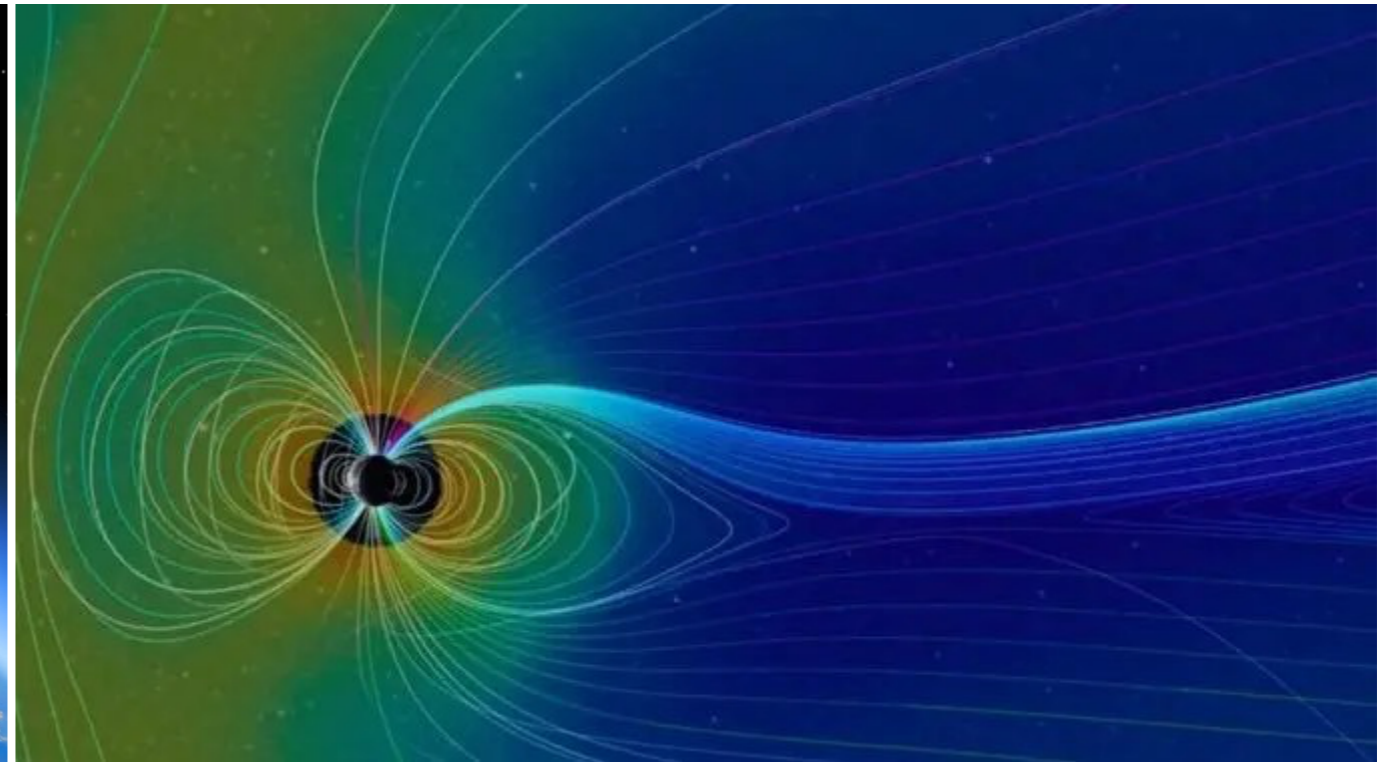


SPACE WEATHER

Introduction

Space Weather

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



THE SUN AS A BALL OF ENERGY

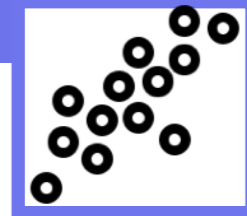
E.M. RADIATION



PLASMA

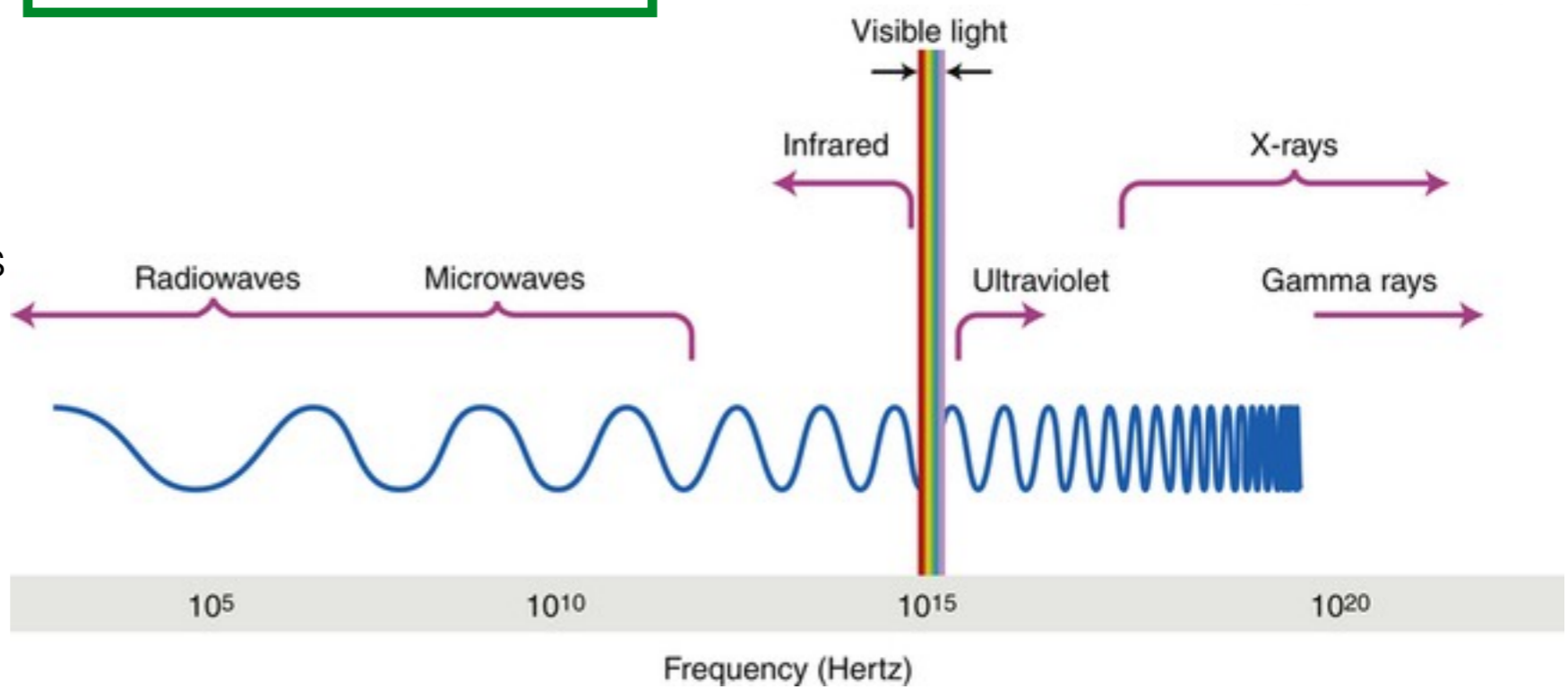


ENERGETIC
PARTICLES



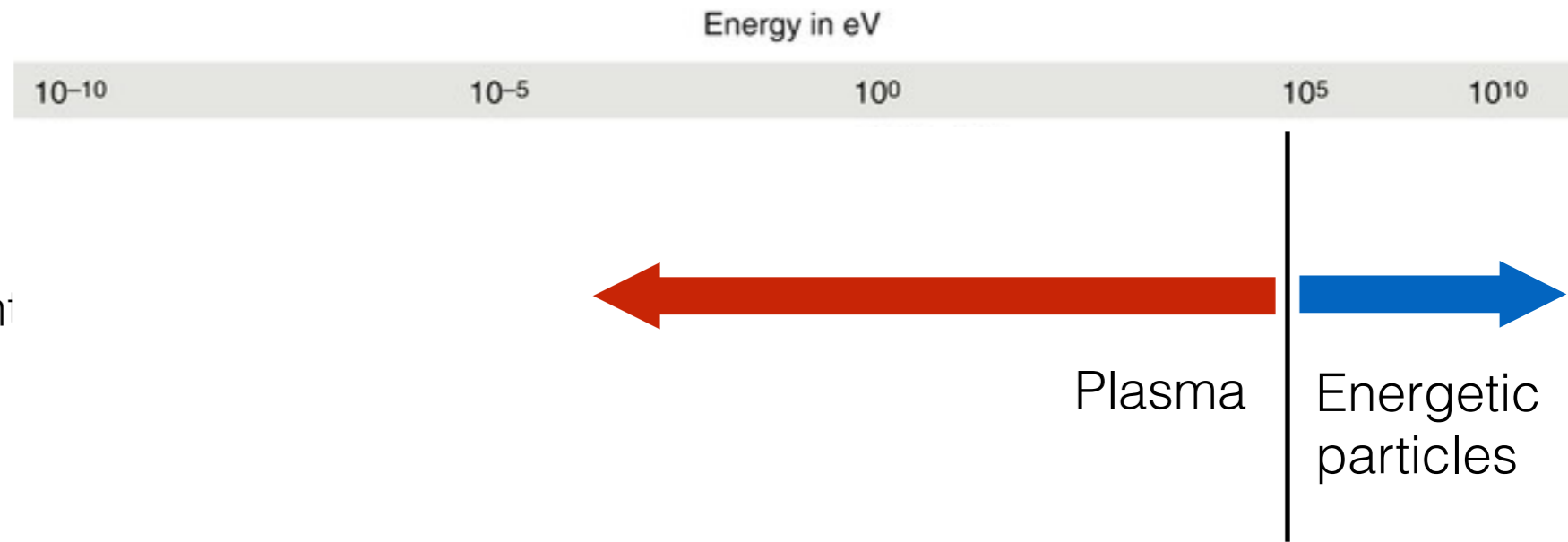
Electromagnetic radiation

- Photons / electromagnetic waves
- Speed of light



Particles

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



3 SPACE WEATHER PHENOMENA

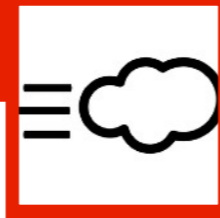
The sun's energy reaches the earth in 3 forms: light, moving gas and particle precipitation. This energy interacts with the magnetosphere and the atmosphere of the earth. This is space weather.

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

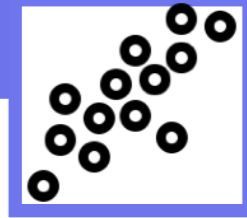
LIGHT



WIND



PARTICLE RAIN



SOLAR WEATHER & STORMS

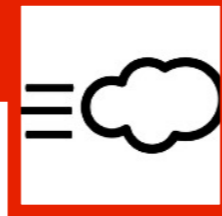
At a certain moment, energy can be released on a shorter time scale. A solar feature like a sunspot, an active region, coronal hole, filament etc. lies at the base of a solar storm in which energy is released. The release of energy might be in an abrupt, impulsive and brutal way (flare, Coronal Mass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



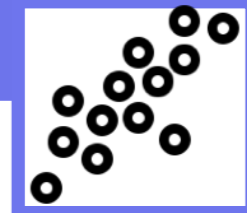
FLARE



Coronal Mass Ejection
Coronal Hole



PARTICLE STORM





AIA 131

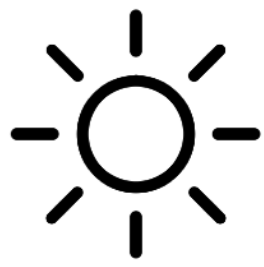
2014-02-25 00:10:08

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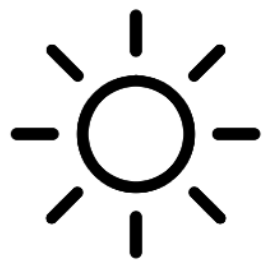
AU TRANSIT TIME

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



AU TRANSIT TIME

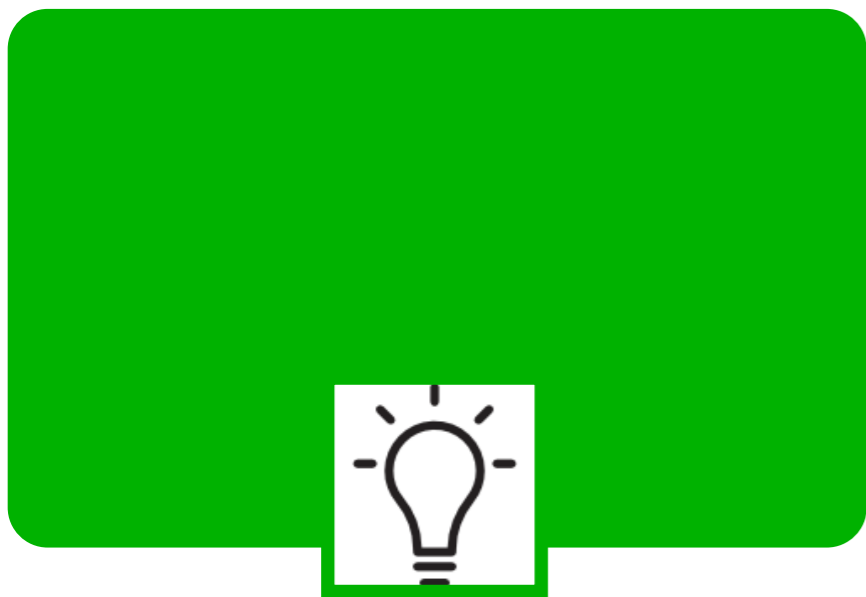
The energy released during a solar storm moves through space, each with its own typical speed: speed of light, order of a few 100 km/s, relativistic speeds.



8 MIN

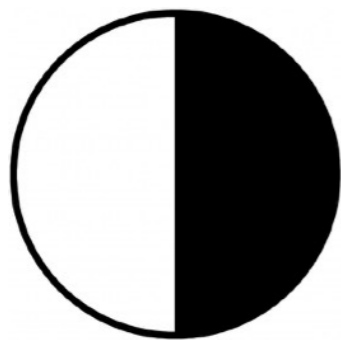


AREA OF IMPACT



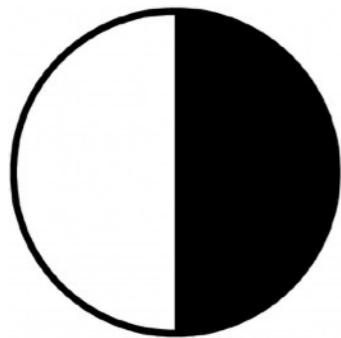
AREA OF IMPACT

Illuminated area

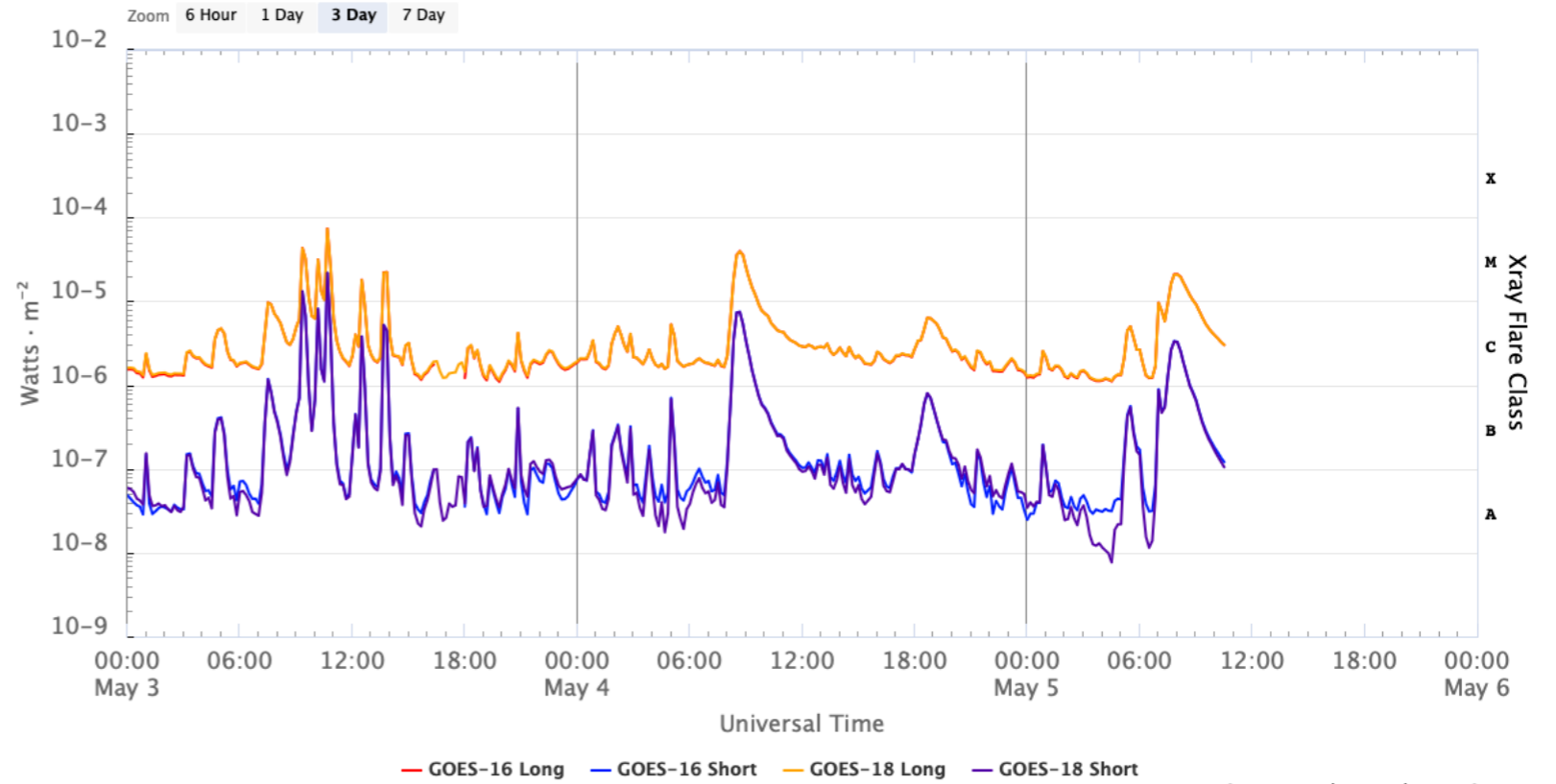


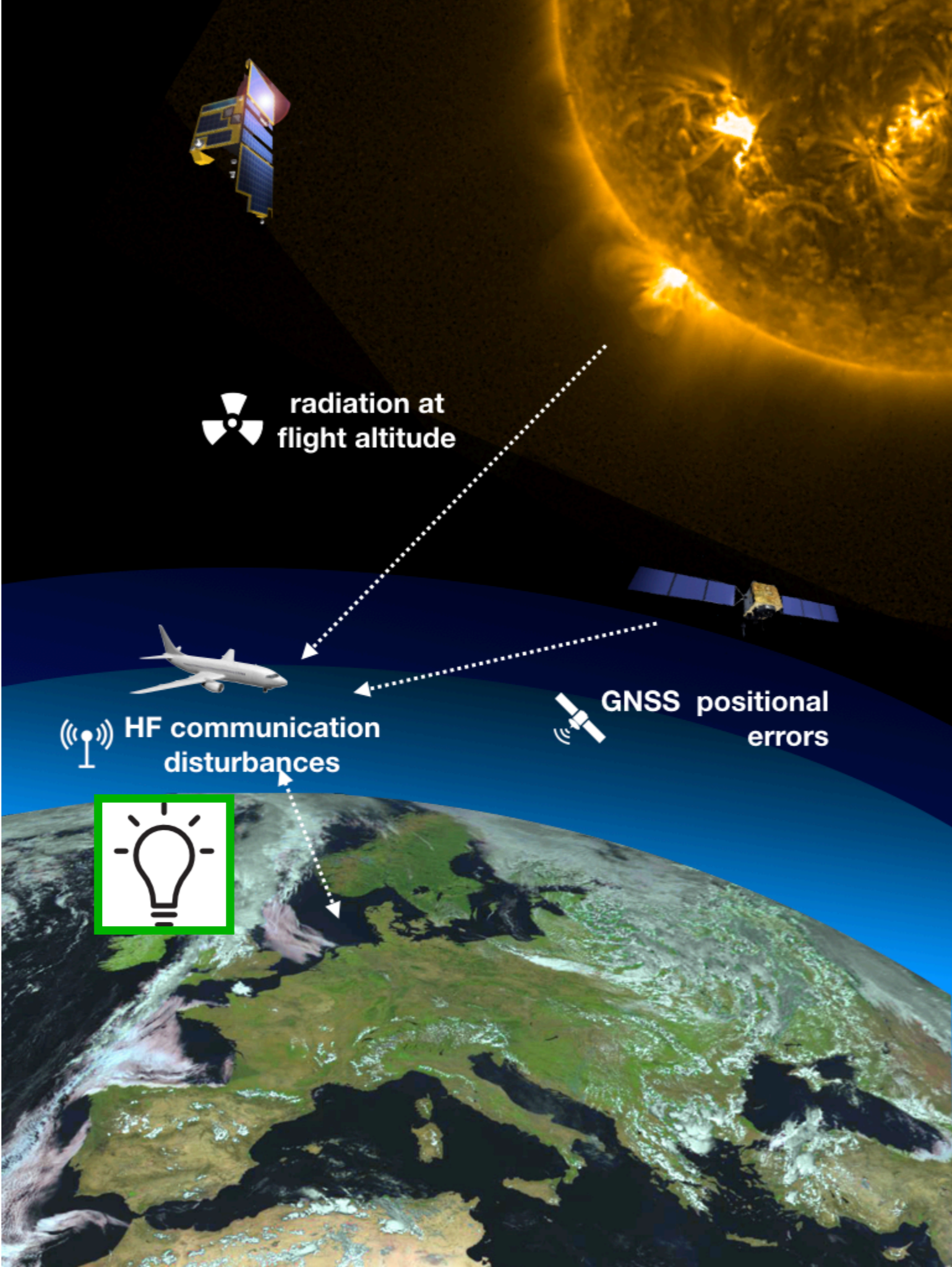
STORM SCALE

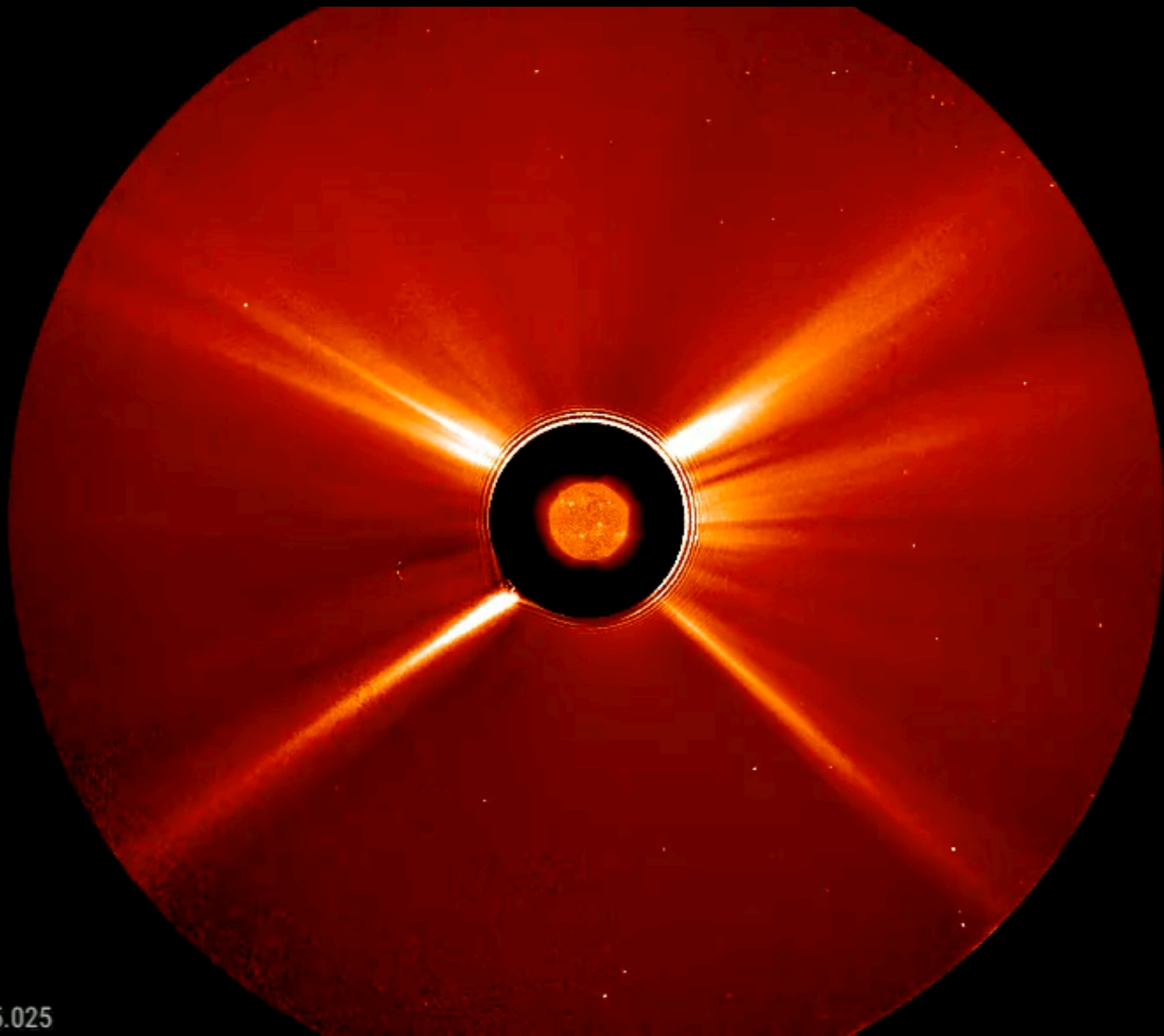
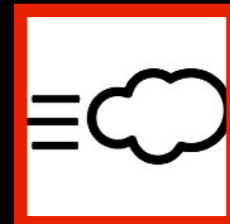
A,B,C,M,X



GOES X-Ray Flux (1-minute data)



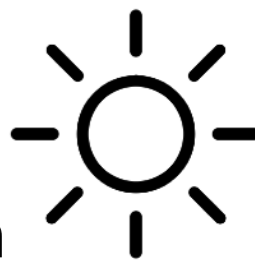




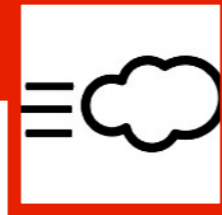
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AU TRANSIT TIME

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,....

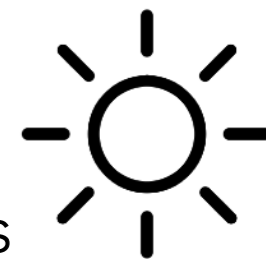


8 MIN



AU TRANSIT TIME

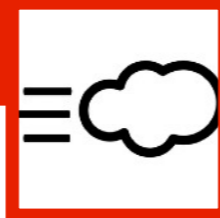
The energy released during a solar storm moves through space, each with its own typical speed: speed of light, order of a few 100 km/s, relativistic speeds.



8 MIN

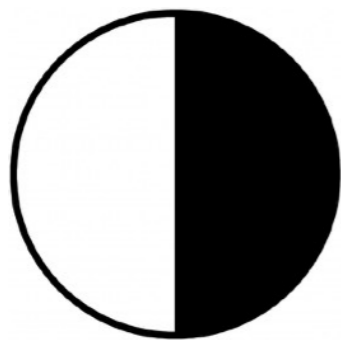


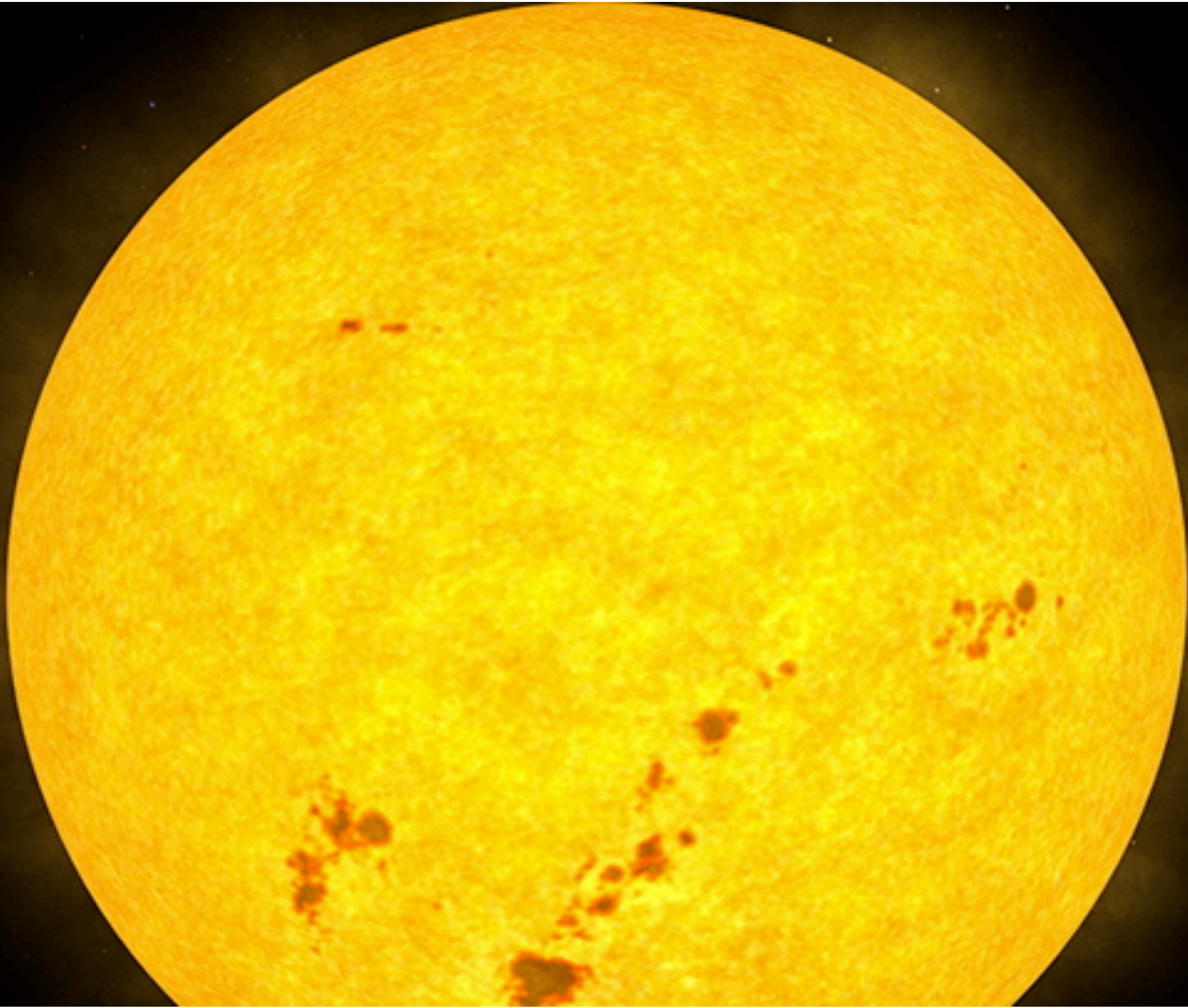
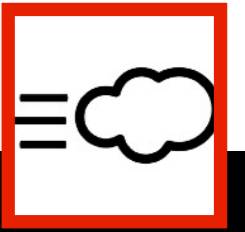
DAYS



AREA OF IMPACT

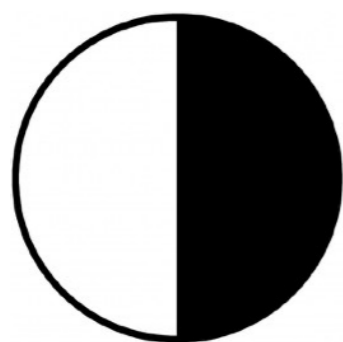
Illuminated area





AREA OF IMPACT

Illuminated area



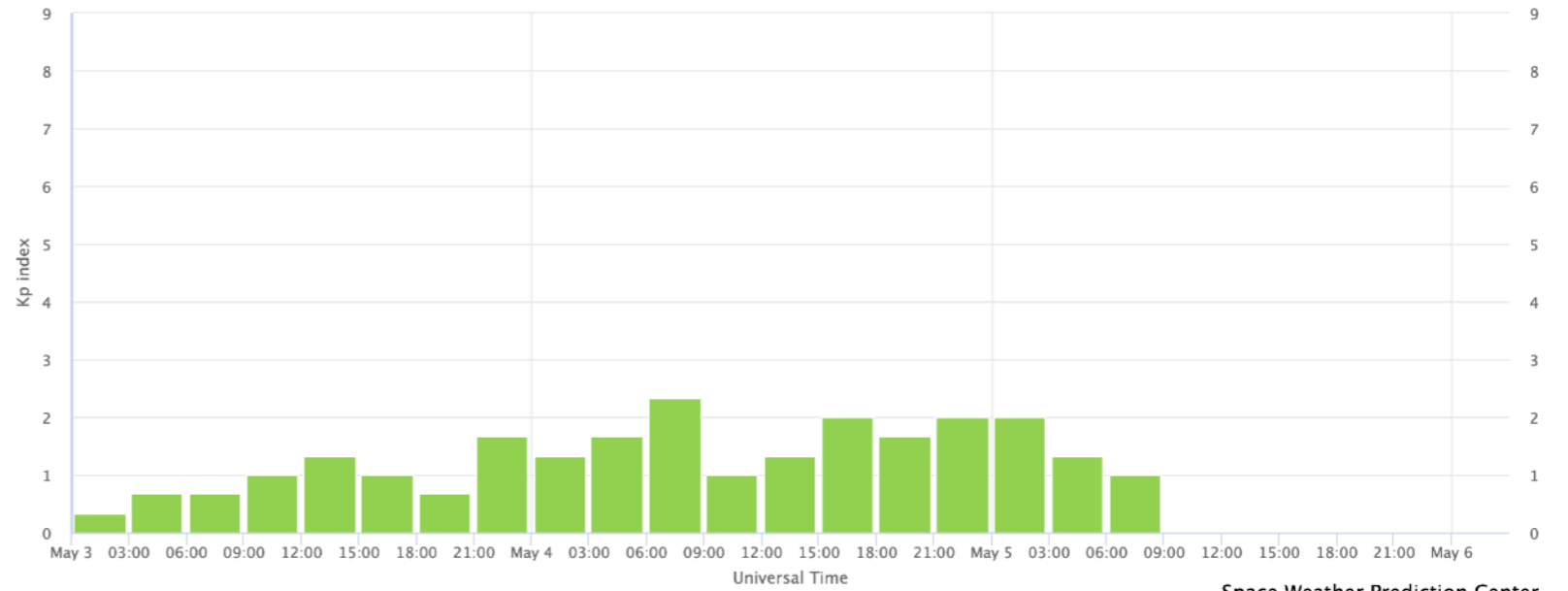
Polar Cap



STORM SCALE

Estimated Planetary K index (3 hour data)

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

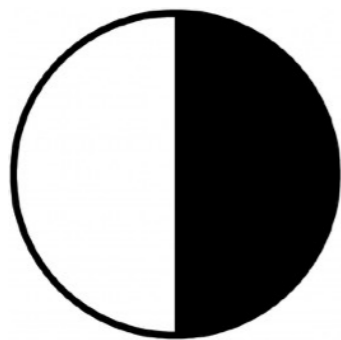
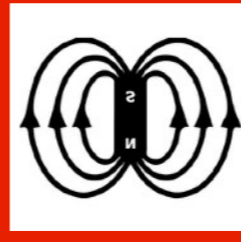


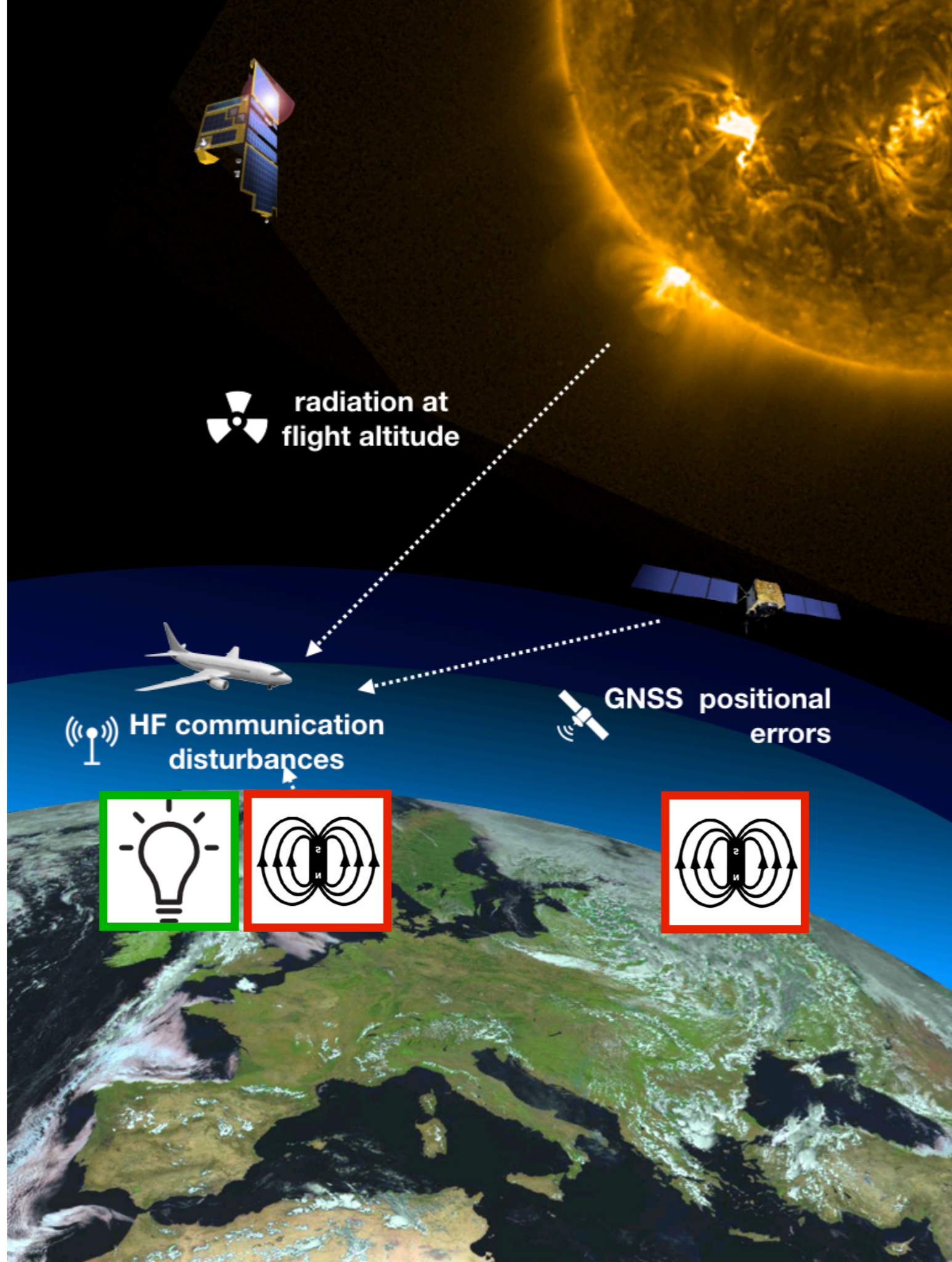
Space Weather Prediction Center

A,B,C,M,X



Kp
0 - 9

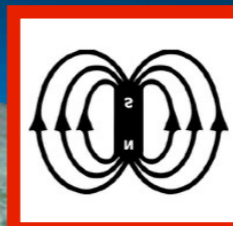
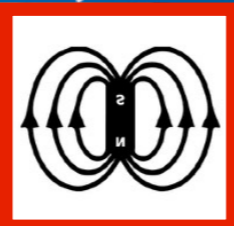


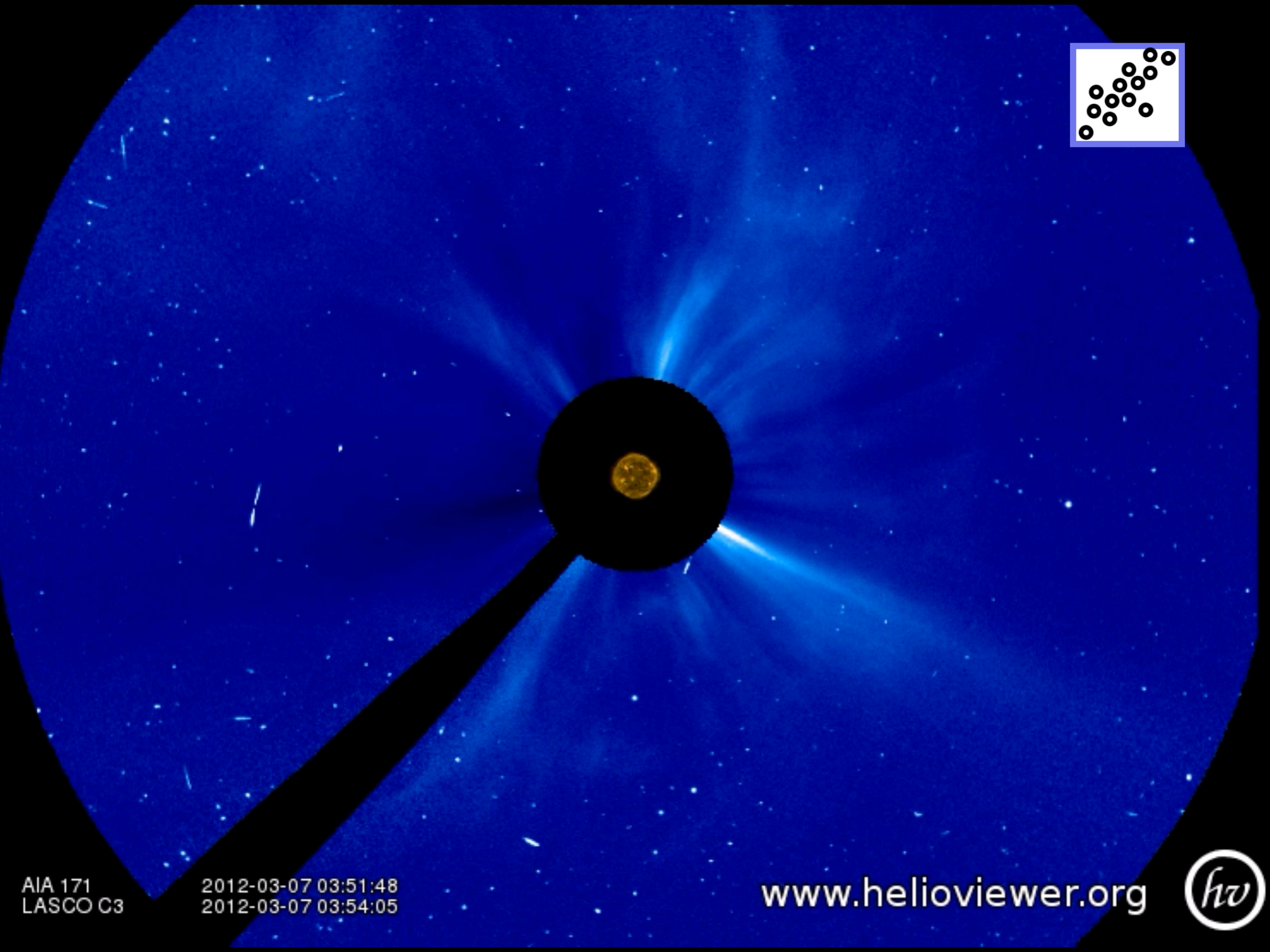
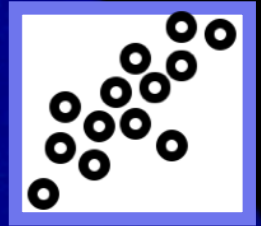


radiation at flight altitude

HF communication disturbances

GNSS positional errors





AIA 171
LASCO C3

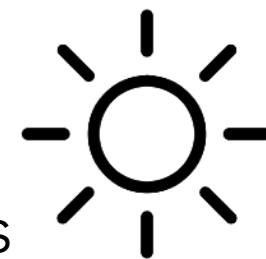
2012-03-07 03:51:48
2012-03-07 03:54:05

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AU TRANSIT TIME

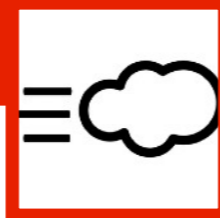
The energy released during a solar storm moves through space, each with its own typical speed: speed of light, order of a few 100 km/s, relativistic speeds.

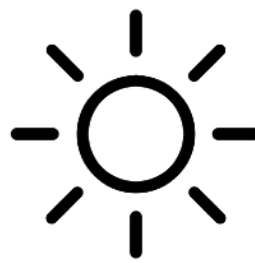


8 MIN



DAYS





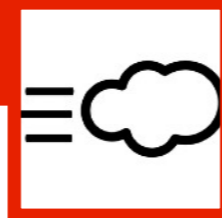
AU TRANSIT TIME

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.

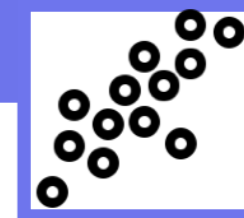
8 MIN



DAYS

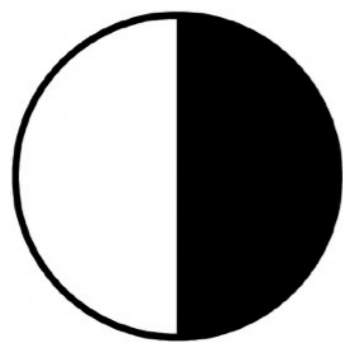


HOUR

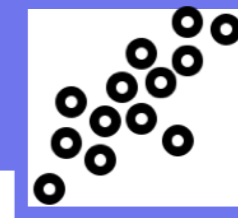
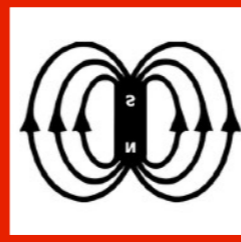


AREA OF IMPACT

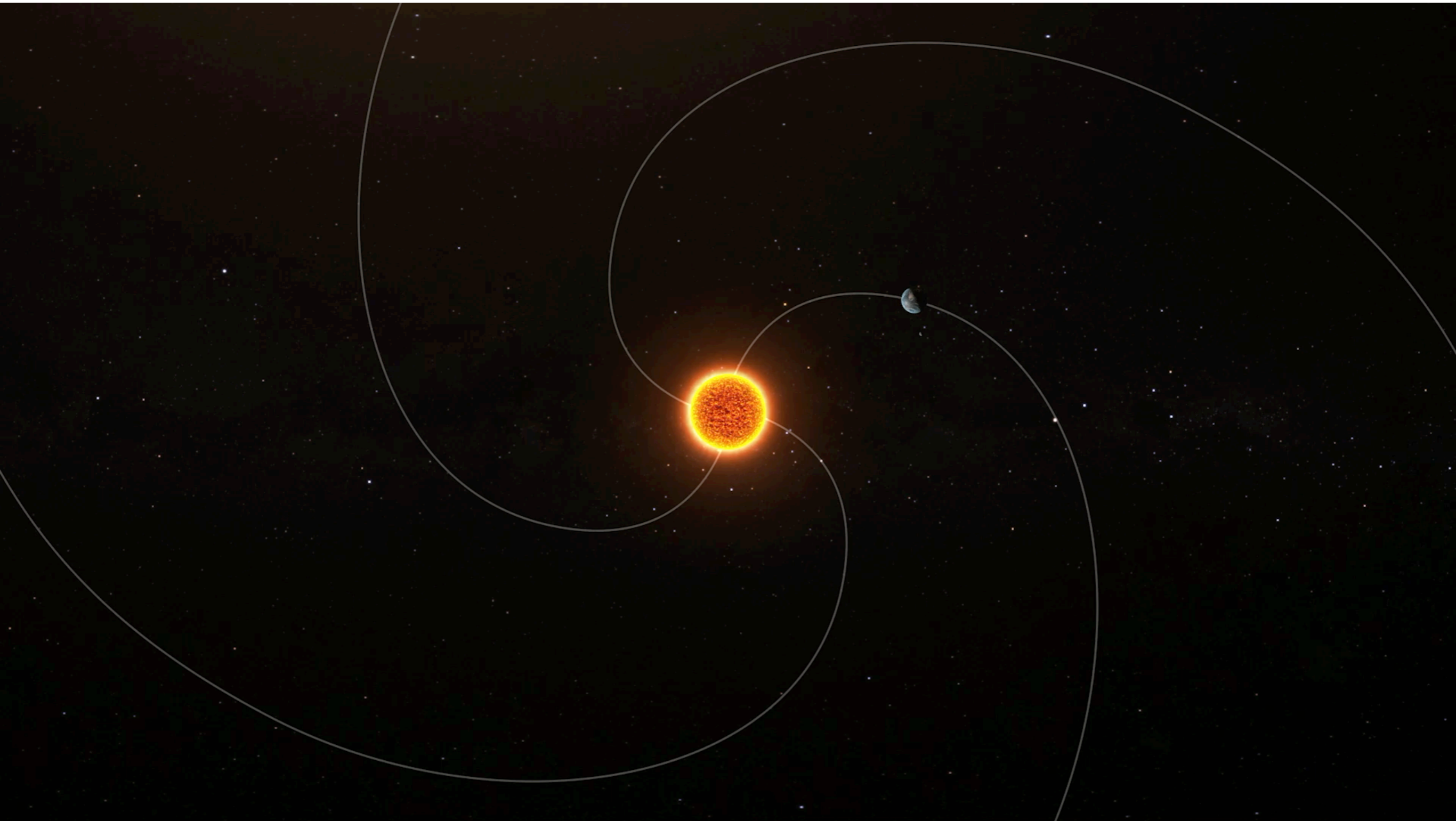
Illuminated area

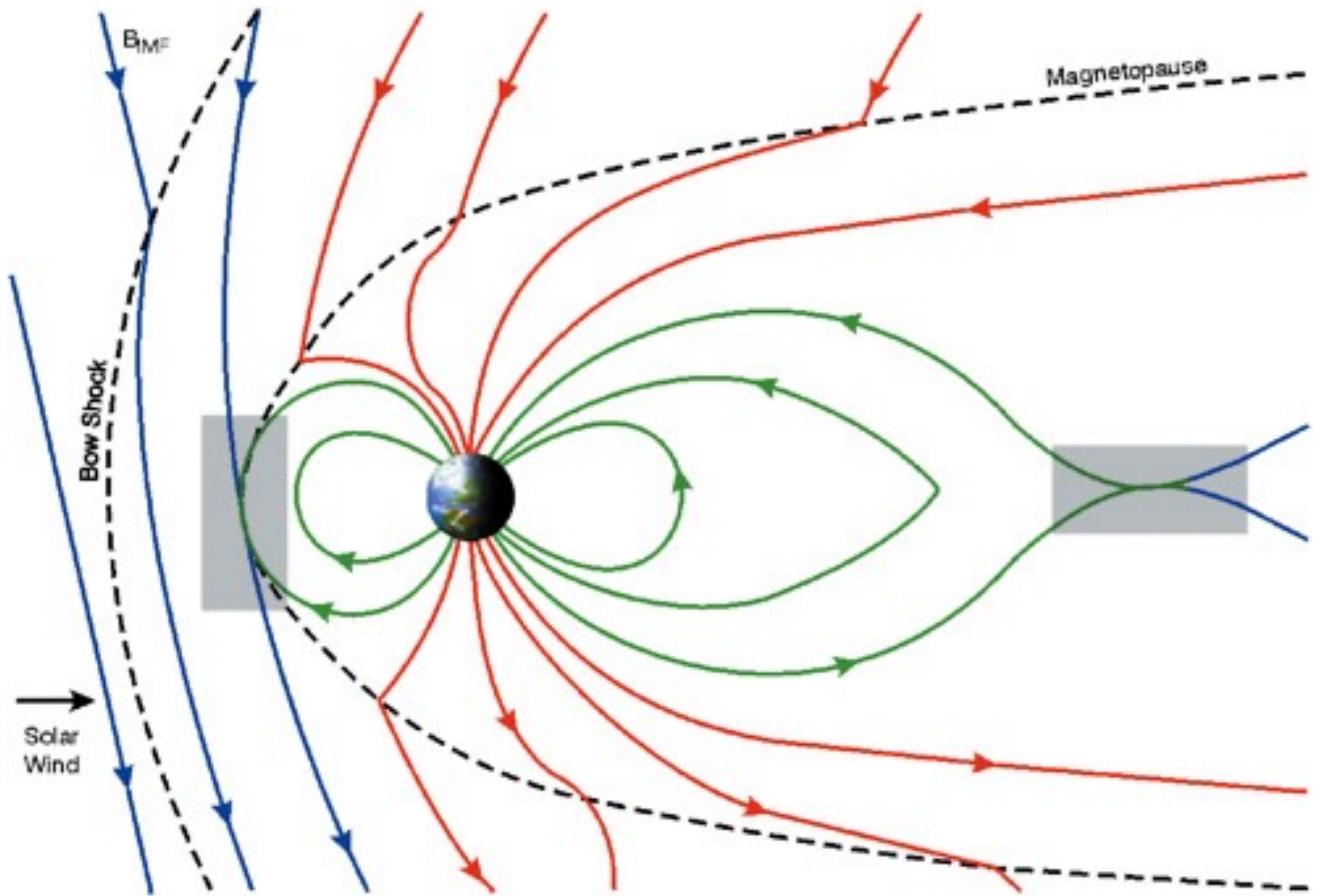


Polar Cap



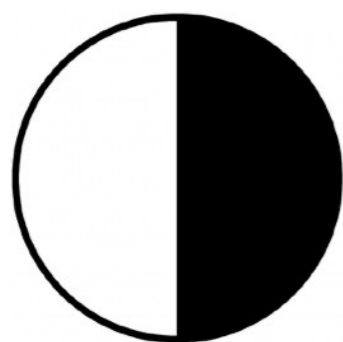
PARTICLES FOLLOW THE PARKER SPIRAL



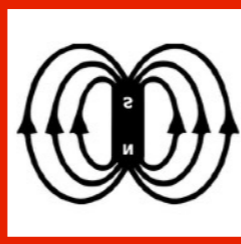


AREA OF IMPACT

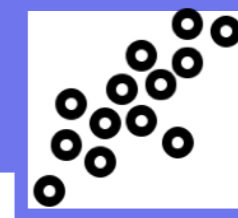
Illuminated area



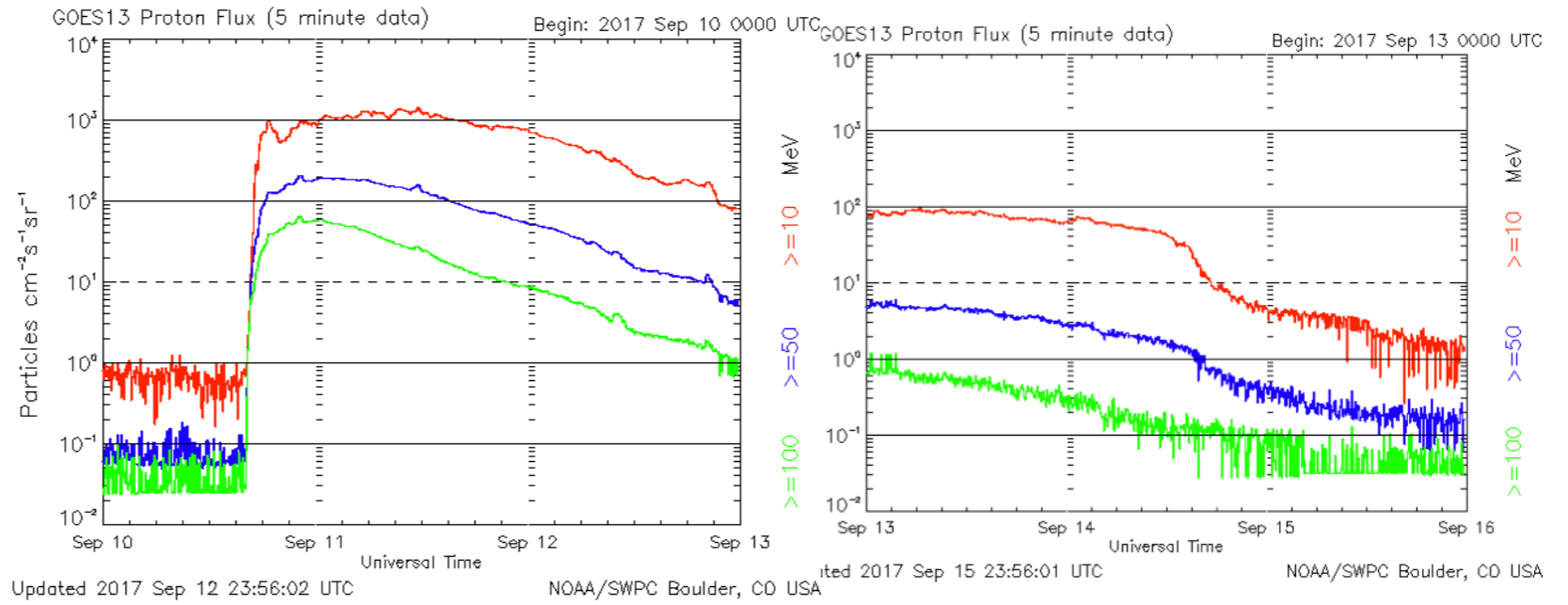
Polar Cap



Polar Cap
High Altitude



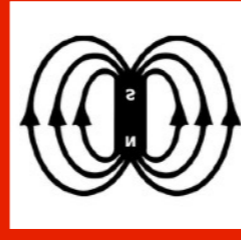
STORM SCALE



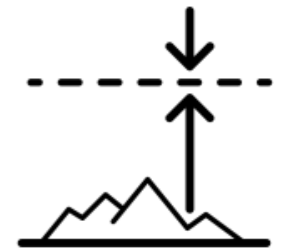
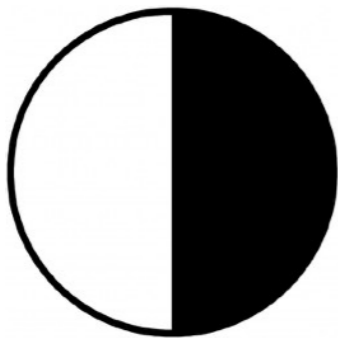
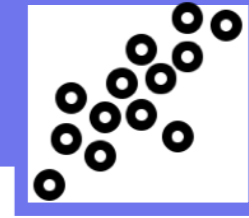
A,B,C,M,X

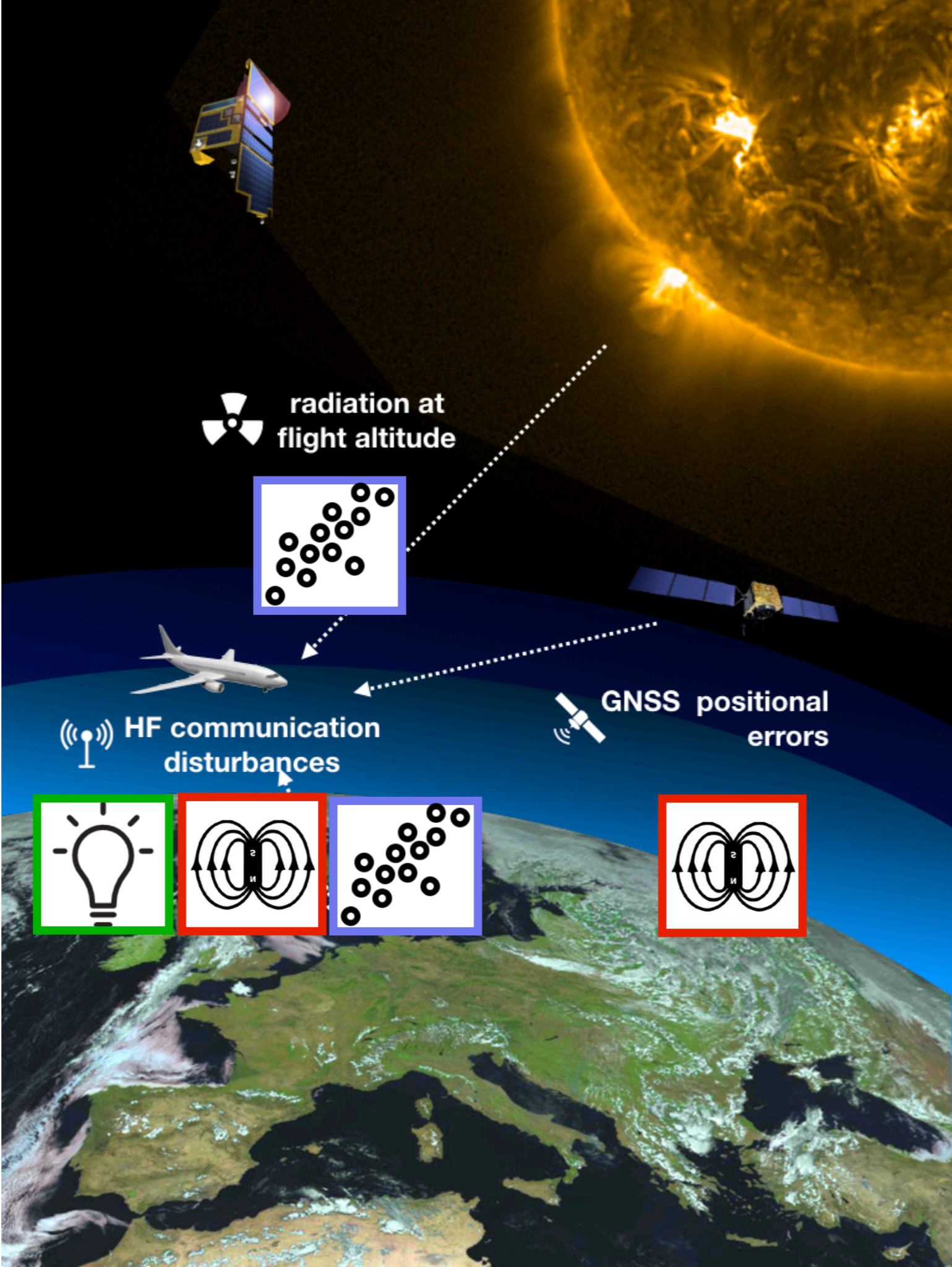



Kp
0 - 9



Proton Flux

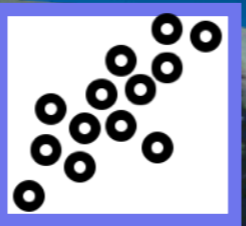
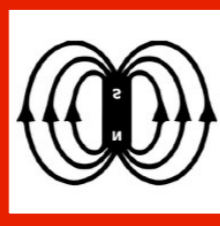




 radiation at flight altitude



 HF communication disturbances



 GNSS positional errors

