STCE Newsletter

27 Jan 2014 - 2 Feb 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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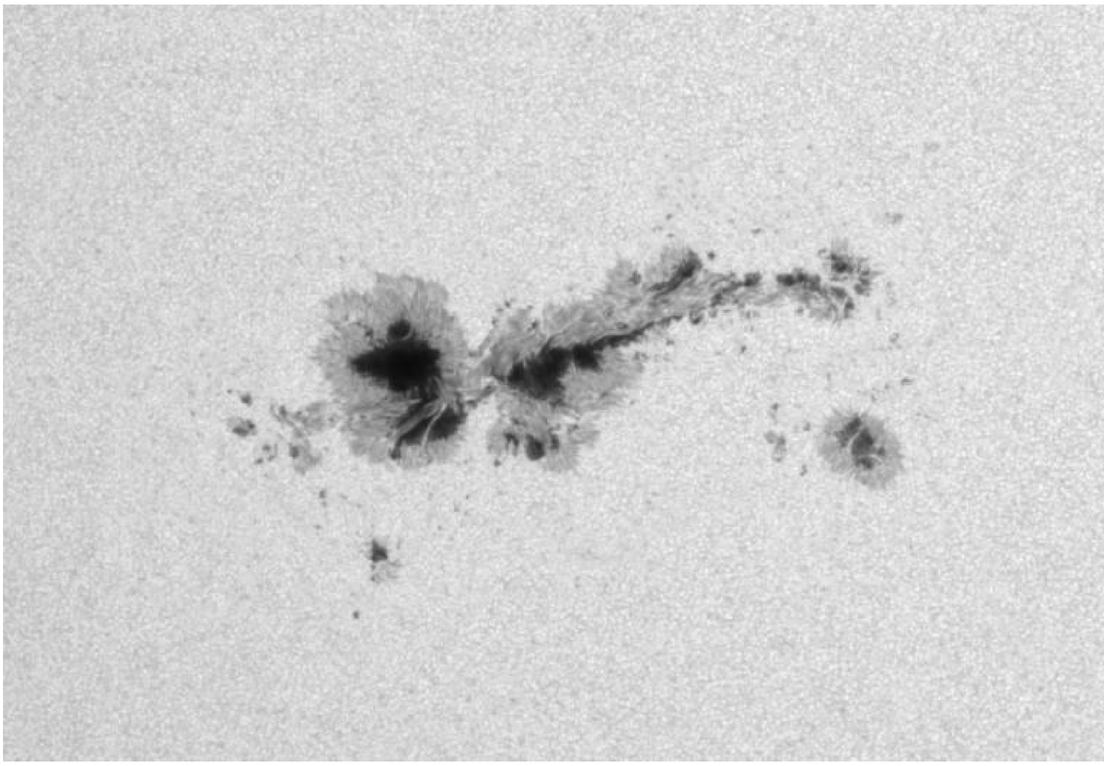
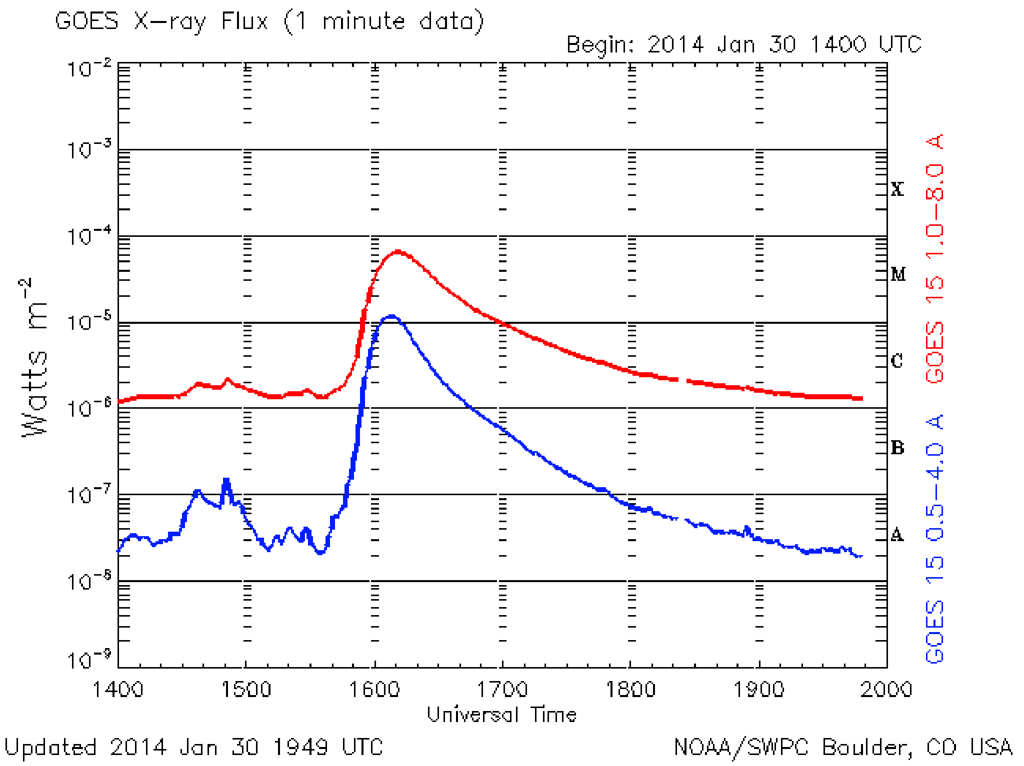
1. M6 flare in NOAA 1967 (27 Jan 2014 - 2 Feb 2014)

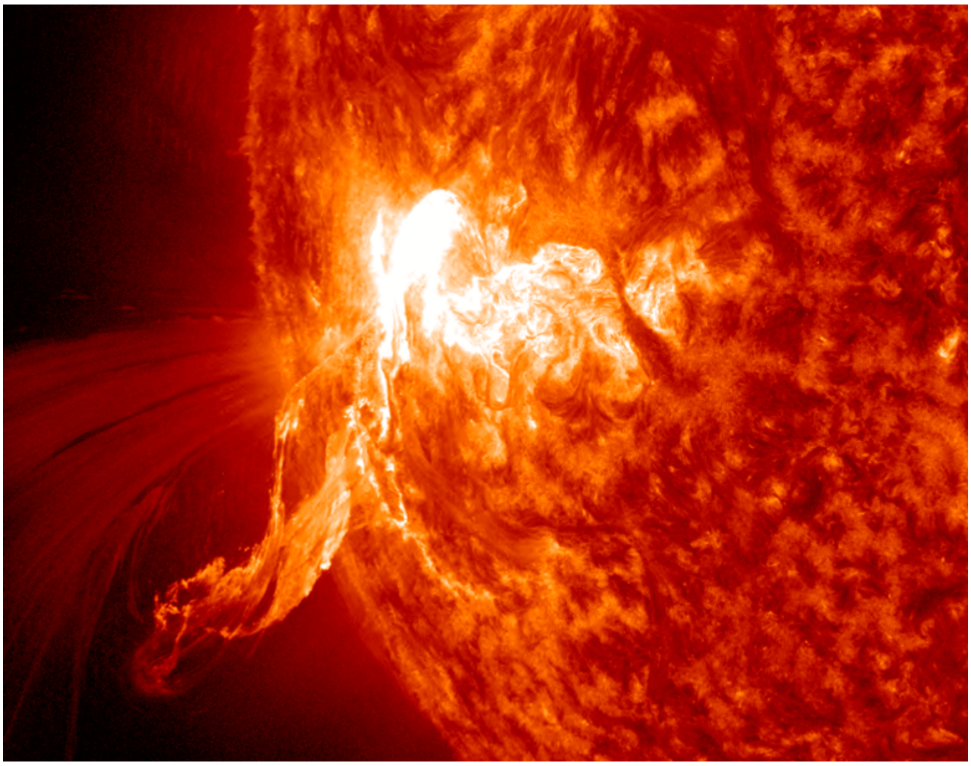
On 27 January, a big, complex region rounded the Sun's east limb and was labelled NOAA 1967. This large sunspot group was the return of NOAA 1944 which appeared early January and was very active at that time, including 7 M- and 1 X-class flare. Using solar eclipse glasses, both groups were easy naked-eye objects.



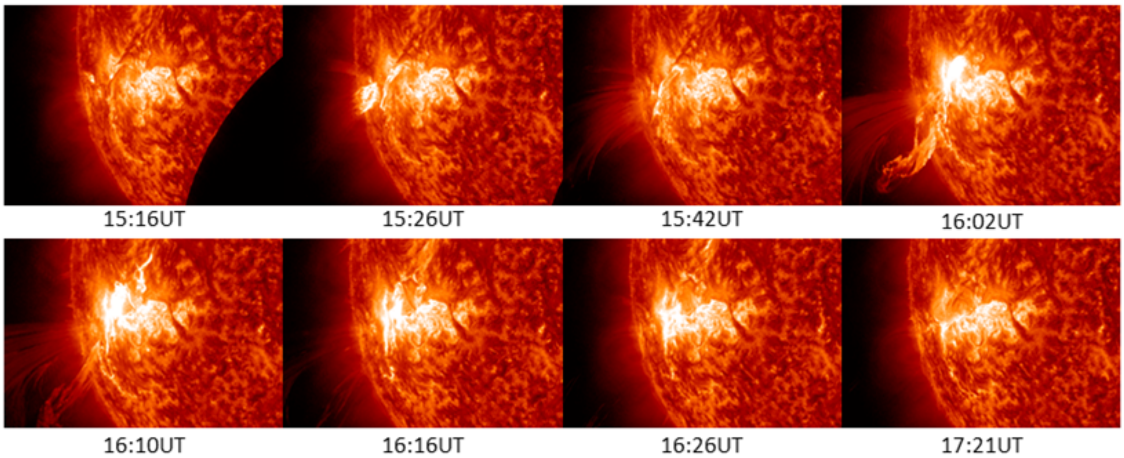
During the week, NOAA 1967 increased its sunspot area and magnetic complexity. So far, this has resulted in 34 C- and 20 M-class flares. The strongest flare occurred on 30 January (M6.6 peaking at 16:11UT) and was associated with a filament eruption east of NOAA 1967's trailing portion.



Interestingly, this flare did not take place in one of the various strong delta structures of the group (sunspots of opposite magnetic polarity very close to each other: see http://stce.be/news/222/welcome.html). Instead, the eruption took place behind the main spots of the group's trailing section.

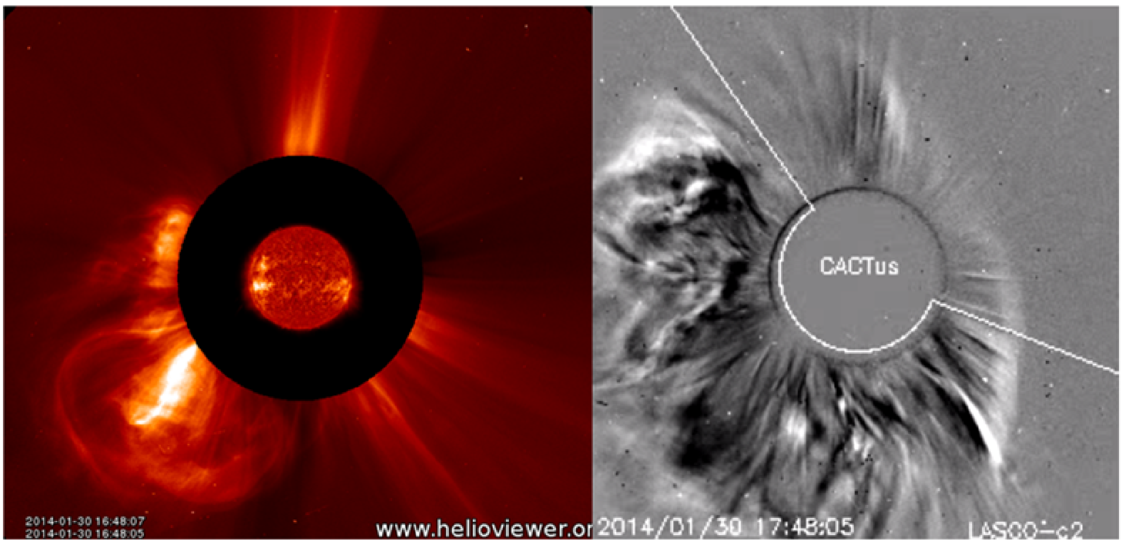


The mosaic underneath shows the various phases of this flare (15:00-18:00UT). First, there was a small flare just behind the filament resulting in a fan shaped plasma ejection. This event resulted in the filament becoming unstable and being ejected. The brightest phase of the flare took place near the top end of the area where the filament was ejected. Finally, over the location of the blast site, a series of post-flare coronal loops were formed (a so-called "arcade").



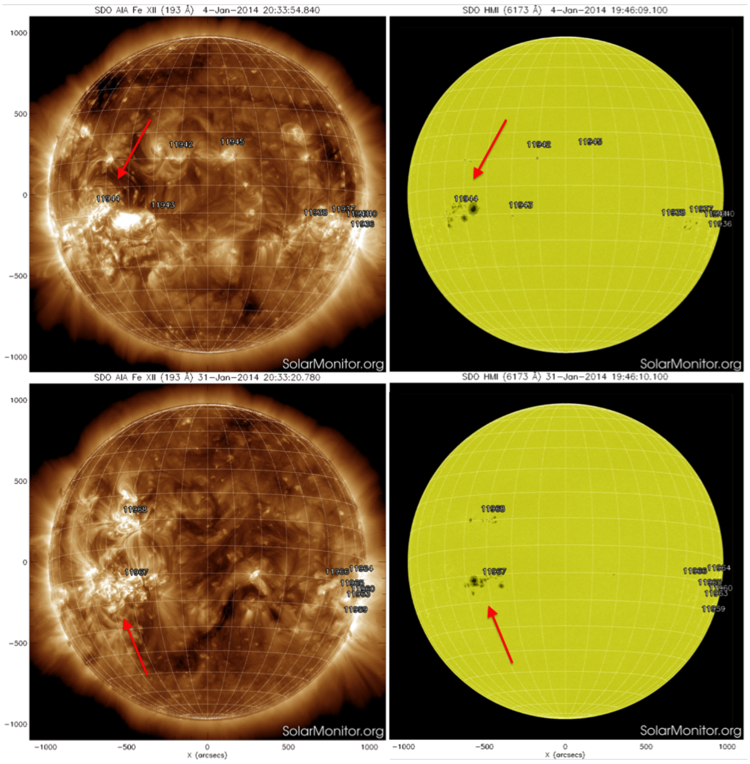
The movie at http://youtu.be/rKjPA3wDWbo first shows the evolution of NOAA 1967 in white light from 30 January till 2 February. Then follow 3 movies in successively higher temperatures (SDO/AIA 304, 171 and 131 - http://sdo.gsfc.nasa.gov/) showing the evolution of the M6-event from 15:00UT till 18:00UT. In the beginning of each of these 3 movies, the end of a partial lunar eclipse can be seen and the Sun is a little bit shaky. Indeed, the fine guidance systems on AIA and HMI can't work because they need to see the whole Sun to keep the images centered from exposure to exposure. Steady images resumed once the eclipse was over.

The movie ends with LASCO/C2 clips from the associated full halo coronal mass ejection (CME) in white light and difference imagery, first seen in LASCO/C2 (SOHO: http://sohowww.nascom.nasa.gov/ home.html) imagery at 16:12UT. The glancing blow of this CME arrived late on 2 February, but the impact was weak and geomagnetic conditions remained quiet.

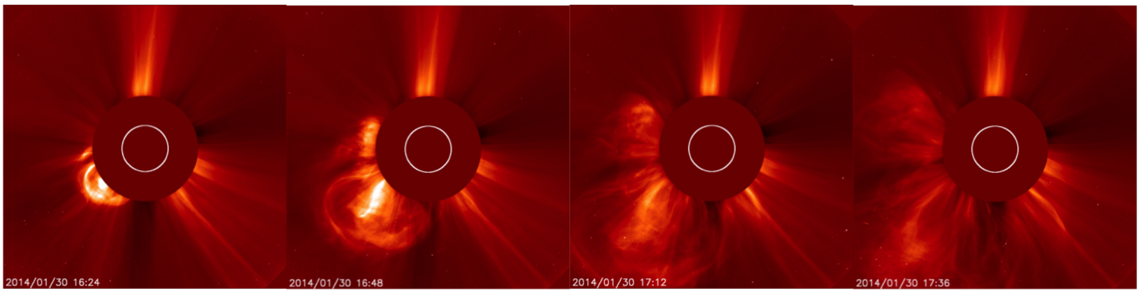


2. Review of solar activity (27 Jan 2014 - 2 Feb 2014)

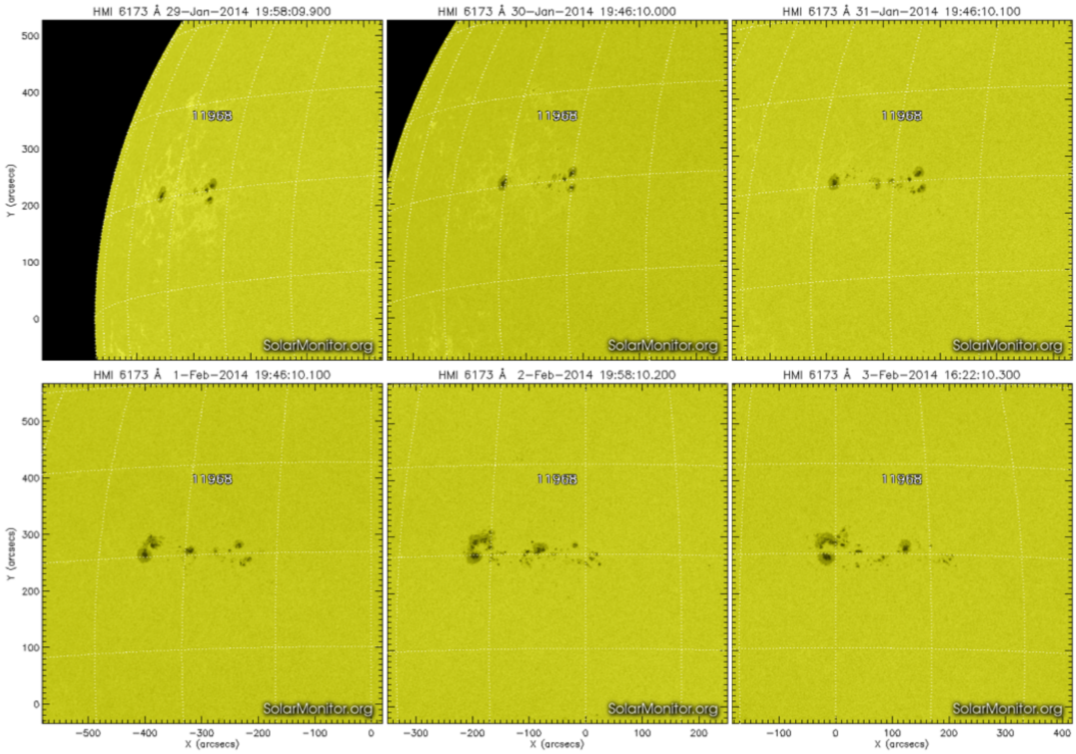
Solar activity has been at active levels all week, mainly due to active region NOAA 1967. This large sunspot group was the return of NOAA 1944 which appeared early January and was very active at that time (incl. 7 M- and 1 X-class flare). NOAA 1967 rounded the east limb on 27 January and increased its sunspot area and magnetic complexity during the summary week. Below you see the active region on 4 and 31 January in the EUV (left) and in visible light (right).



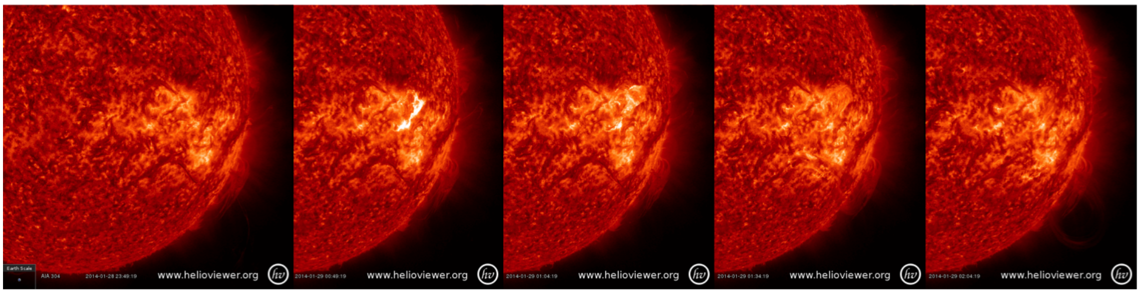
So far, NOAA 1967 was the source of 34 C- and 20 M-class flares, including an M3-spike lasting only 4 minutes (28 January, maximum at 15:26UT). The strongest flare occurred on 30 January (M6.6 peaking at 16:11UT) and was associated with a filament eruption east of NOAA 1967's trailing portion. At that moment, the 1967 was situated near the east limb with the filament not in sight. A full halo CME was related to this event and first seen in LASCO/C2 imagery at 16:12UT.



Three other M-flares were produced, all by NOAA 1968. This group was a lot smaller than NOAA 1967 and located in the northern hemisphere at about the same longitude. It matured more slowly, with the strongest flare peaking on 2 February (M2 at 06:34UT).



Another noteworthy event was a filament eruption east of the small sunspot groups NOAA 1959 and 1960. The event occurred early on 29 January (C4-flare peaking at 00:49UT), but the bulk of the associated partial halo CME, first seen in LASCO/C2 at 00:24UT, was directed away from the Earth.



3. Noticeable Solar Events (27 Jan 2014 - 2 Feb 2014)

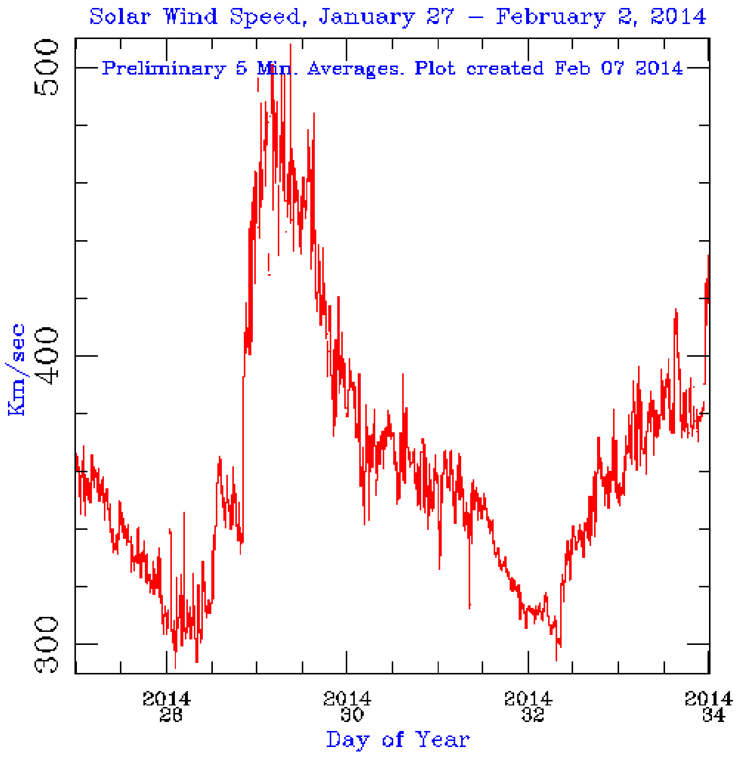
DAY	BEGIN	MAX	END	LOC	XRAY	OP	10CM	TYPE	Cat	NOAA
27	0105	0122	0139		M1.0			III/2		1967
27	0202	0211	0218		M1.1					1967
27	2205	2210	2215		M4.9					1967
28	0402	0409	0413		M1.5					1967
28	0725	0731	0734		M3.6			III/2		1967
28	1134	1138	1141		M1.4			III/2		1967
28	1238	1246	1250		M1.3					
28	1233	1246	1250		M1.3					1967
28	1900	1940	1946	S14E76	M4.9	1F	1700	III/1		1967
28	2204	2216	2220	S14E75	M2.6	1F				1967
30	0633	0639	0644	S15E54	M2.1	SF			28	1967

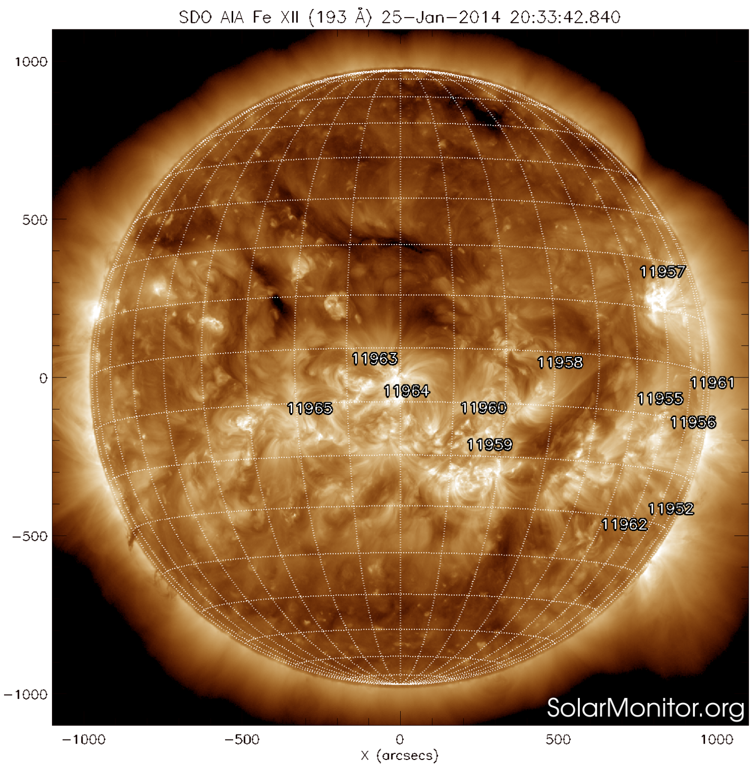
30	0754	0811	0841	S12E52	M1.1	SF	69	III/2	28	1967
30	1548	1611	1628	S13E58	M6.6	2N	220	VI/1	28	1967
31	1532	1542	1553		M1.1				27	1968
01	0119	0125	0138	S11E26	M1.0	1F			28	1967
01	0714	0723	0736	S11E23	M3.0	1B		VI/2	28	1967
02	0624	0634	0637	N12E18	M2.6	1B		III/1	27	1968
02	0717	0820	0829	S10E14	M2.2	1N			28	1967
02	0924	0931	0936	S11E13	M4.4	1B		III/2	28	1967
02	1401	1406	1409		M1.3		71	III/1	28	1967
02	1624	1629	1636		M1.0				27	1968
02	1805	1811	1818		M3.1		180		28	1967
02	2124	2204	2214		M1.3			III/3	28	1967

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. Review of geomagnetic activity (27 Jan 2014 - 2 Feb 2014)

Solar wind speed varied mostly between 300 and 350 km/s. On 28 January around 20:30UT, solar wind speed changed from about 330km/s to 450-500 km/s. The high temperature, low density stream had a Bz varying between -7 and +7 nT. The source of this high speed stream was most probably a small coronal hole that passed the central meridian on 25 January.

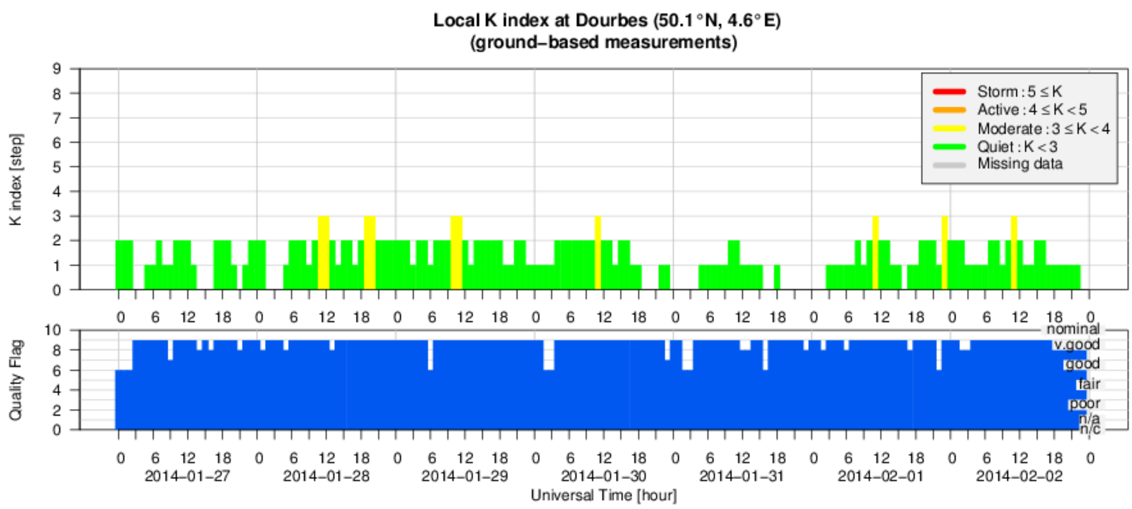




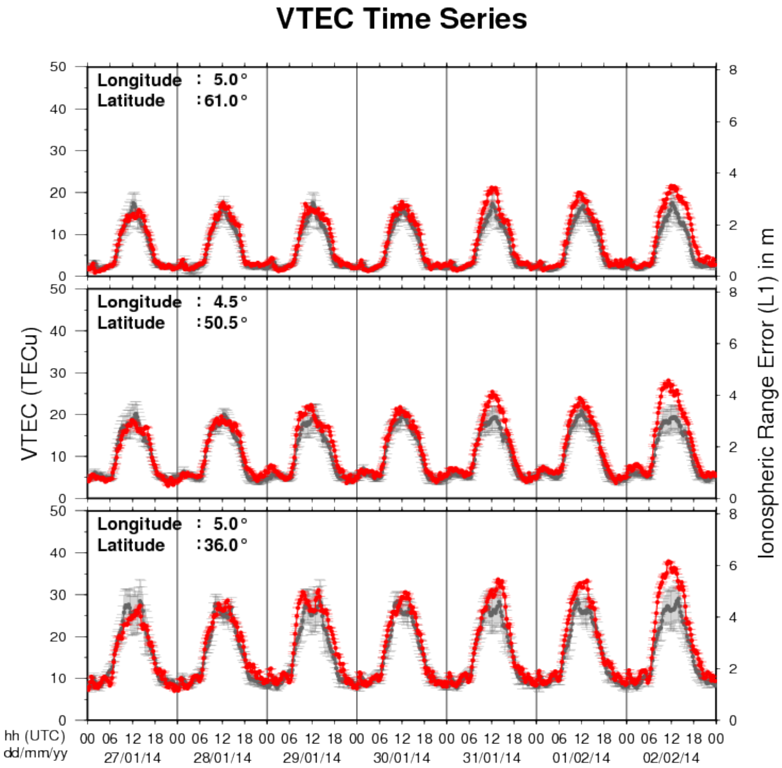
Its effects lasted well into the next day before the wind speed started to decline towards values around 300 km/s. Around 08:45UT on 1 February, solar wind speed gradually began rising from 300 km/s to about 380 km/s. The M6 full halo CME may have arrived late on 2 February around 23:00UT (ACE), with wind speed increasing from 370 to 450 km/s and Bz between -5 and +5 nT. Although, the signature in ACE data is not clearly pointing into the direction of a CME arrival, or even a glancing blow. Anyway, the impact was limited.

The entire week, geomagnetic conditions remained quiet.

5. Geomagnetic Observations at Dourbes (27 Jan 2014 - 2 Feb 2014)



6. Review of ionospheric activity (27 Jan 2014 - 2 Feb 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