# STCE Newsletter

## 19 Jan 2015 - 25 Jan 2015

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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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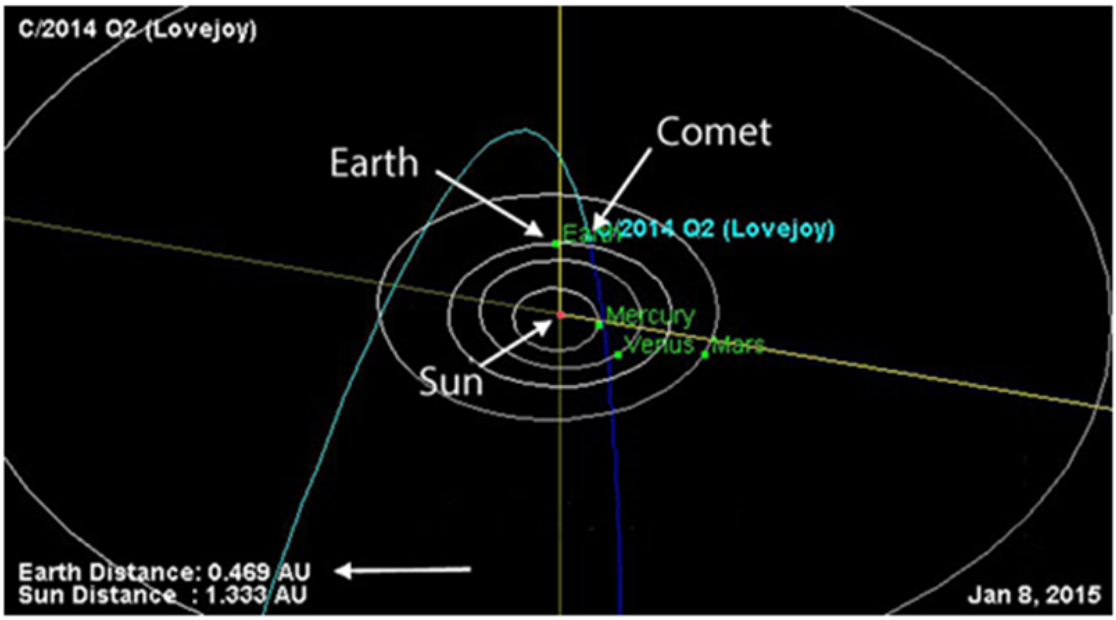
## 1. A comet's tale

Over the last few weeks, sky gazers have been enjoying a relatively bright and colorful comet in the northern skies. Comet Lovejoy, named after its discoverer Terry Lovejoy (Australia), has been the source of many beautiful pictures that can be admired on the web (see e.g. Spaceweather.com comet gallery at http://spaceweathergallery.com/comet_gallery.html).

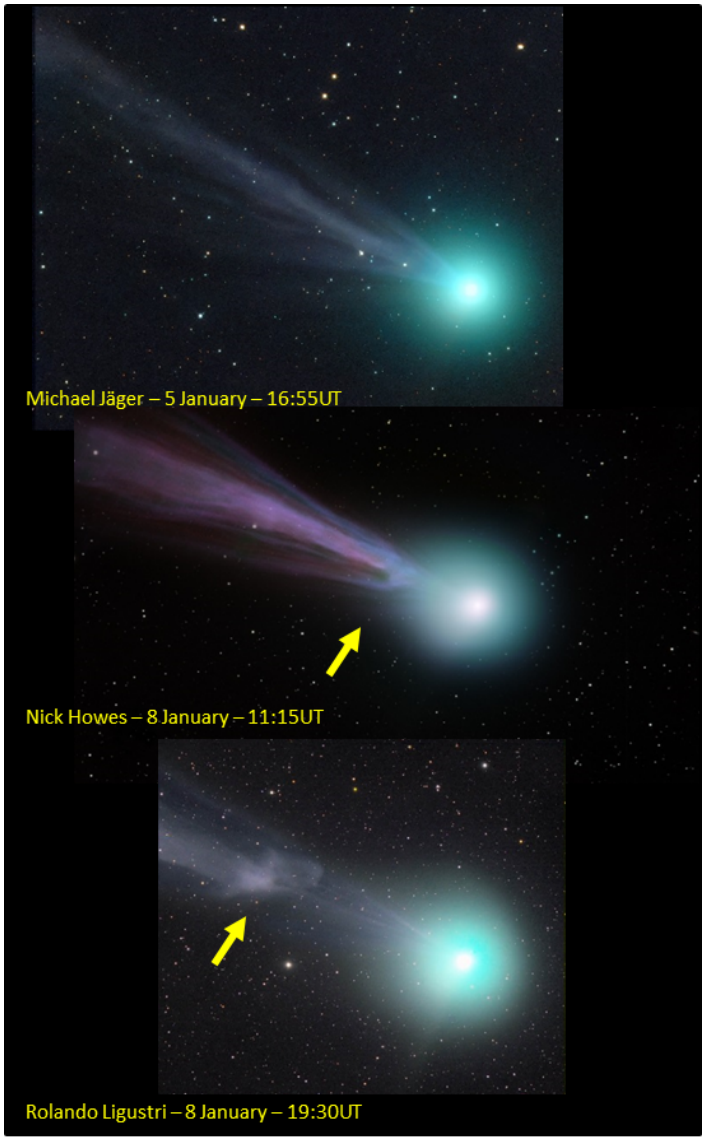
*Credits: Dominique Dierick*

The comet was closest to Earth on 7 January, passing above the ecliptic (the Sun-Earth plane) 2 days later which resulted in better viewing conditions for observers on the northern hemisphere. At the time, the comet was at a distance of about 200 million kilometers from the Sun (see diagram below). Many observers reported it even visible to the naked eye.

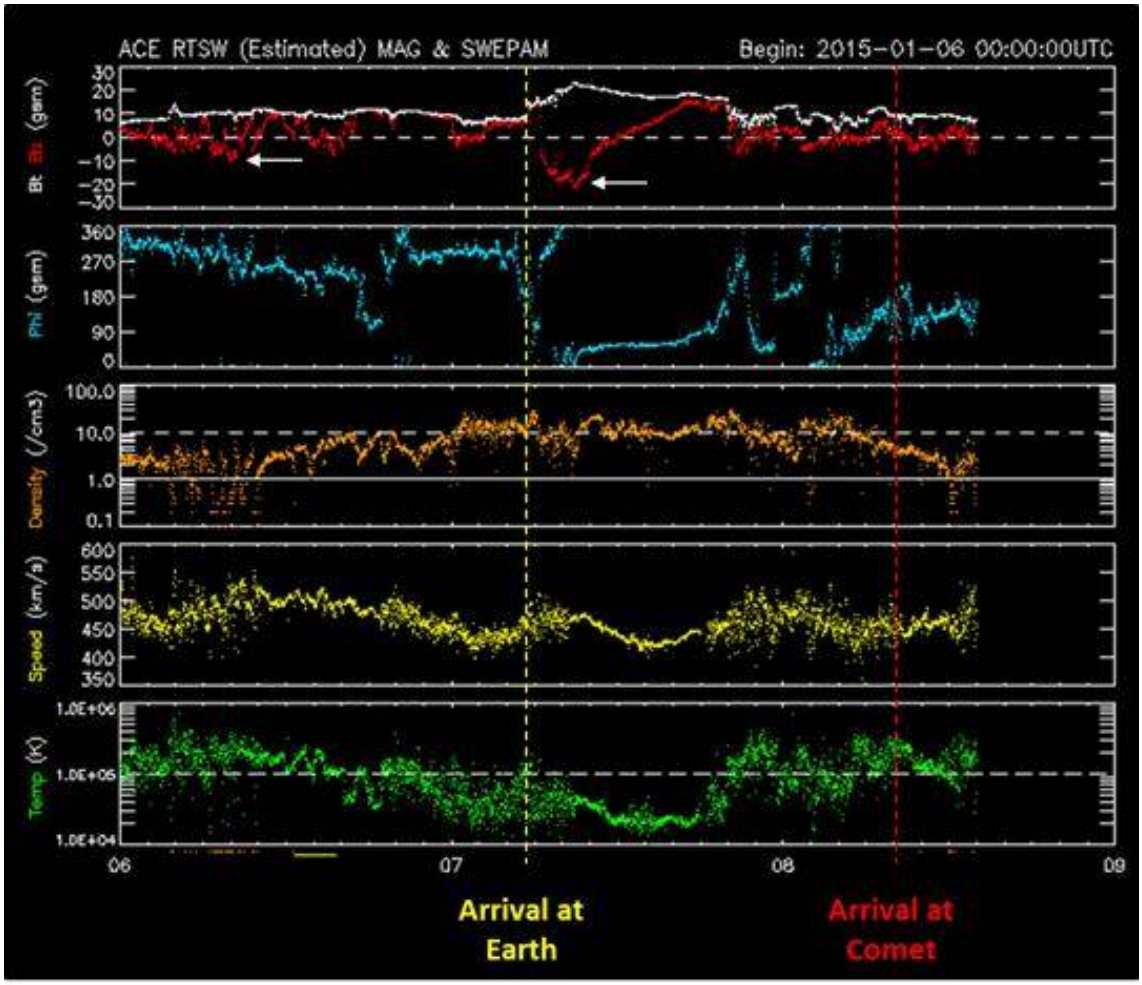



*Credits: NASA/JPL Horizons*

Interestingly, on 8 January, an abrupt change in the comet's ion tail could be observed. An ion tail forms when ultraviolet sunlight rips one or more electrons from gas atoms in the particle cloud around the comet's nucleus, turning them into ions (charged particles). The solar wind then carries these ions straight outward and away from the Sun along the magnetic field lines that are draped around the comet. This is why an ion tail is always pointing away from the Sun. Hence, it is no surprise that when there is a sufficiently strong disturbance in the solar wind, this tail can get detached from the comet. This is called a disconnection event (DE). Such a disconnection event occurred on 8 January (see annotated images below).




The intriguing question is if we can trace back the source of the perturbation in the solar wind. As it turns out, the culprit might have been the same curious, strong disturbance that created a major geomagnetic storm on 7 January at Earth (see this news item at http://stce.be/news/290/welcome.html). Indeed, the comet was more or less in the same pathway of the disturbance as the Earth (see the diagram above). At the observed speed of 480-500 km/s at Earth, it would take about 28-30 hours for the solar wind to transit the remaining 50 million kilometers to the comet. This would put the timing of the encounter of the disturbance with the comet somewhere between 08:00 and 09:00UT on 8 January, nicely fitting Nick Howes 11:15UT image, taken just after the DE had started. The magnetic field of the disturbance had also enough enough punch to detach the comet's tail. Its magnetic field was twice as strong than that of passing high speed streams from coronal holes (e.g. a component of resp. 20 nT vs. 10 nT). See the annotated diagram underneath.



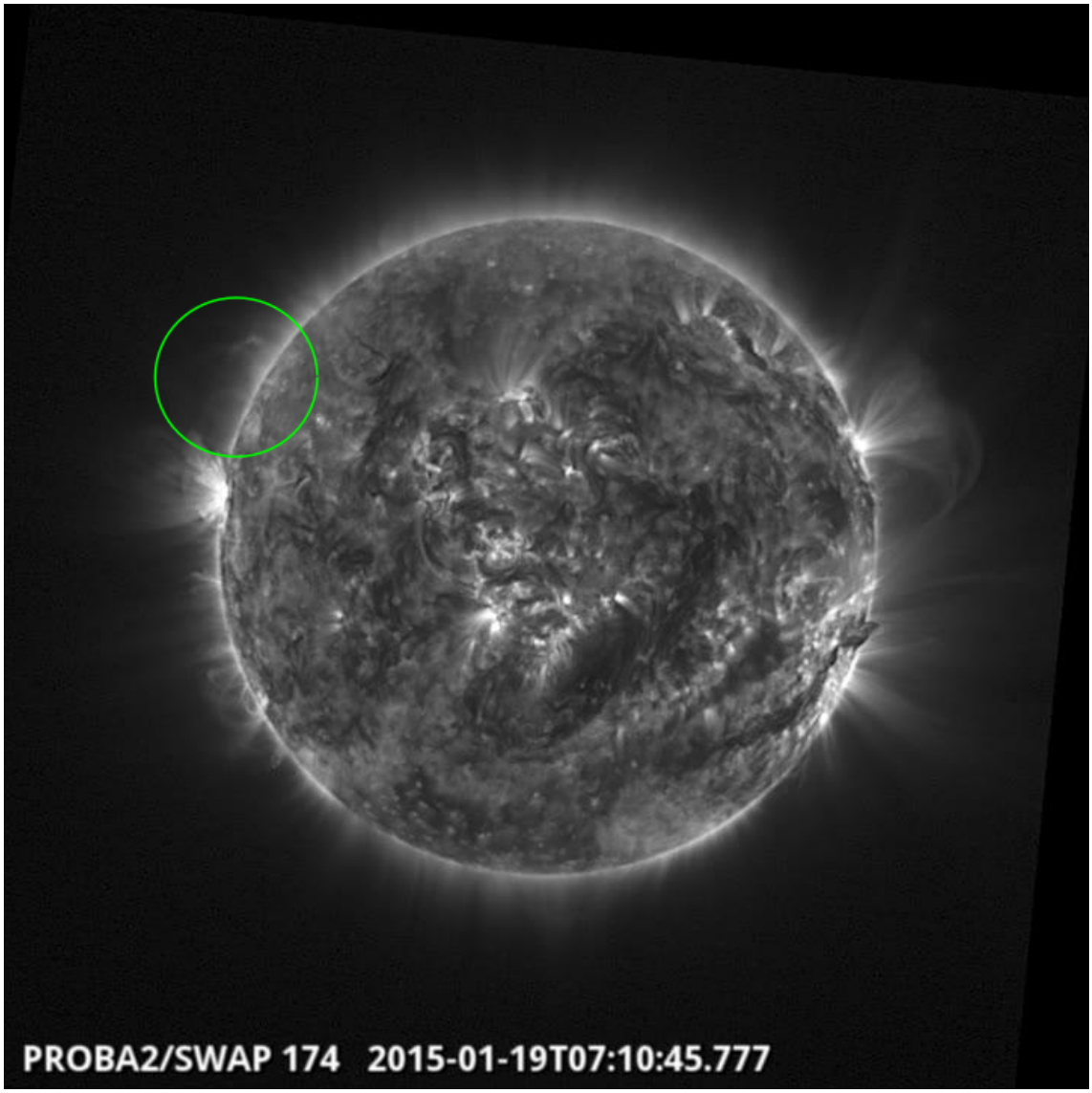

Credits: The original images of the comet can be found at the Spaceweather.com comet gallery (http://spaceweathergallery.com/comet_gallery.html):
- Michael Jäger (http://spaceweathergallery.com/indiv_upload.php?upload_id=106346);
- Nick Howes (http://spaceweathergallery.com/indiv_upload.php?upload_id=106566);
- Rolando Ligustri (http://spaceweathergallery.com/indiv_upload.php?upload_id=106529).

# 2. PROBA2 Observations (19 Jan 2015 - 25 Jan 2015)

## Solar Activity

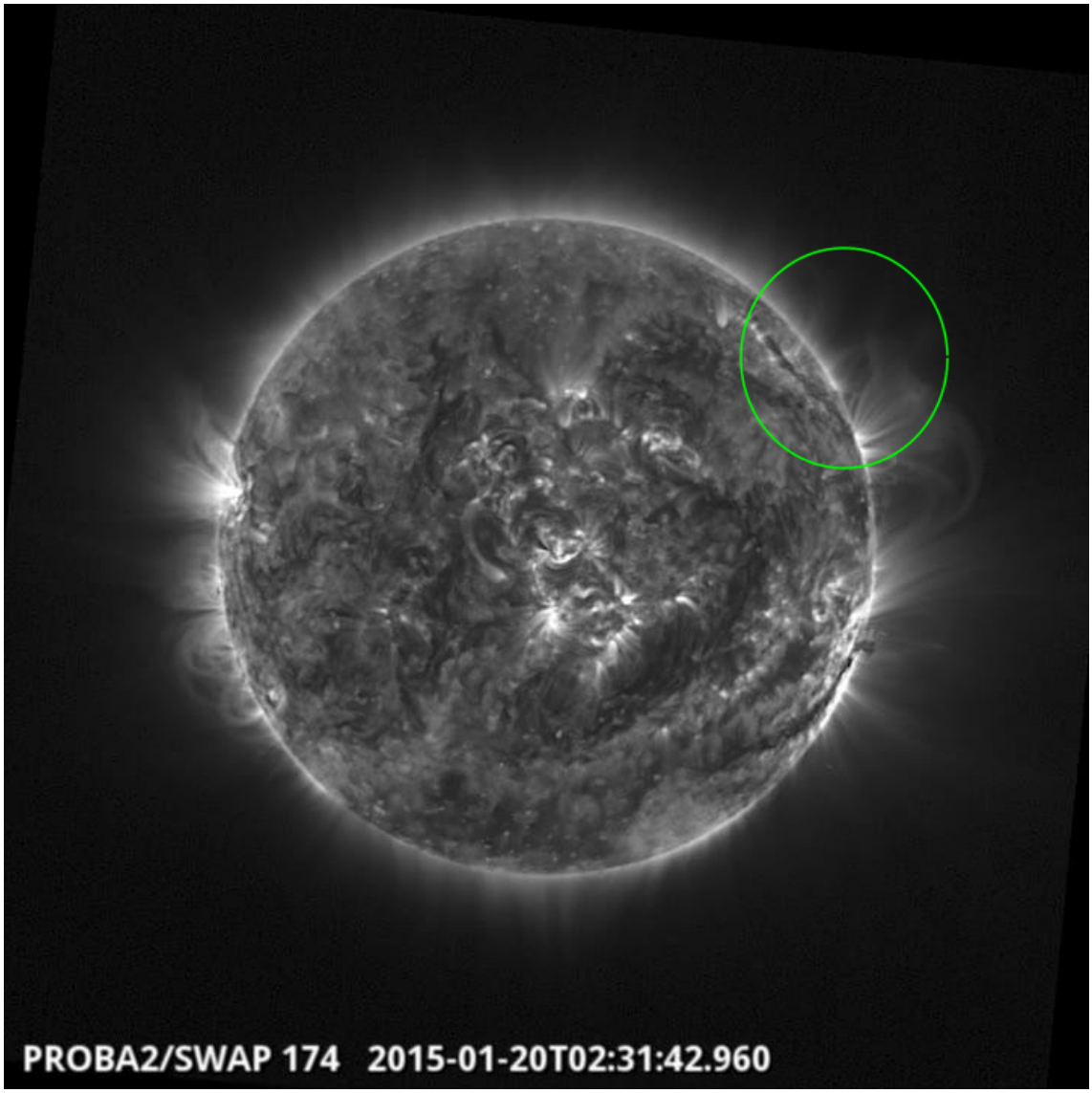
Solar flare activity fluctuated between low and moderate during the week.
In order to view the activity of this week in more detail, we suggest to go to the following website from which all the daily (normal and difference) movies can be accessed:http://proba2.oma.be/ssa
This page also lists the recorded flaring events.
A weekly overview movie can be found here (SWAP week 252).
http://proba2.oma.be/swap/data/mpg/movies/weekly_movies/weekly_movie_2015_01_19.mp4
Details about some of this week's events, can be found further below.

## Monday Jan 19



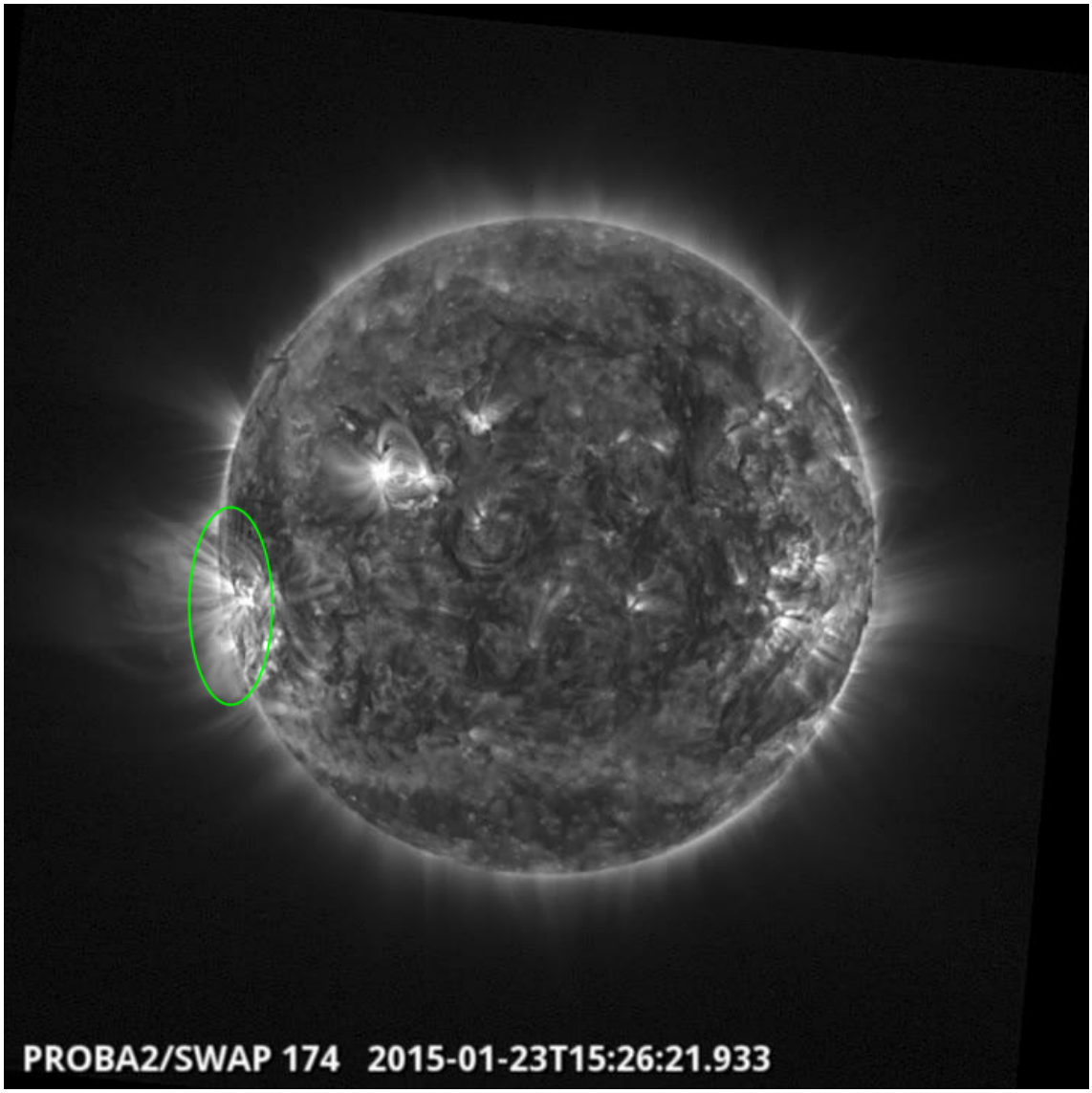

Eruption north east limb @ 07:10 SWAP image
Find a movie of the events here (SWAP movie)
http://proba2.oma.be/swap/data/mpg/movies/20150119_swap_movie.mp4

## Tuesday Jan 20




Eruption north west limb @ 02:31 SWAP image
Find a movie of the events here (SWAP movie)
http://proba2.oma.be/swap/data/mpg/movies/20150120_swap_movie.mp4

**Friday Jan 23**

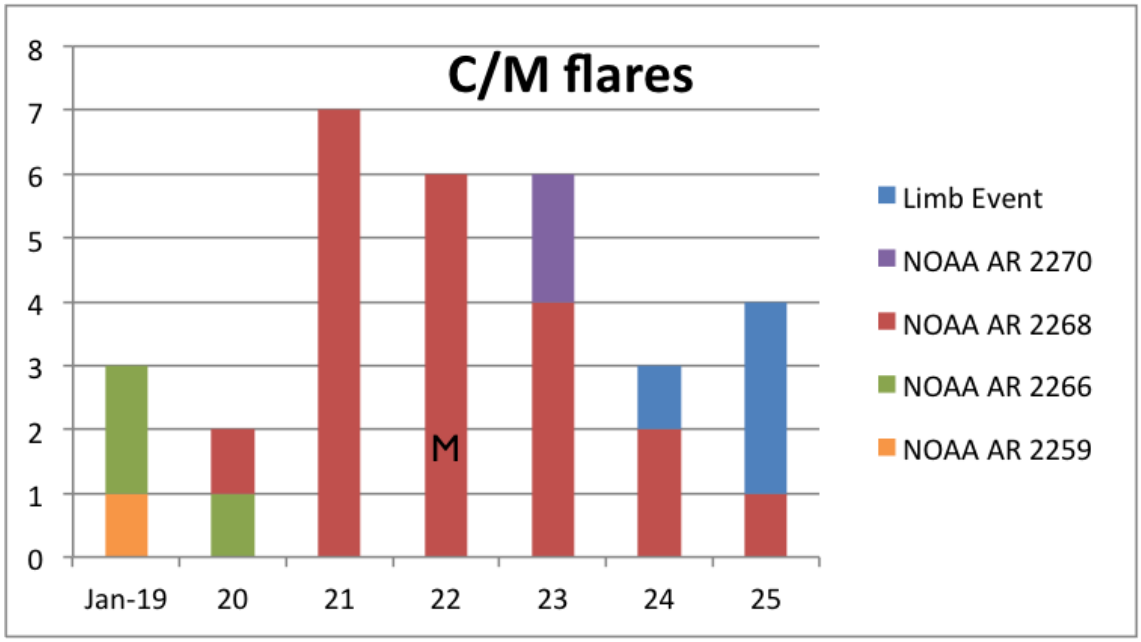



Filament restructuring on the east limb @ 15:26 SWAP image
Find a movie of the event here (SWAP movie)
http://proba2.oma.be/swap/data/mpg/movies/20150123_swap_movie.mp4

# 3. Review of solar and geomagnetic activity

## Solar Activity

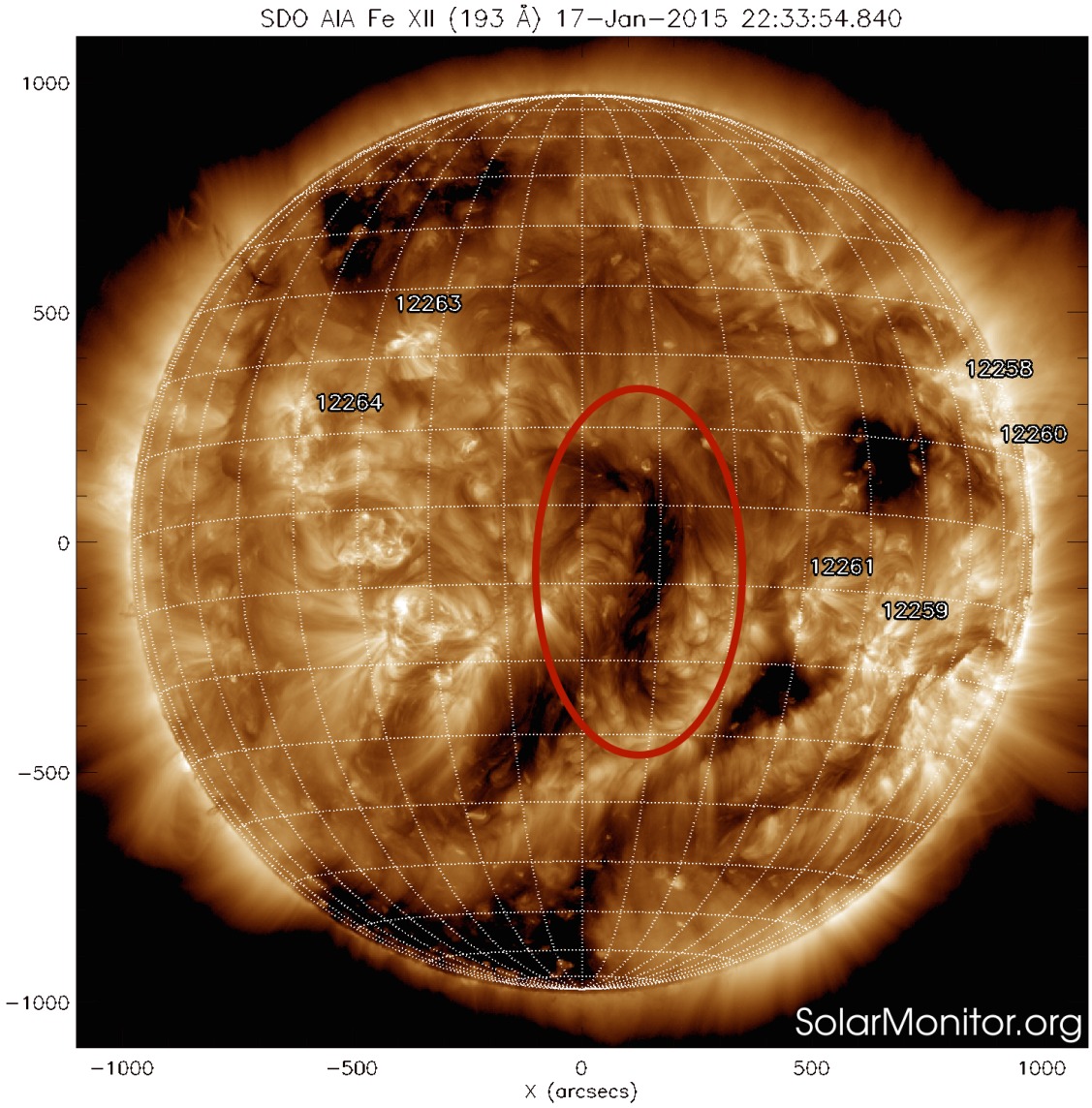
Solar activity at the beginning of the week was very low with only minor C-class flaring. The activity increased with the appearance of NOAA AR 2268 over the east limb producing several C-class flares and one M1.4 flare on January 22, with peak at 04:52 UT.



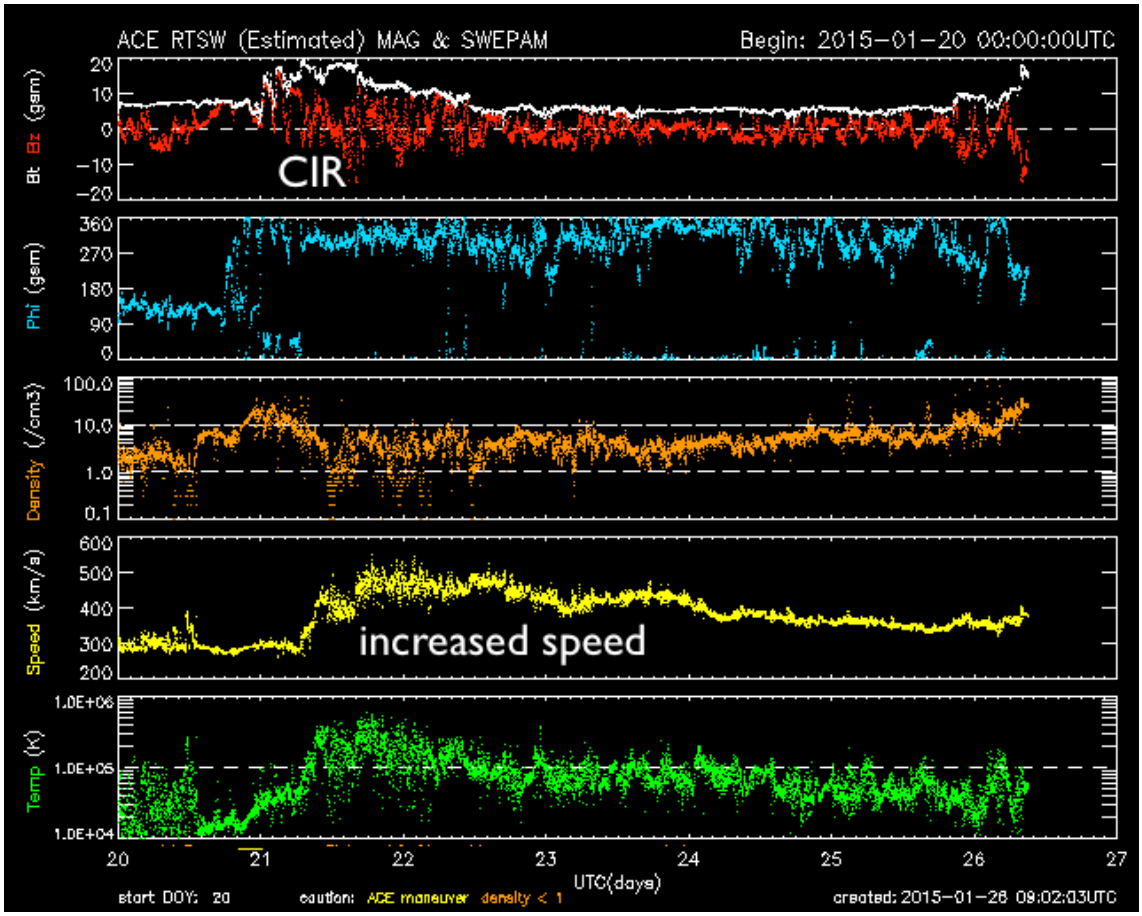

A slow partial halo CME mostly directed to the south, was seen at 15:48 UT on January 24 from a filament eruption close to disk center.

## Geomagnetic Activity

The fast speed stream from a coronal hole (below: SDO/AIA on January 17, red oval) arrived to the Earth on January 21, raising geomagnetic conditions to active levels during the night of January 21 to 22. The rest of the week was at quiet to unsettled levels.




ACE data show the co-rotating interaction region (CIR°) with increased density and magnetic field and the fast solar wind.



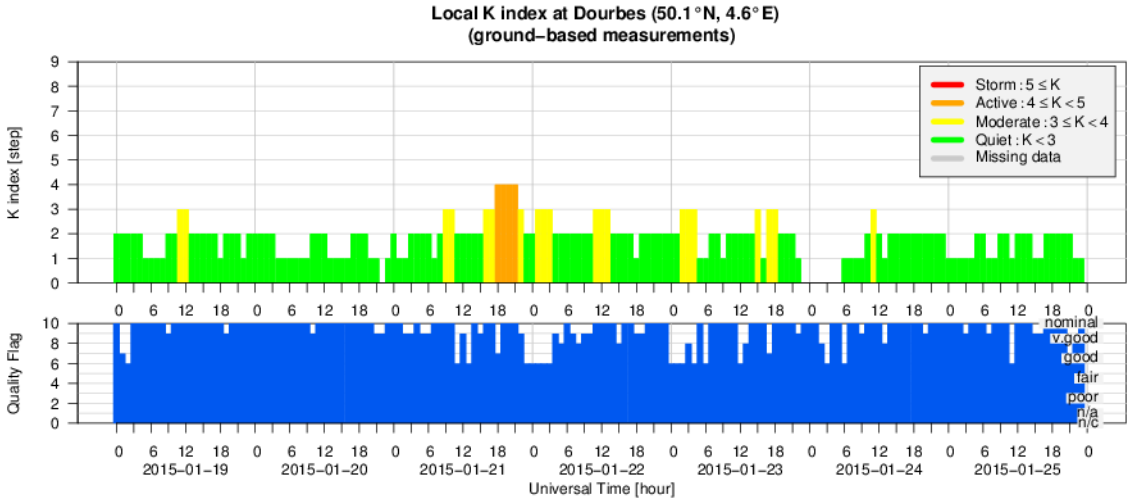

Although the CME from January 24 was mostly directed to the south, a part of it may hit the Earth on January 29. Due to the southward direction and the low speed, the January 24 CME did not arrive.

## 4. Noticeable Solar Events (19 Jan 2015 - 25 Jan 2015)

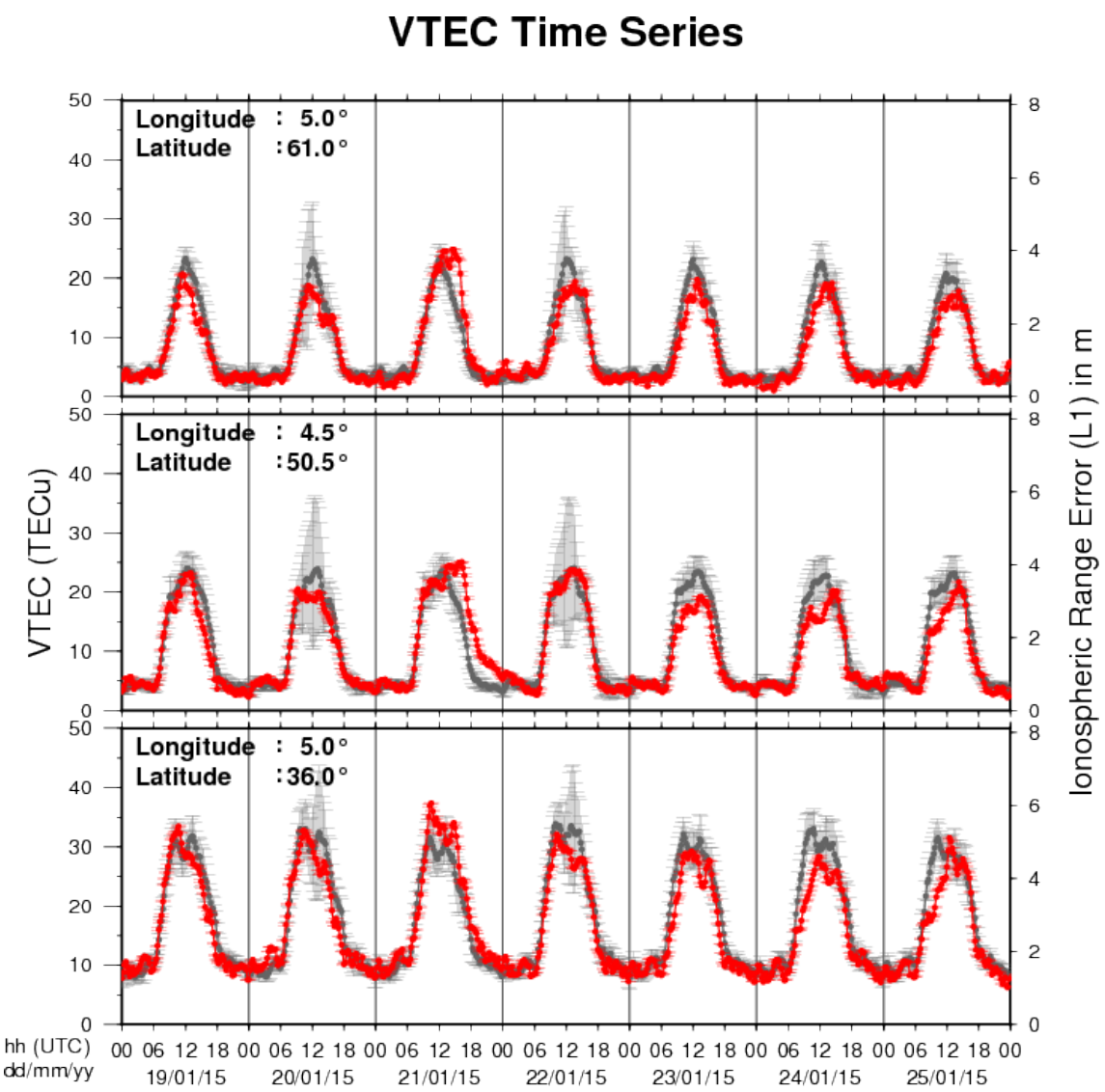
| DAY | BEGIN | MAX | END | LOC | XRAY | OP | 10CM | TYPE | Cat | NOAA |
|---|---|---|---|---|---|---|---|---|---|---|
| 22 | 0443 | 0452 | 0502 | | M1.4 | | | | | 2268 |

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

## 5. Geomagnetic Observations at Dourbes (19 Jan 2015 - 25 Jan 2015)



## 6. Review of ionospheric activity (19 Jan 2015 - 25 Jan 2015)




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

# 7. Future Events

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

## Conference on Sun-Climate Connections (SCC 2015) in Kiel, Germany

Start : 2015-03-16 - End : 2015-03-19
This international conference will provide an overview of our current understanding of Sun-Climate Connections starting at processes on the Sun itself over space weather and solar wind towards solar influence on the upper atmosphere down to the ocean. It will also provide insights into the heatedly debated role of the Sun in climate change. In four sessions the various contributions of solar variability influence on Earth's climate will be presented and discussed by bringing together solar physicists, space scientists, atmospheric scientists, climate modellers, and paleoclimatologists.
We expect contributions from scientists participating in SCOSTEP/ROSMIC, SPARC-SOLARIS/HEPPA, the EU cost network TOSCA, as well as any other interested scientists. The conference will last three full days, beginning Monday morning, 16 March 2013. The programme will consist of invited and keynote lectures, a few contributed oral presentations and ample time dedicated to poster sessions. The fourth day will be devoted to public outreach activities as well as panel discussions.
Website: http://scc.geomar.de/

## URSI AT-RASC 2015 in Gran Canaria, Spain

Start : 2015-05-18 - End : 2015-05-22
URSI AT-RASC 2015 will be the first edition of the newly established triennial URSI Atlantic Radio Science Conference as one of the URSI Flagship Conferences. AT-RASC 2015 will have an open scientific program composed of submitted papers within the domains covered by all ten Commissions of URSI.
Website: http://www.at-rasc.com/

## Los Alamos Space Weather Summer School, in Los Alamos, NM, USA

Start : 2015-06-01 - End : 2015-07-24
The Space Weather Summer School at Los Alamos National Laboratory, established in 2011 under the founding Director Josef Koller, is dedicated to space weather, space science and applications. Every year we solicit applications for the Los Alamos Space Weather Summer School. This summer school is sponsored and supported by a number or organizations at LANL. This year our top sponsors include the Los Alamos Institute of Geophysics, Planetary Physics and Signatures (IGPPS) and the Laboratory Directed Research and Development Office (LDRD). The summer school brings together top space science students with internationally recognized researchers at LANL in an educational and collaborative atmosphere.
Website:
http://www.swx-school.lanl.gov/

## Loops7: Heating of the Magnetically Closed Corona in Cambridge, UK

Start : 2015-07-21 - End : 2015-07-23
The conference will review past and recent achievements, as well as future challenges in the field of solar coronal loop physics.
Website:
http://www.damtp.cam.ac.uk/user/astro/cl7/index.html

## Heliophysics Summer Schoool 2015: Seasons in Space: Cycles of variability of Sun-Planet systems, in Boulder, CO, USA

Start : 2015-07-28 - End : 2015-08-04
Heliophysics is all of the science common to the field of the Sun-Earth connections. This fast-developing field of research covers many traditional sub-disciplines of space physics, astrophysics, and climate studies. The NASA Living with a Star program, with its focus on the basic science underlying all aspects of space weather, acts as a catalyst to bring the many research disciplines together to deepen our understanding of the system of systems formed by the Sun-Earth connection.
Website:
http://www.heliophysics.ucar.edu/

## 34th International Cosmic Ray Conference (ICRC) in The Hague, The Netherlands

Start : 2015-07-30 - End : 2015-08-06
The 34th International Cosmic Ray Conference (ICRC) will be held from July 30 to August 6, 2015, in The Hague, The Netherlands. It is an important and large conference in the field of Astroparticle Physics. The ICRC covers: cosmic-ray physics, solar and heliospheric physics, gamma-ray astronomy, neutrino astronomy, and dark matter physics.
Website: http://icrc2015.nl

## Ground-based Solar Observations in the Space Instrumentation Era in Coimbra, Portugal

Start : 2015-10-05 - End : 2015-10-09
This CSPM-2015 scientific meeting will cover various aspects of solar dynamic and magnetic phenomena which are observed over the entire electromagnetic spectrum: white-light, Hα, Ca II, and radio from ground and in a variety of other wavelengths (white light, UV and EUV, and X-rays) from space. Emphasis will also be placed on instrumentation, observing techniques, and solar image processing techniques, as well as theory and modelling through detailed radiative transfer in increasingly realistic MHD models. The long-term (cyclic) evolution of solar magnetism and its consequence for the solar atmosphere, eruptive phenomena, solar irradiation variations, and space weather, will be in focus. Here, special attention will be devoted to the long-term observations made in Coimbra and also to the results of the SPRING / SOLARNET and SCOSTEP VarSITI studies. In particular, the weak solar activity during the current solar maximum will be discussed. Finally, since this meeting is organised around the 90th anniversary of performing the first spectroheliographic observations in Coimbra, a session will be specially dedicated to new solar instruments (both ground-based and space-borne) that will give access to unexplored solar atmospheric features and dynamic phenomena over the coming years.
Website:
http://www.mat.uc.pt/~cspm2015/

## 41st COSPAR Scientific Assembly in Istanbul, Turkey

Start : 2016-07-30 - End : 2016-08-07
The 41st COSPAR Scientific Assembly will be held in Istanbul, Turkey from 30 July - 7 August 2016. This Assembly is open to all bona fide scientists.
Website:
https://www.cospar-assembly.org/