

STCE Newsletter

24 Mar 2014 - 30 Mar 2014



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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.

Content	Page
1. Homologous flares	2
2. Relive 2012	5
3. 7th Solar Information Processing Workshop	5
4. Science and Food	6
5. PROBA2 Observations (24 Mar 2014 - 30 Mar 2014)	7
6. Review of solar and geomagnetic activity	12
7. Noticeable Solar Events (24 Mar 2014 - 30 Mar 2014)	14
8. Geomagnetic Observations at Dourbes (24 Mar 2014 - 30 Mar 2014)	15
9. Review of ionospheric activity (24 Mar 2014 - 30 Mar 2014)	15
10. Future Events	16
11. New documents in the European Space Weather Portal Repository	16

Final Editor :

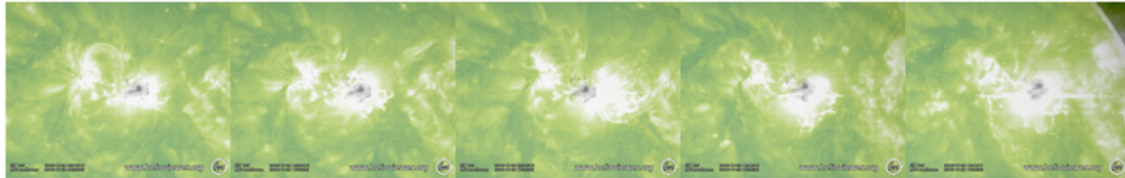
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Petra Vanlommel

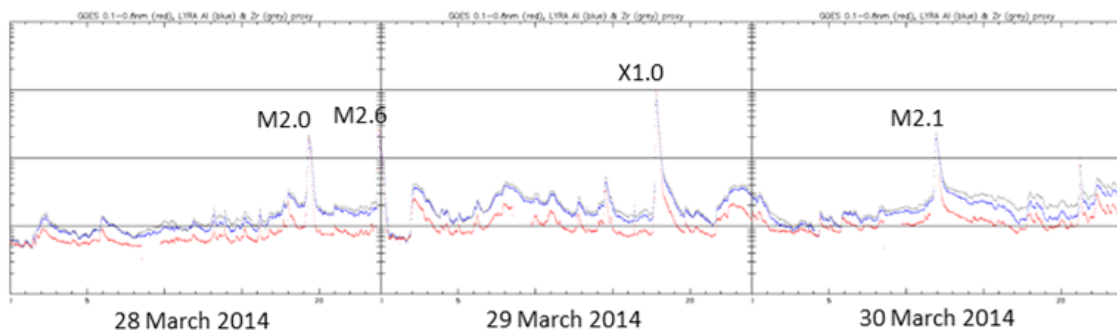
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1. Homologous flares

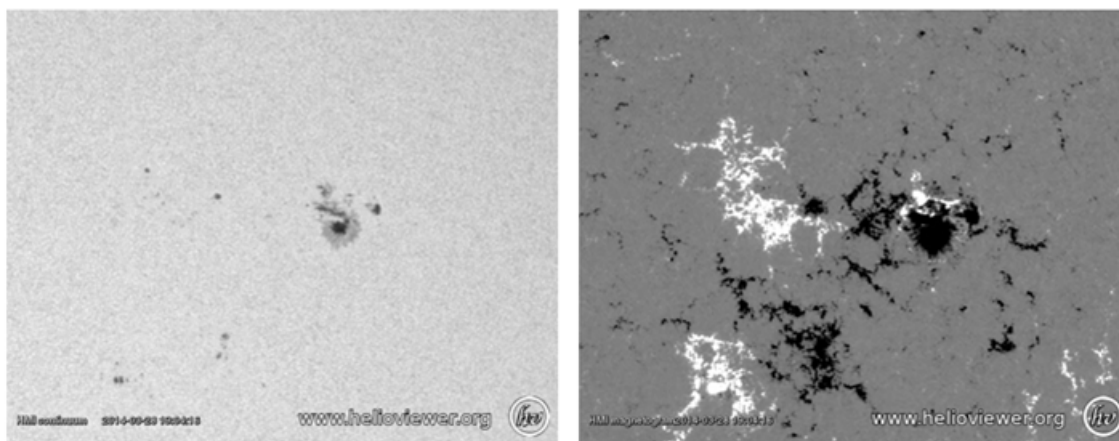
Homologous flares are the solar equivalent of identical twins. They concern a series of solar flares taking place repetitively in the same active region with essentially the same position and with a common pattern of development, i.e. having the same main footpoints and general shape in the main phase as defined in H-alpha or EUV-imagery. Though not a requirement, homologous flares often have similar strength, and if there are more than two, they sometimes occur within similar time intervals.



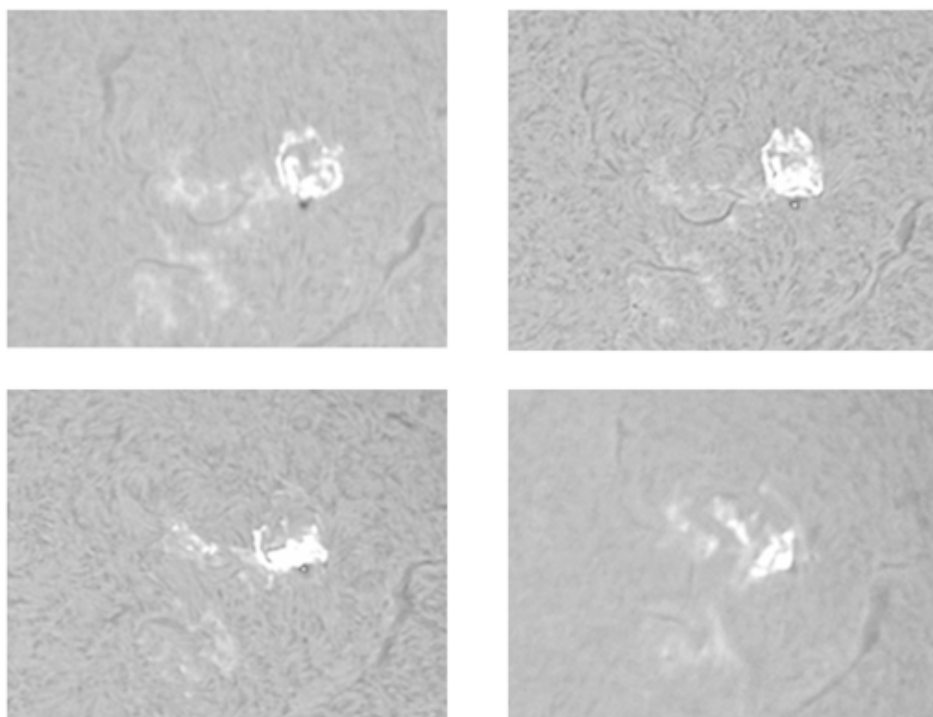
A good example occurred on 24-26 November 2000, when five homologous X-class (!) flares were produced by active region NOAA 9236 southwest of its main leading spot (image above). Note in the middle image, there's a difference of 5 hours between SOHO's EUV image and the continuum on which it is overlaid. The study of this kind of flares is important as it might provide information on flare trigger mechanisms, as well as on the processes of energy storage and release. Hence, these studies may offer vital clues for improving space weather forecasts.



Last week, moderately sized sunspot region NOAA 2017 produced 1 X- and 3 M-class flares within less than 48 hours (see image above). On 28 March, there was an M2.0 flare (peak at 19:18UT) followed a few hours later by an M2.6 flare (peak at 23:51UT). One day later, an X1.0 flare peaked at 17:48UT, and on 30 March there was an M2.1 flare hitting its maximum at 11:55UT. The flares occurred near a delta region to the north and east of the main spot (image underneath). A delta concerns spots of opposite polarity within the same penumbra and within 2.5 degrees from each other (more info at <http://stce.be/news/222/welcome.html>).

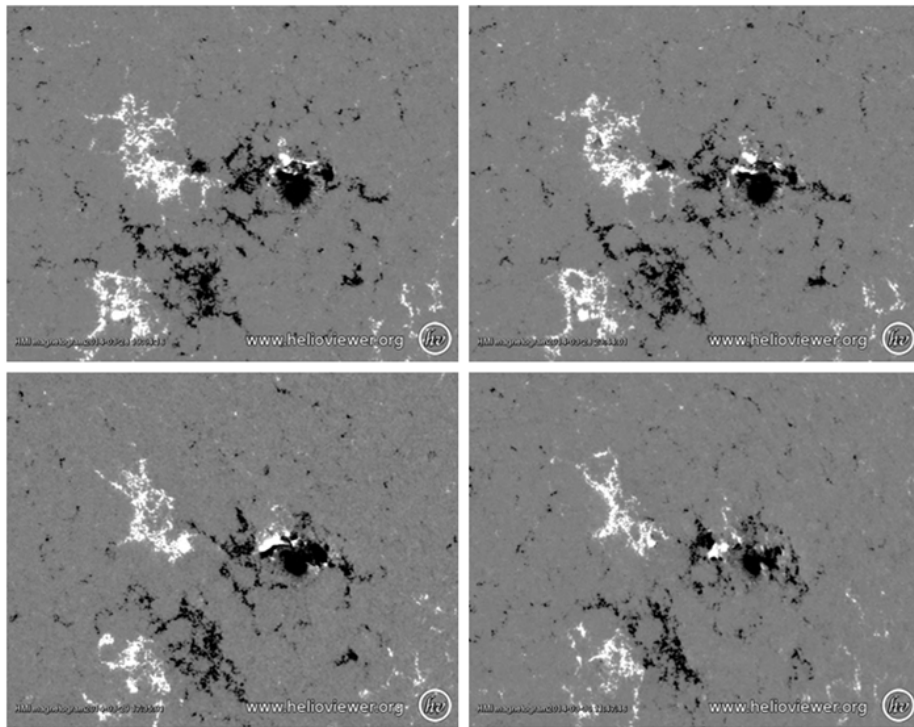


A preliminary analysis of H-alpha (showing the cool inner atmosphere of the Sun) and AIA 171 (showing the Sun's much hotter upper transition region) imagery seems to indicate that the first two flares might indeed be homologous, as they have a very similar (but not identical) outlook and also show a clear surge in H-alpha (image underneath, top). This is not the case with the X1-flare and the third M2-flare (bottom images), having an outlook that is clearly distinct from the first two, with no surge and a different post-flare loops configuration. The X1-flare was also the only event to enhance the proton flux levels, though no threshold was reached.

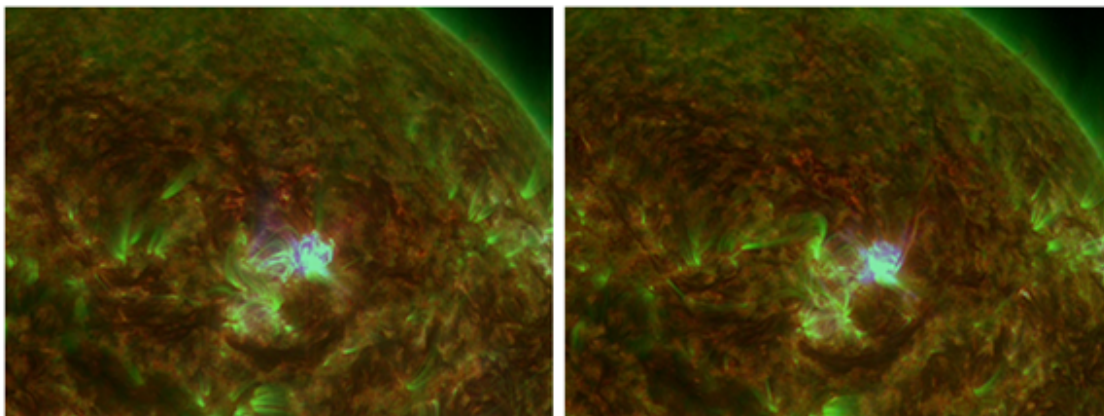


The first two M-class flares are similar, but not completely identical. For example, the surge from the first M2-flare is less pronounced and double. Also, the second M2-flare produced a faint Moreton wave (in H-alpha: a bright arc rapidly moving to the north), just as the much stronger X1-flare. All these differences may be due to changes in the magnetic field of the sunspot region, as can be seen in the mosaic

underneath. Notice the similarity and subtle differences for the first two flares (top images), and the major changes in the delta region for the two other flares (bottom images).



Over the years, the concept of "homology" has been extended to the flare-associated EIT-waves (see <http://stce.be/news/241/welcome.html>), coronal mass ejections (CME), and even radio-bursts. The movie at <http://youtu.be/BQzpkfkGIJ4> first shows the white light and magnetic evolution of the sunspot group NOAA 2017, followed for each of the four events by the activity in H-alpha and EUV (overlaid on white light imagery), and ends by showing the associated EIT-waves and CMEs (difference images, i.e. only changes between two subsequent images are shown).



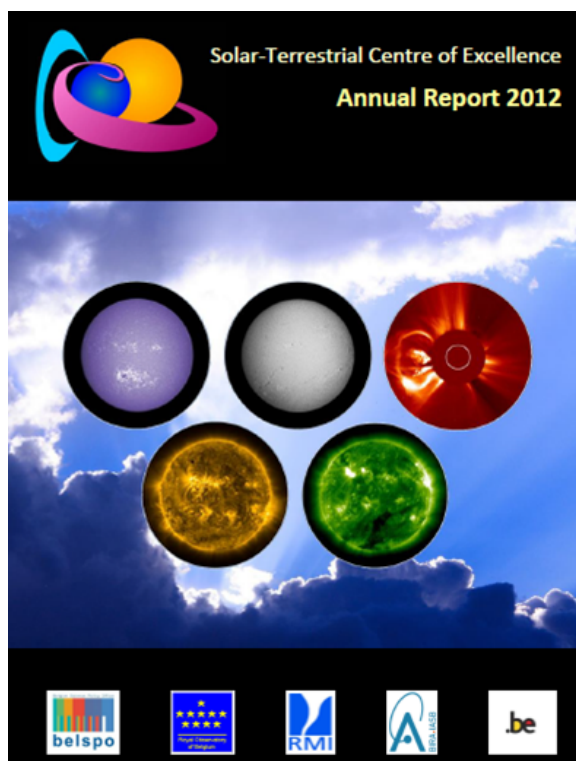
Credits - Imagery and data were taken from SDO (<http://sdo.gsfc.nasa.gov/data/aiahmi/>), GONG H-alpha Network (<http://halpha.nso.edu/>), SOHO (http://sohodata.nascom.nasa.gov/cgi-bin/data_query), PROBA2 (<http://proba2.oma.be/ssa>), and (J)Helioviewer (<http://helioviewer.org/>).

2. Relive 2012

The STCE Annual Report 2012 is now available at <http://stce.be/annualreport.php>

It is a compilation of the activities done in 2012 within the frame of the Solar-Terrestrial Centre of Excellence (STCE). This report continues the style from the previous edition. Hence, as it is targeting a more general public, it presents only a selection of the 2012-activities in easy-to-digest summaries. These summaries emphasize the intense collaboration between the institutes at the Space Pole, as well as with our external partners.

We hope you enjoy this report, which features articles on the evolution of the solar activity, the 9th European Space Weather Week, PROBA2, Integrated Water Vapor observations, SIMBA the nanosatellite, user applications such as STAFF, LIDAR, and ionospheric models, olympic disciplines for scientists and much more... Happy reading!



3. 7th Solar Information Processing Workshop

7th Solar Information Processing Workshop

18-21 August 2014, Floreal Club Hotel, La Roche-en-Ardenne, Belgium

We are pleased to announce that registration and abstract submission are OPEN.

Please go to

<http://www.stce.be/sipworkshop2014/registration.php>

<http://www.stce.be/sipworkshop2014/abstract.php>

Students and early career post-doctoral researchers may apply for financial support at abstract submission.

The SIP workshop bring solar physics, statisticians and data processing expert together to discuss data analysis of solar missions and other joint topics of interest. The STCE welcomes all the participants with a drink and a bite on Sunday 17 August such that your energy level is optimal to start on Monday for the four days meeting with daily morning plenary sessions and afternoon splinters.

Sessions

Power laws in solar physics: observations and proper estimation

Invited Speakers:

Prof. Clare Parnell (U. St Andrews): Power laws in solar physics

Prof. David Van Dyk (Imperial College): Bayesian paradigm for statistical inference of power laws

Optimal combination of in-situ and imaging data

How do we combine the information given by heterogenous data sets such as the one given by Solar Orbiter?

Invited Speakers:

Dr Christian Mostl (University of Graz): Combining HI and in situ observations to constrain CME evolution

Dr Tim Howard (SWRI): Tracking of CMEs and ICMEs through the heliosphere

How well can we predict solar eruptions (flares, CME arrival, SEP arrival) and geomagnetic disturbances?

Invited Speakers:

Dr Graham Barnes (NWRA): Physics behind flare prediction and current methods for flare forecasting

Prof. Pierre Dupont (U. catholique de Louvain): Machine learning in flare forecasting

Tracking of small scale magnetic features and its applications

What is the "best" way to track small scale features on the Sun, and how can we use this information to distinguish between different solar dynamo models?

Invited Speakers:

Dr Thomas Corpetti (U. Rennes) : Recent methods in tracking of small scale features

Origin of variability and prediction of solar wind

How can we predict solar wind conditions at Earth? What other data and analysis techniques do we need to better understand the solar wind?

Invited Speakers:

Prof. William Matthaeus (U. Delaware): Solar wind turbulence and the future missions

Solar Orbiter and Solar Probe Plus Dr Khurom Kiyani (U. Warwick): Analysing techniques in solar wind turbulence

More <http://www.stce.be/sipworkshop2014/> .

The SIP workshop is organised by the Solar-Terrestrial Centre of Excellence.

4. Science and Food

Workshop - Physical processes in solar-terrestrial plasmas

22-23 May 2014, Meridian Room at ROB

The 2014 - international workshop - Physical processes in solar-terrestrial plasmas - is a successor and extended edition of the past STCE workshop series on Alfvén waves and turbulence. In addition to the waves, turbulence, and related effects, this workshop will include magnetic reconnection, plasma heating and acceleration, particles energization, and other physical processes crucial for solar-terrestrial connections. We aim to improve our understanding of basic physical processes driving space weather phenomena.

The final program will be distributed in the next announcement 29 April 1014. Please inform voitenko at oma.be and Andrei.Zhukov at oma.be before this date if you would like to give a presentation.

Info: <http://stce.be/annualmeeting/2014/waves.php>

P.S. Brain calories (i.e. lunch) are foreseen on both days.

5. PROBA2 Observations (24 Mar 2014 - 30 Mar 2014)

Solar Activity

Solar flare activity fluctuated between low and high 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 209).

http://proba2.oma.be/swap/data/mpg/movies/WeeklyReportMovies/WR209_Mar24_Mar30/weekly_movie_2014_03_24.mp4

Details about some of this week's events, can be found further below.

Wednesday Mar 26

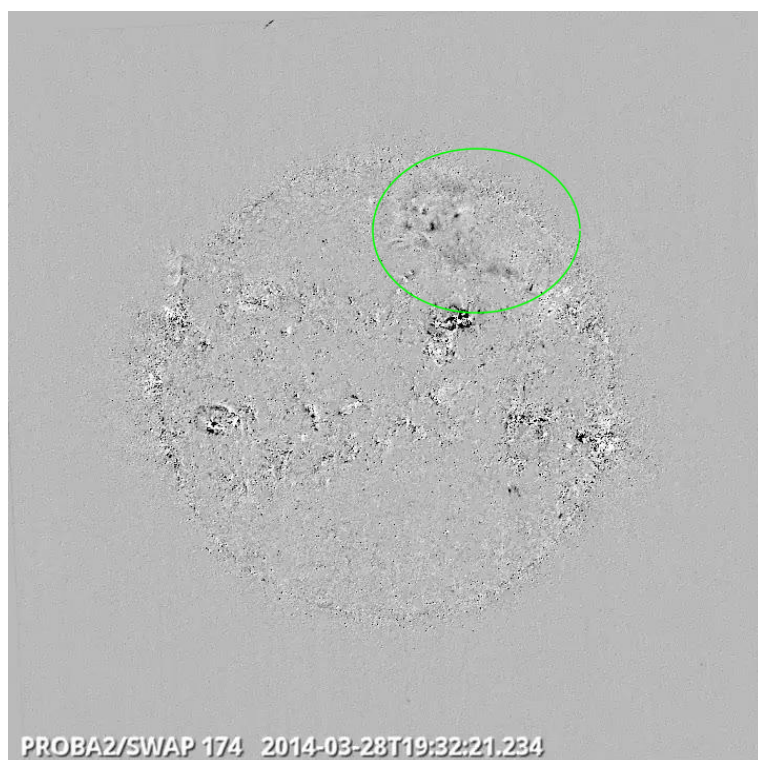


Friday Mar 28

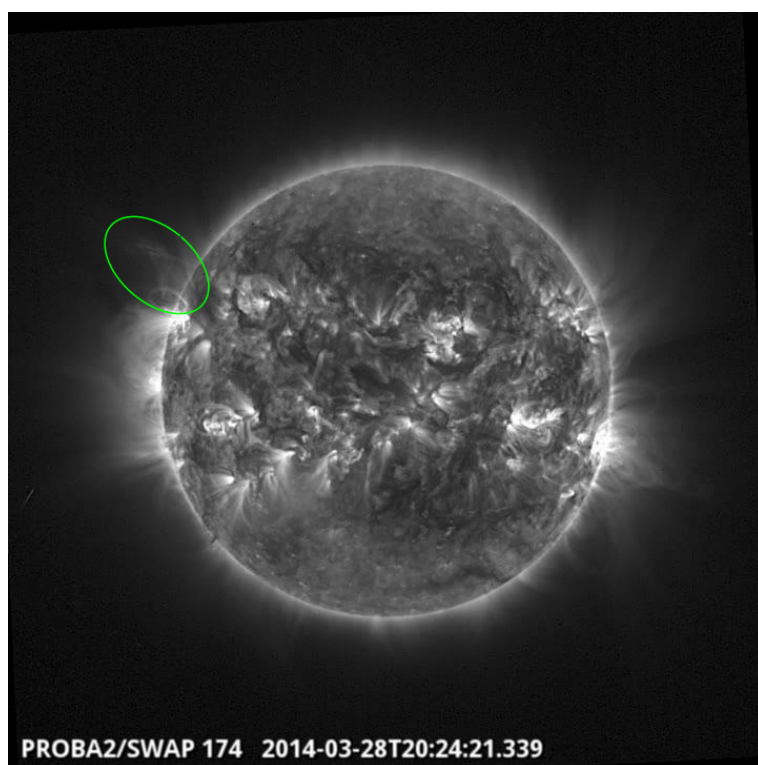
Eruption on the southeast limb @ 05:34 SWAP difference image

Find a movie of the event here (SWAP daily difference movie)

http://proba2.oma.be/swap/data/mpg/movies/20140326_swap_diff.mp4



EIT wave on the northwest quad @ 19:32 SWAP difference image
Find a movie of the event here (SWAP daily difference movie)
http://proba2.oma.be/swap/data/mpg/movies/20140328_swap_diff.mp4

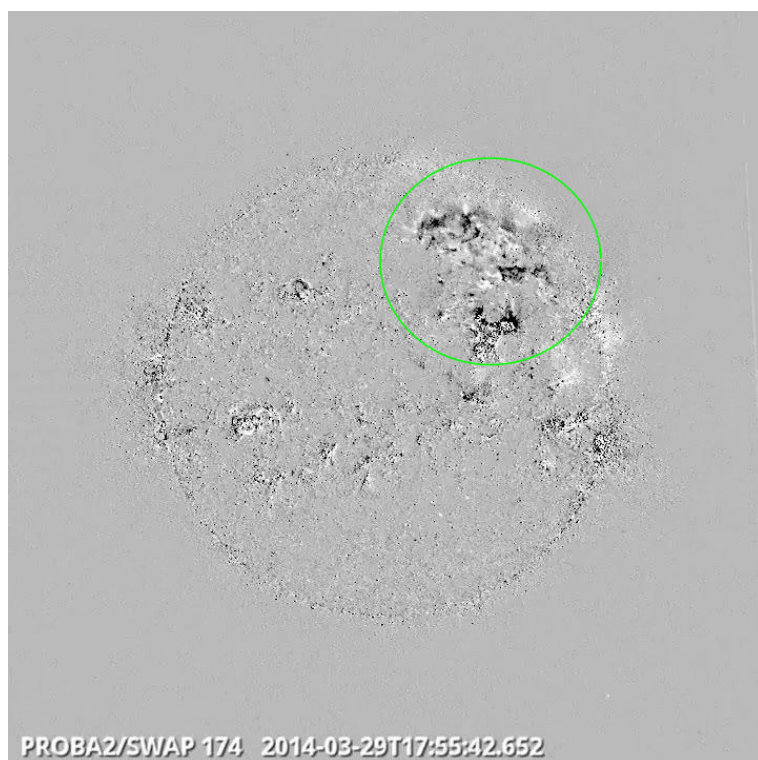


Eruption on the northeast limb @ 20:24 SWAP image
Find a movie of the event here (SWAP daily movie)
http://proba2.oma.be/swap/data/mpg/movies/20140327_swap_movie.mp4

Saturday Mar 29



Eruption on the northeast quad @ 02:06 SWAP difference image
Find a movie of the event here (SWAP daily movie)
http://proba2.oma.be/swap/data/mpg/movies/20140329_swap_movie.mp4
Find a movie of the event here (SWAP daily difference movie)
http://proba2.oma.be/swap/data/mpg/movies/20140329_swap_diff.mp4

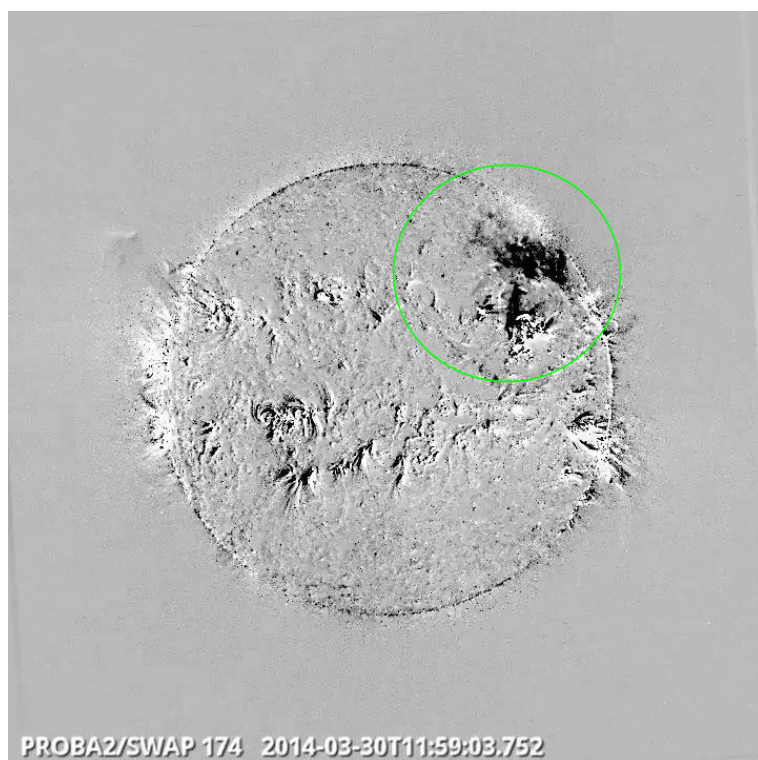


Sunday Mar 30

EIT wave on the northwest quad @ 17:55 SWAP difference image

Find a movie of the event here (SWAP daily difference movie)

http://proba2.oma.be/swap/data/mpg/movies/20140329_swap_diff.mp4



EIT wave on the northwest quad @ 11:59 SWAP difference image
Find a movie of the event here (SWAP daily difference movie)
http://proba2.oma.be/swap/data/mpg/movies/20140330_swap_diff.mp4



Eruption on the northeast limb @ 13:12 SWAP difference image

Find a movie of the event here (SWAP daily movie)

http://proba2.oma.be/swap/data/mpg/movies/20140330_swap_movie.mp4

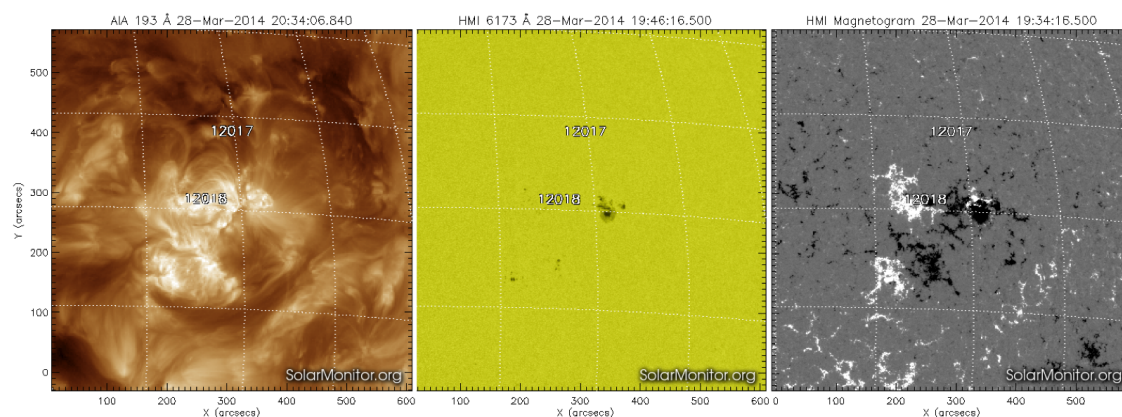
Find a movie of the event here (SWAP daily difference movie)

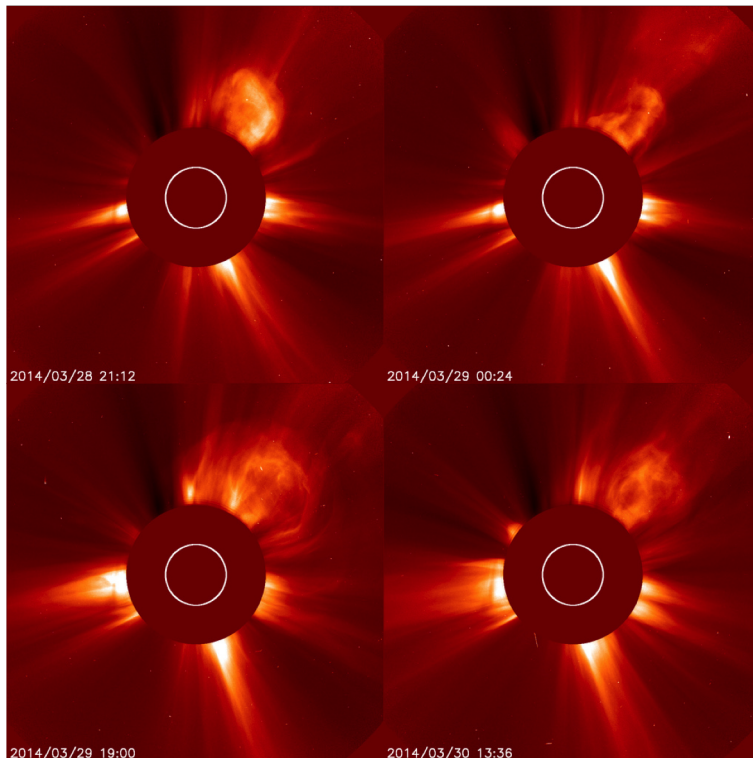
http://proba2.oma.be/swap/data/mpg/movies/20140330_swap_diff.mp4

6. Review of solar and geomagnetic activity

Solar Activity

Solar activity was driven by C-class flares from NOAA ARs 2010, 2014 and 2015, from March 24 until March 28. On March 28, NOAA AR 12017 produced an M2.0 flare with peak at 19:18 UT and an M2.6 flare peaking at 23:51 UT. They were associated with two front-sided halo CMEs. The first one with a speed of around 400 km/s (first seen by LASCO-C2 at 20:00 UT) and the second one around 550 km/s (at 23:58 UT). A back-sided full halo CME was seen by LASCO-C2 shortly before, at 16:56 UT. NOAA AR 12018 (beta gamma delta magnetic field configuration) released then an X1.0 flare with peak at 17:48 UT on March 29, associated with radio bursts, a full halo CME and an increase in GOES proton fluxes (not passing the threshold). This full halo CME was first seen at 18:12 UT by LASCO-C2 and had a speed around 500 km/s. On March 30, NOAA AR 12017 released an M2.1 peaking at 11:55 UT. It was associated with a partial halo CME, first visible in the LASCO-C2 field of view at 12:24 UT. The CME had an angular width of about 170 degrees and a speed of around 500 km/s (as determined by the CACTUS software).





In the SDO/AIA 193 movie, 4 EUV-waves centralised around NOAA AR 2017 are visible at the time of the M- and X-flares. An EUV wave is an on disk indication of the ejection of coronal plasma. The difference movies are made from images taken by LASCO/C2 onboard of SOHO.

Check the movies:

http://www.stce.be/movies/20140328_aia_193.mp4

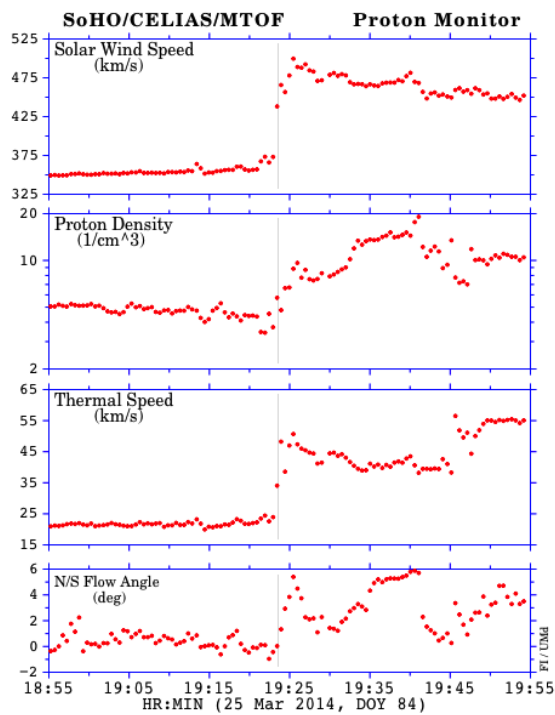
http://www.stce.be/movies/20140328_dc2.mpg

http://www.stce.be/movies/20140329_dc2.mpg

http://www.stce.be/movies/20140330_dc2.mpg

Geomagnetic Activity

Geomagnetic conditions were quiet until the arrival of a shock corresponding to a CME from March 23 - see the SoHO/CELIAS/MTOF graph. This occurred on March 25 at 19:25 UT, and geomagnetic conditions reached active levels. Quiet to unsettled conditions were experienced for the rest of the week.



7. Noticeable Solar Events (24 Mar 2014 - 30 Mar 2014)

DAY	BEGIN	MAX	END	LOC	XRAY	OP	10CM	TYPE	Cat	NOAA
28	1904	1918	1927	N11W21	M2.0	SN		V/2II/2	98	2017
28	2344	2351	2358		M2.6			II/2	98	2017
29	1735	1748	1754	N11W32	X1.0	2B	360	III/3II/3	98	2017
30	1148	1155	1202	N8W43	M2.1	1N	120	III/2II/2	98	2017

LOC: approximate heliographic location

XRAY: X-ray flare class

OP: optical flare class

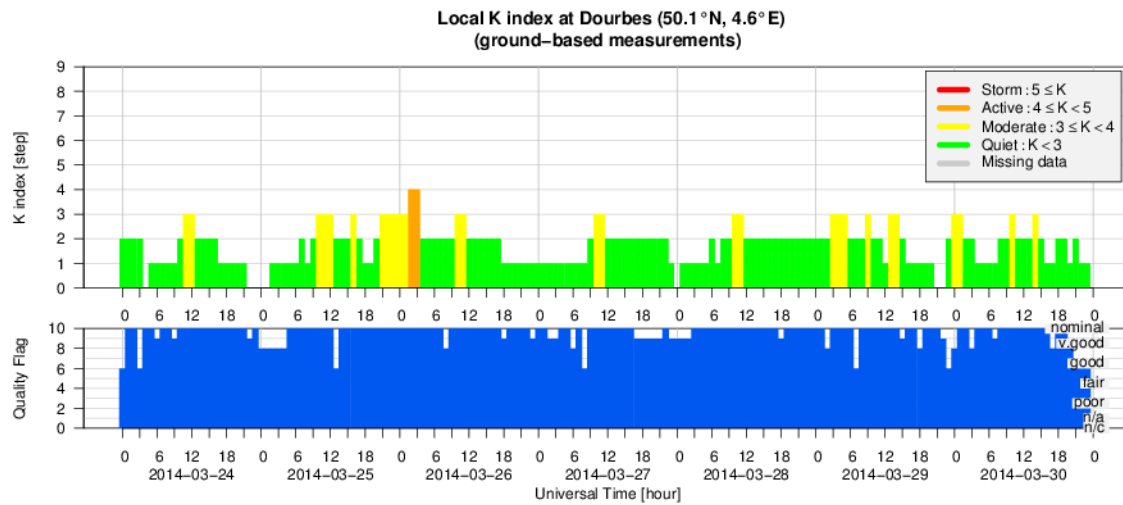
10CM: peak 10 cm radio flux

TYPE: radio burst type

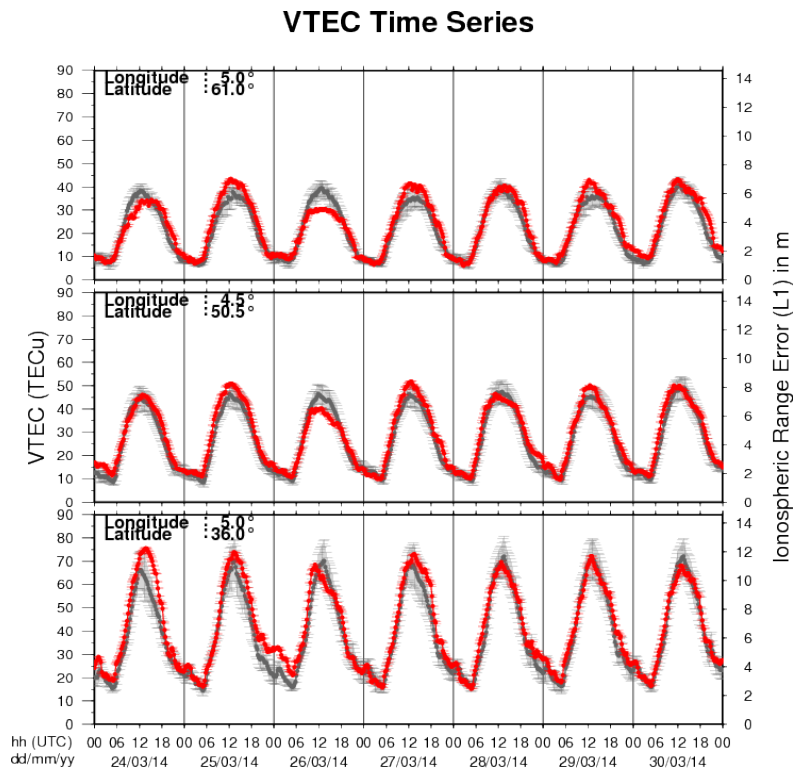
Cat: Catania sunspot group number

NOAA: NOAA active region number

8. Geomagnetic Observations at Dourbes (24 Mar 2014 - 30 Mar 2014)



9. Review of ionospheric activity (24 Mar 2014 - 30 Mar 2014)



The figure shows the time evolution of the Vertical Total Electron Content (VTEC) (in red) during the last week at three locations:

- in the northern part of Europe (N61°, 5°E)
- above Brussels (N50.5°, 4.5°E)
- in the southern part of Europe (N36°, 5°E)

This figure also shows (in grey) the normal ionospheric behaviour expected based on the median VTEC from the 15 previous days.

The VTEC is expressed in TECu (with $\text{TECu} = 10^{16}$ electrons per square meter) and is directly related to the signal propagation delay due to the ionosphere (in figure: delay on GPS L1 frequency). The Sun's radiation ionizes the Earth's upper atmosphere, the ionosphere, located from about 60km to 1000km above the Earth's surface. The ionization process in the ionosphere produces ions and free electrons. These electrons perturb the propagation of the GNSS (Global Navigation Satellite System) signals by inducing a so-called ionospheric delay.

See http://stce.be/newsletter/GNSS_final.pdf for some more explanations ; for detailed information, see http://gnss.be/ionosphere_tutorial.php

10. Future Events

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

EGU General Assembly in Vienna, Austria

Start : 2014-04-27 - End : 2014-05-02

The EGU General Assembly 2014 will bring together geoscientists from all over the world to one meeting covering all disciplines of the Earth, planetary and space sciences. The EGU aims to provide a forum where scientists, especially early career researchers, can present their work and discuss their ideas with experts in all fields of geosciences.

STCE workshop on degradation and inter-calibration of instruments observing in the SXR-EUV range in Brussels, Belgium

Start : 2014-06-10 - End : 2014-06-11

The STCE workshop 'Inter-Calibration and Degradation of EUV Instruments' aims at understanding the differences observed between the various instruments observing in the SXR-EUV range and at analyzing the ageing effects that affect their results. It targets imagers as well as spectrometers and photometers. The workshop will be followed by two days of working sessions (June 12-13) organized by the Solar EUV Irradiance Working Group (also supported by the STCE). These working sessions are in the continuity of similar events organized in 2011, 2012 and 2013, but they are open to new participants and you are welcome to join if you are interested.

Website:

<http://www.stce.be/euvworkshop2014/>

3rd SWARM science meeting in Copenhagen, Denmark

Start : 2014-06-19 - End : 2014-06-20

During the summer of 2014 DTU Space will host the 3rd Swarm Science Meeting, sponsored by the European Space Agency, ESA . This meeting will take place at the IDA Conference Centre in Copenhagen on June 19th to 20th 2014 and is open to the science community at large.

Website:

<http://congrexprojects.com/2014-events/Swarm/home>

11. New documents in the European Space Weather Portal Repository

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

eHEROES -Investigating a possible connection between the evolution of flare loop systems and the kinematics of an associated CME

<http://www.spaceweather.eu/en/repository/show?id=491>

eHEROES - CME tracking from STEREO image data de-projected by different methods

<http://www.spaceweather.eu/en/repository/show?id=492>

eHEROES - Comparing tools for heliospheric CME propagation: ENLIL versus DBM

<http://www.spaceweather.eu/en/repository/show?id=493>

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<http://www.spaceweather.eu/en/repository/show?id=494>