_Mar02/Events/20140301_Eruption_WestLimb_1331_swap_diff.mp4

Papers using SWAP data

This paper discusses an event study of a streamer observed on 2010 October 20 and 21, by several instruments including PROBA2/SWAP EUV telescope.
Goryaev, F.; Slemzin, V.; Vainshtein, L.; Williams, David R. 2014 "Study of Extremeultraviolet Emission and Properties of a Coronal Streamer from PROBA2/SWAP, Hinode/EIS and Mauna Loa Mk4 Observations"
http://adsabs.harvard.edu/abs/2014ApJ...781..100G

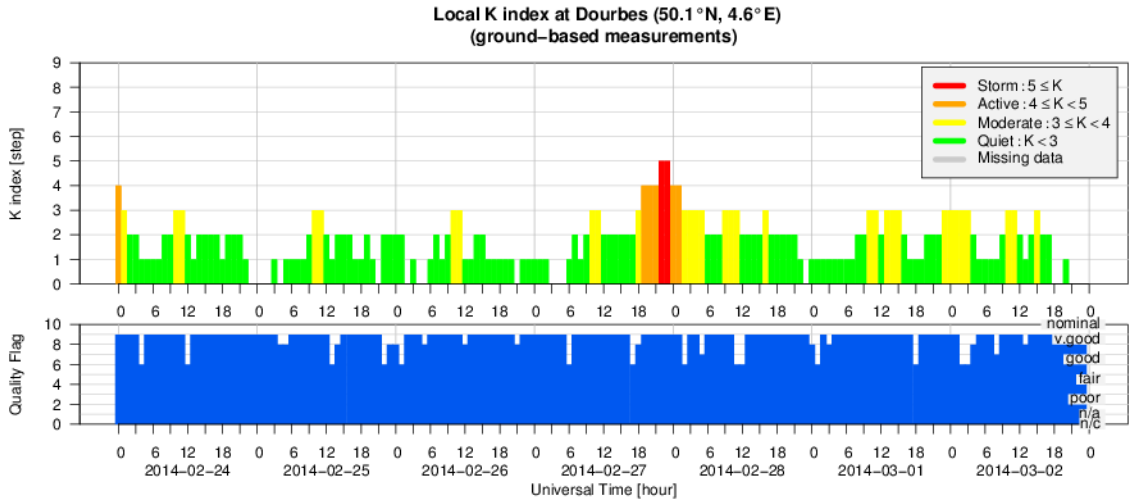
5. Review of geomagnetic activity (24 Feb 2014 - 2 Mar 2014)

A "glancing blow" shock of the CME associated with the X4.9 flare of 25 February was observed by the ACE spacecraft on 27 February after 16:00UT, which was much later than what was anticipated by ENLIL modelling (27 February at 00:00UT). Solar wind speed jumped from 350 km/s to just over 500 km/s.

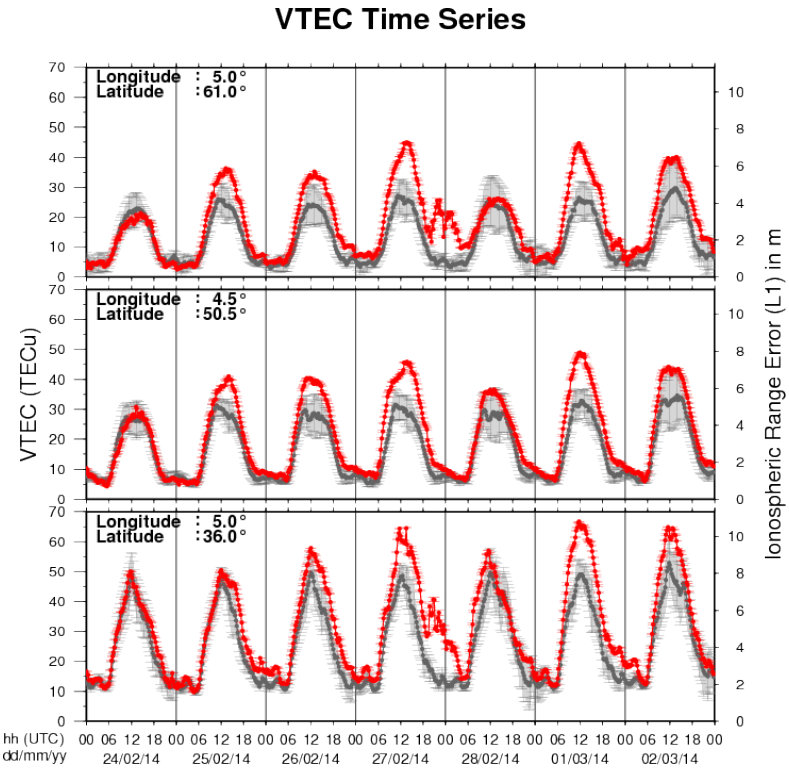


This lead to a geomagnetic storm at the K=5 level in Dourbes and Kp=6 (NOAA, estimated). Remarkably, northern lights were observed as south as Scotland and the north of The Netherlands and Germany (night from 27-28 February). A movie from the event, made by an all-sky camera near the Belgian coast, can be found at http://youtu.be/_cw-tys0Ax8 (credits Astrolab Iris, Franky Dubois). Note that, at these locations, the polar lights were only just above the horizon which made them harder to see by the naked eye than to make a picture of it.
Besides this episode, geomagnetic activity was quiet during the week.

6. Geomagnetic Observations at Dourbes (24 Feb 2014 - 2 Mar 2014)



7. Review of ionospheric activity (24 Feb 2014 - 2 Mar 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

8. New documents in the European Space Weather Portal Repository

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

eHEROES - Het Ruimteweer

Lecture given to the members and public audience at the Cosmodrome Public Observatory. It focuses mainly on the effects of space weather, extreme space weather, and the space weather forecast team at the Space Pole (RWC Brussels). In Dutch, 30 attendees
http://www.spaceweather.eu/en/repository/show?id=487

eHEROES - Het Ruimteweer: stormachtige verhalen over onze ster

Lecture focusing on the effects of space weather, extreme space weather, and the space weather forecasting at the Space Pole (RWC Brussels). The lecture was given to the astronomical association GALILEO in Heerlen, Nederlands-Limburg, The Netherlands. Solar amateur astronomers and public audience, in Dutch, about 20 attendees.
http://www.spaceweather.eu/en/repository/show?id=488

Space weather at University of Graz / Kanzelhöhe Observatory

http://www.spaceweather.eu/en/repository/show?id=489

ESWW10: Splinter "SSA Space Weather Service Network"

Presentation supporting the splinter meeting, see http://www.stce.be/esww10/splinters/ssa.php
http://www.spaceweather.eu/en/repository/show?id=490

9. Future Events

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

7th Community Coordinated Modeling Center (CCMC) Workshop in Annapolis (Maryland), USA

Start : 2014-03-30 - End : 2014-04-04
Biennial CCMC community workshops are designed as opportunities for an in-depth exchange of experiences, opinions and needs between model owners, science and operational users, agency representatives and the CCMC staff.
Website:
http://ccmc.gsfc.nasa.gov/CCMC_Workshop_2014/index.php

EGU General Assemby in Vienna, Austria

Start : 2014-04-27 - End : 2014-05-02
The EGU General Assembly 2014 will bring together geoscientists from all over the world to one meeting covering all disciplines of the Earth, planetary and space sciences. The EGU aims to provide a forum where scientists, especially early career researchers, can present their work and discuss their ideas with experts in all fields of geosciences.