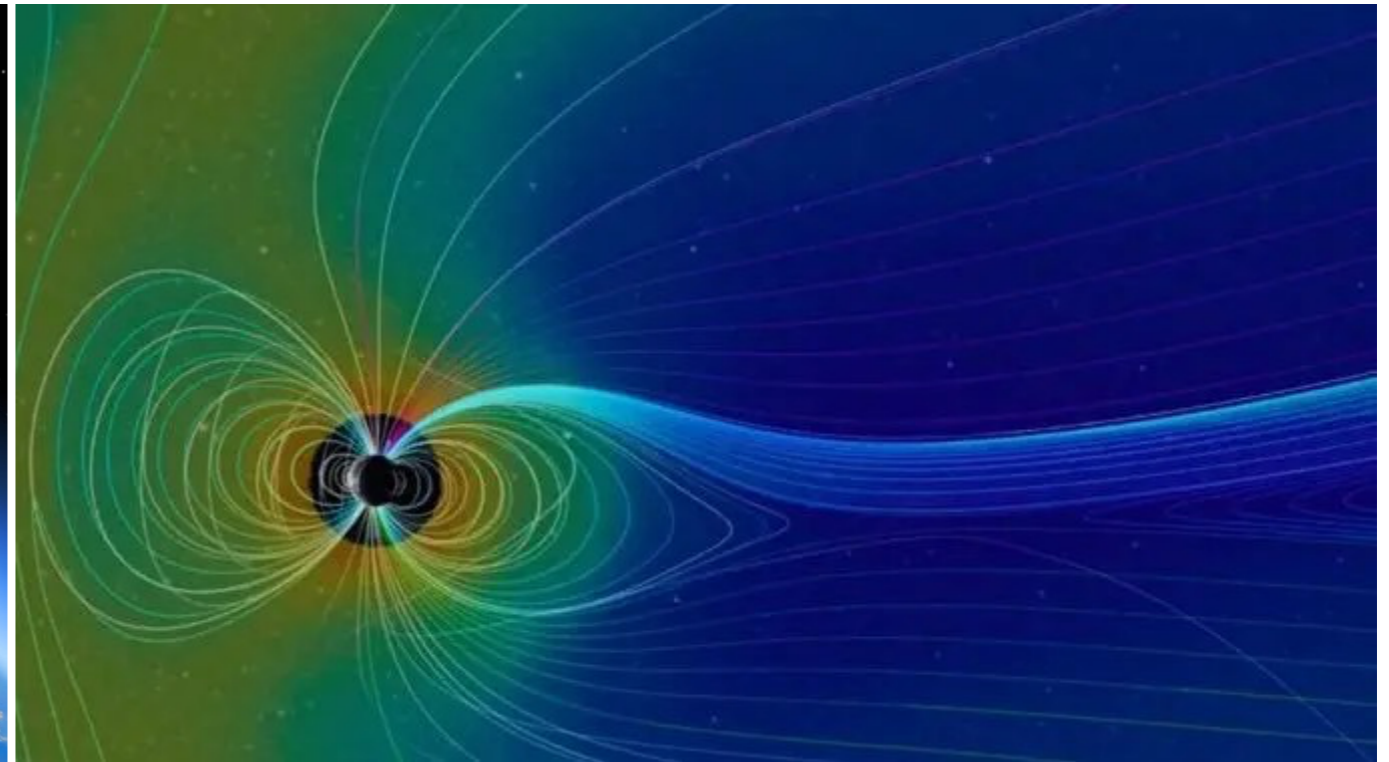


Space Weather

The Sun's energy impacting earth's atmosphere and magnetic shield.



THE SUN AS A BALL OF ENERGY

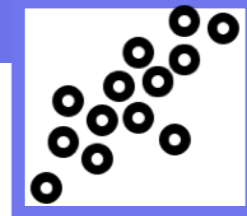
E.M. RADIATION



PLASMA

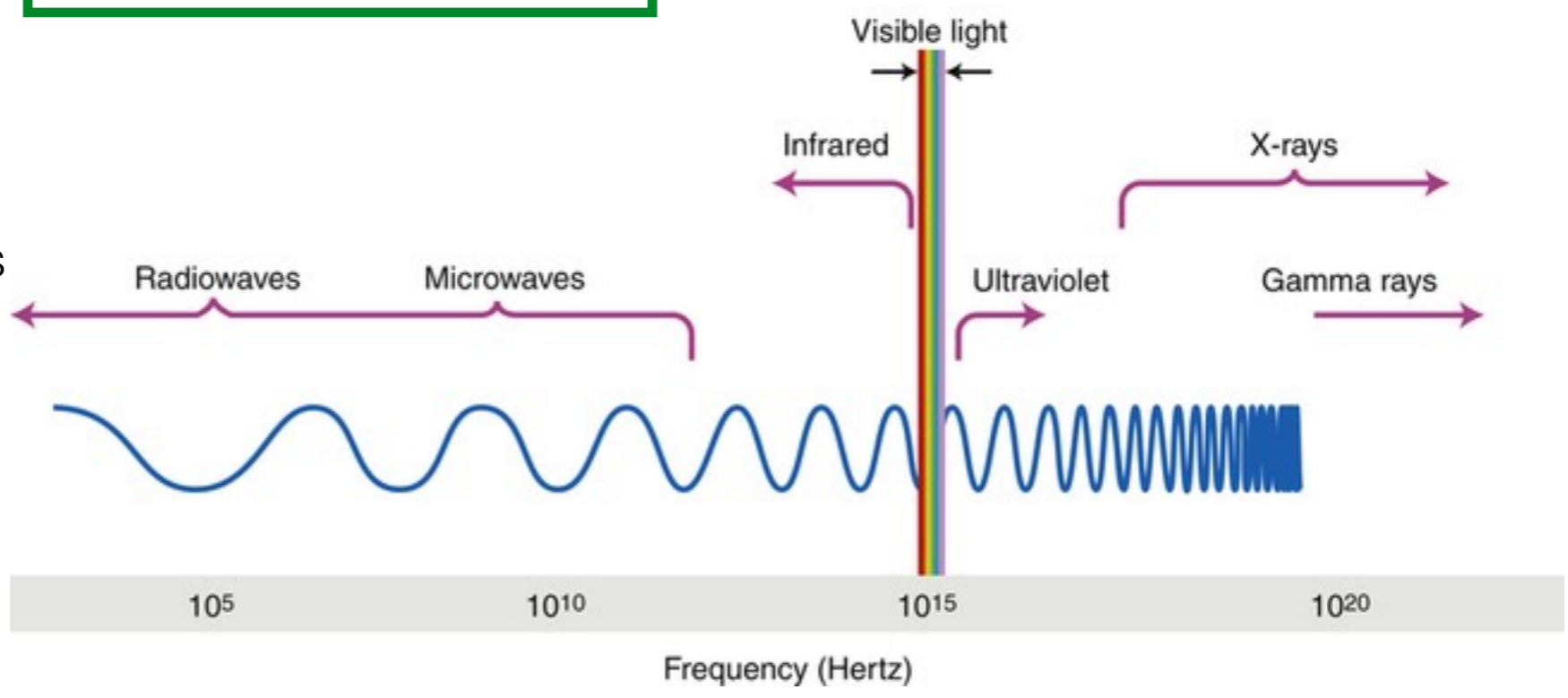


ENERGETIC
PARTICLES



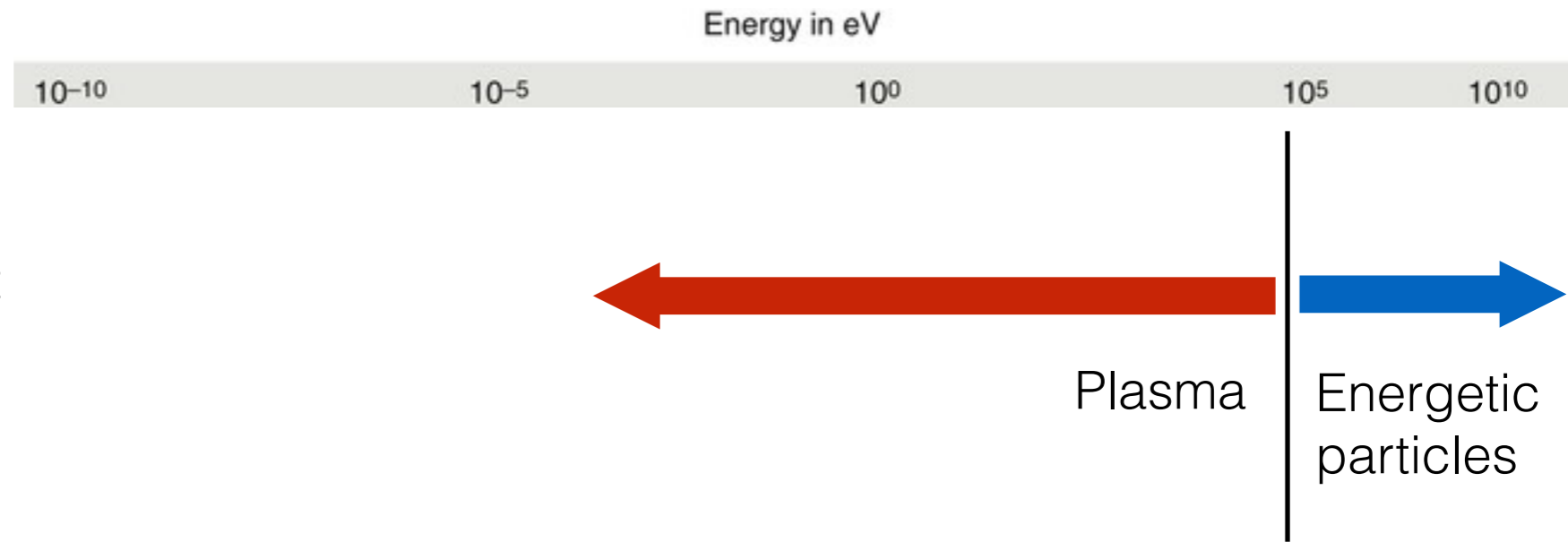
Electromagnetic radiation

- Photons / electromagnetic waves
- Speed of light



Particles

- Atomic & sub-atomic particles
- km/s to fractions of speed of light
- Magnetic Field



3 SPACE WEATHER PHENOMENA

The sun's energy reaches the earth in 3 forms: light, moving gas and particle precipitation. This energy interacts with the magnetosphere and the atmosphere of the earth. This is space weather.

How and where the interaction occurs depends on the type of energy.

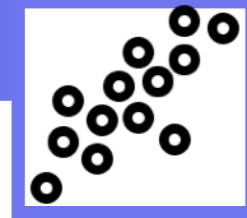
LIGHT



WIND



PARTICLE RAIN



SOLAR WEATHER & STORMS

At a certain moment, energy can be released on a shorter time scale. A solar feature like a sunspot, an active region, coronal hole, filament etc. lies at the base of a solar storm in which energy is released. The release of energy might be in an abrupt, impulsive and brutal way (flare, Coronal Mass Ejection or CME, proton storm) or in a non-eruptive manner (Coronal Hole - CH).



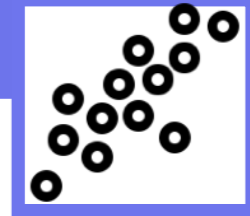
FLARE



Coronal Mass Ejection
Coronal Hole



PARTICLE STORM







AIA 131

2014-02-25 00:10:08

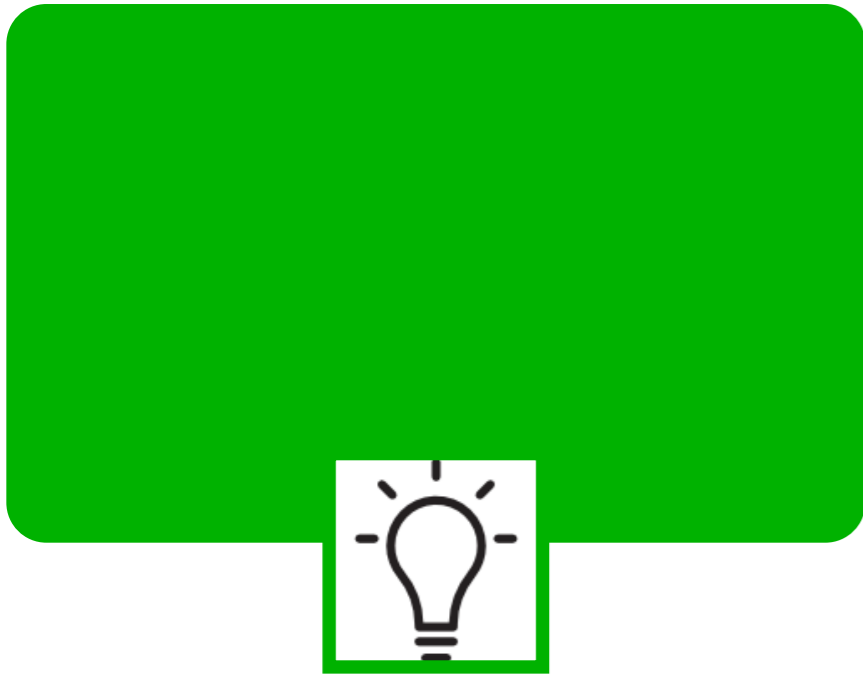
www.helioviewer.org





AU TRANSIT TIME

The energy released during a solar storm moves through space, each with its own typical speed: speed of light,





AU TRANSIT TIME

The energy released during a solar storm moves through space, each with its own typical speed: speed of light, ...

8 MIN



STORM SCALE



<https://www.swpc.noaa.gov/products/goes-x-ray-flux>



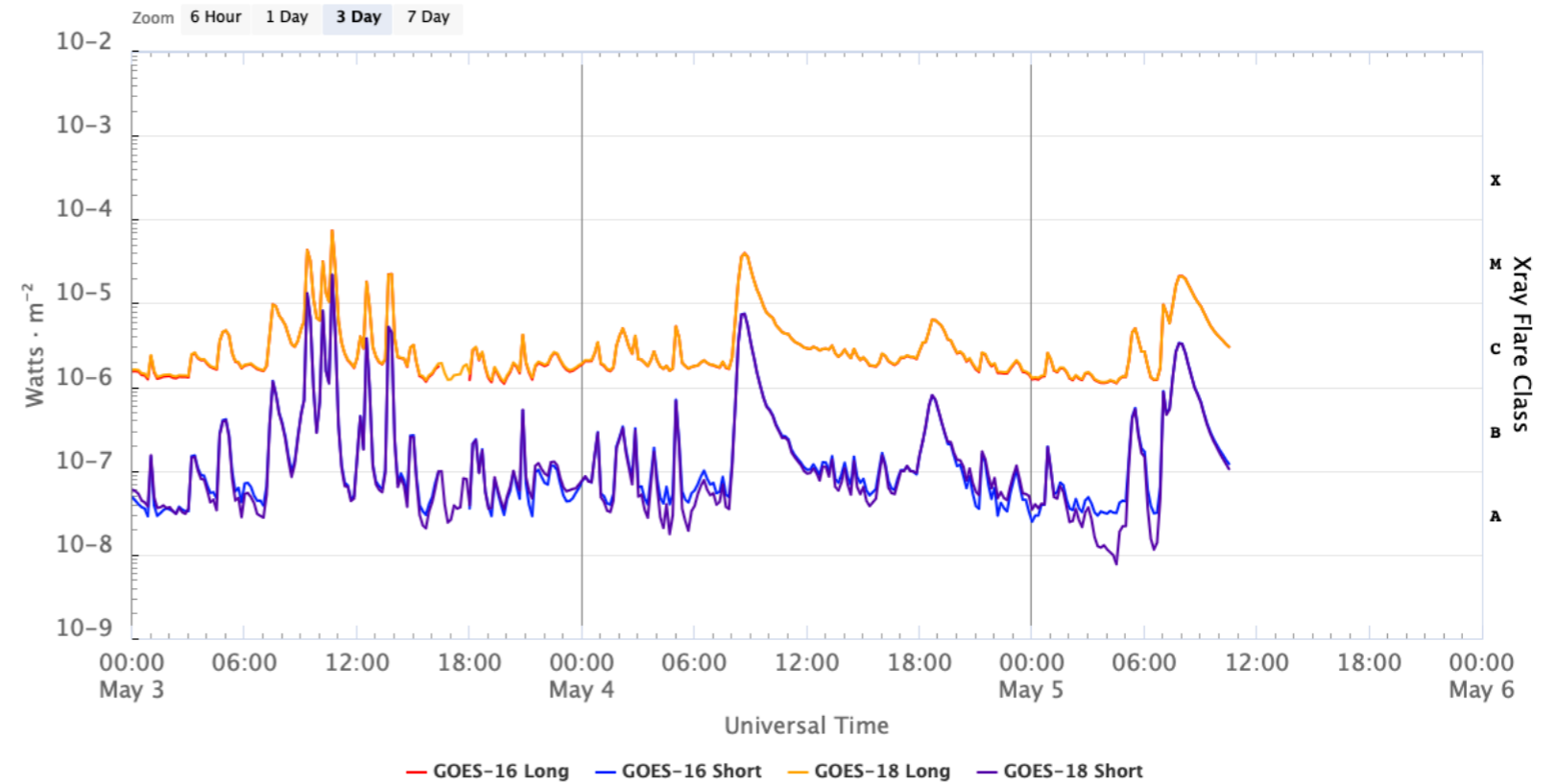
STORM SCALE



A,B,C,M,X



GOES X-Ray Flux (1-minute data)



Updated 2023-05-05 10:34 UTC

Space Weather Prediction Center

<https://www.swpc.noaa.gov/products/goes-x-ray-flux>



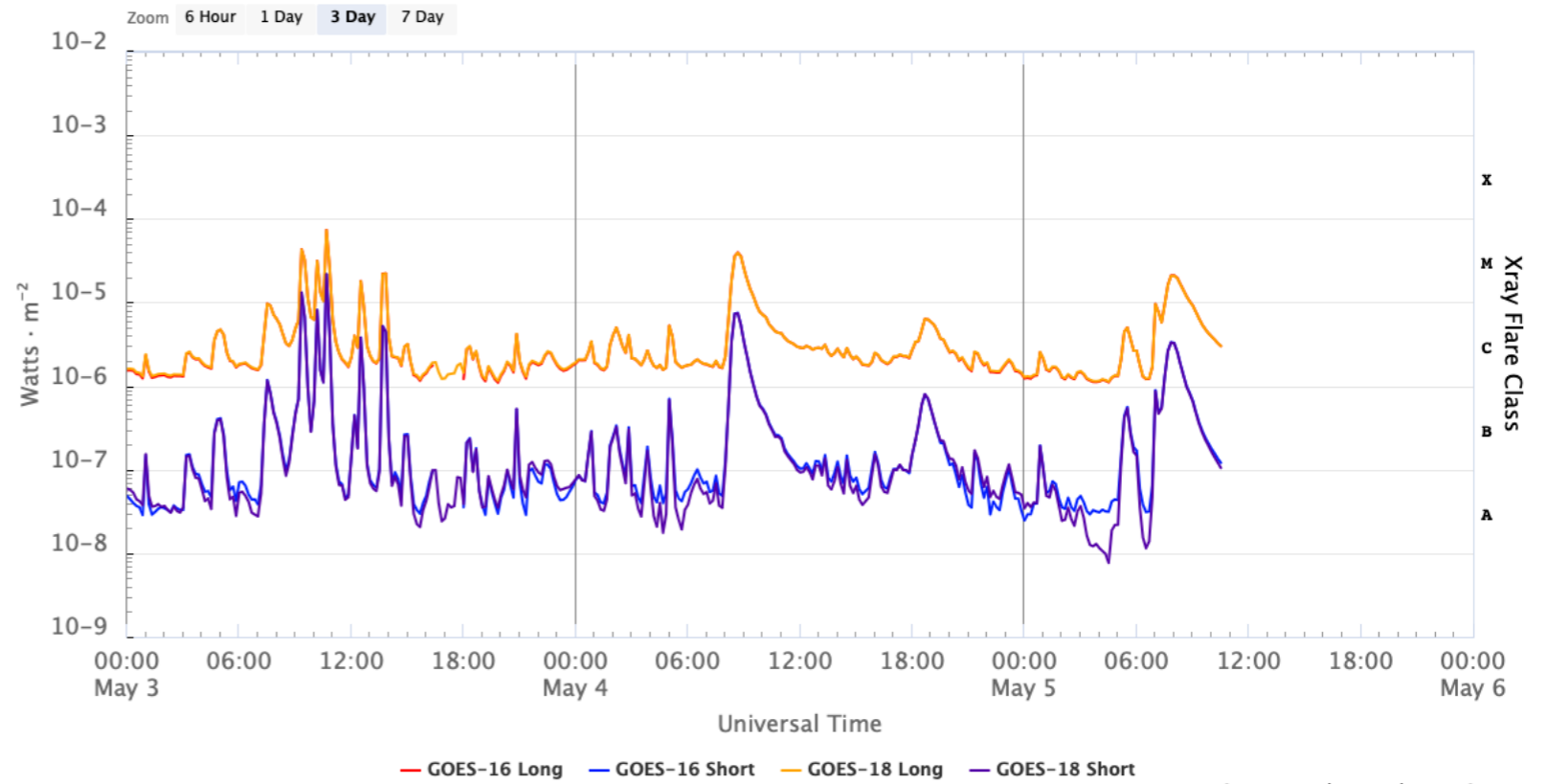
DURATION



MINs to HOUR



GOES X-Ray Flux (1-minute data)

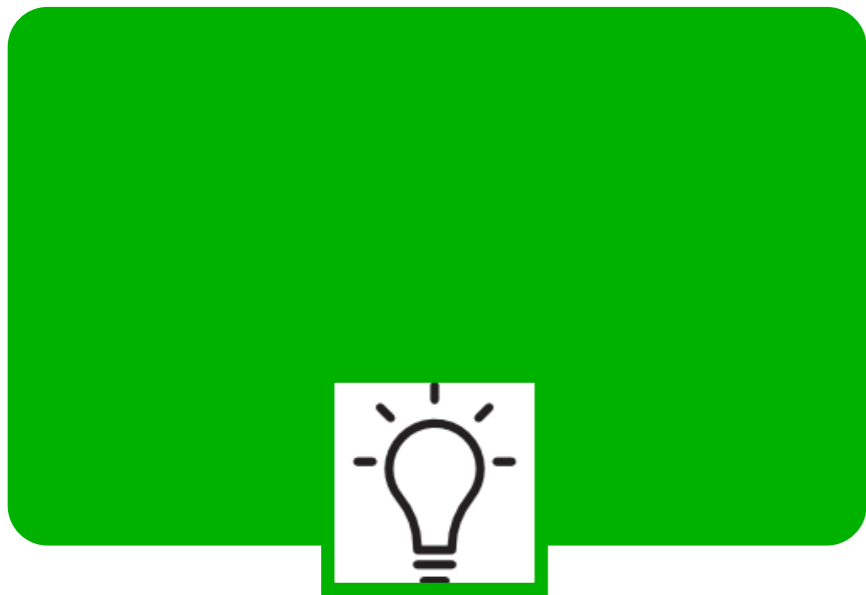


Updated 2023-05-05 10:34 UTC

Space Weather Prediction Center

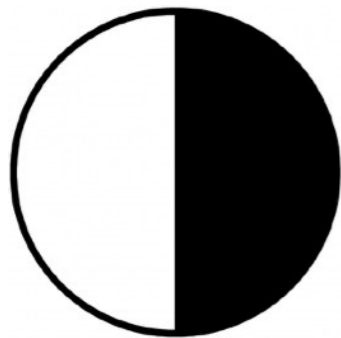


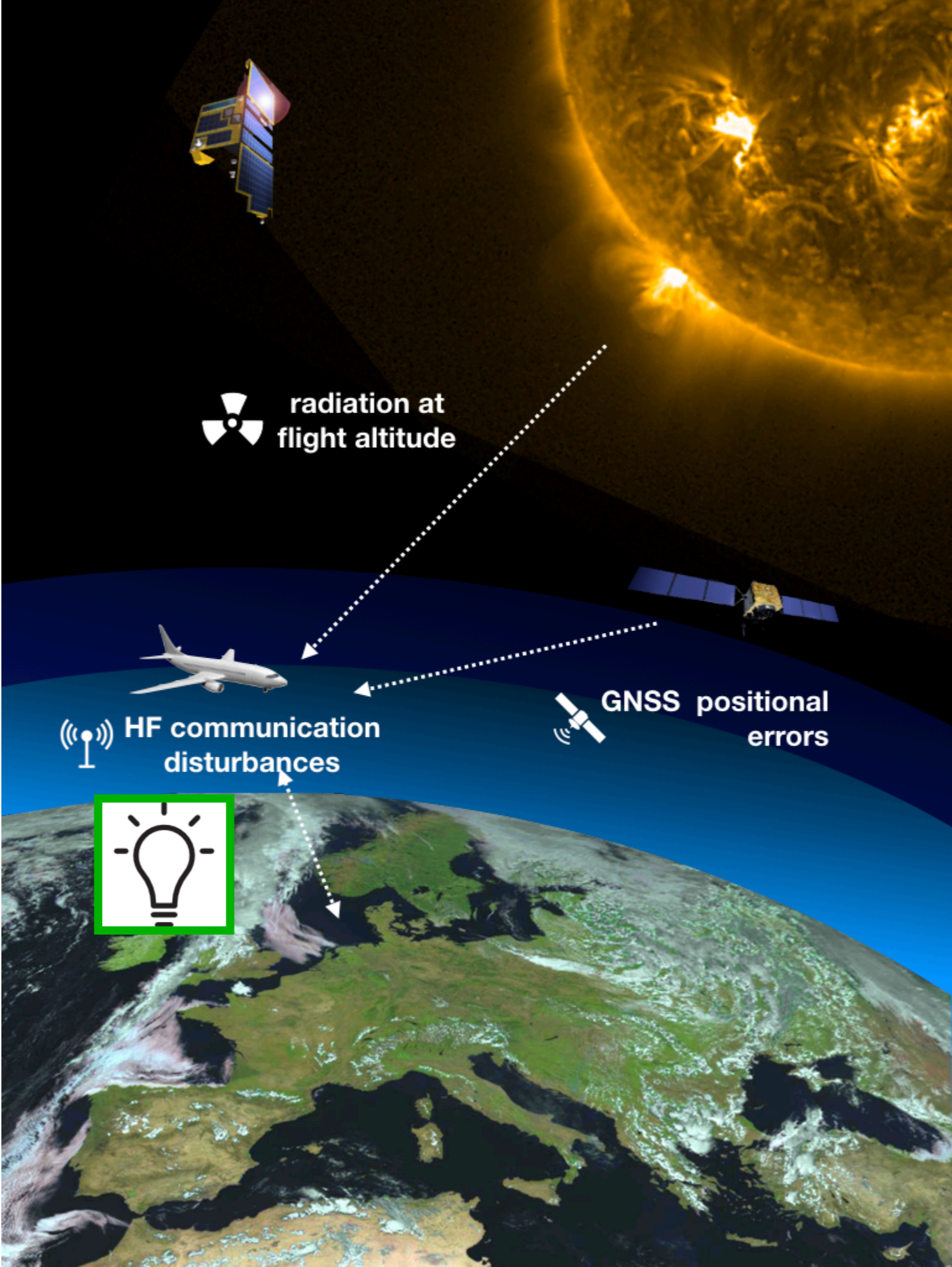
AREA OF IMPACT

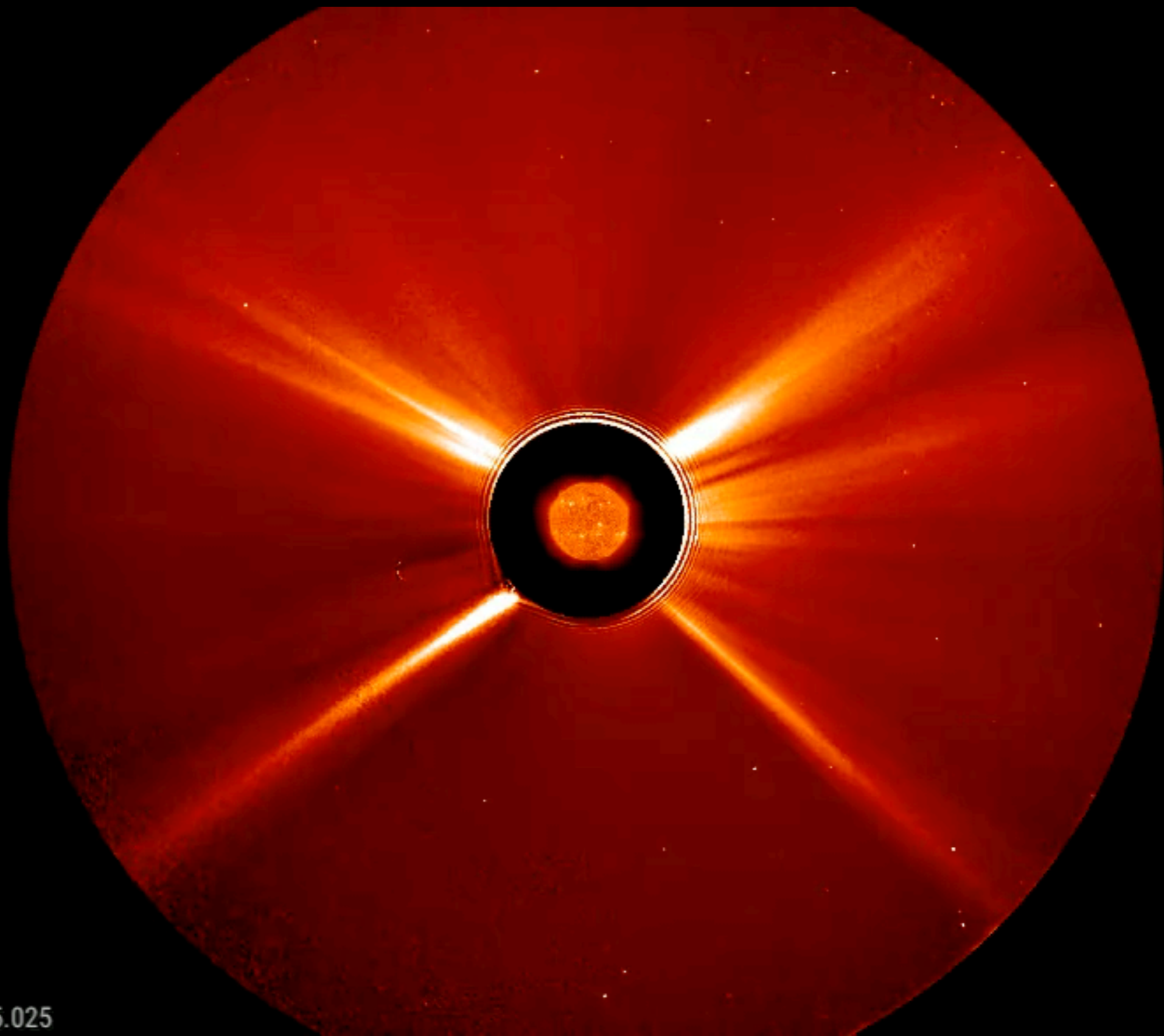
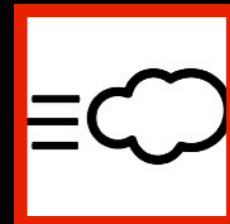


AREA OF IMPACT

Illuminated area







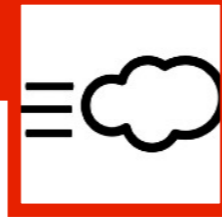
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AU TRANSIT TIME

The energy released during a solar storm moves through space, each with its own typical speed: speed of light, order of a few 100 km/s,....

8 MIN





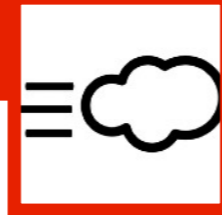
AU TRANSIT TIME

The energy released during a solar storm moves through space, each with its own typical speed: speed of light, order of a few 100 km/s, relativistic speeds.

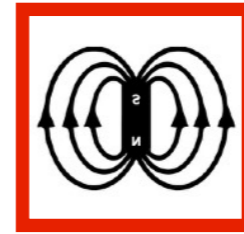
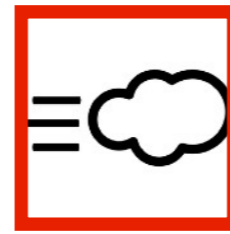
8 MIN



DAYS



STORM SCALE



STORM SCALE



<https://www.swpc.noaa.gov/products/planetary-k-index>

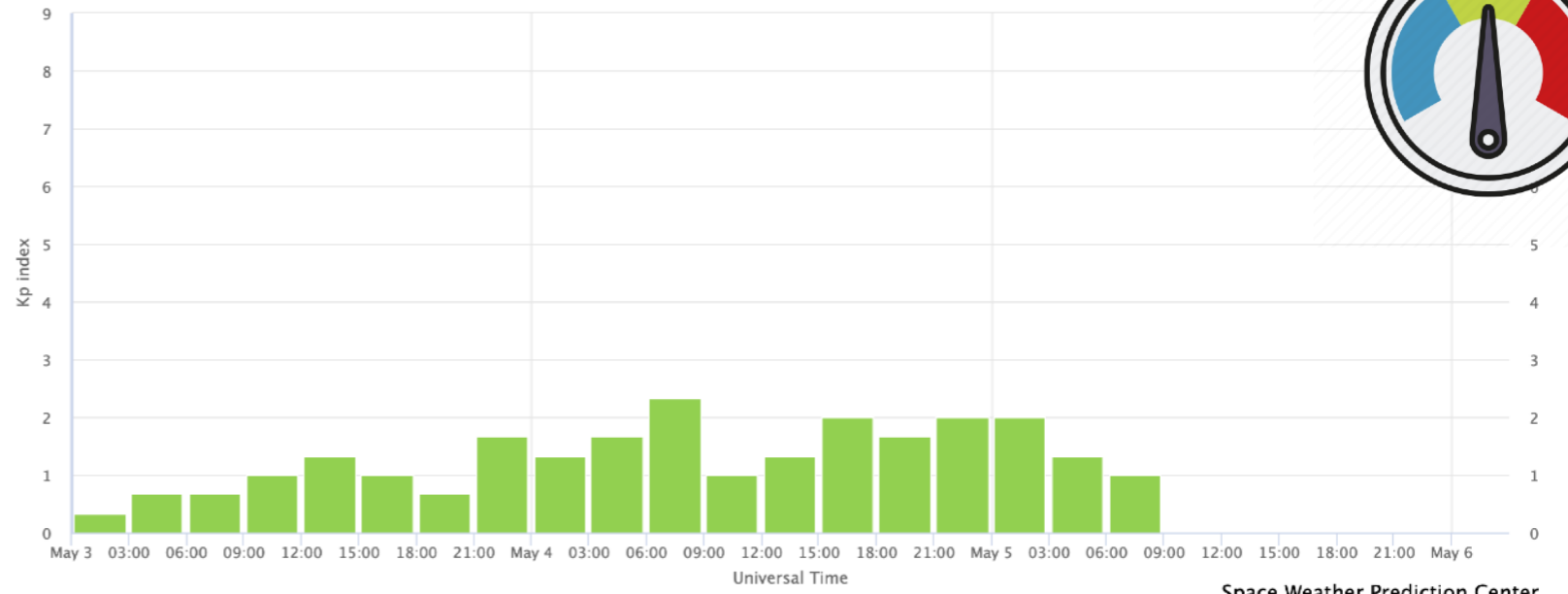
A,B,C,M,X



STORM SCALE

Estimated Planetary K index (3 hour data)

Begin: Wed, 03 May 2023 00:00:00 GMT

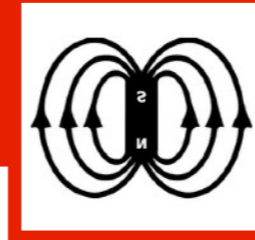


Space Weather Prediction Center

A,B,C,M,X



Kp
0 - 9



DURATION



MINs to HOUR

A white square icon containing a black outline of a lit lightbulb, representing a short-term or immediate duration.

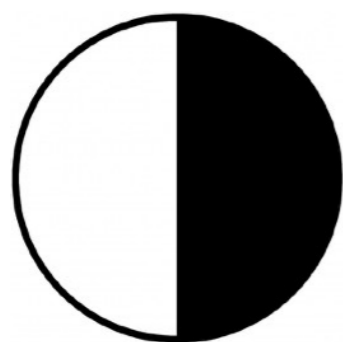
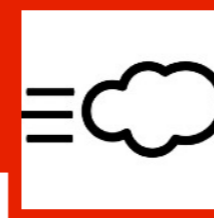
DAY+

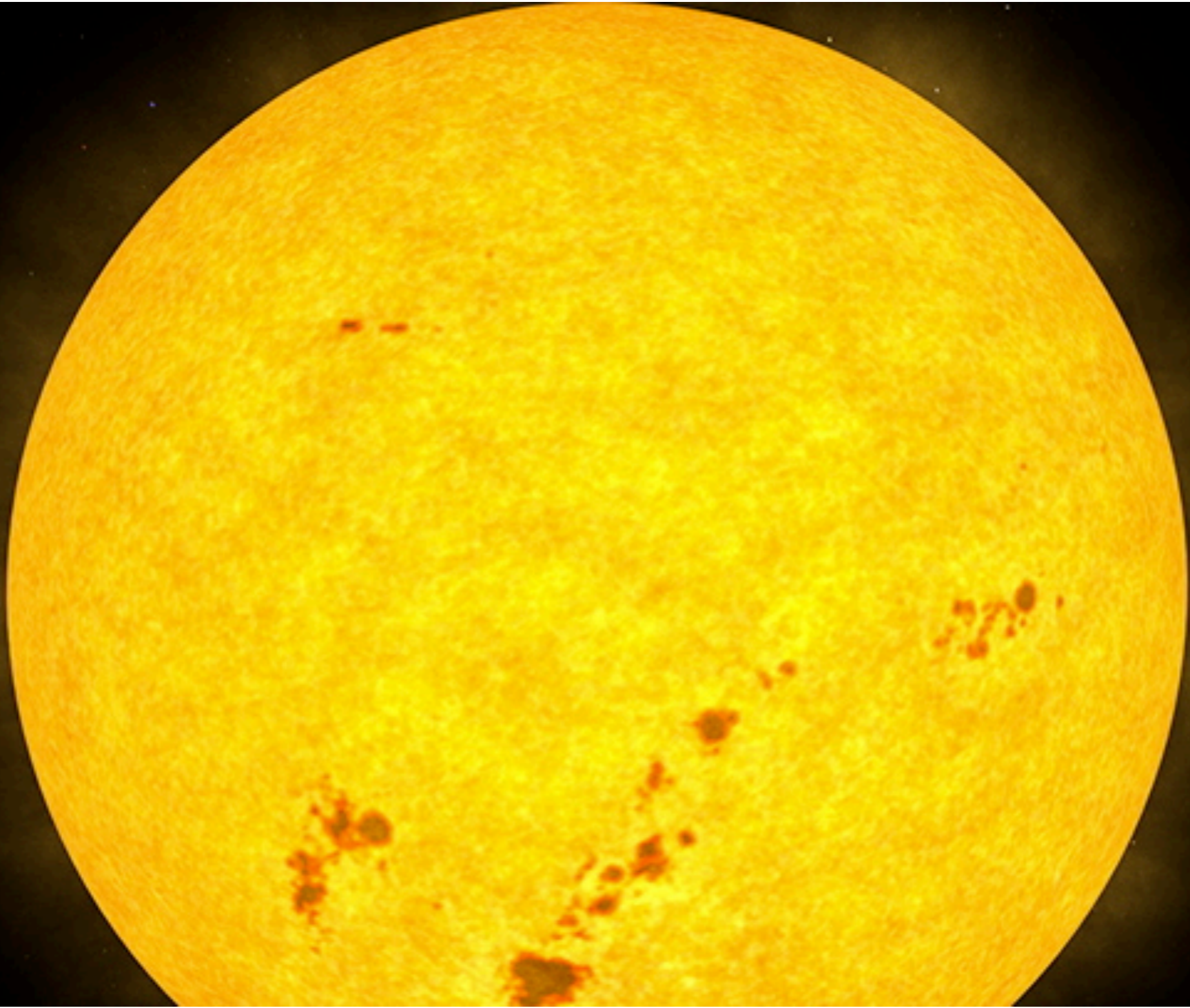
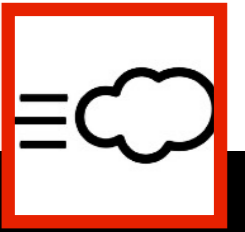
A white square icon containing a black diagram of magnetic field lines with arrows, representing a long-term or extended duration.

AREA OF IMPACT



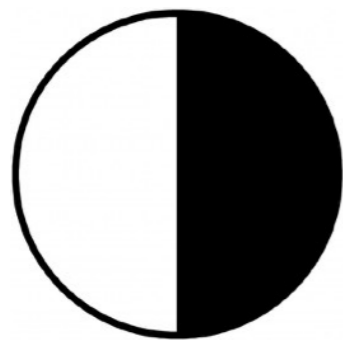
Illuminated area



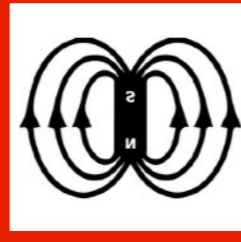


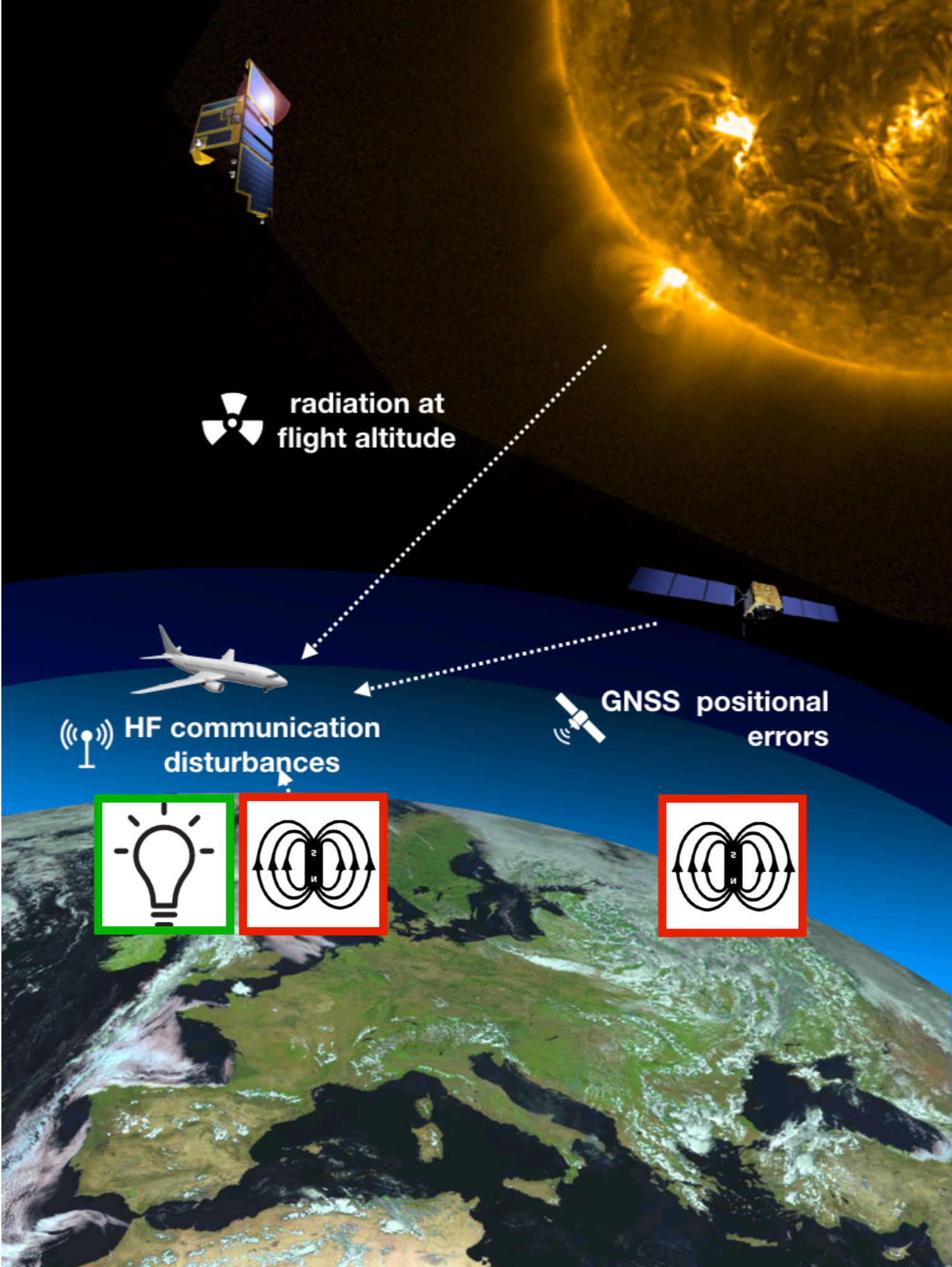
AREA OF IMPACT

Illuminated area



Polar Cap

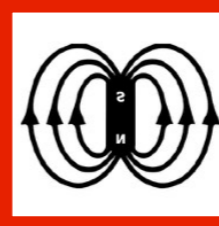
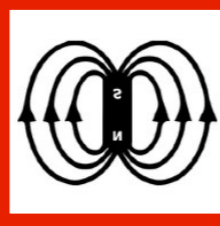


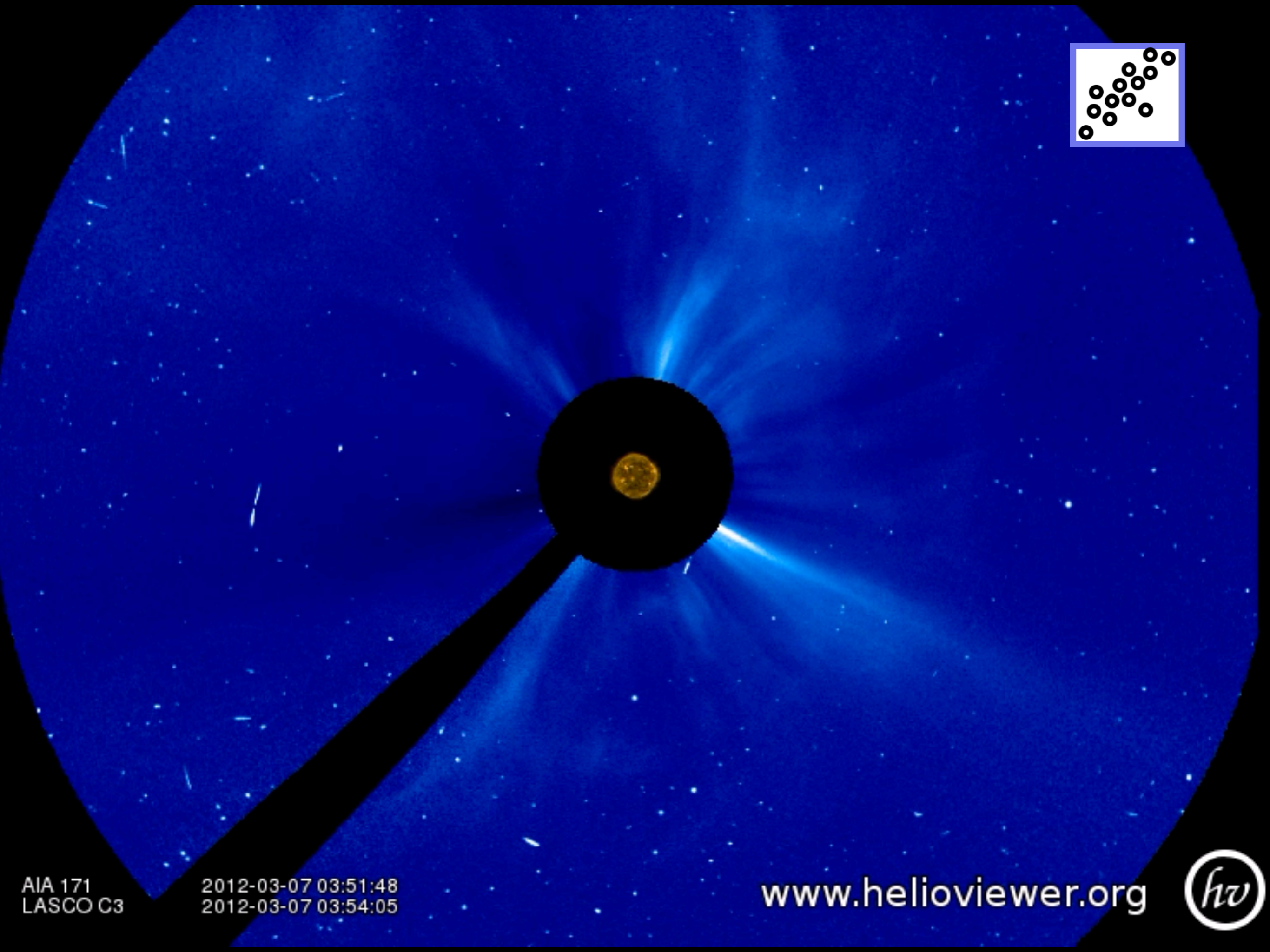
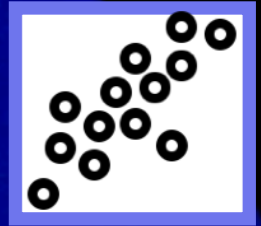


radiation at flight altitude

HF communication disturbances

GNSS positional errors





AIA 171
LASCO C3

2012-03-07 03:51:48
2012-03-07 03:54:05

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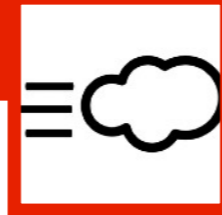
AU TRANSIT TIME

The energy released during a solar storm moves through space, each with its own typical speed: speed of light, order of a few 100 km/s, relativistic speeds.

8 MIN



DAYS





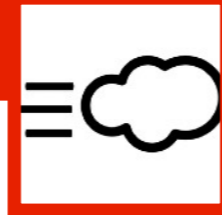
AU TRANSIT TIME

The energy released during a solar storm moves through space, each with its own typical speed: speed of light, order of a few 100 km/s, relativistic speeds.

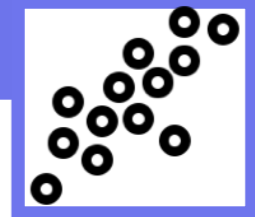
8 MIN



DAYS



HOUR



STORM SCALE

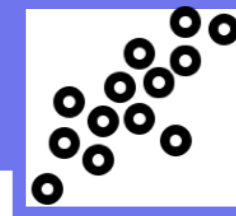
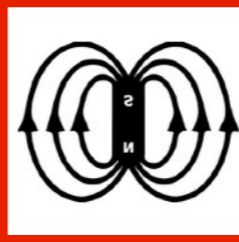


<https://www.swpc.noaa.gov/products/goes-proton-flux>

A,B,C,M,X

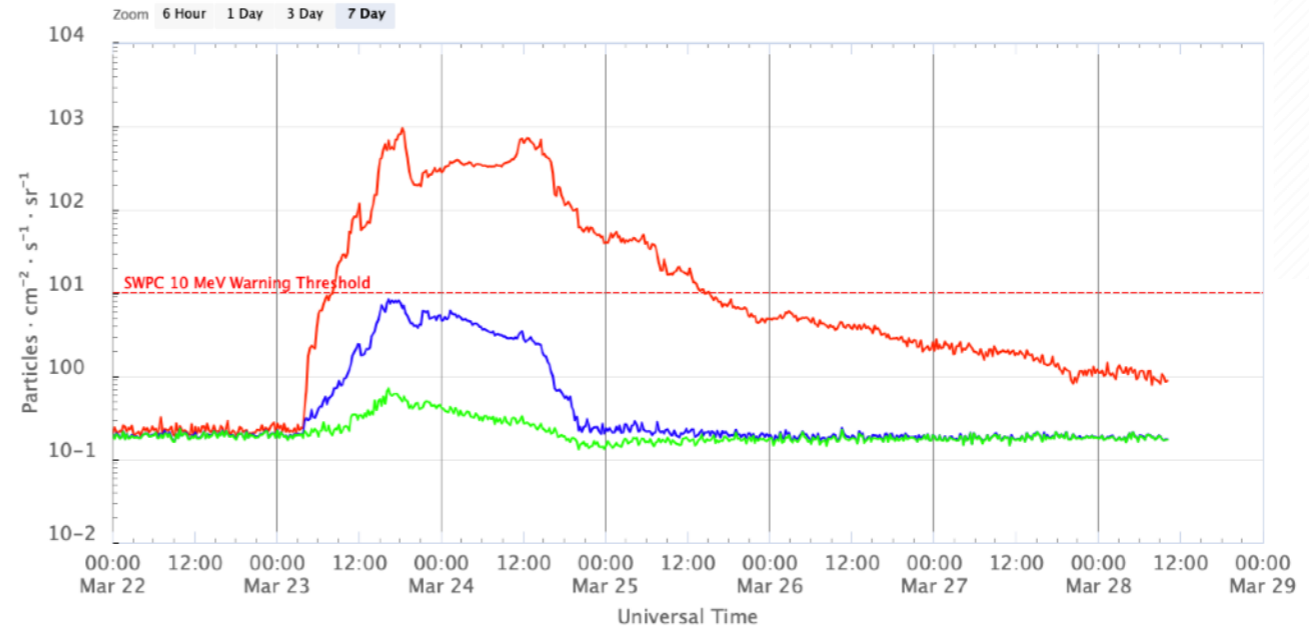


Kp
0 - 9



STORM SCALE

GOES Proton Flux (5-minute data)



A,B,C,M,X

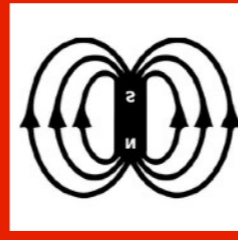


Updated 2024-03-28 10:10 UTC

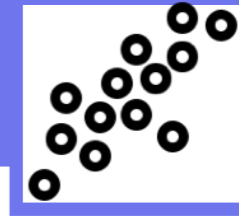
— GOES-18 ≥ 10 MeV — GOES-18 ≥ 50 MeV — GOES-18 ≥ 100 MeV

Space Weather Prediction Center

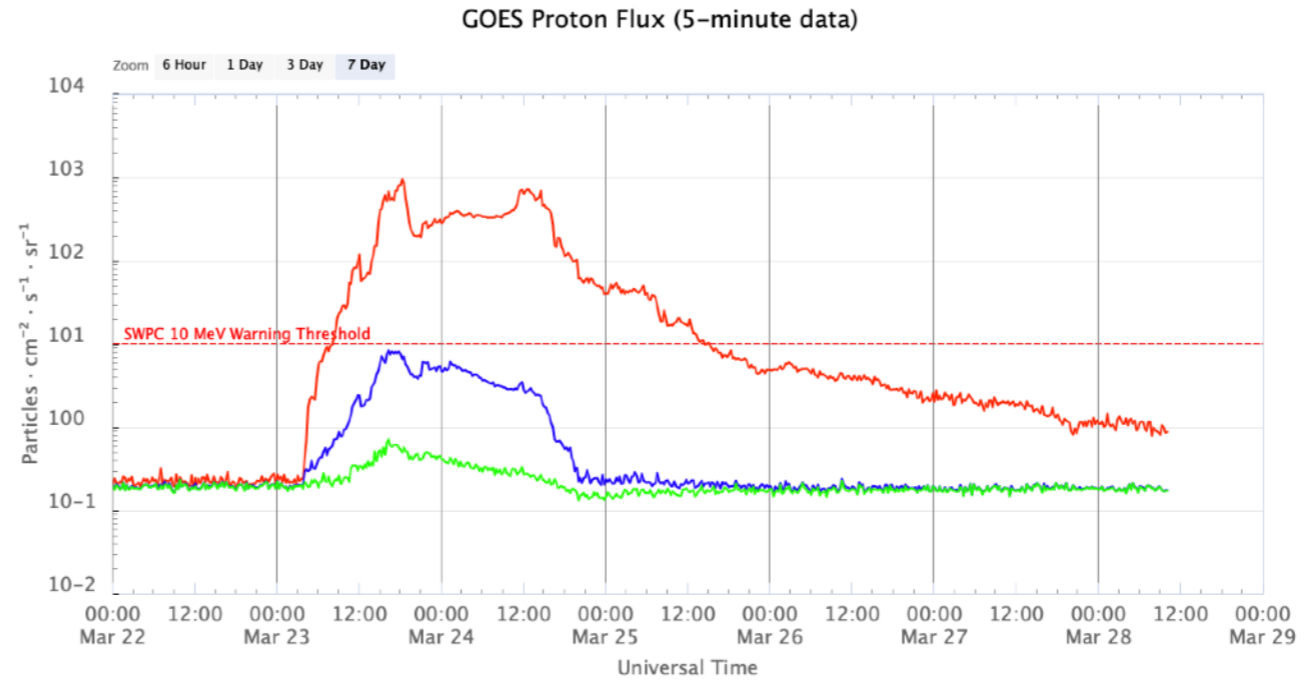
Kp
0 - 9



Storm - major storm



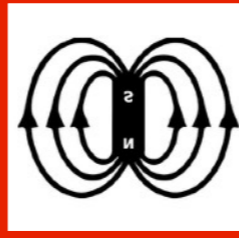
DURATION



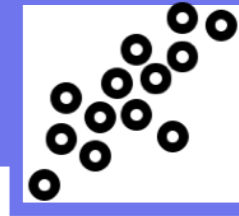
MINs to HOUR



DAY+



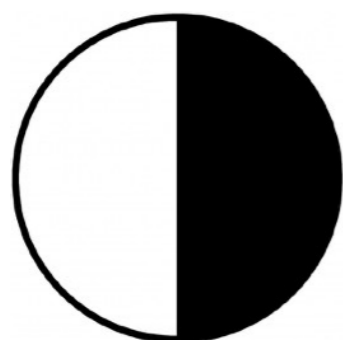
HOURS to DAYS



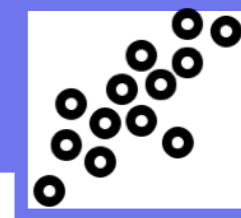
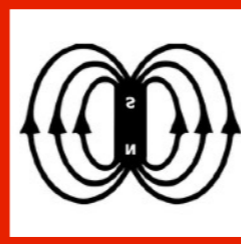
AREA OF IMPACT

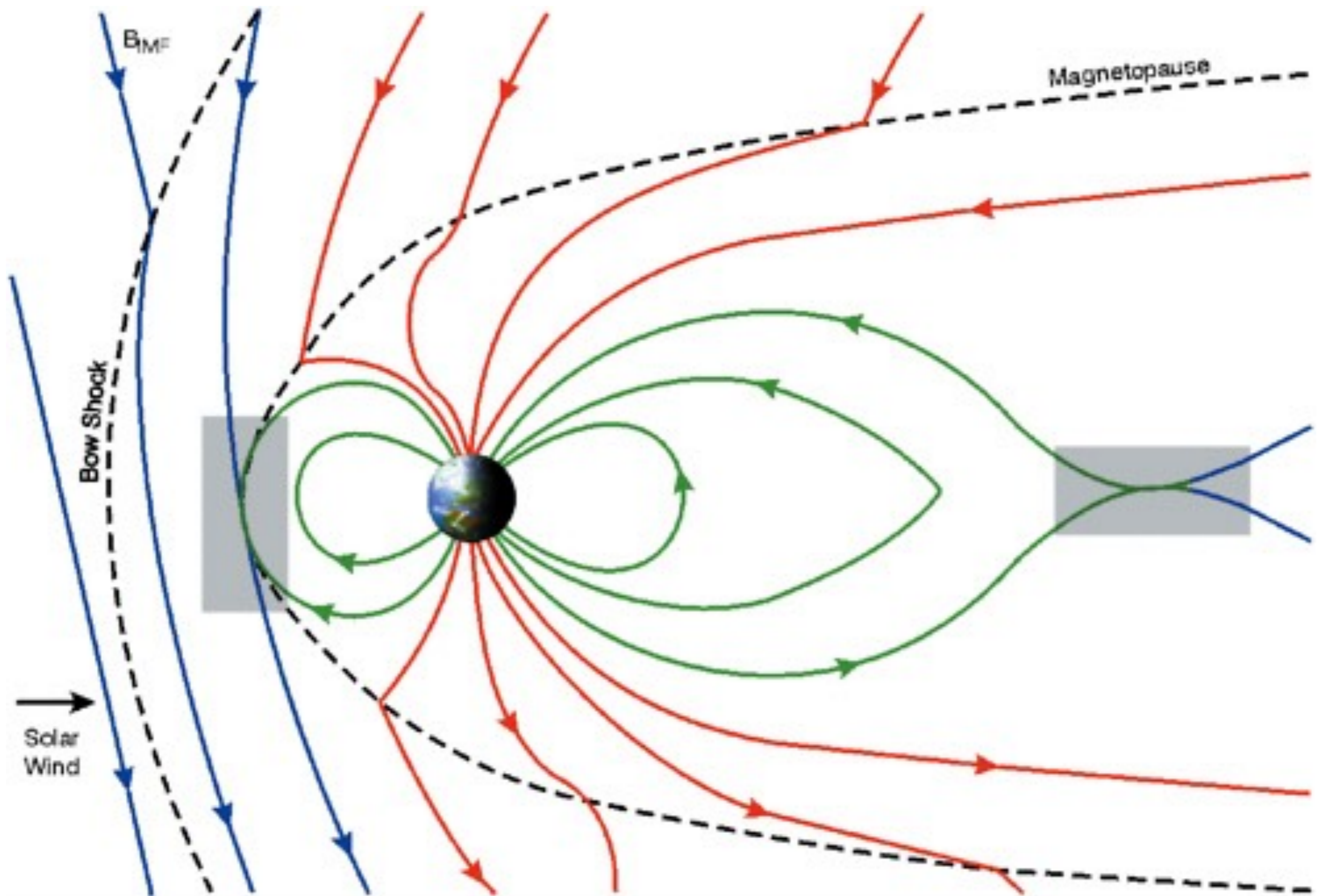


Illuminated area



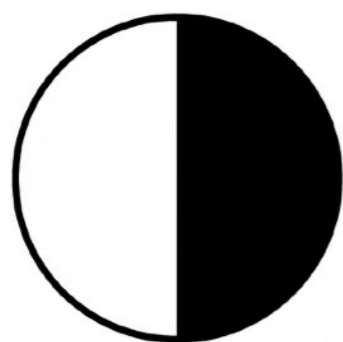
Polar Cap



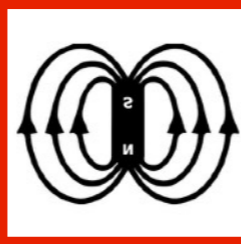


AREA OF IMPACT

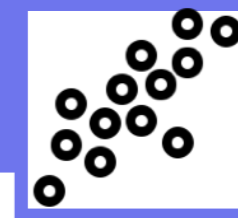
Illuminated area

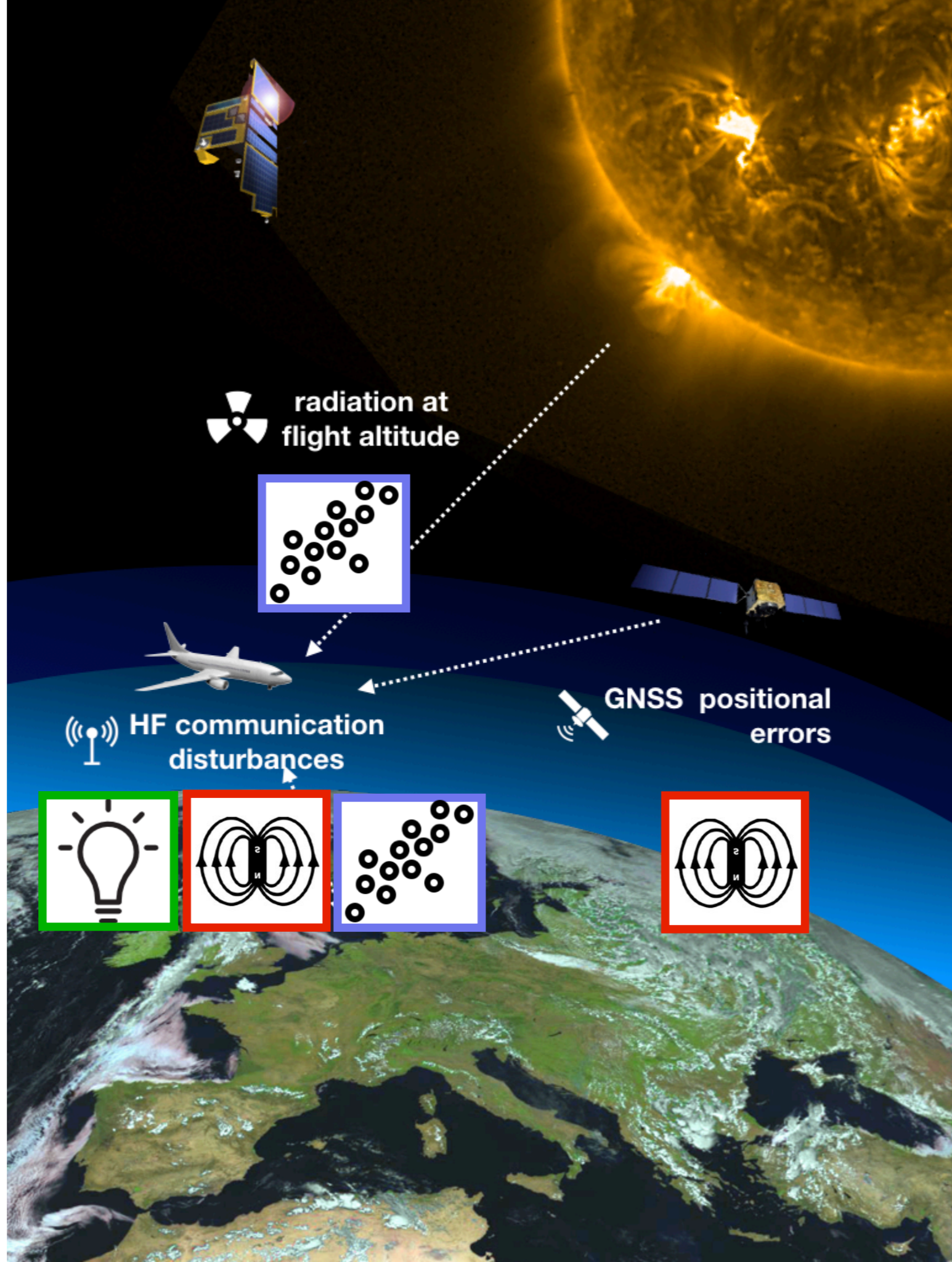



Polar Cap

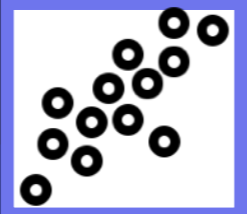


Polar Cap
High Altitude





 radiation at flight altitude



 HF communication disturbances

 GNSS positional errors

