STCE Newsletter

10 Mar 2014 - 16 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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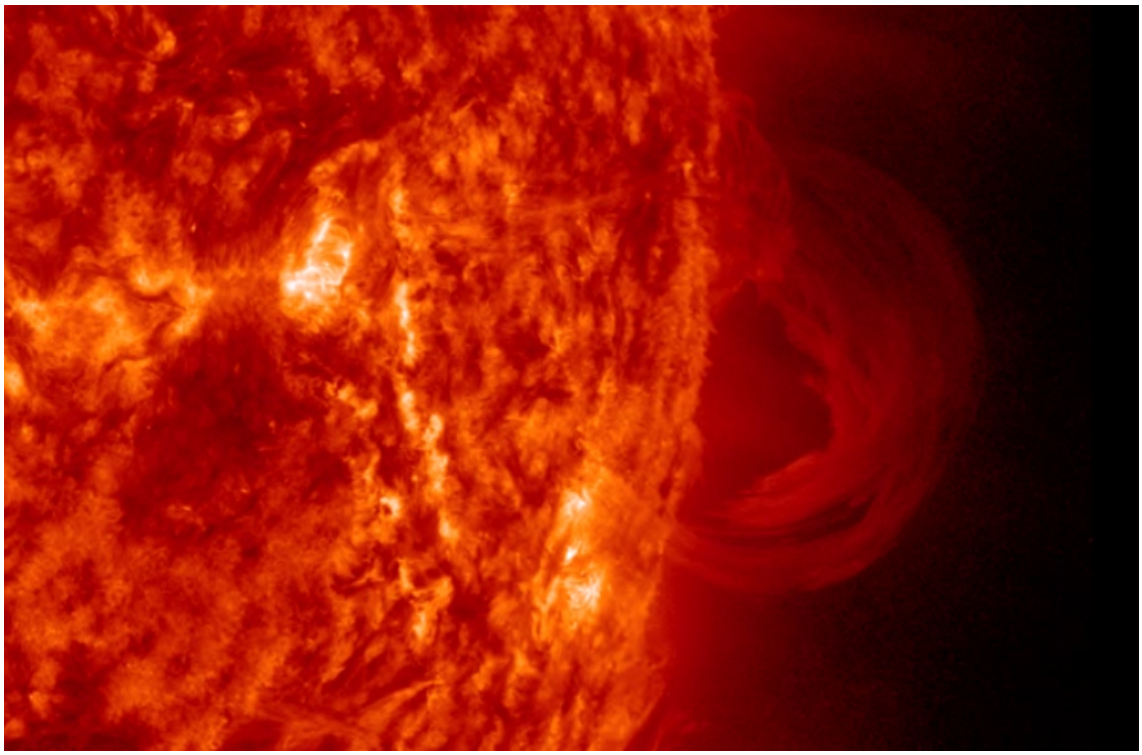
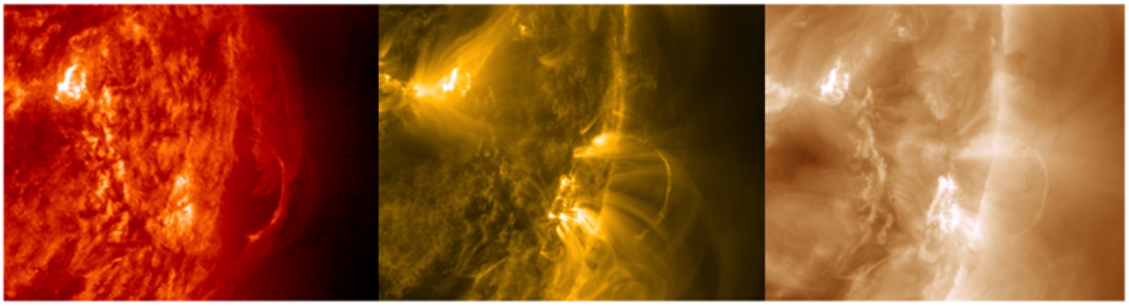
1. Revolt of the filaments

Over the last few weeks, big, complex sunspot groups and associated high flaring activity got everybody's attention. One would almost forget that solar filaments are also part of the solar activity. Time for a change!

Solar filaments are clouds of ionized gas above the solar surface squeezed between magnetic regions of opposite polarity. Being cooler and denser than the plasma underneath and their surroundings, these magnetic borderlines appear as dark lines when seen on the solar disk using special filters. As filaments grow longer, they are more likely to erupt, showing a prominence (near the limb) and often accompanied by a coronal mass ejection (CME).

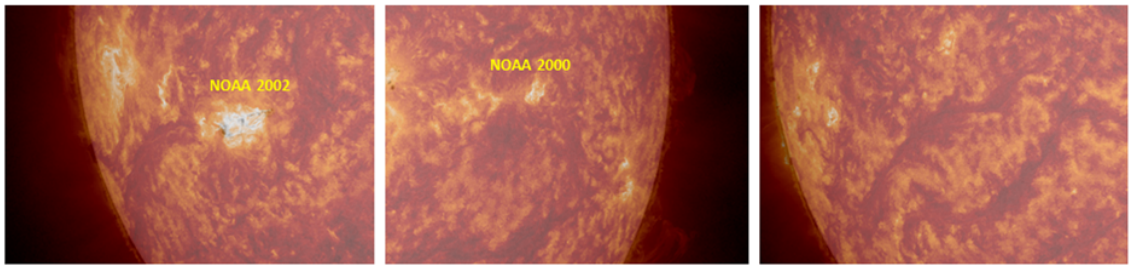


Last week, three nice eruptions occurred on resp. 10 March (east limb; 18:45-20:45UT), 13 March (west limb; 00:00-02:00UT) and 16 March (02:45-04:45UT). This movie at http://youtu.be/DDU4GAo31U4 shows each of them in SDO/AIA 304, 171 and 193 filters. These filters correspond to successively higher temperatures further up in the Sun's atmosphere, i.e. about 80.000 degrees (transition region), 650.000 degrees (upper transition region) and 1.250.000 degrees (corona). The image underneath shows the difference in outlook of the 13 March event (00:41UT) in the three different wavelengths.



Though every event concerned a filament eruption, they differed in various features from each other. For example, the 10 and 16 March filaments were quite long (about 30 degrees or the average Earth-Moon distance), whereas the 13 March filament was only 6 degrees long.

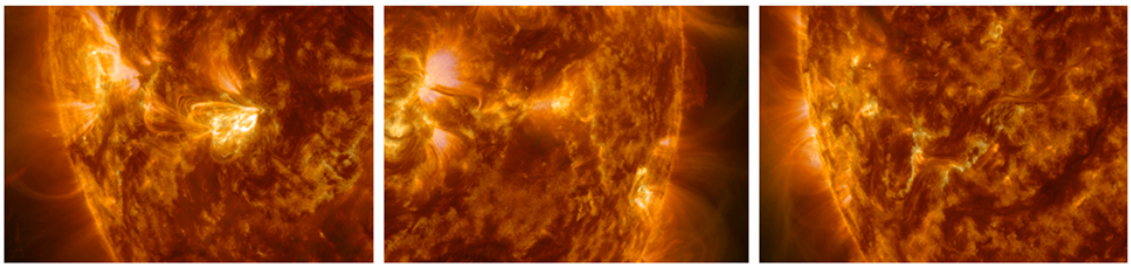
Usually, such long filaments stay away from active regions, but the northern end of the 10 March filament was very close to the trailing section of active region NOAA 2002. The 13 March filament's northern end was close to re-emerging region NOAA 2000, whereas the 16 March filament was buddying with another long and nearby filament to the west, and not near any sunspot region at all.



10 March 13 March 16 March

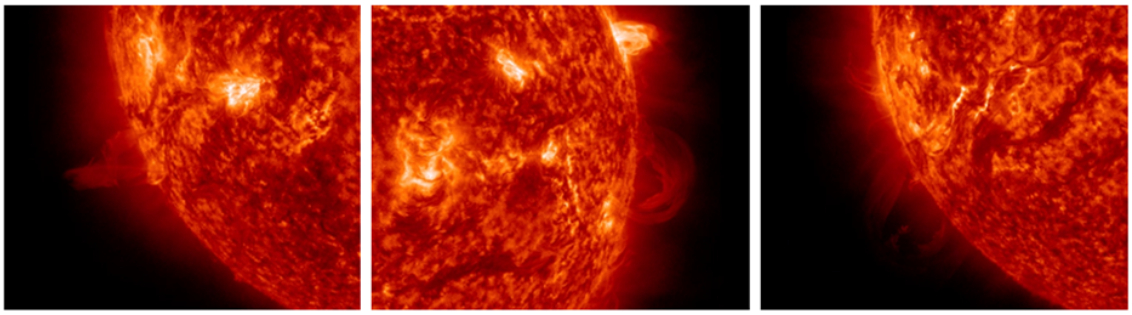
None of the three events seems to be associated to an x-ray flare. The 13 March event occurred in the aftermath of the M9 flare in NOAA 1996 (12 March, 22:34UT) near the northwest limb, so this filament eruption may have been triggered by this flaring event. Note something similar may have happened on 10 March, as NOAA 2002 produced an M1 flare at 15:28UT, just a few hours before the nearby filament eruption started.

In all three cases, post eruption coronal loops became visible, but only the 13 March event had loops over pretty much the entire length of the source filament ("arcade"). For the other two events, these loops were confined to small areas resp. in the north and the middle portion.


10 March 13 March 16 March

The prominences associated to these eruptive events all had a different shape. The 10 March prominence was the most complex and twisted. The 13 March prominence displayed a nice arch shape, with an inner bright rim of hot plasma. The 16 March prominence was not as bright as its predecessors, and resembled an ever expanding "light bulb", of which one of its legs of relatively cool (dark) plasma could be seen moving high above the solar surface. In all three events, one can also see material raining down onto the solar surface, as well as in the filament channel and in the remnants of the source or nearby filament.

If any coronal mass ejection (CME) was associated to the 10 March filament eruption, it is very likely that it was in the same direction as the CME that was already visible at 17:48UT in LASCO/C2. That one was probably associated to the M1 flare in nearby active region NOAA 2002. It came also into view well before the filament eruption started. The two other CMEs were a lot more obvious, in particular the 16 March CME. None of the CMEs had an Earth directed component, so those filaments need to fine-tune their next rebellion.

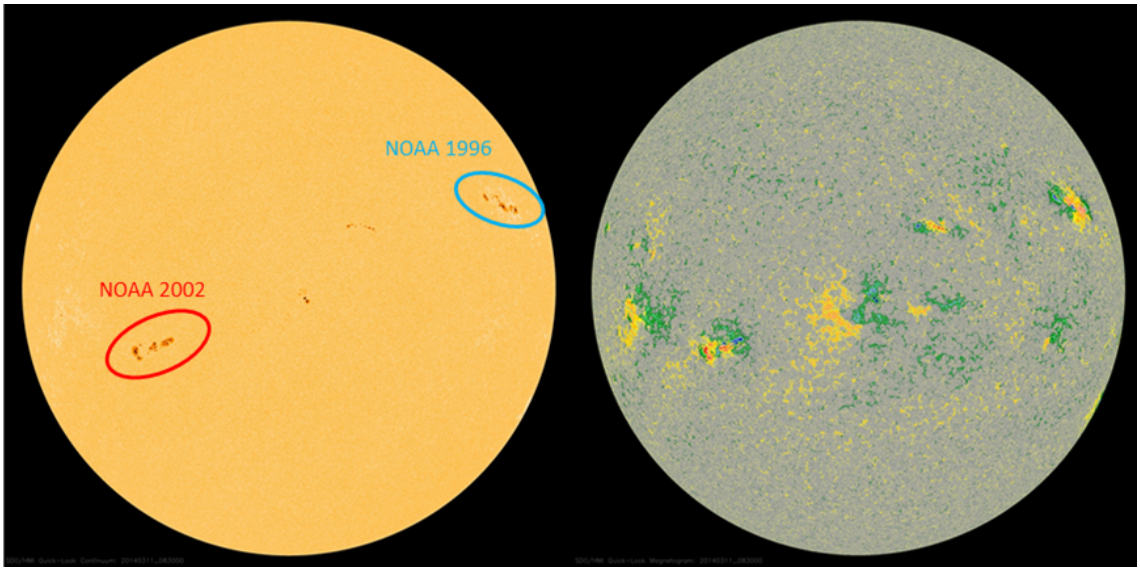


10 March 13 March 16 March

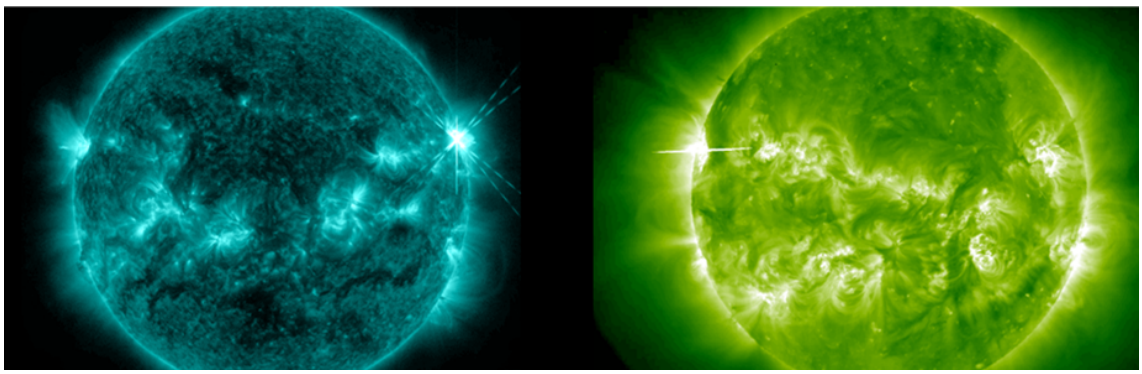
Credits - Imagery for these clips were taken from SDO (http://sdo.gsfc.nasa.gov/) and SOHO/LASCO (http://sohowww.nascom.nasa.gov/), and put together with Helioviewer (http://helioviewer.org/).

2. Review of solar activity (10 Mar 2014 - 16 Mar 2014)

This week, a total of 9 M flares and 35 C flares were observed. In the first half of the week, active regions (AR) NOAA 1996 and 2002 produced nearly all the M-class flares and the majority of the C-class flares.



The largest event was an M9.3 flare produced by NOAA 1996 on 12 March (maximum at 22:34UT). Images underneath by SDO/AIA 131 (left) and STEREO-A/EUVI 195 (right) show the flare at its peak.



Gradually, AR 2003, 1998, and 2005 started generating C flares while AR 2002 and 1996 stopped releasing M flares or even C flares. Over the week, several filament eruptions were observed, however none had an Earth directed component.

3. Noticeable Solar Events (10 Mar 2014 - 16 Mar 2014)

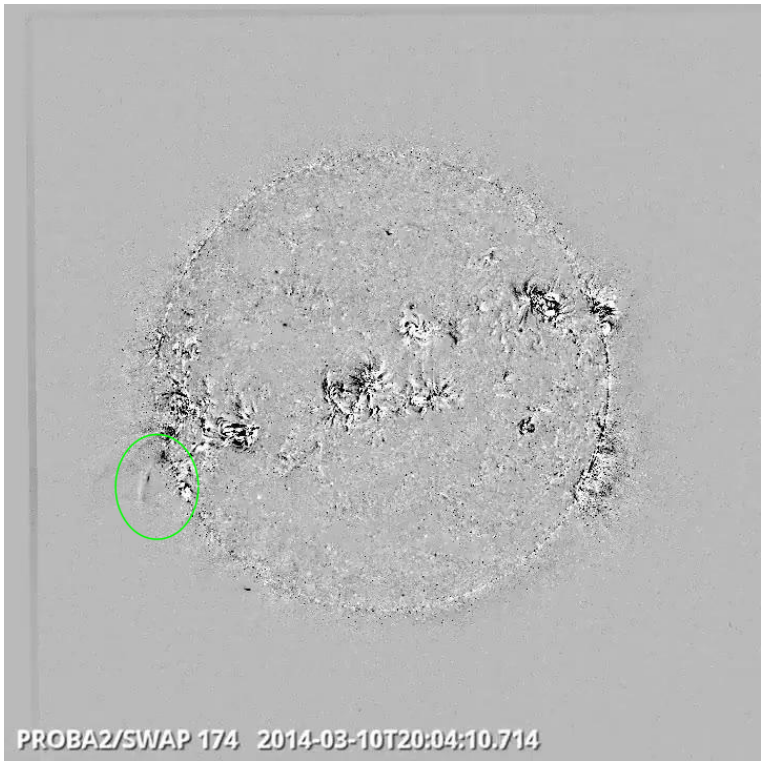
DAY	BEGIN	MAX	END	LOC	XRAY	OP	10CM	TYPE	Cat	NOAA
10	0019	0026	0033	S19E52	M1.1	SF			73	2002
10	0402	0408	0413		M1.0				73	2002
10	1521	1528	1532		M1.7				73	2002
10	2245	2300	2312	N14W51	M1.4	SF			64	1996
11	0344	0350	0356	N13W55	M3.5	1F	110		64	1996
11	1158	1207	1214		M1.7					1991
12	1055	1105	1111	N13W69	M2.5	SN			64	1996
12	2228	2234	2239	N15W78	M9.3	SB	140		64	1996
13	1903	1919	1930		M1.2				64	1996

LOC: approximate heliographic location
XRAY: X-ray flare class
OP: optical flare class
10CM: peak 10 cm radio flux
TYPE: radio burst type
Cat: Catania sunspot group number
NOAA: NOAA active region number

4. PROBA2 Observations (10 Mar 2014 - 16 Mar 2014)

Solar Activity

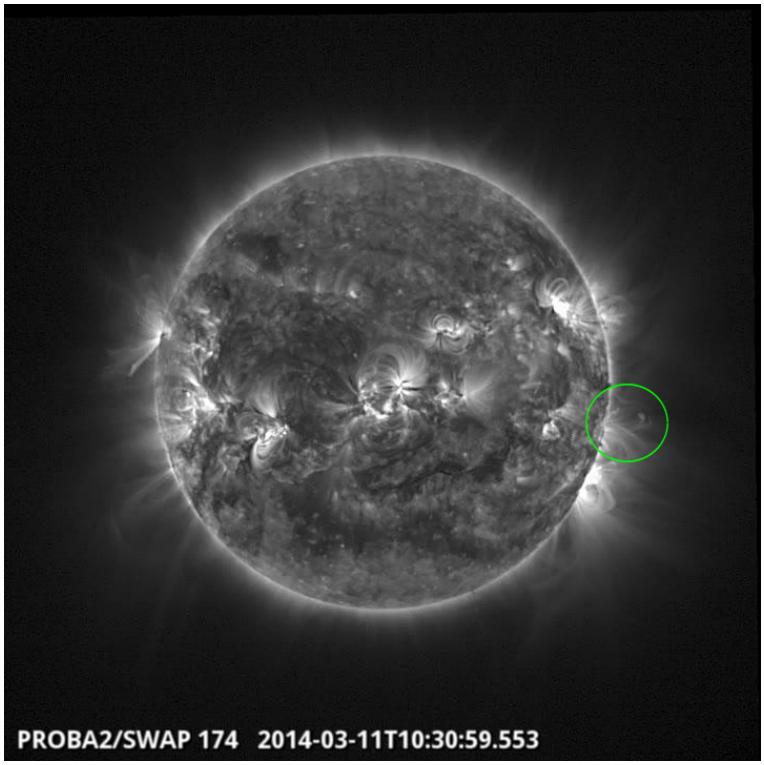
Solar flare activity fluctuated between low and moderate during the week.
In order to view the activity of this week in more detail, we suggest to go to the following website from which all the daily (normal and difference) movies can be accessed: http://proba2.oma.be/ssa
This page also lists the recorded flaring events.
A weekly overview movie can be found here (SWAP week 207).
http://proba2.oma.be/swap/data/mpg/movies/WeeklyReportMovies/WR207_Mar10_Mar16/weekly_movie_2014_03_10.mp4
Details about some of this week's events, can be found further below.



Eruption on the southeast quad @ 20:04 SWAP difference image

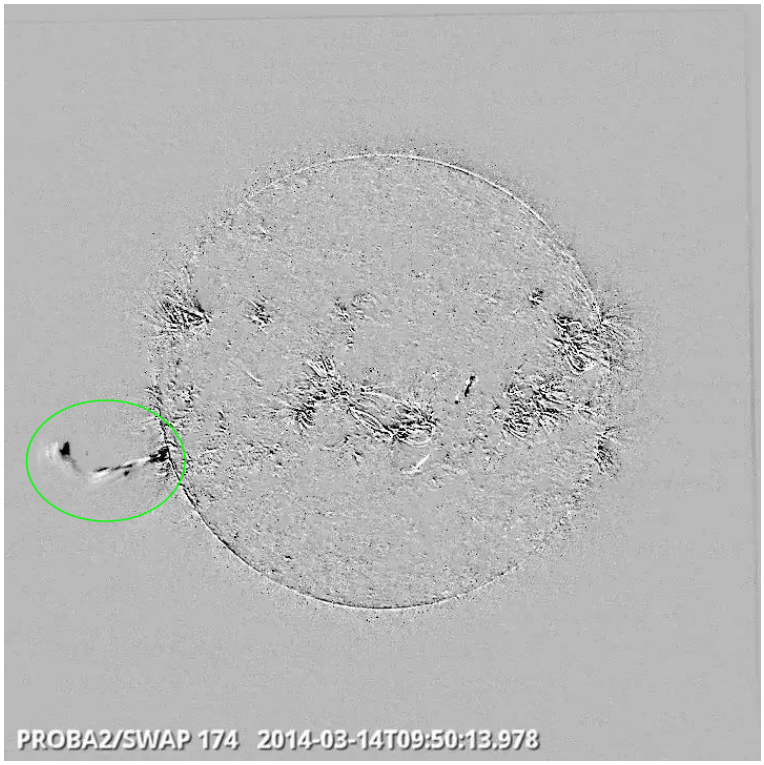
Flows in the southeast quadrant @ 23:30 SWAP difference image
Find a movie of the events here (SWAP daily difference movie)
http://proba2.oma.be/swap/data/mpg/movies/20140310_swap_diff.mp4

Tuesday Mar 11



Eruption on the west limb @ 10:30 SWAP difference image
Find a movie of the event here (SWAP daily movie)
http://proba2.oma.be/swap/data/mpg/movies/20140311_swap_movie.mp4

Friday Mar 14



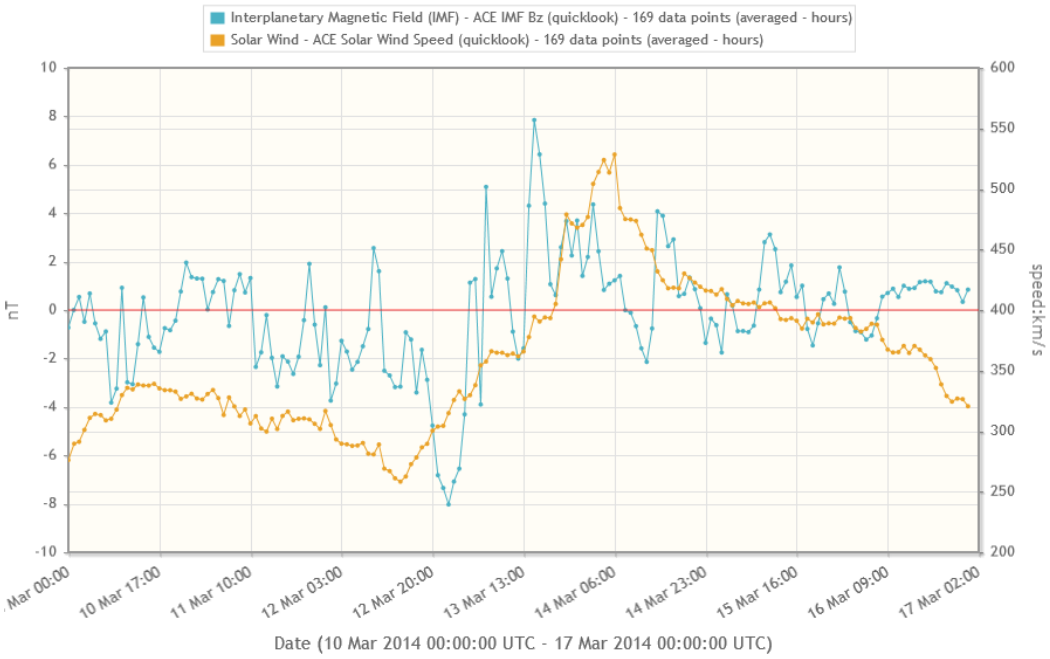
Eruption on the east limb @ 09:50 SWAP difference image
Find a movie of the event here (SWAP daily diff movie)
http://proba2.oma.be/swap/data/mpg/movies/20140314_swap_diff.mp4

Sunday Mar 16

Eruption in the southeast quadrant @ 03:11 SWAP difference image
Find a movie of the event here (SWAP diff movie)
http://proba2.oma.be/swap/data/mpg/movies/WeeklyReportMovies/WR207_Mar10_Mar16/Events/20140316_Eruption_SouthEastQuad_0311_swap_diff.mp4
Find a movie of the event here (SWAP movie)
http://proba2.oma.be/swap/data/mpg/movies/WeeklyReportMovies/WR207_Mar10_Mar16/Events/20140316_Eruption_SouthEastQuad_0311_swap_movie.mp4

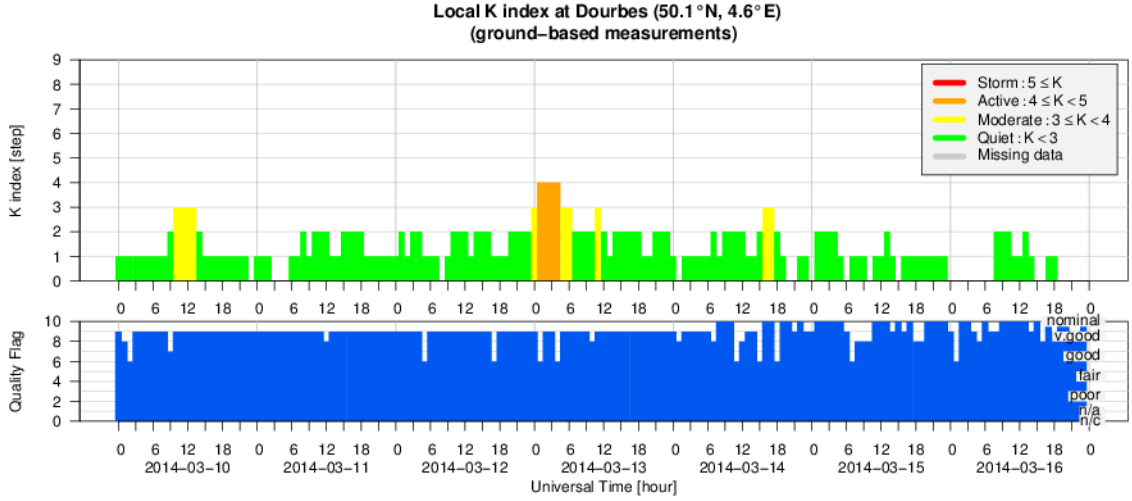
5. Review of geomagnetic activity (10 Mar 2014 - 16 Mar 2014)

Solar wind speed as observed by ACE was low (around 300 km/s) until 12 March when the arrival of a high speed stream from a coronal hole on the southern solar hemisphere gradually increased wind speeds to about 500 km/s on 14 March. The effects of the high speed stream subsided on 15 March. From 12 to 14 March, the magnitude of the Interplanetary Magnetic Field (IMF) varied between 5 and 10 nT. Before and after this period, nominal values of 5 nT or less were registered.

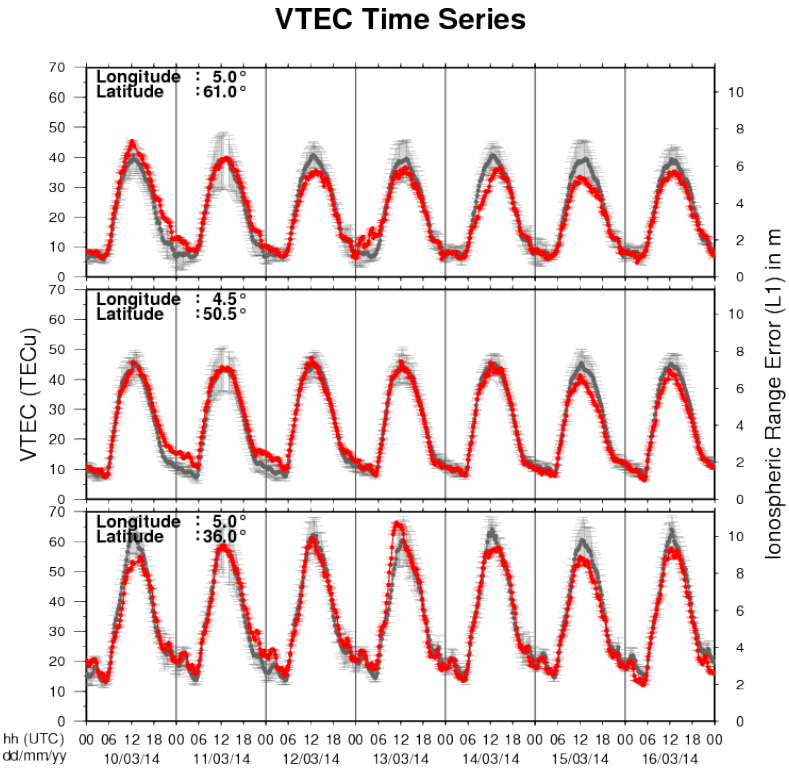


Geomagnetic activity has been quiet (K Dourbes and NOAA Kp smaller than 4) throughout the whole week, except between 0h and 6h UT on 13 March, when K Dourbes reached 4 and Kp reached up to 5, in response to the elevated solar wind speed and IMF magnitude, combined with a negative Bz.

6. Geomagnetic Observations at Dourbes (10 Mar 2014 - 16 Mar 2014)



7. Review of ionospheric activity (10 Mar 2014 - 16 Mar 2014)



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

8. New documents in the European Space Weather Portal Repository

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

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

9. 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 Assemby 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.