STCE Newsletter

24 Aug 2015 - 30 Aug 2015

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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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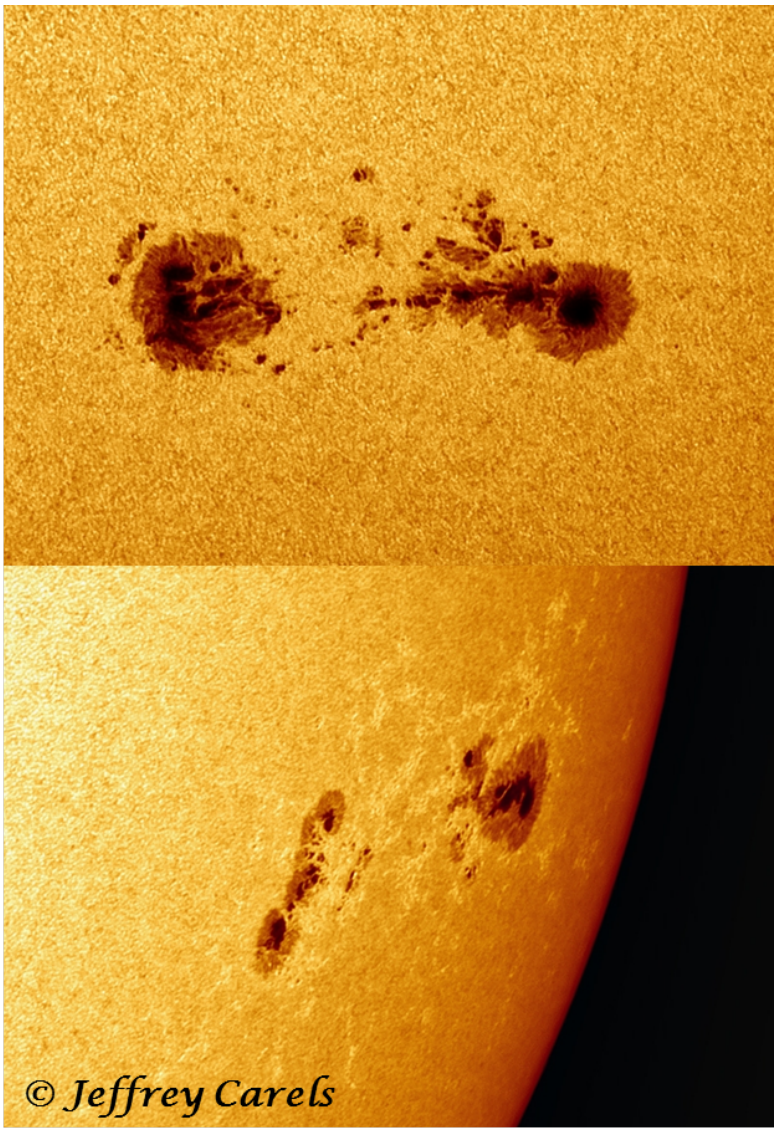
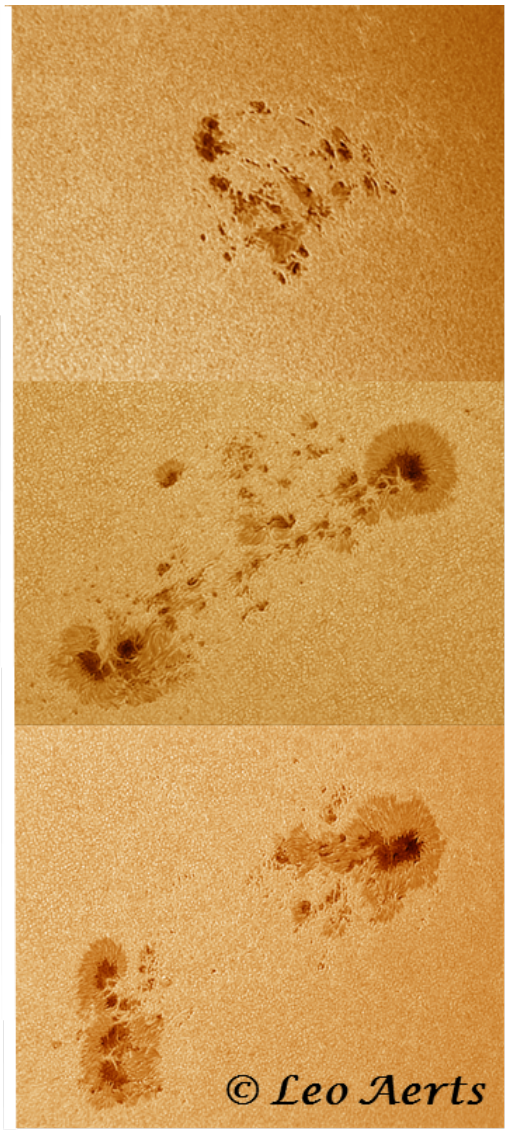
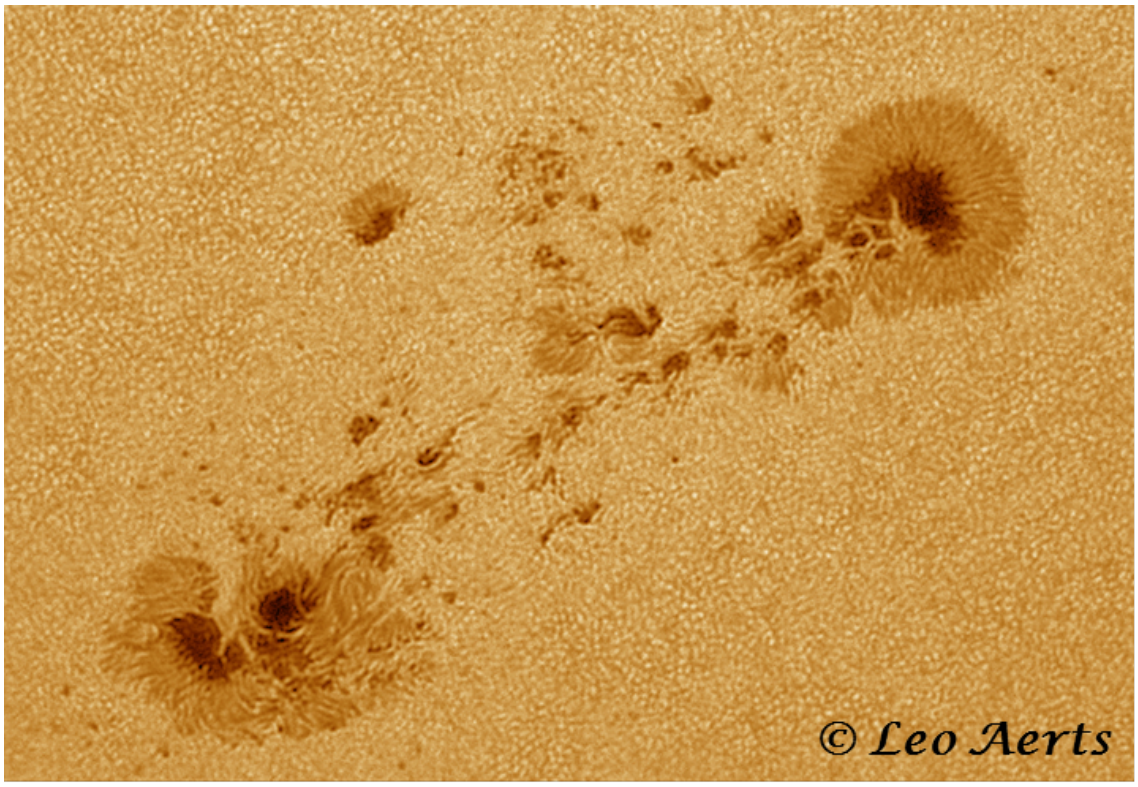
1. Showtime!

NOAA 2403, an active region visible during the last 2 weeks of August, has been one of the largest and most complex sunspot groups so far this year. Its maximum surface area was 7 times that of the Earth, and its mixed magnetic polarities were the source of numerous small and moderate solar flares. No wonder that many astronomers took the time for a photoshoot of this marvellous sunspot group!

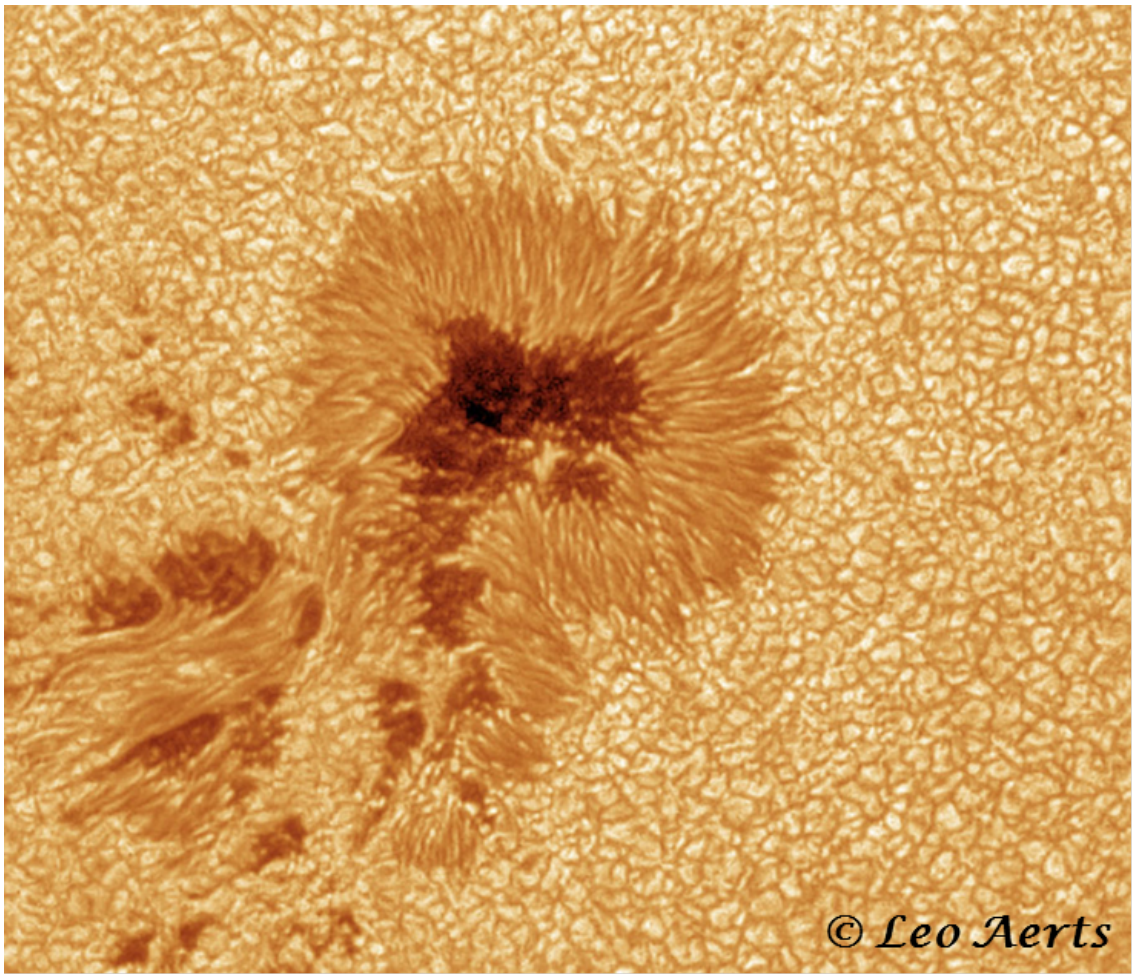


The impressive pictures above were taken by Jeffrey Carels from the Belgian Solar Section who imaged NOAA 2403 on 24 (top) and 28 August (bottom) using only a 10cm refractor. The astonishing images below were acquired by renowned astrophotographer Leo Aerts who used a 14cm Schmidt-Cassegrain with red filter. The images show the evolution of the group from a pile of small sunspots on 20 August, over a mature active region on 23 August, to an open structured bipolar group on 26 August. Using solar eclipse glasses, the group was visible with the naked (unaided) eye during this period (23-26 August).

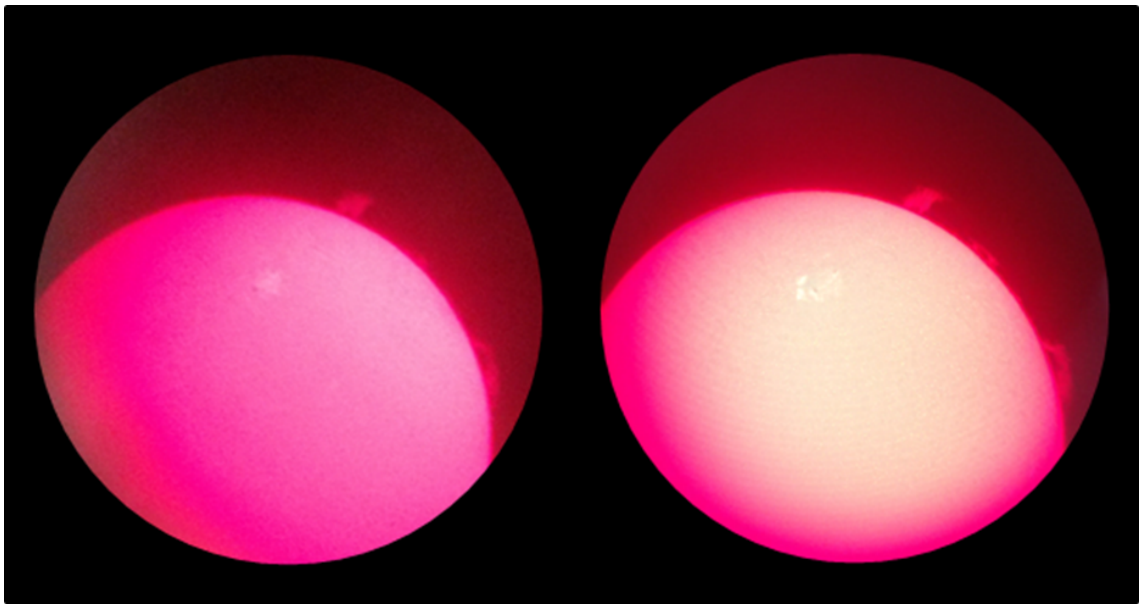

© Leo Aerts



Leo Aerts also took this amazing picture of NOAA 2403's leading portion, showing very fine details in the umbra and penumbra of the spots, as well as the solar granulation (the polygonal cells outside the sunspots).



NOAA 2403 produced no less than 85 C-class and 11 M-class flares, making it one of the most flare-active regions of the current solar cycle. A small 4 cm H-alpha telescope shows the inner solar atmosphere and provides already a good view on the eruptive processes on the solar surface. One of the M-class flares on 21 August (M1.4 peaking at 09:48UT) was imaged using just such a small telescope and a handheld GSM. The image to the left shows the undisturbed region at 08:41UT, where the image to the right shows the flare at its maximum at 09:48UT. The flare is clearly located to the west (left in pictures below) of NOAA 2403's leading portion. A movie from NSO's GONG H-alpha network (http://halpha.nso.edu/) can be found at http://www.stce.be/news/317/M1_21Aug15_GONG.wmv (09:36-10:46UT).



A jaw-dropping high-resolution H-alpha movie of the aftermath of the M1.4 flare was made by the Dutch astrophotographer codenamed "Neo", using a 15 cm refractor telescope modified for H-alpha viewing. The clip lasts 2 seconds and covers 22 minutes of observation time. It can be admired at http://www.astroforum.nl/showthread.php/159736-De-zon-AR2403-en-Class-M-flares-timelapse

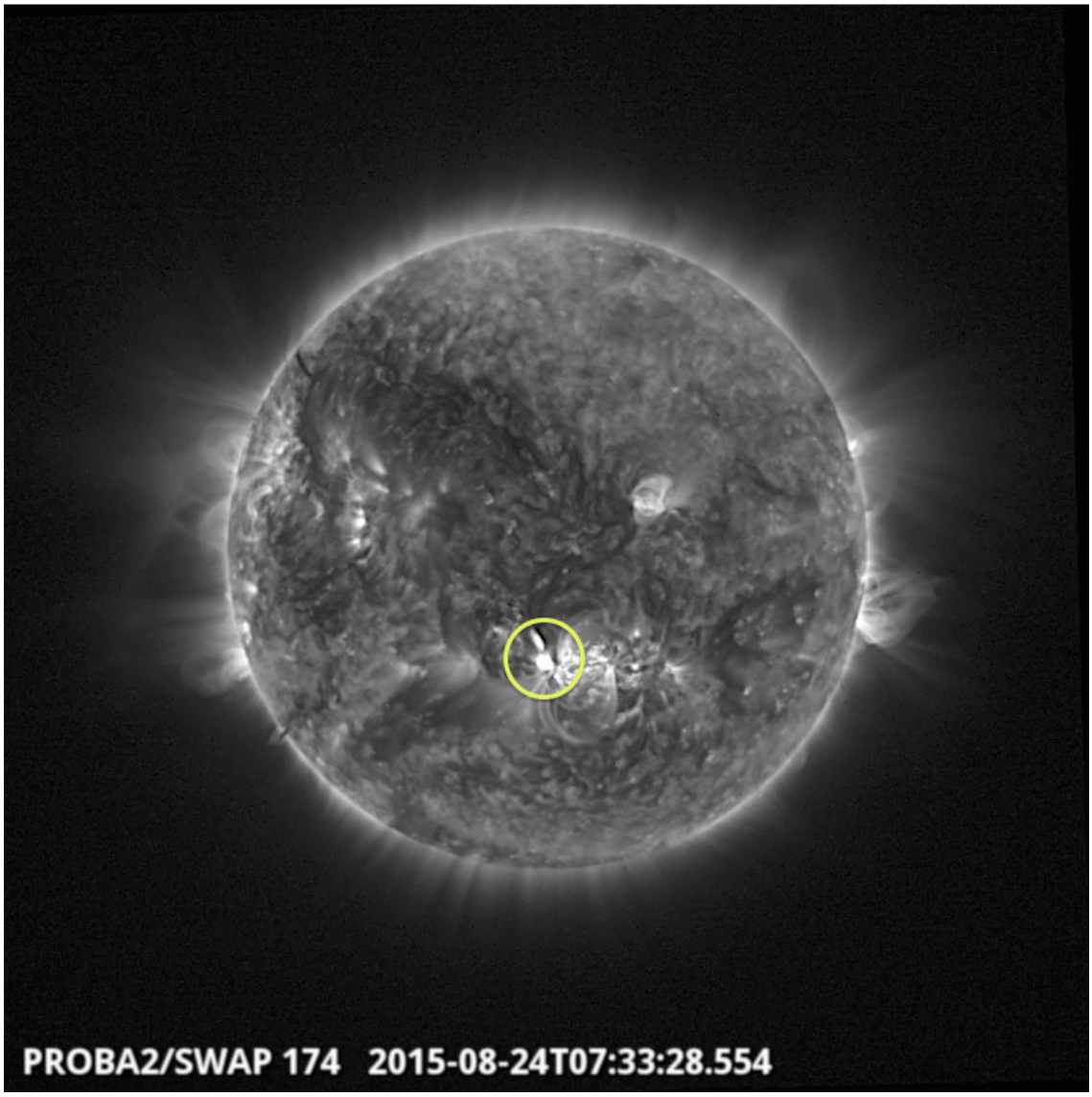
2. PROBA2 Observations (24 Aug 2015 - 30 Aug 2015)

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: http://proba2.sidc.be/swap/data/mpg/movies/weekly_movies/weekly_movie_2015_08_24.mp4 (SWAP week 283).

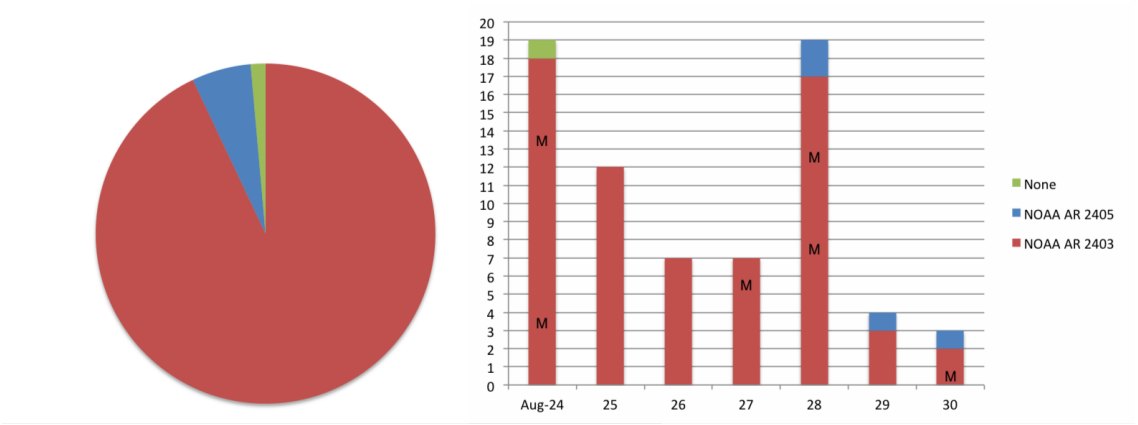
Throughout the week AR 2403 has been very active, producing several M-class flares, the largest being an M5.6 flare on 2015-08-24 around 07h33 UT. SWAP nicely observed a succession of events in that region, see the annotated image below, and the daily SWAP movie from 2015-08-24:
http://proba2.sidc.be/swap/data/mpg/movies/20150824_swap_movie.mp4



3. Review of solar activity

Solar activity was dominated by AR 2403 which was the only (significant) region on disk, as it remained active while transitting the Western hemisphere. It produced 6 M flares: the largest an M5.6 flare peaking at 7:33UT on August 24, while all other flares were below M3 level. Several additional C flares were produced by the region.

Distribution of >B flares, Aug 24 – 30, 2015



The left chart gives an overview of the total number of flares per NOAA AR region for the indicated week. *None* indicates that the flare site is not linked with one particular active region. The right chart gives an overview of the flaring activity per NOAA AR per day.

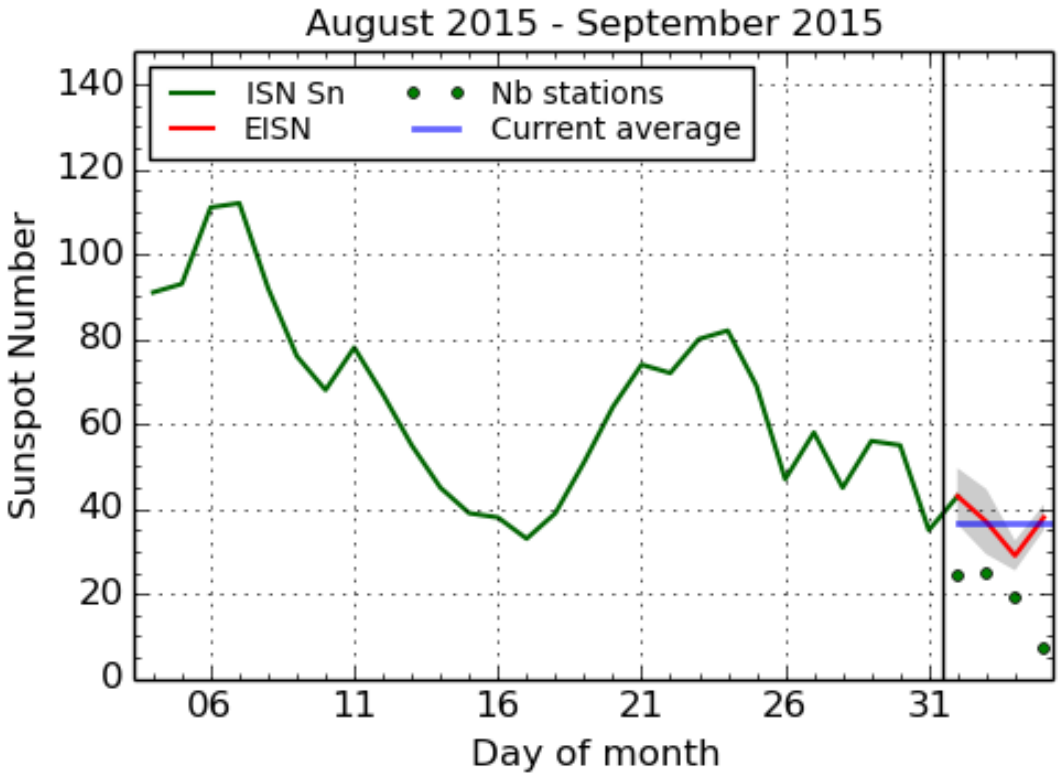
A warning condition for proton events was maintained during most of the period, but proton levels remained at background values throughout the period.
Some of the flaring activity was eruptive but none resulted in significant Earth directed CME's. No (partial) CME's were detected over the period.

4. Noticeable Solar Events (24 Aug 2015 - 30 Aug 2015)

DAY	BEGIN	MAX	END	LOC	XRAY	OP	10CM	TYPE	Cat	NOAA
24	0726	0733	0735	S15W4	M5.6	1B	100	III/3		2403
24	1740	1746	1749		M1.0					2403
27	0448	0544	0603	S14W45	M2.9	1N		III/2		2403
28	1304	1316	1323	S14W65	M2.2	1F				2403
28	1856	1903	1906	S13W70	M2.1	1N				2403
30	0201	0330	0423		M1.4					2403

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

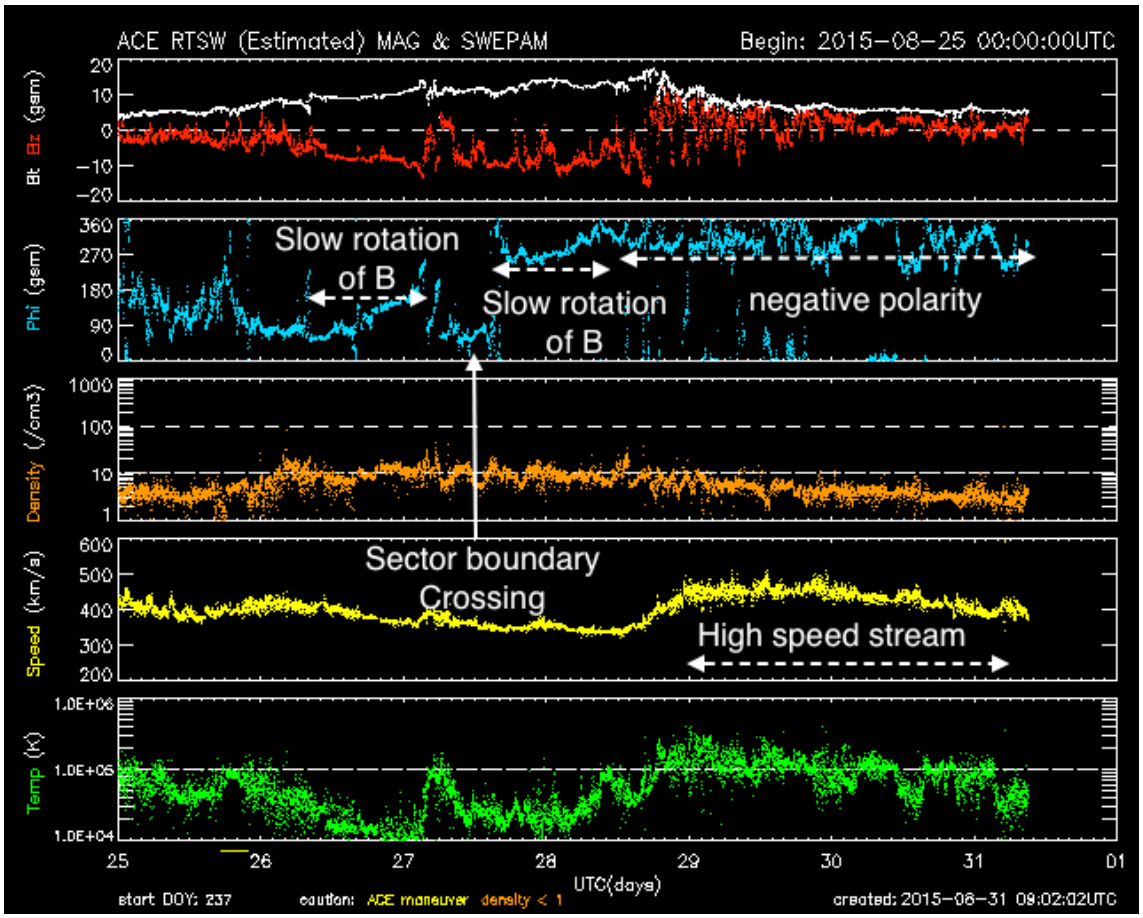
5. The Daily International Sunspot Number



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 (~ 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.

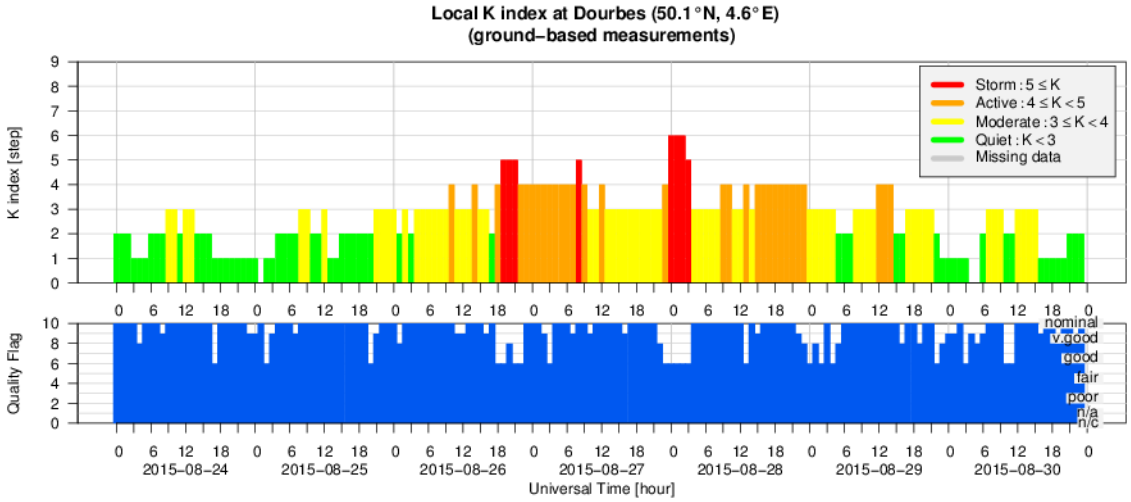
6. Review of geomagnetic activity

Solar wind conditions were recovering from a high speed stream from a positive polarity coronal hole at the start of the period. A possible impact from the weak (partial) halo CME of August 22 was expected on late august 25, but arrived August 26 without appreciable shock signatures or solar wind velocity increase. Nevertheless it caused a rise in total magnetic field up to 17nT and an extended period of continuous and pronounced negative Bz with peaks down to -15nT. These effects persisted through the sector boundary crossing around noon August 27 and up to the arrival of a high speed stream from a negative polarity coronal hole late August 28.

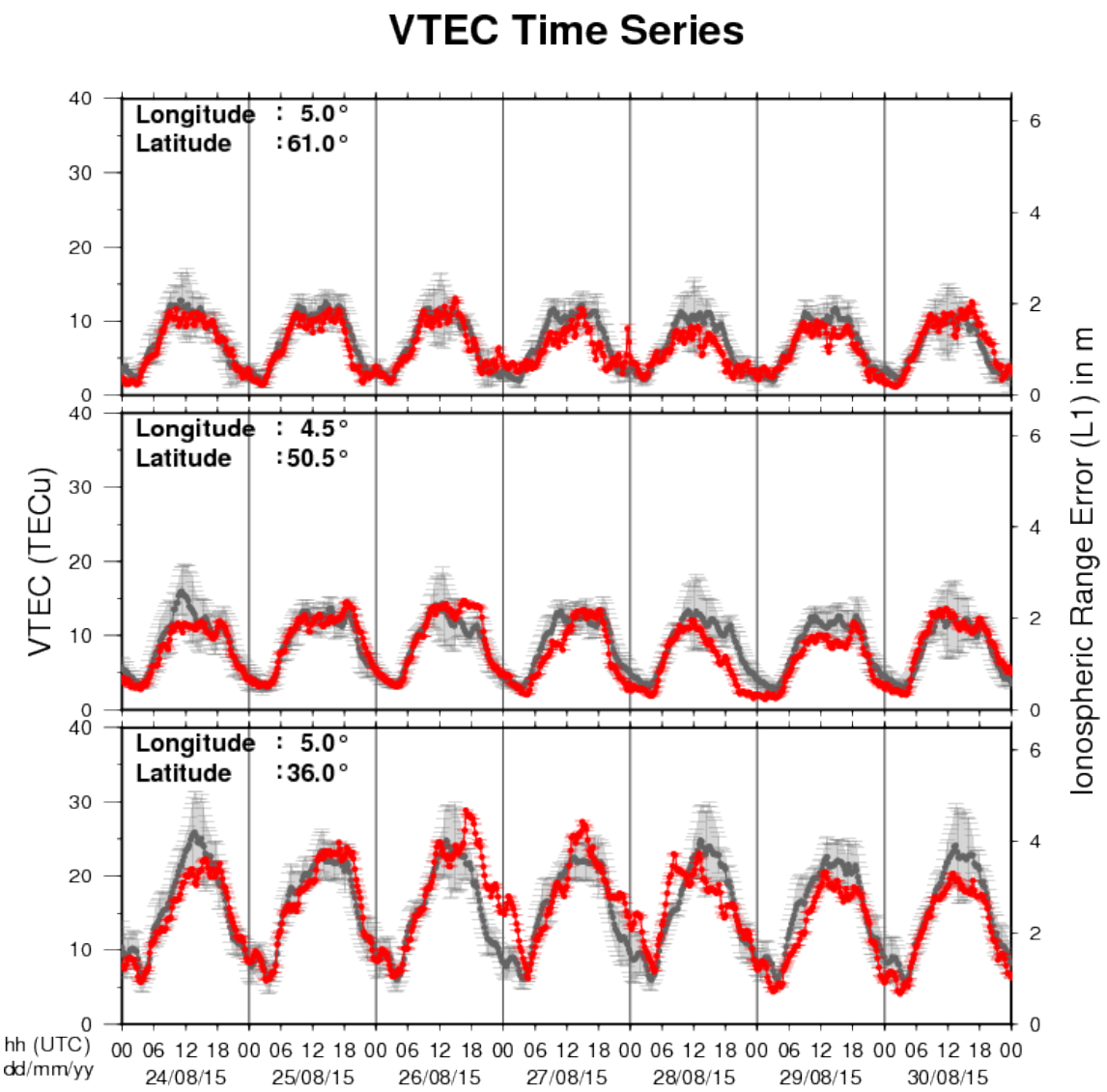


Geomagnetic conditions reached storm levels under the CME influence as well as under the compression region associated to the high speed stream arrival.
While local K Dourbes reached just minor storm levels (local K Dourbes 5) late August 26 at the start of the CME influence, planetary NOAA Kp reached major storm levels (Kp=7) at that occasion. In the wake of the CME local K Dourbes as well as the planetary NOAA Kp reached moderate storm levels (K=6). The high speed stream arrival in turn only caused active geomagnetic conditions locally (local K Dourbes 4) while again reaching major storm levels at planetary level (NOAA Kp 7).

7. Geomagnetic Observations at Dourbes (24 Aug 2015 - 30 Aug 2015)



8. Review of ionospheric activity (24 Aug 2015 - 30 Aug 2015)



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. Future Events

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

The Dynamic Sun - Exploring the Many Facets of Solar Eruptive Events in Potsdam, Germany

Start : 2015-10-26 - End : 2015-10-29
Erupting prominences/filaments, surges, flares, and coronal mass ejections (CMEs) are prominent examples of the dynamic Sun. Multi-wavelength and multi-instrument observations have the potential to reveal highly energetic physical processes on the Sun reaching from the photosphere, over the chromosphere and the transition region, to the corona and beyond. Solar physicists have nowadays access to a suite of new ground-based observing facilities including, for example, the 1.5-meter GREGOR solar telescope at the Observatorio del Teide, Tenerife, Spain, the European Low Frequency Array (LOFAR), the Atacama Large Millimeter/Submillimeter Array (ALMA) in Chile, and the Coronal Multi-Channel Polarimeter for Slovakia (COMP-S) at Lomnicky Peak Observatory. A powerful fleet of space missions, for example, the Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI), the Japanese Hinode, and the Solar Dynamics Observatory (SDO), adds more capabilities to investigate magnetic fields, complex plasma flows, and accelerated particle, and thermal properties of solar eruptive events. In the tradition of the series of Â»Potsdam ThinkshopsÂ«, we invite instrument specialists, observers, modellers, and theorists to exchange ideas, to stimulate discussion, to initiate future collaborations among participants, and to attract new users of instruments by showcasing the capabilities. The aim is to make progress towards a comprehensive description of solar eruptive events effectively aggregating their global properties as well as their highly dynamic fine structure. Thinkshop 12 takes place at the science park Â»Albert EinsteinÂ«, home to AIP's Great Refractor and the Solar Observatory Einstein Tower at the Telegraphenberg.
Website:
https://thinkshop.aip.de/12/cms/

IRIS-5 Workshop in Pune, India

Start : 2015-10-26 - End : 2015-10-29
The IRIS-5 workshop will be conducted at the Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune, India from October 26-29, 2015. This workshop is mainly aimed at the participants who could not attend IRIS-4, which is being held at Boulder, USA. Therefore, set up of the IRIS-5 workshop would be essentially be very similar to that of IRIS-4.
The main aim of the workshop is to introduce the Interface Region Imaging Spectrometer (IRIS) to students and young post docs. This would be done through tutorials on IRIS data analysis, physics of optically thick radiative transfer, MHD simulations of the solar atmosphere related to IRIS and hydrodynamic simulations of flares. There will be lectures as well as hands on sessions.
Website:
http://www.iucaa.ernet.in/~solar/Welcome.html

Solar Storm Early Forecasting in Copenhagen, Denmark

Start : 2015-11-09 - End : 2015-11-11
The fundamentally most important source of inner heliospheric plasma physics and space weather is the active Sun, its solar active region eruptions. Prediction of the evolution and influence of solar active regions on solar storms in the near-Earth environment is of particular interest to several forecasting institutions, industrial stakeholders, and the public in general.
State-of-the-art solar storm prediction tools are limited to monitoring solar active regions, registering eruptions and mass ejections while attempting, then, at extrapolating subsequent evolution and spatio-

temporal propagation: no realistic physics-based and data-driven synthesis tool exists, which is capable of predicting when a solar flare will be triggered, or when a Coronal Mass Ejection will be launched into inter-planetary space. In short, we are not yet able to answer the question: When and why do solar storms launch?
Our meeting will be focused around initiation of space weather events at the Sun. We will discuss and develop three major challenges, and we aim to develop a draft resolution road-map for those challenges during the meeting.
Website:
https://indico.nbi.ku.dk/conferenceDisplay.py?confId=817

Workshop on Solar Astronomy Big Data - IEEE ICDM in Atlantic City, NJ, USA.

Start : 2015-11-13 - End : 2015-11-13
With the launch of NASA's Solar Dynamics Observatory (SDO) mission on 02/11/2010, researchers in solar physics have entered the era of Big Data. The Atmospheric Imaging Assembly (AIA) instrument on SDO provides imaging data and the Helioseismic and Magnetic Imager (HMI) instrument on SDO provides magnetic field data. Both instruments record data at a high spatial resolution and a time cadence, amounting to about 1 Petabyte of scientific data each year. The Big Data challenges in Solar Astronomy are expected to grow even further with the inauguration of the NSF funded Daniel K. Inouye Solar Telescope (DKIST), currently under construction in Hawaii. This telescope is expected to generate: 3-5 Petabytes of data per year.

The Scientific Foundation of Space Weather

Start : 2016-06-27 - End : 2016-07-01
Website:
http://www.issibern.ch/program/workshops.html

10. New documents in the European Space Weather Portal Repository

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

eHEROES - Hitchhikers' guide to space

Report on the eHEROES deliverable 'Hitchhikers' guide to space'.
http://www.spaceweather.eu/en/repository/show?id=586

eHEROES - Project summary, period 1

Report on the first period of the FP7 project eHEROES
http://www.spaceweather.eu/en/repository/show?id=587

eHEROES - Project summary, period 2

Report of the second and final period of the FP7 project eHEROES
http://www.spaceweather.eu/en/repository/show?id=588

eHEROES - Space Weather News

Report on the eHEROES deliverable 'The Space Weather News'.
http://www.spaceweather.eu/en/repository/show?id=589

eHROES - Information and Education

Report on the FP7 project eHEROES deliverable Information and Education
http://www.spaceweather.eu/en/repository/show?id=590

eHEROES - Summer School

Report on the FP7 project eHEROES summer school
http://www.spaceweather.eu/en/repository/show?id=591