Forecaster in less than 3 hours

Hitchhikers guide to the heliosphere

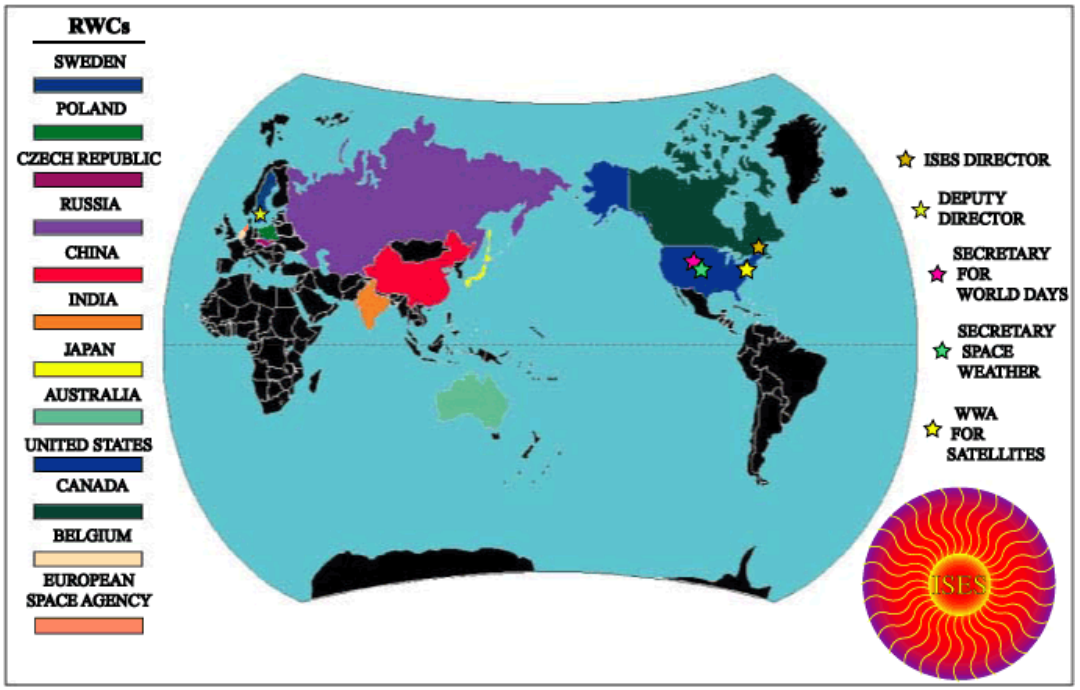
Petra Vanlommel
Solar-Terrestrial Centre of Excellence

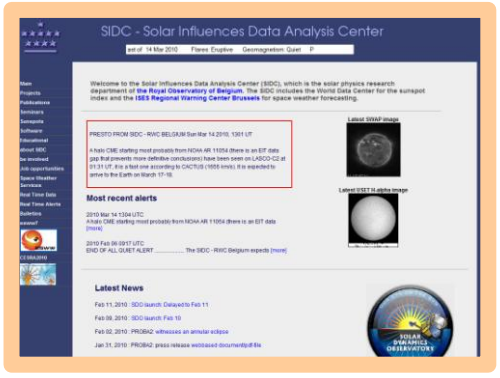
Overview

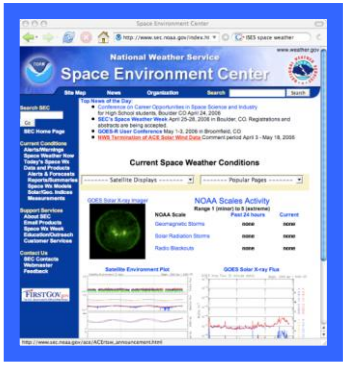
Part 1 – Space Weather
Part 2 – Recognize Space Weather
Part 3 – Space Weather appetizers
Part 4 – Top of the bill: your Forecast

- Forecaster in less than 3 hours

We are not alone







- International Space Environment Service - ISES

Space Weather

Sun – Space - Earth

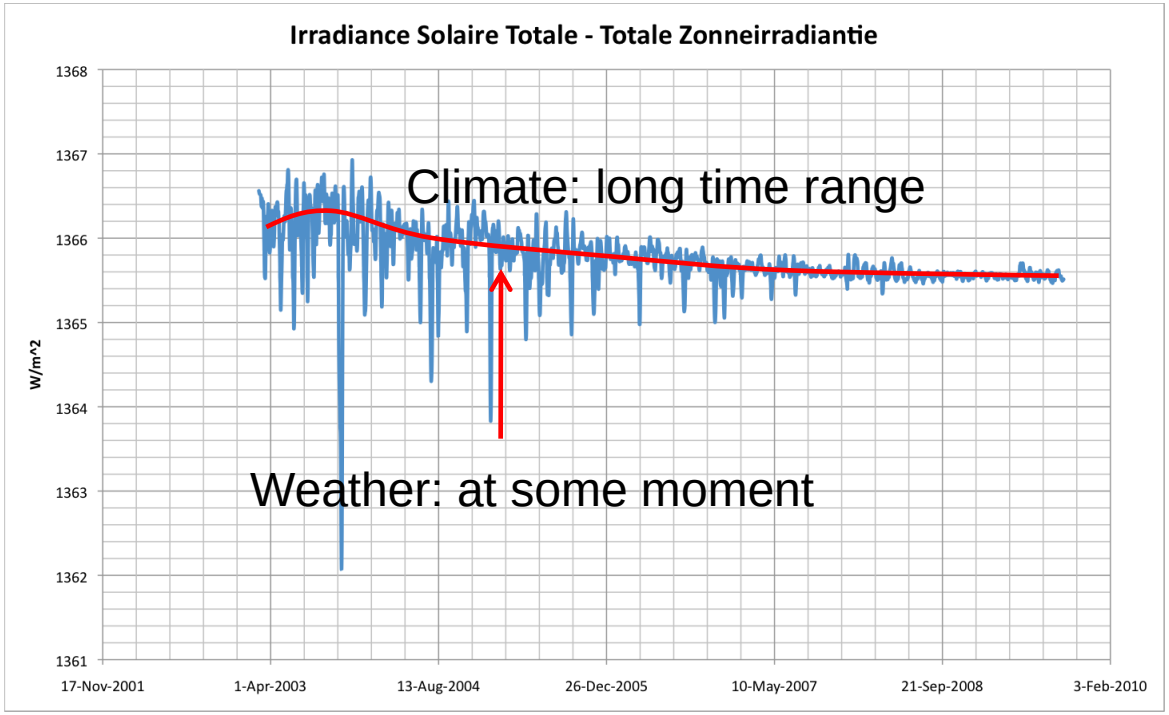
Space weather describes the conditions in space that affect Earth and its technological systems. Space weather storms originate from the Sun and occur in space near Earth or in the Earth's atmosphere. These storms generally occur due to eruptions on the Sun known as solar flares, proton storms and the solar wind.

- What is Space Weather?

The Sun loses Energy

The Sun loses Energy – physical rephrasing

Radiation



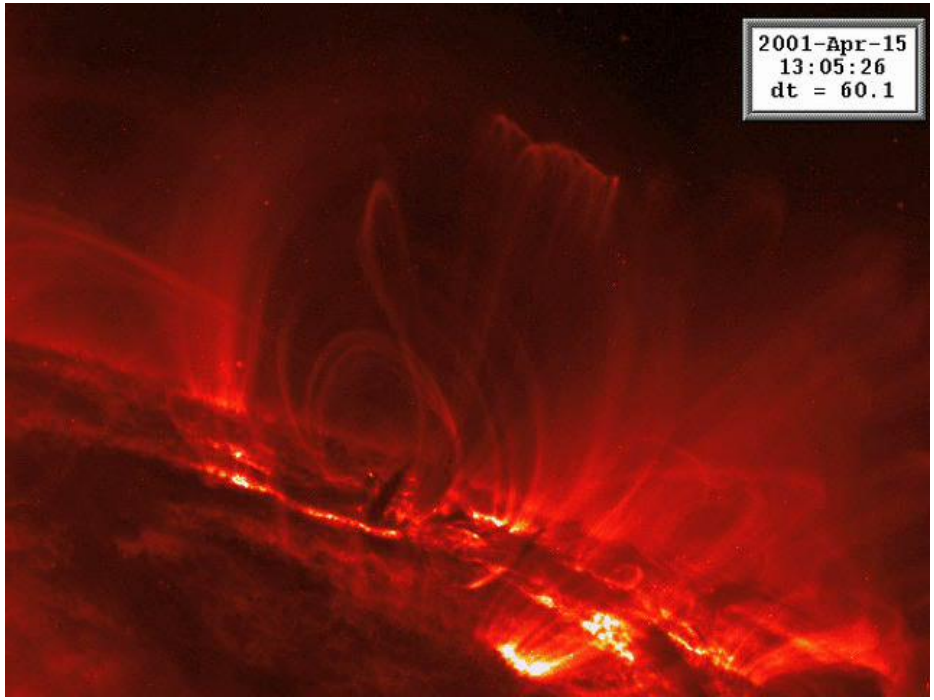
- Climate - Weather

Space Weather events

Time scales

Predictions at the Space Weather Centre

Flares and sunspots

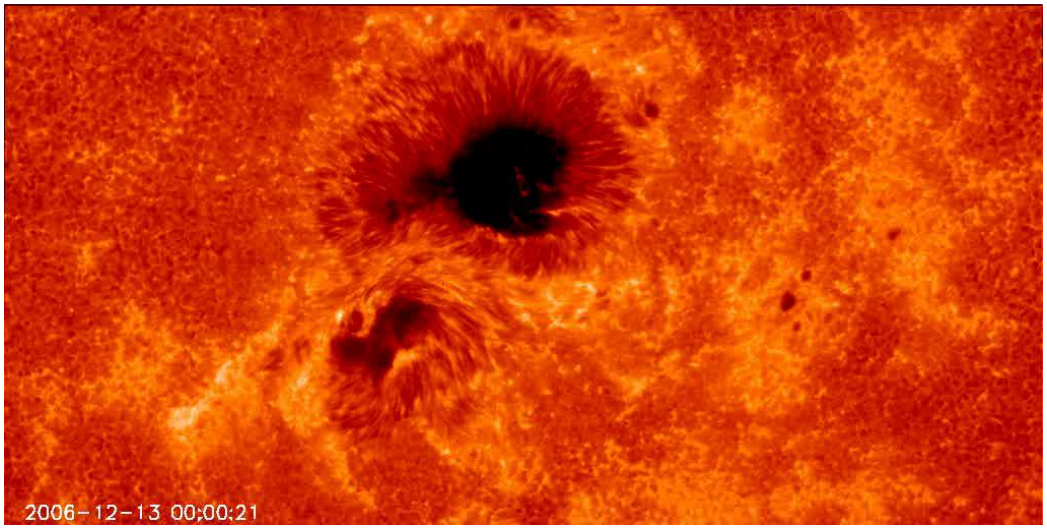


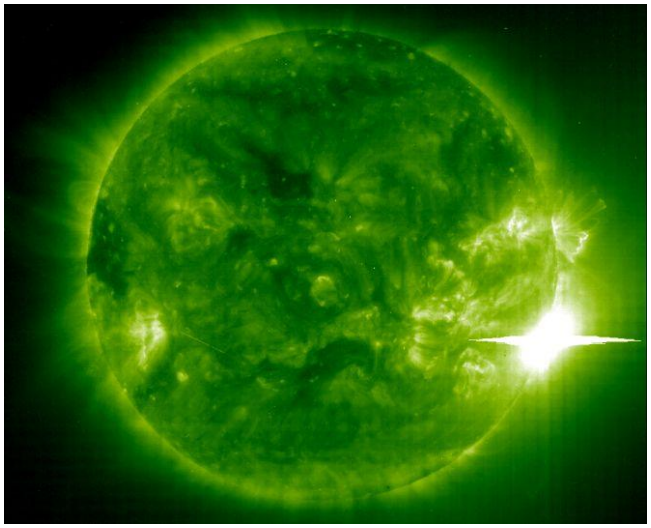
Radiation

A flare is a brutal solar process near sunspots in which a definite plasma volume of the solar atmosphere is heated to at least 10^7 K Magnetic energy escapes in the form of radiation during a limited time period. This heating is the consequence of a fast reorganisation of the magnetic field.

Solar Flares

Light Flashes



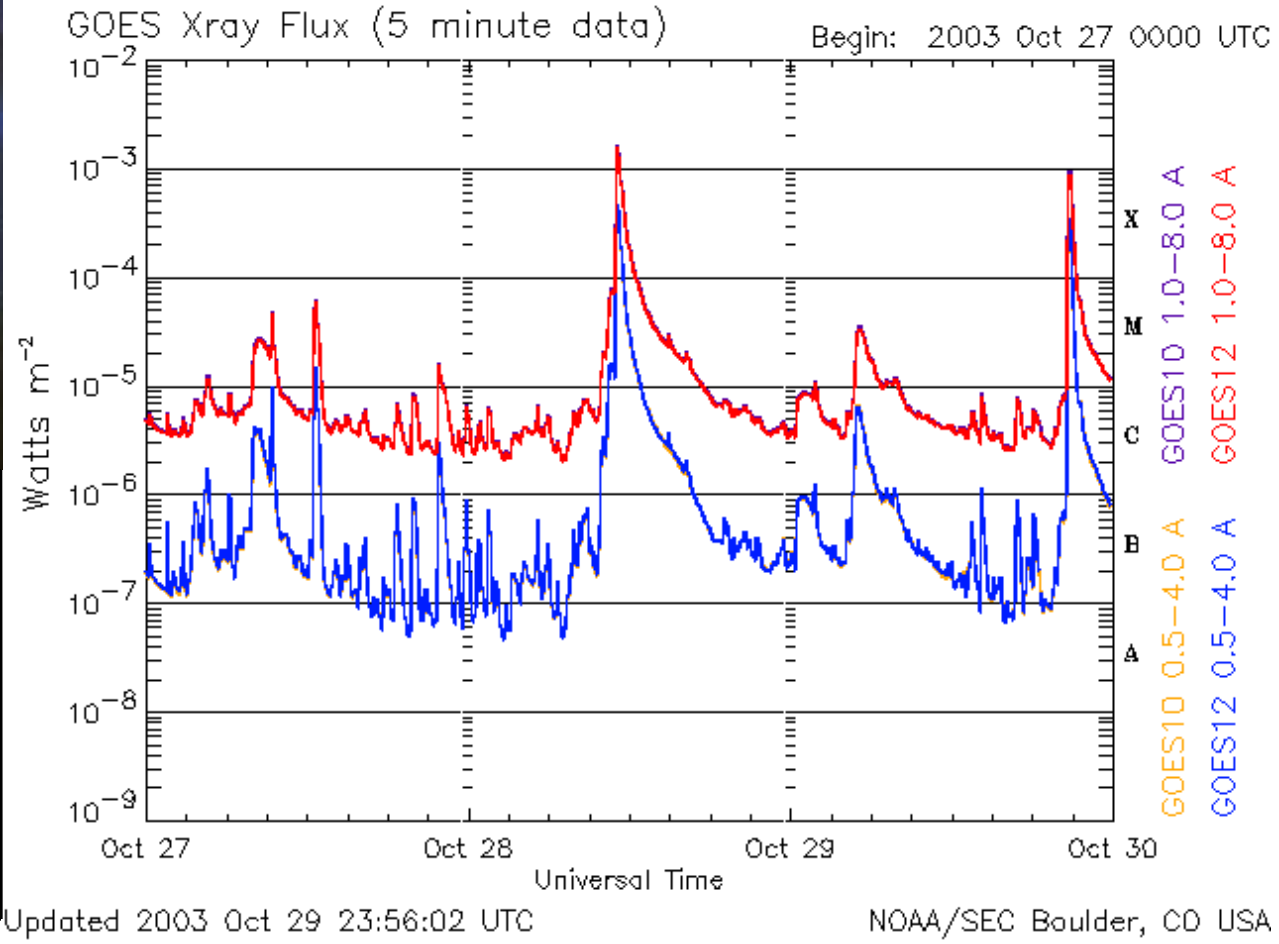


- Space Weather events

Solar Flares

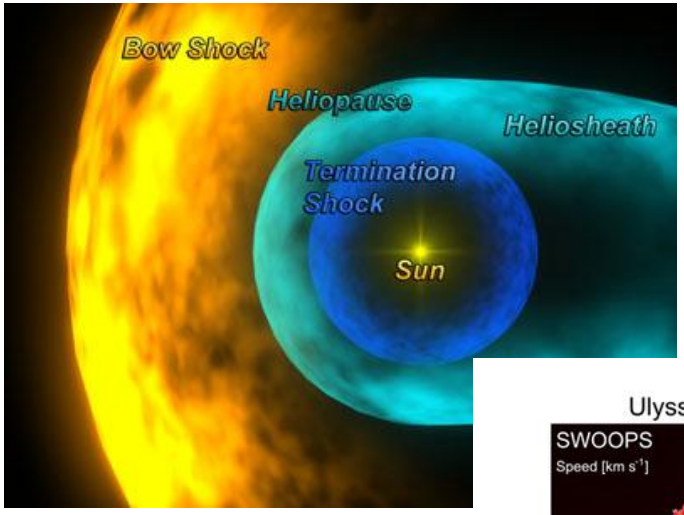
Light Flashes

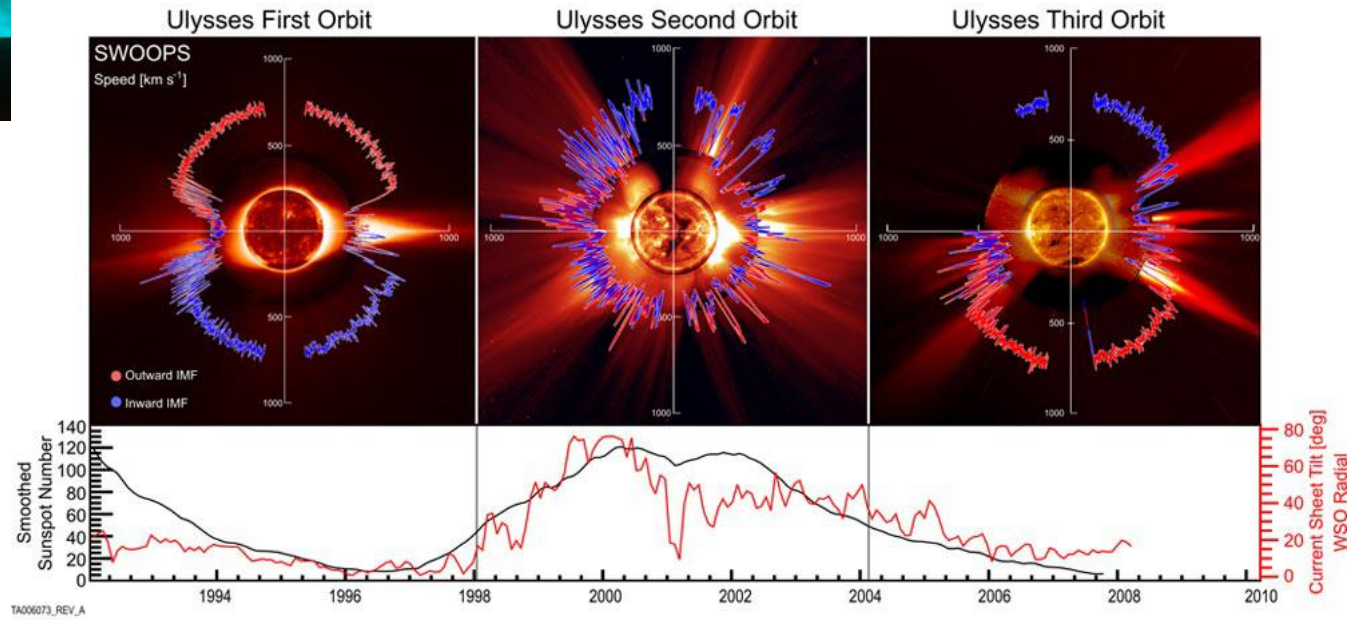
Klasse	Maximum Flux $\log_{10}(P)$ in Wm^{-2}
A	-8
B	-7
C	-6
M	-5
X	-4



- Space Weather predictions - Flares

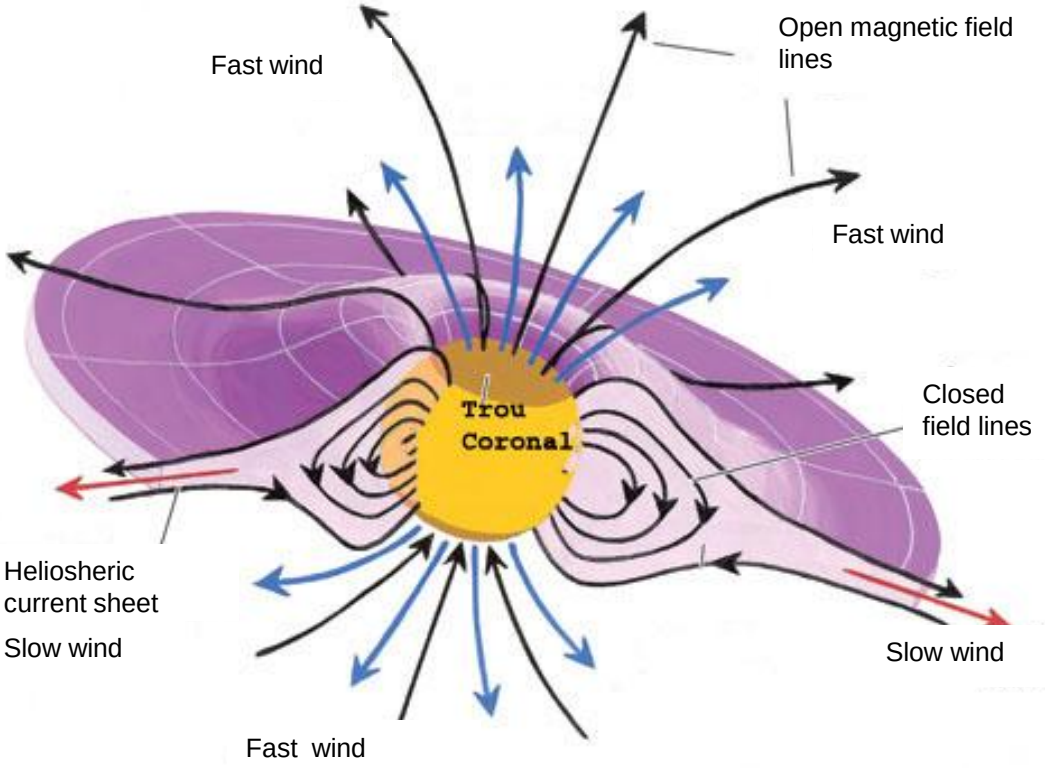
Solar Wind

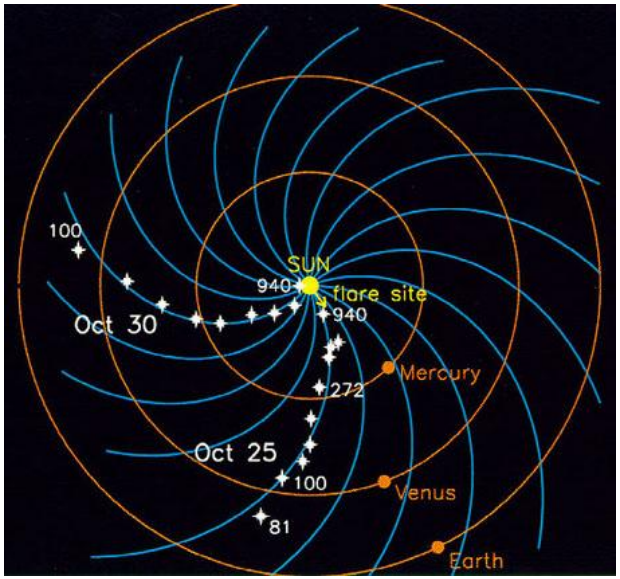


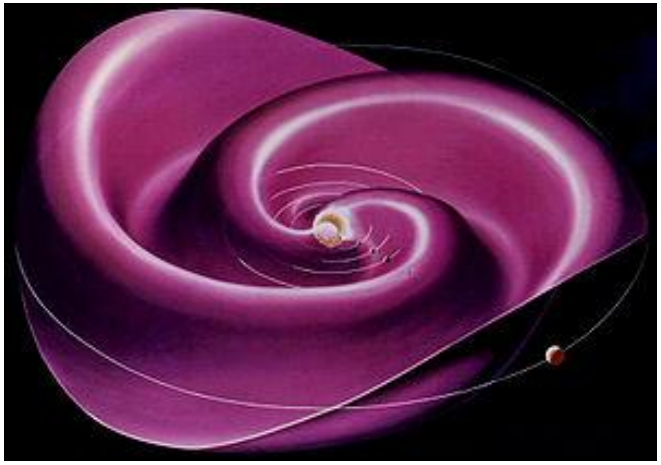


- Space Weather predictions – Solar wind

Solar Wind - Radial

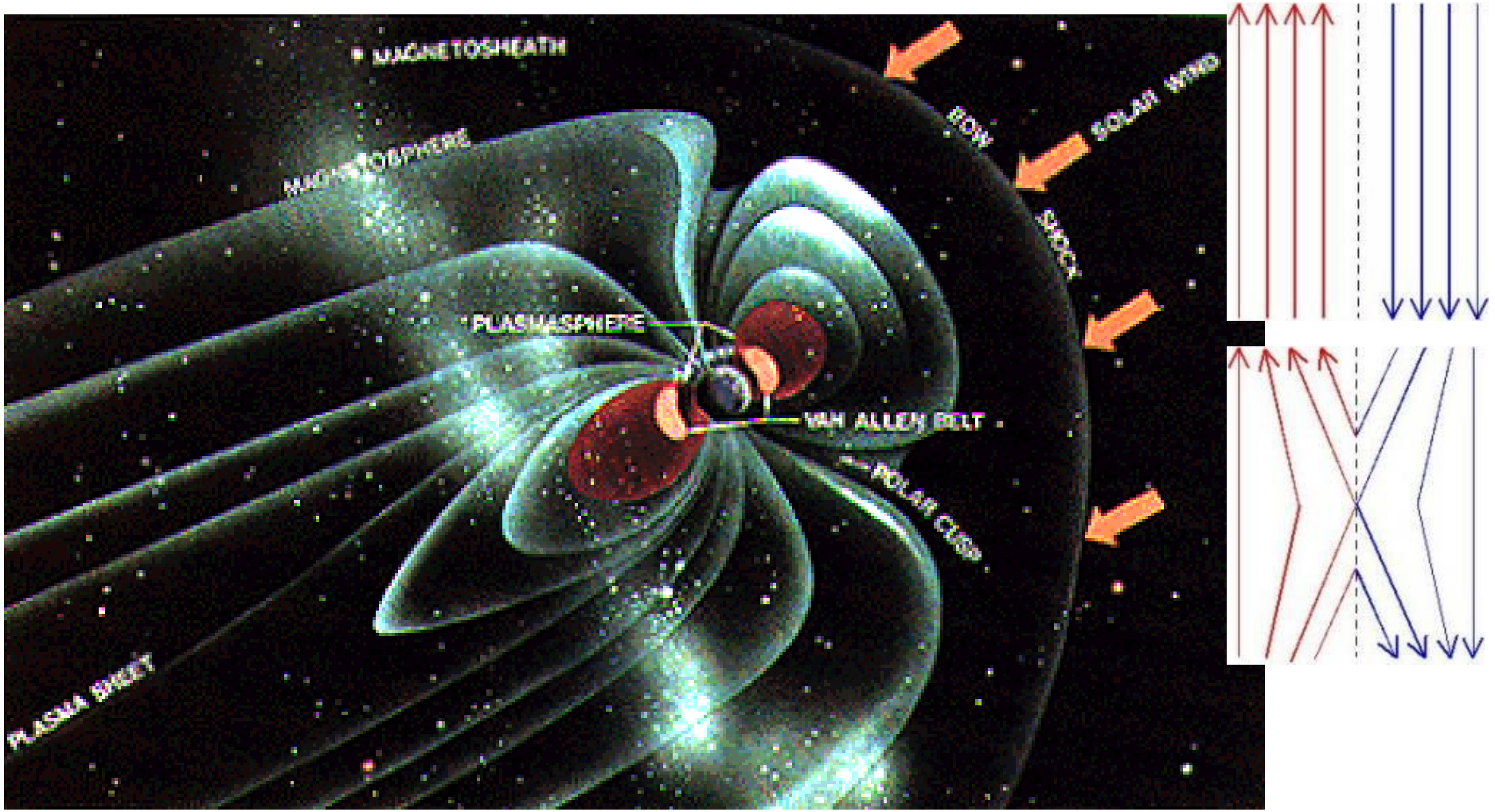






- Solar wind - IMF

Encounter with the Magnetosphere

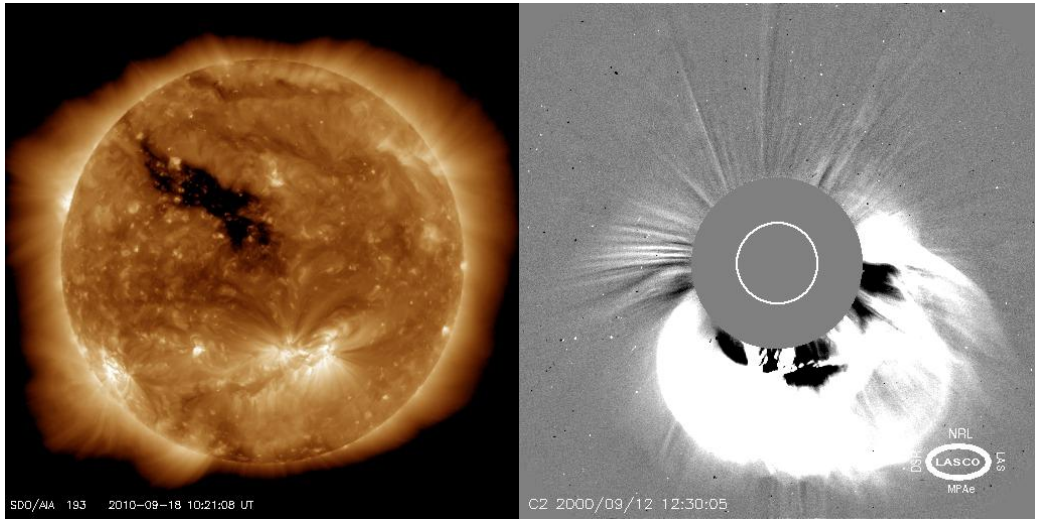


- Solar wind – conditions on Earth

Solar Wind

On top of the usual solar wind, two kind of geo-effective phenomena can happen:

- Not-eruptive structures: coronal holes
- Eruptive structures: CME's



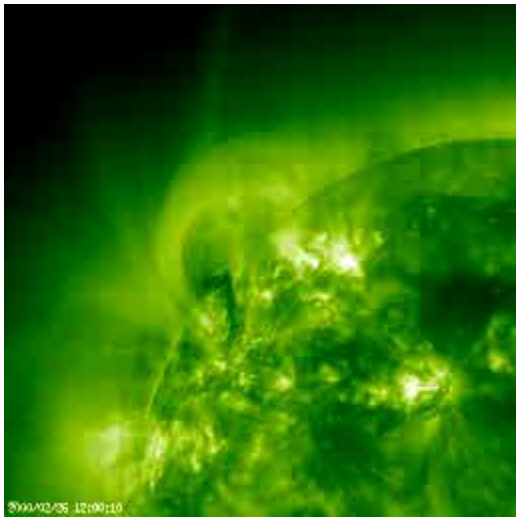
Mass

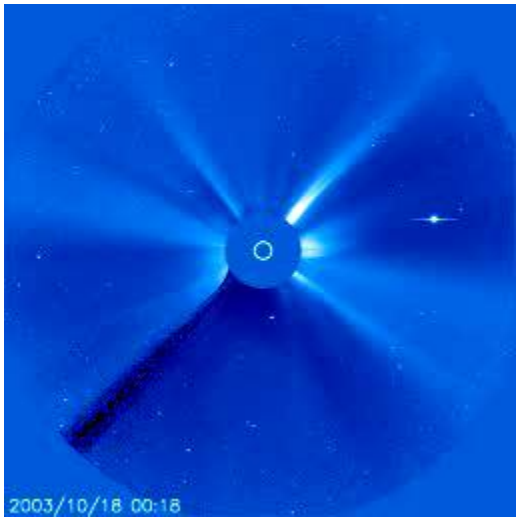
↓

IMF

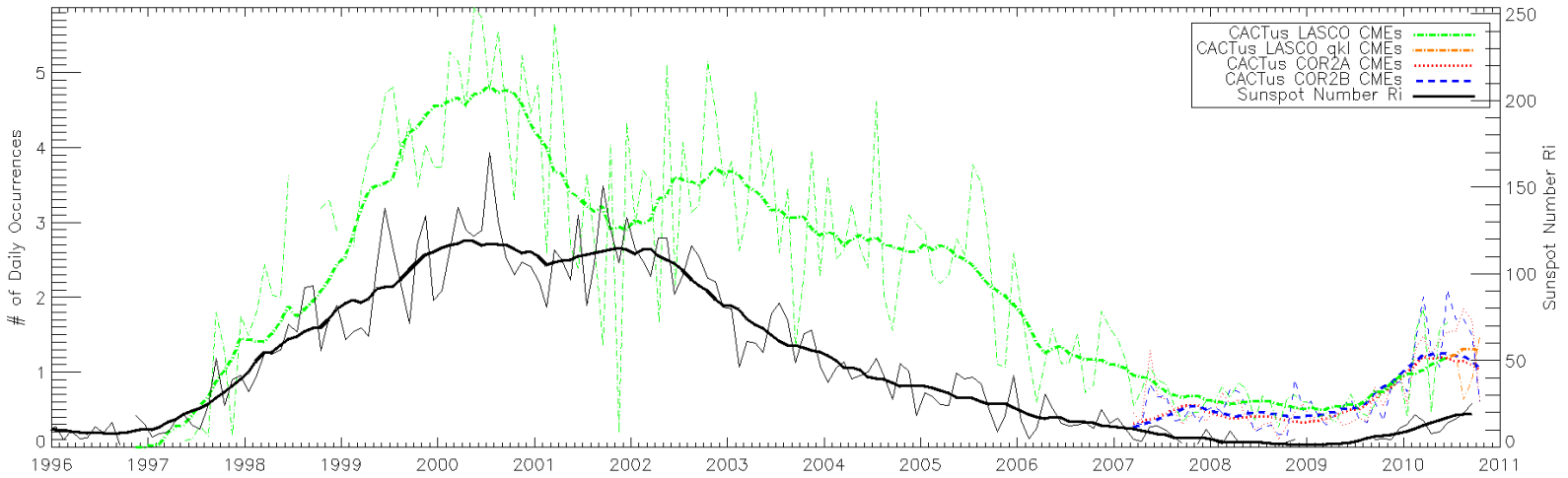
Plasma eruptions in EUV and visible light

- A new, discrete, bright white light feature in the coronograph field-of-view with a predominantly, radial outward velocity.





CME occurrence

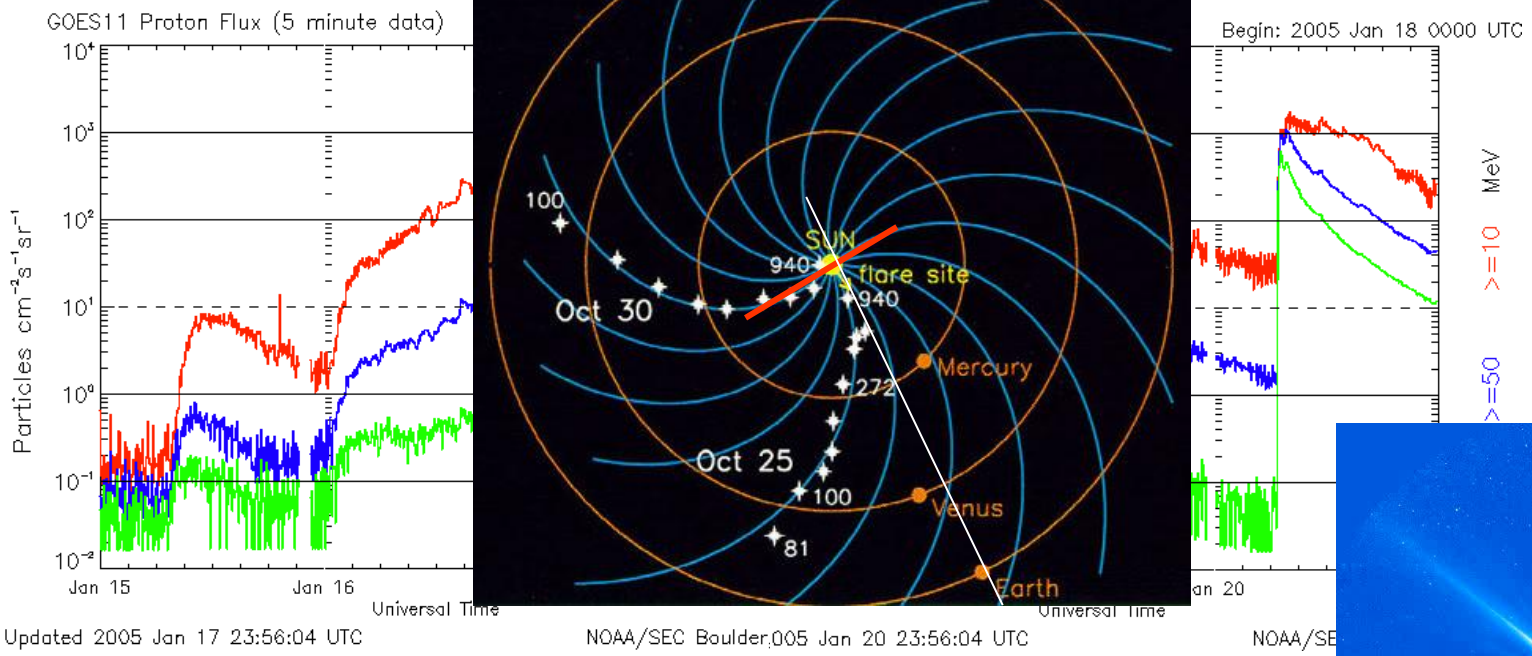


- Solar wind – CME

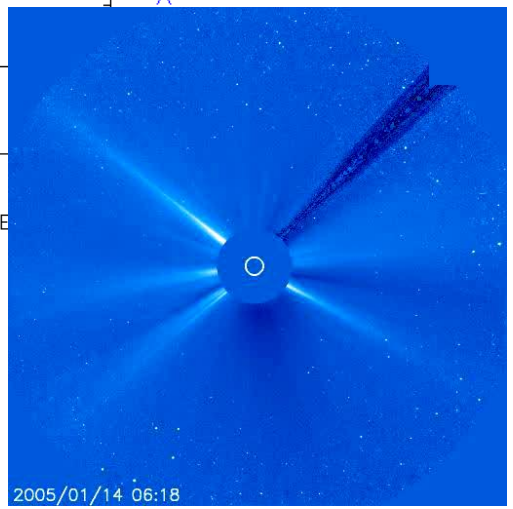
Proton event: In situ observations

CME driven
Gradual event

Flare driven
ulsive event



Magnetic connectivity



Particles → **IMF**

- Space Weather events

Flare-Proton storm-plasma cloud hit Earth

- Light Flash: arrives in 8 minutes
- Particles with relativistic speeds: arrive in 30 minutes
- Plasma cloud: arrive in1 to 4 days
- Magnetosphere: magnetic shield around Earth
- Plasma cloud bumps on Magnetosphere.
- Aurora near the poles

- Space Weather movies

End Part 1