# STCE Newsletter

## 9 Mar 2015 - 15 Mar 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. Solar eclipse - a science party for everybody

Friday 20 March, between 9:26BLT (8:26 UT) and 11:26 BLT (10:47 UT), a large, partial solar eclipse will be visible from Belgium.

## STCE coordinated observation campaign

Solar and radio telescopes in Uccle and Humain will closely monitor this spectacle. STCE scientists also collaborate with European scientists to observe the eclipse with one of the largest radio telescope networks in the world, called LOFAR. Satellites will also trace changes in the ionosphere, a layer of our Earth's atmosphere. Even in the event of bad weather and cloud cover, the decrease in light levels when the Moon is blocking most of the solar disk will be noticeable. The ionospheric and radio observations are not affected by cloud cover.

PROBA2, an ESA satellite built in Belgium and operated from the PROBA2 Science Centre in Uccle, will see the Sun in eclipse in the extreme ultraviolet from its orbit around the Earth. Far above the clouds, the satellite will witness two almost full solar eclipses. Part of the data and images from the first PROBA2 eclipse will be available late in the morning.

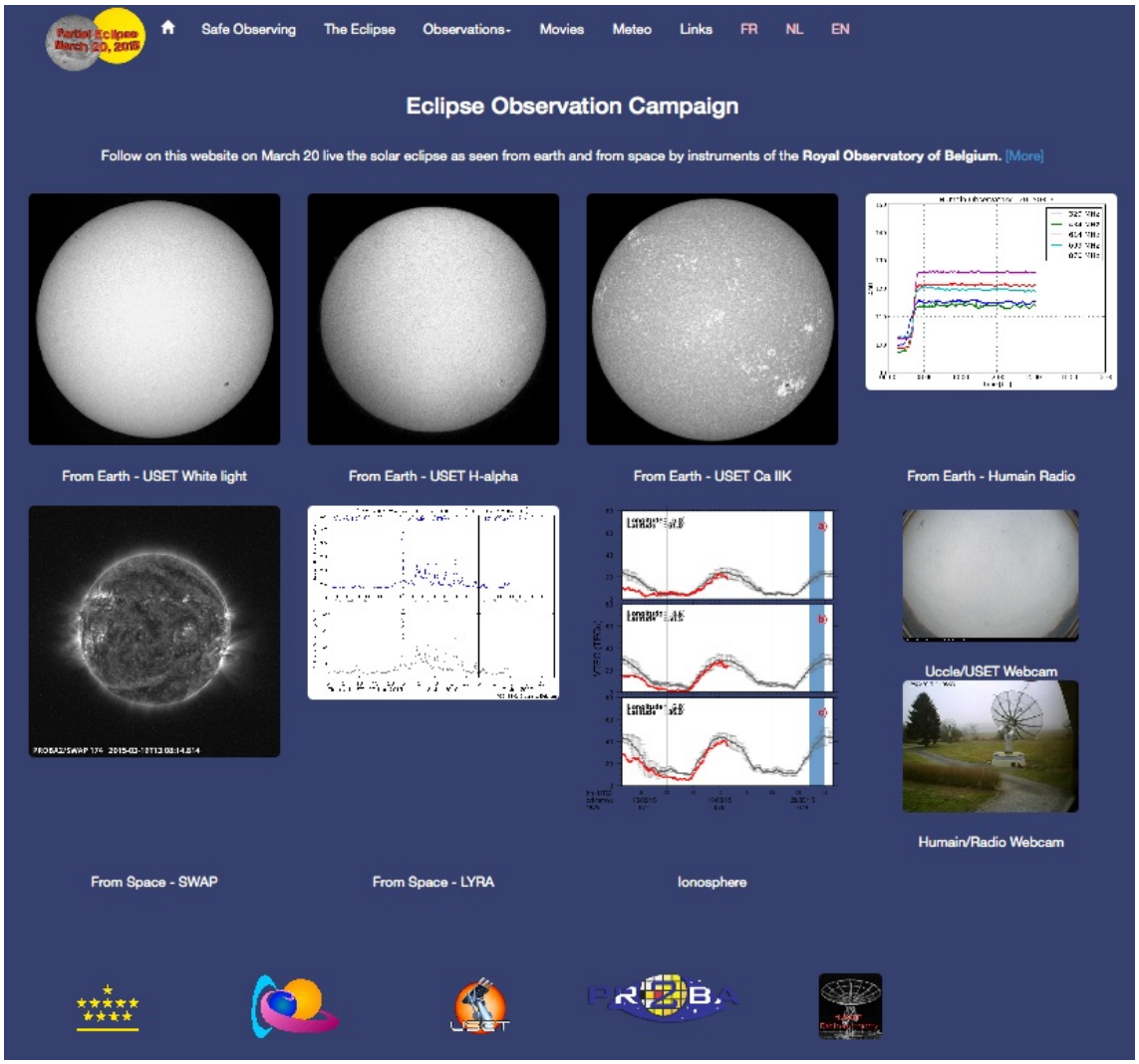
## Why is the eclipse important for us, scientists?

A solar eclipse is a once-in-a-lifetime experience. In the past, a total eclipse was the only way to observe the immediate environment around the Sun and to get an idea of the structure and composition of the solar atmosphere. It made scientists realize how complex and extended the solar atmosphere actually is. Nowadays, we have instruments that can create an artificial eclipse on a permanent base, but they suffer from technical limitations. Observing a solar eclipse in the normal way remains valuable for us scientists as it allows us to calibrate our solar instruments.

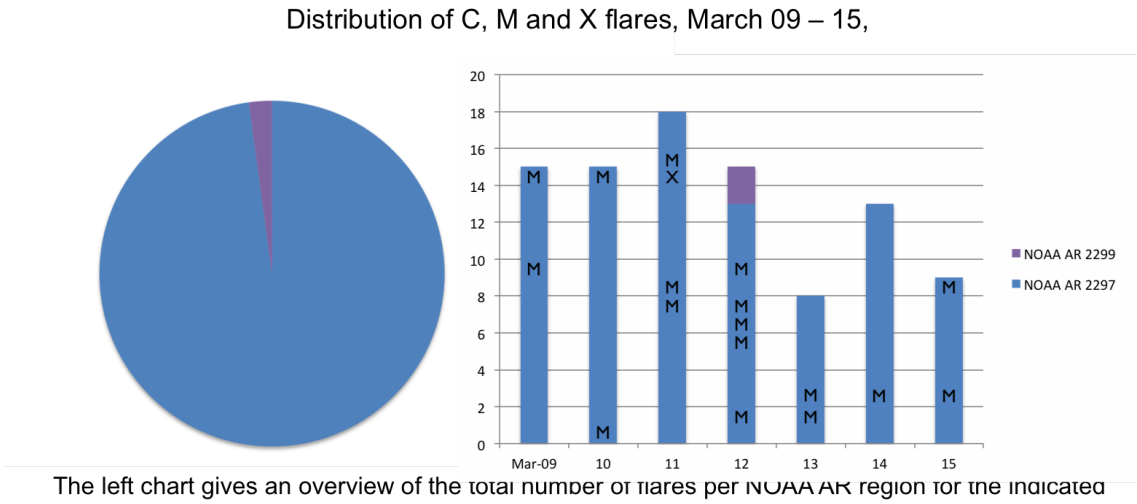
But above all, a solar eclipse offers us the opportunity to put our favorite study object in the picture and pass our enthusiasm. It's a science party for everyone!

## Following the eclipse online, even in case of bad weather

All data and images of the observation campaign are brought together at http://sidc.be/eclipse2015/
This website also contains a brief explanation on the eclipse itself and how to observe it safely.

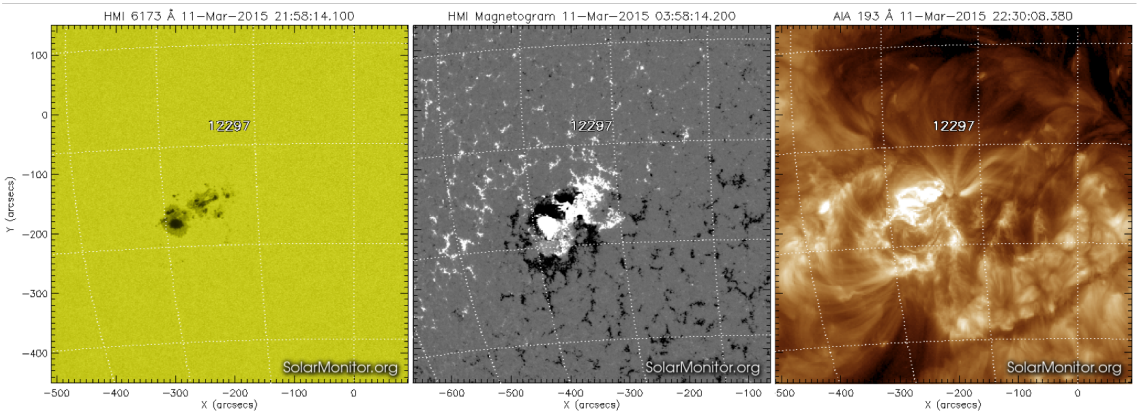

Safe Observing
The Eclipse
Observations-
Movies
Meteo
Links
FR
NL
EN
Eclipse Observation Campaign
Follow on this website on March 20 live the solar eclipse as seen from earth and from space by instruments of the Royal Observatory of Belgium. [More]
From Earth - USET White light
From Earth - USET H-alpha
From Earth - USET Ca IIK
From Earth - Humain Radio
Uccle/USET Webcam
Humain/Radio Webcam
From Space - SWAP
From Space - LYRA
Ionosphere

## 2. Review of solar activity




The left chart gives an overview of the total number of flares per NOAA AR region for the indicated week. The right chart gives an overview of the flaring activity per NOAA AR per day.

Over the past week NOAA AR (Active Region) 2297 was very active producing 17 M-class flares and 1 X-class flare.




AR 2297 was located around central latitudes (S15), and rotated from the Eastern to the Western hemisphere. Throughout the week it grew in size and saw significant flux emergence. It was predominantly classified as a Beta-Gamma-Delta region under the Mount Wilson magnetic classification system. The largest flare, was an X2.1 flare, on Mar 11 peaking at 16:22UT. The left image and from SDO/HMI is AR 2297 in visible light, the middle magneto gram gives an idea of the strength of the photospheric magnetic field of the region, and right image show the active region in the corona.

AR 2298 has evolved into a Beta region, but showed little activity. AR 2299 rotated into view and exhibited a small amount of activity. AR 2301, which emerged near disk center on Mar 14, showed evidence of flux emergence, but has remained small.

There was a large filament located between S05W45 and S30E90 (on Mar 09), which remained stable for the whole week.

AR 2297 produced several CMEs (Coronal Mass Ejection) and continual flows throughout the week.

## 3. Noticeable Solar Events (9 Mar 2015 - 15 Mar 2015)

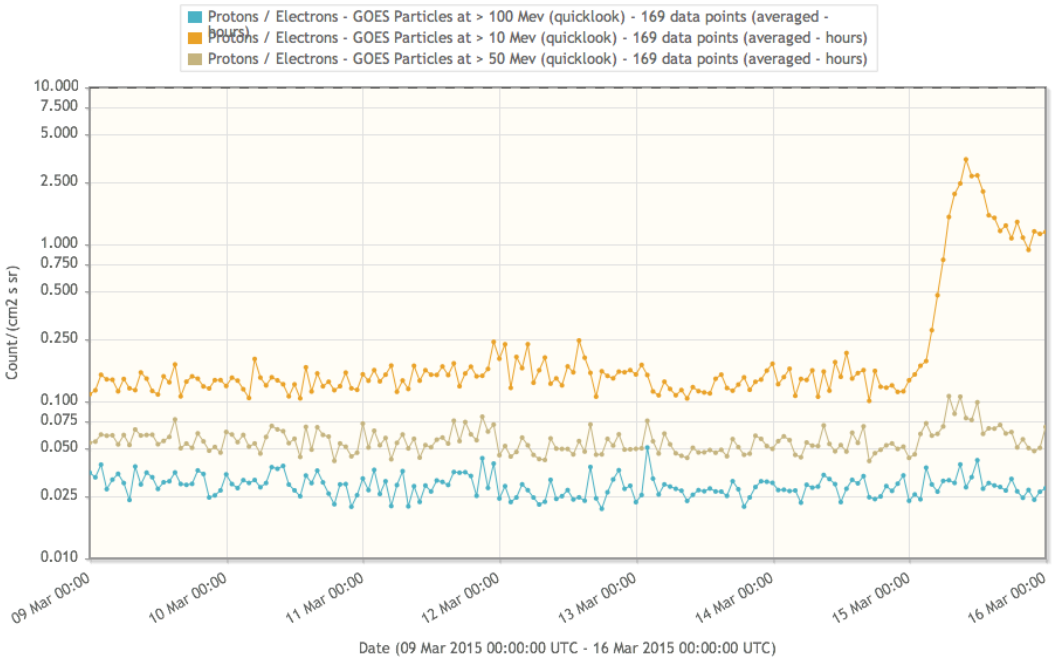
| DAY | BEGIN | MAX | END | LOC | XRAY | OP | 10CM | TYPE | Cat | NOAA |
|---|---|---|---|---|---|---|---|---|---|---|
| 09 | 1422 | 1433 | 1437 | S15E49 | M4.5 | 1N | | III/2 | | 2297 |
| 09 | 2329 | 2353 | 0012 | S18E45 | M5.8 | 2N | 170 | III/1IV/2 | | 2297 |
| 10 | 0319 | 0324 | 0328 | S15E40 | M5.1 | 2B | 1300 | III/3IV/1II/1 | | 2297 |
| 10 | 2346 | 0002 | 0006 | S16E28 | M2.9 | SF | | | | 2297 |
| 11 | 0710 | 0718 | 0743 | S16E26 | M1.8 | 1B | 57 | | 1 | 2297 |
| 11 | 0751 | 0757 | 0803 | | M2.6 | | | VI/2 | 1 | 2297 |
| 11 | 1611 | 1622 | 1629 | S17E21 | X2.1 | 2B | 160 | II/2 | 1 | 2297 |
| 11 | 1837 | 1851 | 1857 | S16E18 | M1.0 | 1N | 77 | V/2 | 1 | 2297 |
| 12 | 0441 | 0446 | 0450 | | M3.2 | | | III/2 | 1 | 2297 |
| 12 | 1138 | 1150 | 1202 | | M1.6 | | | | 1 | 2297 |
| 12 | 1209 | 1214 | 1218 | | M1.4 | | 220 | | 1 | 2297 |
| 12 | 1350 | 1408 | 1413 | S15E6 | M4.2 | 2B | 530 | II/1III/2V/2IV/1 | 1 | 2297 |
| 12 | 2144 | 2151 | 2156 | | M2.7 | | 230 | III/3V/3II/1 | 1 | 2297 |
| 13 | 0347 | 0401 | 0416 | | M1.2 | | | | 1 | 2297 |
| 13 | 0549 | 0607 | 0612 | | M1.8 | | | III/2 | 1 | 2297 |
| 14 | 0423 | 0440 | 0454 | S14W12 | M1.3 | 2N | | | 1 | 2297 |
| 15 | 0936 | 0940 | 0946 | S20W24 | M1.0 | SN | | | 1 | 2297 |
| 15 | 2242 | 2322 | 2338 | | M1.2 | | | III/1 | 1 | 2297 |

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

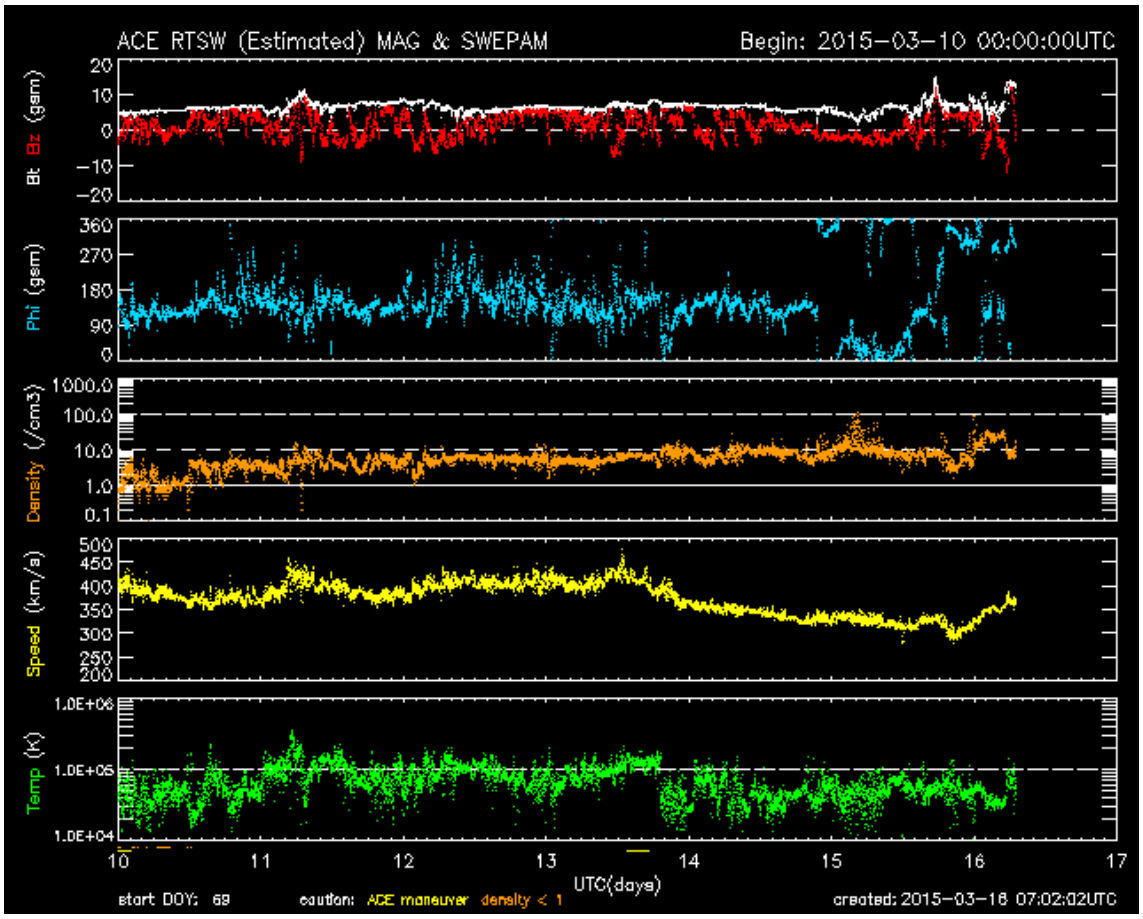
## 4. Review of geomagnetic activity

There were 5 significant partial halo CMEs produced by AR 2297; at 22:24UT on 07 Mar, 00:00UT on 10 Mar, 03:36UT on 10 Mar, 08:24UT on 11 Mar and 02:00UT on 15 Mar. None of these appeared geoeffective.

However, proton numbers remained low throughout the week but began ramping up on 15 Mar which may have been produced by the CME produced on 10 Mar at 00:00UT.

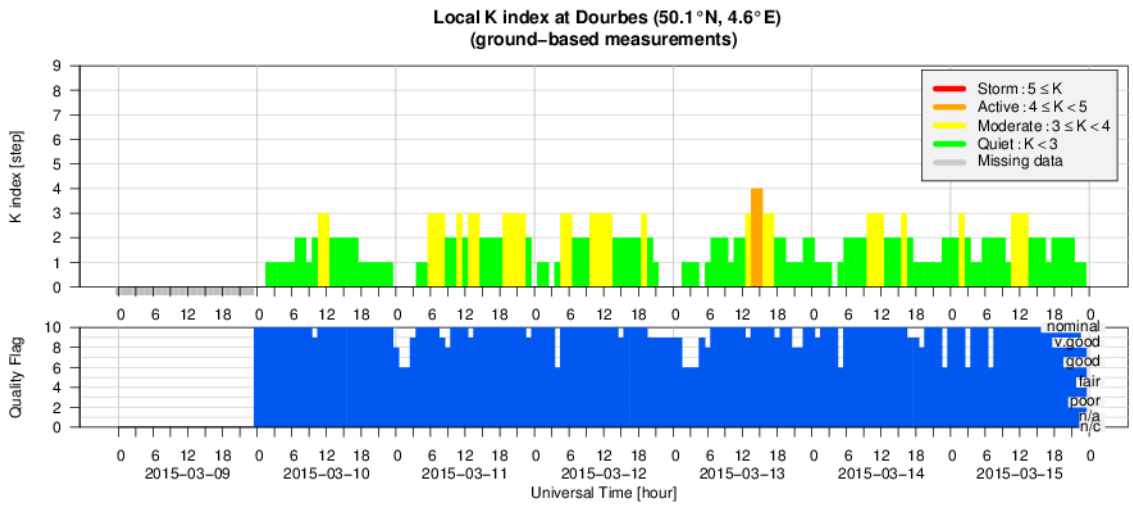



The solar wind speed has remained relatively constant over the past week, ranging from 300 km/s to 460 km/s - the yellow curve in the fourth pannel in the graph below. The total magnetic field has been stable around 5 nT, but has seen some growth over the past 24 hours. The Bz component has fluctuated from positive to negative, ranging between +5 and -5 nT, but this has increased to +10nT to -10nT late 15 Mar - the red curve in the top pannel.

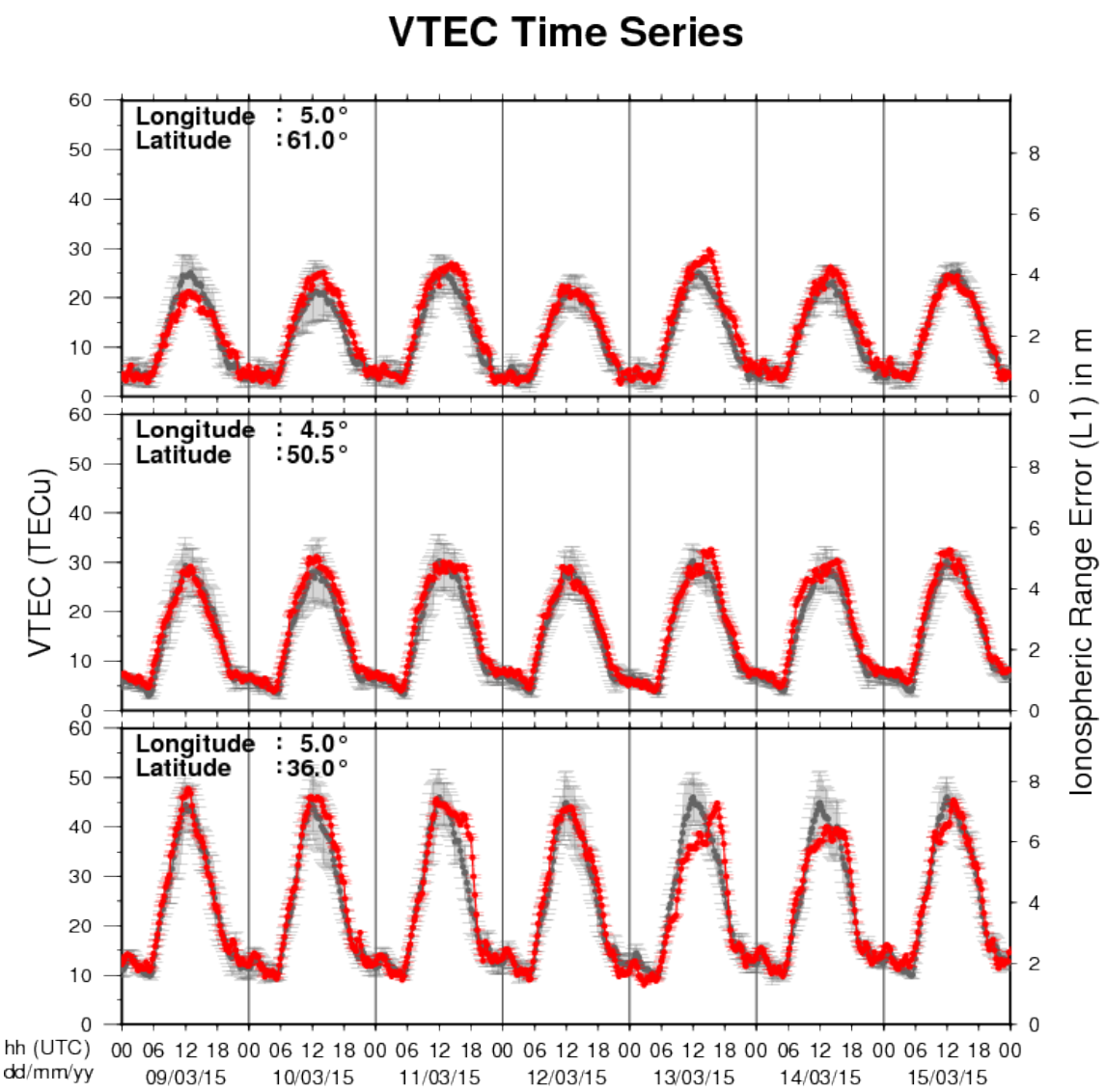



Geomagnetic conditions ranged between Kp index 0-4 (NOAA) and local K index 0-3 (Dourbes) over the past week. A small transient coronal hole located at central latitudes, rotated from S05W05 to S05W60 throughout the week, but showed little sign of enhancing solar wind conditions.

## 5. Geomagnetic Observations at Dourbes (9 Mar 2015 - 15 Mar 2015)



## 6. Review of ionospheric activity (9 Mar 2015 - 15 Mar 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

# 7. Future Events

## For more details, see http://www.spaceweather.eu/en/event/future

### VarSITI-SCOSTEP conference in Kazrin and Tel Aviv, Israel

Start : 2015-04-28 - End : 2015-05-01
At present, solar researches and study of active late-type stars achieve a significant advance thanks new observational facilities and progress of the theory. The problems of an evolution of activity at the billion year-time-scales start to be discussed. Superflares were detected on stars younger than the Sun, and the frequency of superflares occurrence was evaluated. The first hypotheses were proposed for evaluation of flare activity level and expected stellar wind fluxes at the epoch when the regular cycle on the Sun was only established. Now it is a time to discuss further directions of perspective investigations which are essential for evaluation of space factor affecting on geo- and bio-sphere in those epochs and space weather forecast.
Website:
http://www.tau.ac.il/institutes/advanced/cosmic/Conferences/2015-VarSITI_Superflares/VarSITI-2015_ISR.html

### Space Weather And Plasma in Space in Kazrin and Tel Aviv, Israel

Start : 2015-05-02 - End : 2015-05-08

### URSI AT-RASC 2015 in Gran Canaria, Spain

Start : 2015-05-18 - End : 2015-05-22
URSI AT-RASC 2015 will be the first edition of the newly established triennial URSI Atlantic Radio Science Conference as one of the URSI Flagship Conferences. AT-RASC 2015 will have an open scientific program composed of submitted papers within the domains covered by all ten Commissions of URSI.
Website: http://www.at-rasc.com/

### MHD waves and instabilities in the solar atmosphere in Budapest, Hungary

Start : 2015-05-25 - End : 2015-05-29
25-27 May 2015: BUKS 2015 - MHD waves: Observational aspects from ground to space - MHD waves: Theory - where are we? - MHD instabilities
27-28 May 2015: Ruderman Honorary meeting - Theory of linear MHD waves - MHD waves instabilities - Non-linear waves in plasmas
29 May 2015: Joint BUKS/Ruderman's conferences excursion - Boat excursion to Szentendre, Visegrad and Esztergom
Website:
http://swat.group.shef.ac.uk/Conferences/BUKS_2015/index.html

### Los Alamos Space Weather Summer School, in Los Alamos, NM, USA

Start : 2015-06-01 - End : 2015-07-24
The Space Weather Summer School at Los Alamos National Laboratory, established in 2011 under the founding Director Josef Koller, is dedicated to space weather, space science and applications. Every year we solicit applications for the Los Alamos Space Weather Summer School. This summer school is sponsored and supported by a number or organizations at LANL. This year our top sponsors include the Los Alamos Institute of Geophysics, Planetary Physics and Signatures (IGPPS) and the Laboratory Directed Research and Development Office (LDRD). The summer school brings together top space

science students with internationally recognized researchers at LANL in an educational and collaborative atmosphere.
Website:
http://www.swx-school.lanl.gov/

## RadioSun4 Workshop & Summer School in Irkutsk, Russia

Start : 2015-06-08 - End : 2015-06-12
The RadioSun Workshop and Summer School 2015 is the fourth international academic seminar supported by the International Research Staff Exchange Scheme of the Seventh Fromework Programme of the European Union (FP7-IRSES-295272-RADIOSUN). The aims of this project are to establish close research interaction and collaboration between the key EU and non-EU research groups involved in the research of the Sun in the radio band; qualitatively advance our knowledge of the physical processes operating in the solar atmosphere, the basic mechanisms responsible for its evolution and dynamics and its effect on the Earth; and provide younger researchers with extensive training in relevant research techniques and with universal transfer.
Website:
http://www2.warwick.ac.uk/fac/sci/physics/staff/research/davidpascoe/radiosun

## Solar dynamo frontier workshop in Boulder, CO (USA)

Start : 2015-06-09 - End : 2015-06-12
The last five years have seen substantial progress in our understanding of the solar dynamo, fueled by continuing advances in observations and modeling. With the launch of NASA's Solar Dynamics Observatory (SDO) in 2010 came an unprecedented window on the evolving magnetic topology of the Sun, highlighting its intricate 3D structure and global connectivity. The Helioseismic Magnetic Imager (HMI) instrument on SDO in particular has provided potentially transformative yet enigmatic insights into the internal dynamics of the solar convection zone that underlie the dynamo. Attempts to detect subsurface convective motions from helioseismic inversions have yielded only upper limits on the large-scale convective amplitude, challenging our understanding of global solar convection. Yet, potential signatures of giant cells have been detected in photospheric Dopplergrams. Estimates of the meridional flow from HMI and complementary instruments (SOHO/MDI and GONG) have been equally tantalizing and enigmatic. Several disparate techniques, including local and global helioseismic inversions and correlation tracking of surface features, have yielded evidence of a multi-cellular meridional flow but they differ on the detailed flow structure and amplitude. This multi-cellular meridional flow has potentially profound implications for flux-transport dynamo models that previously assumed a very different structure with a single circulation cell per hemisphere.
Website:
https://www2.hao.ucar.edu/Workshop/Solar-Dynamo-Frontiers

## CISM Space Weather Summer School in Boulder, CO, USA

Start : 2015-07-13 - End : 2015-07-24
The CISM Summer School is intended to give students a comprehensive immersion in the subject of space weather: what it is, what it does, and what can be done about it. Space weather is many things: beautiful when seen through the eyes of a sun-viewing telescope, fascinating when studied for its alien worlds of magnetic structures and phenomena, awesome when witnessed as a solar eruption or auroral storm, and devastating to the users of services it disrupts. Space weather links the Sun, the Earth, and the space in between in a branching chain of consequences. Weather systems on the Sun can spawn interplanetary storms of colossal size and energy that envelop the whole planet in electrical hurricanes. Such storms attack high-tech, complex, and expensive technological systems that provide much of the infrastructure that allows modern society to function.
Website:
https://www2.hao.ucar.edu/Events/2015-CISM-Summer-School

## Loops7: Heating of the Magnetically Closed Corona in Cambridge, UK

Start : 2015-07-21 - End : 2015-07-23
The conference will review past and recent achievements, as well as future challenges in the field of solar coronal loop physics.
Website:
http://www.damtp.cam.ac.uk/user/astro/cl7/index.html

## Heliophysics Summer Schoool 2015: Seasons in Space: Cycles of variability of Sun-Planet systems, in Boulder, CO, USA

Start : 2015-07-28 - End : 2015-08-04
Heliophysics is all of the science common to the field of the Sun-Earth connections. This fast-developing field of research covers many traditional sub-disciplines of space physics, astrophysics, and climate studies. The NASA Living with a Star program, with its focus on the basic science underlying all aspects of space weather, acts as a catalyst to bring the many research disciplines together to deepen our understanding of the system of systems formed by the Sun-Earth connection.
Website:
http://www.heliophysics.ucar.edu/

## 34th International Cosmic Ray Conference (ICRC) in The Hague, The Netherlands

Start : 2015-07-30 - End : 2015-08-06
The 34th International Cosmic Ray Conference (ICRC) will be held from July 30 to August 6, 2015, in The Hague, The Netherlands. It is an important and large conference in the field of Astroparticle Physics. The ICRC covers: cosmic-ray physics, solar and heliospheric physics, gamma-ray astronomy, neutrino astronomy, and dark matter physics.
Website: http://icrc2015.nl

## SOLARNET III / HELAS VII: The Sun, the stars, and solar-stellar relations, in Freiburg (Germany)

Start : 2015-08-31 - End : 2015-09-04
The purpose of this conference is to discuss the latest questions and results in solar and stellar physics. Solar and stellar seismology will be one particular focus but contributions on all aspects of solar-stellar relations will be welcome. We aim to establish links and synergies between the day- and night-time fields of astrophysics.
Website:
http://www.iac.es/congreso/solarnet-3meeting/

## 1st Joint Solar Probe Plus-Solar Orbiter Workshop, in Florence (Italy)

Start : 2015-09-02 - End : 2015-09-04
The Workshop will address how the joint exploration of the corona and inner heliosphere will lead to advances in our understanding of coronal heating and solar wind acceleration, the magnetic and plasma structure of the heliosphere, and the acceleration of energetic particles at shocks and flares. The workshop will inspire research that will make use of SO and SPP observations within the context of the NASA Heliophysics Observatory System and identify key areas for preparatory research. Synergistic observations from other ground based and space based assets will also be addressed.
Website:
http://www.solarprobeplus.org/2015/

## Ground-based Solar Observations in the Space Instrumentation Era in Coimbra, Portugal

Start : 2015-10-05 - End : 2015-10-09

This CSPM-2015 scientific meeting will cover various aspects of solar dynamic and magnetic phenomena which are observed over the entire electromagnetic spectrum: white-light, Hα, Ca II, and radio from ground and in a variety of other wavelengths (white light, UV and EUV, and X-rays) from space. Emphasis will also be placed on instrumentation, observing techniques, and solar image processing techniques, as well as theory and modelling through detailed radiative transfer in increasingly realistic MHD models. The long-term (cyclic) evolution of solar magnetism and its consequence for the solar atmosphere, eruptive phenomena, solar irradiation variations, and space weather, will be in focus. Here, special attention will be devoted to the long-term observations made in Coimbra and also to the results of the SPRING / SOLARNET and SCOSTEP VarSITI studies. In particular, the weak solar activity during the current solar maximum will be discussed. Finally, since this meeting is organised around the 90th anniversary of performing the first spectroheliographic observations in Coimbra, a session will be specially dedicated to new solar instruments (both ground-based and space-borne) that will give access to unexplored solar atmospheric features and dynamic phenomena over the coming years.
Website:
http://www.mat.uc.pt/~cspm2015/

## Third Remote Sensing of the Inner Heliosphere and Space Weather Applications Workshop in Morelai, Michoacan (Mexico)

Start : 2015-10-19 - End : 2015-10-23
The workshop aims to gather experts from the various fields of remoteÂ sensing observations of the inner heliosphere, including whiteÂ light, EUV, and radio observation, together with modellers in order to tackle key outstanding science and spaceÂ weather operational issues, establish closer working relations, and devise the best ways to move the field forward as a whole. In addition, the science learned from remote Âsensing observations is critical to improving our capabilities of spaceÂ weather forecasting. The workshop aims to look at ways in which we can more easily and efficiently share and access the various types of data between individual groups and subÂcommunities and to officially launch the IPS Common Data Format v1.0 (IPSCDFv1.0) now in use. It also aims to allow investigations into ways in which we model the inner heliosphere looking at the advantages and disadvantages of the available modelling, updates on present and future remoteÂsensing capabilities, and investigating further the ways in which these data sets all complement each other and are necessary to gain knowledge and understanding of the fundamental physical processes that occur within the inner heliosphere. These are critical processes that are key to both Heliophysics science as well as to spaceÂweather operations and forecasting.
Website:
http://www.sciesmex.unam.mx/workshop2015/

## 2015 Sun-Climate Symposium in Savannah, Georgia, USA

Start : 2015-11-10 - End : 2015-11-13
Observations of the Sun and Earth from space have revolutionized our view and understanding about impacts of solar variability and anthropogenic forcing on Earth climate. For more than three solar cycles since 1978, the total and spectral solar irradiance (TSI and SSI) and global terrestrial atmosphere/surface have been observed continuously, enabling unprecedented quality data for Sun-climate studies. The primary objective of this symposium is to convene climate scientists, solar physicists, and experimentalists together for a better understanding how Earth climate system changes and responds to solar variability.
Website: http://lasp.colorado.edu/home/sorce/news-events/meetings/2015-sun-climate-symposium/

## 41st COSPAR Scientific Assembly in Istanbul, Turkey

Start : 2016-07-30 - End : 2016-08-07
The 41st COSPAR Scientific Assembly will be held in Istanbul, Turkey from 30 July - 7 August 2016. This Assembly is open to all bona fide scientists.
Website:
https://www.cospar-assembly.org/

## 8. New documents in the European Space Weather Portal Repository

### See http://www.spaceweather.eu/en/repository

### STCE - Space weather science, infrastructure, services and products: SW events and impact

Presentation given during a users' visit about the STCE operational space weather services and products.
http://www.spaceweather.eu/en/repository/show?id=558

### STCE - Space weather science, infrastructure, services and products: Service Centers

Presentation given during a users' visit about the STCE operational space weather services and products.
http://www.spaceweather.eu/en/repository/show?id=559

### STCE - Space weather science, infrastructure, services and products: Operational Software and Products

Presentation given during a users' visit about the STCE operational space weather services and products.
http://www.spaceweather.eu/en/repository/show?id=560

### STCE - Space weather science, infrastructure, services and products: SW forecast

Presentation given during a users' visit about the STCE operational space weather services and products.
http://www.spaceweather.eu/en/repository/show?id=561

### STCE - Space weather science, infrastructure, services and products: SEP

Presentation given during a users' visit about the STCE operational space weather services and products.
http://www.spaceweather.eu/en/repository/show?id=562

### STCE - Space weather science, infrastructure, services and products: Ionospheric event

Presentation given during a users' visit about the STCE operational space weather services and products.
http://www.spaceweather.eu/en/repository/show?id=563

### eHEROES - De verschillende vormen van zonneactiviteit en hun invloed op de mens en zijn technologie

Invited review submitted to the journal Revue E. This article is the first in a series of 3 articles. De Zon, Helios, Sol, ... er bestaan vele namen voor die gele bol die dagelijks ons hemelgewelf doorkruist en onze warmte- en lichtbron bij uitstek is. Dankzij satellietwaarnemingen hebben we onze ster leren kennen als een dyna- misch en explosief hemelobject dat aan de basis ligt van het zogenaamde ruimteweer dat een belangrijke impact heeft op onze technologie.
http://www.spaceweather.eu/en/repository/show?id=564

## eHEROES - Onderzoek naar de zonnecorona

On the occasion of the solar eclipse of March 20, 2015, we contributed to the March 2015 edition of the amateur astronomer journal 'Zenit'. We highlighted the outcome of LASCO onboard of SOHO and focussed on the role of the STCE on space missions like PROBA2, PROBA3 and Solar Orbiter. The text is written in Dutch.
http://www.spaceweather.eu/en/repository/show?id=565