

# STCE Newsletter

5 Oct 2015 - 11 Oct 2015



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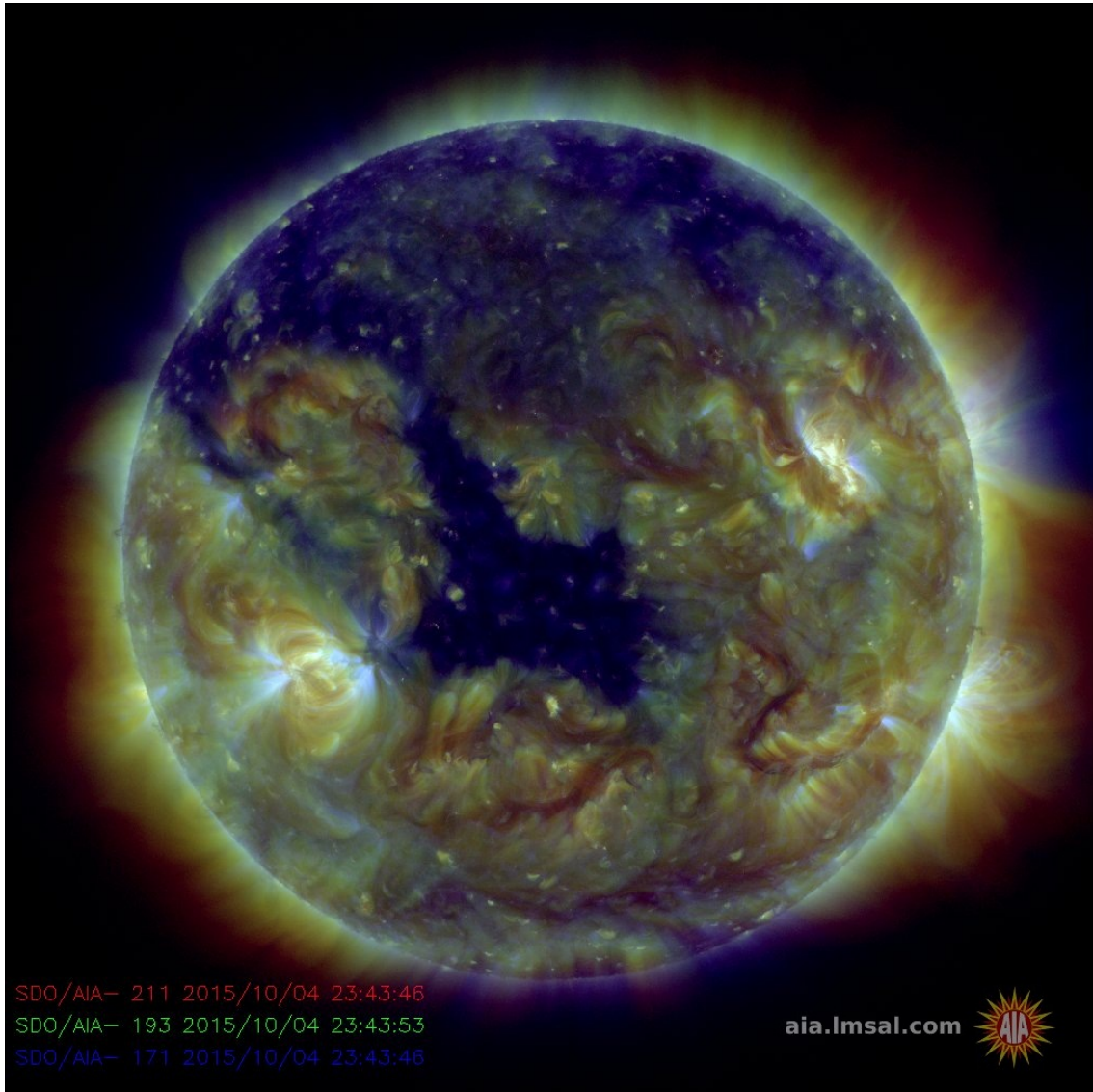
The Solar-Terrestrial Centre of Excellence (STCE) is a collaborative network of the Belgian Institute for Space Aeronomy, the Royal Observatory of Belgium and the Royal Meteorological Institute of Belgium.

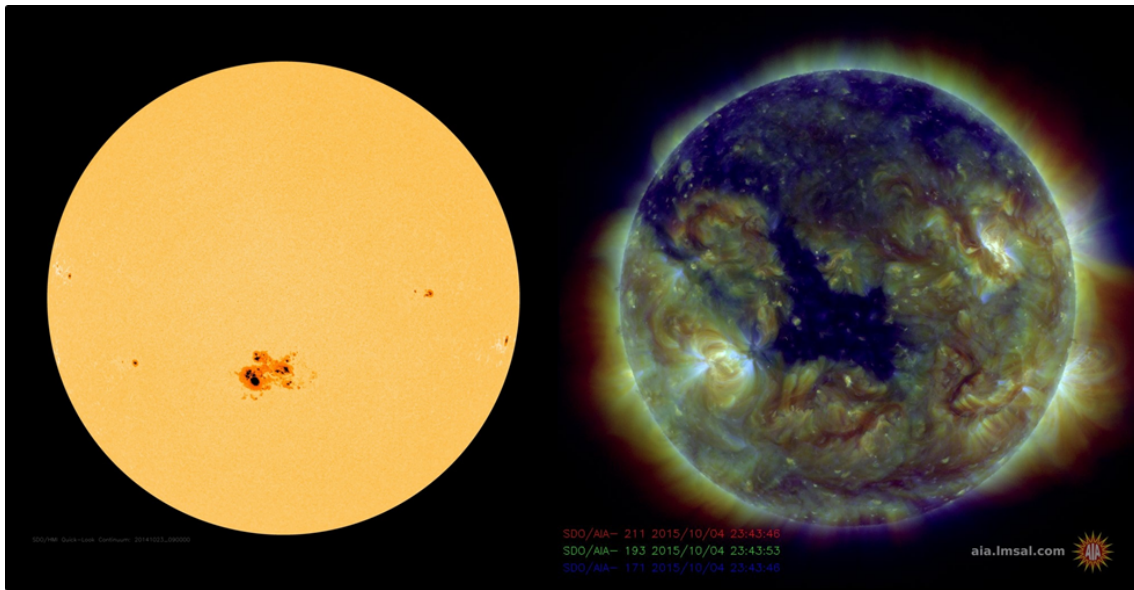
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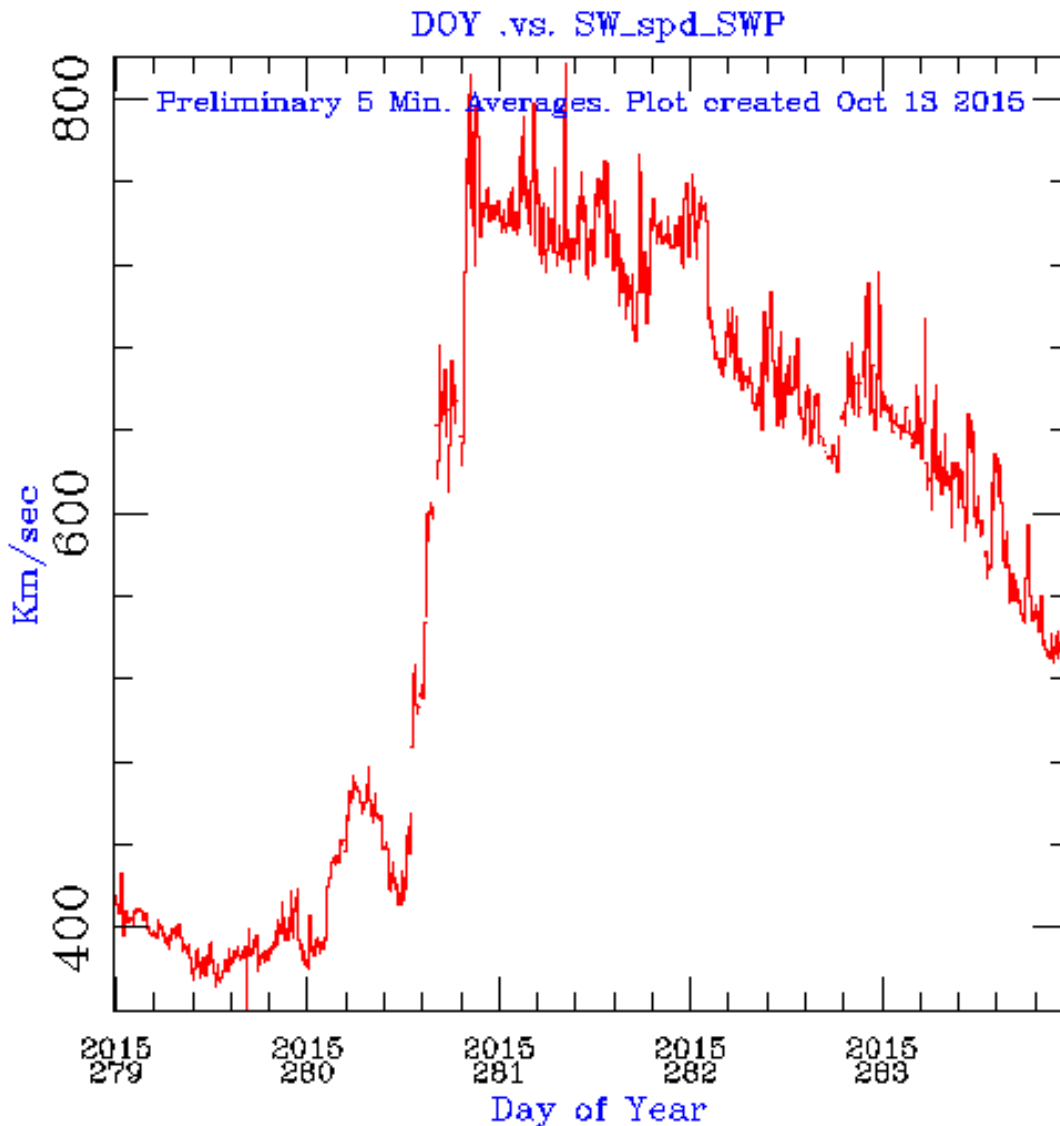
## 1. A swiftly blowing wind

On 04 October, a rather large trans-equatorial coronal hole (CH) transited the Sun's central meridian. According to LMSAL data (<http://sdowww.lmsal.com/suntoday/#>), it had a surface area of nearly 150 times that of the Earth. For comparison: NOAA 2192, the largest sunspot group so far this solar cycle, was about 9 times smaller!

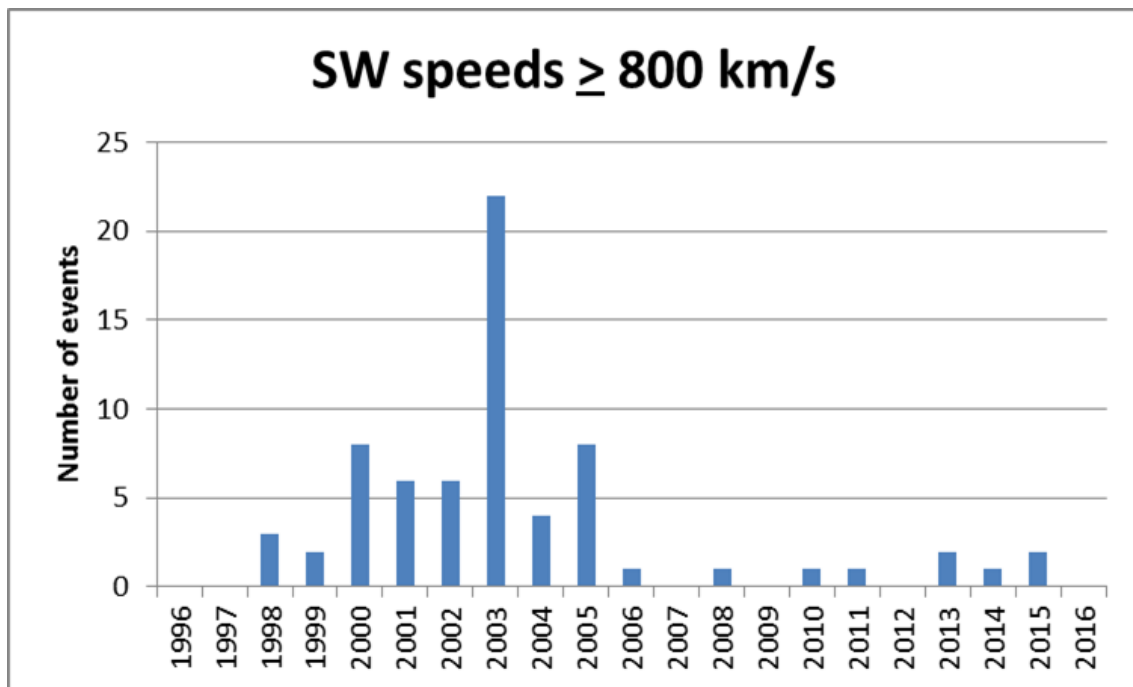




Already three days later, around noon on 07 October, the high speed stream of this CH arrived at Earth. The solar wind speed gradually increased to a swift 800 km/s, and values greater than 600 km/s were recorded for nearly 3 days. The graph below (courtesy from ACE Science Center at <http://www.srl.caltech.edu/ACE/ASC/> ) shows the evolution of the wind speed from 6 till 10 October 2015 (day-of-year 279 till 283). The maximum (5-minutes average) speed was 817 km/s on 08 October at 08:20UT. ACE, the Advanced Composition Explorer satellite, was launched on 25 August 1997 and is providing measurements of the solar wind from the L1 Lagrange point ([https://en.wikipedia.org/wiki/Lagrangian\\_point](https://en.wikipedia.org/wiki/Lagrangian_point) ) already for 18 years.



It is quite rare that solar wind speeds near the Earth reach 800 km/s or more. A quick analysis of the quick-look data at ASC ([http://www.srl.caltech.edu/ACE/ASC/browse/view Browse\\_data.html](http://www.srl.caltech.edu/ACE/ASC/browse/view Browse_data.html) ) is quite revealing in this respect. As it turns out, this was only the 2nd time this year that solar wind speeds reached these high values, and only the 7th time so far this solar cycle. Rare indeed! The highest solar wind speed recorded at Earth so far this solar cycle was on 13 January 2014 when a value of 907 km/s was recorded. Since the start of the ACE measurements, 2003 stands out both in number as in top speeds with resp. more than 20 events and more than 1100 km/s. The latter was related to the Halloween events.



## 2. ESWW12 News

### Get your daily dose of space weather forecast

What are the chances for flares? - Will my solar panels of my satellite in a geostationary orbit be damaged? - Should I wear my proton-proof jacket? You can make jokes, but Space Weather is indeed serious business impacting our daily lives.

Live at ESWW12!

Check <http://www.stce.be/esww12/liveforecast.php>



### 3. PROBA2 Observations (5 Oct 2015 - 11 Oct 2015)

#### Solar Activity

Solar flare activity fluctuated between low and quiet 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\\_10\\_05.mp4](http://proba2.sidc.be/swap/data/mpg/movies/weekly_movies/weekly_movie_2015_10_05.mp4) (SWAP week 289).

Solar activity was low this week, only one C-class flare occurred (on 2015-Oct-11 around 22:27 UT, on the East limb). SWAP also observed an eruption on the West limb on 2015-Oct-07 around 07:06 UT, see the annotated SWAP image below. A movie of the event can be found here: [http://proba2.sidc.be/swap/data/mpg/movies/20151007\\_swap\\_movie.mp4](http://proba2.sidc.be/swap/data/mpg/movies/20151007_swap_movie.mp4) (SWAP daily movie).

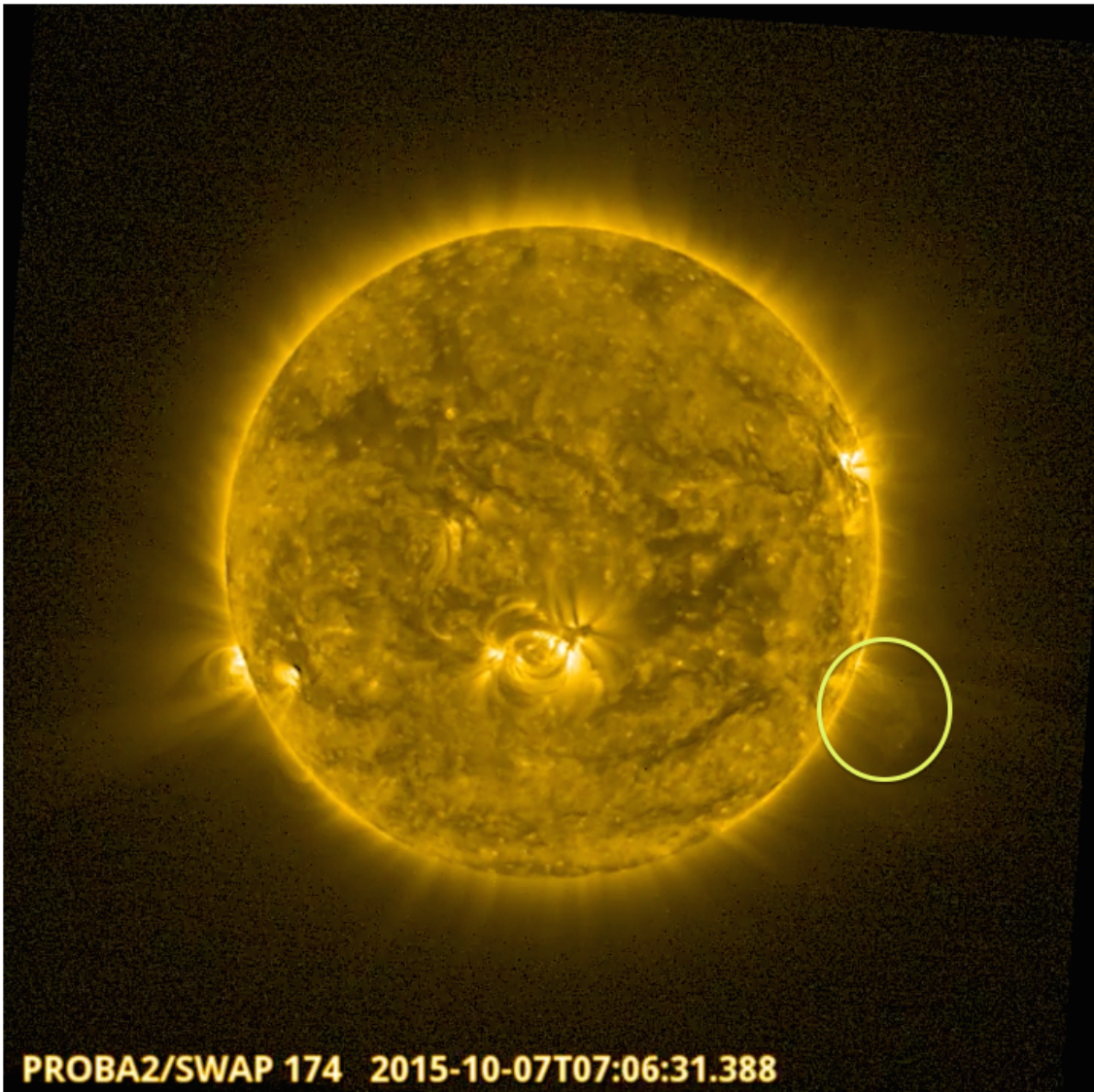
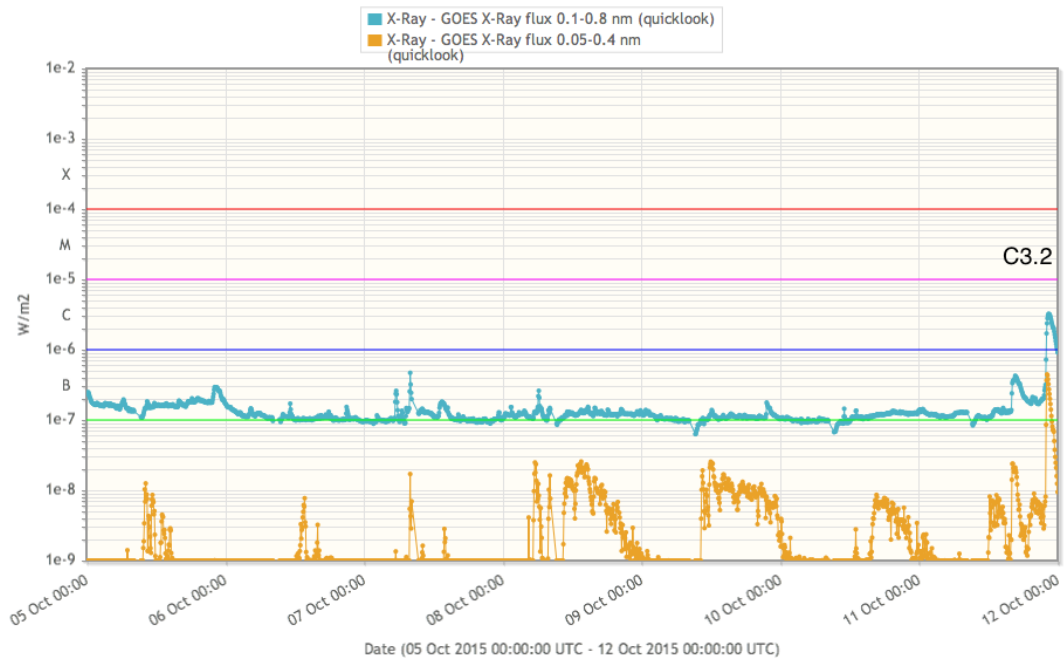


Figure: Eruption on the West limb around 07:06 UT - SWAP image

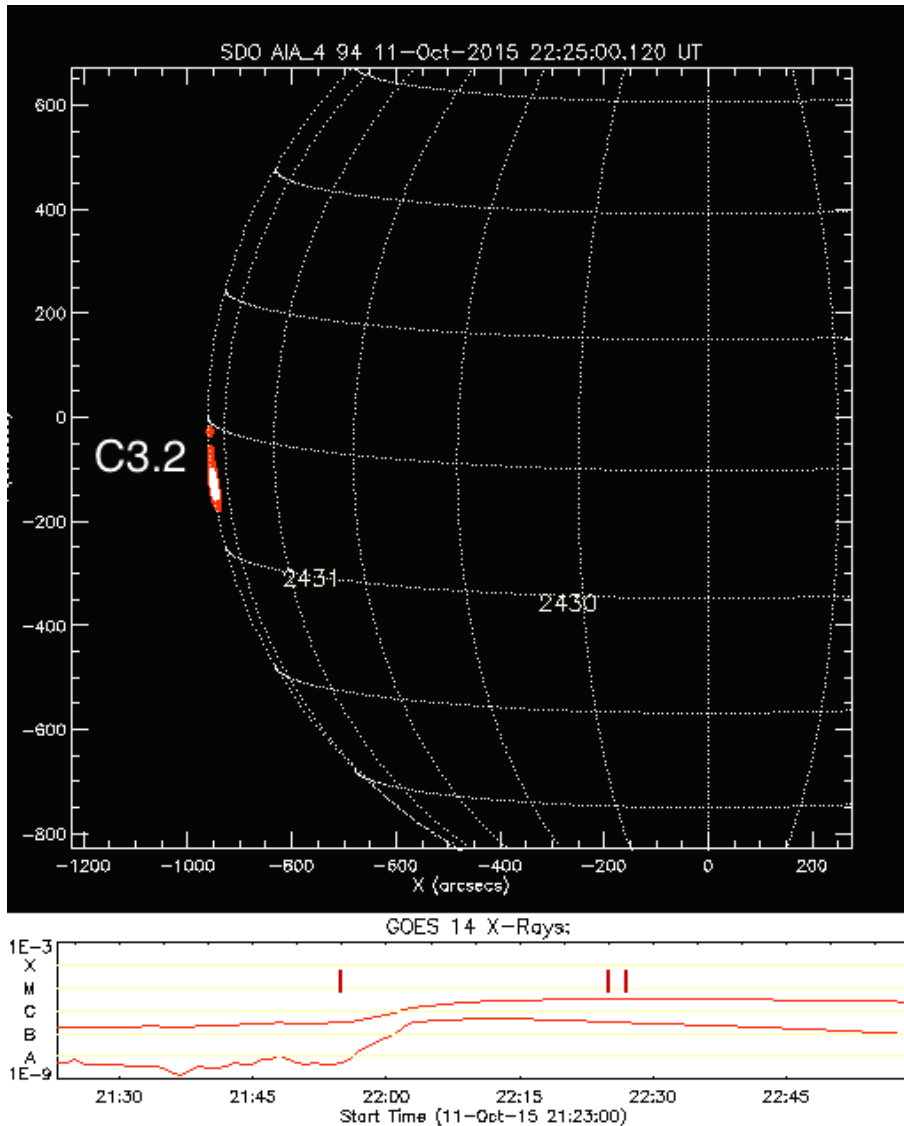
## 4. Review of solar and geomagnetic activity

### Solar Activity

Solar activity was very low during the week. Only one C-class flare - C3.2, peaking at 22:29 UT on October 11 from a source behind the east limb.







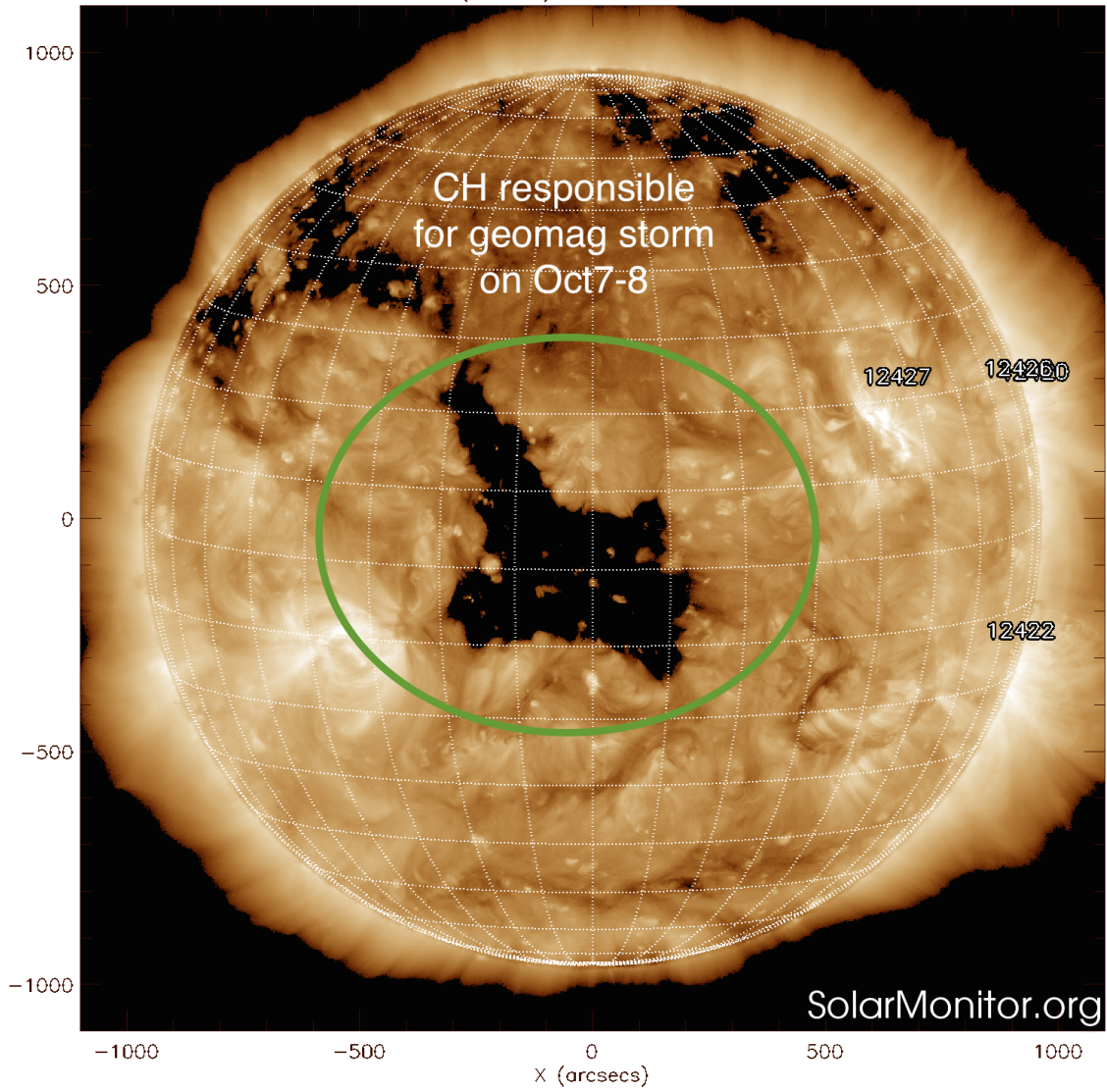
One CME on October 7 had slight chances of arriving to the Earth, but did not. Protons remained at low levels the full week.

### Geomagnetic Activity

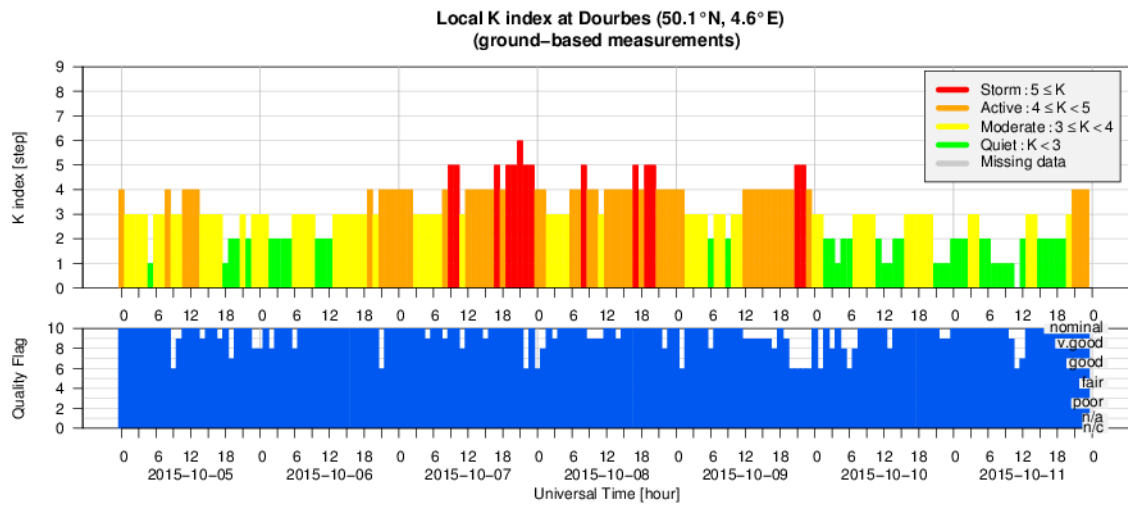
The Earth was under the influence of a fast speed solar wind stream emanating from an equatorial coronal hole (CH), from October 7 to October 10. It created major storm conditions at Dourbes (k reaching 6) and severe storm conditions at planetary levels (Kp = 7), on October 7 and 8. It decreased to active levels on October 9 (with isolated minor storm periods at Dourbes).

See 'A swiftly blowing wind'.

SDO AIA Fe XII (193 Å) 4-Oct-2015 23:43:05.840

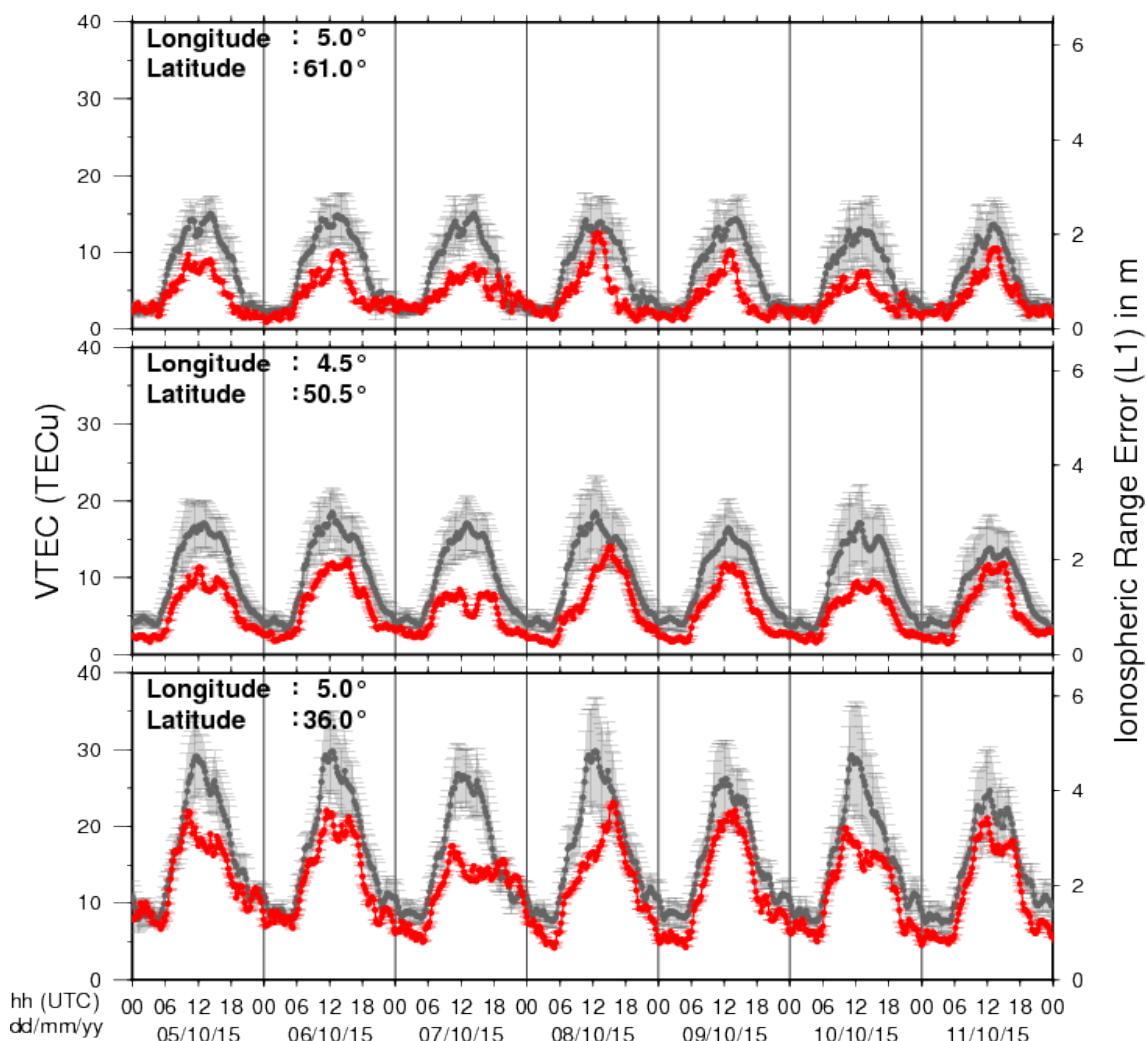


## 5. Geomagnetic Observations at Dourbes (5 Oct 2015 - 11 Oct 2015)



## 6. Review of ionospheric activity (5 Oct 2015 - 11 Oct 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)

## 7. 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 (RHESI), 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>