STCE Newsletter

7 Sep 2015 - 13 Sep 2015



Published by the STCE - this issue : 18 Sep 2015. Available online at http://www.stce.be/newsletter/.

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.

Content	Page
1. PROBA2 observes an annular solar eclipse	2
2. Flying your ideas to the stratosphere	5
3. PROBA2 Observations (7 Sep 2015 - 13 Sep 2015)	5
4. Review of solar and geomagnetic activity	6
5. The International Sunspot Number	9
6. Geomagnetic Observations at Dourbes (7 Sep 2015 - 13 Sep 2015)	10
7. Review of ionospheric activity (7 Sep 2015 - 13 Sep 2015)	11
8. Future Events	12

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

1. PROBA2 observes an annular solar eclipse

The total solar eclipse observed in March 2015 caught a lot of people's attention, especially as the path of totality passed over most of Northern Europe. There was a great deal of fan-fair and plans to observe the eclipse from the ground. However, due to heavy cloud cover, a lot of people had to turn to space-based observations, such as those made by the sun watching extreme-ultraviolet imager: SWAP, on board the European Space Agency's PROBA2 satellite, which images the Sun from the vantage point of a polar Earth orbit, away from pesky cloud cover. More information about the March eclipse can be found at http://proba2.oma.be/total-eclipse-2015 and at http://proba2.oma.be/Eclipse-Analysis-2015

SWAP observes the solar corona in a passband centered on a wavelength of 17.4 nm. The structures seen in SWAP images have a temperature of approximately 1 million degrees. More information about the SWAP instrument is available at http://proba2.oma.be/about/SWAP

It may come as some surprise, especially for those in Europe, that there was another eclipse observed on 13 September 2015. Whether you are able to observe an eclipse from the ground depends on your geographic location, in contrast to the March eclipse which was seen from Northern Europe and the Arctic regions, the September eclipse was observed in the southern hemisphere from Antarctica and southern Africa. In any given year the Earth will experience at least 2 solar eclipses due to the Earth and Moon's orbit.

Although the eclipse was not visible from Europe, it was once again clearly observed with the SWAP imager on board the European Space Agency's PROBA2 satellite. An image of the eclipse from SWAP can be seen underneath.



A movie of the eclipse can be found at http://proba2.oma.be/Events/2015-Sep-13-SolarEclipse/movies/ swap_eclipse_2015_09_13_logos.mp4 , and other media are at http://proba2.oma.be/Events/2015-Sep-13-SolarEclipse/

Those with a keen eye for detail, may notice a few subtle differences between the annular eclipse observed last Sunday (13 September; below, left) and the total eclipse from earlier this year (20 March; below, right), the most striking being the apparent size of the Moon. In September, the Moon looked much smaller.



The type of eclipse observed in September was classed as a partial eclipse from the ground, but was observed as an annular eclipse from the perspective of SWAP. Eclipses come in a variety of types, these include:

- Total eclipses where the Moon completely blocks the Sun's disk
- Partial eclipses where the Moon only covers part of the Sun

- Annular eclipses where the Moon's disk covers the Sun, but a significant portion of the Sun's edge remains visible around the Moon

Annular eclipses only occur when the Moon is at apogee, that is, when the Moon is furthest from the Earth. The Moon's orbit is elliptical rather than a perfect circle around the Earth, so from the ground, the relative sizes of the Moon and the Sun vary according to where the Moon is in its orbit. More information about this phenomenon can be found at http://www.timeanddate.com/astronomy/moon/lunar-perigee-apogee.html

So why does the eclipse appear as a partial eclipse from the Earth, but as an annular eclipse from the perspective of SWAP? The center of the Moon's shadow was located some number of kilometers above (from the perspective of an observer on the ground) the south pole. PROBA2's orbit, at about 700 km above the Earth's surface was the right height to pass through this central shadow region where the eclipse is truly annular. From a vantage point on the ground, however, an observer was not in this central shadow, so the disk of the Moon didn't pass entirely over the disk of the Sun, and the eclipse was a partial one, as illustrated at http://eclipse.gsfc.nasa.gov/SEplot/SEplot2001/SE2015Sep13P.GIF The next total solar eclipse observed from the ground will be observed in 08 March 2016 from South-East Asia and North-East Australia, and then closely followed by another observed in 21 August 2017 from North America.

This item was written by Matthew West and the PROBA2-team and can be read at http://proba2.oma.be/ annular-eclipse-2015

2. Flying your ideas to the stratosphere



Project Call: ASGARD challenges students to think of a science experiment, build it a space proof version, test it, fly it on a stratospheric balloon and analyse the results.

Exciting - challenging - act as a real scientist - serious fun

Spread the news to interested students and schools!

Check

http://www.esero.be/_WP/?page_id=218

3. PROBA2 Observations (7 Sep 2015 - 13 Sep 2015)

Solar Activity

Solar flare activity fluctuated between quiet 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:

http://proba2.sidc.be/swap/data/mpg/movies/weekly_movies/weekly_movie_2015_09_07.mp4 (SWAP week 285).

The Sun has been particularly quiet this week, no M-class flares or above were observed.

STCE Newsletter

7 Sep 2015 - 13 Sep 2015

However, one specific event drew our attention: On Sunday 13 September, the PROBA2 satellite witnessed three partial solar eclipses. The SWAP image provided below shows a snapshot of one of the eclipses. Images and movies of the events can be found on the PROBA2 website through the following link:

http://proba2.oma.be/Events/2015-Sep-13-SolarEclipse/

The complete daily SWAP movie from that day can be found here: http://proba2.sidc.be/swap/data/mpg/movies/20150913_swap_movie.mp4



4. Review of solar and geomagnetic activity

Solar Activity

Solar activity was very low this week: the strongest reported flare was only a C-class flare. There was no further flaring activity above the B level.

No Earth directed CMEs were observed during this week.

STCE Newsletter

7 Sep 2015 - 13 Sep 2015

Geomagnetic activity

A partial halo CME, associated with the filament which erupted from the south-east quadrant of the Sun on September 4, arrived at the Earth at about 12 UT on September 7. The arrival of the ICME induced a geomagnetic storm on September 7 and September 9.



On September 7, ACE data showed a simultaneous increase of the solar wind speed from 500 km/s up to about 600 km/s, and the increase of the interplanetary magnetic field magnitude to a value of about 22 nT on September 8. The Bz component of the interplanetary magnetic field had long southward intervals (down to -12nT) on September 7. This rather strong southward field and the fast solar wind produced long lasting geomagnetic storm, NOAA reported Kp=6 and local stations Dourbes and Izmiran reported K=5.

On September 09, the Bz component of the interplanetary magnetic field had long southward intervals (of about -10 nT) which induced the geomagnetic storm conditions, NOAA reported Kp=6 and local station Dourbes reported K=5.

The fast flow associated with the elongated equatorial coronal hole (20S to 20N) which crossed central meridian in the morning of September 08, arrived at the Earth on September 11, around 06:40 UT.

STCE Newsletter

The maximum speed of this fast flow was about 700 km/s (reported around the mid-day of September 11). The arrival of the fast flow induced geomagnetic storm conditions, NOAA reported Kp=7 and local stations Dourbes and Izmiran reported K=6 on September 11.



SDO AIA Fe XII (193 Å) 8-Sep-2015 23:42:53.840

5. The International Sunspot Number



ILSO graphics (http://sidc.be/silso) Royal Observatory of Belgium, 2015 September 18

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. Geomagnetic Observations at Dourbes (7 Sep 2015 - 13 Sep 2015)



7. Review of ionospheric activity (7 Sep 2015 - 13 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:

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

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 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 »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?confld=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