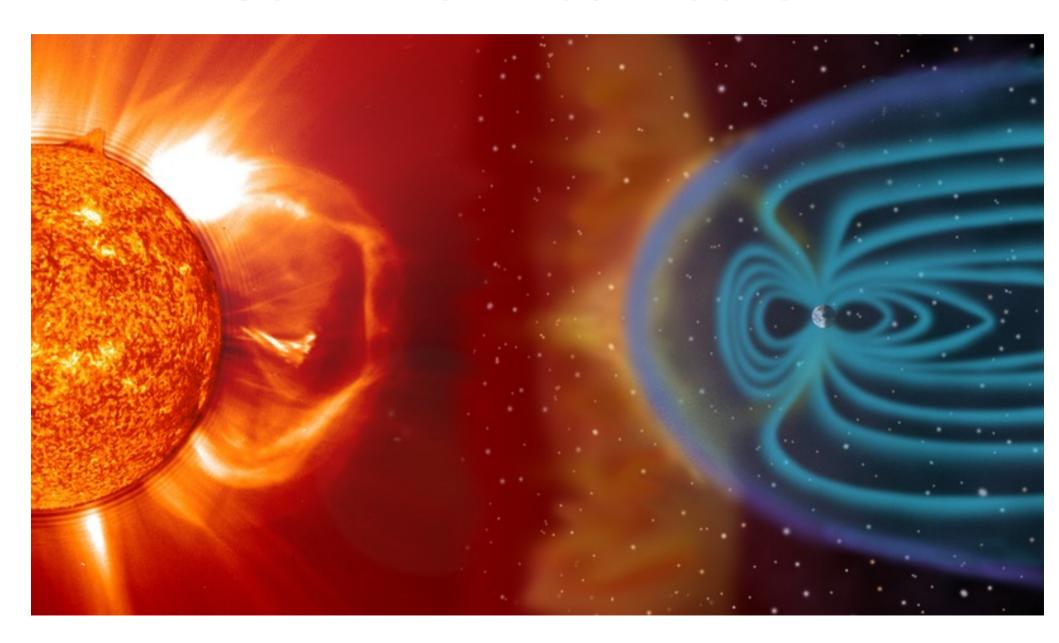
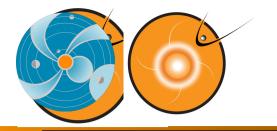


Sun – Earth connection





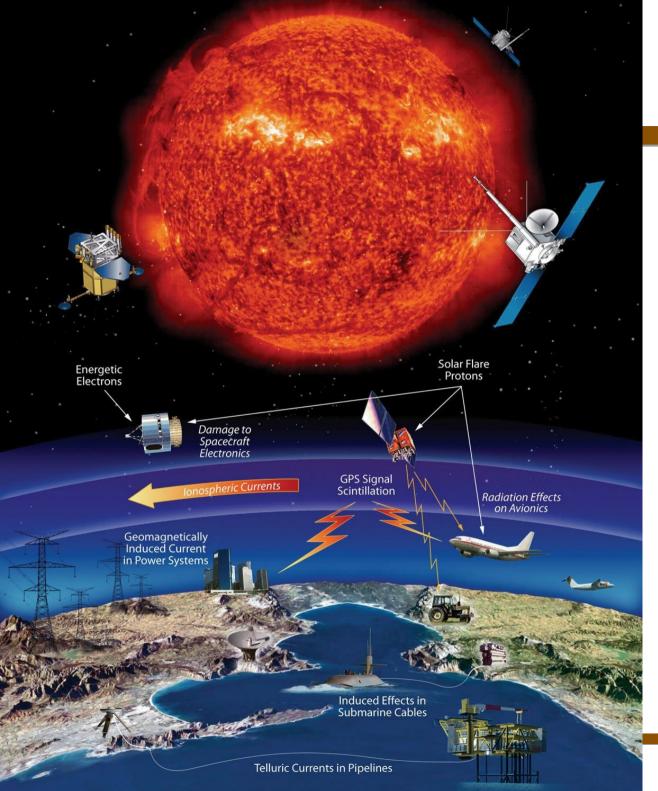
Space weather 101



"Space weather refers to conditions on the Sun and in the solar wind, magnetosphere, ionosphere, and thermosphere that can influence the performance and reliability of space-borne and ground-based technological systems and can endanger human health. Adverse conditions in the space environment can cause disruption of satellite operations, communications, navigation, and electric power distribution grids, leading to a variety of socioeconomic losses."

US National Space Weather Program

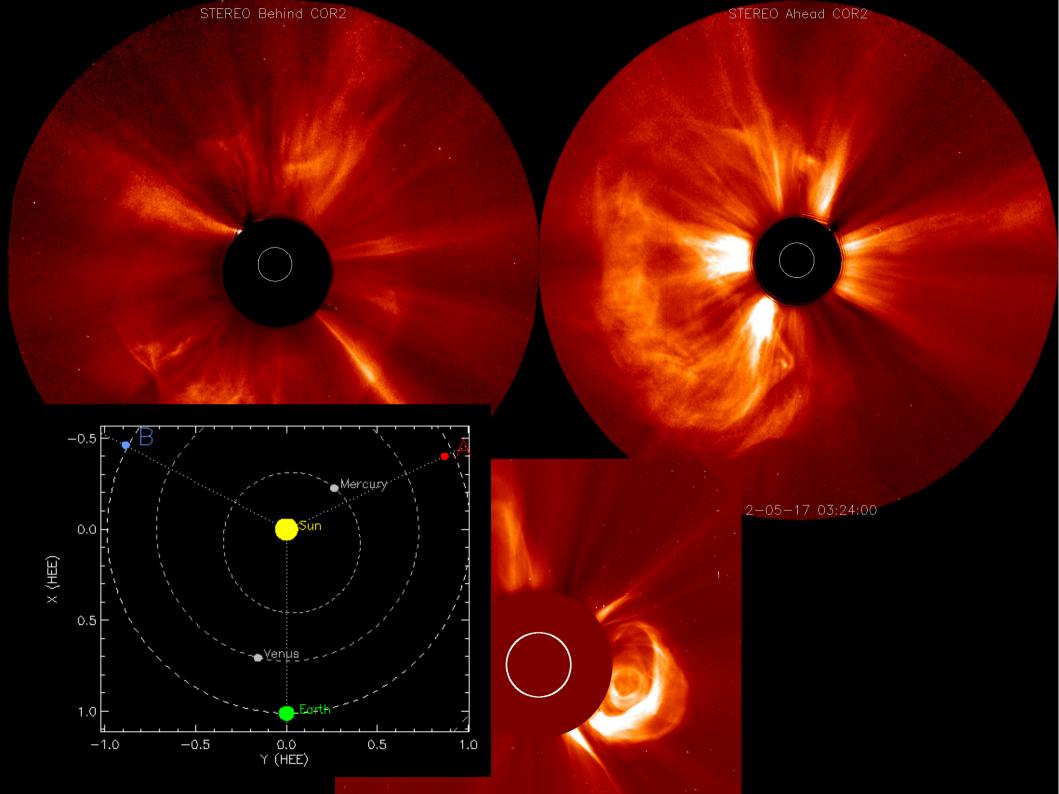




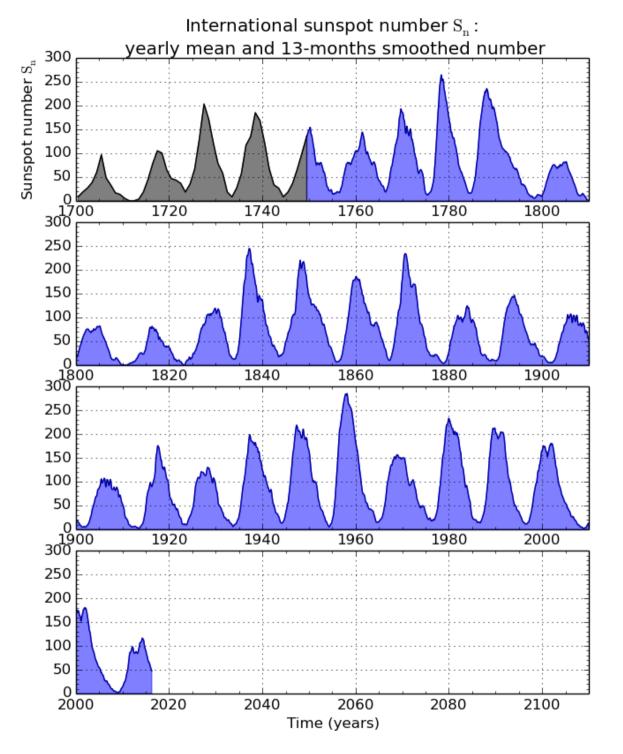


The Sun: source of space weather

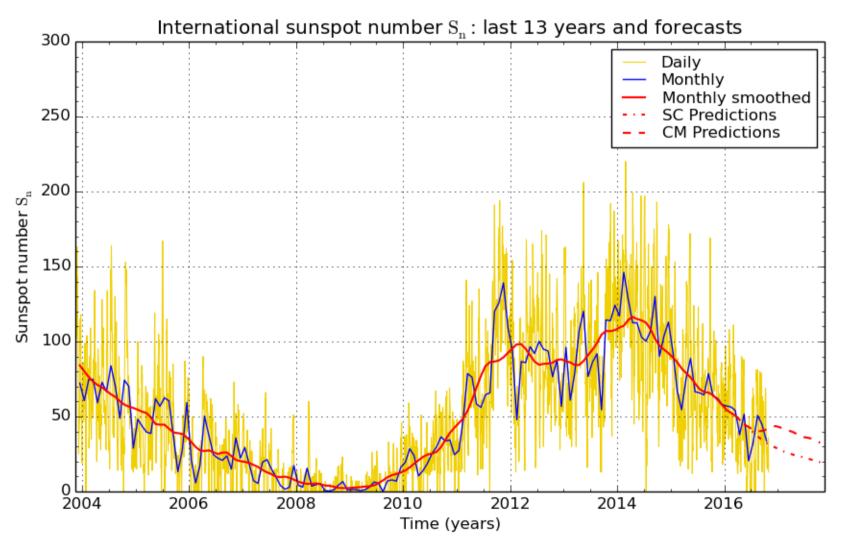
CME, flares and high speed streams: three very important solar wind disturbances/structures for space weather



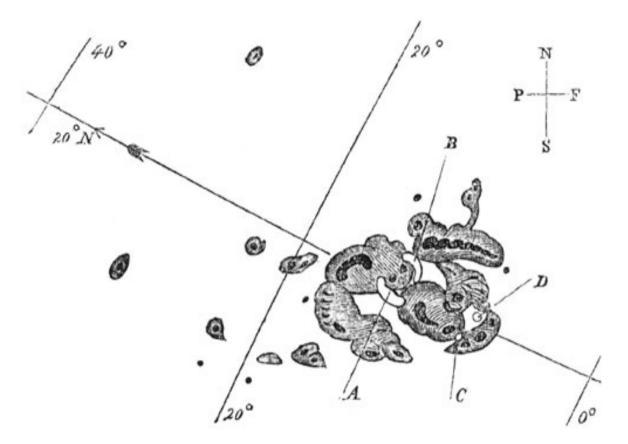
Solar cycle: historic data



Solar cycle: most recent data



Extreme Space Weather Events: The Carrington event (1859)



Sunspot drawing by Richard C. Carrington (1. Sept. 1859): intense brightenings at location A and B at 11:18, and C and D at 11:23 – indicating a white light flare!

Extreme Space Weather Events: The Carrington event (1859)

Starting about 18h later (and lasting for 2 days) telegraph systems all over Europe and North America failed, in some cases giving telegraph operators electric shocks. telegraph pylons threw sparks. Magnetometers that measure geomagnetical disturbances all went off scale (and therefore give no reliable values) excepta one station in Bombay. Intense auroras were visible all over Europe and North America, but also as far

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Extreme Space Weather Events: 23.July 2012 event

Flare and CME detected by STEREO spacecraft, source region of event at lon=130 deg (not visible from Earth!), CME heading towards STEREO A (halo CME).

estimated parameters of the CME close to the sun:

speed: 2800 km/s (at 21.5 r_sun)

estimated arrival time around 18h after flare

observed solar wind parameters at STEREO A of CME:

total magnetic field B: 80 nT

(compare to: background wind: a few nT, normal CMEs 10-20 nT

solar wind speed: 1000 km/s

(compare to: background slow wind 300-400 km/s, normal CME

400-600 km/s, fast solar wind 600-800 km/s

Extreme Space Weather Events:

Table 2. Estimated Frequencies for Geomagnetic Storms of Different Magnitudes

Strength of the Storm (nanoTesla)	Frequency
> 100	4.6 per year
> 200 -Tormenta solar del Día de la Bastilla, 14 de julio de 2000 Aprox. 317 nT -Halloween, octubre-noviembre 2003 Aprox. 383 nT	9.4 per 10 years
> 400 Quebec, 13 de marzo 1989 Aprox. 640 nT - Evento 14-15 mayo 1921, >-640 nT (indeterminado todavia)	9.73 per 100 years
> 800 - Carrington, 1 de septiembre 1859 Aprox. 850 nT	2.86 per 1,000 years
> 1,600	7.41 per 1,000,000

Source: Love and Gannon (2009)

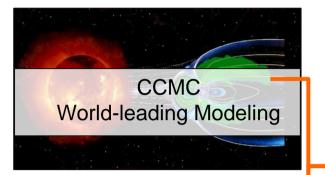


SWRC Functional Diagram

Alerts
Weekly Reports
Anomaly Analysis Support
Workshops

Protecting NASA's

Missions





Space Weather

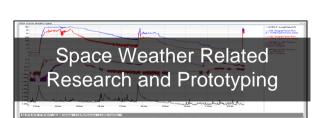






Partnering









Innovative Solutions for Research, Analysis, Forecasting & Validation



Stereo CME Analysis Tool

StereoCAT



1-Click WSA-Enlil



Generation-2
1-Click
Runs-onRequest
System for RealTime & Historic
Events

Database Of Notifications, Knowledge, Information

DONKI



ScoreBoard



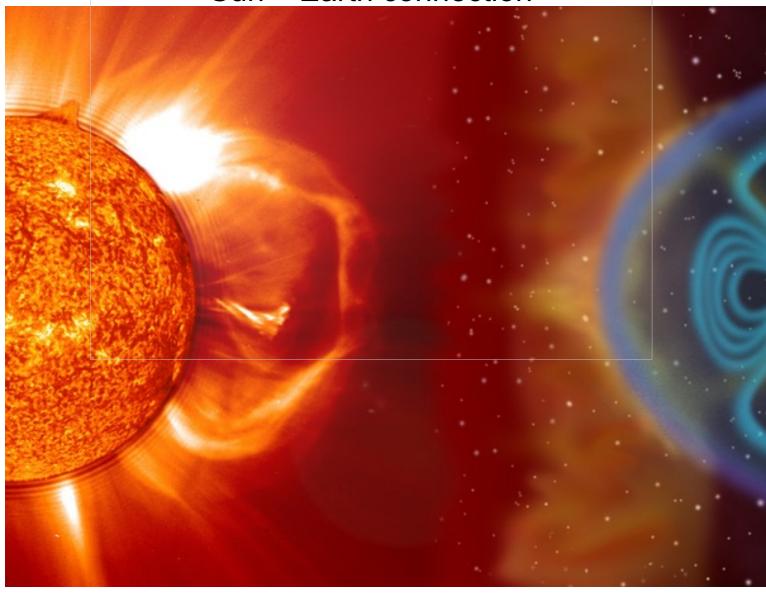
Community-Wide SW Forecasting Methods Validation Activity

Integrated Space Weather Analysis System (ISWA):













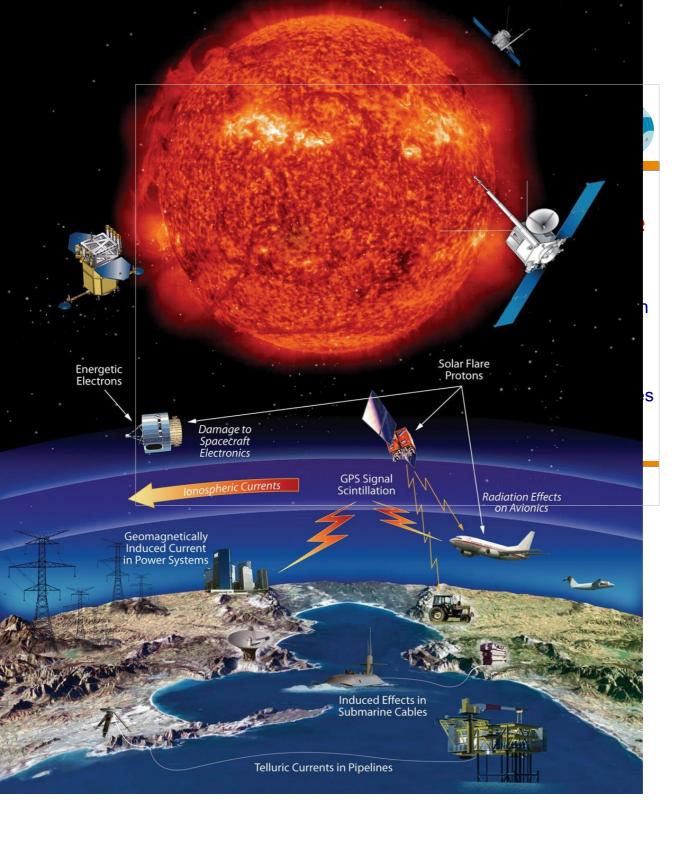


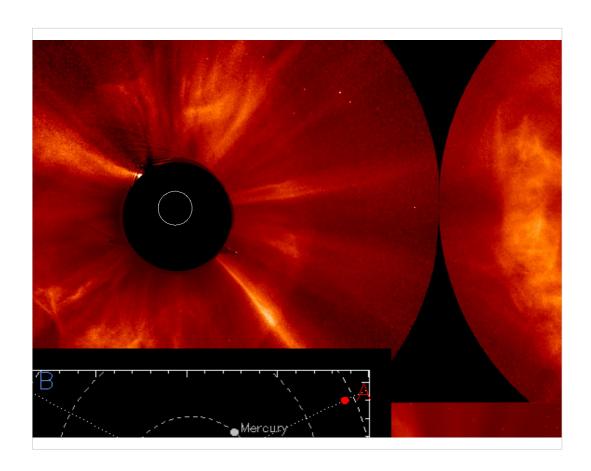
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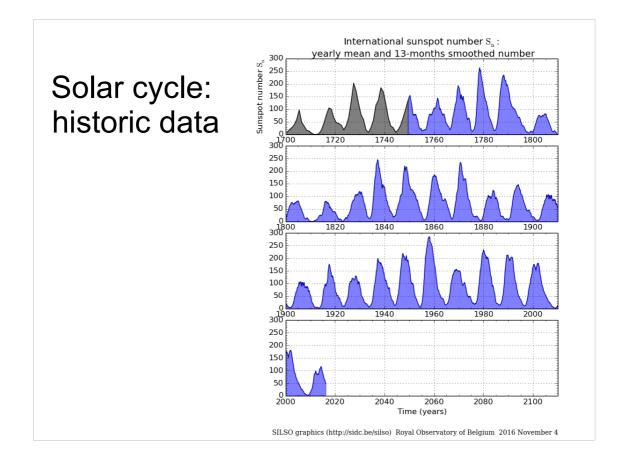
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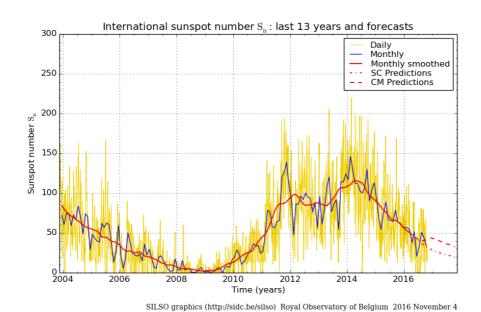


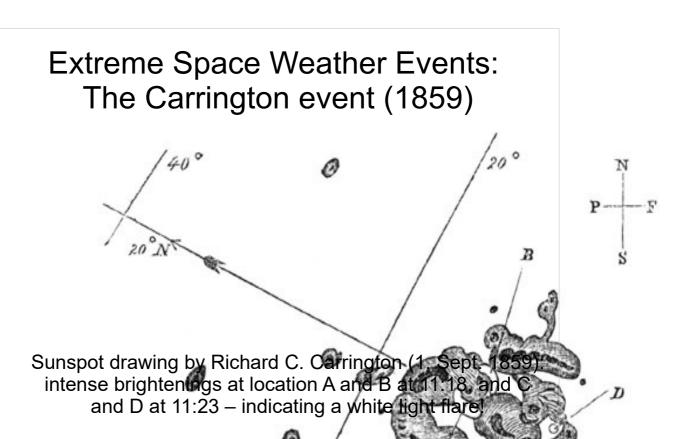






Solar cycle: most recent data





Extreme Space Weather Events: The Carrington event (1859)

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Shiow ISWA layout of event, DONKI entry and magnetospere modeling!

Strength of the Storm

(nanoTesla)

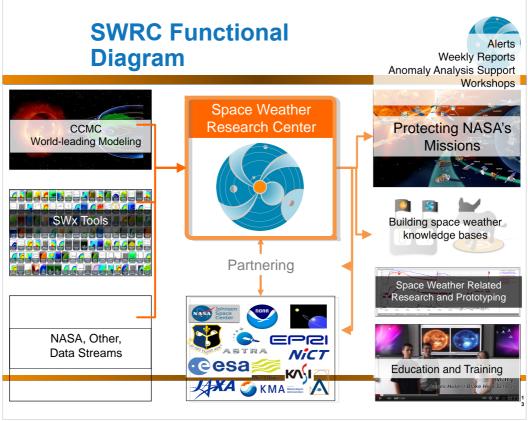
> 100

- Tormenta solar del Día de la Bastilla, 14 de julio de 2000 Aprox. 317 nT

- Halloween, octubre-noviembre 2003

Aprox. 383 nT





SWRC addressed unique NASA need by providing unique space weather information and services.





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