STCE Newsletter

28 Sep 2015 - 4 Oct 2015

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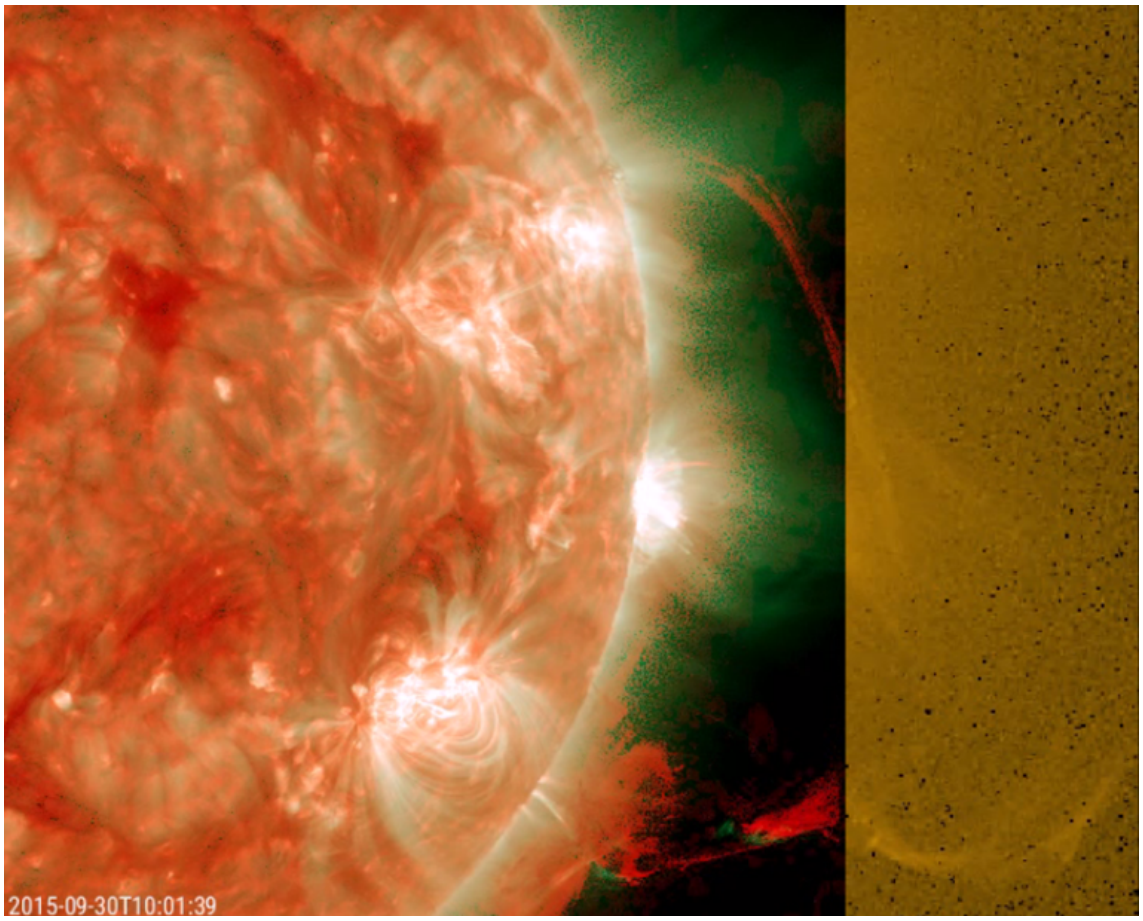
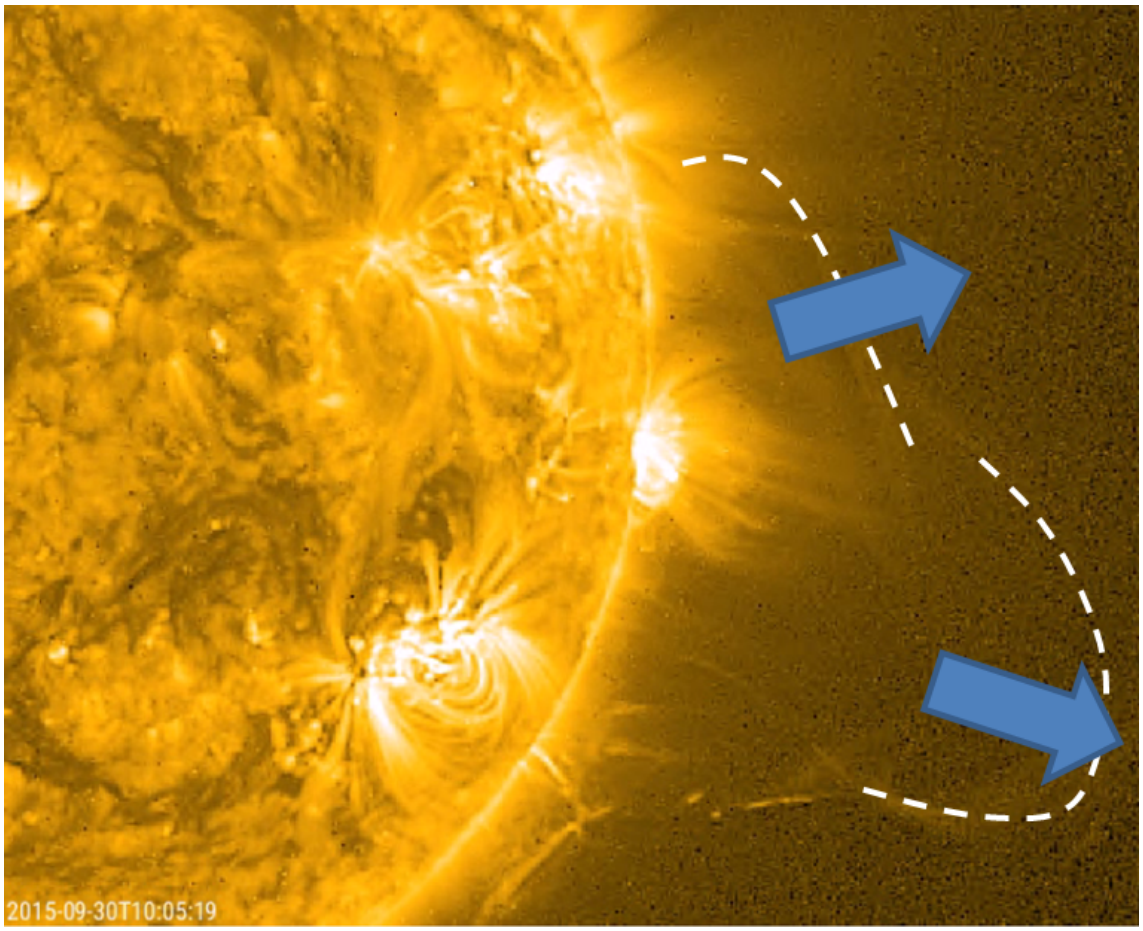
The Solar-Terrestrial Centre of Excellence (STCE) is a collaborative network of the Belgian Institute for Space Aeronomy, the Royal Observatory of Belgium and the Royal Meteorological Institute of Belgium.

Final Editor : Petra Vanlommel
Contact : R. Van der Linden, General Coordinator STCE,
Ringlaan - 3 - Avenue Circulaire, 1180 Brussels,
Belgium

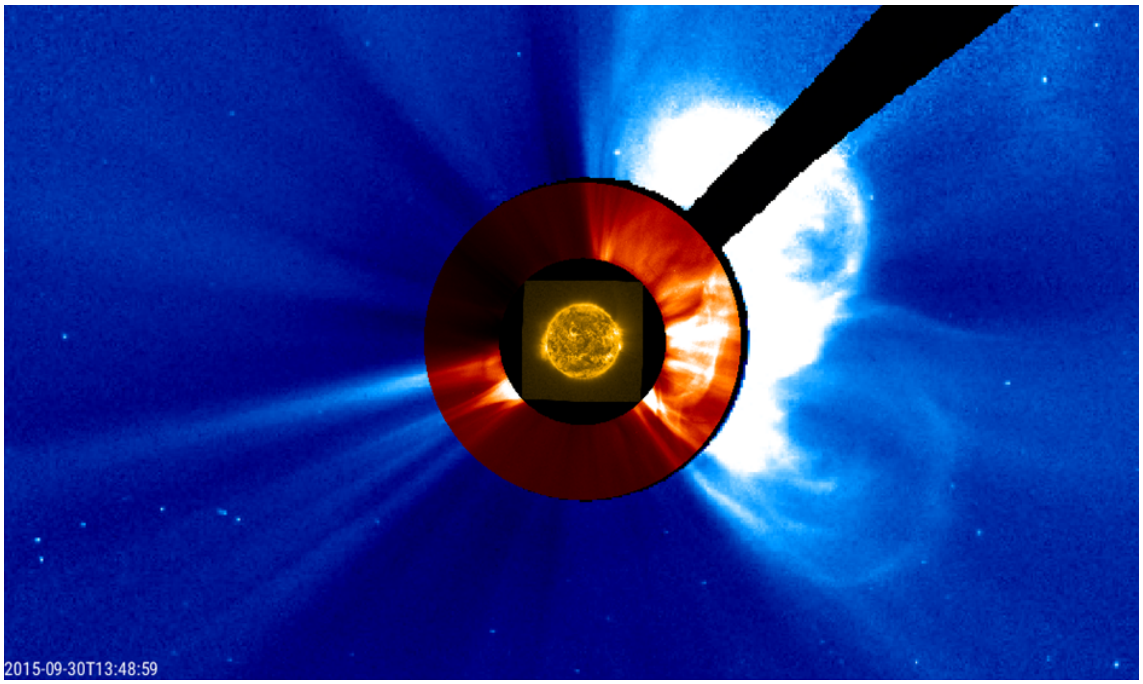
1. A two-stage CME

On 30 September, a prominence near the southwest solar limb got ejected into space. Prominences are clouds of plasma (charged particles) which are suspended in the corona, squeezed between large magnetic fields of opposite polarity, but denser and cooler than the surrounding coronal plasma. The structure had been visible during the last 2 weeks, before the surrounding magnetic field became unstable and ejected it into space starting around 07:30UT.

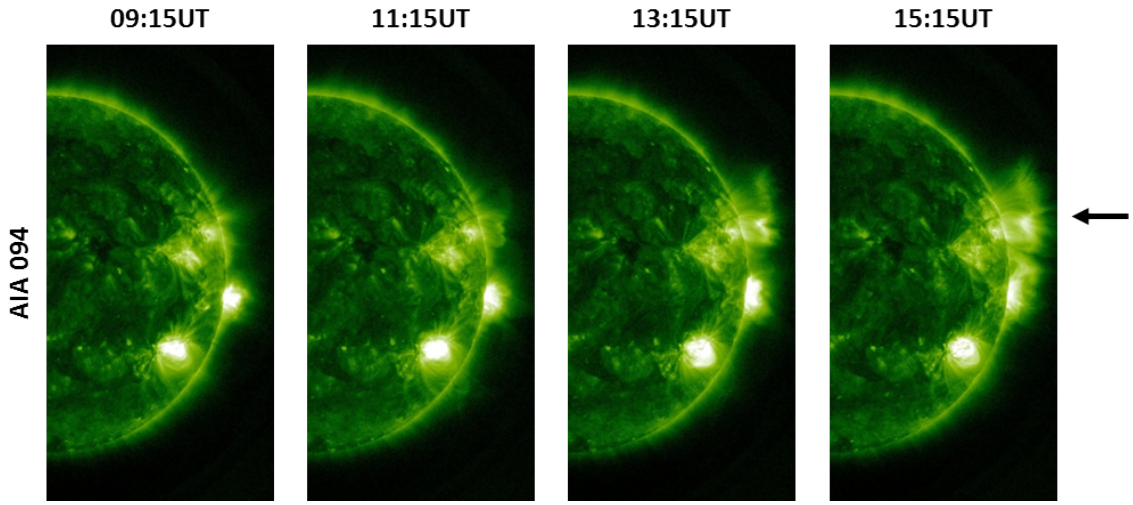


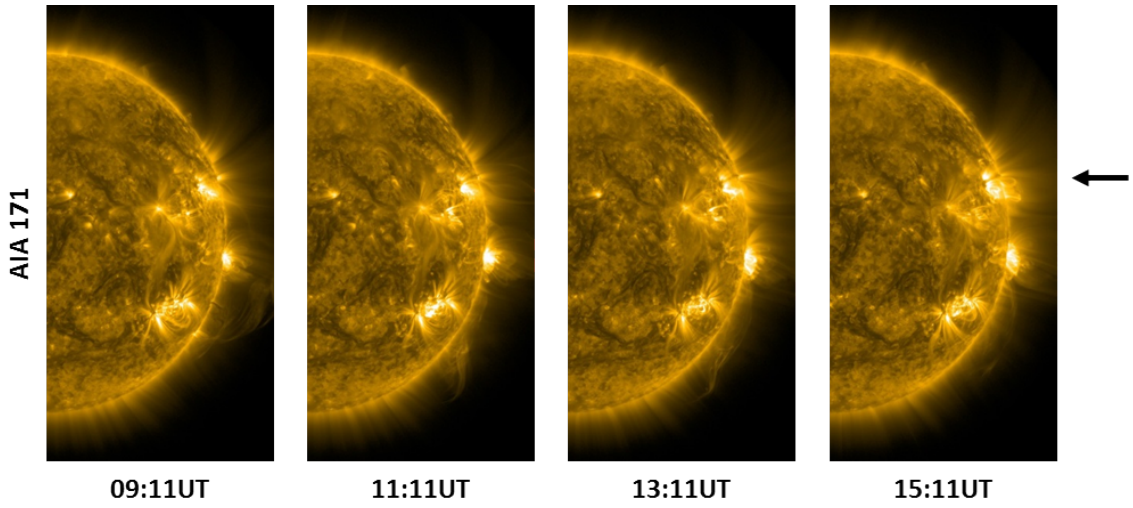


As can be seen in the widefield PROBA2/SWAP image above, the escaping material seems to have triggered more reconnections in the corona, with material raining down near the northwest solar limb. Hence, the first coronal mass ejection (CME) is quickly followed by another CME this time directed to the northwest. CACTus (http://www.sidc.oma.be/cactus/) combined the two CMEs seen in SOHO's coronagraphs (image below) into one 150-degrees-wide partial halo CME, but they can clearly be distinguished from each other, both in direction and timing. The first CME became visible at 09:24UT and was headed in the southwest direction, the second CME became visible around 10:36UT and was headed to the northwest. Both CMEs were slow, with a speed of around 330 km/s, and they were not directed to Earth.



The most impressive features were observed in the aftermath of the eruption. Indeed, over the northwestern footpoint one can see supra-arcade downflows, i.e. sunward moving voids often seen above developing post-eruption coronal loops. The downflows became visible in SDO's AIA 094 filter starting around 12:00UT. This filter shows the corona at temperatures of several million degrees, and the features are not visible in lower temperature filters such as SDO/AIA 171 (700.000 degrees) or PROBA2/SWAP (about 1 million degrees). The appearance of these structures add to the complexity of the eruption as a whole.





The movie at https://youtu.be/QexI-qEqsL0 first shows the eruption in extreme ultraviolet (resp. first a combo from AIA193/304 and SWAP; then purely SWAP), followed by two clips combining the PROBA2/SWAP images with coronagraphic imagery from SOHO/LASCO, finally ending with AIA094 (full disk) and a AIA094/171 combo (zoom) of the supra-arcade downflows.

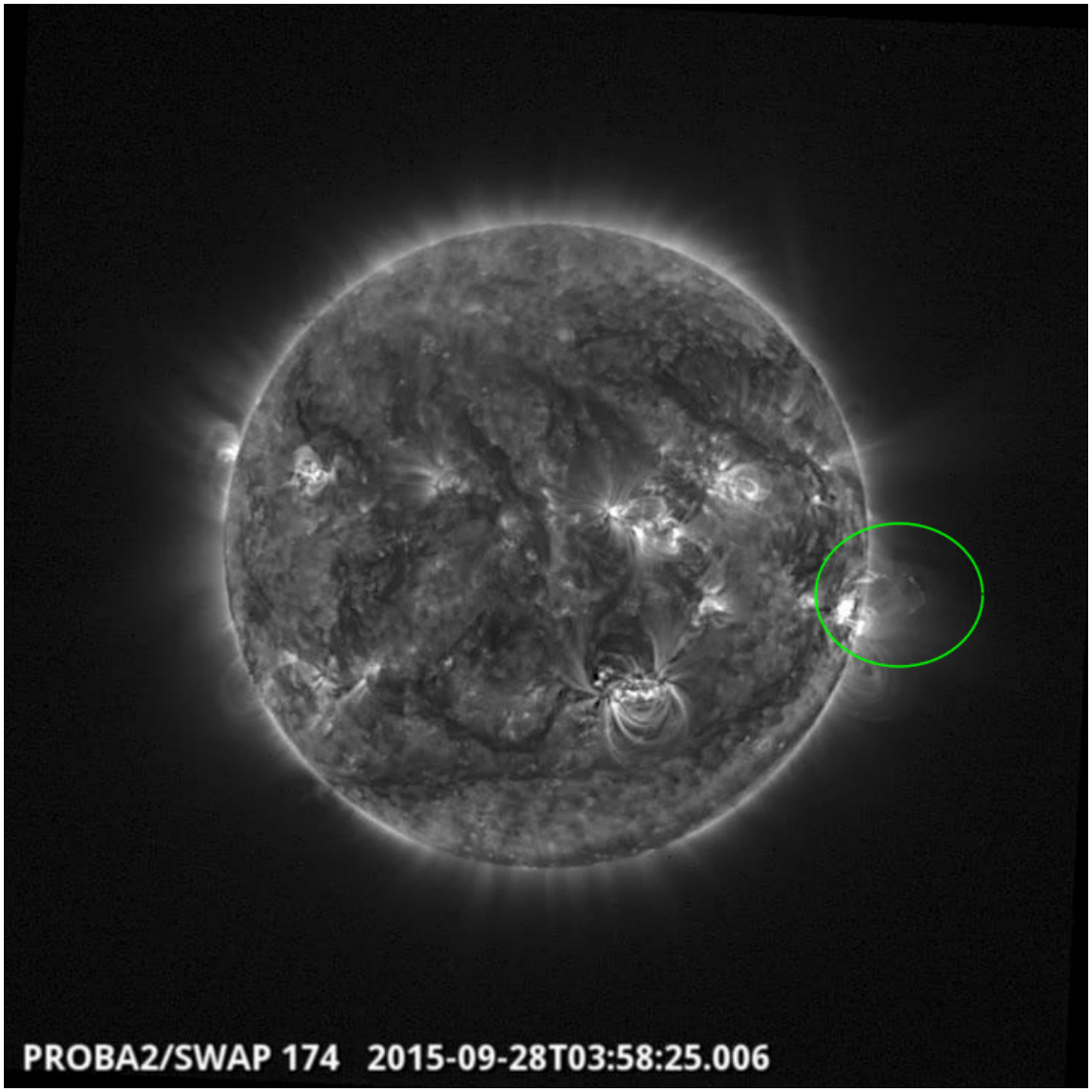
Credits - Data and imagery for the movie clips were taken from SDO/AIA (http://sdo.gsfc.nasa.gov/data/aiahmi/), PROBA2/SWAP (http://proba2.oma.be/ssa), SOHO/LASCO (http://sohowww.nascom.nasa.gov/home.html), and (J)Helioviewer (http://helioviewer.org/).

2. PROBA2 Observations (28 Sep 2015 - 4 Oct 2015)

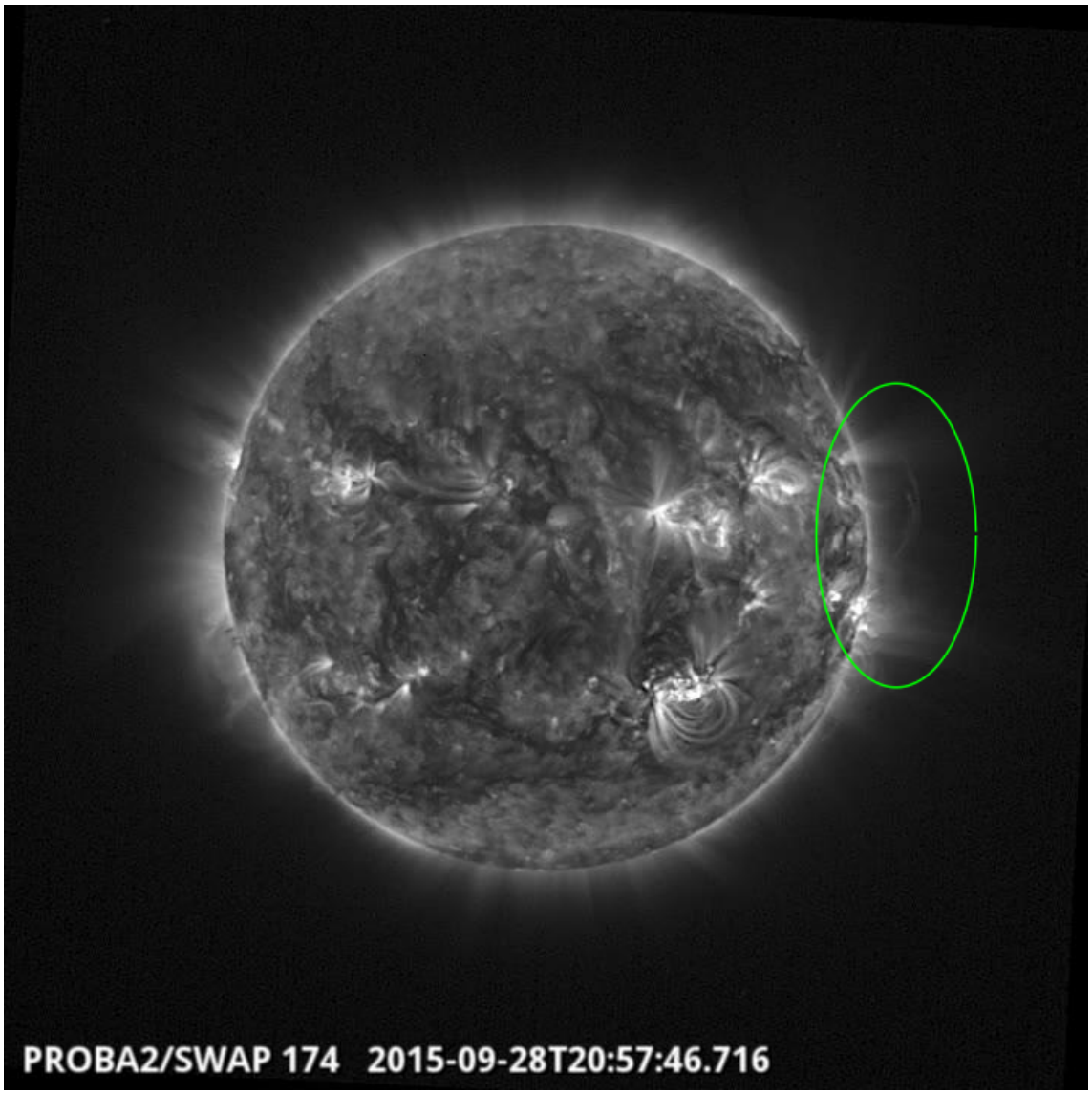
Solar Activity

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 (SWAP week 288).
http://proba2.oma.be/swap/data/mpg/movies/weekly_movies/weekly_movie_2015_09_28.mp4
Details about some of this week's events, can be found further below.

Monday Sep 28

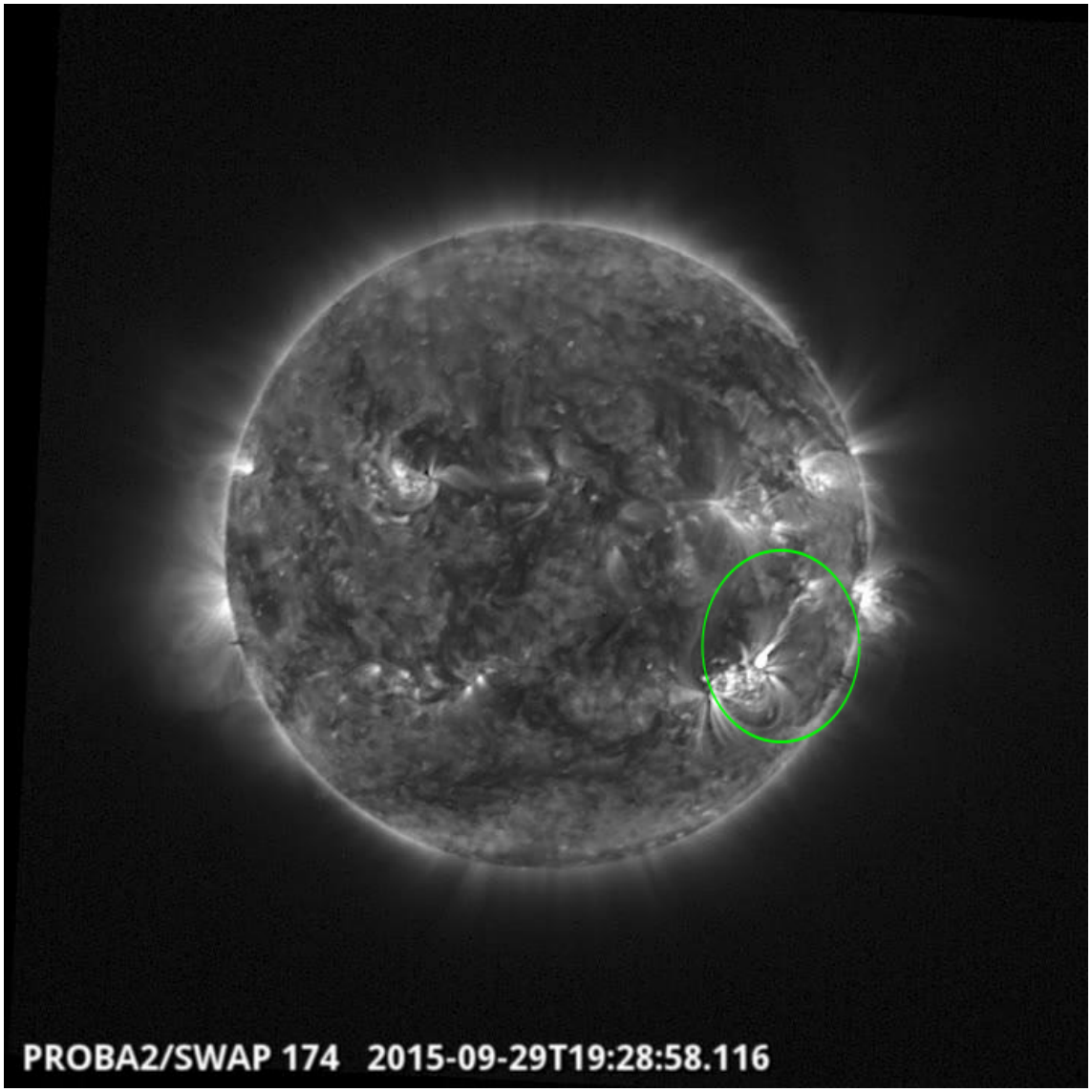


Failed eruption on the west limb @ 03:58 SWAP image
Find a movie of the events here (SWAP movie)
http://proba2.oma.be/swap/data/mpg/movies/2015/09/20150928_swap_movie.mp4



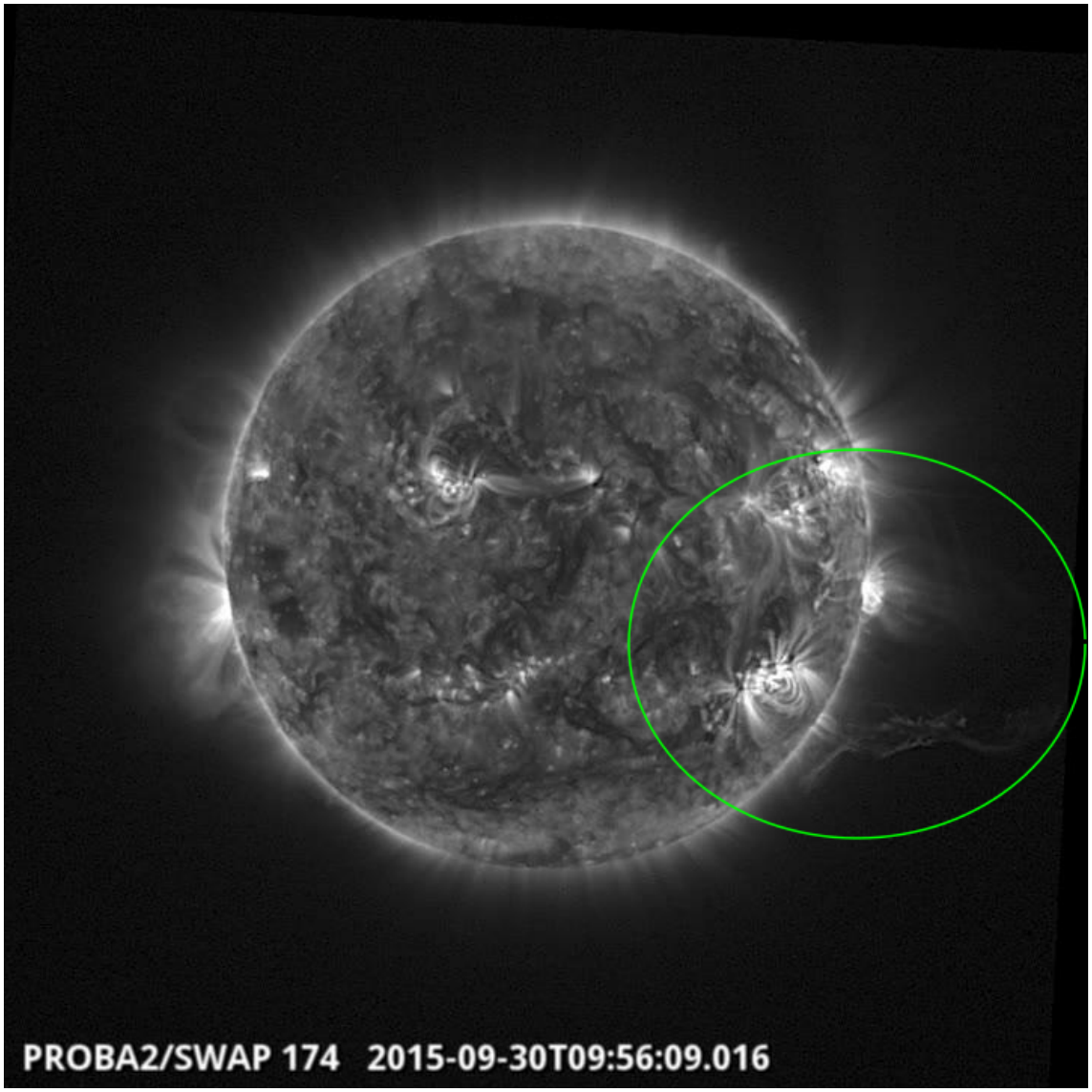
Prominence flow on the west limb @ 20:57 SWAP image
Find a movie of the events here (SWAP movie)
http://proba2.oma.be/swap/data/mpg/movies/2015/09/20150928_swap_movie.mp4

Tuesday Sep 29



Mflare on the south west quadrant @ 19:28 SWAP image
Find a movie of the event here (SWAP movie)
http://proba2.oma.be/swap/data/mpg/movies/2015/09/20150929_swap_movie.mp4

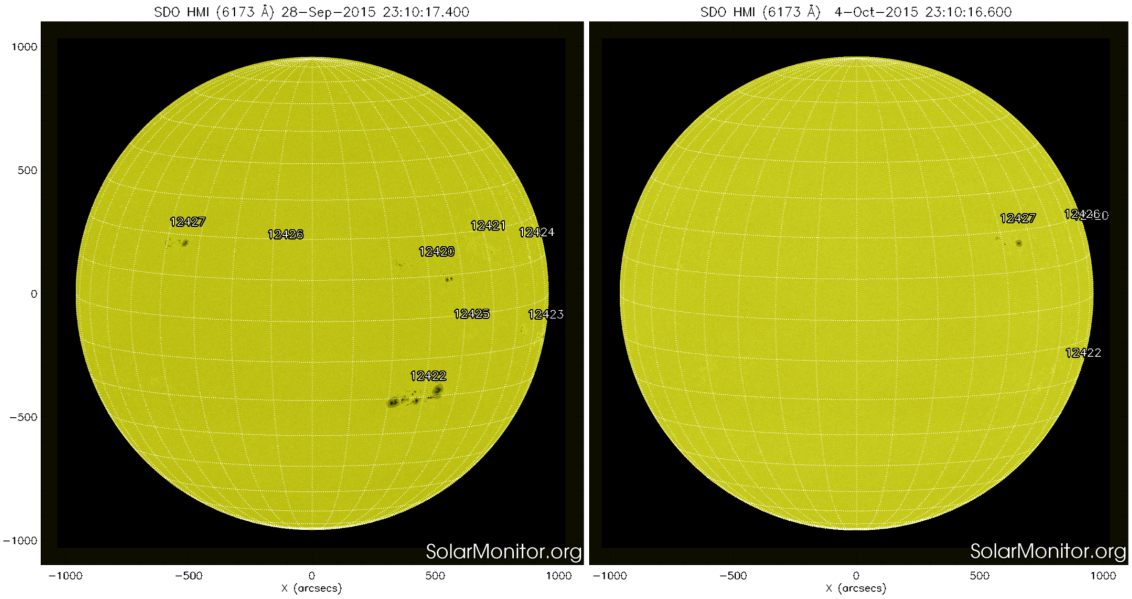
Wednesday Sep 30



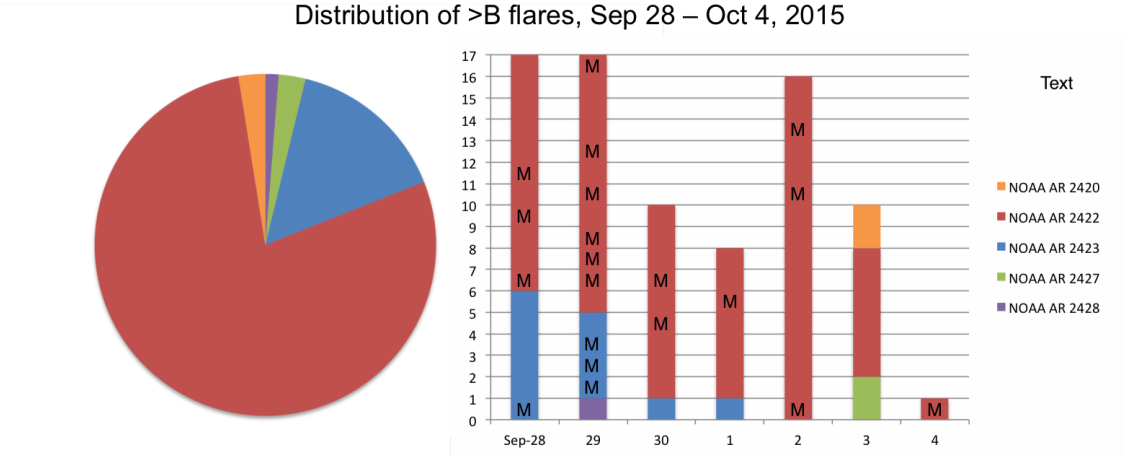
Eruptions on the west limb @ 09:56 SWAP image
Find a movie of the event here (SWAP movie)
http://proba2.oma.be/swap/data/mpg/movies/2015/09/20150930_swap_movie.mp4

The initial erupting prominence from the limb was apparently linked to a second prominence near AR 12422, which itself subsequently erupted at the end of the day.

3. Review of solar activity

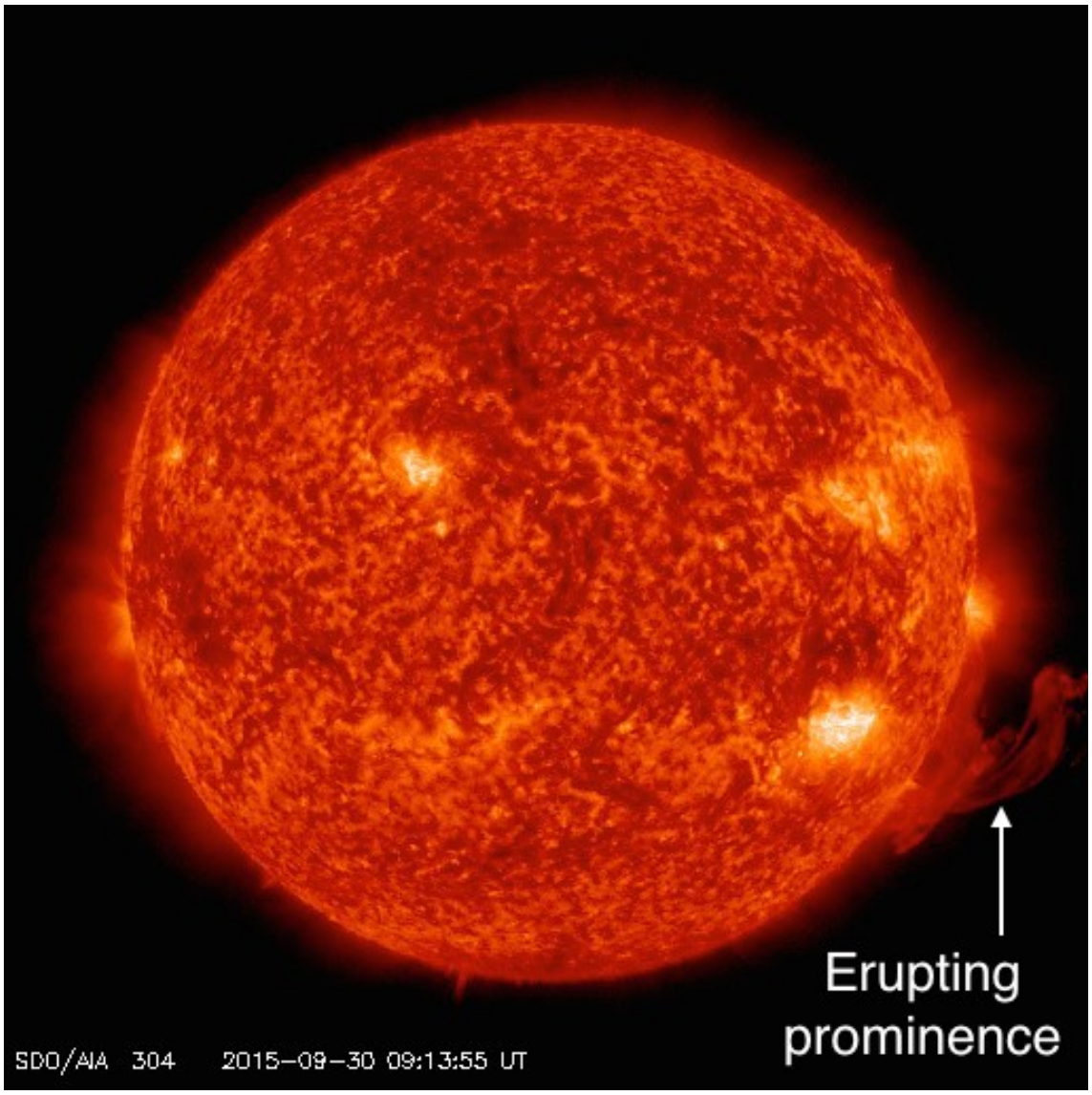


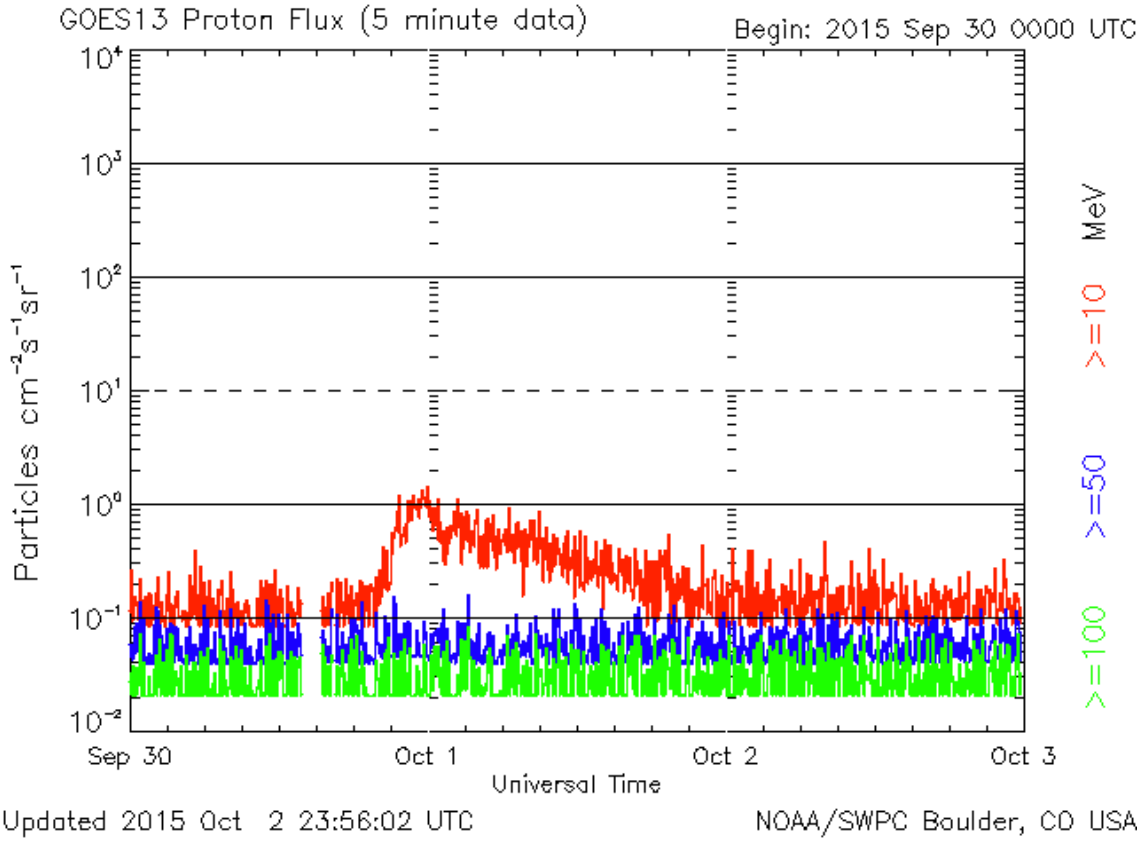
The week started with eight regions on the solar disk, but as most of the activity was located at the western hemisphere there was only one region left at the last day of the week.



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.

Solar activity was dominated by NOAA 2422 and at the beginning of the week -to a lesser degree- by NOAA 2423. In total 59 C-flares and 20 M-flares were observed, mostly confined. Beta-gamma-delta region NOAA 2422 was responsible for 46 C-flares and 16 M-flares, with an M7.6 flare on September 28 as the strongest one, while 8 C-flares and 4 M-flares originated from NOAA 2423.


Erupting
prominence
SDO/AIA 304 2015-09-30 09:13:55 UT



A prominence eruption was visible on September 30, followed by a sequence of CMEs propagating West of the Sun-Earth line (see 'A two-stage CME' - 'PROBA2 observations'). An enhancement of the proton flux (at > 10 MeV) was observed on October 1, but flux values stayed well below the event threshold and gradually returned to the background level.

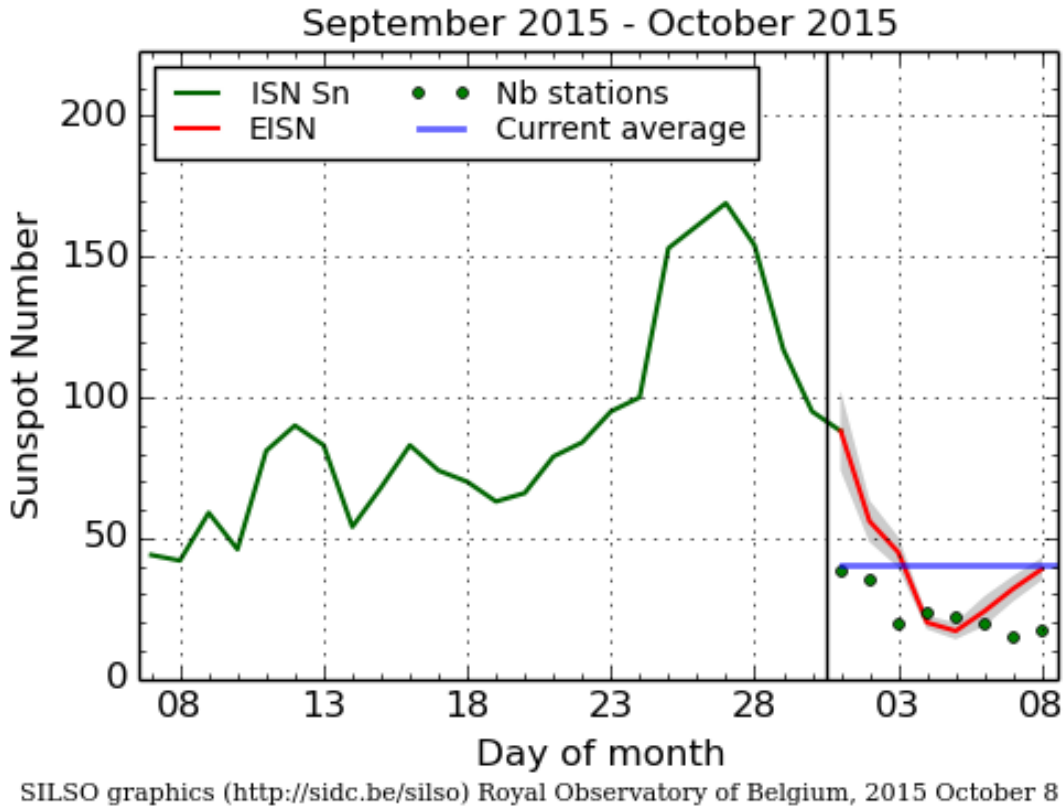
4. Noticeable Solar Events (28 Sep 2015 - 4 Oct 2015)

DAY	BEGIN	MAX	END	LOC	XRAY	OP	10CM	TYPE	Cat	NOAA
28	0345	0355	0359	S9W67	M3.6	SF		V/2III/3	36	2423
28	0727	0735	0746	S22W20	M1.1	1N			39	2422
28	1301	1318	1329	S22W24	M1.1	1N			39	2422
28	1453	1458	1503		M7.6		100		39	2422
29	0311	0316	0331	S8W78	M1.2	SF			36	2423
29	0341	0343	0353	S20W36	M1.1	SF			39	2422
29	0505	0516	0523	S21W37	M2.9	SF			39	2422
29	0533	0537	0539	S9W82	M1.2	SF			36	2423
29	0553	0556	0604		M1.0				39	2422
29	0639	0643	0646	S20W34	M1.4	1N			39	2422
29	0846	0851	0855	S10W77	M1.3	1N			36	2423
29	1109	1115	1120	S21W37	M1.6	1B			39	2422
29	1920	1924	1927	S20W36	M1.1	1B		III/2	39	2422
30	1049	1059	1113	S22W46	M1.3	1N		CTM/1		2422
30	1318	1320	1321	S23W59	M1.1	1N				2422
01	1303	1310	1314	S23W64	M4.5	SN				2422

02	0006	0013	0017	S19W67	M5.5	1N	III/1	2422
02	1219	1226	1231		M1.0			2422
02	1708	1718	1723	S19W76	M1.0	SF		2422
04	0234	0241	0248		M1.0			2422

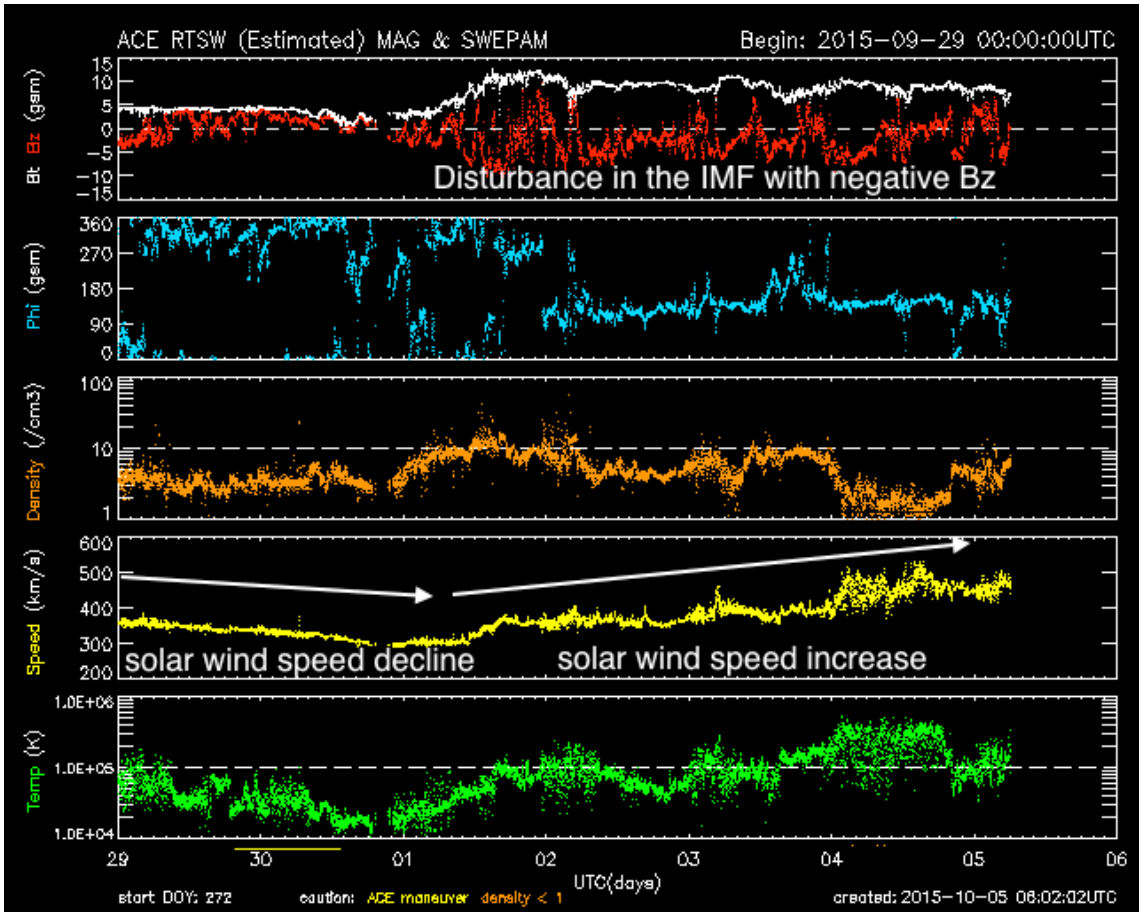
LOC: approximate heliographic location
XRAY: X-ray flare class
OP: optical flare class
10CM: peak 10 cm radio flux
TYPE: radio burst type
Cat: Catania sunspot group number
NOAA: NOAA active region number

5. The International Sunspot Number

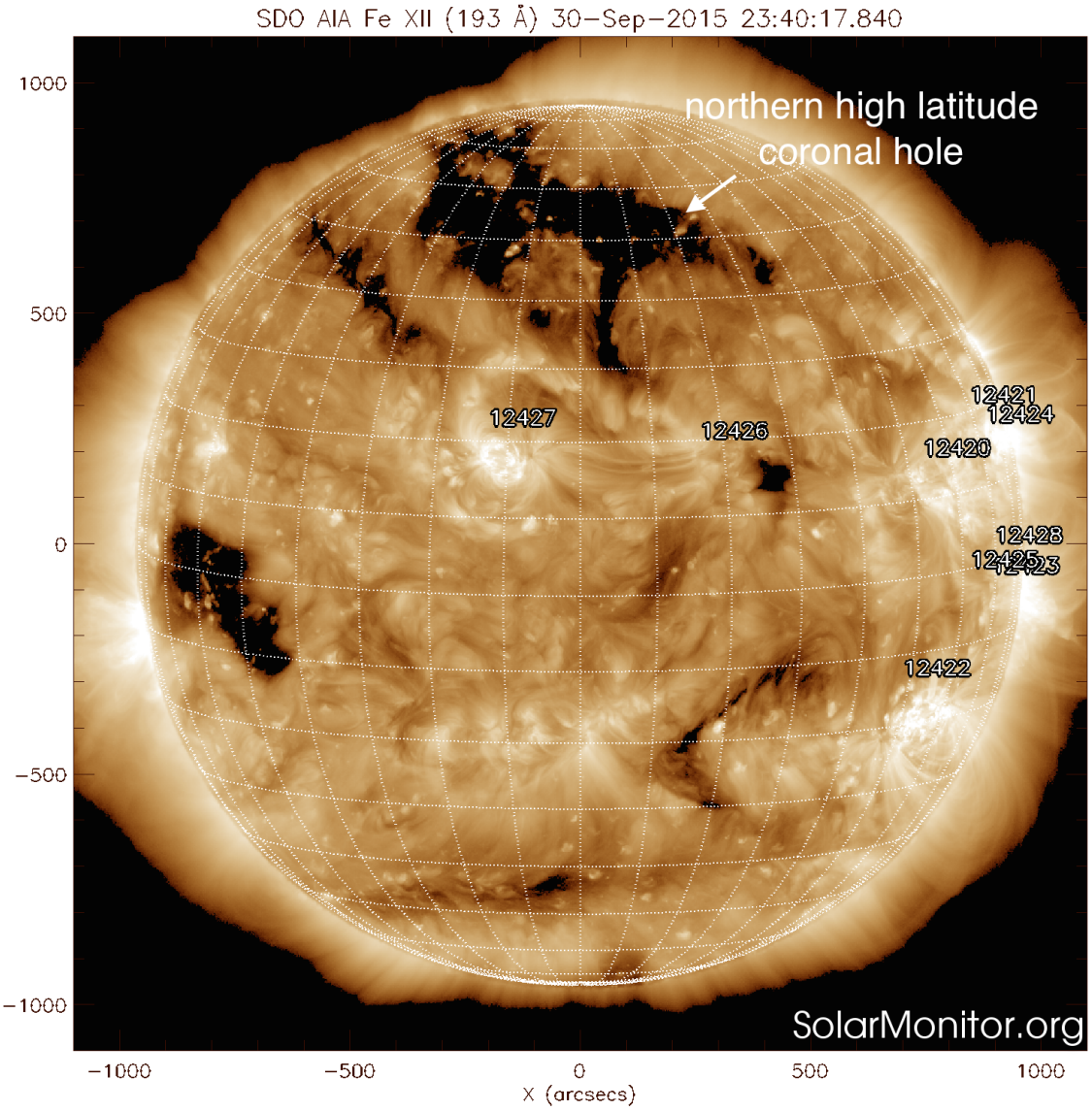


The daily Estimated International Sunspot Number (EISN, red curve with shaded error) derived by a simplified method from real-time data from the worldwide SILSO network. It extends the official Sunspot Number from the full processing of the preceding month (green line). The plot shows the last 30 days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

6. Review of geomagnetic activity

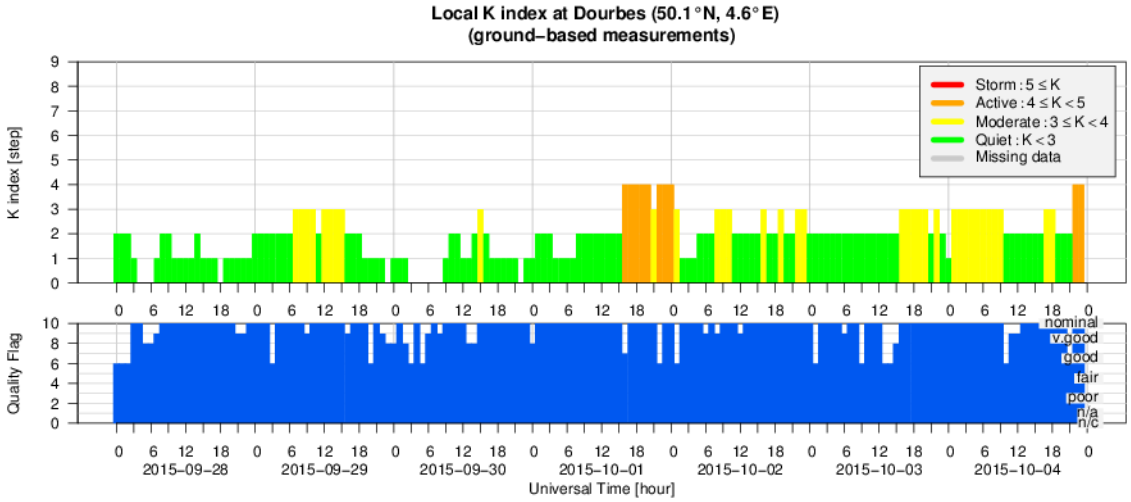


Earth was inside a slow solar wind for most of the week. The solar wind speed was declining from 400 to 300 km/s till October 1. From October 1 a gradual increase in the solar wind speed to about 500 km/s was noticed, accompanied by a disturbance in the interplanetary magnetic field (IMF). The magnitude of the IMF reached a maximum of 12 nT and the north-south component was largely negative in the period October 1-4 with a minimum of -10 nT on October 1.

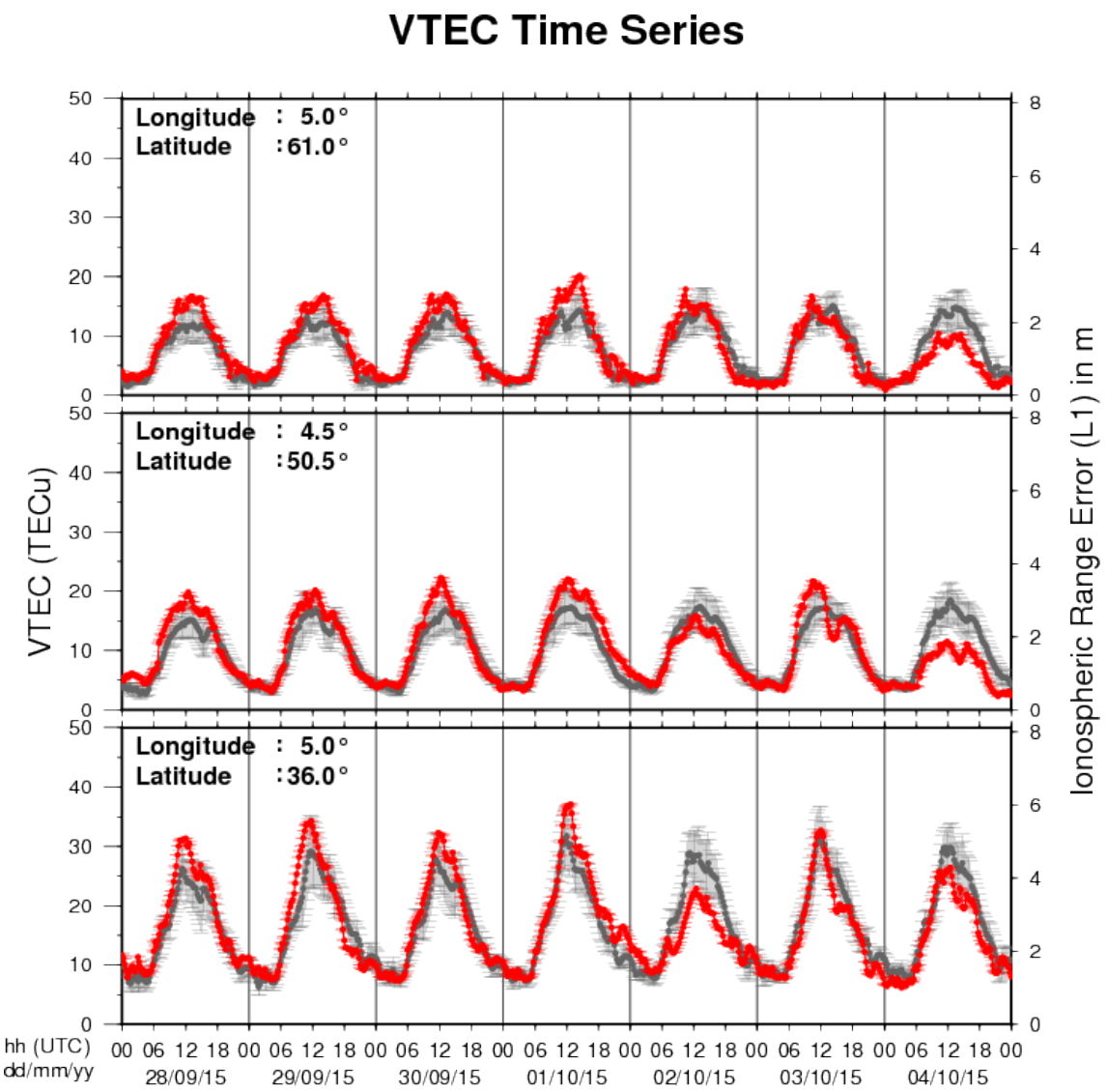


This disturbance was due to a flow emanating from an extension of a northern high latitude coronal hole. Geomagnetic levels were quiet (K=0-2) to unsettled (K=3) for most of the week. From October 1 to 4 a few time slots of active conditions (K=4) were obtained at local (Dourbes) and planetary (Potsdam Kp) level. A single time slot of minor conditions even was reached at NOAA (Kp=5) on October 4.

7. Geomagnetic Observations at Dourbes (28 Sep 2015 - 4 Oct 2015)



8. Review of ionospheric activity (28 Sep 2015 - 4 Oct 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