STCE Newsletter

23 Feb 2015 - 1 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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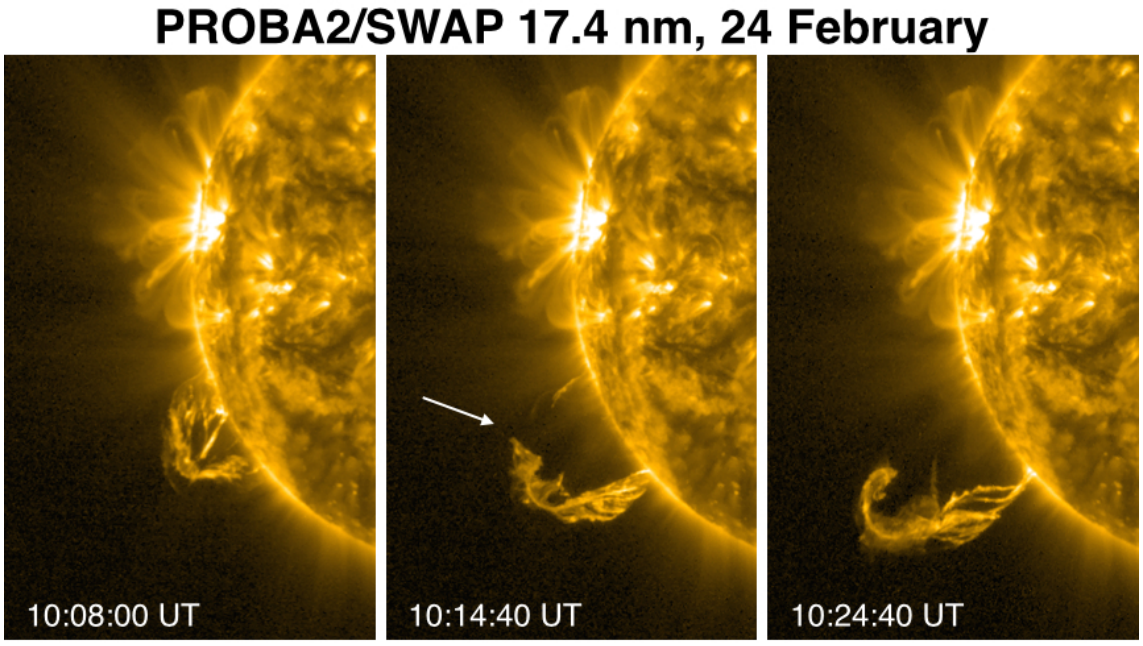
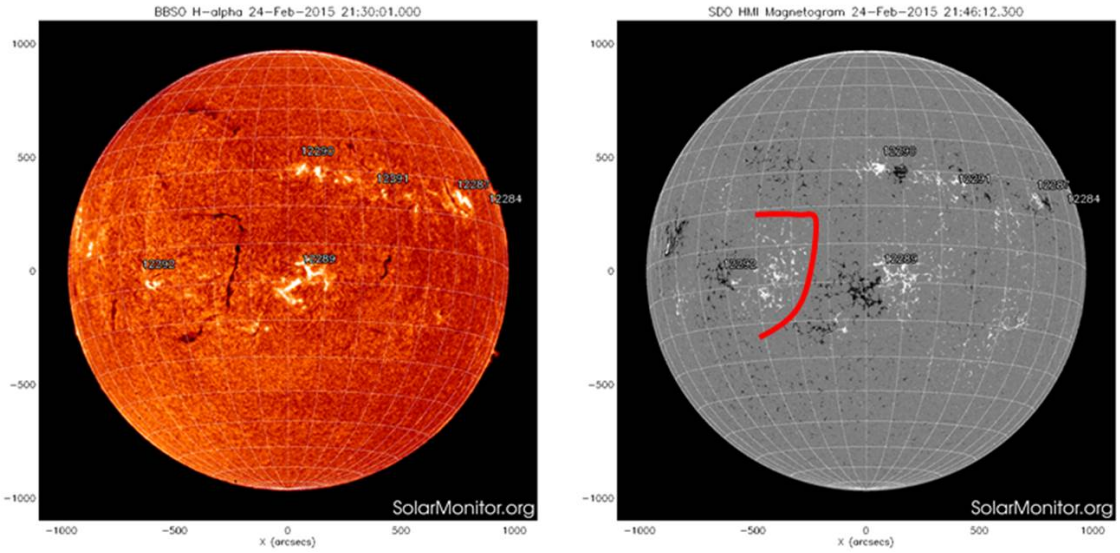
1. A gorgeous filament eruption

On 24 February 2015, around 10:00UT, the Sun put on quite a show with a gorgeous filament eruption. PROBA2 was on the outlook, and its EUV camera (SWAP) recorded a magnificent movie of the event (see http://proba2.oma.be/swap/data/mpg/movies/campaign_movies/2015_02_24/).

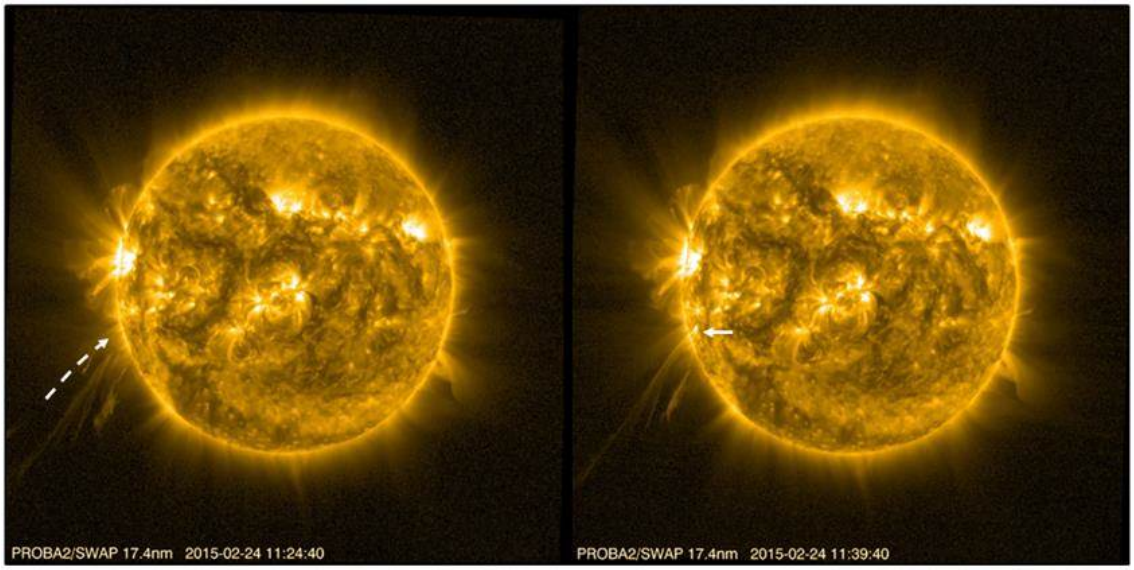


Filaments are clouds of plasma which are suspended in the corona, but they are denser and cooler than the surrounding coronal plasma. This plasma is trapped in dips in the magnetic field, such that it can not flow back down to the chromosphere (the inner atmosphere of the Sun). Filaments generally occur above photospheric neutral lines, which are the dividing line between magnetic fields that are directed into (negative, "black") and out (positive, "white") of the surface of the Sun, as can be seen in the sketch underneath. Filaments can be very long, as reported in previous news items (such as http://stce.be/news/294/welcome.html), or they can be smaller. Most of the shorter ones occur within active regions. In the images below, from the day of the eruption, you can see both long and short filaments. But you can't see the filament that erupted, because at the time these images were taken it had already erupted!



The eruption that you can see in the movie looks like it begins slightly behind the limb of the Sun, so that from the point of view of Earth we might not be seeing the whole original filament. Unfortunately, the STEREO spacecraft are currently in hibernation on the far side of the Sun, so we don't have any more information about the 3D nature of this eruption. But we can clearly see the filament material rise into the solar atmosphere during the eruption.

In the early stages of this eruption, the filament roughly traces a large loop that is expanding. As it expands, the leg closest to the equator appears to "break", as indicated in the top middle image. The filament plasma is a tracer of the magnetic field, it is not showing us the whole picture. While it is possible that there is a magnetic reconnection event where the filament plasma separates, it is not the only explanation. In this case the field might very well be continuously expanding with no abrupt topological changes at that stage.

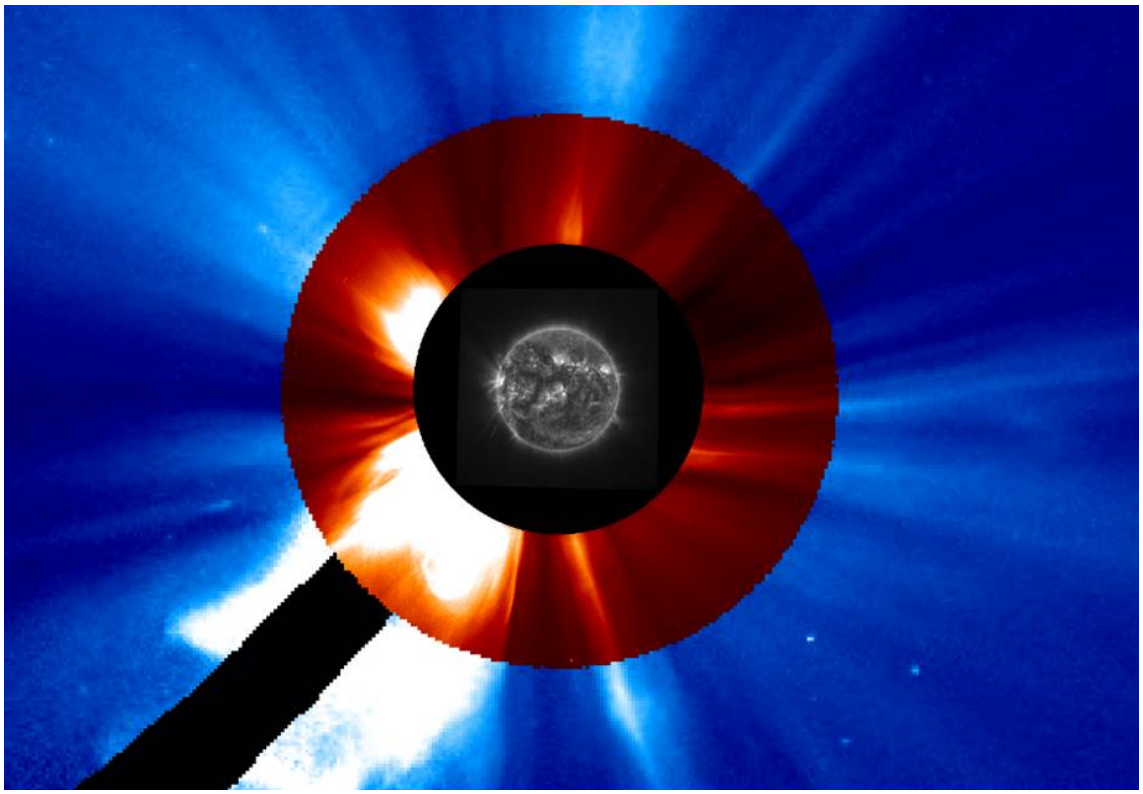


Later in the event, some of the filament material is seen to fall back down to the surface of the Sun (see image above on the left). These parcels of filament material are trapped on dips in the magnetic

field. When the field expands during the eruption, some of the field stretches and the dips disappear. If a magnetic flux tube straightens out, but remains connected to the Sun, the plasma on that tube may slide back to the Sun, and this is what we see in the movie. The filament plasma then causes localized brightenings where it hits the surface, as indicated by an arrow in the image above on the right.

Behind these localized brightenings, bright loops form rapidly near the former location of the filament footpoint shortly after 12:00UT. These loops are known as post eruptive loops, and they are a common signature of reconnection. See the news items at http://stce.be/news/274/welcome.html (21 October 2014) and http://stce.be/news/291/welcome.html (22 January 2015) for more examples of post eruptive loops.

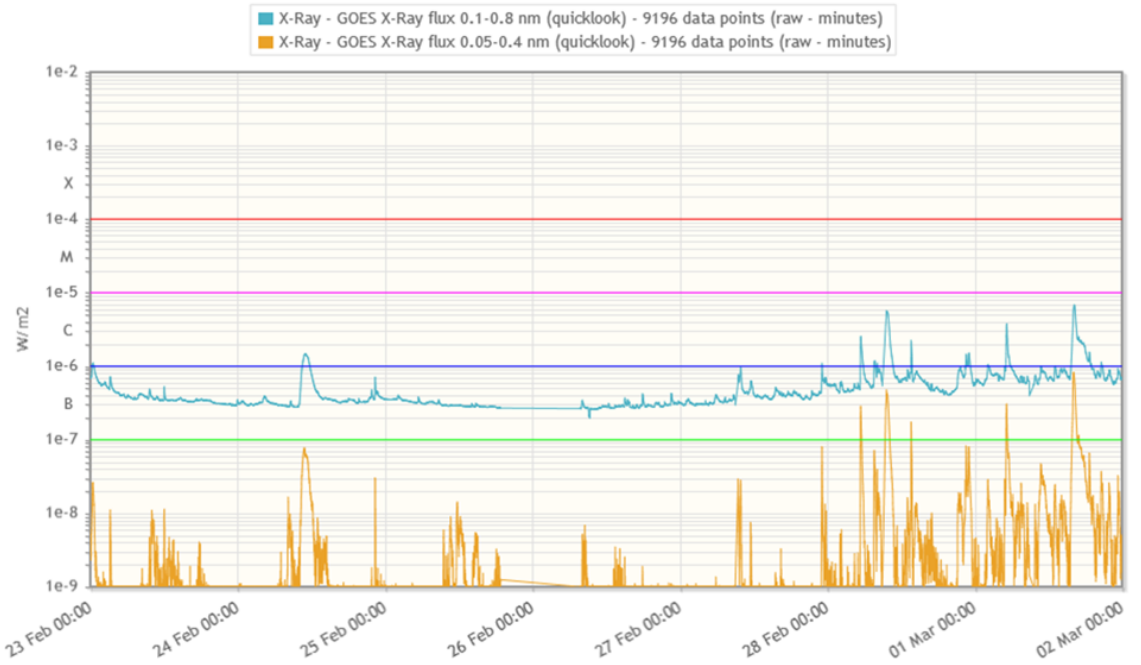
By looking at SOHO's coronagraphic imagery, however, we do know that this filament eruption caused a gorgeous coronal mass ejection (CME). Unfortunately for us, the direction of the CME is almost perfectly aligned with the support post of the disk that hides the detector from direct sunlight.

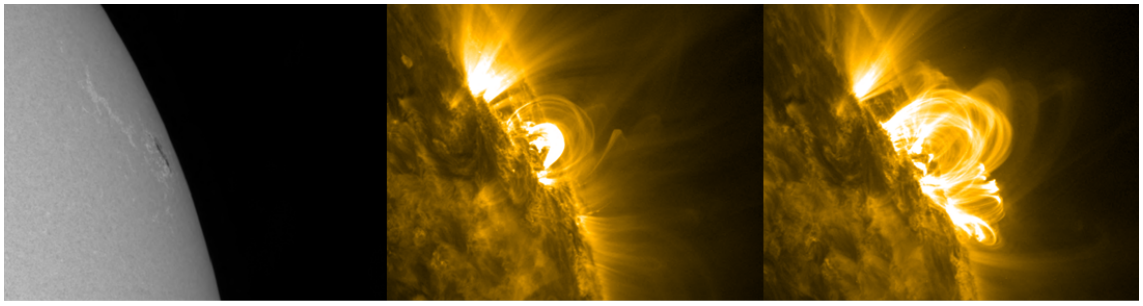


This article was written by the PROBA2 Team. If you have any questions, you can contact them at swap_lyra@oma.be

2. Review of solar activity (23 Feb 2015 - 1 Mar 2015)

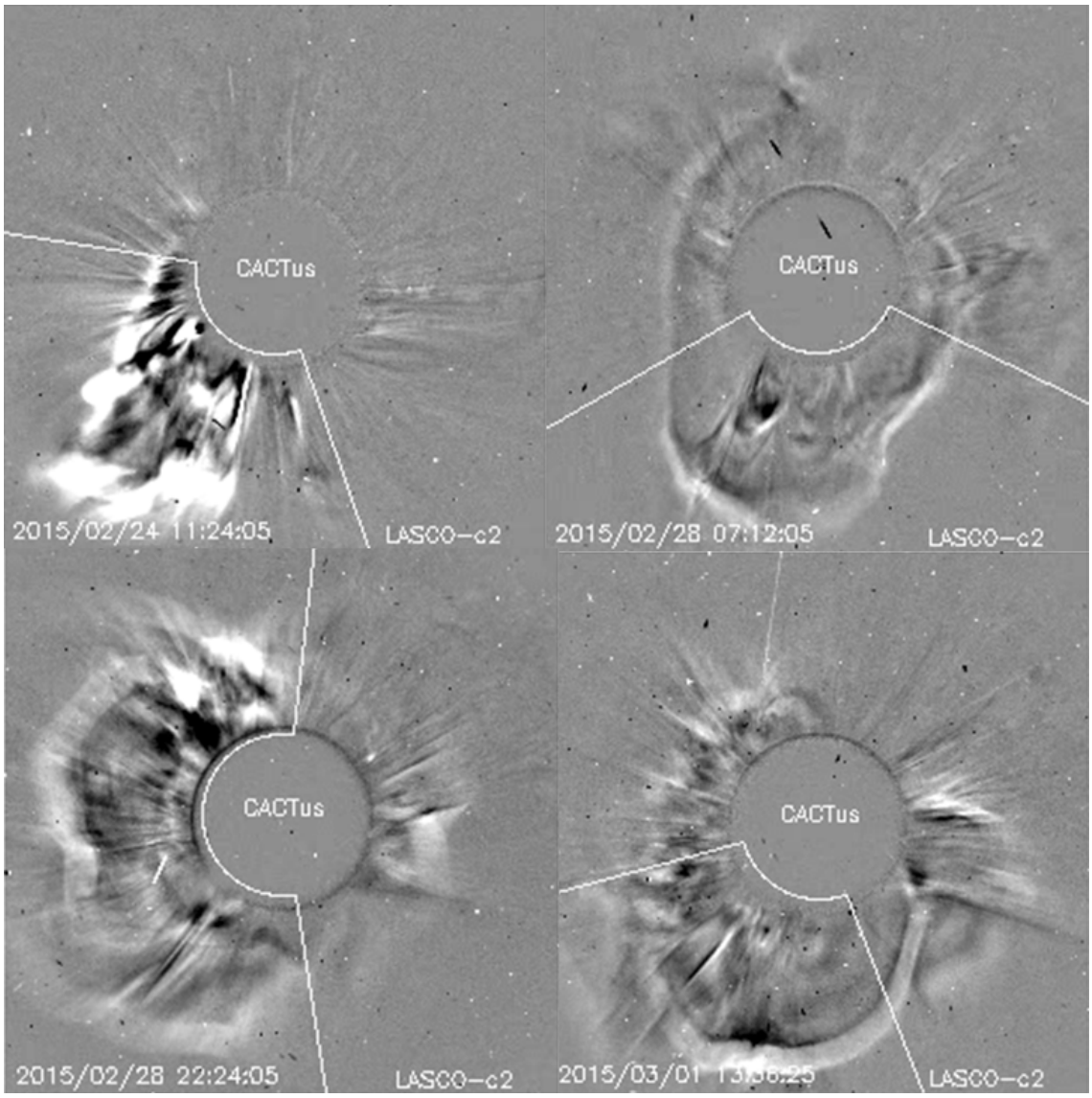
Solar activity was very low until 28 February when active region NOAA 2294 obtained a beta-gamma configuration and started producing C-class flares, together with NOAA 2290. The strongest one was a C6.8 peaking at 16:13UT on 01 March from NOAA 2290. The figures underneath show the overall flare evolution during the week, and NOAA 2290 (left), the C6 flare (middle) and the post-flare coronal loops (right).





SDO/HMI – 16:43UT SDO/AIA 171 – 16:43UT SDO/AIA 171 – 19:43UT

There were four strong backsided coronal mass ejections (CMEs; depicted below): on 24 February at 10:24UT (partial halo); on 28 February at 04:36UT (halo) and at 21:36UT (halo); and on 01 March at 12:36UT (almost full halo).



On 24 February, there were also two slow CMEs (at 13:36UT with +/-300 km/s, and at 23:24UT with +/-200 km/s), with slight chances of an Earth encounter by 01 March. No important geomagnetic consequences were expected, due to the low speeds. Another slow CME (about 300 km/s) was seen erupting on 28 February at 15:12UT with possible arrival by 04 March, but also in this case the CME was not expected to produce more than active periods.

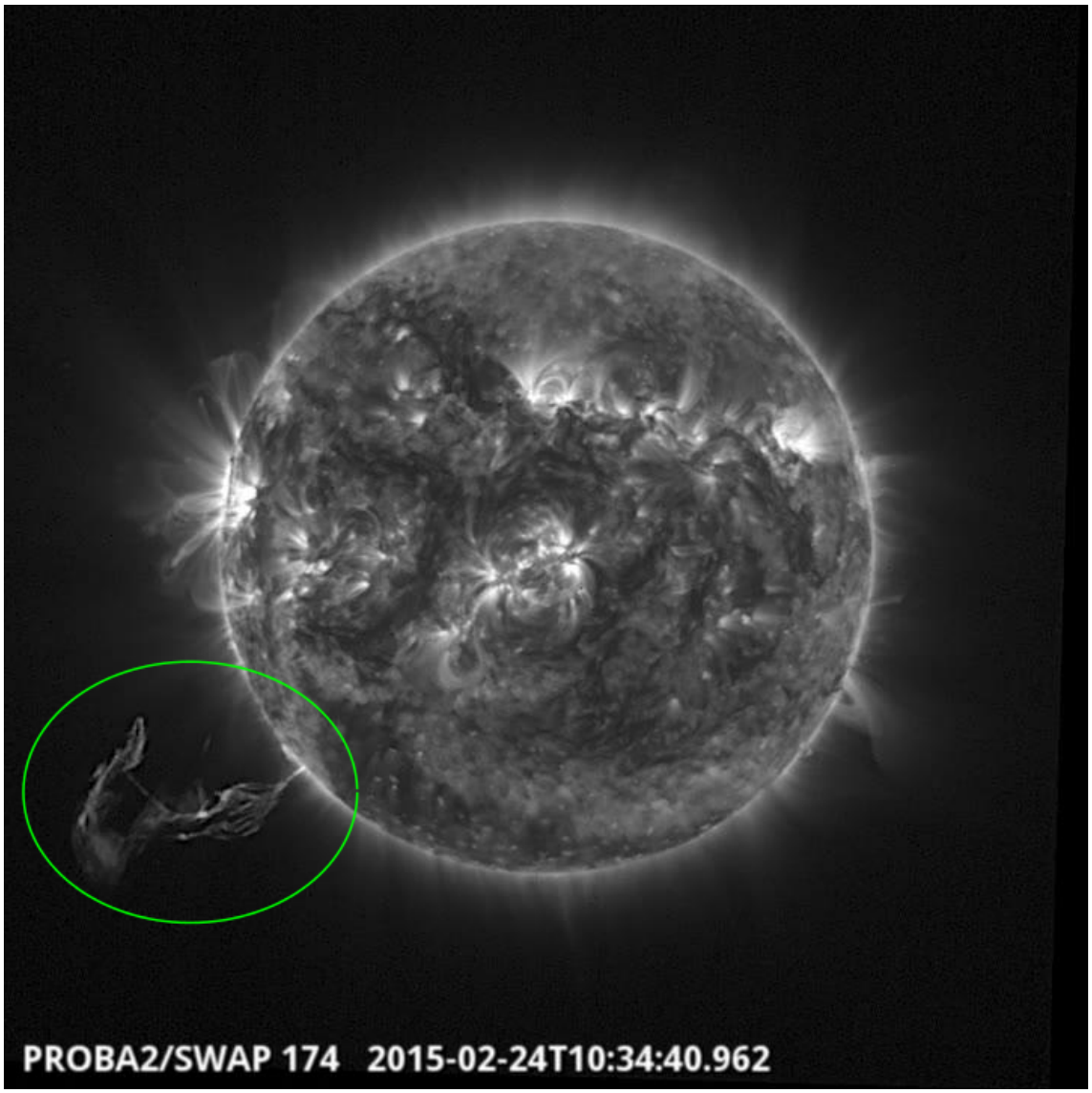
3. PROBA2 Observations (23 Feb 2015 - 1 Mar 2015)

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 (SWAP week 257).

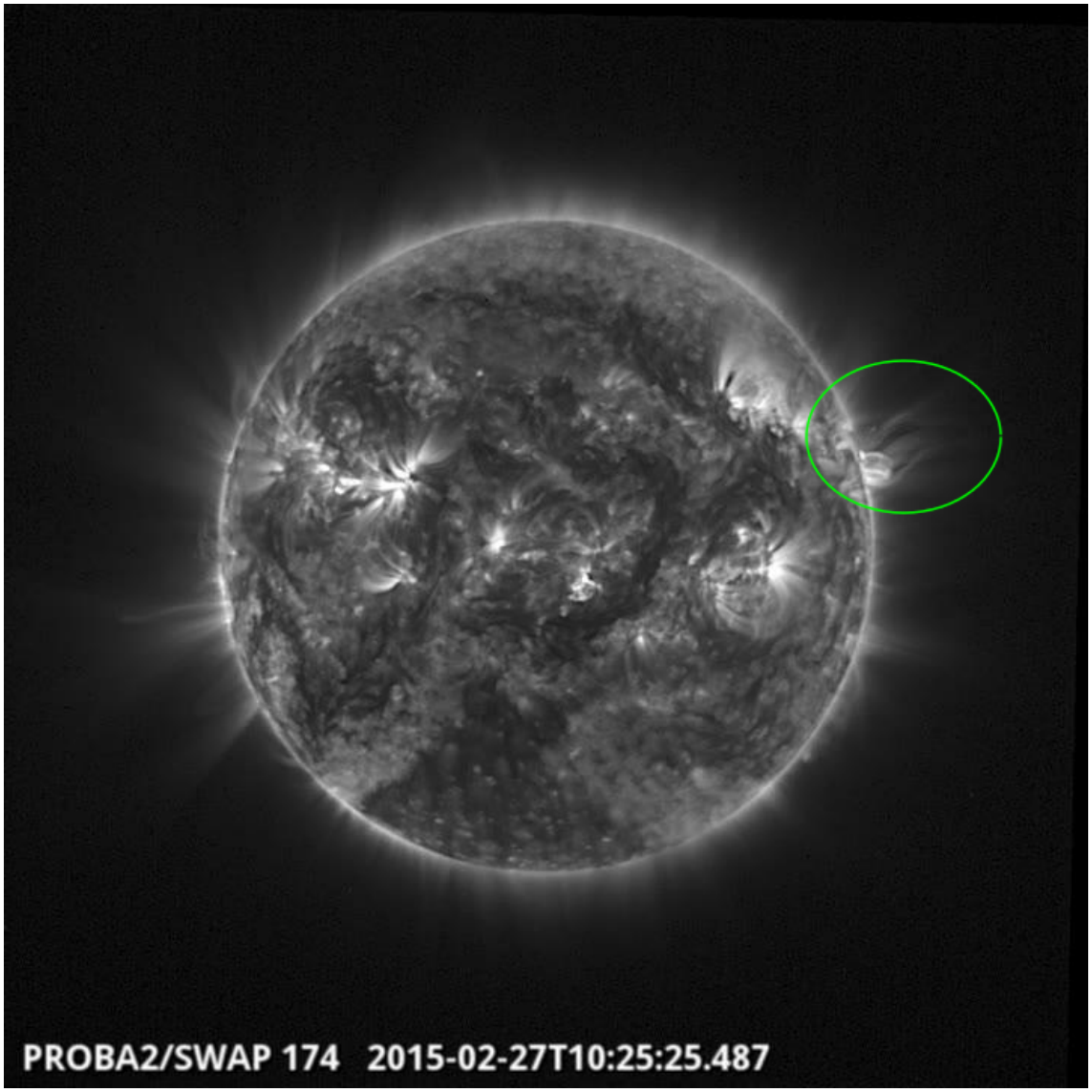
http://proba2.oma.be/swap/data/mpg/movies/weekly_movies/weekly_movie_2015_02_23.mp4
Details about some of this week's events, can be found further below.

Tuesday Feb 24



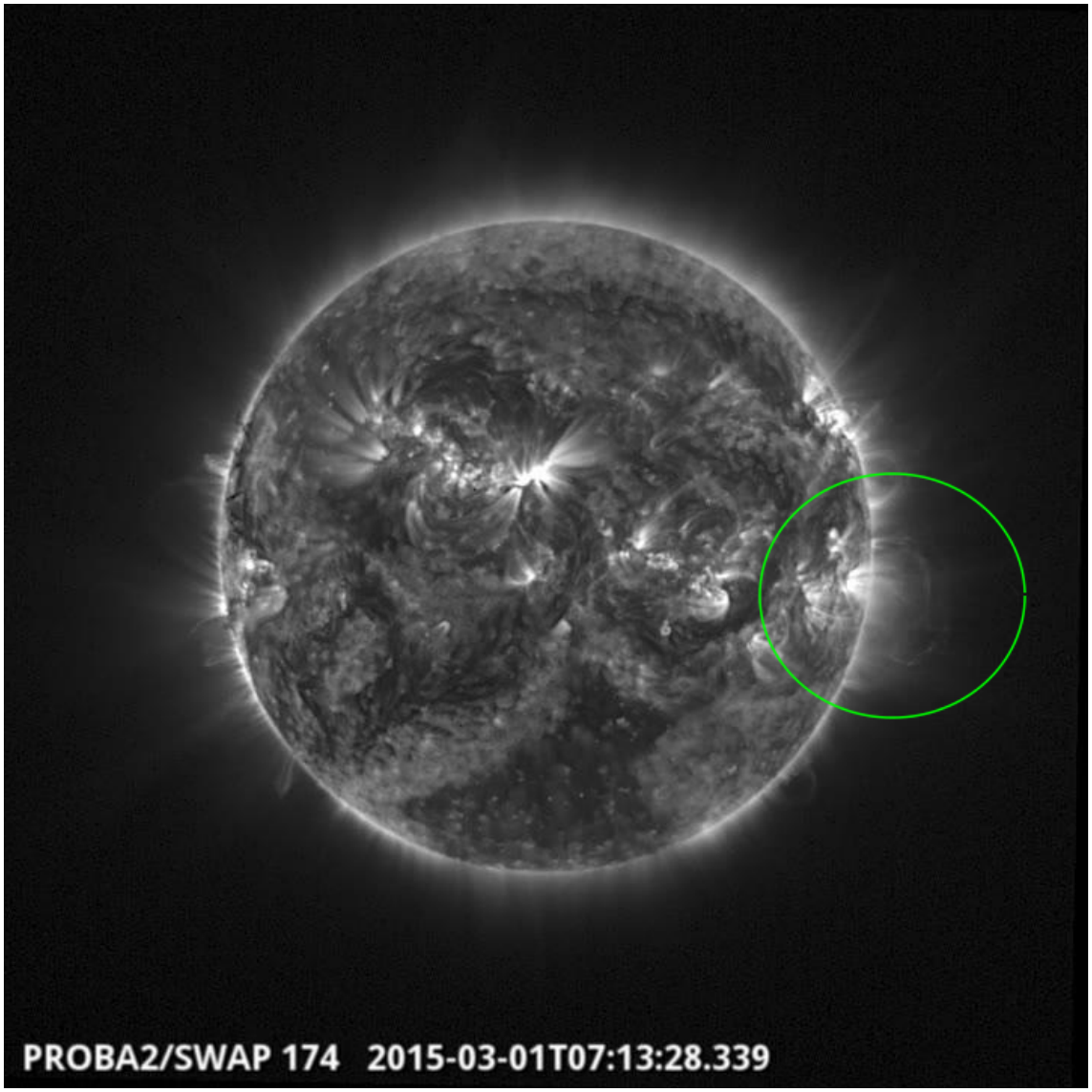
Eruption on south east limb @ 10:34 SWAP image
Find a movie of the event here (SWAP movie)
http://proba2.oma.be/swap/data/mpg/movies/2015/02/20150224_swap_movie.mp4

Friday Feb 27

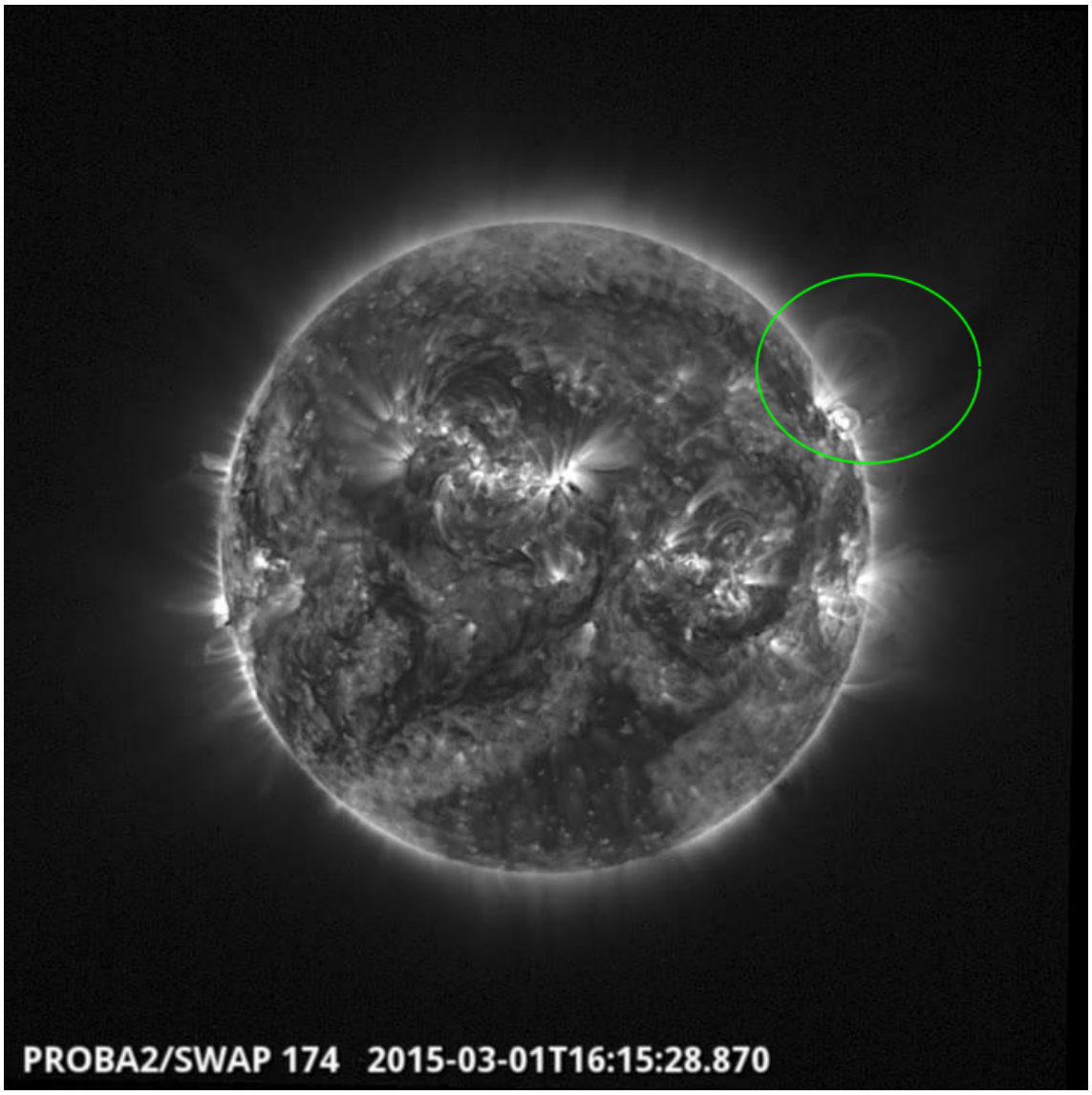


Eruption on the west limb @ 10:25 SWAP image
Find a movie of the event here (SWAP movie)
http://proba2.oma.be/swap/data/mpg/movies/2015/02/20150227_swap_movie.mp4

Sunday Mar 01



Eruption on the west limb @ 13:28 SWAP image
Find a movie of the event here (SWAP movie)
http://proba2.oma.be/swap/data/mpg/movies/20150301_swap_movie.mp4

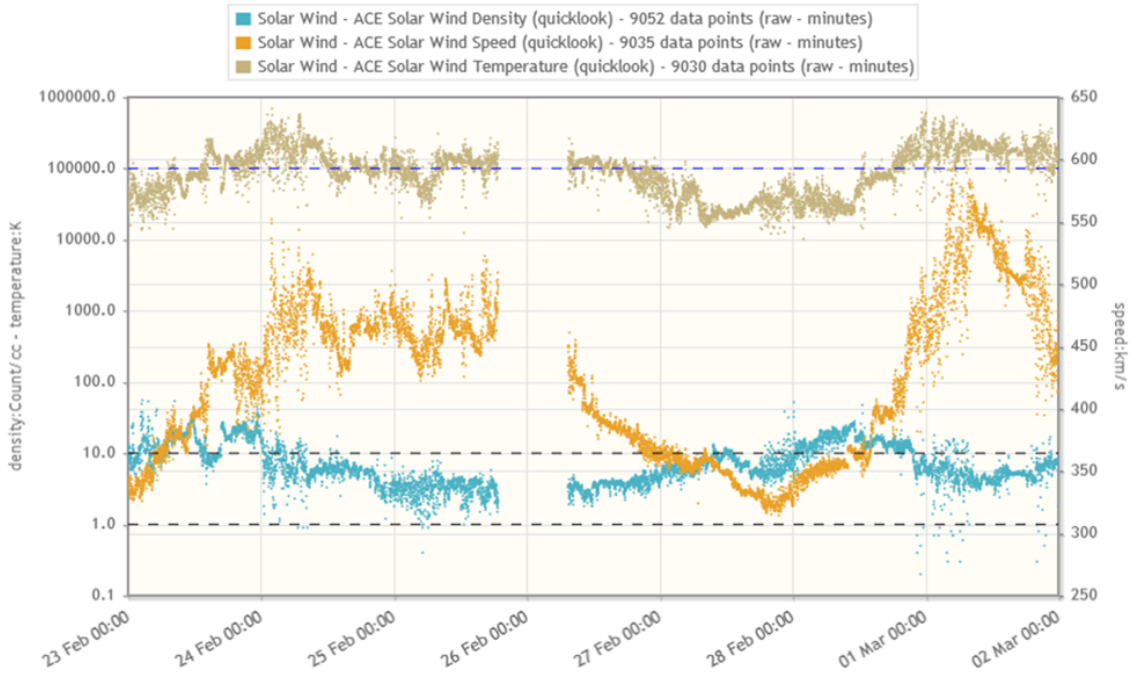


Eruption on the north west limb @ 16:15 SWAP image
Find a movie of the event here (SWAP movie)
http://proba2.oma.be/swap/data/mpg/movies/20150301_swap_movie.mp4

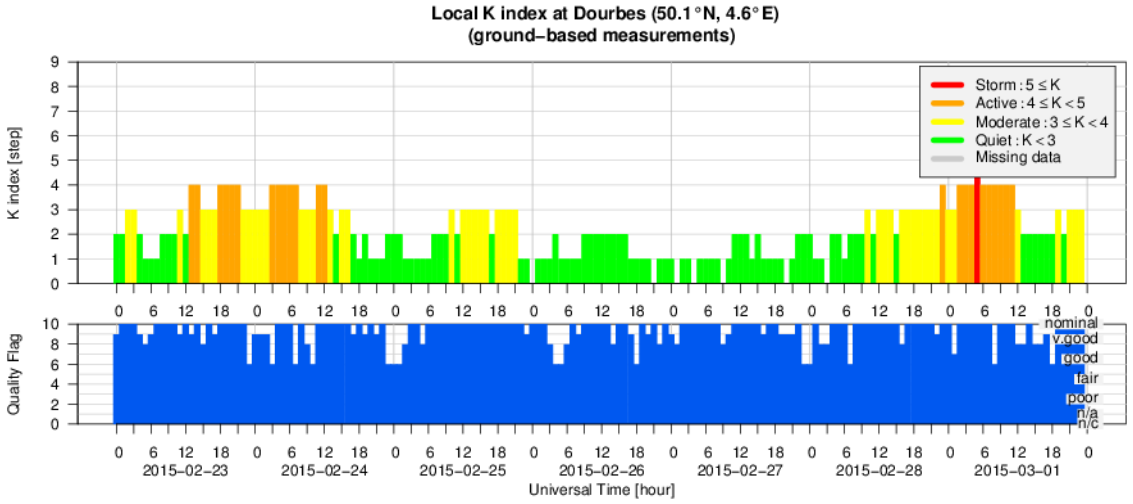
4. Review of geomagnetic activity (23 Feb 2015 - 1 Mar 2015)

There were two fast speed streams affecting the Earth. One started on 23 February and caused active conditions in Dourbes and minor storm conditions globally (Kp) on February 24. The second stream arrived at the Earth on 28 February and caused minor storm conditions at local and planetary levels on 01 March. None of the aforementioned CMEs arrived at Earth.

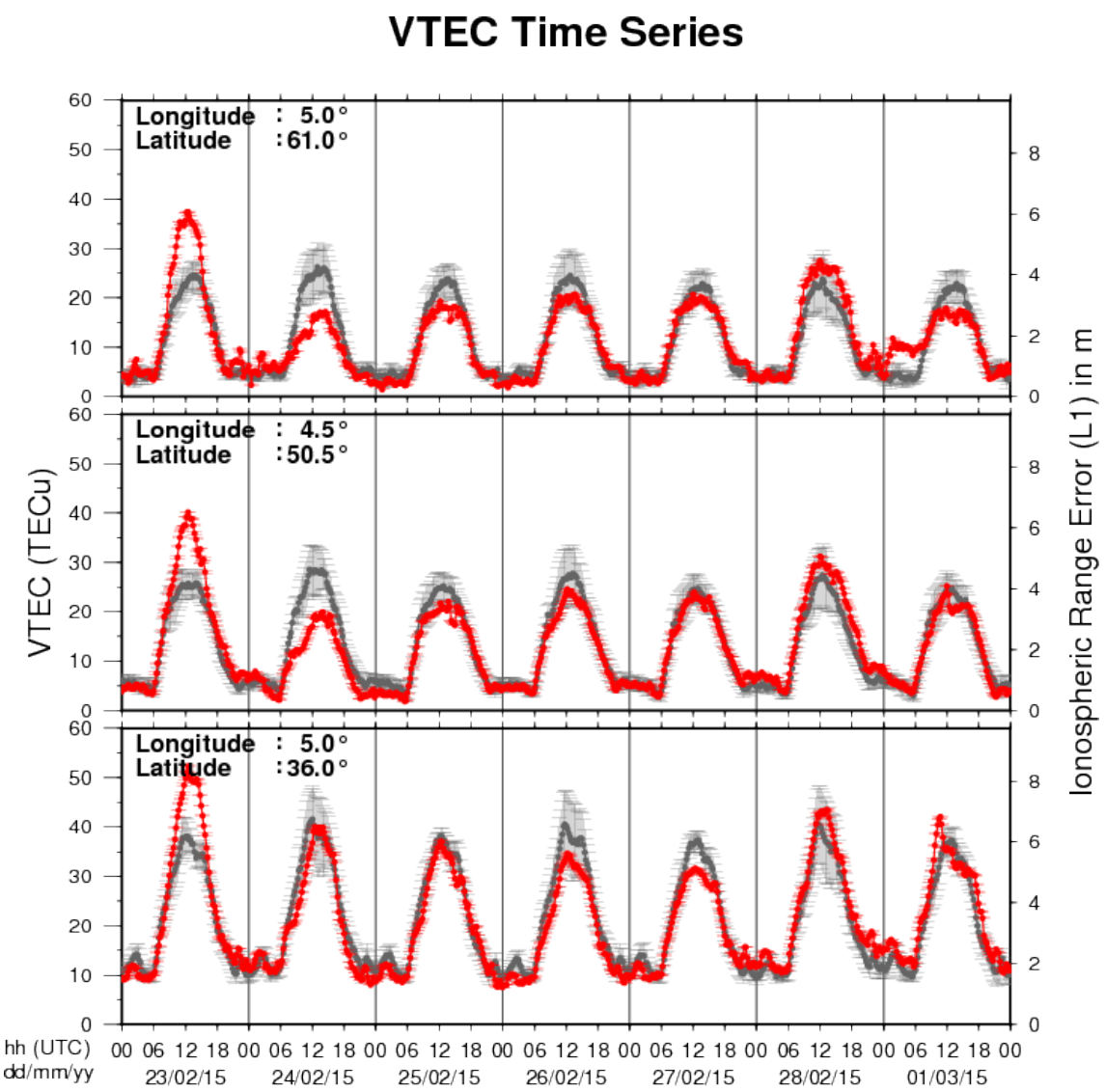
The graphs underneath show the density (blue) of the solar wind, its speed (orange), and temperature (grayish).



5. Geomagnetic Observations at Dourbes (23 Feb 2015 - 1 Mar 2015)



6. Review of ionospheric activity (23 Feb 2015 - 1 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

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/

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/

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/

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

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