STCE Newsletter

14 Sep 2015 - 20 Sep 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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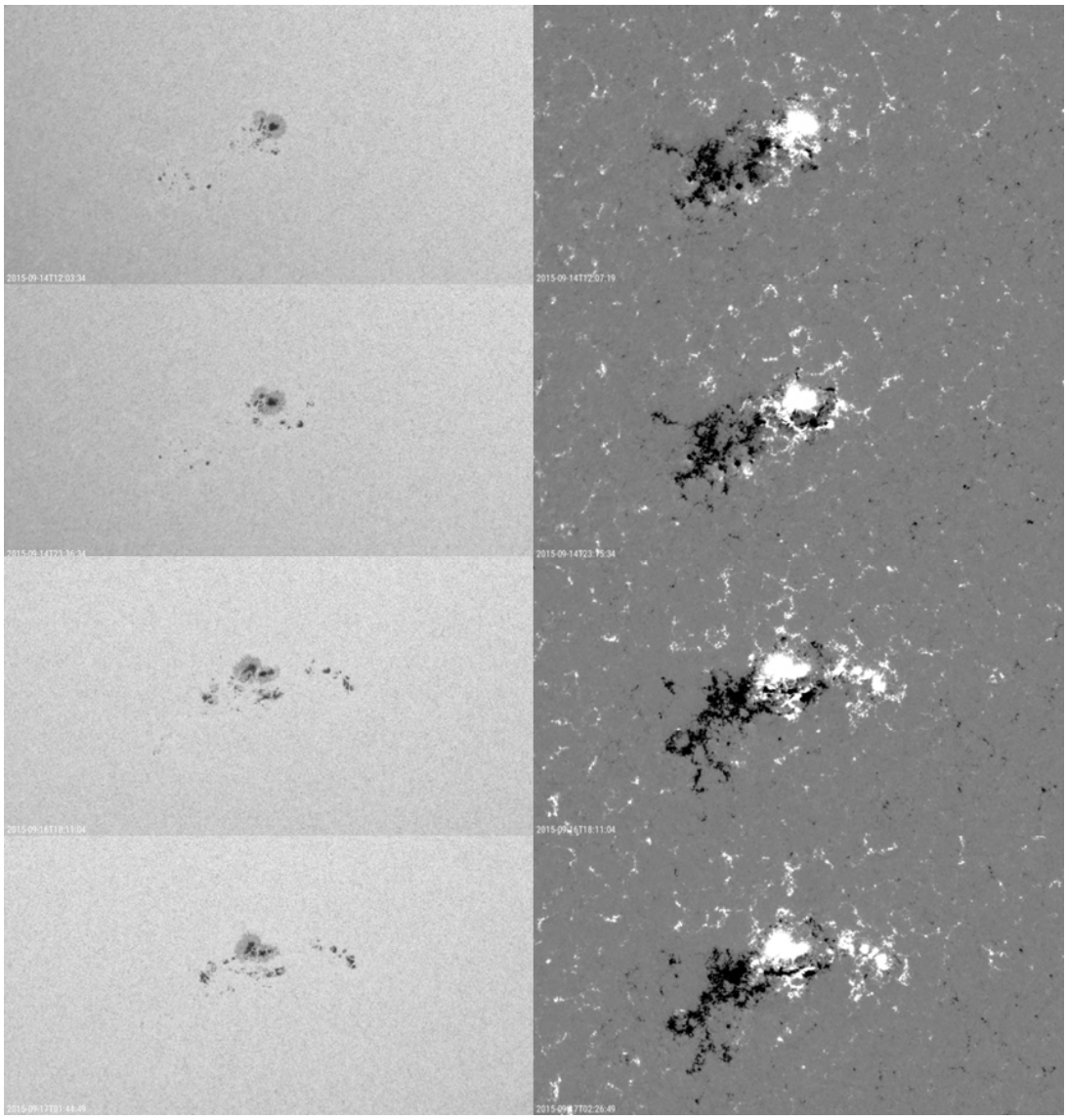
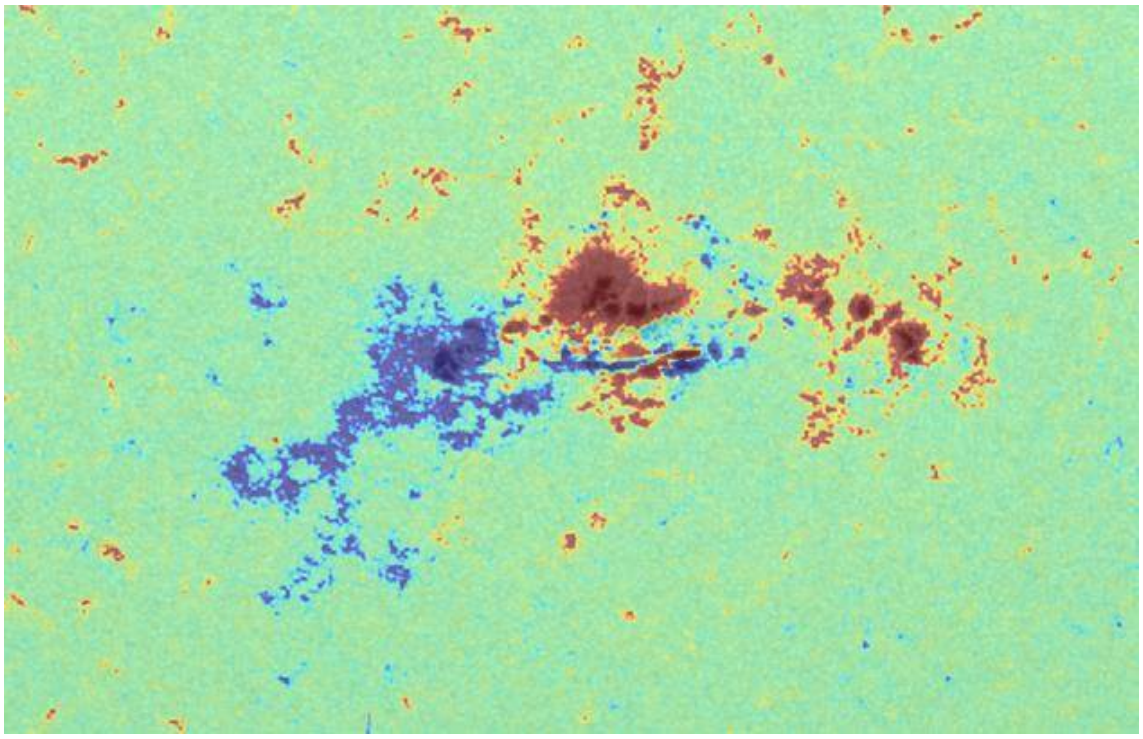
1. Another head-to-tail collision

NOAA 2415 started out as a rather quiet and dull sunspot group, until during the afternoon of 14 September a bipolar magnetic flux emerged right in front (to the southwest) of NOAA 2415's main leading spot. During the next few hours and days, the newly bipolar region developed further, with the positive (white) polarity spots drifting away to the west. However, its negative (black) trailing spots remained very close to the original main spot (white), and started to interact with each other. This resulted in increasingly stronger flares on 16 and 17 September, culminating in a C9 and an M1 flare on 17 September (peaking resp. at 03:03UT and 09:40UT).

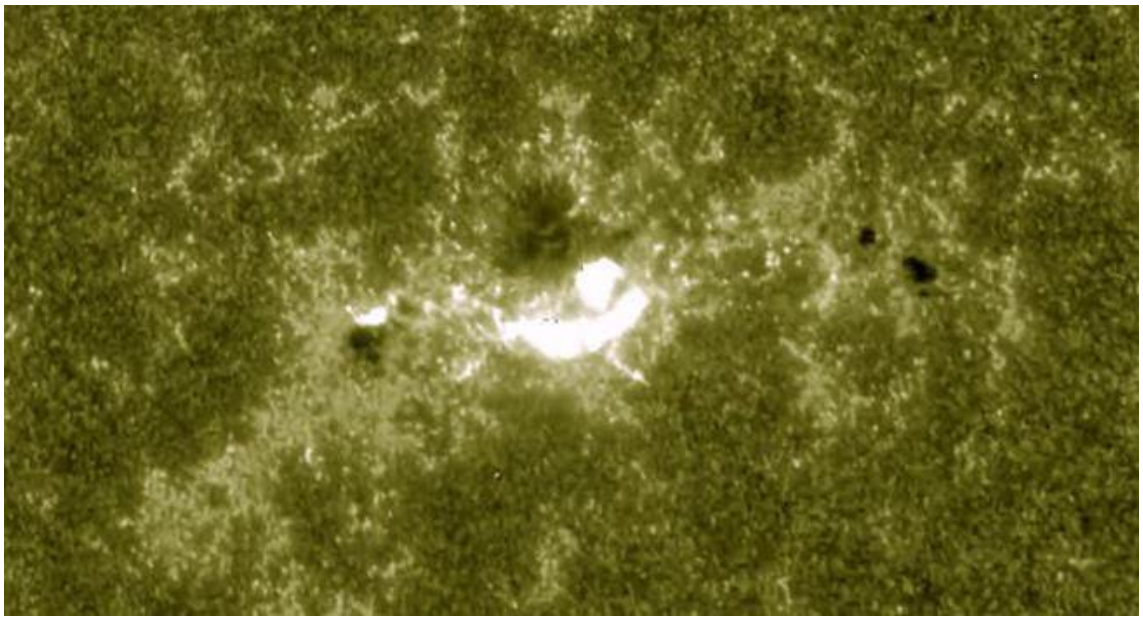
The images underneath show NOAA 2415 in white light and the corresponding magnetogram resp. on 14 September around 12:00UT, on 14 September around 23:30UT (just before a long image gap), on 16 September around 18:00UT and on 17 September around 02:00UT (just before the start of the C9 and M1 flares). White means positive polarity (magnetic field coming out of the solar surface), black means negative polarity (magnetic field returning into the solar surface).



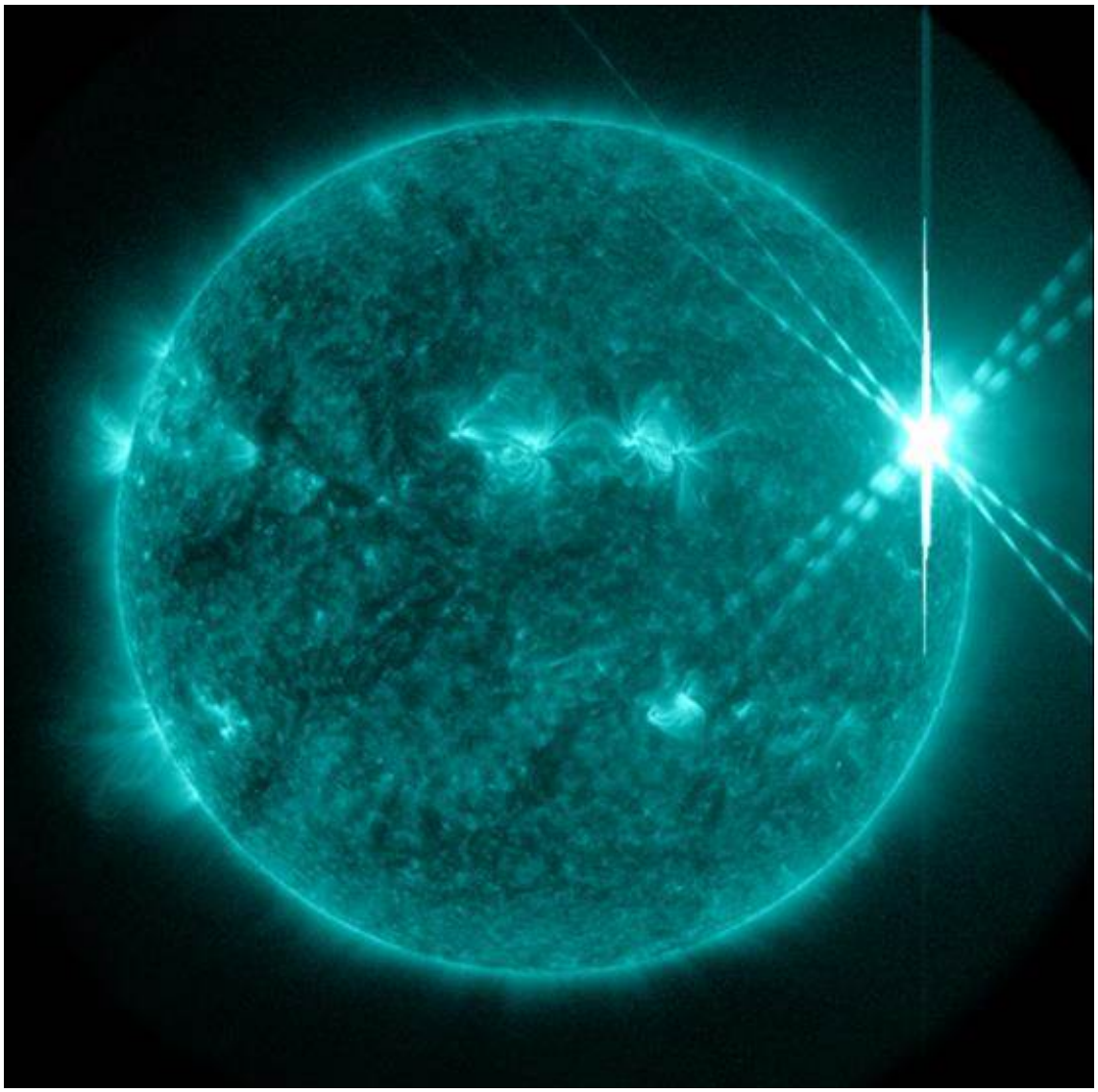
The image underneath shows a colorized version of the magnetogram overlaid on the white light image on 17 September around 04:00UT. A small delta can be seen to the southwest (lower right) of the main spot. The C9 flare had just taken place.



The image underneath shows the M1 flare near its maximum as seen through SDO's AIA 1600 filter (http://sdo.gsfc.nasa.gov/). The AIA 1600 pictures the Sun in the transition zone between the Sun's lower atmosphere and the corona (hot outer atmosphere) at temperatures of around 100.000 degrees. At the same time, it is also very sensitive for emission from the upper photosphere ("solar surface") near 5.000 degrees, which is the reason why one sees the sunspots very well too. A movie of the colorized magnetogram (30 minutes cadence) and AIA 1600 (5 minutes cadence) can be found at https://www.youtube.com/watch?v=YckB_jOZoh4



This kind of "collision" flares happen quite often and can be much stronger than the 17 September events. In fact, the strongest flare so far this solar cycle (SC24), i.e. the X6.9 flare from 09 August 2011, was also the result of two sunspot groups bumping into each other. In that particular case, the newly bipolar flux emerged behind the existing NOAA 1263 on 06 August, with the leading portion of the new flux colliding with the already existing opposite polarity trailing spots. One sometimes wonder how those sunspot groups get their driver's license!



2. ESWW12 - Call for fair stand

If you want to promote your company or institute, its activities, products and services in an interactive way for the ESWW audience, the Space Weather Week Fair is your thing. Register for a fair stand and get a manned stand during the Fair event on Wednesday Nov 25, 16:30 - 18:00 and/or an unmanned stand for the whole week.

Fair - Wednesday 25th November 2015 - http://www.stce.be/esww12/program/fair.php
Registration for a fair stand: http://www.stce.be/esww12/registration.php
Since we have a limited number of stands, we adopt the first come, first served policy.

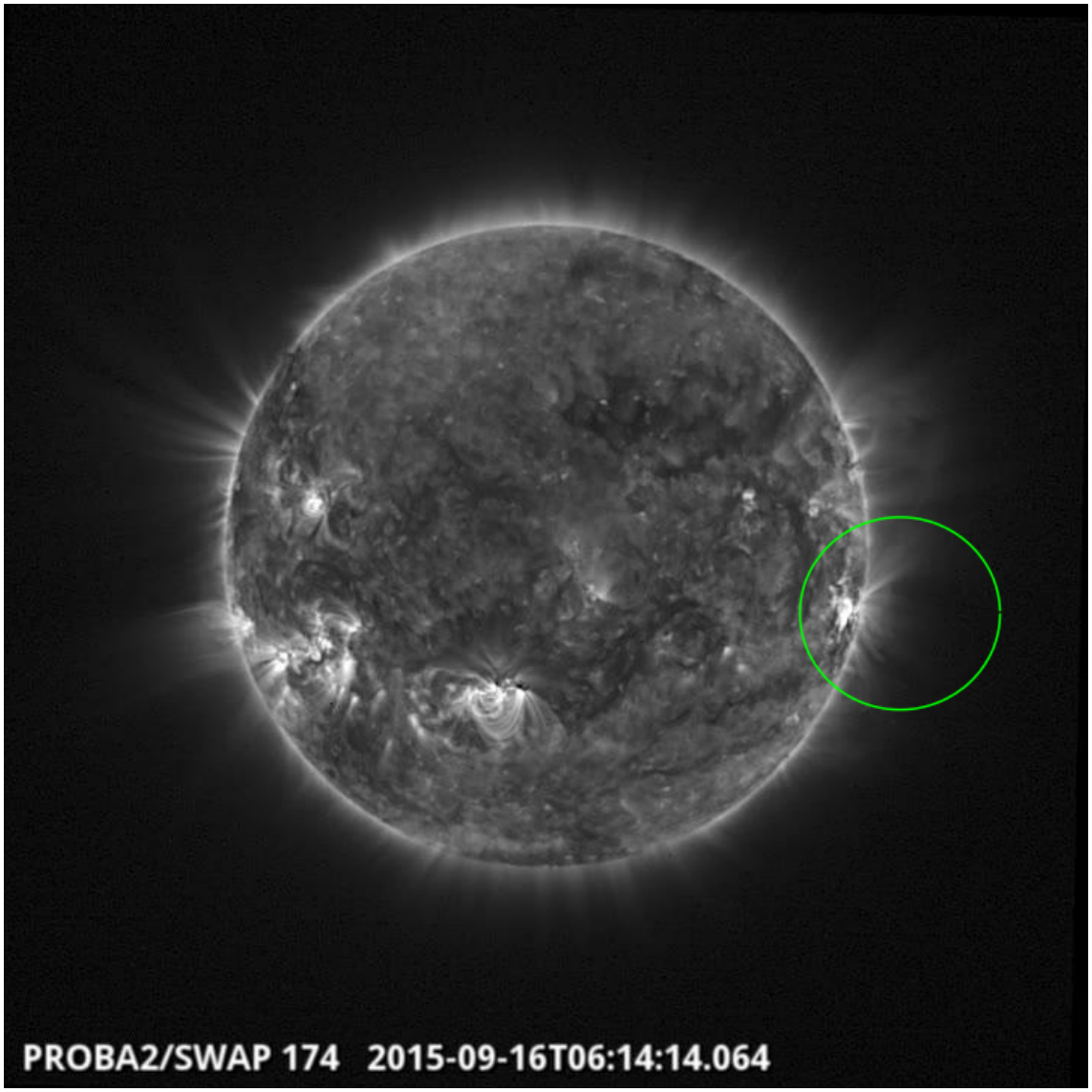
3. PROBA2 Observations (14 Sep 2015 - 20 Sep 2015)

Solar Activity

Solar flare activity fluctuated between very 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.

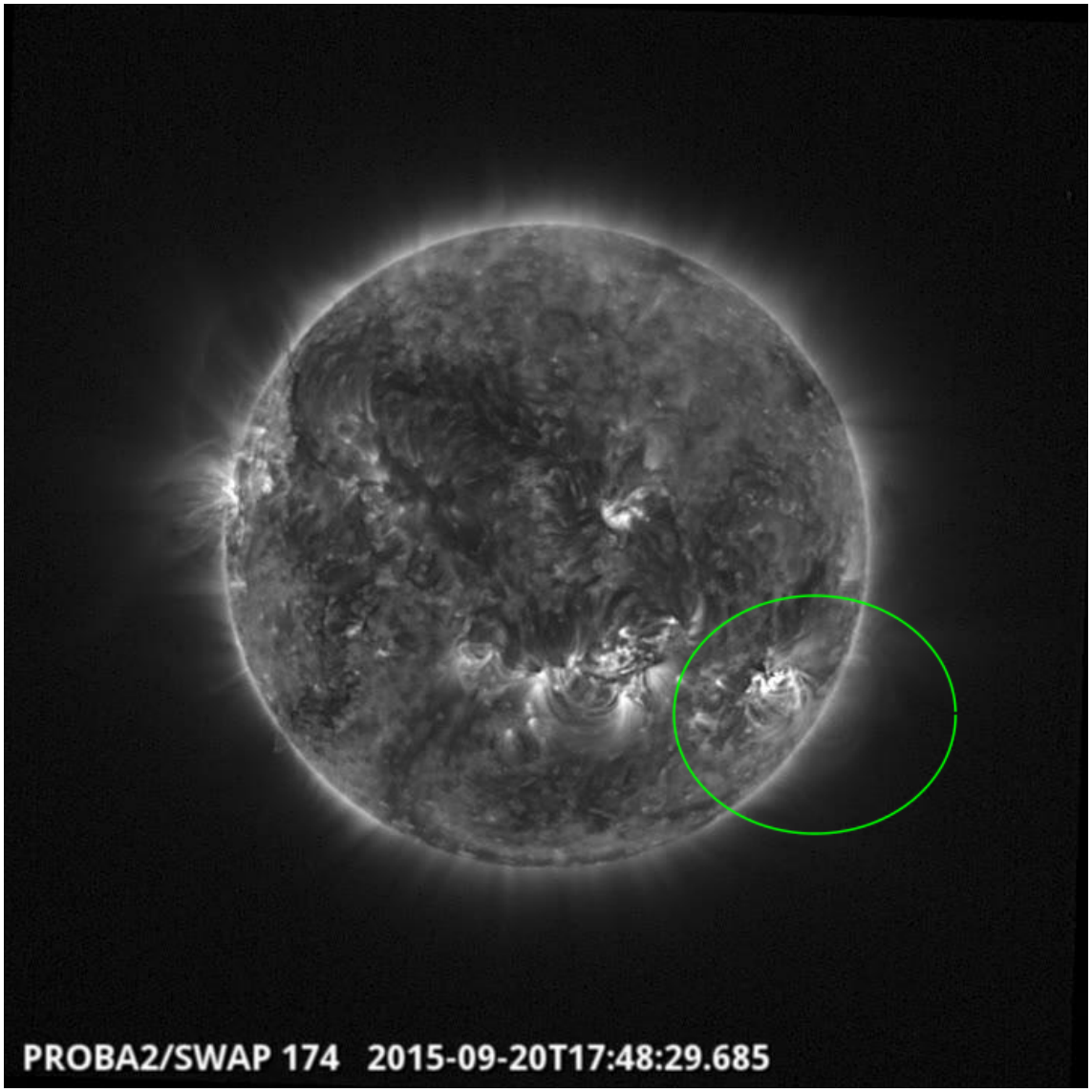
A weekly overview movie can be found here (SWAP week 286).
http://proba2.oma.be/swap/data/mpg/movies/weekly_movies/weekly_movie_2015_09_14.mp4
Details about some of this week's events, can be found further below.

Wednesday Sep 16



Eruption on the west limb @ 06:14 SWAP image
Find a movie of the event here (SWAP movie)
http://proba2.oma.be/swap/data/mpg/movies/20150916_swap_movie.mp4

Sunday Sep 20



Eruption on the west limb @ 17:48 SWAP image
Find a movie of the event here (SWAP movie)
http://proba2.oma.be/swap/data/mpg/movies/20150920_swap_movie.mp4

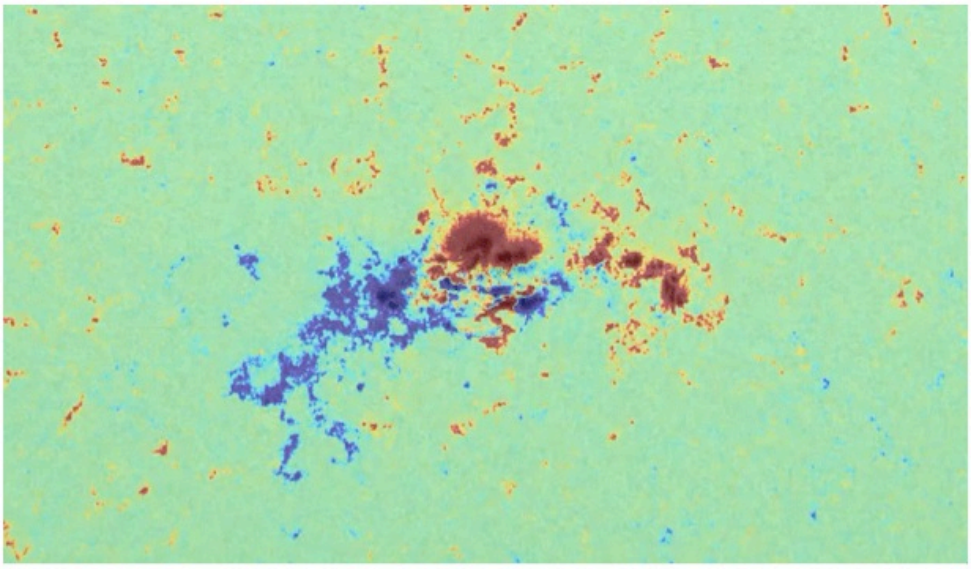
4. Review of solar activity

Solar activity in pictures

Solar activity was determined by NOAA 2415, a moderately sized sunspot group with a complex magnetic configuration.
NOAA AR 2415 produced 33 C- and 2 M-class flares: An M1.1 flare on 17 September peaking at 09:40UT, and an M2.1 flare on 20 September peaking at 18:03UT.

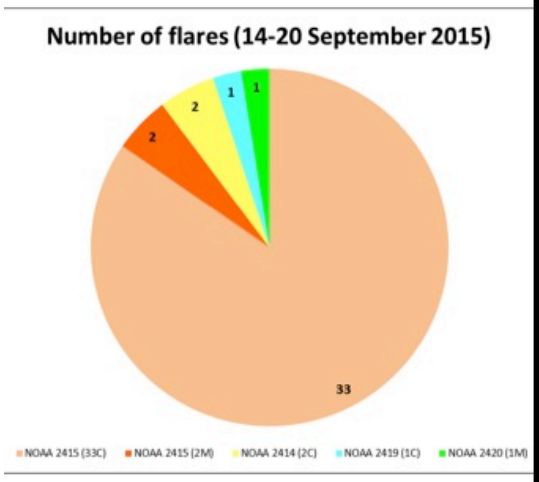
NOAA 2415 – Magnetogram

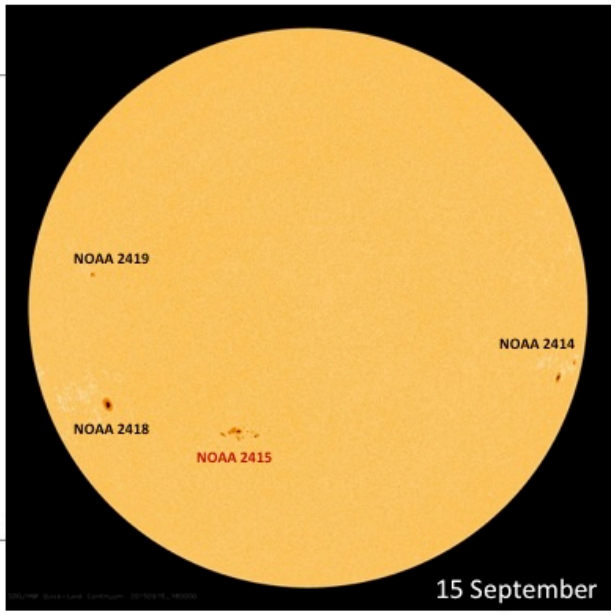
16/12:00UT – 17/12:00UT September



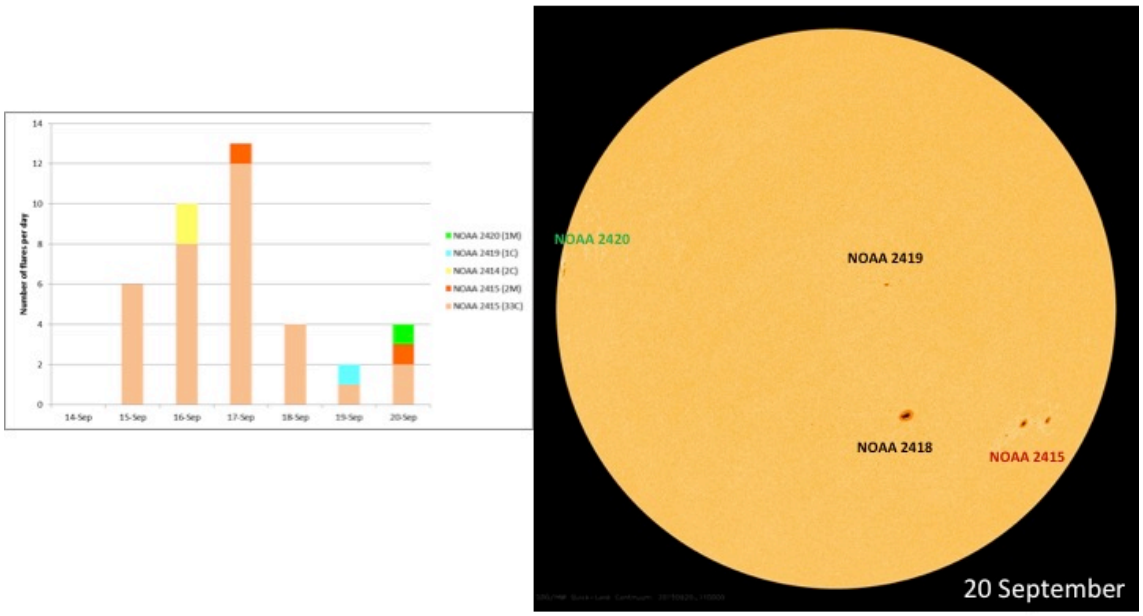
The following diagrams show when and how many >B9.9 flares happened. The white light images give an idea where the sunspot groups are located on the solar disk on September 15 and 20.

Sunspot groups & flaring activity

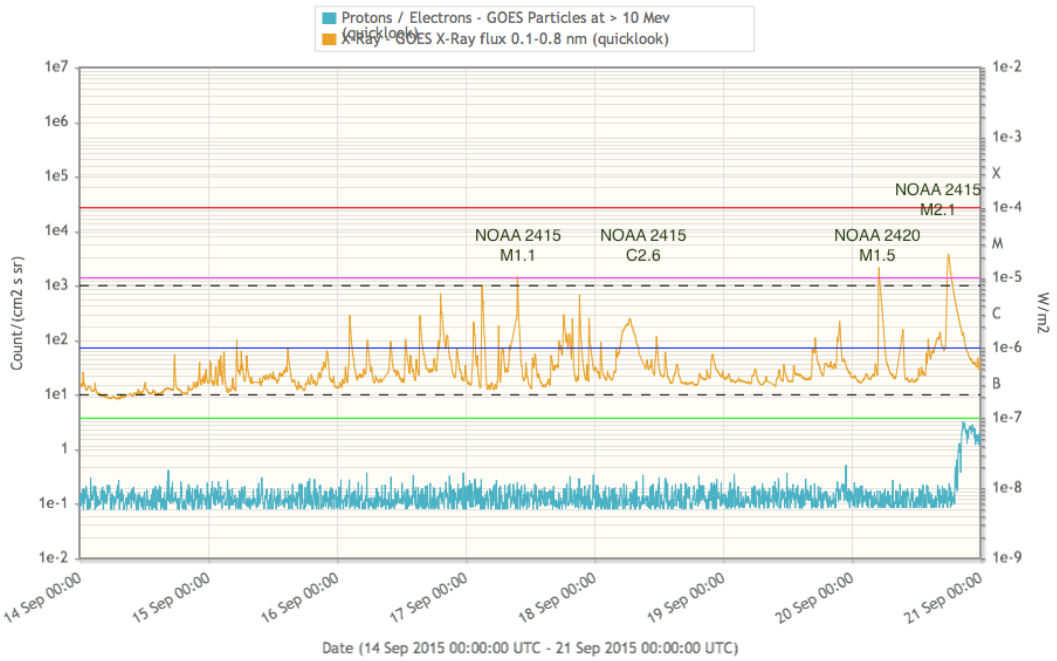




Sunspot groups & flaring activity



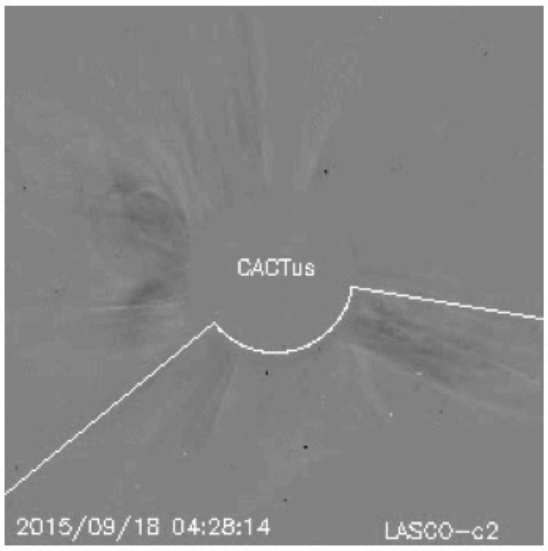
The M2.1 flare on 20 September was associated with a solid and fast (plane-of-the-sky (p-o-s) speed of 1250 km/s) coronal mass ejection (CME). In response to this M2 flare, proton flux levels were enhanced but stayed below the event threshold.



On 18 September, NOAA 2415 was the source of a long duration C2.6 flare, starting at 04:22UT, peaking at 06:31UT, and finally ending at 07:20UT. The associated CME had a p-o-s speed of 530 km/s and was expected to deliver a glancing blow late on 20 September.

Coronal Mass Ejections

14-20 September 2015



CME | t0 | dt0| pa | da | v | dv | minv| maxv| halo?
0009|2015/09/18 05:00| 03 | 195| 132| 0530| 0107| 0233| 0697| II

NOAA 2414 and 2419 produced the remaining 3 low-level C-class flares of the period. NOAA 2420, while still rounding the northeast limb, produced this week's third M-class flare early on 20 September, peaking at 05:03UT.

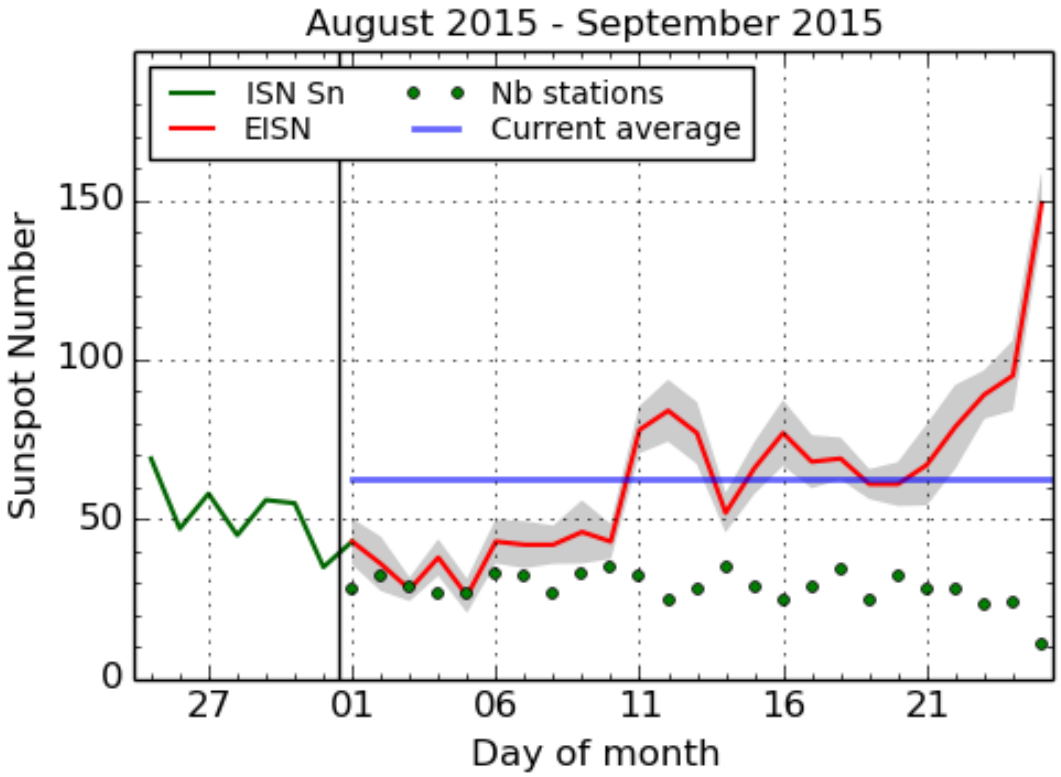
Thanks to Jan Janssens, the forecaster on duty for providing input.

5. Noticeable Solar Events (14 Sep 2015 - 20 Sep 2015)

DAY	BEGIN	MAX	END	LOC	XRAY	OP	10CM	TYPE	Cat	NOAA
17	0934	0940	0945	S21W4	M1.1	SF			31	2415
20	0455	0503	0517		M1.5					2420
20	1732	1803	1829	S20W24	M2.1	2N	320	VI/2III/1II/1	31	2415

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

6. The International Sunspot Number

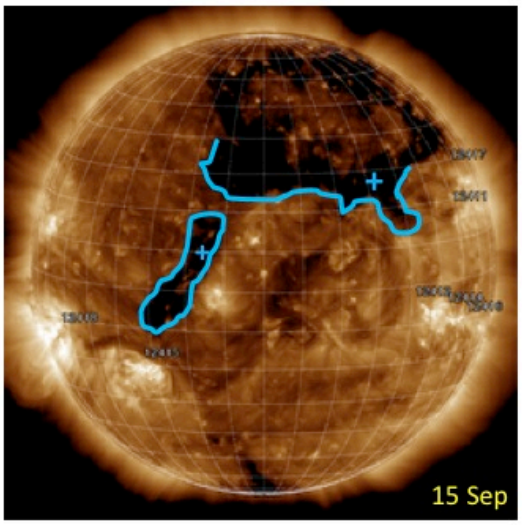


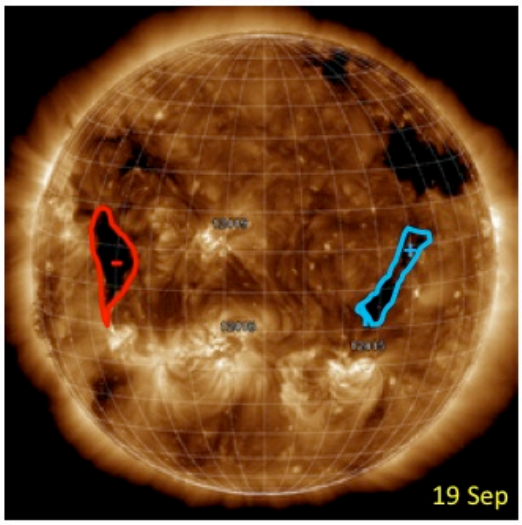
The daily Estimated International Sunspot Number (EISN, red curve with shaded error) derived by a simplified method from real-time data from the worldwide SILSO network. It extends the official Sunspot Number from the full processing of the preceding month (green line). The plot shows the last 30 days (~ 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.

7. Review of geomagnetic activity

During the first half of the week, Earth was under the influence of the solar wind stream of a northern coronal hole (CH) - left picture.

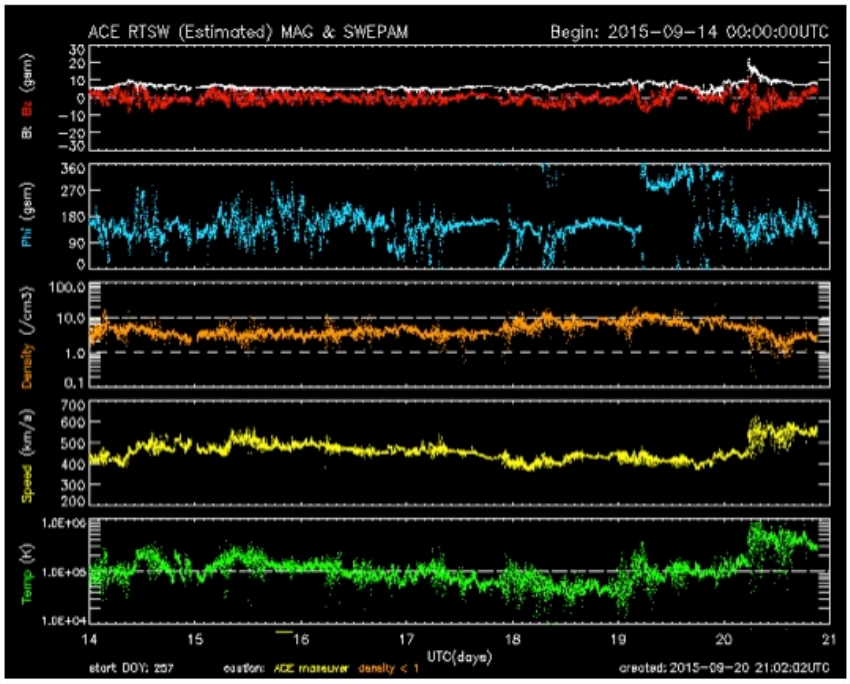
Coronal Holes





Solar wind speed reached values of 550 km/s early on 15 September, before gradually declining and settling around 400 km/s on 18-19 September.

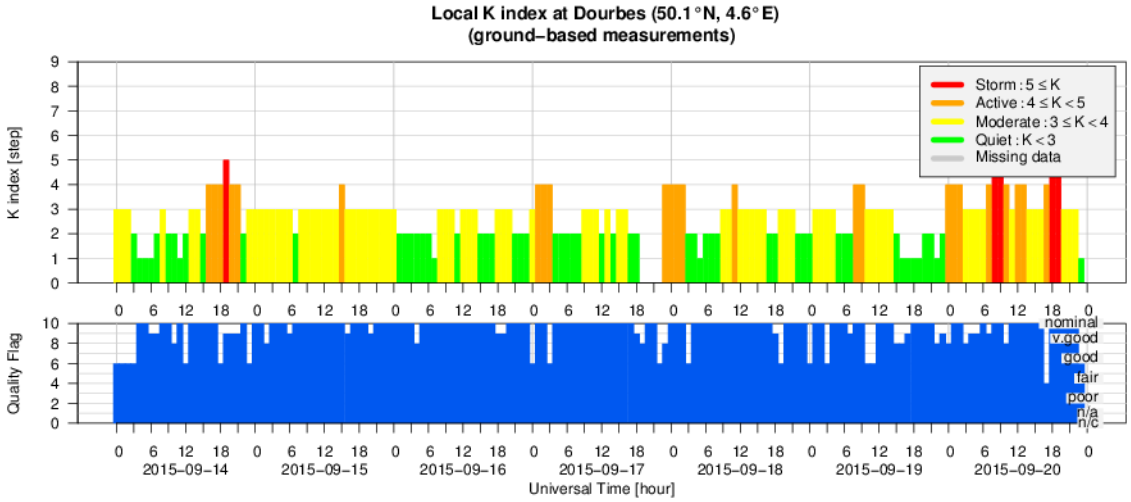
Solar Wind (ACE)



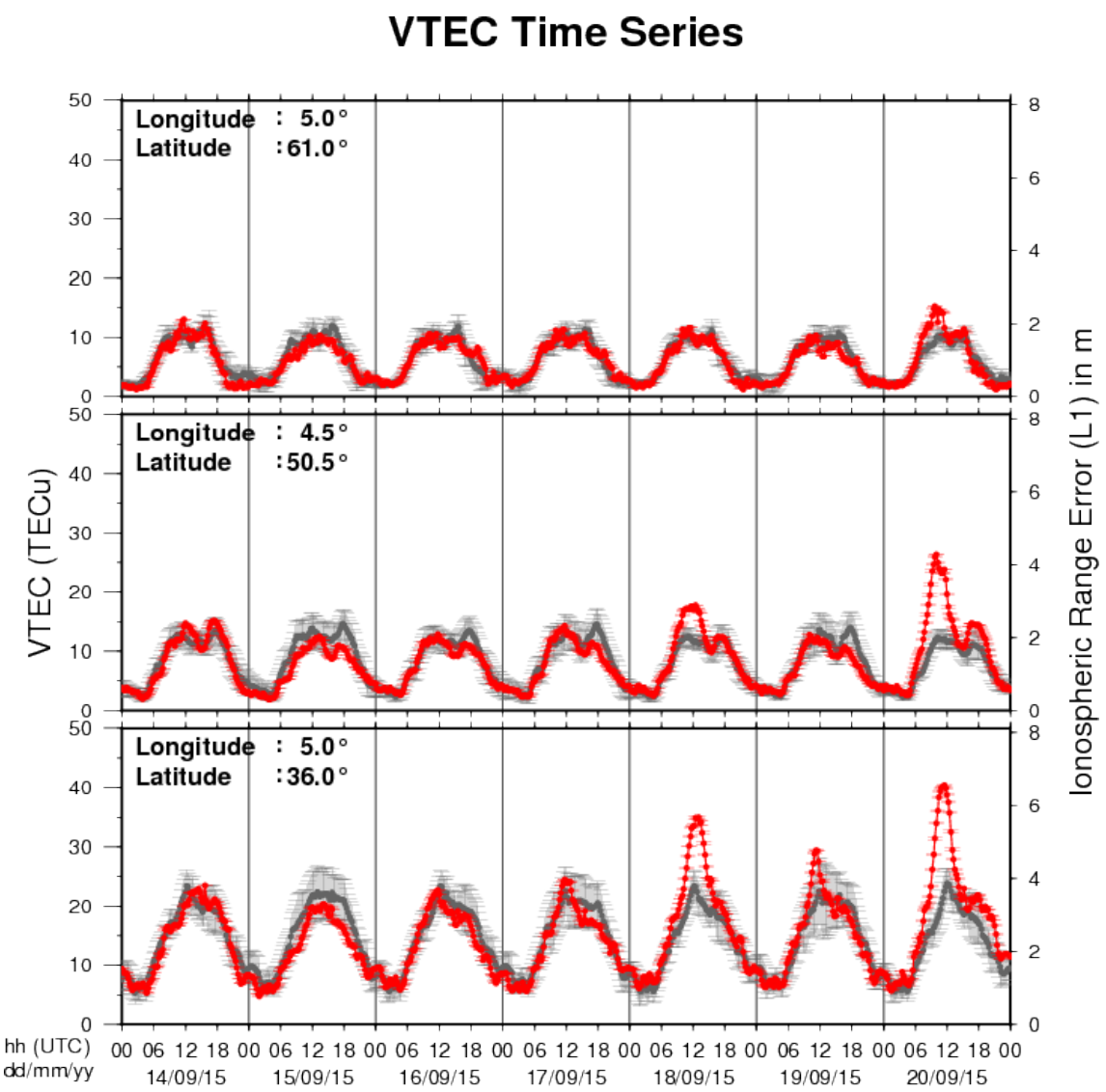
Minor geomagnetic storming was observed late on 14 September, and active episodes on all days except 16 September (unsettled). On 19 September, an apparently short-lived sector boundary crossing stirred the geomagnetic field, with Kp=5 recorded (K Dourbes at 4). On 20 September at 05:27UT, a shock was observed in the solar wind, with wind speed abruptly increasing from about 450 to 550 km/s, and Bz dipping briefly to -17 nT. This seems to have been the much earlier than expected arrival of the 18 September CME. The planetary index reached major geomagnetic storming (Kp=7), while K Dourbes reached 5. The remainder enduring elevated wind speeds varying mostly between 500 and 600 km/s. This was possibly the anticipated effect of a transequatorial CH that transited the central meridian on 16-17 September - right picture of the first image.

Thanks to Jan Janssens, the forecaster on duty for the provided input.

8. Geomagnetic Observations at Dourbes (14 Sep 2015 - 20 Sep 2015)



9. Review of ionospheric activity (14 Sep 2015 - 20 Sep 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

10. 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