STCE Newsletter

16 Jun 2014 - 22 Jun 2014

Published by the STCE - this issue : 26 Jun 2014. Available online at http://www.stce.be/newsletter/ .

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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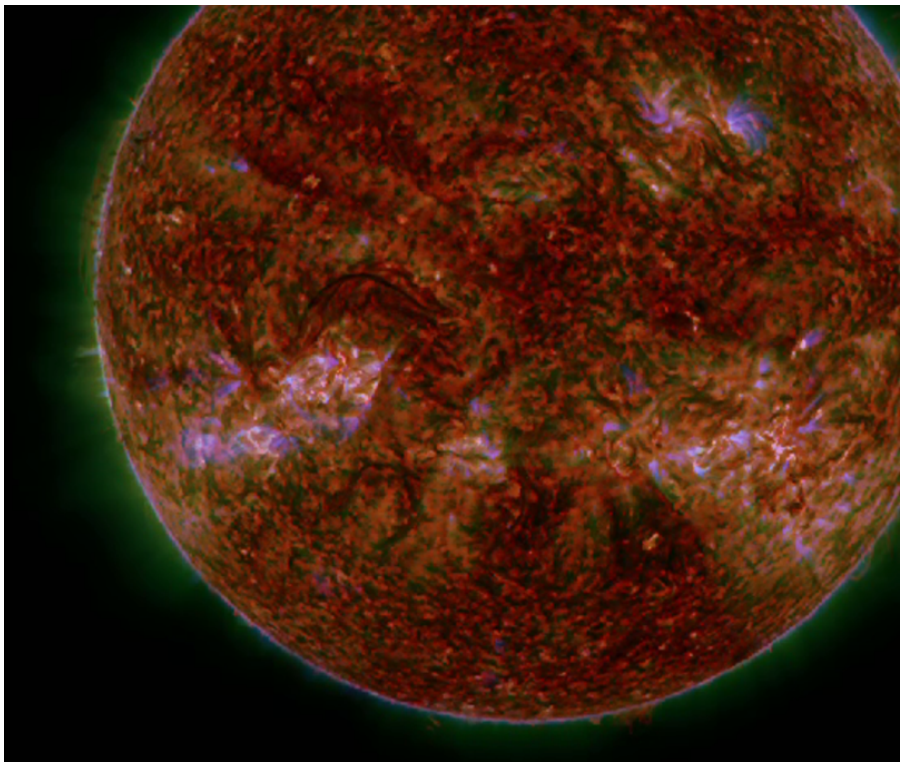
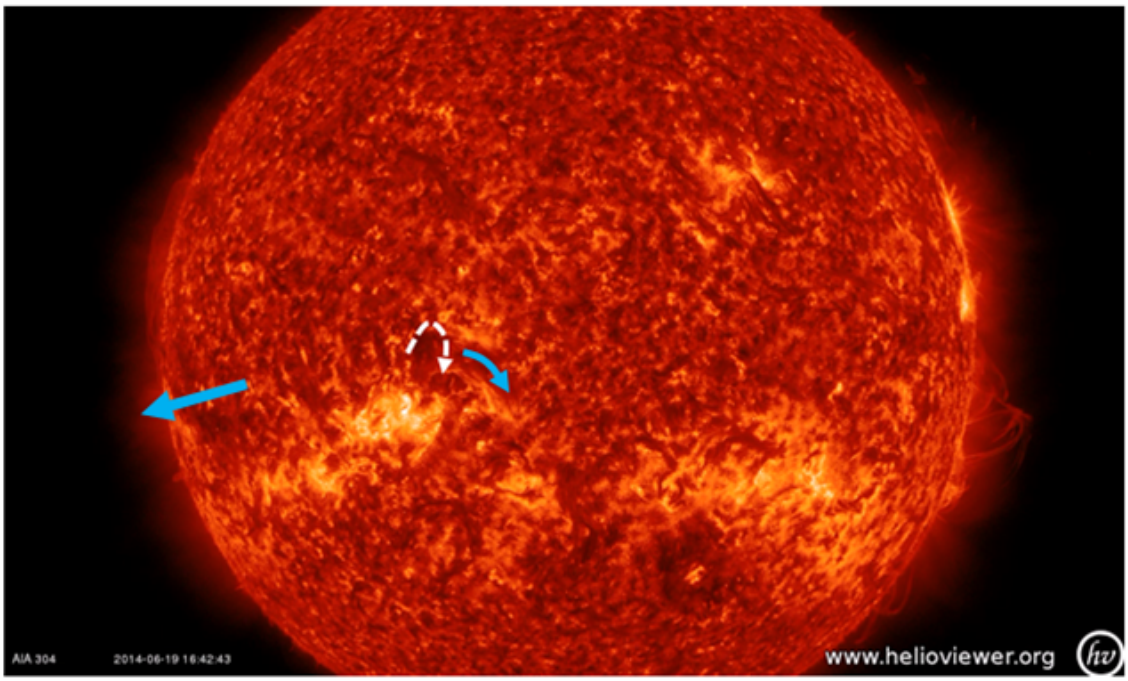
1. Up, up and away!...

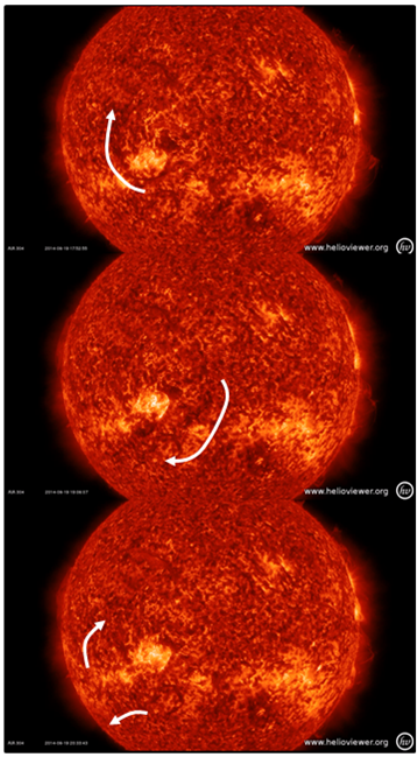
Solar filaments are clouds of ionized gas above the solar surface squeezed between magnetic regions of opposite polarity. Being cooler and denser than the surrounding plasma, they appear as dark lines when seen on the solar disk using special filters. On 19 June, a filament north of sunspot region NOAA 2093 became unstable and swirled away from the Sun.



The event is best visible in EUV images taken by SDO/AIA 304. Around 15:00UT, the filament becomes unstable. About an hour later, the filament clearly gets torn, with the left part moving fast away from the filament's original position. The other part rains down onto the solar surface, while the outer end is severely twisted and in the process seems to eject an amount of relatively cool matter (dark in the AIA 304 images).



Over the next two hours, this material is caught in an upward swirl, completing a full 360 degrees turn around (and above) NOAA 2093, while the arc is gradually expanding. The helical movement is best visible in fast EUV-movies.



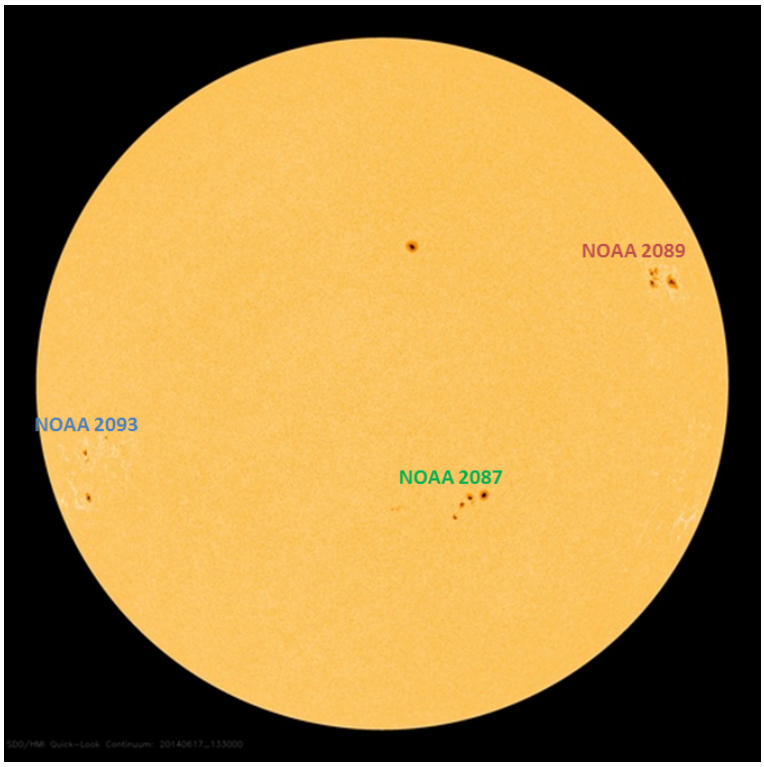
This movie at http://youtu.be/VvYaqY_6B-I first shows the event as seen in the relatively cool chromosphere (solar inner atmosphere, about 10.000 degrees), then in the transition zone (AIA 304, about 50.000-100.000 degrees). In the chromospheric imagery, not much movement is seen as the

filament only seems to disappear. The corkscrew movements are much better captured in the AIA 304 imagery (see also this news item at http://stce.be/news/218/welcome.html).
The combination clips include also images from the hot corona and do not show the swirls very well. However, they do show a transient coronal hole, indicating the ejection of plasma into space. The associated coronal mass ejection probably hit Earth late on 23 June, but did not produce a substantial geomagnetic disturbance. The movie ends with three repeats of the AIA 304 clip, but played 4 times faster in order to better show the swirling movement of the ejected plasma.

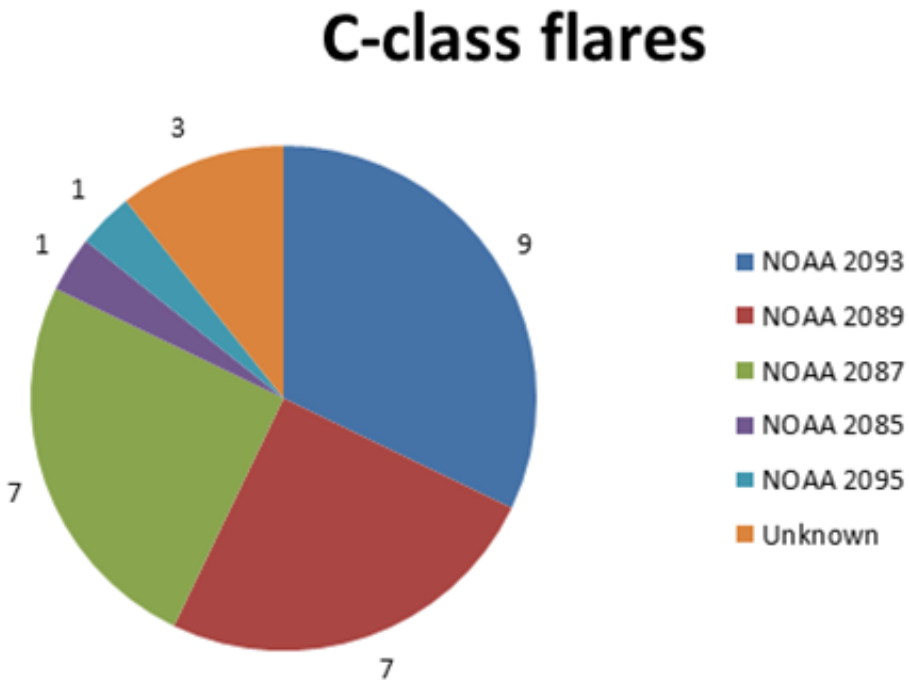
Credits: Images were taken from the GONG H-alpha Network (http://halpha.nso.edu/), SDO/AIA (http://sdo.gsfc.nasa.gov/data/aiahmi/), and (J)Helioviewer (http://helioviewer.org/).

2. Review of solar activity (16 Jun 2014 - 22 Jun 2014)

Eight sunspot groups were reported by NOAA during the week. The most flare productive were (corresponding Catania numbers are shown in brackets) NOAA Active Regions 2087 (81), 2089 (82), and 2093 (89 and 90).



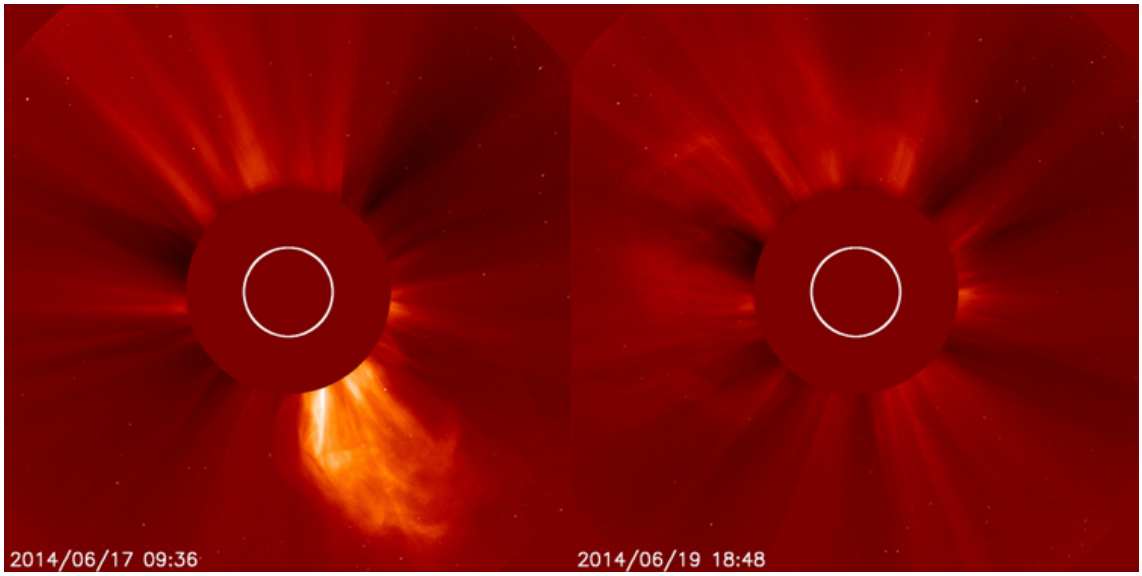
NOAA 2087 (81) produced the strongest flare (M1.0) peaking at 00:01UT on 16 June, but starting at 23:50UT on 15 June and thus technically belonging to the previous period. No associated coronal mass ejection (CME) was detected by SOHO/LASCO. In total, 28 C-class flares were recorded, the strongest being a long duration C8 flare on 16 June produced by NOAA 2085 from behind the west limb. Over the period, both the soft X-ray flux background and the flaring activity then gradually decreased, and on 22 June only B-class flares were observed.



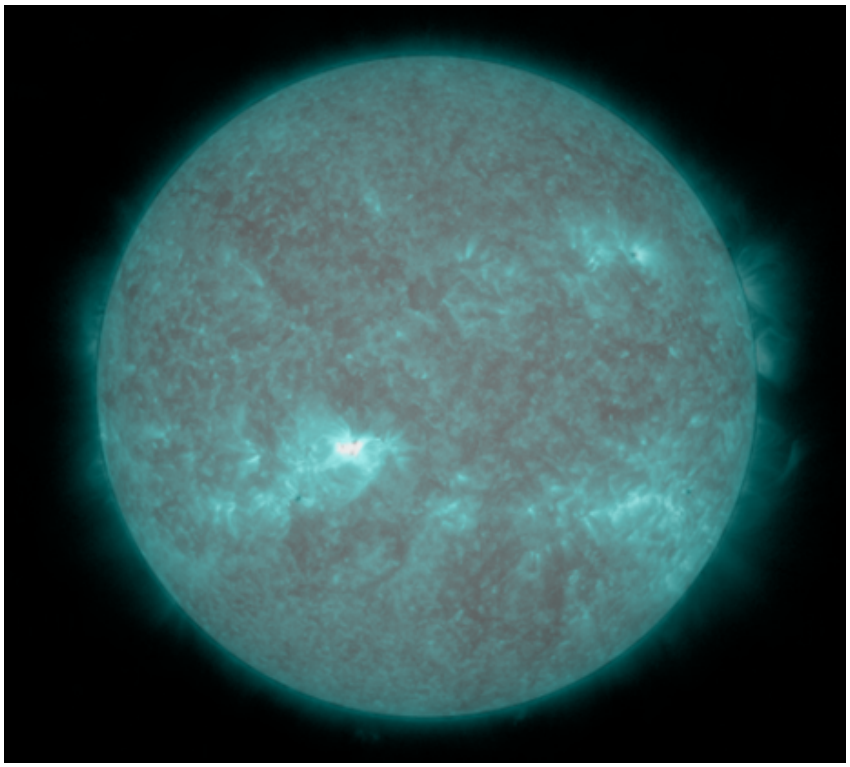
Four partial halo CMEs were detected during the week.

The first and best visible started to appear in the SOHO/LASCO C2 field of view at 09:12UT on 17 June. It was related to a far side eruption in former active region NOAA 2080.

A partial halo CME appeared in the LASCO C2 field of view on 19 June at 17:00UT. The CME had an angular width of around 190 degrees and projected plane-of-the-sky speed of around 400 km/s. It was produced by the eruption of a filament to the north of NOAA 2093, starting around 14:25UT as seen by SDO/AIA. The eruption was also accompanied by coronal dimmings and a post-eruption arcade. An interplanetary shock probably driven by this partial halo CME was detected by ACE and SOHO/CELIAS at 22:00UT on 23 June.



A rather symmetric, but very weak partial halo CME (angular width around 270 degrees, projected plane-of-the-sky speed around 350 km/s) first appeared in the LASCO C2 field of view at 12:24UT on 20 June. It was associated with the C5.0 flare peaking at 11:20UT in the Catania sunspot group 89 (leading part of NOAA 2093). See image below (combination of SDO/AIA 131 and SDO/HMI intensitygram).



The last partial halo CME (angular width around 160 degrees, projected plane-of-the-sky speed around 300 km/s) was first seen in the LASCO C2 field of view at 05:24UT on 21 June. It was associated with a filament eruption at the central meridian in the northern hemisphere, and mostly directed to the north of the ecliptic plane.

3. PROBA2 Observations (16 Jun 2014 - 22 Jun 2014)

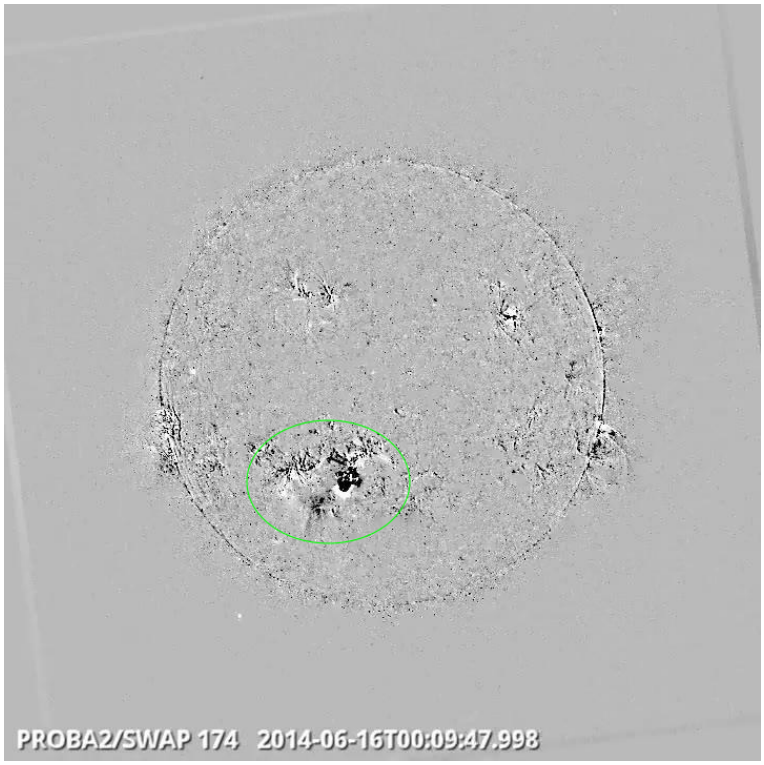
This week, the level of solar activity decreased from moderate on Monday, mostly low during the week and very low on Sunday.

In order to view the activity of this week in more detail, we suggest going 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/WR221_Jun16_Jun22/weekly_movie_2014_06_16.mp4 (SWAP week 221).

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

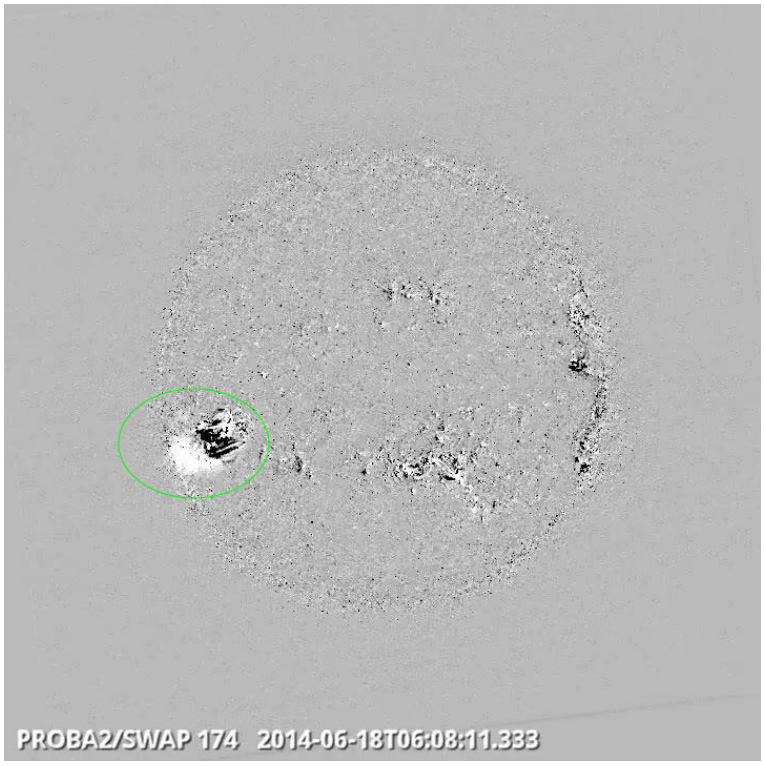
Monday Jun 16



Eruption in the Southeast quadrant @ 00:09 - SWAP difference image

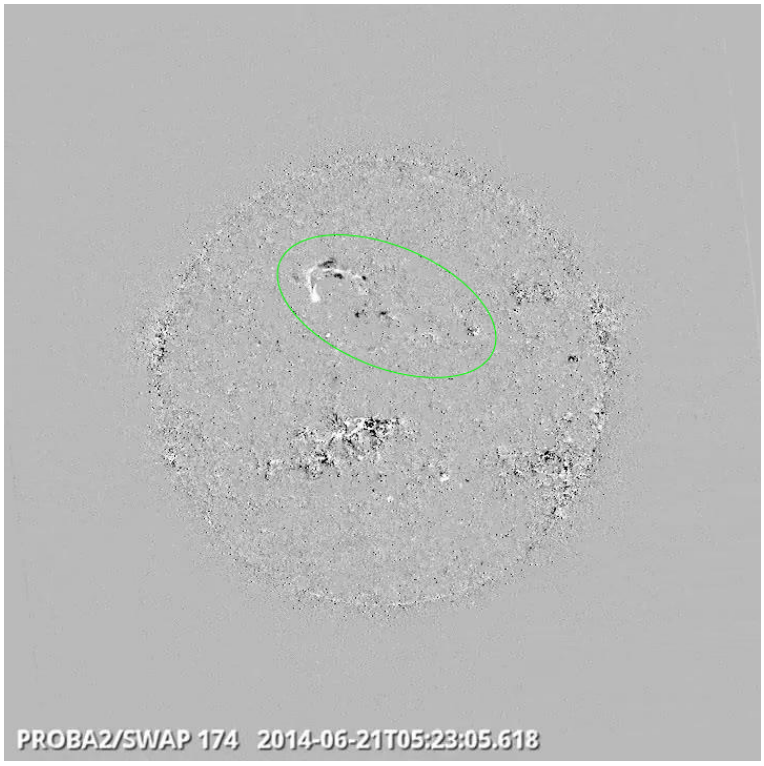
Eruption on the East limb; Prominence Eruption on the West limb @ 11:43 - SWAP difference image

Wednesday Jun 18



Eruption in the Southeast quadrant @ 06:08 - SWAP difference image

Saturday Jun 21



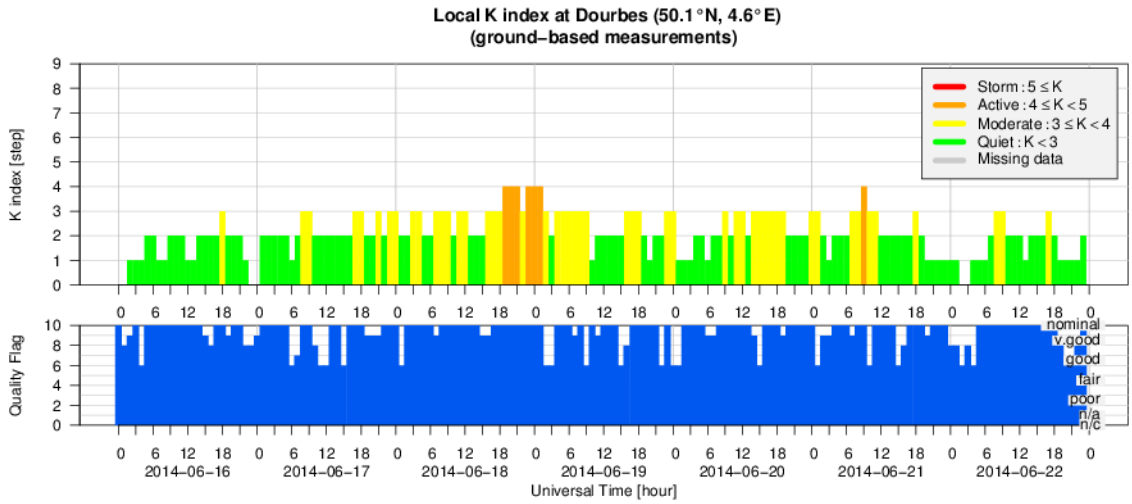
Big Prominence Eruption, Northern Hemisphere @ 05:23 - SWAP difference image
A SWAP difference movie of this event: http://proba2.oma.be/swap/data/mpg/movies/WeeklyReportMovies/WR221_Jun16_Jun22/20140621_PromEruption_N_Hemi_0523_SWAPdiff.mp4. It is also nicely visible in the SWAP daily movie: http://proba2.oma.be/swap/data/mpg/movies/20140621_swap_movie.mp4.

4. Review of geomagnetic activity (16 Jun 2014 - 22 Jun 2014)

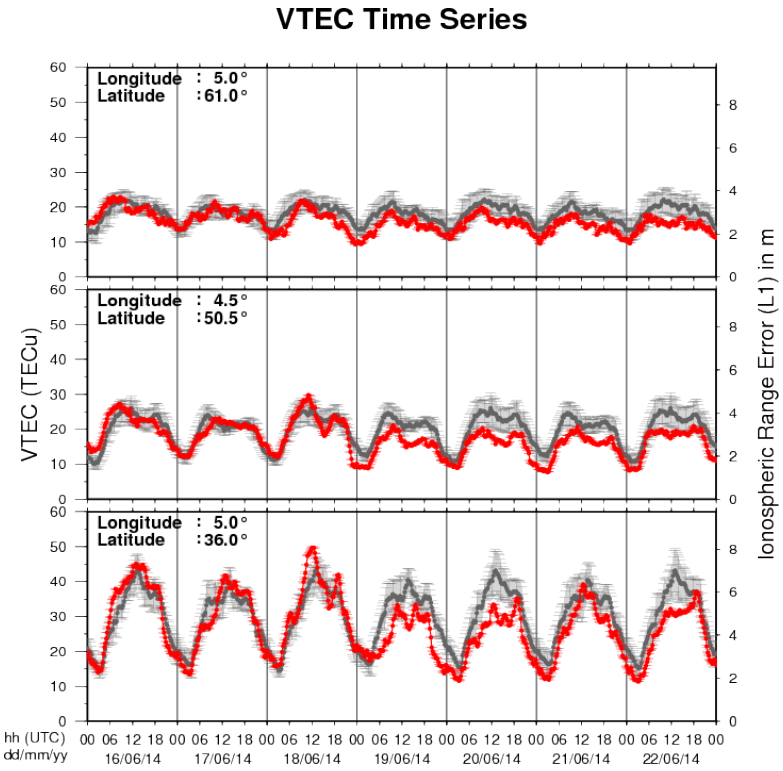
In the beginning of the week, the Earth was situated inside a slow solar wind flow, and the geomagnetic conditions were quiet. An interplanetary sector boundary was crossed around 17:00 UT on 17 June. The interplanetary magnetic field (IMF) magnitude increased up to 10 nT, but did not exhibit prolonged intervals of strongly negative north-south component Bz. The geomagnetic conditions were quiet to unsettled.

After that, the solar wind flow became rather inhomogeneous in speed and IMF magnitude, with the solar wind speed reaching 500 km/s and the IMF magnitude reaching 10 nT. Active to minor storm geomagnetic conditions were reported in the evening of 18 June, as well as on 21 June. Otherwise, the geomagnetic conditions were on the quiet to unsettled level until the end of the week.

5. Geomagnetic Observations at Dourbes (16 Jun 2014 - 22 Jun 2014)



6. Review of ionospheric activity (16 Jun 2014 - 22 Jun 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