

# STCE Newsletter

25 Jun 2018 - 1 Jul 2018



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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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Final Editor : Petra Vanlommel  
Contact : R. Van der Linden, General Coordinator STCE,  
Ringlaan - 3 - Avenue Circulaire, 1180 Brussels,  
Belgium

## 1. The Annie Maunder Astrographic Telescope

Over the past year, members of the astronomy team at the Royal Observatory of Greenwich have been installing a new suite of telescopes in the 19th Century Altazimuth Pavilion. The cluster of instruments consists of a 14 inch (35.5 cm) reflecting telescope for high-resolution images of the sun, moon and planets, a dedicated H-alpha solar telescope, a telescope for observing distant nebulae, and a general purpose telescope. They collectively are called AMAT: the Annie Maunder Astrographic Telescope. The telescopes already saw their first light in June, and will be opening this summer. It will take the Royal Observatory back to being a "working observatory" in the sense that research-grade observations can be done, though the telescopes' main purpose is for public engagement, the potential for research and discovery. The captivating images will be put online, reaching a global audience. Indeed, to the AMAT team, inspiring people is as important as doing research.



Astronomer Brendan Owens prepares the new Annie Maunder Astrographic Telescope at the Royal Observatory Greenwich

The suite of telescopes has been named in honour of Annie Maunder. Annie Scott Dill Russell was born on 14 April 1868, and graduated with honours in the notoriously rigorous mathematical tripos ([https://en.wikipedia.org/wiki/Mathematical\\_Tripos](https://en.wikipedia.org/wiki/Mathematical_Tripos)) in 1889. She was hired as a human computer at the Royal Observatory in 1891. Also, as the telescopes at Greenwich were specifically designed for photographing the Sun, Annie worked alongside her colleagues in taking the photographs, making notes, developing the plates and reviewing the images in detail.



Annie Scott Dill Maunder (née Russell) by Lafayette 1931 © National Portrait Gallery, London

When she married Walter Maunder (her supervisor in the Solar Department) in 1895, she -as a government employee- was required to give up her position. However, she continued to develop her astronomical skills as a volunteer and focused her energies on organizing solar eclipse expeditions with her husband through the British Astronomical Association. She was a keen photographer and achieved considerable success in capturing images of the Sun's atmosphere during the brief few minutes of a total solar eclipse. Her pictures of the 22 January 1898 solar eclipse, when she photographed an enormous 14 solar radii long ray-like structure appearing to burst from the Sun. This coronal streamer was the longest ever recorded up to that time.

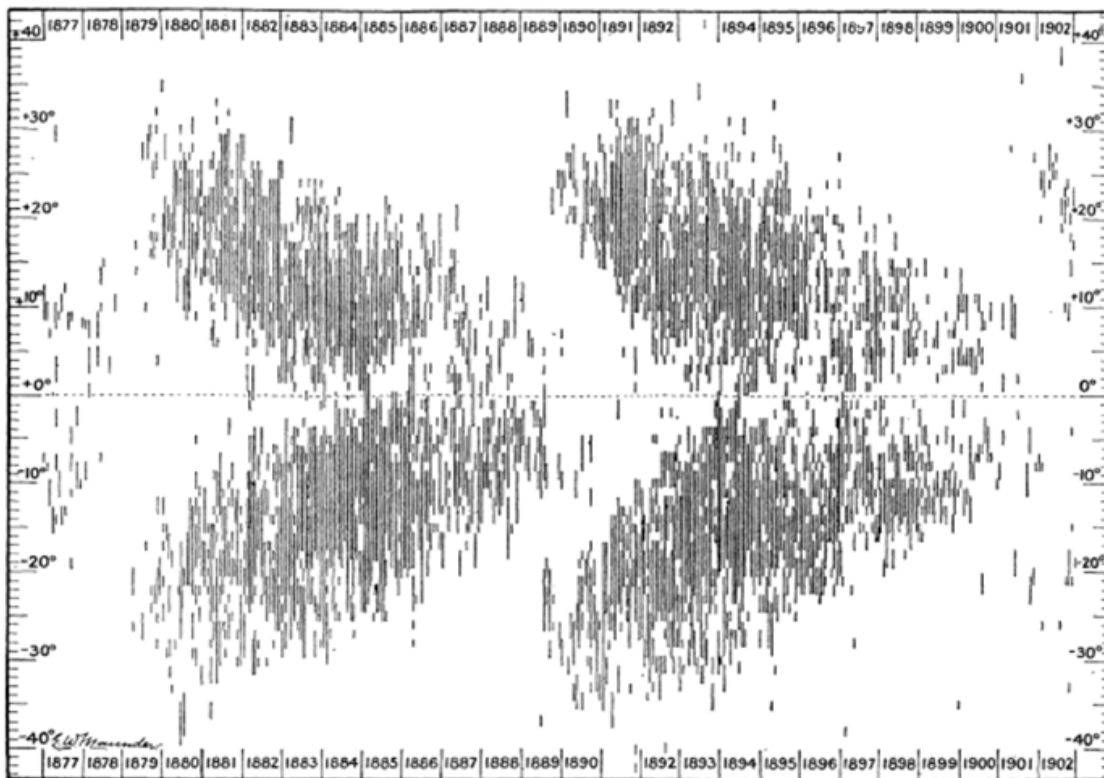


FIG. 8.—DISTRIBUTION OF SPOT-CENTRES IN LATITUDE, ROTATION BY ROTATION, 1877-1902.

Annie continued to assist her husband with his research. Part of Maunder's job at the Observatory involved photographing and measuring sunspots, and in doing so he observed that the solar latitudes at which sunspots occur varies in a regular way over the course of the 11 year cycle. In 1904, he published their results in the form of the "butterfly" diagram, showing the evolution of the latitude of sunspot groups throughout the solar cycle. The husband-and-wife team often published their articles in joint names and sought to bring astronomy to new audiences through newspaper articles and books on popular astronomy. These included a catalogue of some 600 recurrent sunspot groups observed and photographed at Greenwich (1907), and "The Heavens and their Story" (1910), a book which Walter admits in its introduction was "almost wholly the work of my wife."

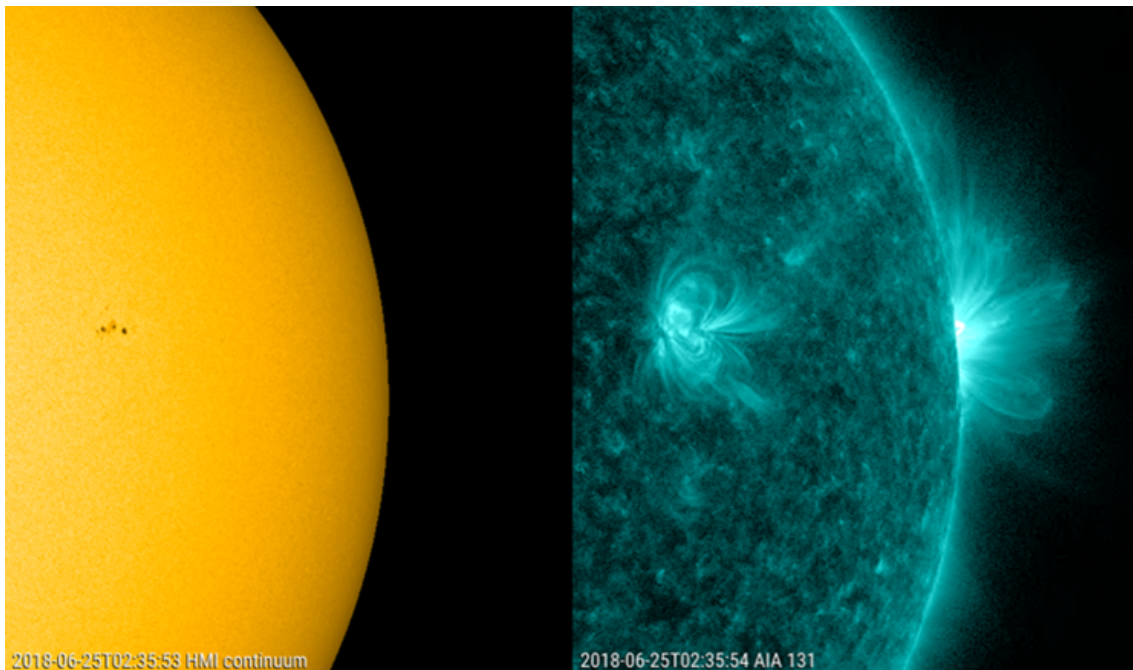
In 1916 Annie Maunder became one of the first women accepted by the Royal Astronomical Society. Annie died, aged 79, in Wandsworth, London in 1947, surviving her husband by almost 20 years. The crater Maunder on the Moon is jointly named for Walter and Annie Maunder, as is the Maunder Minimum.

### Credits and further reading

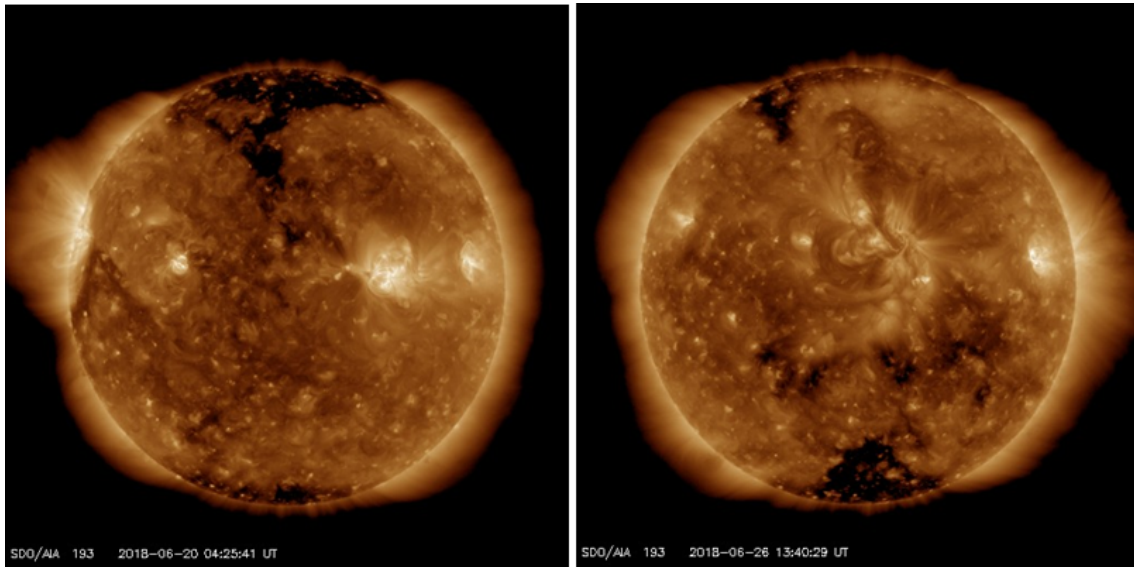
This article was mostly based on the Royal Museums Greenwich webpages "First Light: a new era for the Royal Observatory" by Kate Wilkinson, as well as the article "Annie Russell Maunder". Both texts are available online at resp. <https://www.rmg.co.uk/discover/behind-the-scenes/blog/first-light> and <https://www.rmg.co.uk/discover/explore/annie-russell-maunder> Images were taken from the Royal Museums Greenwich, with the image of the butterfly diagram coming from Maunder's 1904 paper (<http://adsabs.harvard.edu/abs/1904MNRAS..64..747M>).

## 2. Review of solar activity

Solar flaring activity was very low during the week with no C-class flares and only 3 low-level B-class flares reported. Catania sunspot group 88 (Active Region (AR) NOAA 2715) was the only sunspot group observed on the visible side of the solar disk this week, producing 2 B-class flares. The other (and strongest) B-class event was a B2.5 flare which originated in NOAA 2713 from behind the west limb (see the SDO imagery underneath). There were no wide or Earth-directed coronal mass ejections (CMEs) observed and the solar proton flux remained at the background level during the whole week.



Two coronal holes were observed this week. The first one was the low-latitude extension of the northern polar coronal hole (CH) which was close to the west limb at the beginning of the week. This CH had a positive magnetic polarity and had reached the central meridian during the previous week, in the morning of 20 June. The second, rather patchy and elongated, negative polarity equatorial coronal hole transited the central meridian from about 23 till the morning of 28 June.



### 3. PROBA2 Observations (25 Jun 2018 - 1 Jul 2018)

#### Solar Activity

Solar flare activity remained very low during the week.

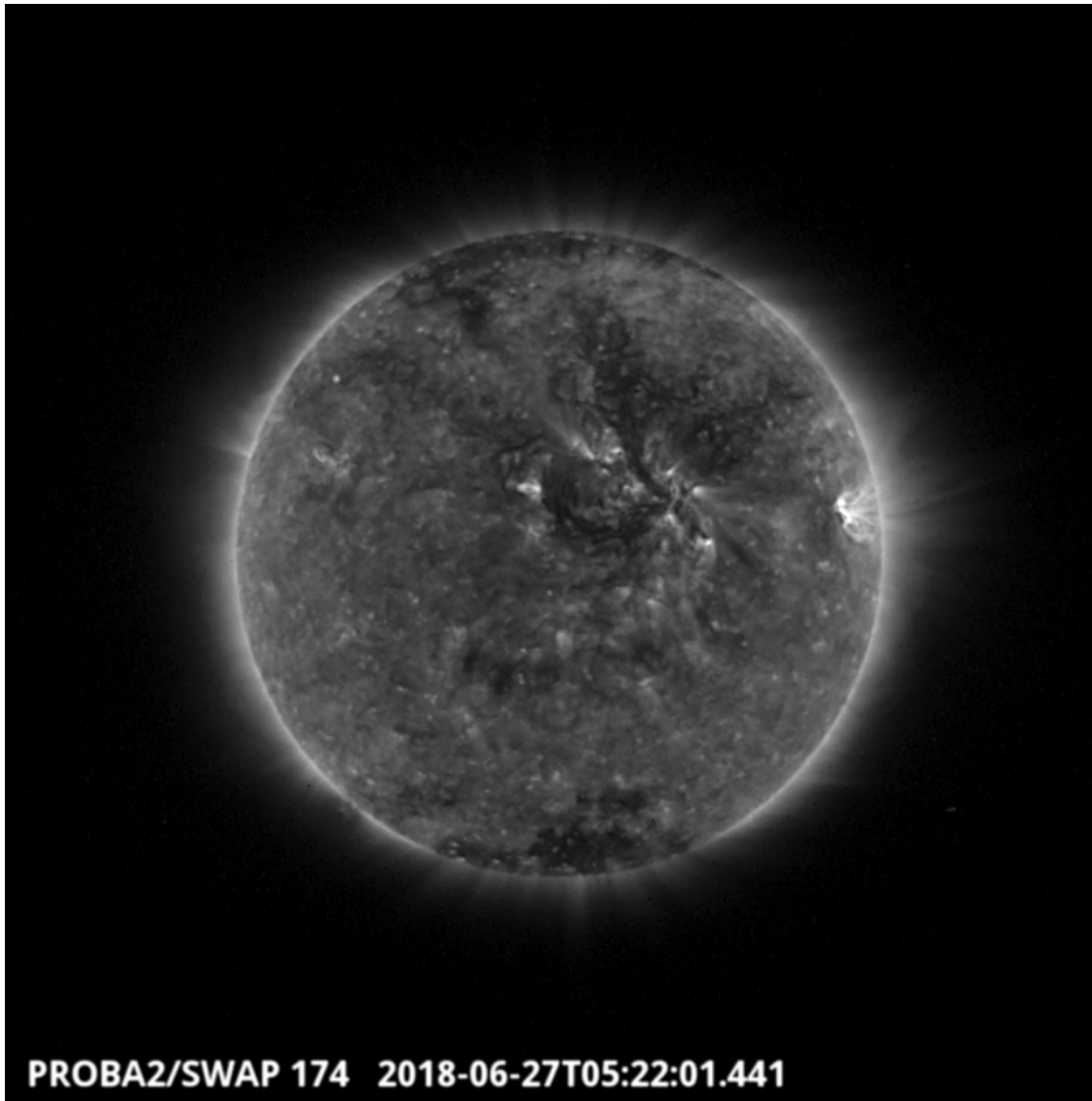
In order to view the activity of this week in more detail, we suggest to go to the following website from which all the daily (normal and difference) movies can be accessed: <http://proba2.oma.be/ssa>  
This page also lists the recorded flaring events.

A weekly overview movie can be found here (SWAP week 431): [http://proba2.oma.be/swap/data/mpg/movies/weekly\\_movies/weekly\\_movie\\_2018\\_06\\_25.mp4](http://proba2.oma.be/swap/data/mpg/movies/weekly_movies/weekly_movie_2018_06_25.mp4)

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

If any of the linked movies are unavailable they can be found in the P2SC movie repository here: <http://proba2.oma.be/swap/data/mpg/movies/>

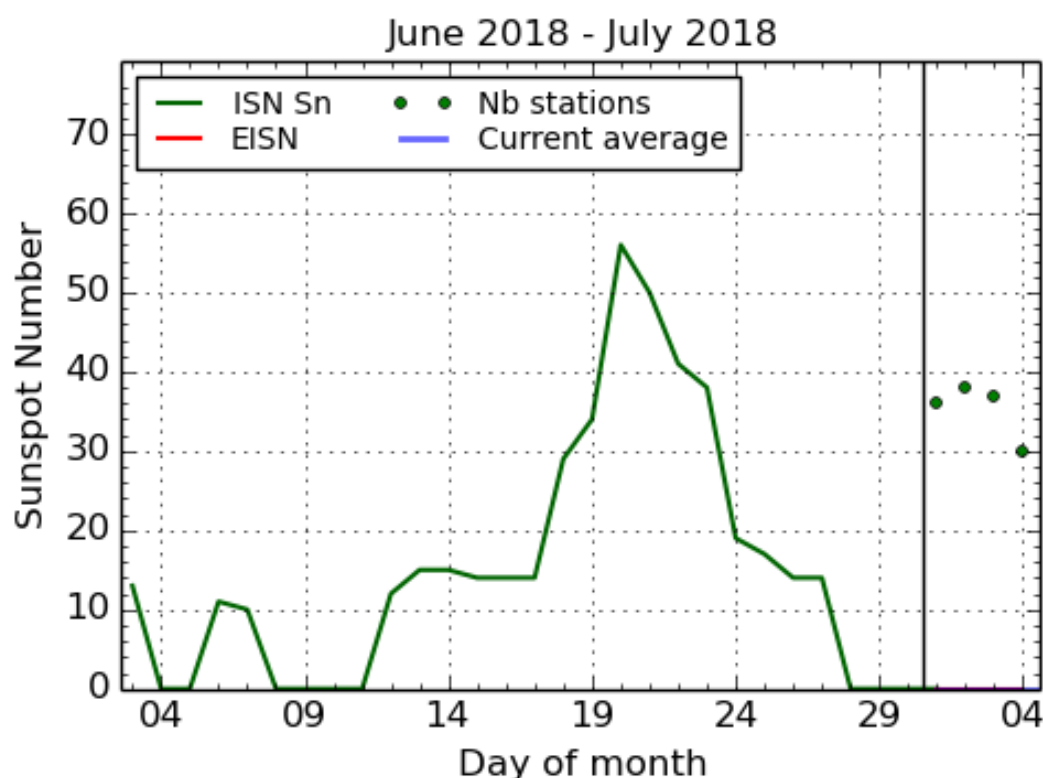
**Wednesday Jun 27**



A B2.3 flare was observed by SWAP near the west limb of the Sun on 2018-Jun-27. This is shown in the SWAP image above at 05:22 UT.

Find a movie of the event here (SWAP movie): [http://proba2.oma.be/swap/movies/20180627\\_swap\\_movie.mp4](http://proba2.oma.be/swap/movies/20180627_swap_movie.mp4)

## 4. The International Sunspot Number



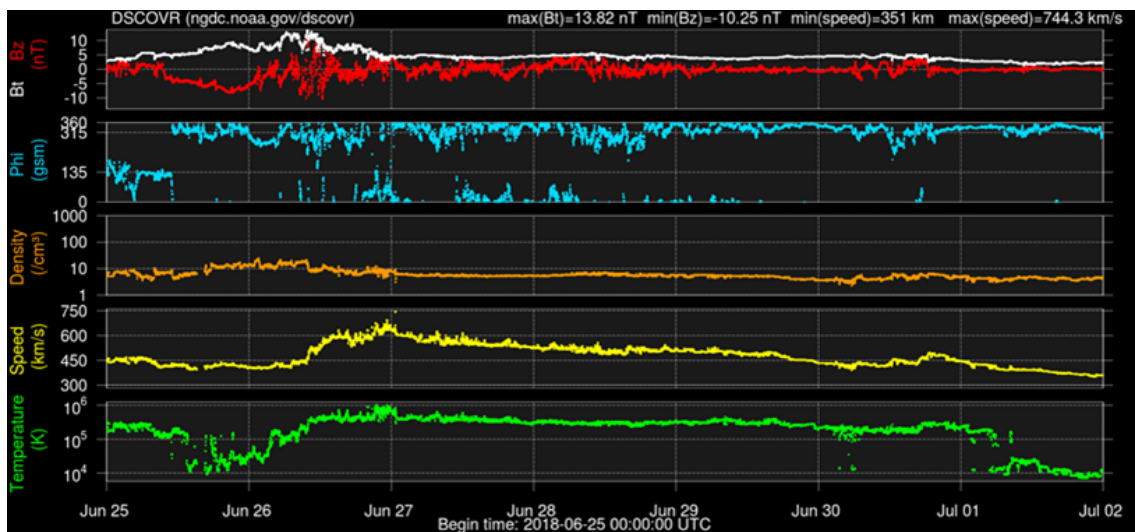
SILSO graphics (<http://sidc.be/silso>) Royal Observatory of Belgium, 2018 July 4

The daily Estimated International Sunspot Number (EISN, red curve with shaded error) derived by a simplified method from real-time data from the worldwide SILSO network. It extends the official Sunspot Number from the full processing of the preceding month (green line). The plot shows the last 30 days (about one solar rotation). The horizontal blue line shows the current monthly average, while the green dots give the number of stations included in the calculation of the EISN for each day.

## 5. Review of geomagnetic activity

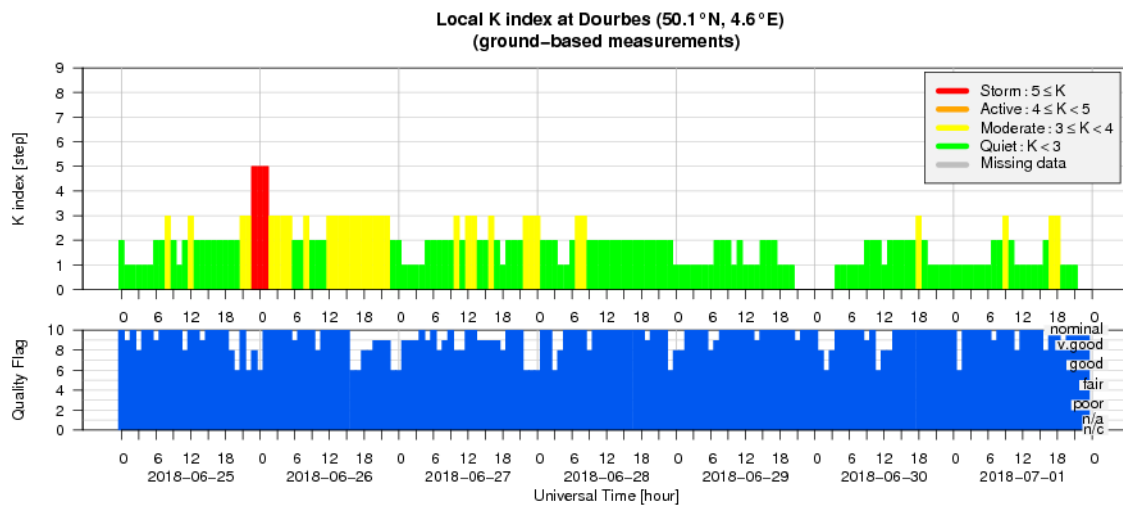
The week started with the arrival of the fast solar wind associated with the patchy equatorial negative polarity coronal hole which started its central meridian transit around 23 June. The fast flow arrival was indicated by the sector change and smooth increase of the interplanetary magnetic field (IMF) magnitude, observed starting from midday of 25 June, which was followed by strong variation of its  $B_z$  component. The maximum of the solar wind speed of about 660 km/s was recorded on 27 June. The IMF remained directed towards the Sun (negative sector) for the rest of the week.





Due to the long interval of negative values of the Bz component, both the local station at Dourbes as well as NOAA recorded minor geomagnetic storming conditions (K=5 and Kp=5, respectively) on midnight between 25 and 26 June. For the rest of the week, the geomagnetic conditions were mostly quiet with several unsettled intervals.

## 6. Geomagnetic Observations at Dourbes (25 Jun 2018 - 1 Jul 2018)



## 7. The SIDC Space Weather Briefing

The Space Weather Briefing presented by the forecaster on duty from 25 June till 1 July. It reflects in images and graphs what is written in the Solar and Geomagnetic Activity reports. A .wmv version can be found at [http://stce.be/movies/SIDCbriefing\\_20180625\\_0701.wmv](http://stce.be/movies/SIDCbriefing_20180625_0701.wmv) A pdf version is available at [http://stce.be/movies/SIDCbriefing\\_20180625\\_0701.pdf](http://stce.be/movies/SIDCbriefing_20180625_0701.pdf)

# SIDC Space Weather briefing

25 June – 01 July 2018

Jasmina Magdalenic  
&  
SIDC forecaster team

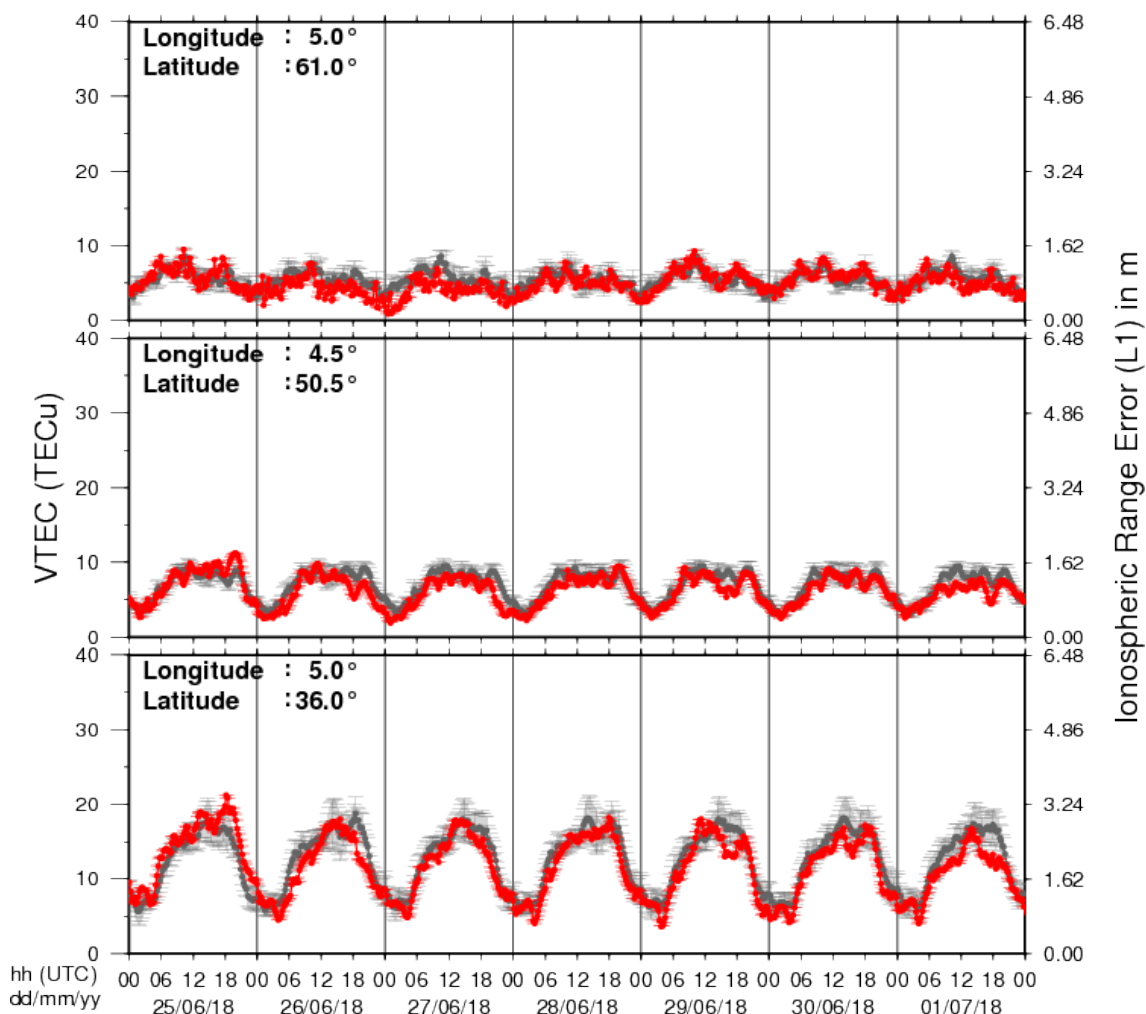
Solar Influences  
Data analysis Centre  
[www.sidc.be](http://www.sidc.be)



Royal Observatory  
of Belgium

## 8. Review of ionospheric activity (25 Jun 2018 - 1 Jul 2018)

### 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:

- in the northern part of Europe (N61°, 5°E)
- above Brussels (N50.5°, 4.5°E)
- 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](http://stce.be/newsletter/GNSS_final.pdf) for some more explanations ; for detailed information, see [http://gnss.be/ionosphere\\_tutorial.php](http://gnss.be/ionosphere_tutorial.php)