STCE Newsletter

2 Mar 2015 - 8 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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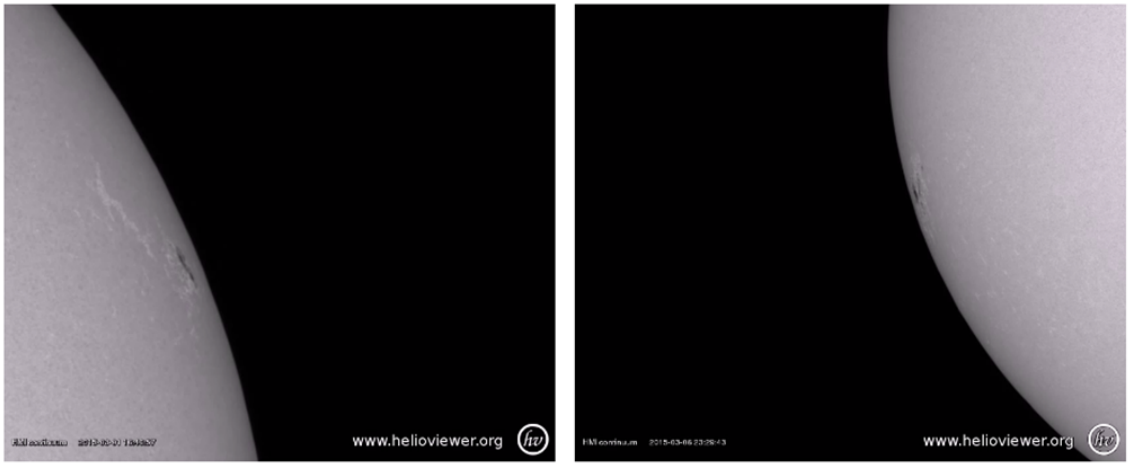
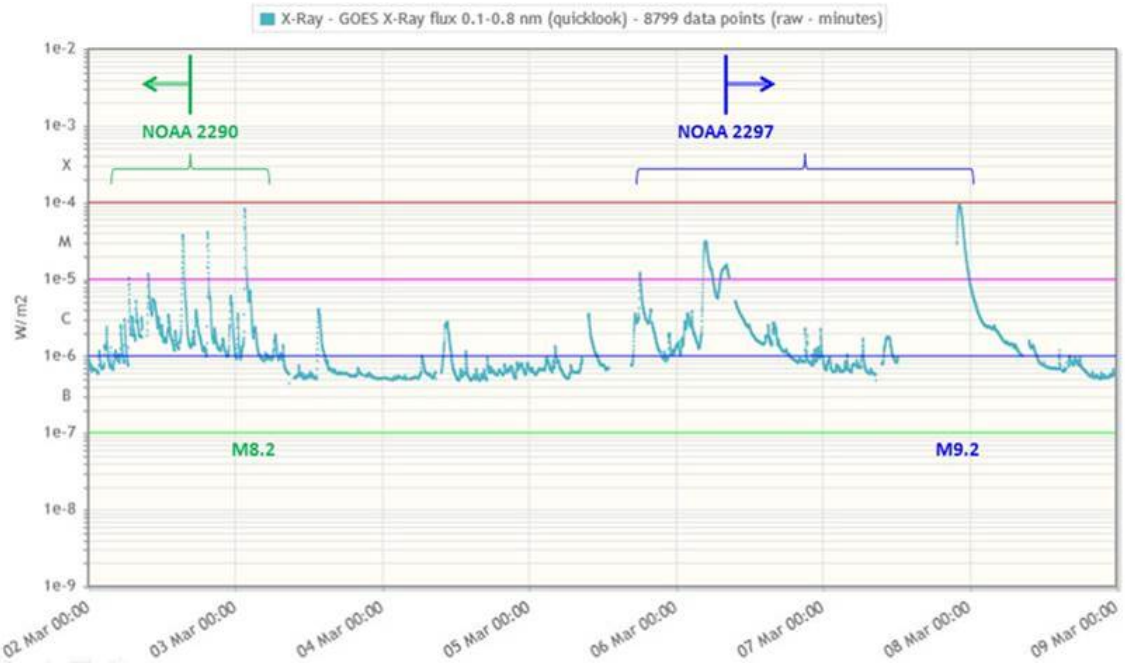
1. Marvellous M-flares

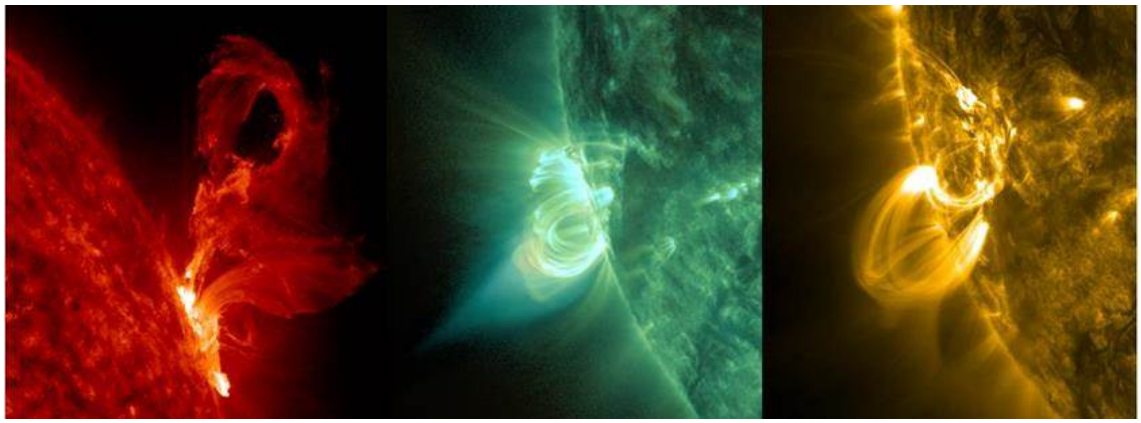
Though the Sun was devoid of big sunspot groups this week, no less than 9 M-class flares were recorded. These medium flares were produced by only 2 active regions: NOAA 2290 (5) and NOAA 2297. Interestingly, both regions were at the solar limb when they unleashed their flares. In fact, the last two (and strongest) M-class events of NOAA 2290 were produced when the region had already rounded the northwest solar limb, whereas NOAA 2297 had already released 2 of its 4 M-class events before it rounded the southeast limb.



Both regions were not very big, but they were magnetically complex. This resulted in two strong flares: NOAA 2290 produced an M8.2 flare on 03 March peaking at 01:35UT, and NOAA 2297 produced an M9.2 flare on 07 March peaking at 02:22UT. In all cases, the bulk of the related coronal mass ejections was not directed to Earth.



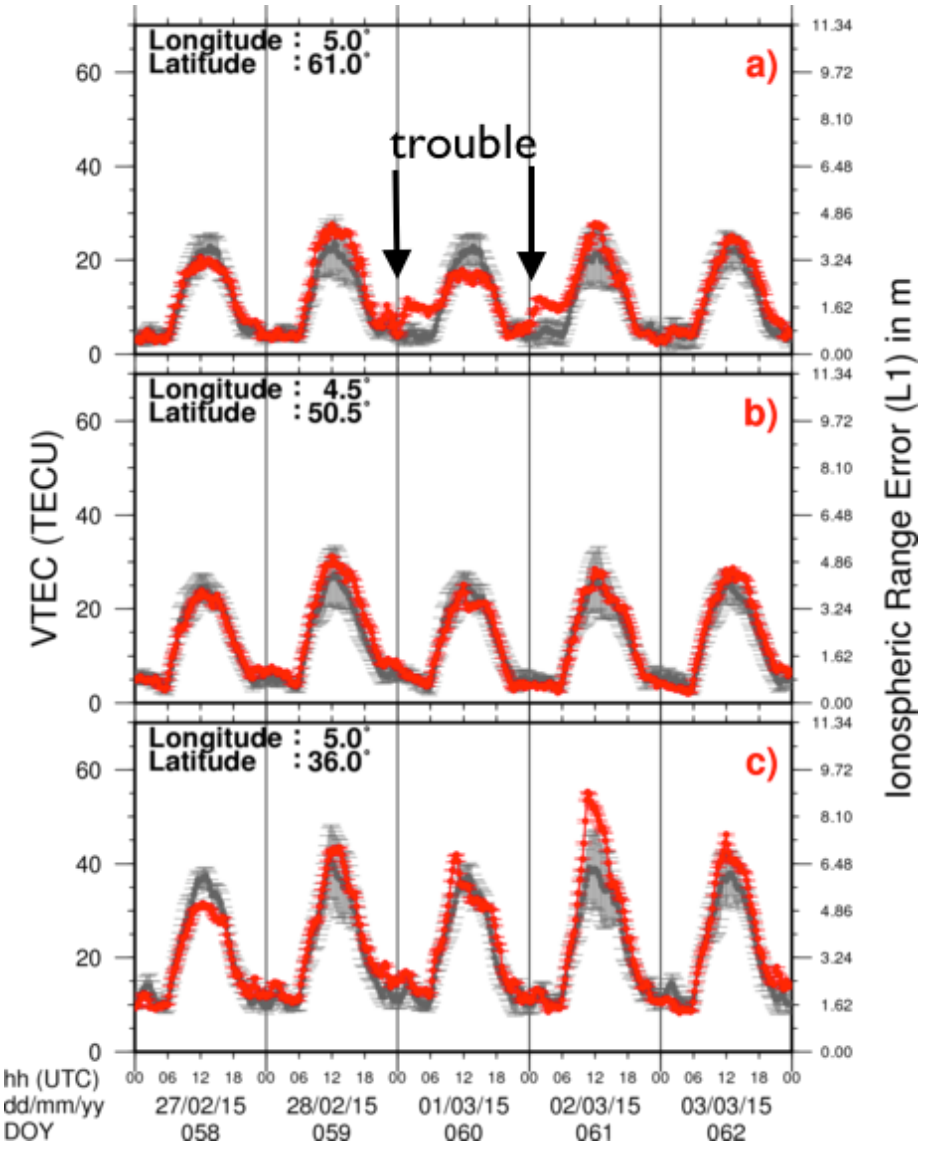
This movie at http://youtu.be/qHALNFnTp-A shows 3 M-class flares in EUV as seen by SDO/AIA (http://sdo.gsfc.nasa.gov/). It first shows the impressive eruption related to the M3.7 flare from NOAA 2297 on 02 March in temperatures of about 80.000 degrees (AIA304). This is followed by the duo of M-class flares early on 06 March (M3.0 and M1.5), showing a very hot cusp (pale blue flamelike feature) over the post-flare coronal loops. This is a clip combining images in hot temperatures (AIA131; blue; multimillion degrees) with images seen in the AIA171 filter (yellow; temperatures around 700.000 degrees). The last clip shows the impressive coronal loops that followed the M9.2 flare late on 07 March (AIA171).



2. Trouble in the ionosphere

The ionosphere is a layer of charged particles in the Earth's atmosphere, located from about 60km to 1000km above the Earth's surface.

As the Sun's radiation ionizes this layer, the ionosphere is a plasma of ions and free electrons (hence its name). These electrons perturb the propagation of communication signals by inducing a so-called ionospheric delay. The number of electrons is represented by the Vertical Total Electron Content (VTEC). It is directly related to the signal propagation delay due to the ionosphere.



The figure shows the time evolution of the VTEC (the red line) during the last week in the northern part of Europe (top), above Brussels (middle), and in the southern part of Europe (bottom). This figure also shows (in grey) the normal ionospheric behavior expected based on the median VTEC from the 15 previous days.

A coronal hole did it

We see a strange behaviour of the red curve on the early morning March 01 and 02 due to a disturbed geomagnetic field. The solar wind emanating from a southern polar coronal hole (see 'Geomagnetic Activity') left a clear imprint in the ionosphere.

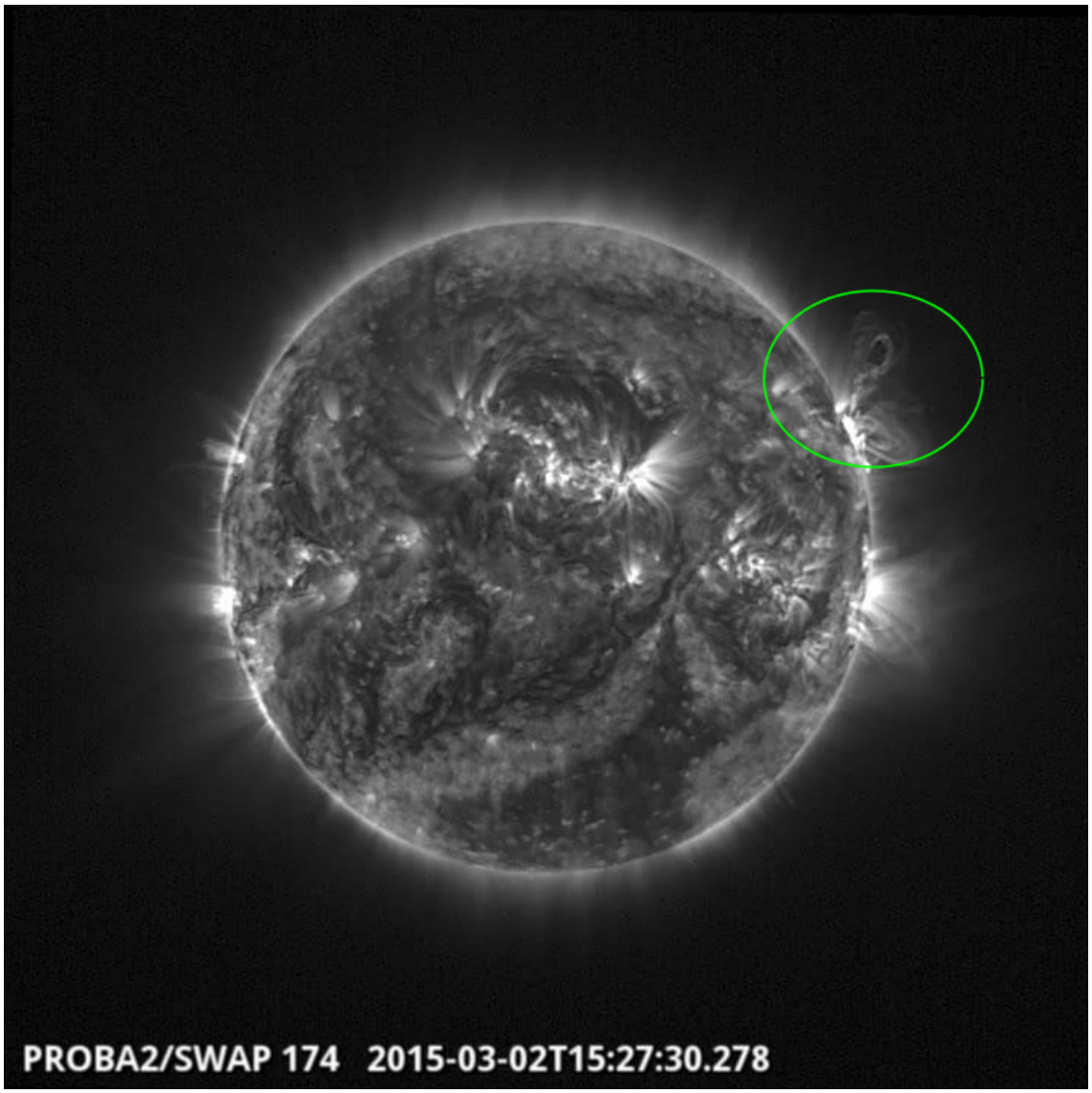
check
http://gnss.be/Atmospheric_Maps/ionospheric_event.php?date=2015-03-01

3. PROBA2 Observations (2 Mar 2015 - 8 Mar 2015)

Solar Activity

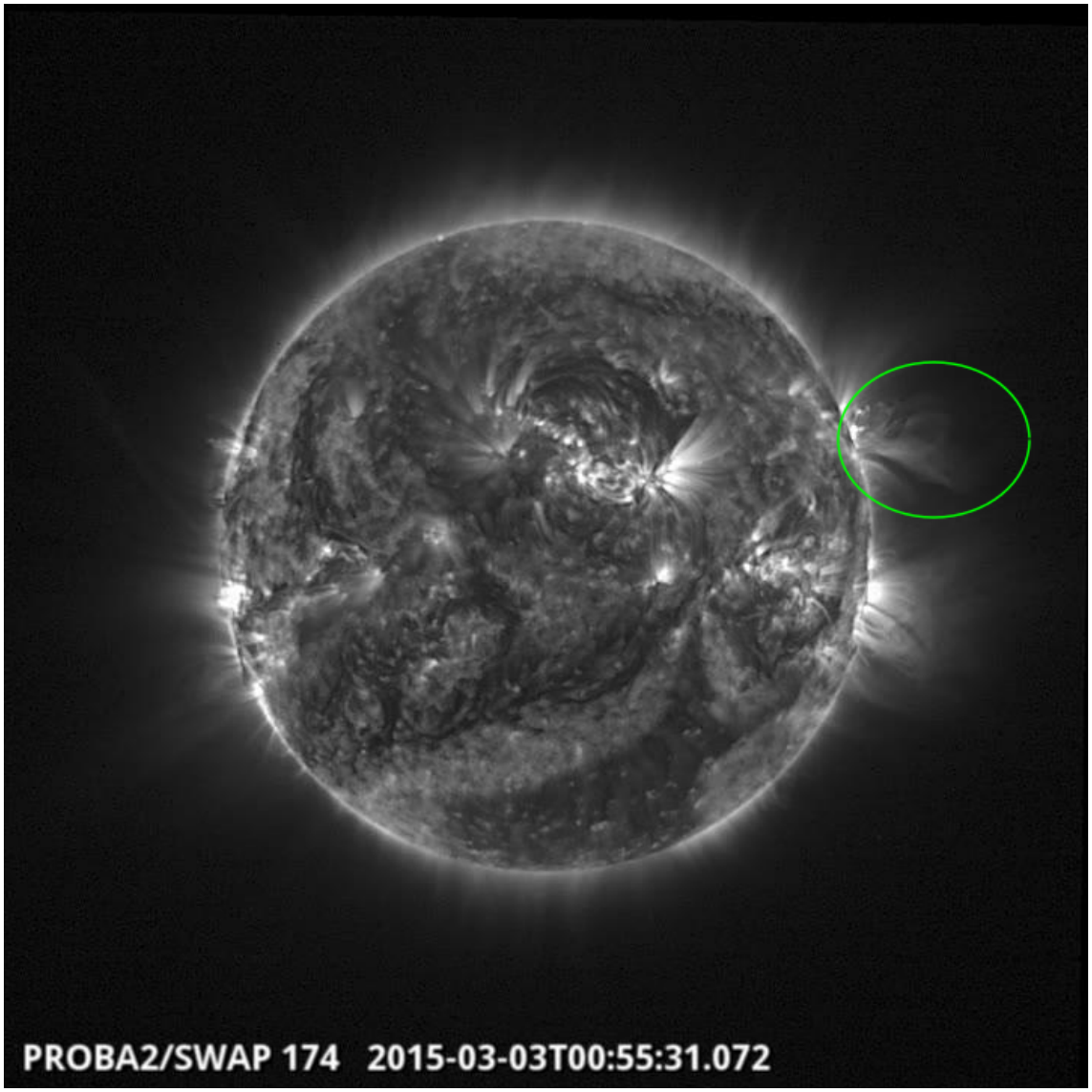
Solar flare activity fluctuated between low and moderate during the week.
In order to view the activity of this week in more detail, we suggest to go to the following website from which all the daily (normal and difference) movies can be accessed:http://proba2.oma.be/ssa
This page also lists the recorded flaring events.
A weekly overview movie can be found here (SWAP week 258).
http://proba2.oma.be/swap/data/mpg/movies/weekly_movies/weekly_movie_2015_03_02.mp4
Details about some of this week's events, can be found further below.

Monday Mar 02

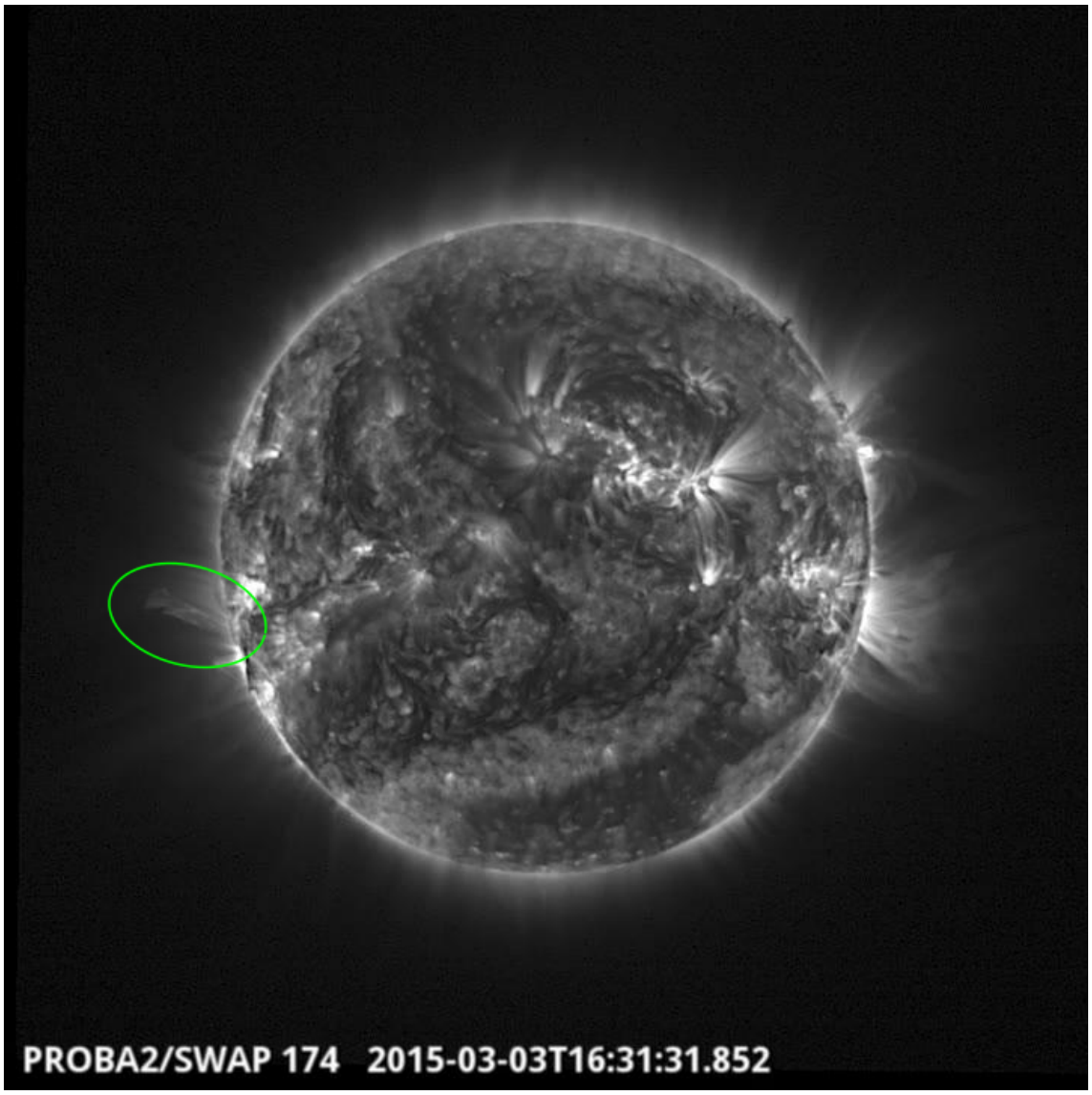


Eruption on the west limb @ 15:27 SWAP image
Find a movie of the events here (SWAP movie)
http://proba2.oma.be/swap/data/mpg/movies/20150302_swap_movie.mp4

Tuesday Mar 03

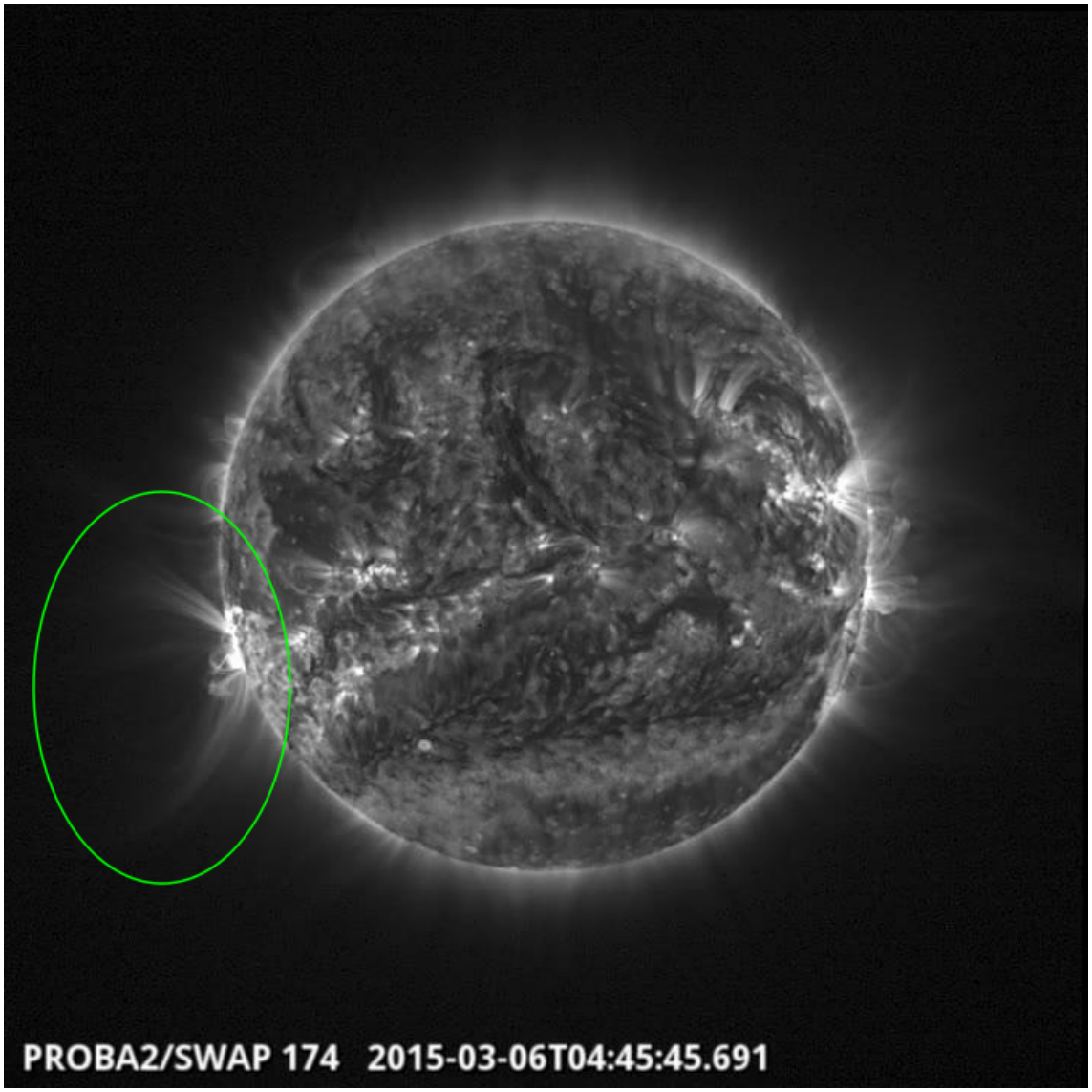


Eruption on the west limb @ 00:55 SWAP image
Find a movie of the events here (SWAP movie)
http://proba2.oma.be/swap/data/mpg/movies/20150303_swap_movie.mp4



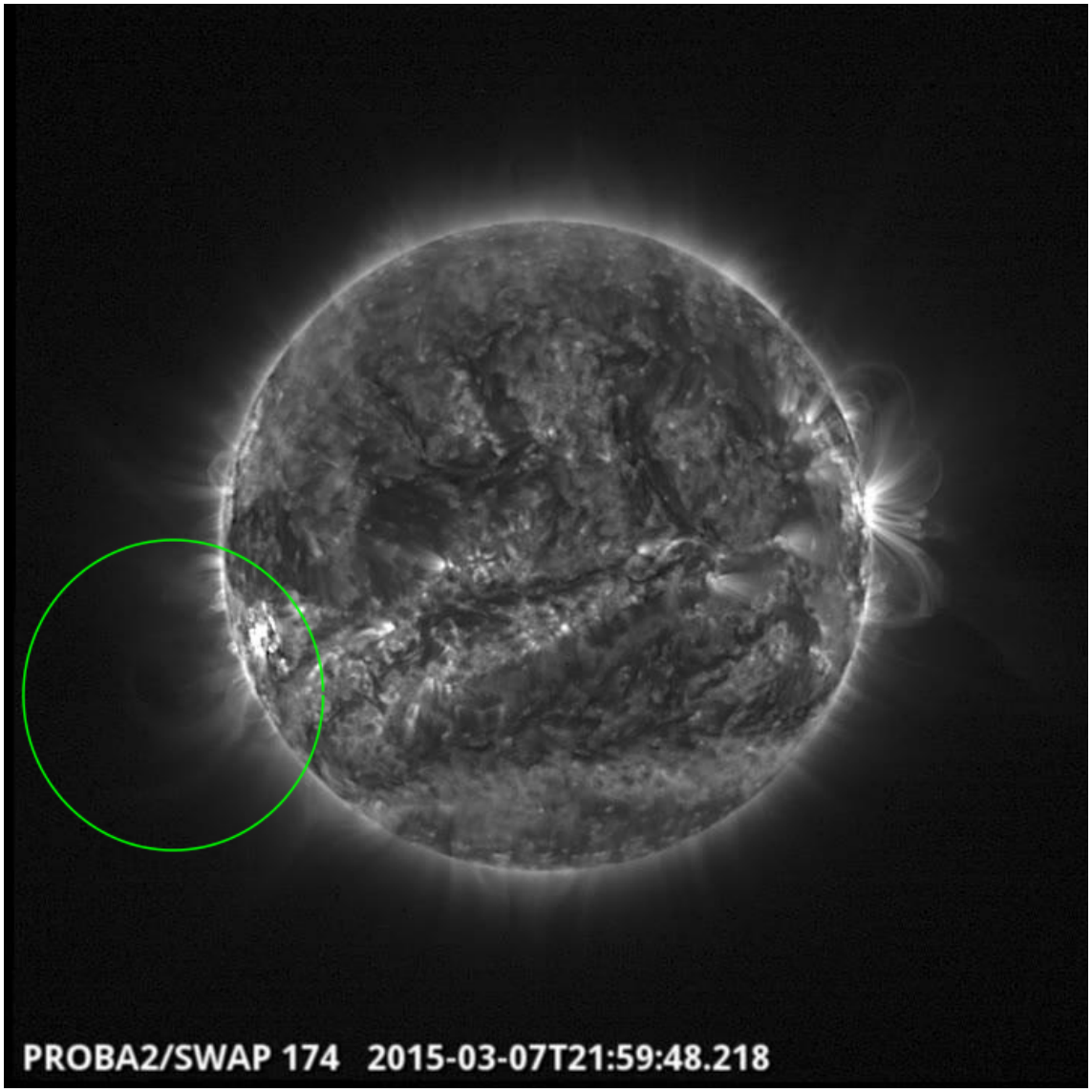
Failed eruption on the west limb @ 16:31 SWAP image
Find a movie of the events here (SWAP movie)
http://proba2.oma.be/swap/data/mpg/movies/20150303_swap_movie.mp4

Friday Mar 06



Eruption on the east limb @ 04:75 SWAP image
Find a movie of the events here (SWAP movie)
http://proba2.oma.be/swap/data/mpg/movies/20150306_swap_movie.mp4

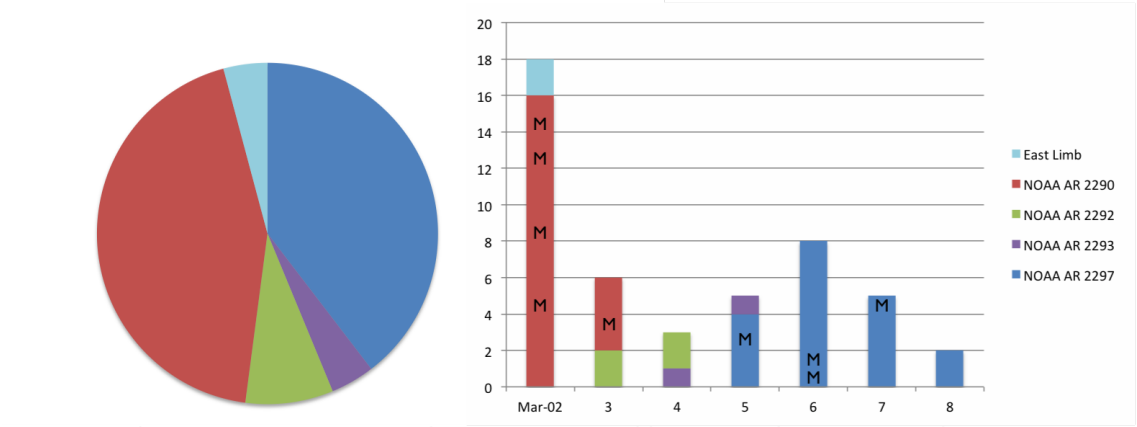
Saturday Mar 07



Eruption on the east limb @ 21:59 SWAP image
Find a movie of the events here (SWAP movie)
http://proba2.oma.be/swap/data/mpg/movies/20150307_swap_movie.mp4

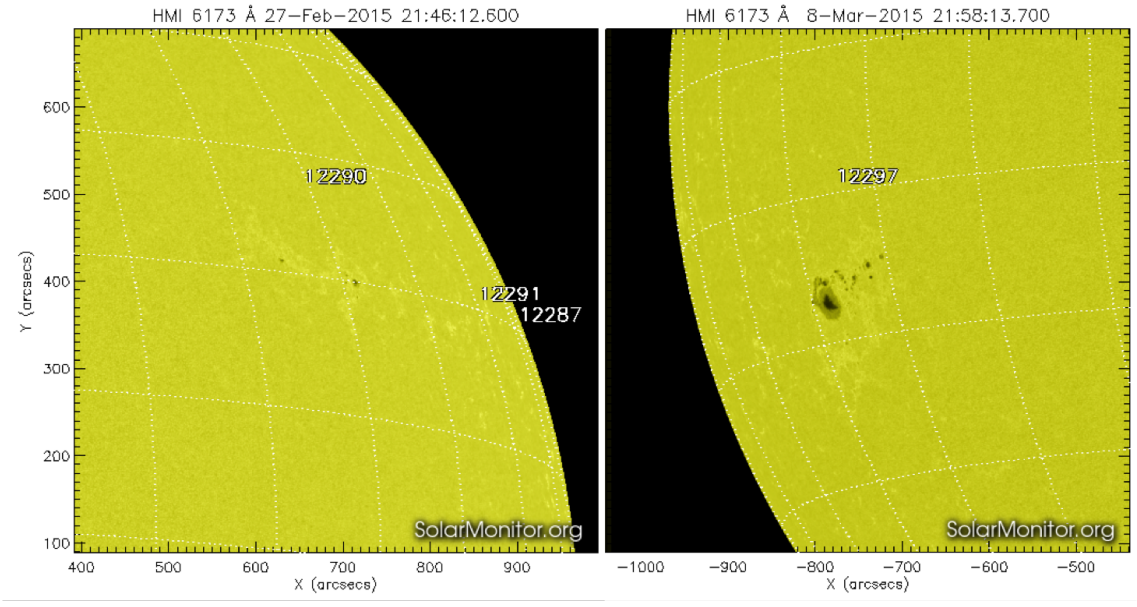
4. Review of solar activity

Distribution of C and M flares, March 02 – 08,



The left chart gives an overview of the total number of flares per NOAA AR region for the indicated week. *East Limb* indicates that the flaring source was located at the east limb and did not have a NOAA numbering yet . The right chart gives an overview of the flaring activity per NOAA AR per day.

Solar activity was concentrated in 2 periods. NOAA 2290 was responsible for 5 M-class flares in 24 hours, with the last and strongest (M8.2) flare peaking early on 3 March (01:35UT) from behind the northwest limb. None of the associated CMEs had an Earth-directed component. A few days later, early on 06 March, NOAA 2297 rounded the southeast limb having produced already 2 M-class flares. This active region was also the source of the strongest event of the week, an M9.2 flare peaking on 07 March at 22:22UT. The bulk of the associated CME was directed away from the Earth. Combined, NOAA 2290 and 2297 produced all 9 M-class flares and 30 of the 38 C-class flares this week. The proton flux was at nominal levels during the entire period.



The left picture taken by SDO/HMI in visible light shows the photospheric appearance of NOAA AR 2290 on Feb 27. At the moment of the M-flares, March 02 and 03, the NOAA 2290 was not visible any more. The right picture shows NOAA AR 2297 on the day it produced 2 M-flares: March 06.

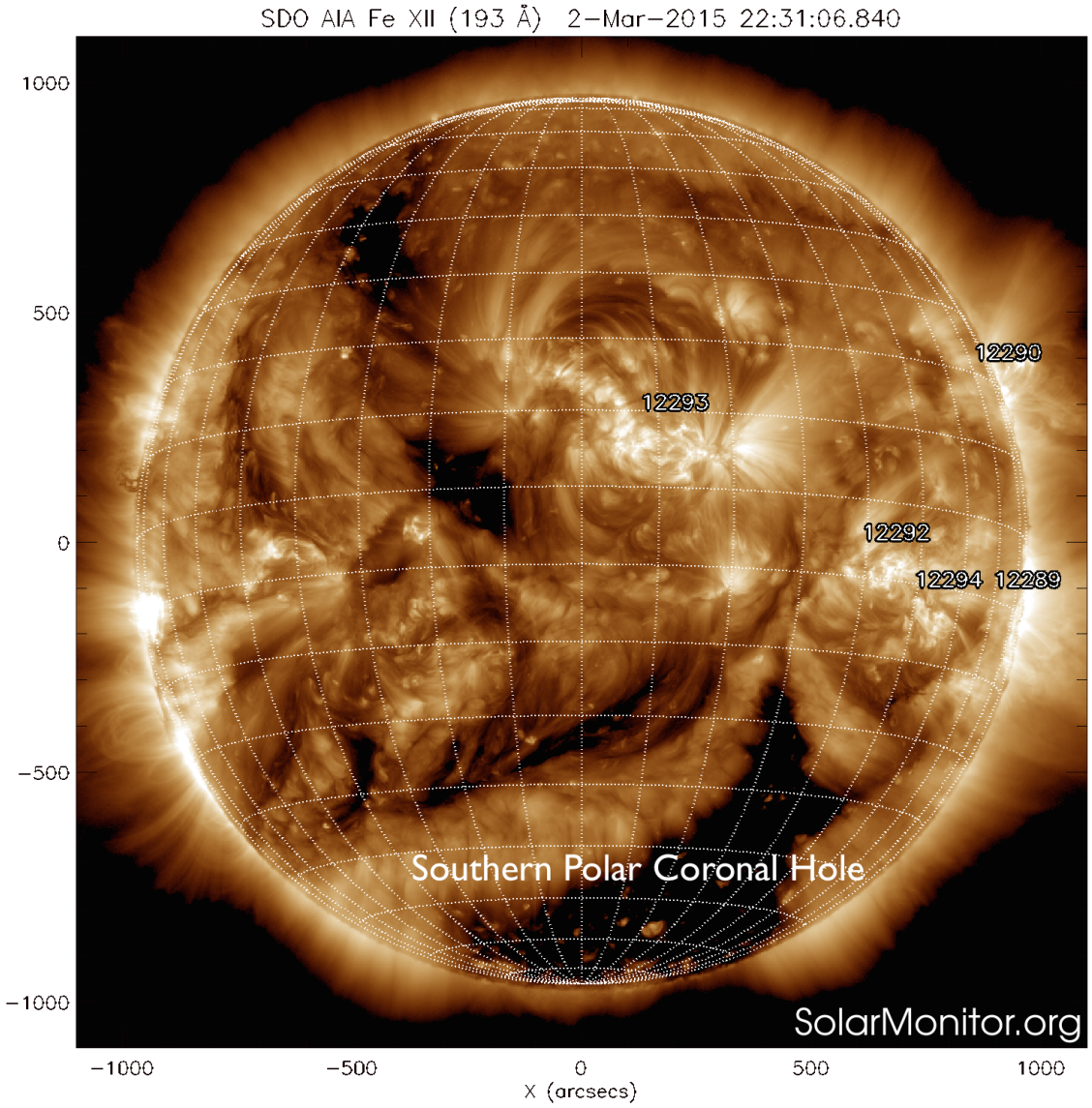
5. Noticeable Solar Events (2 Mar 2015 - 8 Mar 2015)

DAY	BEGIN	MAX	END	LOC	XRAY	OP	10CM	TYPE	Cat	NOAA
02	0631	0639	0644	N19W84	M1.0	1F		III/1VI/1II/1	90	2290
02	0937	0948	0958		M1.1				90	2290
02	0852	0948	0958		M1.1				90	2290
02	1510	1528	1537		M3.7		16		90	2290
02	1921	1931	1936		M4.1			III/1	90	2290
03	0125	0135	0142	N21W87	M8.2	SB		IV/1II/1III/1		2290
05	1706	1811	1826		M1.2					2297
06	0414	0457	0527		M3.0		120	III/1		2297
06	0655	0815	0828		M1.5			CTM/1		2297
07	2145	2222	2258		M9.2		260	II/1IV/2		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

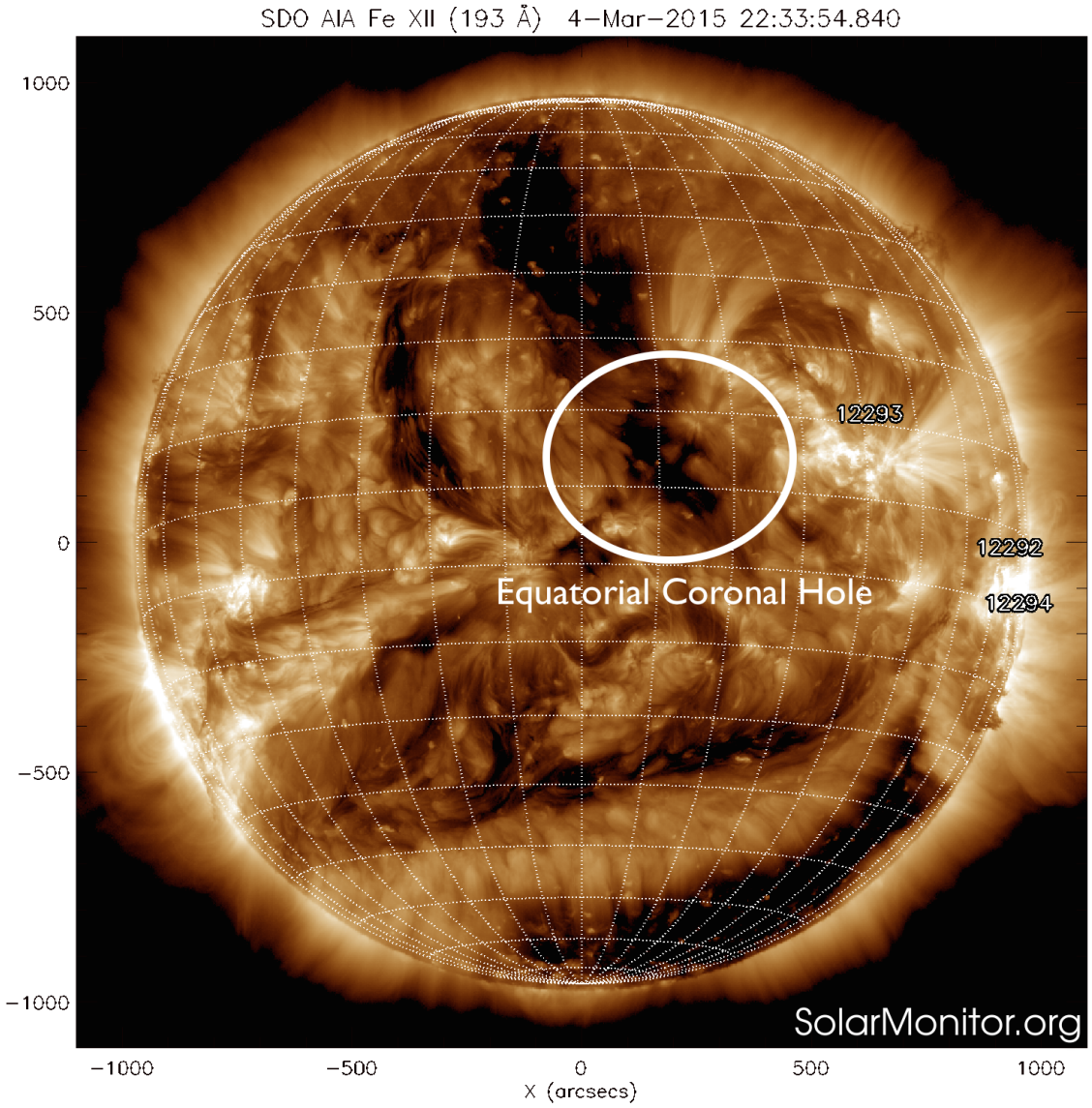
6. Review of geomagnetic activity

At the beginning of the week, the geomagnetic field was under the influence of a high speed stream from a negative polarity southern polar coronal hole (CH). It resulted in active (Dourbes) to minor storming conditions (Kp=5) on 02 March. The CH is clearly visible in the SDO AIA image below.

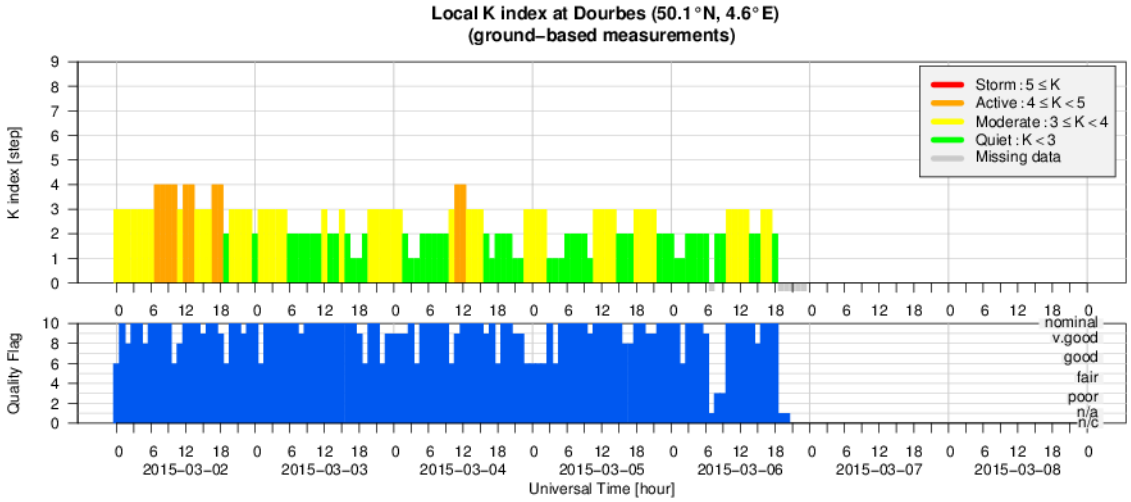


A sector boundary crossing occurred on 04 March, with the direction of the Interplanetary Magnetic field changing from towards to away from the Sun. Unsettled to locally (Dourbes) active geomagnetic conditions were registered.

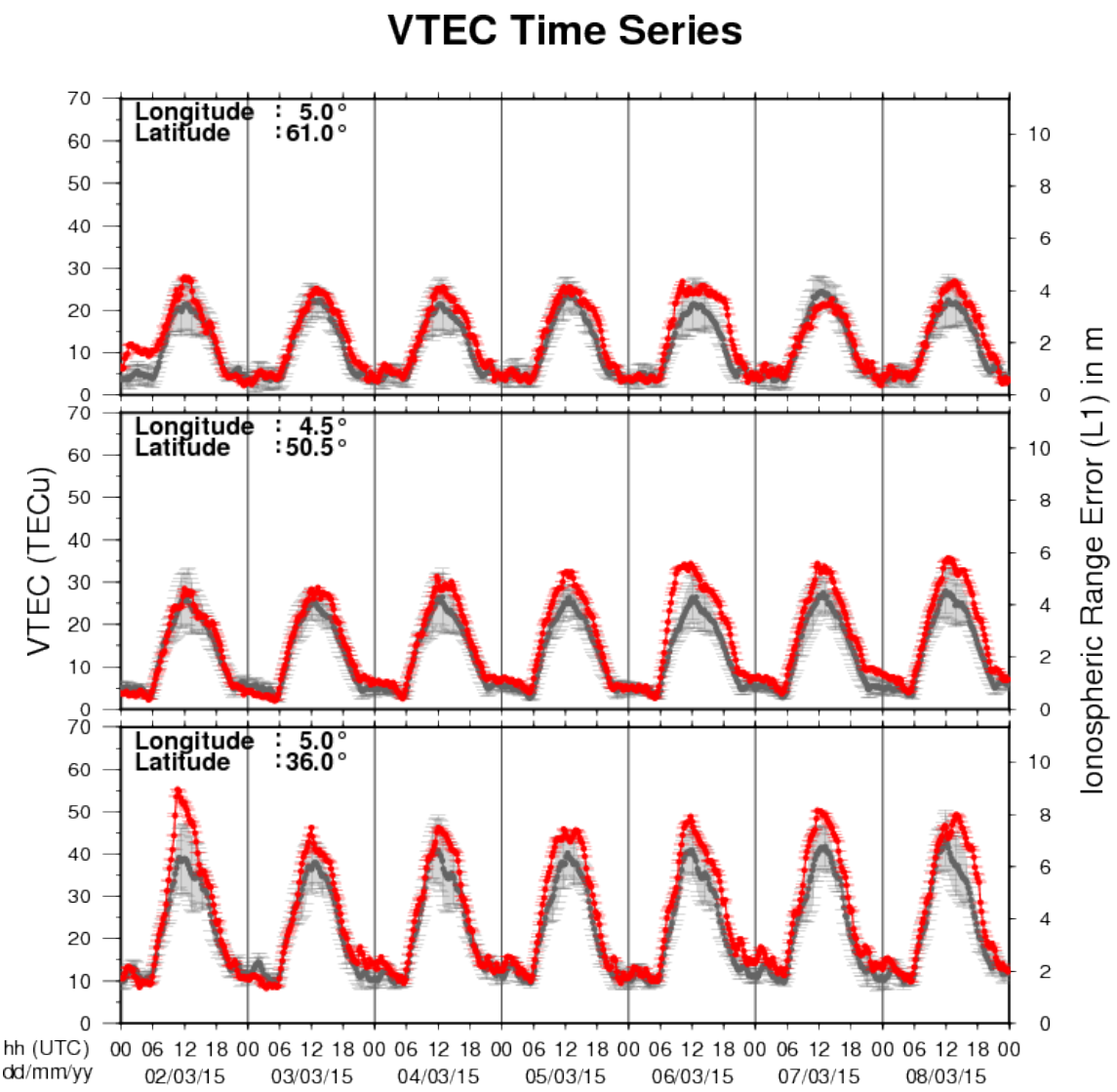
Starting on 06 March, Earth's magnetic field became influenced by the high-speed stream of a positive polarity equatorial CH (see picture below) resulting in quiet to sporadically active geomagnetic conditions for the remainder of the week.


SDO AIA Fe XII (193 Å) 4-Mar-2015 22:33:54.840
1000
500
0
-500
-1000
12293
12292
12294
Equatorial Coronal Hole
SolarMonitor.org
-1000
-500
0
500
1000
X (arcsecs)

7. Geomagnetic Observations at Dourbes (2 Mar 2015 - 8 Mar 2015)



8. Review of ionospheric activity (2 Mar 2015 - 8 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

9. Future Events

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

Conference on Sun-Climate Connections (SCC 2015) in Kiel, Germany

Start : 2015-03-16 - End : 2015-03-19
This international conference will provide an overview of our current understanding of Sun-Climate Connections starting at processes on the Sun itself over space weather and solar wind towards solar influence on the upper atmosphere down to the ocean. It will also provide insights into the heatedly debated role of the Sun in climate change. In four sessions the various contributions of solar variability influence on Earth's climate will be presented and discussed by bringing together solar physicists, space scientists, atmospheric scientists, climate modellers, and paleoclimatologists.
We expect contributions from scientists participating in SCOSTEP/ROSMIC, SPARC-SOLARIS/HEPPA, the EU cost network TOSCA, as well as any other interested scientists. The conference will last three full days, beginning Monday morning, 16 March 2013. The programme will consist of invited and keynote lectures, a few contributed oral presentations and ample time dedicated to poster sessions. The fourth day will be devoted to public outreach activities as well as panel discussions.
Website: http://scc.geomar.de/

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/

10. New documents in the European Space Weather Portal Repository

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

eHEROES - De Zon

Theoretical course on the Sun and space weather for participants to the astronomy course in Public Observatory MIRA, Grimbergen (Belgium). Given on 19 March 2014 for 35 attendees.
http://www.spaceweather.eu/en/repository/show?id=557

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