

STCE Newsletter

3 Mar 2014 - 9 Mar 2014



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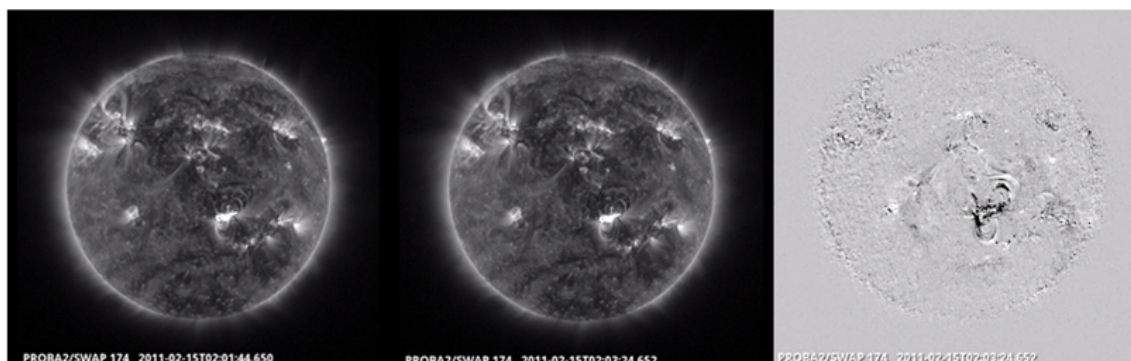
The Solar-Terrestrial Centre of Excellence (STCE) is a collaborative network of the Belgian Institute for Space Aeronomy, the Royal Observatory of Belgium and the Royal Meteorological Institute of Belgium.

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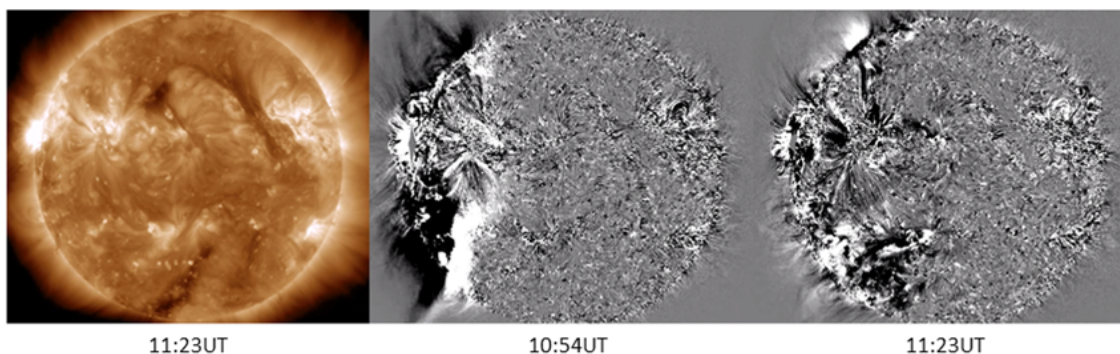
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1. The big wave!... (3 Mar 2014 - 9 Mar 2014)

EIT-waves are named after the Extreme-ultraviolet Imaging Telescope (EIT) onboard SOHO, with which this phenomenon was discovered in 1996-1997. They are large-scale bright fronts observed in extreme ultraviolet (EUV) and propagating over a significant portion of the solar surface. An example is given underneath, from the 15 February 2011 event (X2-flare in the active region NOAA 1158). As these fronts are not so easily visible, scientists often use difference images, i.e. the difference between two subsequent images is shown. The image to the right shows the difference between the two PROBA2/SWAP images to the left.



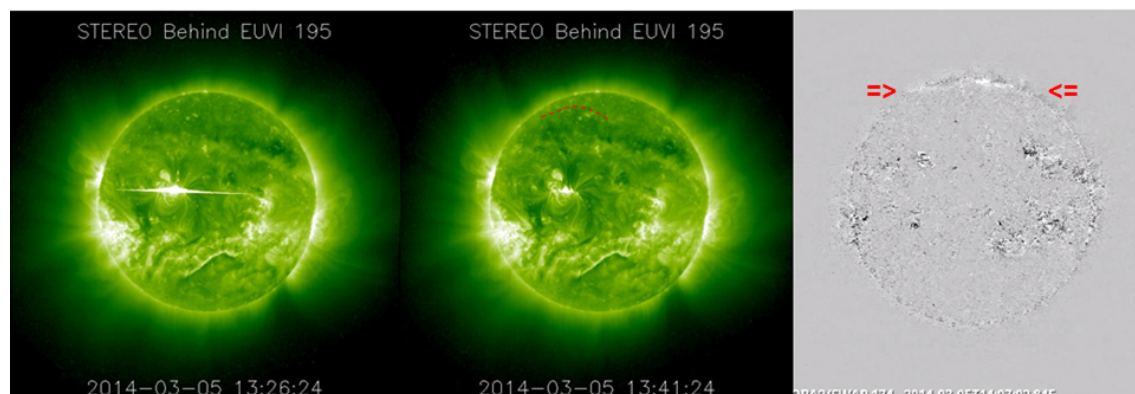
17 years later, the true nature of these waves remains under debate, though there is a gradual convergence towards it being primarily a fast magnetosonic wave (directly related to the presence of a coronal mass ejection, CME, rather than a flare), but often also with a contribution from the CME expansion (see Note 1). Other typical characteristics are its relatively low average speed of 200-600km/s, and that these fronts can be stopped at the boundary of coronal holes or near active regions. An example is given underneath, with the EIT-wave propagating from an X1.4 flare (22 September 2011, NOAA 1302) at the east limb, part of which was stopped by a coronal hole in the southern solar hemisphere.



Last week on 5 March around 14:00UT, scientists of the PROBA2 Science Centre noticed something strange near the Sun's north pole. There was some brightening wave quickly fading as it was progressing further onto the solar disk, as a sea wave extinguishing when it reaches a beach. As there were no notable events on the solar disk facing Earth, this wave must have come from the Sun's backside. EUV imagery from STEREO-B quickly revealed that a strong eruptive flare had taken place at around 13:26UT, and that a bright front had been propagating away from the eruption site and to the north pole, where it arrived just over 30 minutes later.

The estimated average speed corresponds to about 500 km/s. No obvious front signature was found towards the south, as a number of active regions and filaments prevented its propagation. This may also

explain the outlook of the associated (backside) halo CME, which was clearly more pronounced towards the north than to the south.



A movie with clips from the three events discussed above can be found at http://youtu.be/O5Lr8-ZgC_c
More movies on EIT-waves as observed by SDO/AIA can be found at http://aia.lmsal.com/AIA_Waves/index.html

Note 1 - A fast magnetosonic wave is a longitudinal wave of charged particles in a magnetized plasma propagating in all directions, including perpendicularly and parallel to the magnetic field. See image underneath (Source: Wikipedia: http://en.wikipedia.org/wiki/Longitudinal_wave).



Credits - Data and imagery were taken from PROBA2/SWAP (<http://proba2.oma.be/ssa>), SDO (<http://sdo.gsfc.nasa.gov/data/>), STEREO (<http://stereo.gsfc.nasa.gov/>), and SOHO (<http://sohowww.nascom.nasa.gov/>).

2. Science and Food

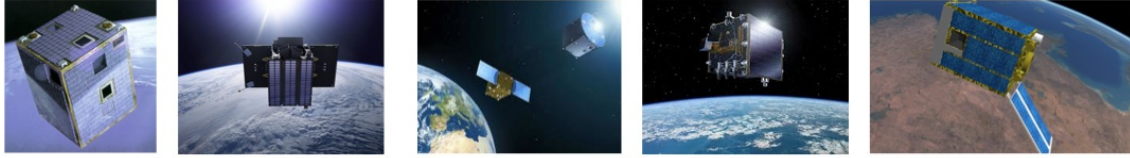
We have two moments of Science and Food in the near future.

Cruising through space

The workshop 'Science and science operations of the PROBA2 satellite fleet' will take place on March 31, 2014 and will give an expert insight in the micro satellite serie, with PROBA, PROBA-V and PROBA-2 already up and running and PROBA-3 in the preparatory phase. All are a state of the art, but PROBA-3 is really a special case: two separate satellites will fly in formation. One of the satellites will be the occulter to make coronagraphic images. This will be literally rocket science.

More : <http://www.stce.be/annualmeeting/2014/PROBA.php>

Special effects in space imagery



PROBA

PROBA-2

PROBA-3

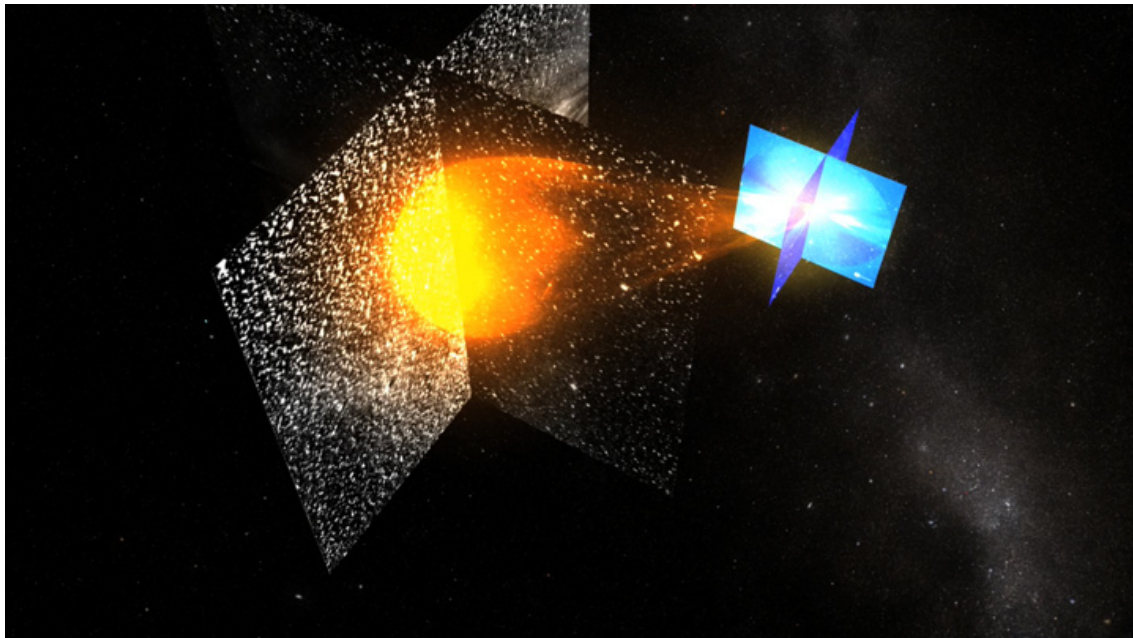
PROBA-V

PROBA-Next

Not only in movies, 3D effects are used. Plasma clouds and shock waves are being reconstructed in their full glory helping forecasters to get a more complete insight how of the structure clashes with the earth magnetosphere. It makes a difference if the collision is frontal or only from aside. The workshop not only focuses on CME's and shock waves, but tackles multi-dimensional imaging in general. 3D glasses are not necessary to participate in this workshop 'Tomography and 3D reconstruction in space science' on April 7, 2014.

More : <http://www.stce.be/annualmeeting/2014/tomography.php>

What about food?



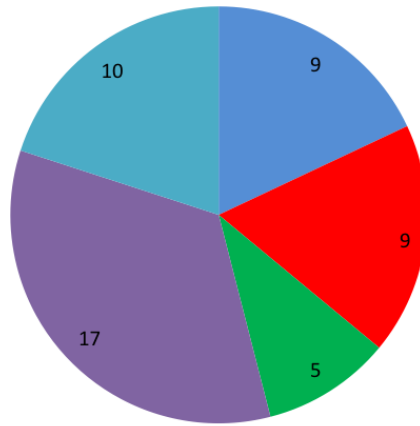
Lunch will be served during the workshops.

3. Review of solar activity (3 Mar 2014 - 9 Mar 2014)

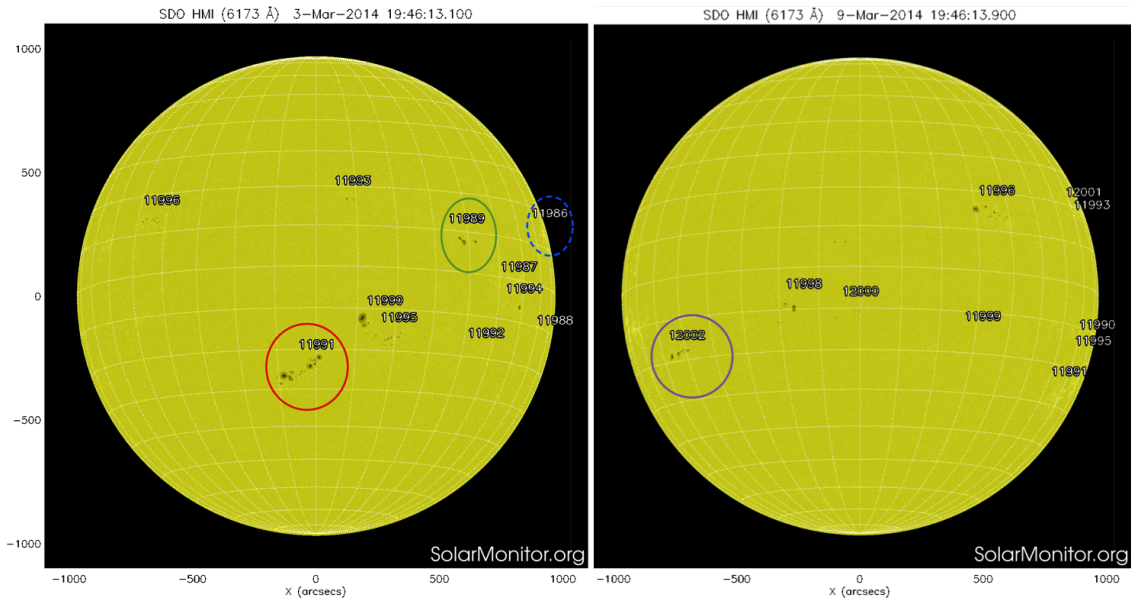
Solar activity varied between eruptive and active levels this week. Two impulsive M1-flares were observed from active regions NOAA 1989 and 1991 on resp. 3 March (15:58UT) and 5 March (02:10UT). For the next two days, only C-class flares were observed. GOES picked up C-flaring activity of NOAA 1986 from the far-side from the Sun. Then on 8 March, small but compact active region NOAA 2002 rounded the southeast limb. It produced numerous C-class flares, as well as three M1-flares: one late on 8 March (23:41UT), and two on 9 March (13:58UT and 20:28UT).

A quantitative overview of the number of C/M flares produced this week is in given in the chart below. The corresponding NOAA active regions are shown in SDO/HMI continuum pictures.

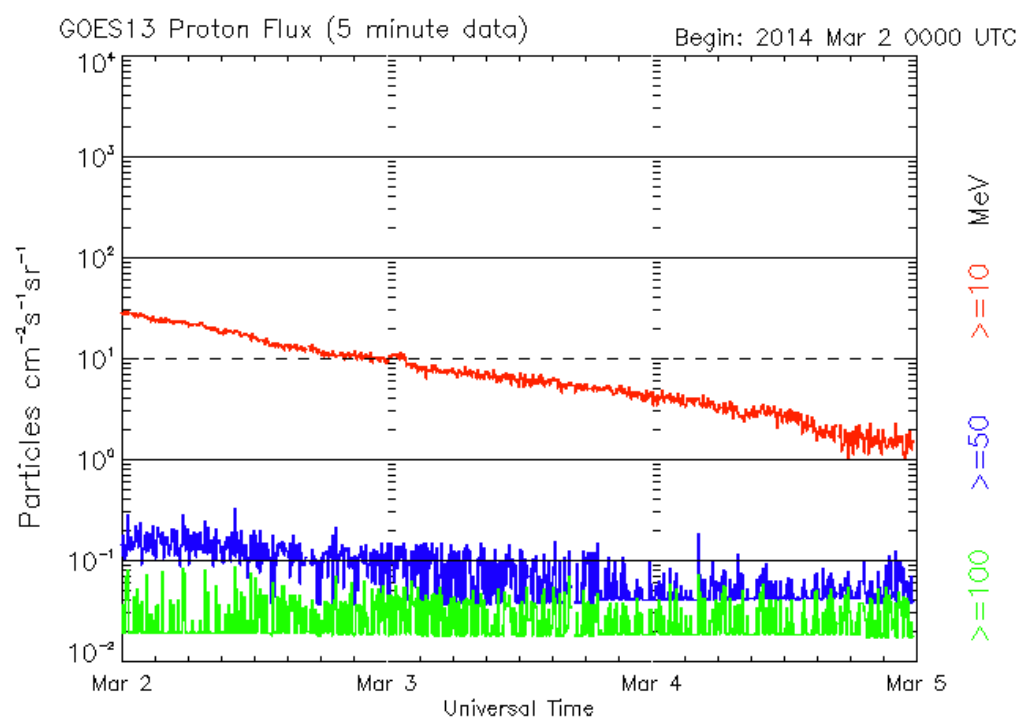
C/M flares, Mar 3-9, 2014



■ NOAA 1986 ■ NOAA 1991 ■ NOAA 1989 ■ NOAA 2002 ■ Other



None of these events was associated to an Earth-directed CME. The observed (partial) halo CMEs on 4, 5 and 9 March were all backside events. The moderate proton event from last week's X4-flare (25 February) ended on 3 March at 01:50UT as can be seen in the GOES Proton Flux graph below.



Updated 2014 Mar 4 23:56:03 UTC

NOAA/SWPC Boulder, CO USA

4. Noticeable Solar Events (3 Mar 2014 - 9 Mar 2014)

DAY	BEGIN	MAX	END	LOC	XRAY	OP	10CM	TYPE	Cat	NOAA
03	1554	1558	1601	N5W36	M1.2	SN	89		50	1989
05	0206	0210	0212		M1.0			III/3	58	1991
08	2326	2341	2350		M1.4					2002
09	1352	1358	1405	S17E58	M1.0	SN				2002
09	2013	2028	2035	S19E54	M1.0	SF				2002

LOC: approximate heliographic location

TYPE: radio burst type

XRAY: X-ray flare class

Cat: Catania sunspot group number

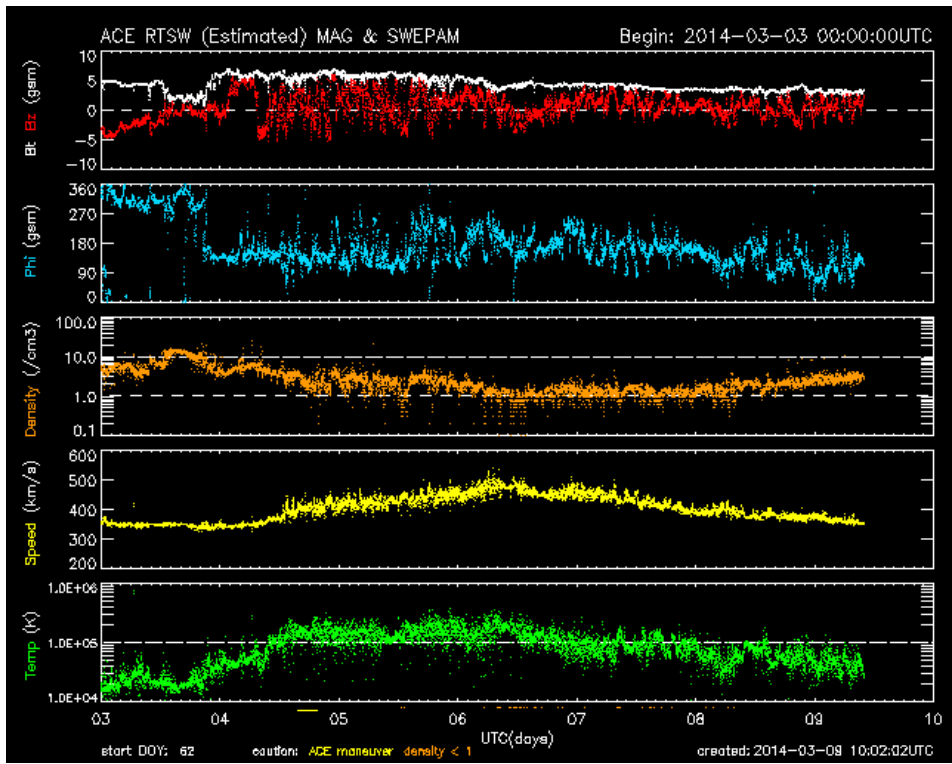
OP: optical flare class

NOAA: NOAA active region number

10CM: peak 10 cm radio flux

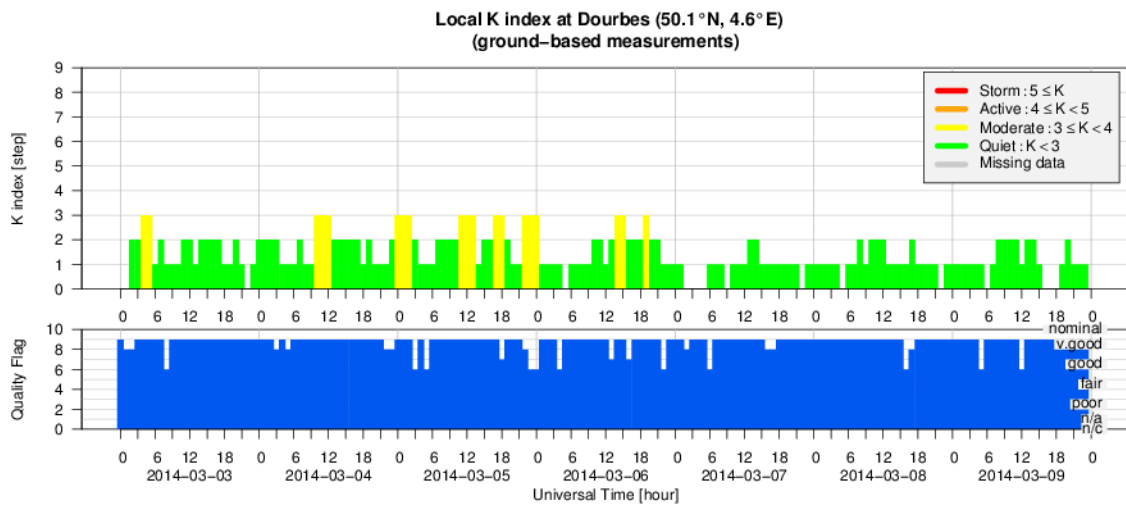
5. Review of geomagnetic activity (3 Mar 2014 - 9 Mar 2014)

On 3 March, solar wind speed was around 350 km/s. From 4 March onwards, it gradually increased to values near 500 km/s early on 6 March after which a steady decline set in. Values of 300 km/s were reached by the end of the period.



The source of this moderate-speed, high-temperature, low-density stream was possibly a coronal hole (CH) that passed the central meridian (CM) on 26-27 February. B_z fluctuated between -5nT and $+5\text{nT}$. Geomagnetic conditions remained quiet throughout the period, with locally some $K=3$ episodes from 3-6 March.

6. Geomagnetic Observations at Dourbes (3 Mar 2014 - 9 Mar 2014)



7. PROBA2 Observations (3 Mar 2014 - 9 Mar 2014)

Solar activity was moderate at the beginning and the end of the week, with an intermediate period of low activity. 5 lower level M-flares were observed, the strongest was an M3.0 level flare.

In order to view the activity of this week in more detail, we suggest to go to the following website from which all the daily (normal and difference) movies can be accessed: <http://proba2.oma.be/ssa>

This page also lists the recorded flaring events.

A weekly overview movie can be found here: http://proba2.oma.be/swap/data/mpg/movies/WeeklyReportMovies/WR206_Mar03_Mar09/weekly_movie_2014_03_03.mp4 (SWAP week 206).

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

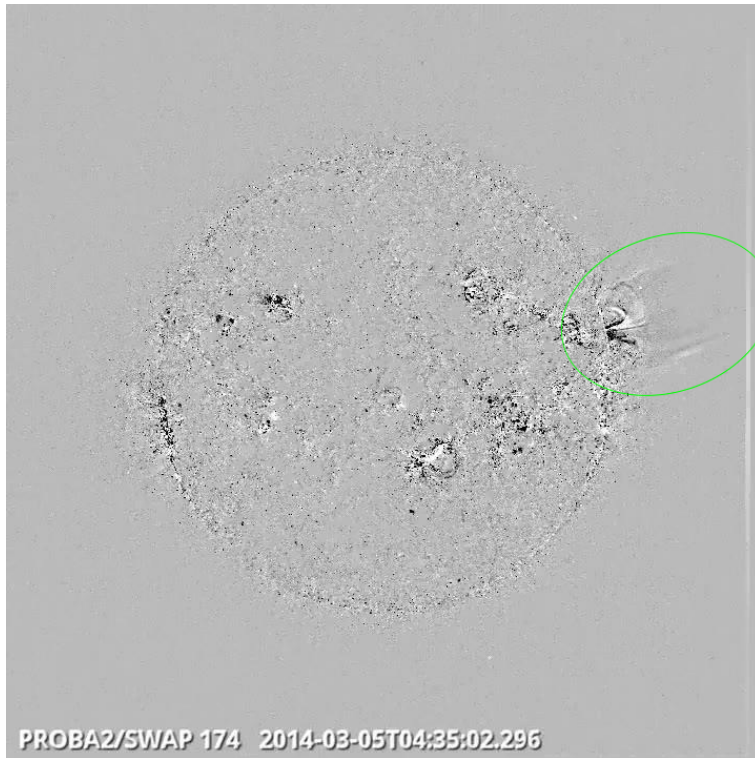
Tuesday Mar 04



Double Prominence Eruption, North West and South Limb @ 21:26 - SWAP difference image

Find a movie of the event here: http://proba2.oma.be/swap/data/mpg/movies/WeeklyReportMovies/WR206_Mar03_Mar09/Events/20140304_DoubleProminenceEruption2126_SWAPdiff_annotated.mp4 (SWAP difference movie)

Wednesday Mar 05



Eruption on the NorthWest Limb @ 04:35 - SWAP difference image



Eruption on the NorthWest Limb @ 06:49 - SWAP difference image

Both eruptions can be seen in this movie here: http://proba2.oma.be/swap/data/mpg/movies/WeeklyReportMovies/WR206_Mar03_Mar09/Events/20140305_Eruption_NWLimb_0649_SWAPdiff_annotated.mp4 (SWAP difference movie)



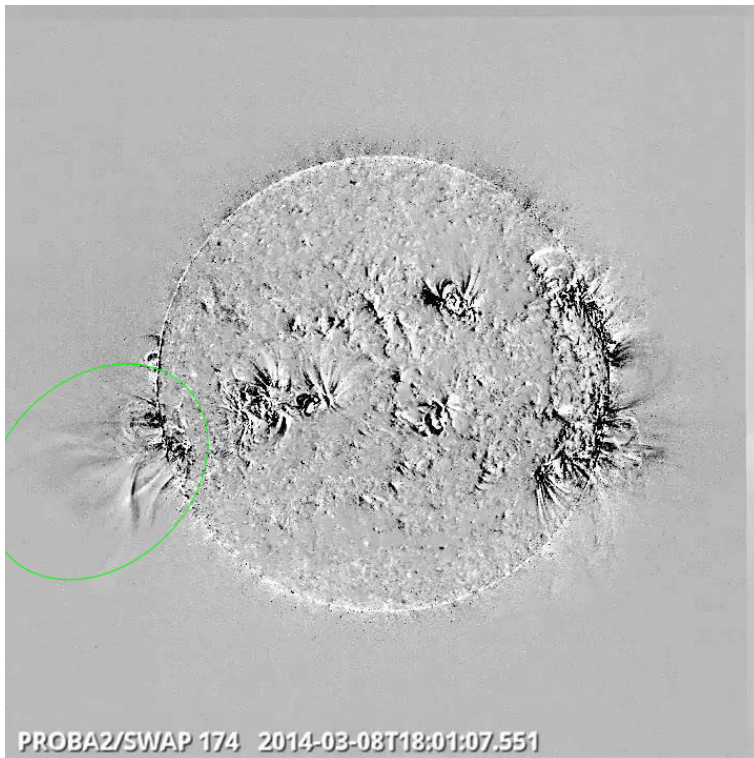
A wave appearing from behind the North limb, following a backside Northern eruption @ 14:15 - SWAP difference image

Find a movie of the event here: http://proba2.oma.be/swap/data/mpg/movies/WeeklyReportMovies/WR206_Mar03_Mar09/Events/20140305_NorthWave_NWLimb_1415_SWAPdiff_annotated.mp4(SWAP difference movie)

Thursday Mar 06



Flare Eruption on the East limb @ 09:45 - SWAP difference image
Saturday Mar 08



Eruption on the SouthEast Limb @ 18:01 - SWAP difference image

Find a movie of the event here: http://proba2.oma.be/swap/data/mpg/movies/WeeklyReportMovies/WR206_Mar03_Mar09/Events/20140308_SouthEastLimb_1801_SWAPdiff.mp4 (SWAP difference movie)

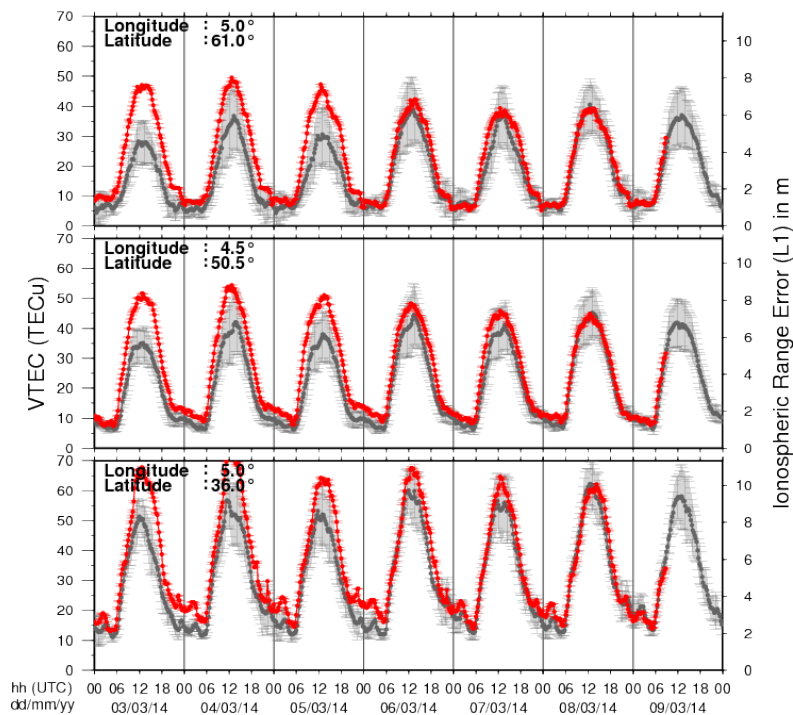
Sunday Mar 09



Prominence Eruption on the South Limb @ 10:14 - SWAP difference image

8. Review of ionospheric activity (3 Mar 2014 - 9 Mar 2014)

VTEC Time Series



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

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

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

The VTEC is expressed in TECu (with $\text{TECu} = 10^{16}$ 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

9. New documents in the European Space Weather Portal Repository

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

eHEROES - Het Ruimteweer

Lecture given to the members and public audience at the Cosmodrome Public Observatory. It focuses mainly on the effects of space weather, extreme space weather, and the space weather forecast team at the Space Pole (RWC Brussels). In Dutch, 30 attendees
<http://www.spaceweather.eu/en/repository/show?id=487>

eHEROES - Het Ruimteweer: stormachtige verhalen over onze ster

Lecture focusing on the effects of space weather, extreme space weather, and the space weather forecasting at the Space Pole (RWC Brussels). The lecture was given to the astronomical association GALILEO in Heerlen, Nederlands-Limburg, The Netherlands. Solar amateur astronomers and public audience, in Dutch, about 20 attendees.
<http://www.spaceweather.eu/en/repository/show?id=488>

Space weather at University of Graz / Kanzelhöhe Observatory

<http://www.spaceweather.eu/en/repository/show?id=489>

ESWW10: Splinter "SSA Space Weather Service Network"

Presentation supporting the splinter meeting, see <http://www.stce.be/esww10/splinters/ssa.php>
<http://www.spaceweather.eu/en/repository/show?id=490>

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>

10. Future Events

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

7th Community Coordinated Modeling Center (CCMC) Workshop in Annapolis (Maryland), USA

Start : 2014-03-30 - End : 2014-04-04

Biennial CCMC community workshops are designed as opportunities for an in-depth exchange of experiences, opinions and needs between model owners, science and operational users, agency representatives and the CCMC staff.

Website:

http://ccmc.gsfc.nasa.gov/CCMC_Workshop_2014/index.php

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.