

# STCE Newsletter

31 Aug 2015 - 6 Sep 2015



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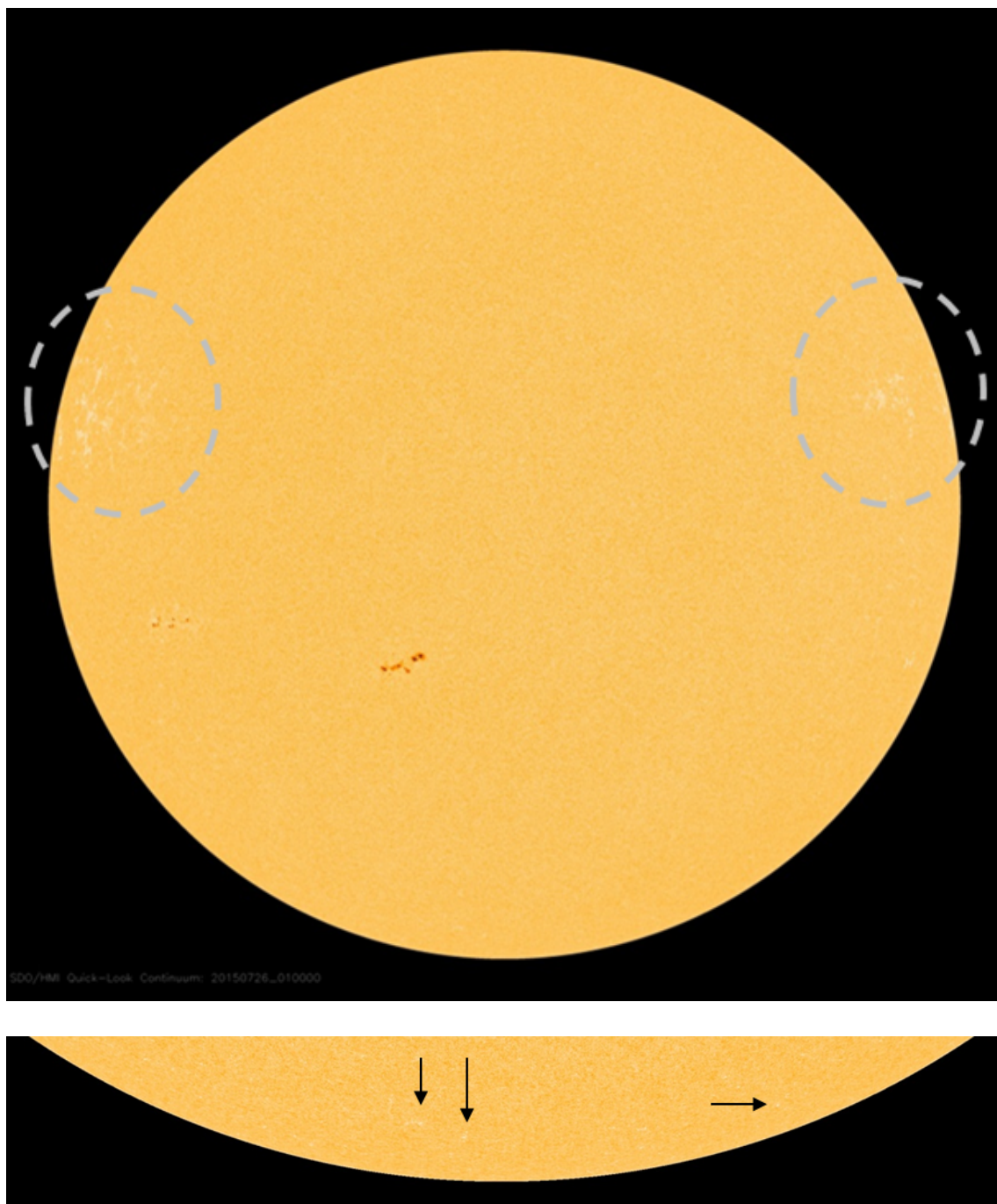
The Solar-Terrestrial Centre of Excellence (STCE) is a collaborative network of the Belgian Institute for Space Aeronomy, the Royal Observatory of Belgium and the Royal Meteorological Institute of Belgium.

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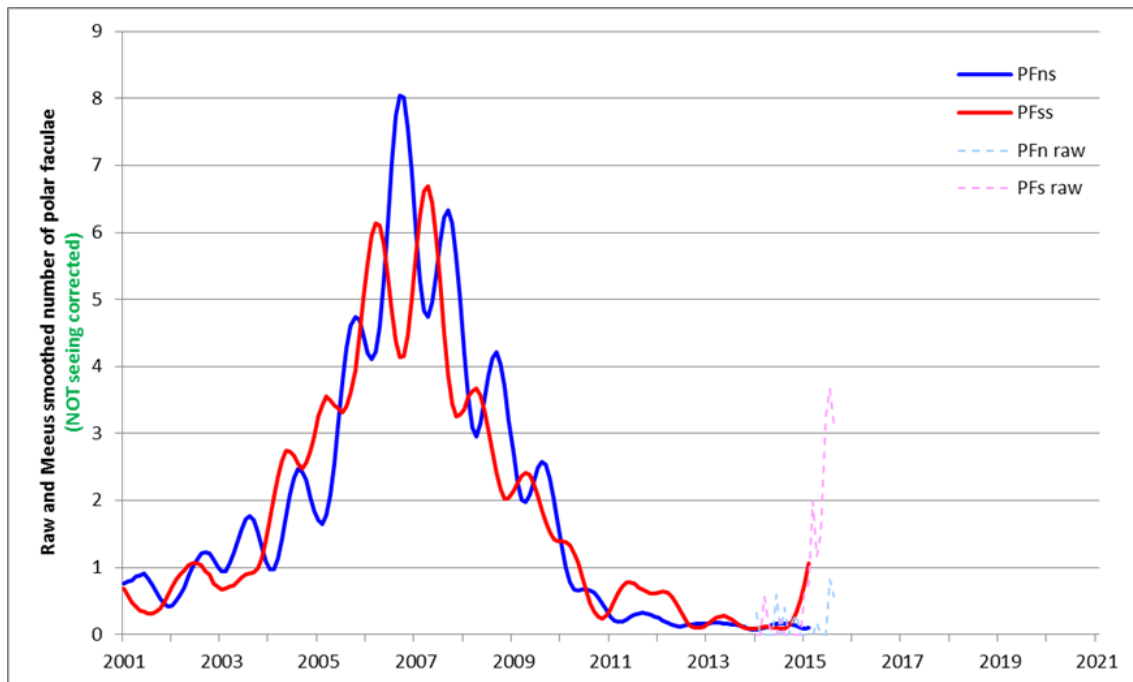
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## 1. Polar faculae near the Sun's south pole

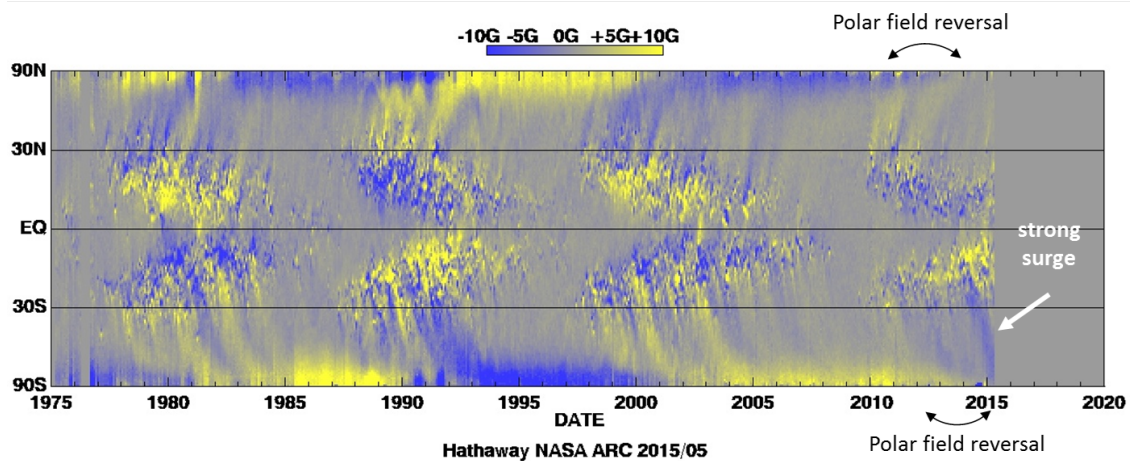
Solar polar faculae (PF) appear in white light as bright points near the northern and southern solar poles, usually at heliographic latitudes greater than about 60 degrees. In contrast to their equatorial counterparts (the main zone faculae), they are pointlike, less bright, and randomly distributed. Faculae are local concentrations of magnetic field, but not that strong that they can form sunspots. The SDO/HMI images underneath show main zone faculae fields (in the gray dashed circles) on 26 July 2015, as well as -for the same day- a highly magnified view of the south pole with some polar faculae indicated by arrows (bright dots).



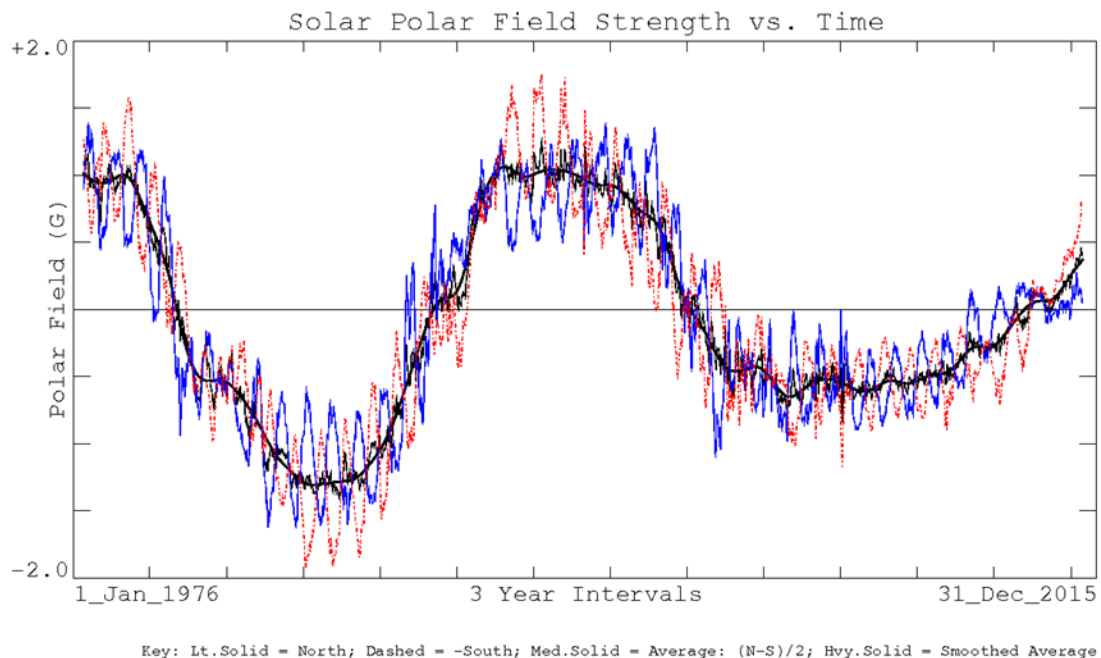
An important difference between the PF and main zone faculae is that the number of PF evolves oppositely to the "normal" solar cycle, i.e. PF are most numerous during solar cycle minima, and (near) zero during solar cycle maxima. The latter corresponds to the period of polar magnetic field reversal, offering an explanation for the absence of the PF during these years. Interestingly, over the last few months, observers of the Belgian solar section (see their newsletter at <http://www.vvs.be/werkgroepen/werkgroep-zon/nieuwsbrieven>) noticed a significant increase in the number of PF near the Sun's south pole. This can be seen in graph underneath, showing an observer's smoothed number of polar faculae for the northern (blue) and southern solar pole (red). The sudden increase in southern polar faculae (shown at the end of the graph) is a bit unexpected because the next solar minimum is still many years away.



What seems to be happening is that a surge of negative magnetic field flux reached the south pole late in 2014, cancelling and effectively overturning the previously existing southern polar magnetic field of opposite polarity. This can be seen in the annotated magnetic diagram underneath from NASA/Ames Research Center (<http://solarscience.msfc.nasa.gov/images/magbfly.jpg>). Yellow is positive polarity and blue is negative. Increased PF activity associated to the arrival of such surges has been documented in the past by professional solar observers such as N. R. Sheeley (e.g. in 1974: see <http://adsabs.harvard.edu/abs/2008ApJ...680.1553S>). No such \*strong\* surge has been observed near the north pole so far this cycle, despite the polar field reversal having taken place there more than a year before the southern one. Completely conform to these findings, no obvious increase in PF has been observed near the north pole during the last two years.



Magnetic field measurements by the Wilcox Solar Observatory (<http://wso.stanford.edu/gifs/Polar.gif>) independently confirm the magnetic ongoing near the Sun's poles, with neutral (close to zero) values near the north pole (in "blue"), and a sharp upturn in magnetic field strength near the south pole (in "red"; see chart underneath). Just as for the PF, the undulations (regular up-and-downs) are caused by the fact that Earth has a better view on the Sun's south pole during spring months, and on the north pole during autumn because of the tilt of the solar rotation axis. The values of the polar field strength can be used for the prediction of the strength of the upcoming solar cycle, but for solar cycle 25, an accurate prediction is still a few years away (awaiting stable fields at maximum strength). For SC24 predictions, one can refer to e.g. Svalgaard (2005) at <http://adsabs.harvard.edu/abs/2005GeoRL..32.1104S> and Schatten (2005) at <http://adsabs.harvard.edu/abs/2005GeoRL..32.21106S> ).



## 2. The heliospheric cruise ship STAFF



STAFF, the software to cruise through data of the solar system is upgraded. STAFF is a dynamic online timeline viewer which allows you to plot and compare data with a few mouse clicks. You can dig now into GOES data up to 1986, radio 10.7 cm flux data up to 1947. You are given more control on plotting options.

Become the captain of the heliospheric cruise ship STAFF : <http://www.staff.oma.be>

Happy cruising!

## 3. PROBA2 Observations (31 Aug 2015 - 6 Sep 2015)

### Solar Activity

Solar flare activity fluctuated between very low and low 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>

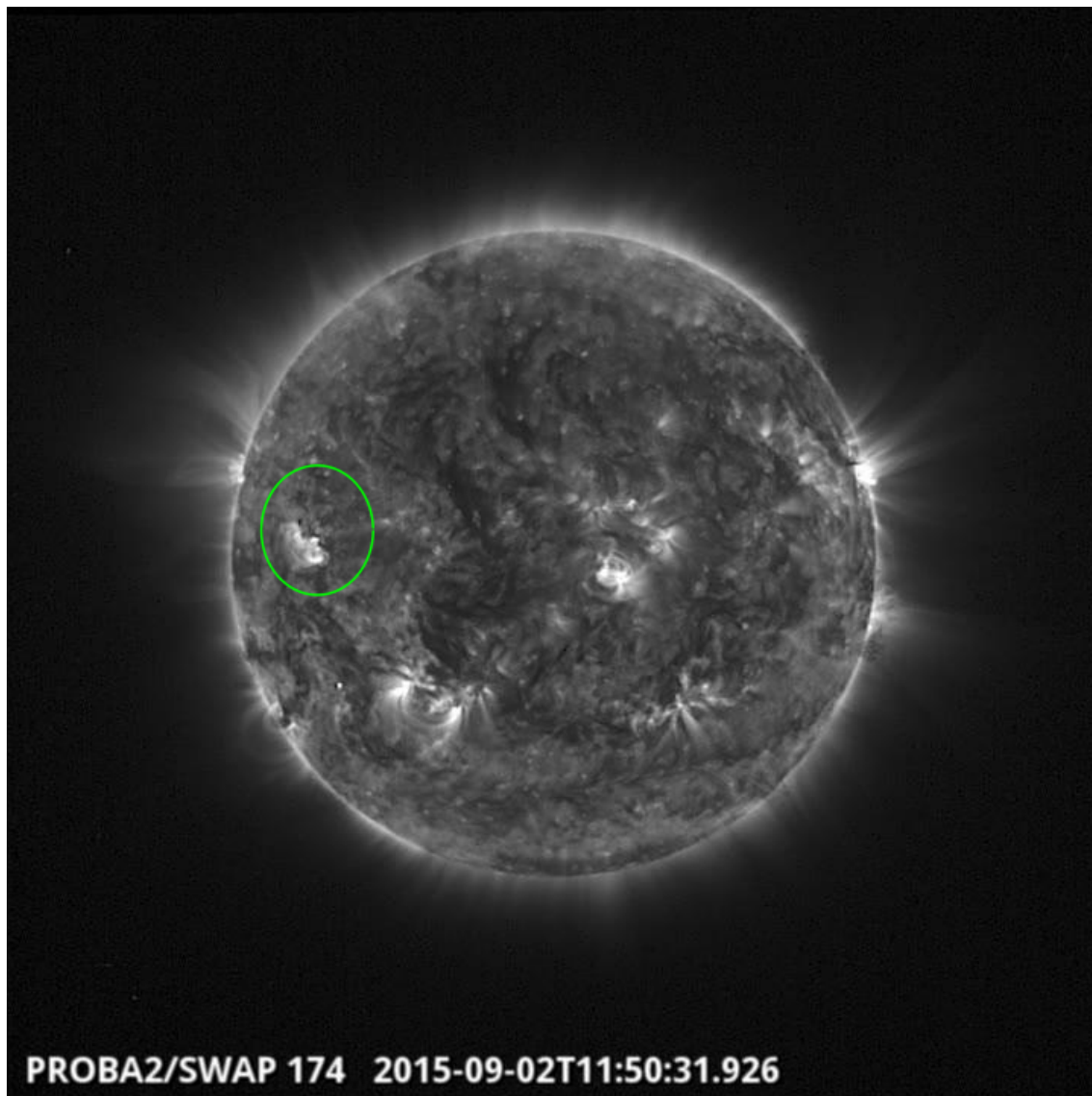
This page also lists the recorded flaring events.

A weekly overview movie can be found here (SWAP week 284).

[http://proba2.oma.be/swap/data/mpg/movies/weekly\\_movies/weekly\\_movie\\_2015\\_08\\_31.mp4](http://proba2.oma.be/swap/data/mpg/movies/weekly_movies/weekly_movie_2015_08_31.mp4)

Details about some of this week's events, can be found further below.

## Wednesday Sep 02



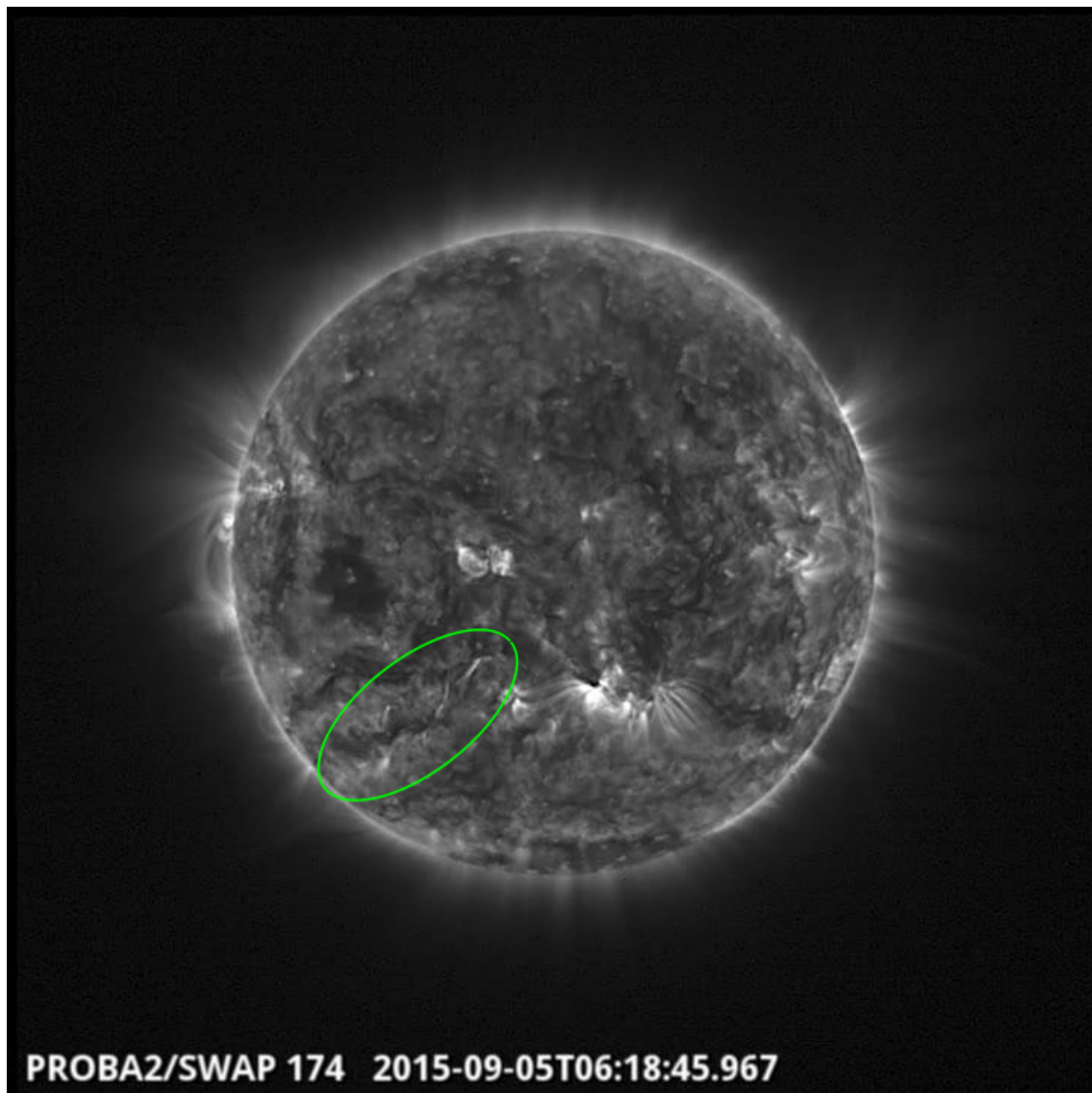
Dimming in the East @ 11:50 UT on 02Sep2015 SWAP image

Find a movie of the event here (SWAP movie)

[http://proba2.oma.be/swap/data/mpg/movies/20150902\\_swap\\_movie.mp4](http://proba2.oma.be/swap/data/mpg/movies/20150902_swap_movie.mp4)



Friday Oct 05



Flows in the south east @ 06:18 UT on 05Sep2015 SWAP image  
Find a movie of the event here (SWAP movie)  
[http://proba2.oma.be/swap/data/mpg/movies/20150905\\_swap\\_movie.mp4](http://proba2.oma.be/swap/data/mpg/movies/20150905_swap_movie.mp4)

#### **4. Review of solar and geomagnetic activity**

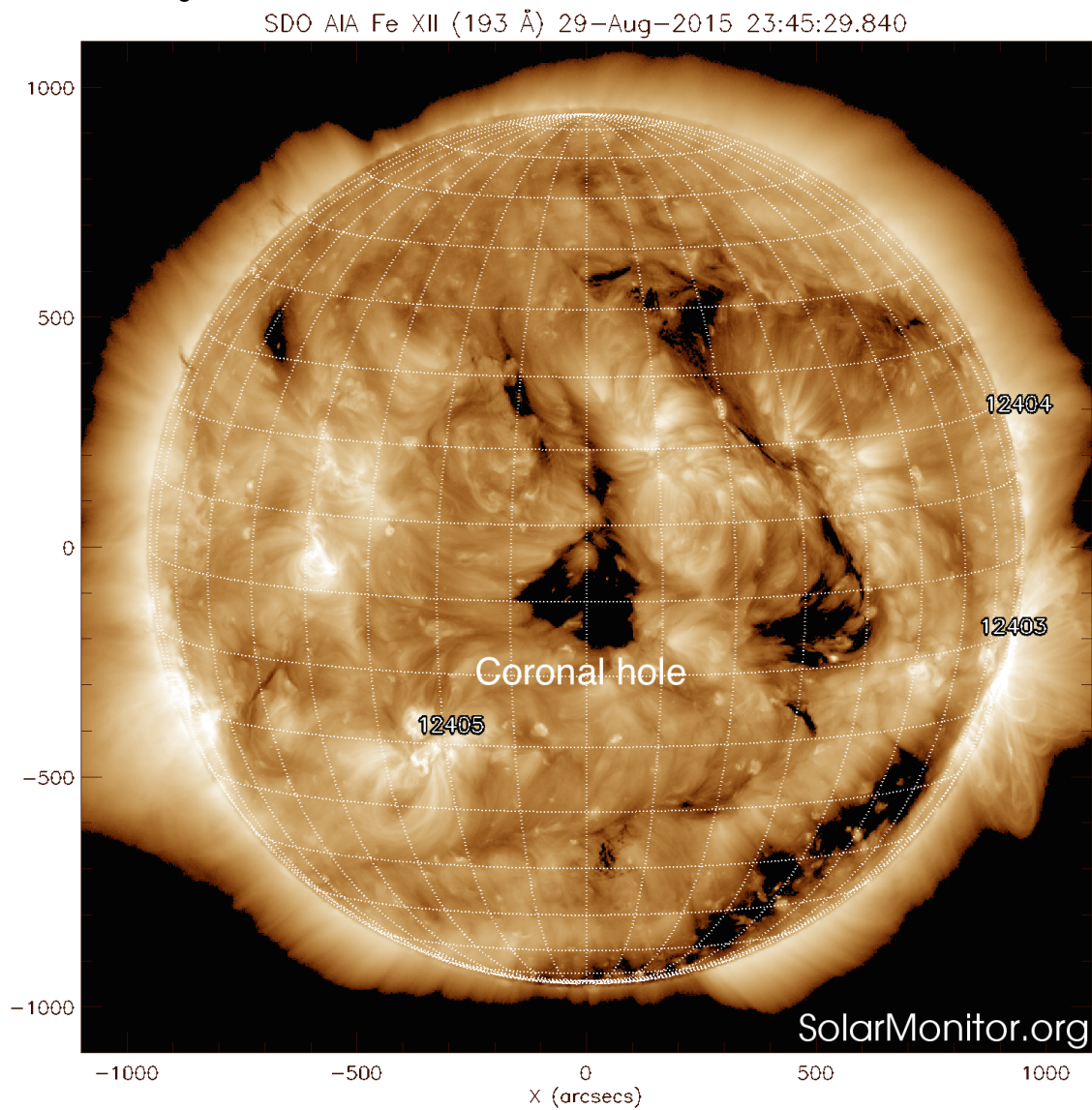
##### **Two flares and a CME**

Solar activity was very low all week, only 2 minor C-class flares occurred. A slow and faint partial halo CME (directed to the south) erupted on September 4th did arrive at the Earth on September 7th around 12 UT.

##### **A coronal hole and a sector boundary crossing**

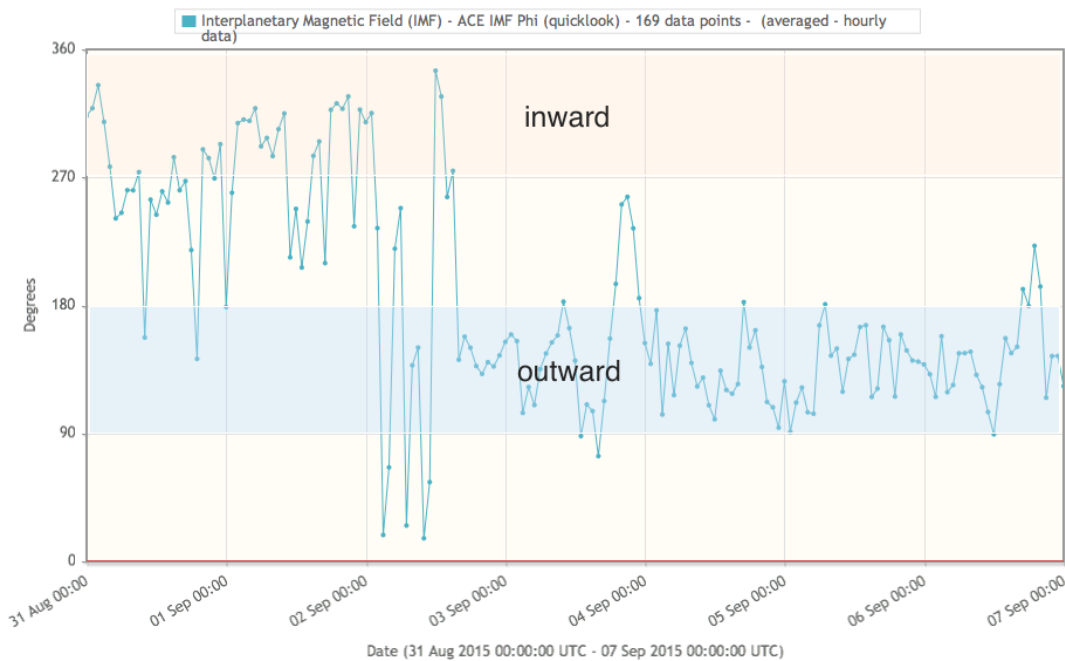
A mild fast speed stream affected the Earth starting on September 2 and produced isolated active conditions (Kdourbes=4) on September 4, 5 and 6.

The fast speed stream was associated with a small equatorial coronal hole which passed the central meridian on August 29.

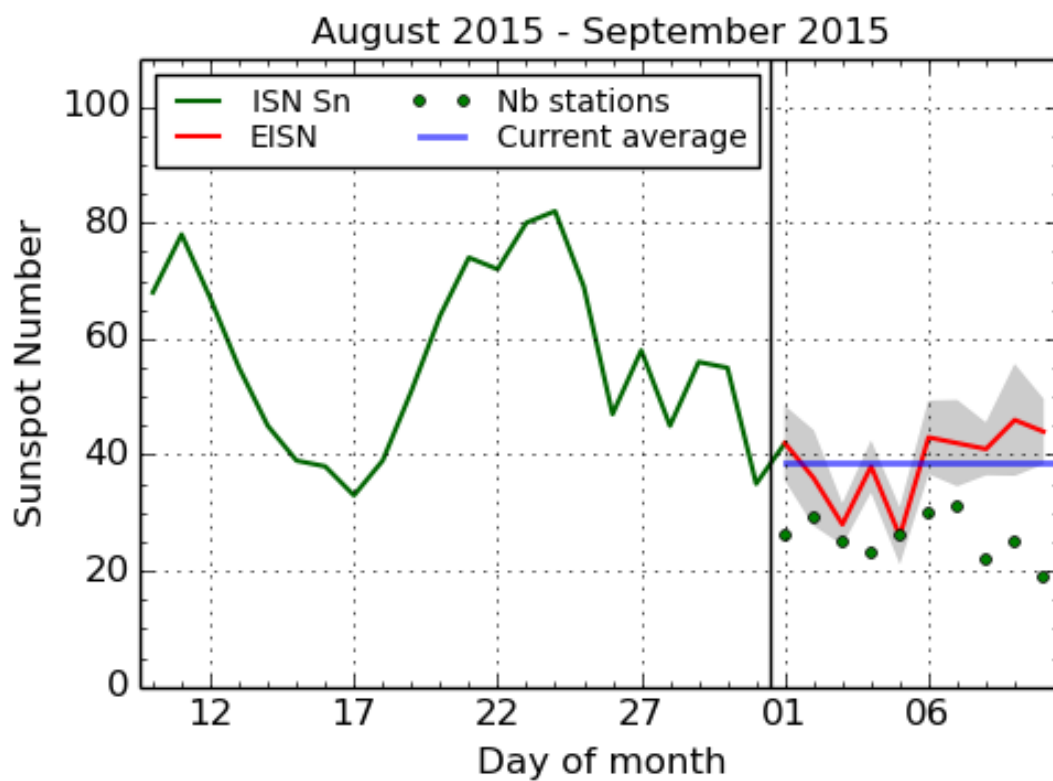


On September 2, the Earth passed the boundary from an inward to an outward pointing magnetic sector.





## 5. Daily International Sunspot Number



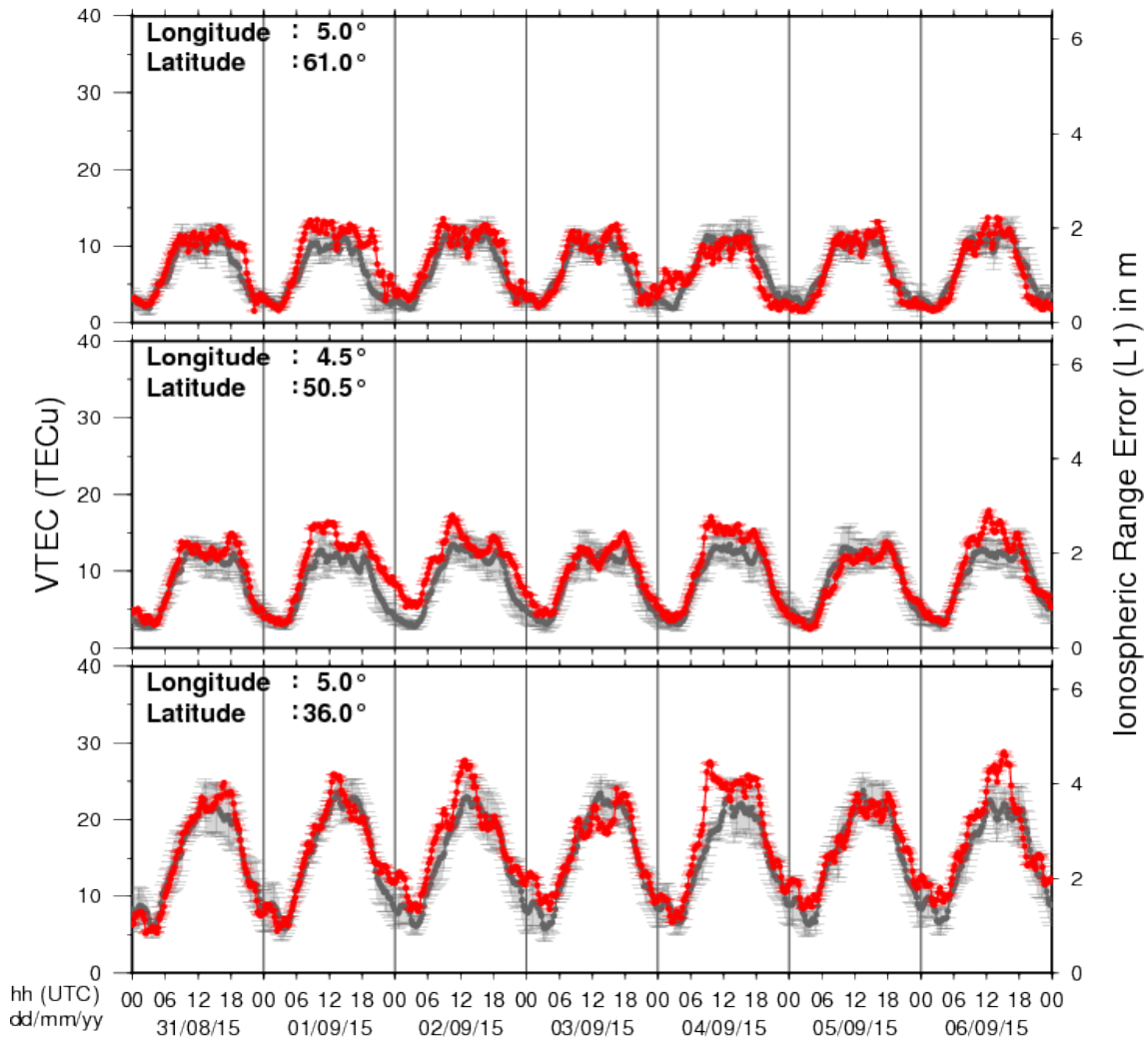
ILSO graphics (<http://sidc.be/silso>) Royal Observatory of Belgium, 2015 September 10

## 6. Geomagnetic Observations at Dourbes (31 Aug 2015 - 6 Sep 2015)



## 7. Review of ionospheric activity (31 Aug 2015 - 6 Sep 2015)

### VTEC Time Series



The figure shows the time evolution of the Vertical Total Electron Content (VTEC) (in red) during the last week at three locations:

- in the northern part of Europe (N61°, 5°E)
- above Brussels (N50.5°, 4.5°E)
- 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  $\text{TECu} = 10^{16}$  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](http://stce.be/newsletter/GNSS_final.pdf) for some more explanations ; for detailed information, see [http://gnss.be/ionosphere\\_tutorial.php](http://gnss.be/ionosphere_tutorial.php)

## **8. 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 Lomnický 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 «Potsdam Thinkshops», 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 «Albert Einstein», 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>

## **9. New documents in the European Space Weather Portal Repository**

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