STCE Newsletter

13 May 2019 - 19 May 2019

Published by the STCE - this issue : 24 May 2019. 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. Treasures from the past - precursors for solar physics

Eugène Spée, precursor for solar physics at the ROB

Solar physics at the ROB has deep roots that go as far back as the late 19th century. However, the path to the current SIDC research team was not a simple continuous one. It involved a first promising era, followed by a 33-year long hiatus.

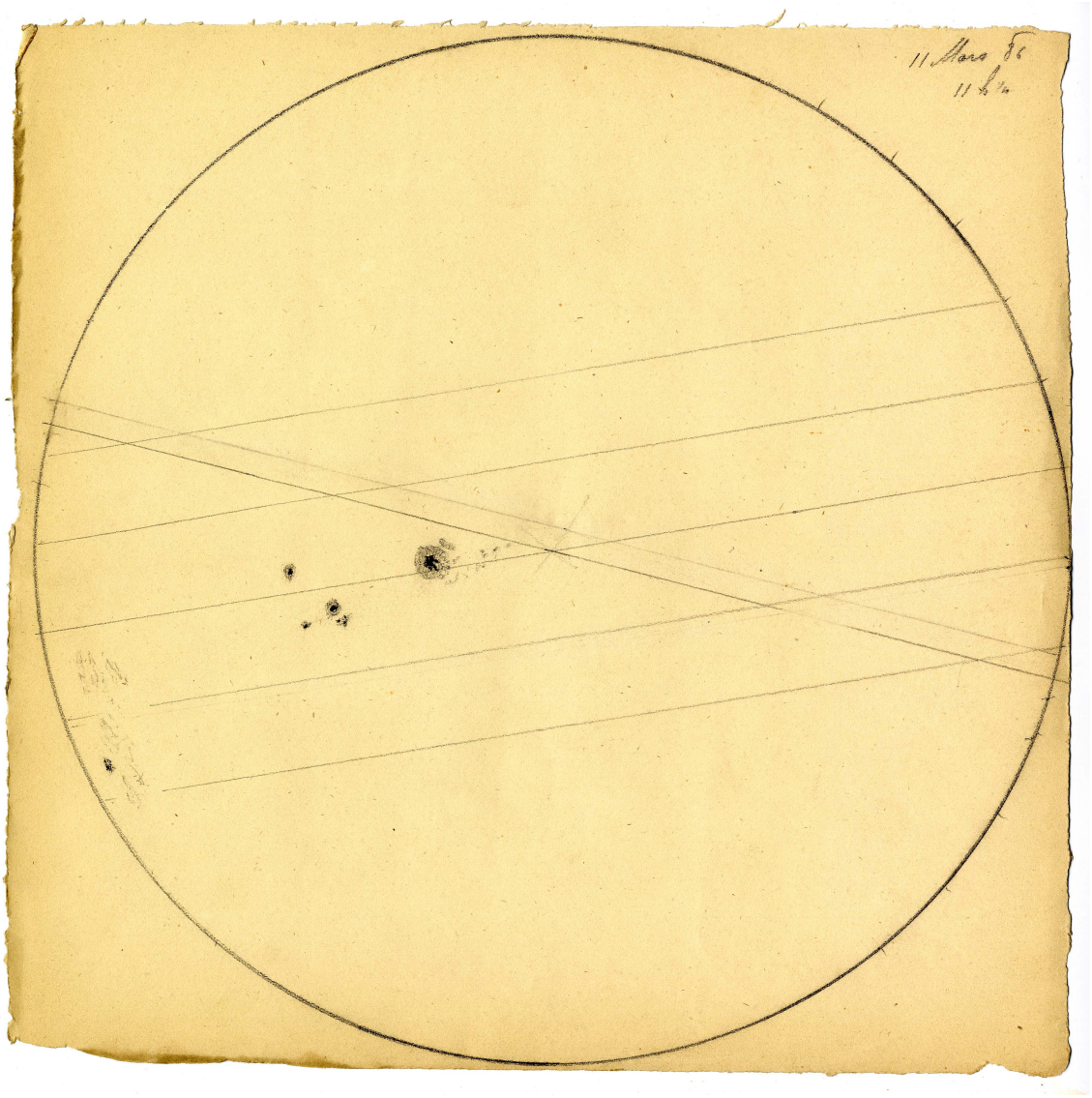
We owe the first era of solar studies to a single central actor, Eugène Jean Hubert Spée (Liège, Nov. 19 1843, Grivegnée, Dec. 11, 1924). Spée got his PhD at the Catholic University of Leuven in 1874.

Portrait of Spée

Simultaneously, he pursued a religious vocation and became Canon of the catholic church. Immediately after his PhD, he moved to the Observatory of the Jesuit Collegio Romano in the Vatican (Rome), where he worked as assistant of the famous Italian solar physicist Angelo Secchi (1818-1878). There, he took part in the daily solar observations and developed an expertise in solar spectroscopy, a new technique of which Italian solar observers were then at the forefront.

After 10 years in Rome, on Aug. 23, 1885, Eugène Spée was appointed astronomer at the Royal Observatory of Belgium. During his 23-year career at the Observatory, until his retirement Jan. 24, 1909, he devoted his research primarily to the Sun. His main achievements were accomplished in solar spectroscopy.

sample drawing by Spée for March 11, 1886 (first year of his observations)



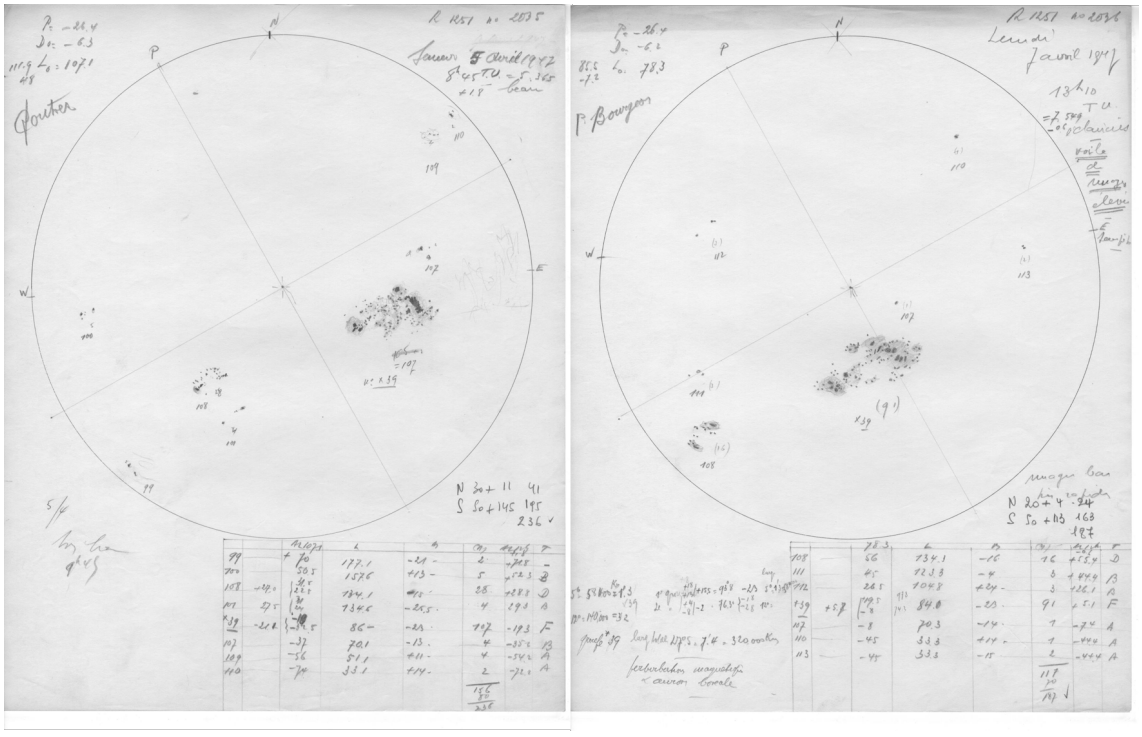
Spée continued the work of French solar spectroscopist Louis Thollon (1829-1887) of the Observatory of Nice, who had undertaken the first comprehensive cataloging of all absorption lines in the visible range of the solar spectrum. Thollon had started with the red part of the spectrum, working blue-wards, but he had only reached the green part, with already 3000 registered lines, when he died in 1887. Spée continued the construction of the second half of the spectrum over the green and blue parts. For this work, he made several scientific missions at the Observatory of Nice. This first atlas of the solar spectrum formed the base of the subsequent work by H.A. Rowland (1848-1901), inventor of the diffraction grating.

Next to the solar spectrum, Spée also made regular drawings of sunspots, which are preserved in our archives. Those high quality drawings have a projected solar diameter of 25 cm, and were most probably made with the 16cm Merz-Grubb refractor that is still in use nowadays for the Uccle sunspot drawings.

This early collection includes a few hundred drawings made over the period 1886 - September 1906. As shown by his publications, Spée was particularly interested in the evolution of the morphology of large sunspots, their motion and their relation with prominences recorded by spectrographs in chromosp#eric lines. Sun-Earth relations, now called "space climate", were also part of the issues that he considered, with titles like: "Of the solar activity compared to terrestrial magnetism"(1886) or "Does the physical state of the Sun have an influence on the Earth global temperature?"(1894). So, the hot questions of the 21st century have been already in the mind of solar physicists for quite a while!

By 1905, Spée's health degraded and his frequent and long absences led to tense relations with the ROB director, who was then Georges Lecointe (1869-1929). The Director finally obtained to terminate Spée's tenure by hasting his official retirement. Perhaps because of this unfortunate contentious episode, Lecointe decided to close all solar-related activities at the ROB, thereby ending Spée's early solar legacy. It took many more years and a change of director before a new era opened for solar physics at the ROB, with the start in 1939 of the first systematic sunspot drawings of the modern Uccle collection. The new primary observers were Gaston Coutrez, Paul Bourgeois and André Koeckelenbergh, who later became the first director of the SIDC in 1980. This revival was followed by many other achievements in the decades that followed: radio astronomy, world data center for sunspots, space-borne EUV coronal imagers, up to the STCE today.

sample drawings from the early years of the new series, made by Gaston Coutrez and Paul Bourgeois: April 5 and 7, 1947, with the largest sunspot group of the 20th century. The drawing of Apr. 7 contains annotations mentioning the visibility of an aurora borealis and geomagnetic disturbances (lower left corner):



Contribution from Dr. Frederic Clette

2. PROBA2 Observations (13 May 2019 - 19 May 2019)

Solar Activity

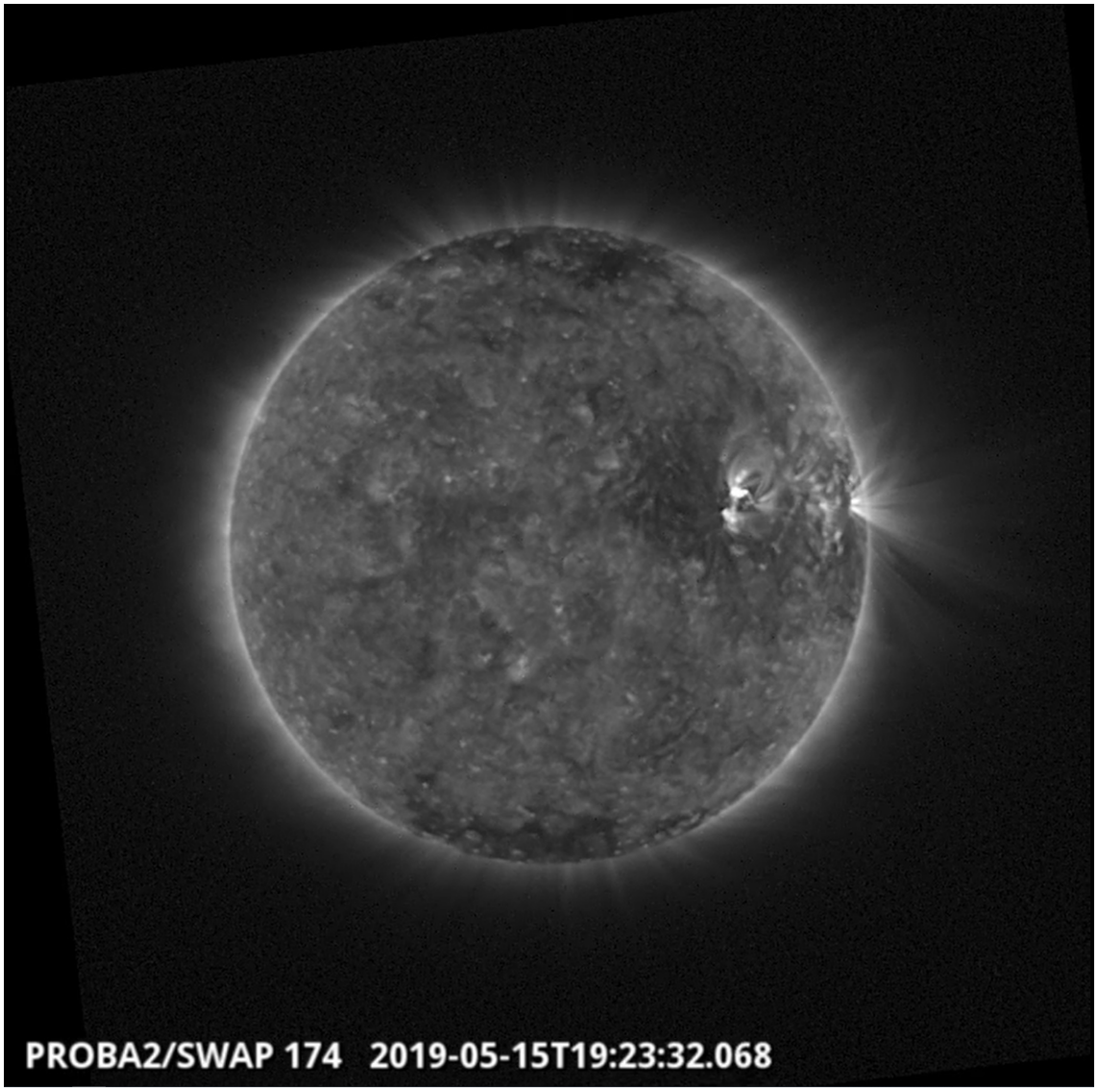
Solar flare activity fluctuated between very low and low during the week.
In order to view the activity of this week in more detail, we suggest to go to the following website from which all the daily (normal and difference) movies can be accessed: http://proba2.oma.be/ssa
This page also lists the recorded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

A weekly overview movie can be found here (SWAP week 477): http://proba2.oma.be/swap/data/mpg/movies/weekly_movies/weekly_movie_2019_05_13.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 May 15



The largest flare of the week (C2.0), associated with NOAA AR 2741, was observed by SWAP and LYRA on 2019-May-15 and is visible in the western hemisphere of the Sun in the SWAP image above taken at 19:23 UT.
Find a movie of the event here (SWAP movie): http://proba2.oma.be/swap/data/mpg/movies/20190515_swap_movie.mp4

3. Review of solar activity

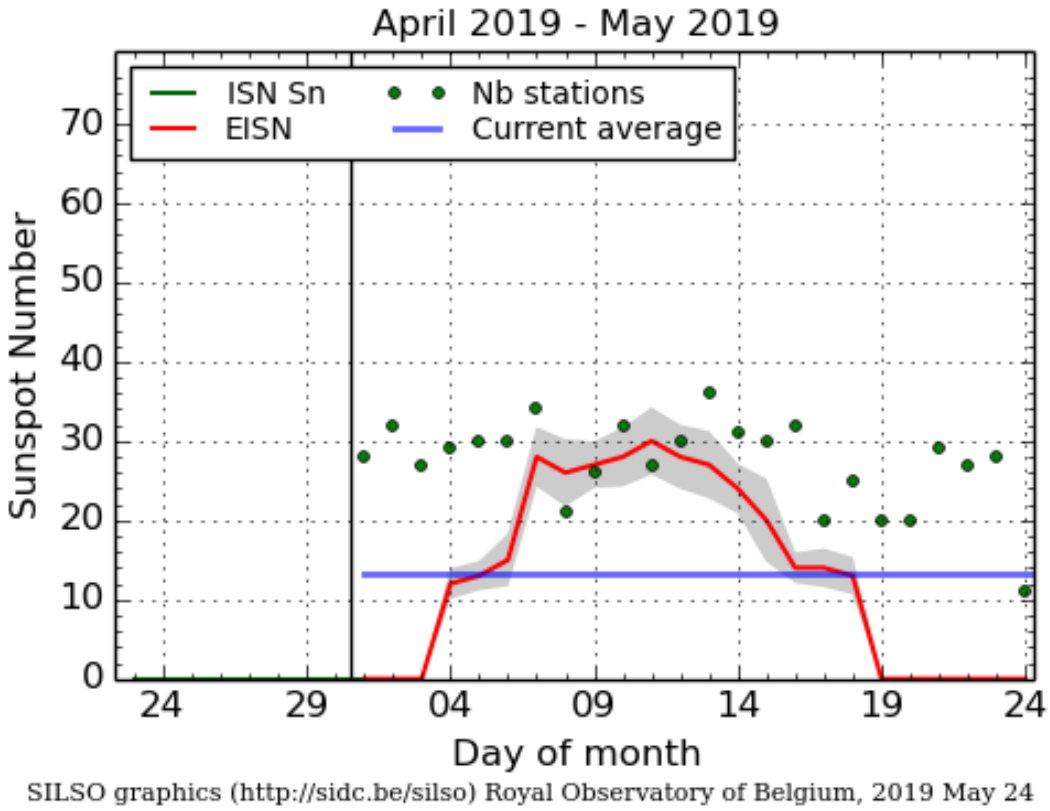
Two alpha regions were visible: NOAA 2740 and 2741. Whereas region 2740 turned into a plage and rotated from the solar disk on May 16, region 2741 kept its sunspots and produced one C flare.
The GOES X-ray flux background varied between the A9 and B1 level.
An Earth-directed CME was detected on May 12 and 13. The May 12 CME was associated with a filament eruption near region 2741.
The greater than 10 MeV proton flux was at nominal levels.

4. Review of geomagnetic activity

The solar wind as registered by DSCOVR showed clear signs of an ICME in the period May 13, 22 UT until May 14, 17 UT. This could be the CME of May 10 passing the DSCOVR spacecraft.
There are hints of a second ICME in the period May 14, 17 UT and May 16, 1 UT. This could be the signature of a combination of the CMEs of May 11, 12 and 13. The solar wind speed reached its maximum - around 570 km/s - on May 14 (8 UT), while the Interplanetary Magnetic Field (IMF) peaked around 15 nT at 6 UT.

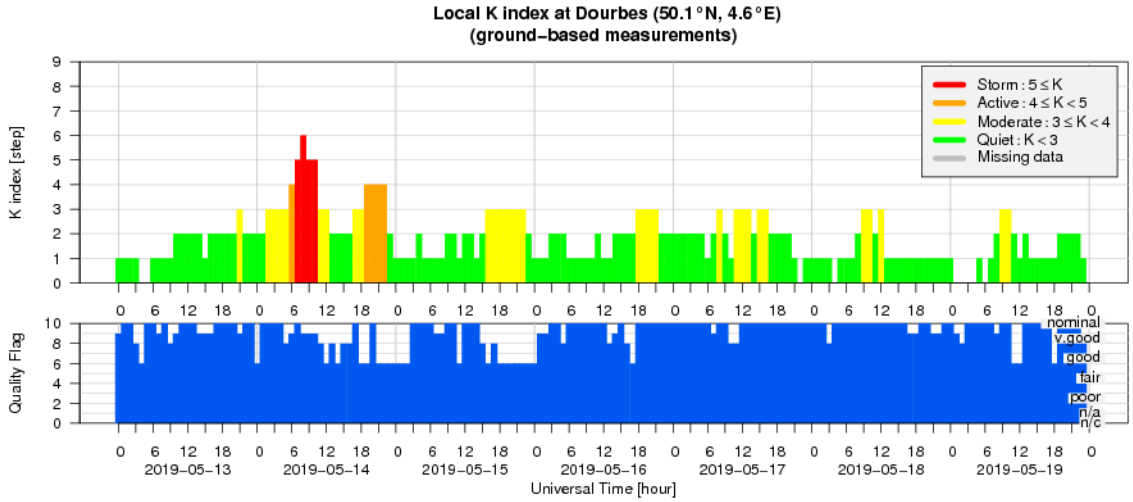
The ICMEs induced a geomagnetic storm: NOAA Kp reached values of 6 and 7 on May 14, AM. K Dourbes reached values of 5 and 6.

5. The International Sunspot Number by SILSO



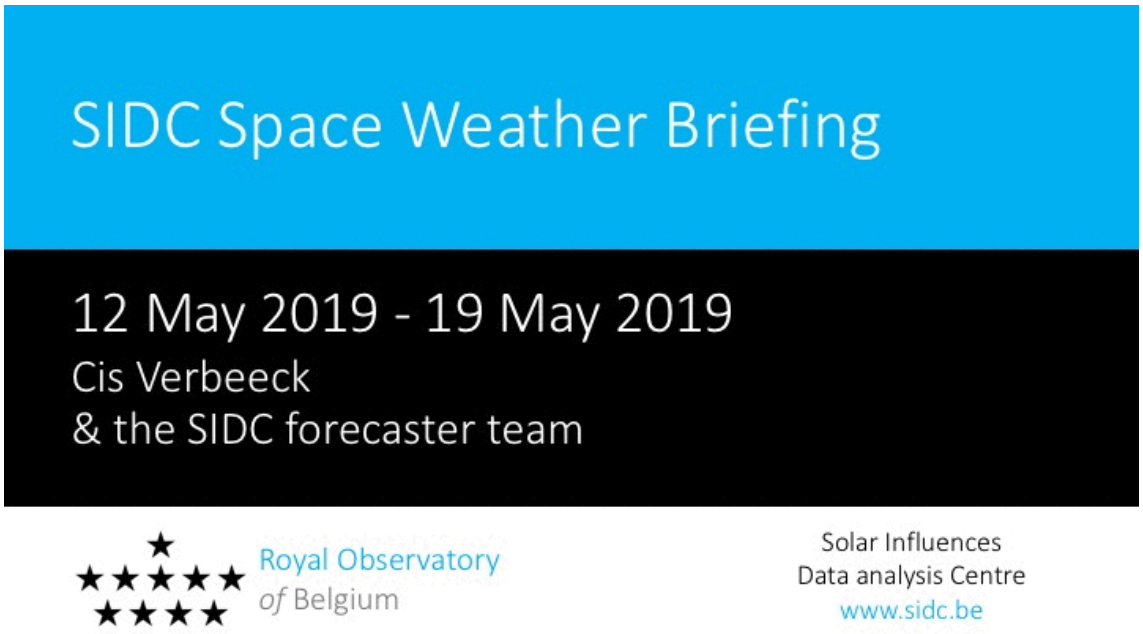
The daily Estimated International Sunspot Number (EISN, red curve with shaded error) derived by a simplified method from real-time data from the worldwide SILSO network. It extends the official Sunspot Number from the full processing of the preceding month (green line). The plot shows the last 30 days (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.

6. Geomagnetic Observations at Dourbes (13 May 2019 - 19 May 2019)



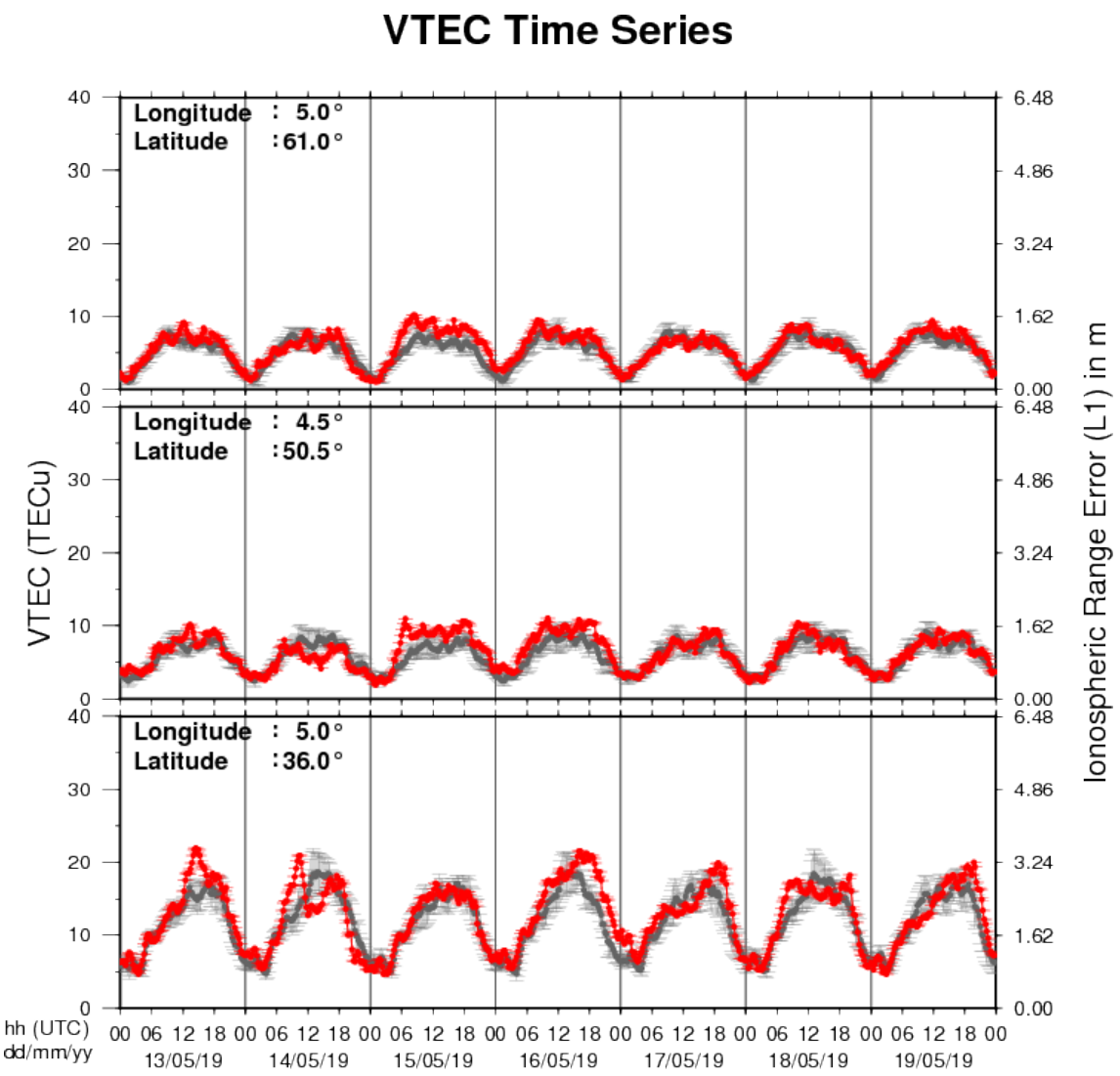
7. The SIDC space weather Briefing

The Space Weather Briefing presented by the forecaster on duty from May 13 to 19. It reflects in images and graphs what is written in the Solar and Geomagnetic Activity report.



The pdf-version: http://www.stce.be/briefings/20190520_SWbriefing.pdf
The automatically running presentation: http://www.stce.be/briefings/20190520_SWbriefing.ppsm

8. Review of ionospheric activity (13 May 2019 - 19 May 2019)



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