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An introduction to Space Weather

Jan Janssens

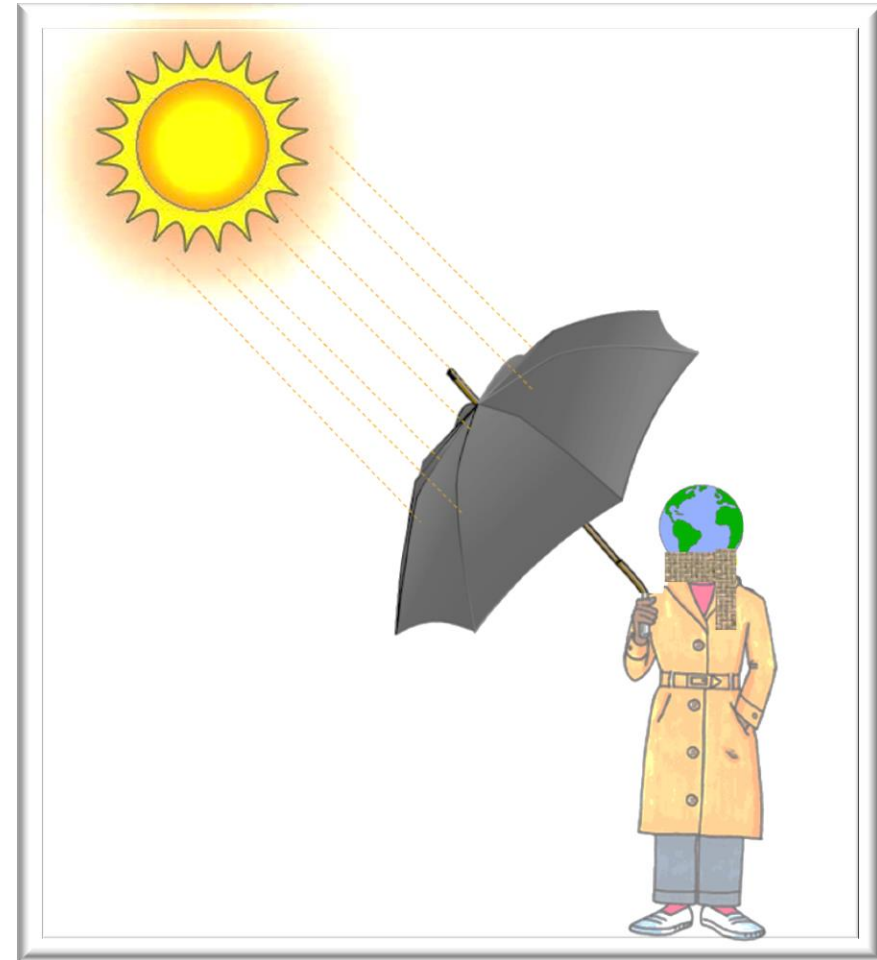
Solar-Terrestrial Centre of Excellence

10 January 2019



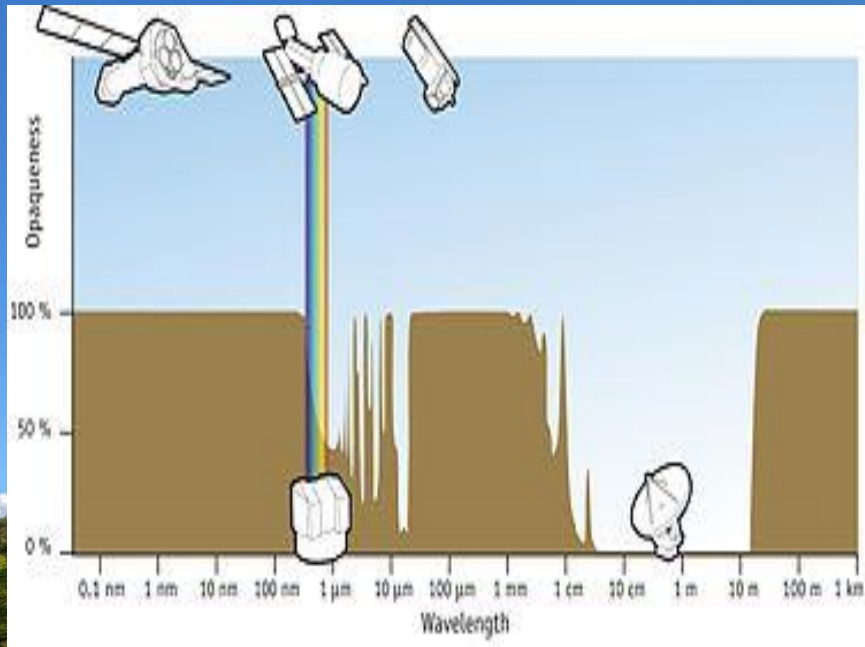
Space Weather (SWx)

- Space weather refers to the environmental conditions in Earth's magnetosphere, ionosphere and thermosphere due to the Sun and the solar wind that can influence the functioning and reliability of spaceborne and ground-based systems and services or endanger property or human health.

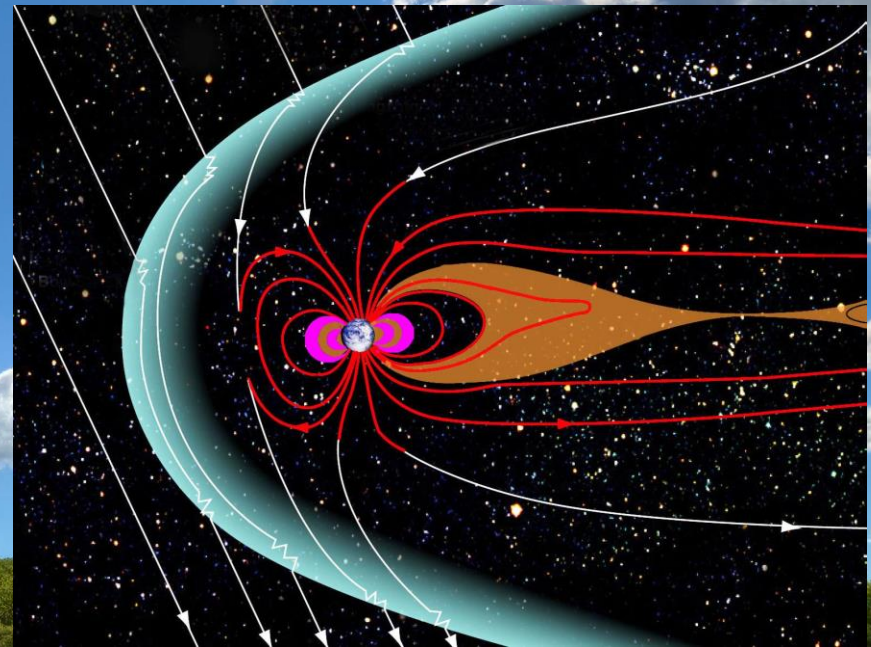


NSWP, ESA

The quiet Sun



Electromagnetic radiation



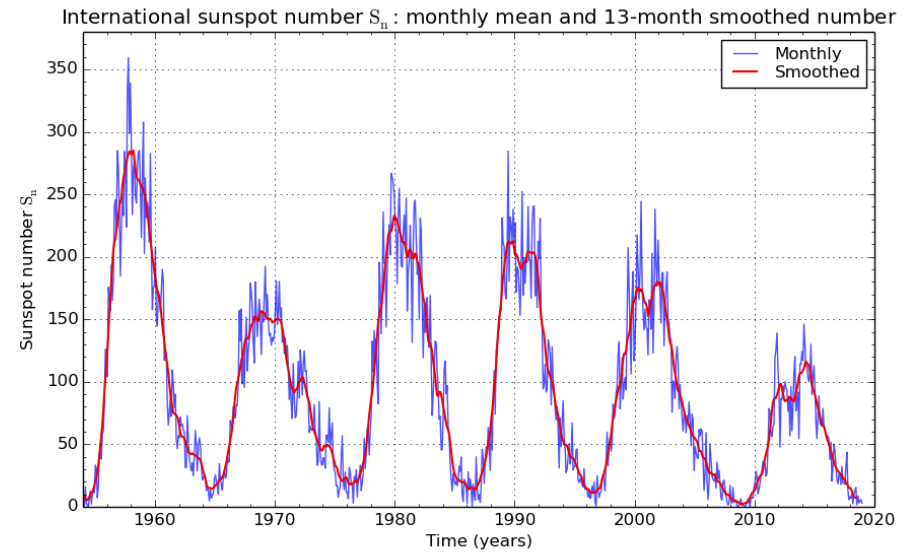
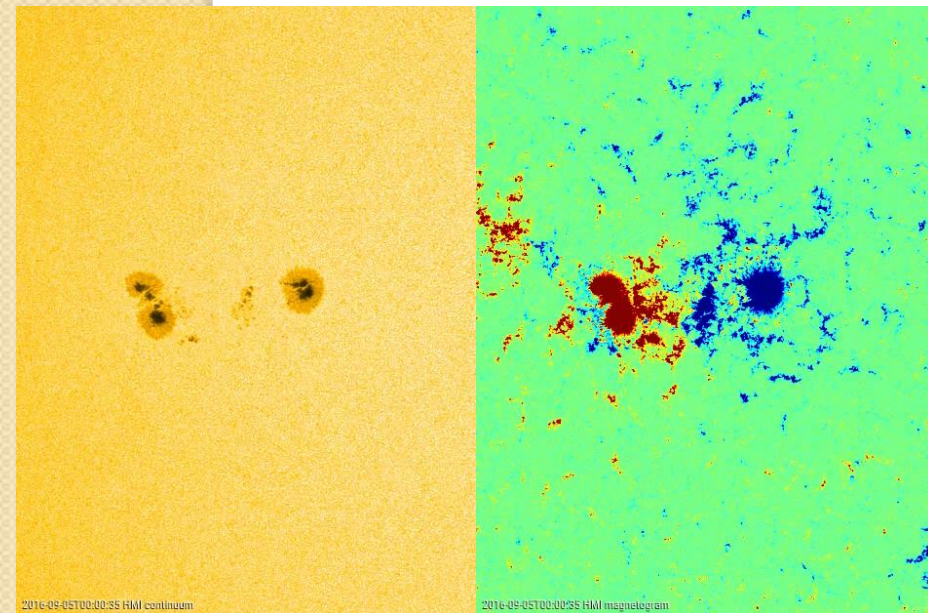
Particles – Solar wind

Solar activity: Sunspots



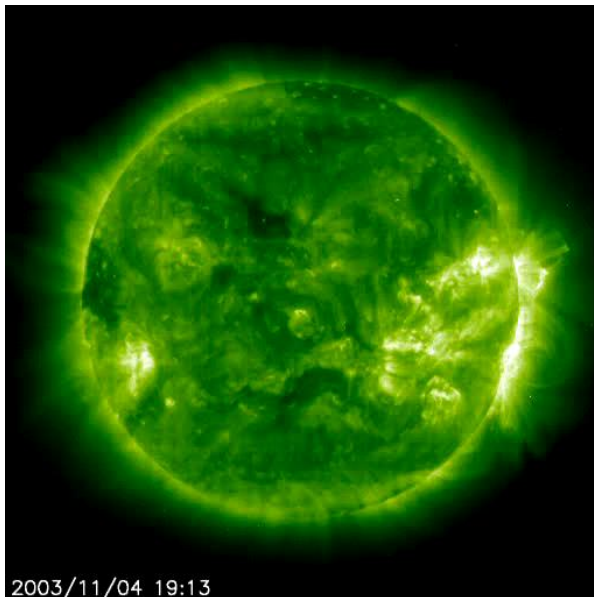
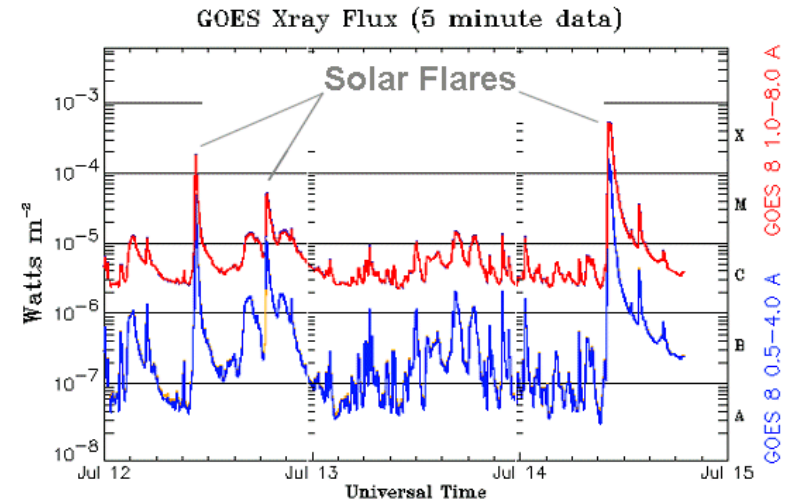
SDO/HMI Quick-Look Continuum 20140322_010000

Solar activity: Solar cycle

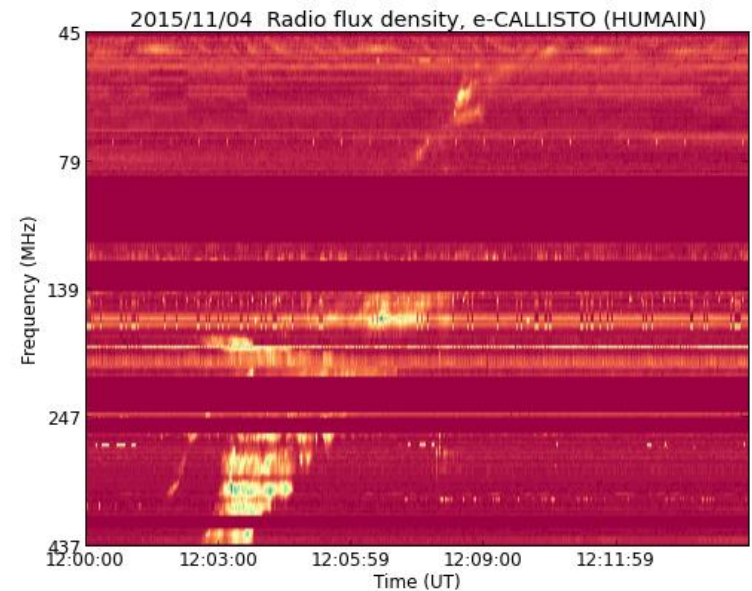


SILSO graphics (<http://sidc.be/silso>) Royal Observatory of Belgium 2019 January 8

Solar flares (radiation)



2003/11/04 19:13



Drivers of disturbed space weather

Solar eruptions

Solar corona

Magnetic Reconnection

Solar wind

Radiation

Particles

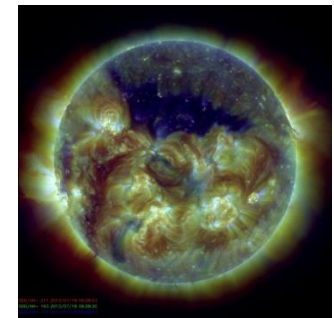
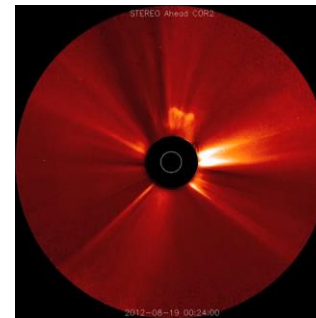
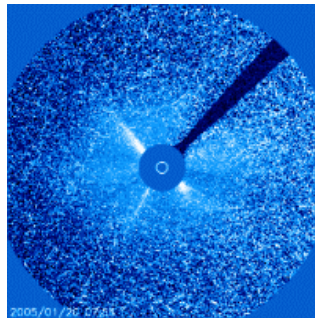
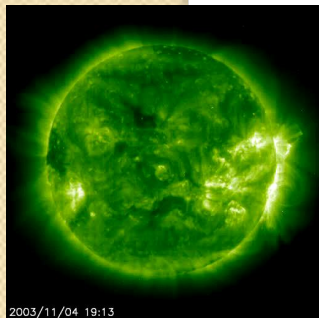
Particles

Solar flares

Proton events

Coronal Mass Ejections

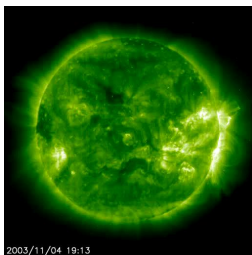
Coronal Holes



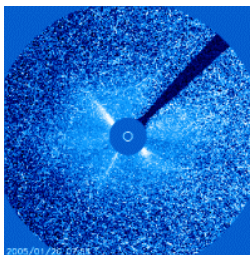
Effects from disturbed space weather

Source

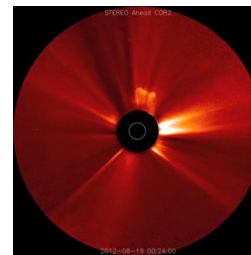
Solar flares



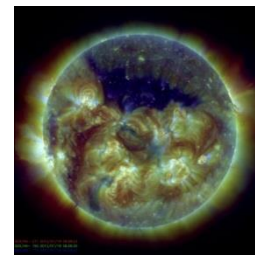
Proton events



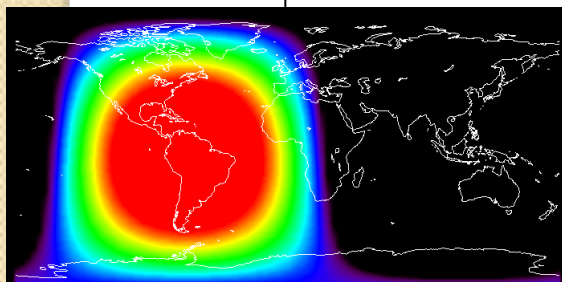
CMEs



CHs

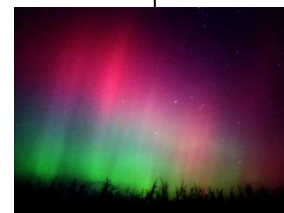
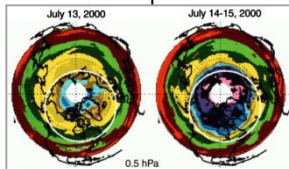


Effects

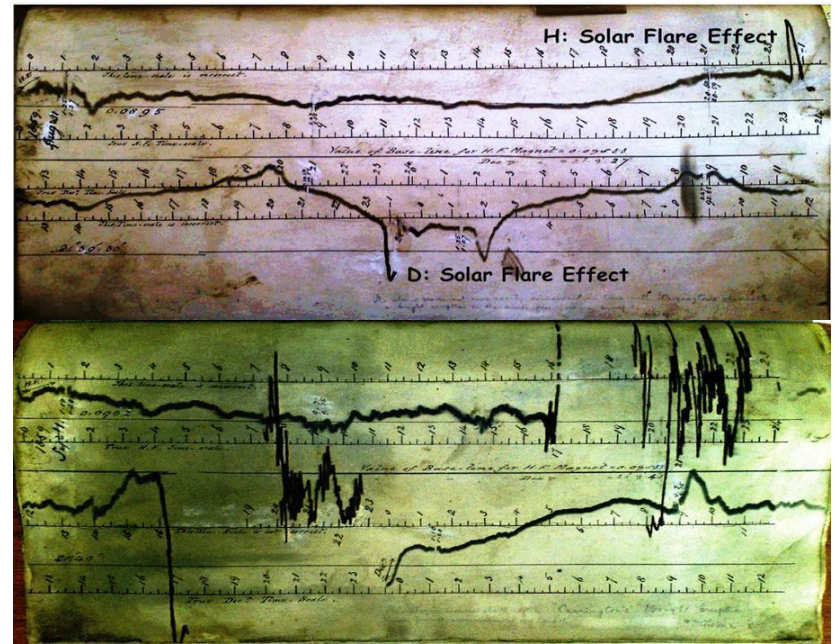
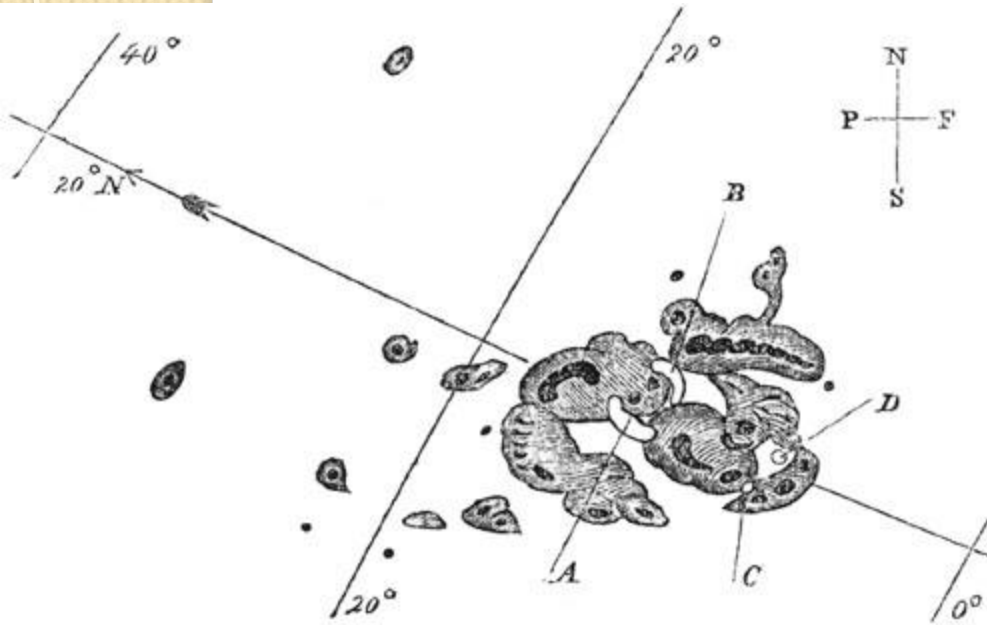


Strong X-ray flux
 Product Valid At : 2015-03-11 16:22 UTC

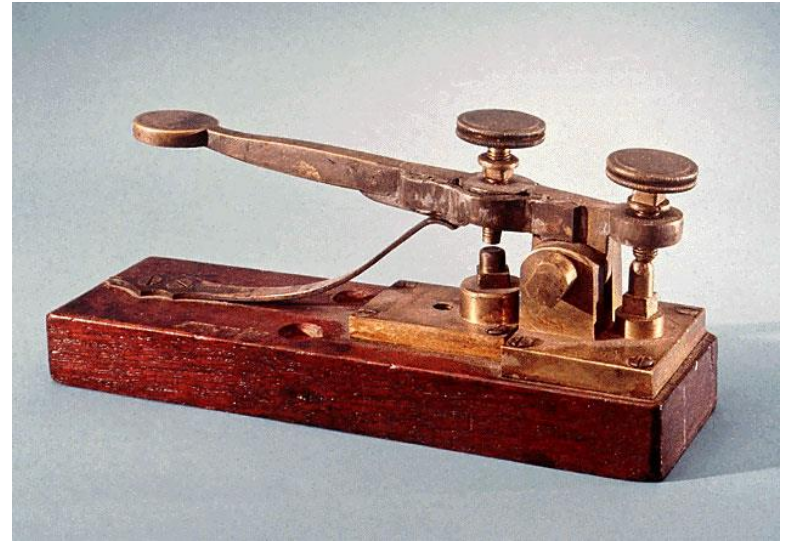
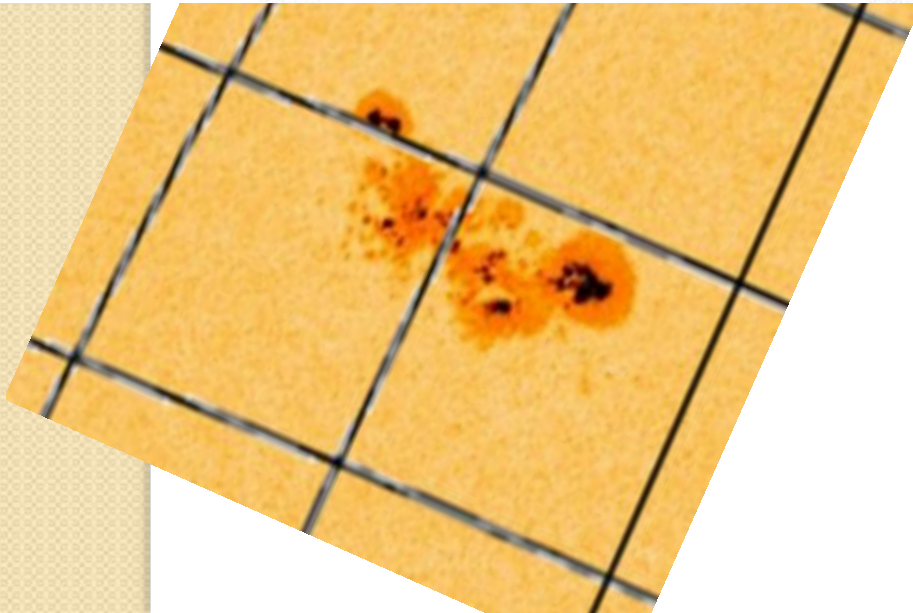
Normal Proton Background
 NOAA/SWPC Boulder, CO USA



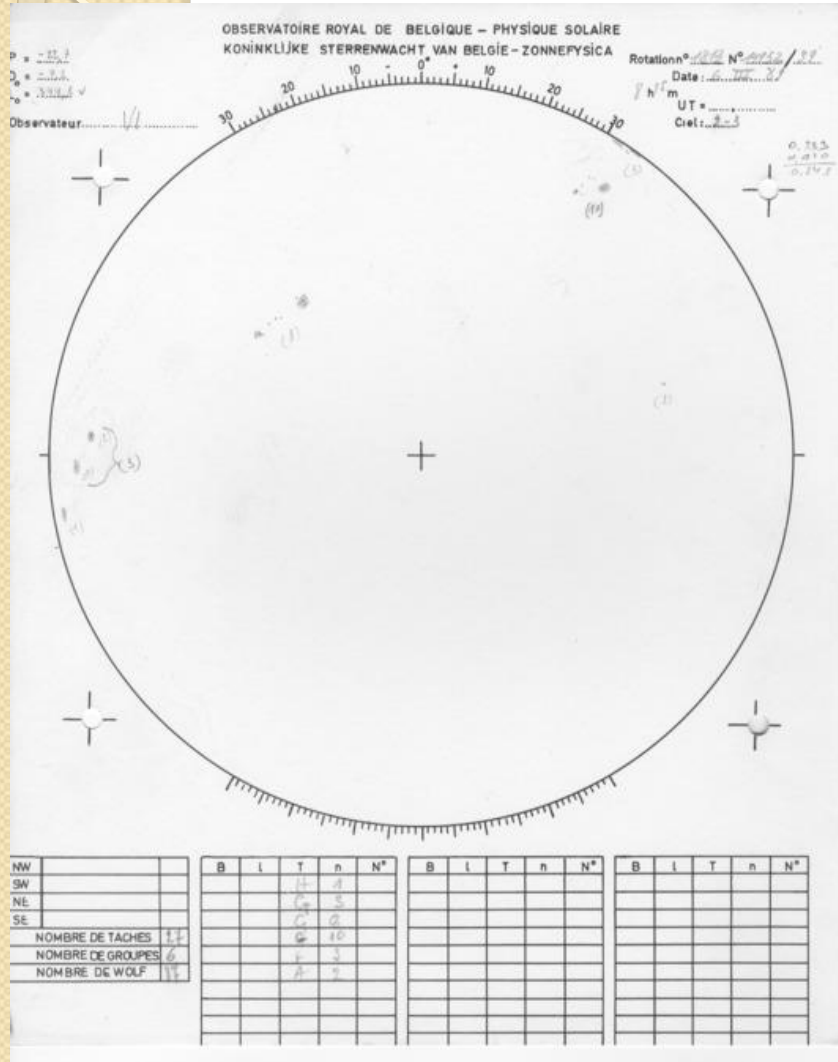
1 September 1859: Carrington event



<http://www.geomag.bgs.ac.uk/education/carrington.html>



13-14 March 1989: Québec event



28 October 2003: Halloween event



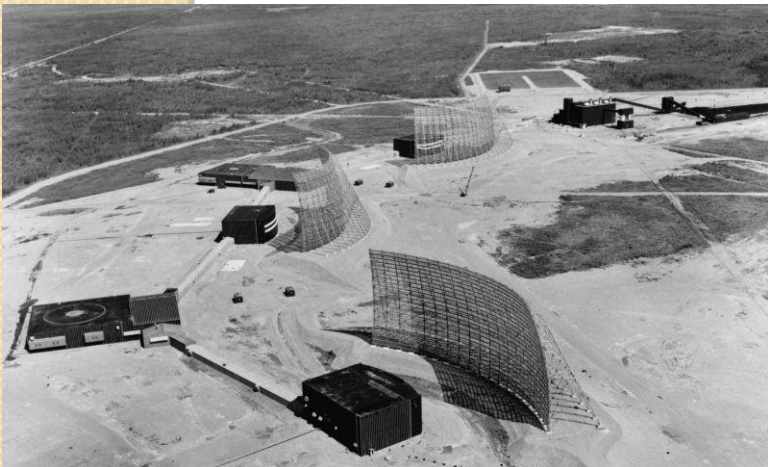
SWx and the military



18-19 September 1941 – Geomagnetic « Blitz »



23 February 1956 - HMS Acheron



23 May 1967 – Disturbance BMEWS



4 August 1972 – Unintended detonation sea mines

SWx effects during SC24

- 24-25 October 2011
 - WAAS/EGNOS services interrupted; blood-red aurora
- 24 January 2012
 - Polar flight detours
- 7 March 2012
 - Polar flight detours
- 7 January 2014
 - Delay launch supply rocket ISS
- 1 September 2014
 - ST-B lost sun-lock
- 4 November 2015
 - Swedish Air Traffic down
- 6-12 September 2017
 - HF comms down during hurricane Irma



Questions?

- **SIDC:**
 - <http://www.sidc.be/>
- **SSCC:**
 - <http://swe.ssa.esa.int/web/guest/contact>
 - helpdesk.swe@ssa.esa.int
- **STCE:**
 - <http://www.stce.be/>
 - jan.janssens@oma.be
- **Address:**
 - Space Pole
 - Avenue Circulaire - Ringlaan, 3
1180 Uccle - Ukkel
 - BELGIUM



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SC24 highlights page NEW
Every year, the STCE publishes a news item with an overview of the most memorable solar and space weather highlights.

Backside eruptions NEW
Once again, solar observers were

STCE Annual meeting GOOD

European Space Weather Week GOOD
13TH EUROPEAN SPACE WEATHER WEEK
November 14-16, 2014
Oostende, BELGIUM
At ESWW13 we try to make the