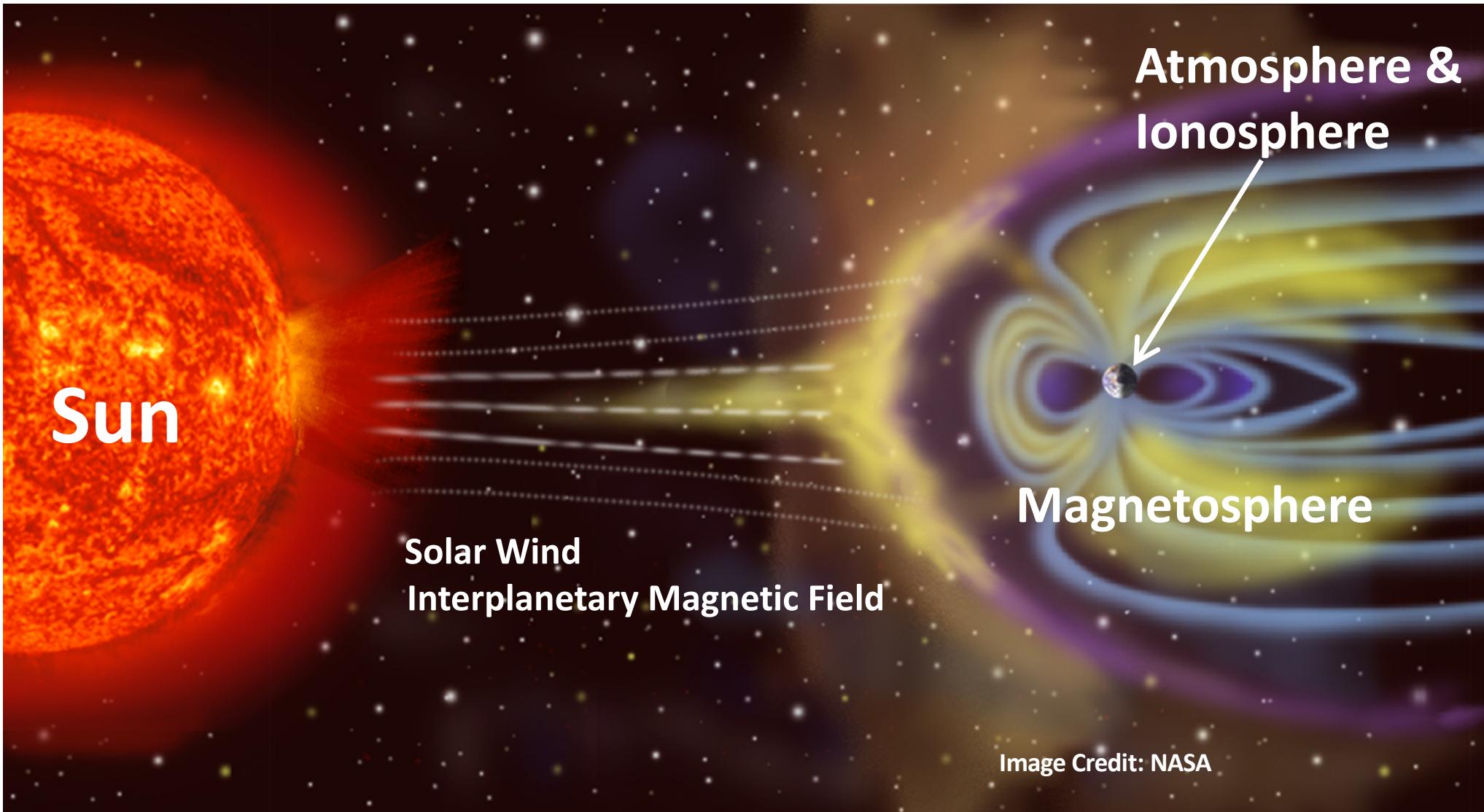


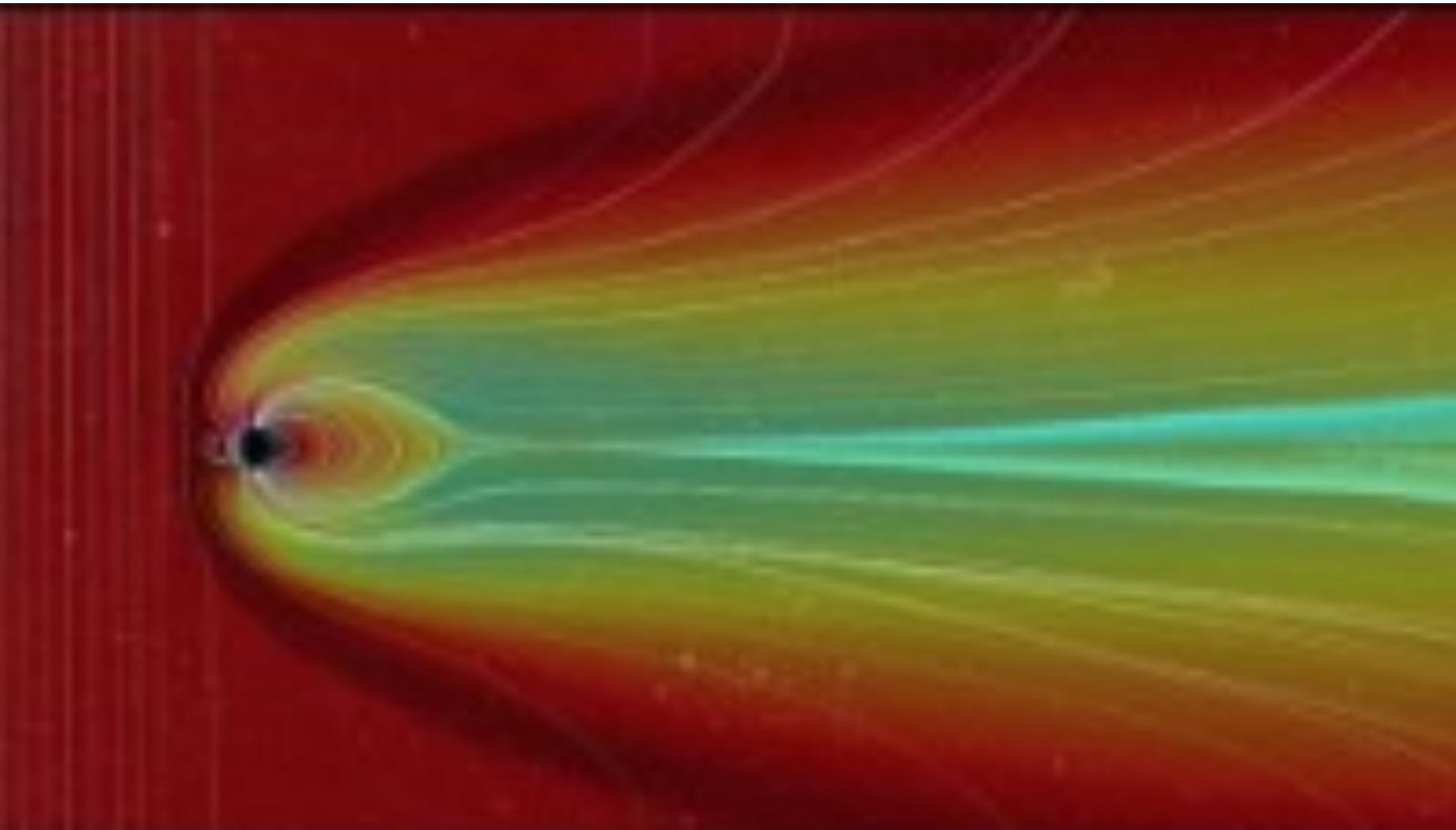
Space Physics Data Analysis

PHYS 384: ST: SPACE PHYSICS
SPRING 2021

The Geospace System

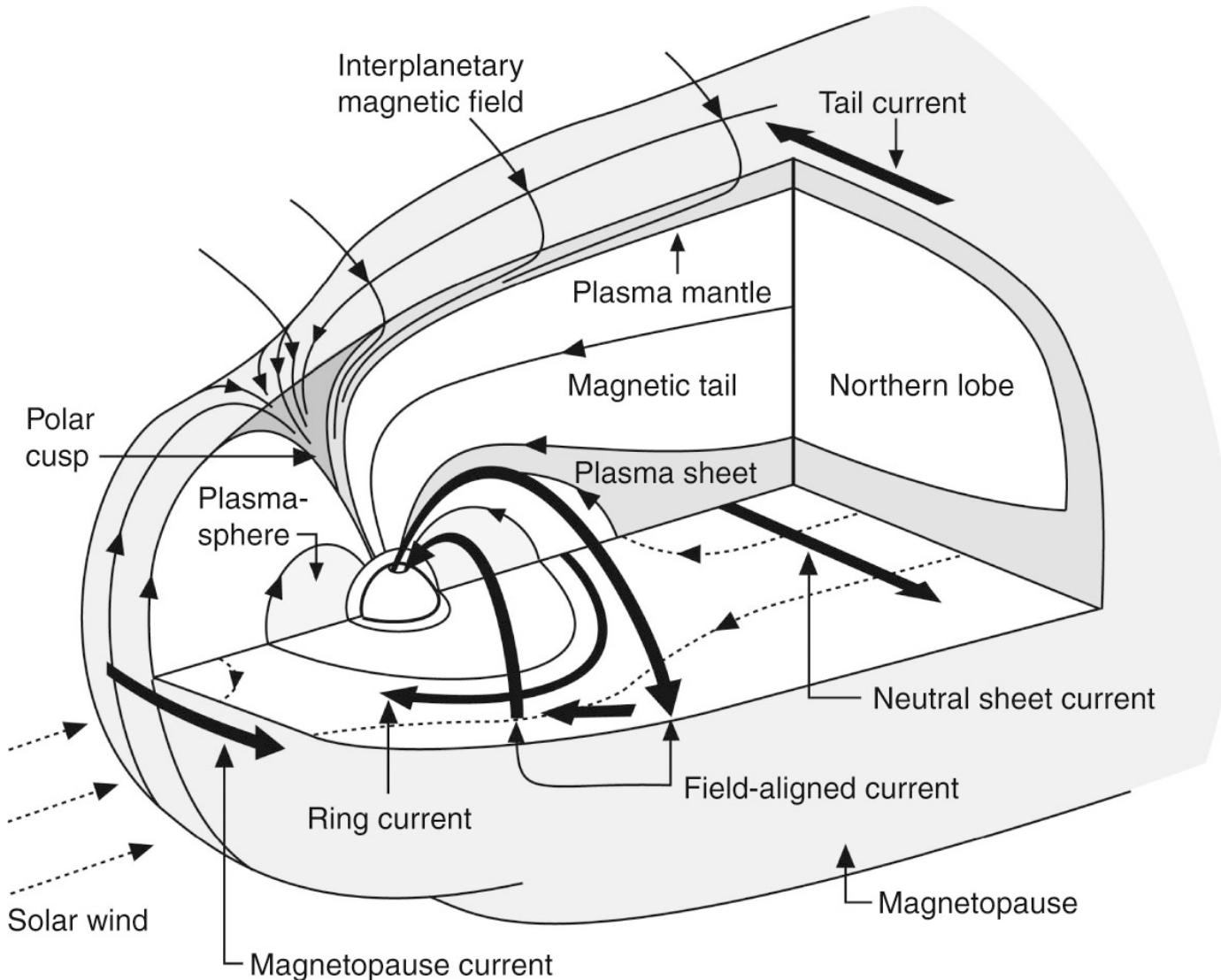


NASA: Comparing CMEs with Model Runs



<https://www.youtube.com/watch?v=cLLq6plMjU0>

Earth's Magnetosphere



Gradient and Curvature Drift

- Gradients and curvatures in the background magnetic field will also cause the particles to drift.
- In the special case where there are no local currents within the plasma, the gradient and curvature drift can be combined into a single equation:

$$\vec{v}_{g+c} = (W_{\perp} + 2W_{\parallel}) \frac{\vec{B} \times \nabla B}{qB^3}$$

Exercise

- Sketch the Earth as if you are looking down onto the North Pole.
- The magnetosphere contains a plasma consisting of both electrons and ions.
- Using the gradient and curvature drift formula, draw:
 - The direction of the electron drift
 - The direction of the ion drift
 - What does this mean in terms of current?

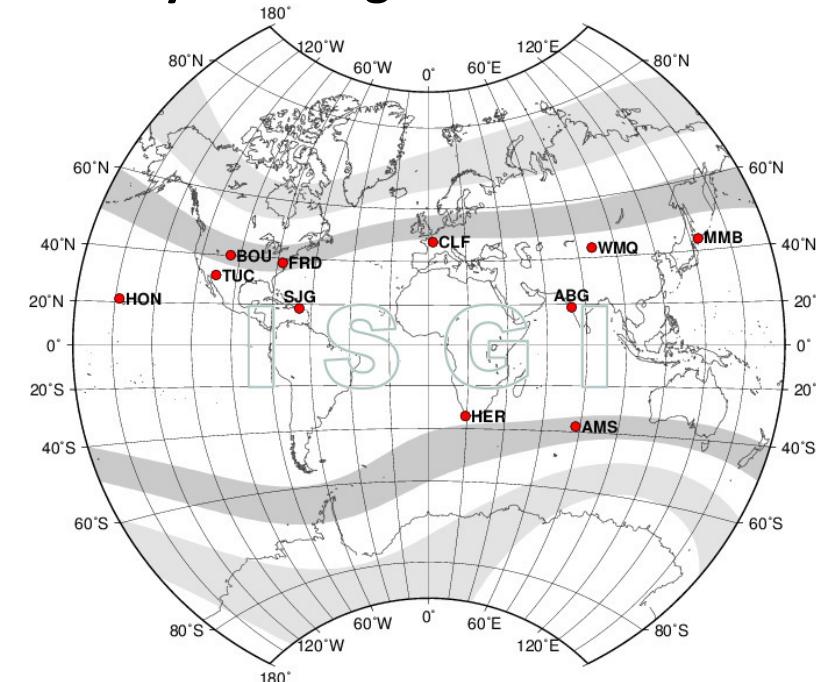


$$\vec{v}_{g+c} = (W_{\perp} + 2W_{\parallel}) \frac{\vec{B} \times \nabla B}{qB^3}$$

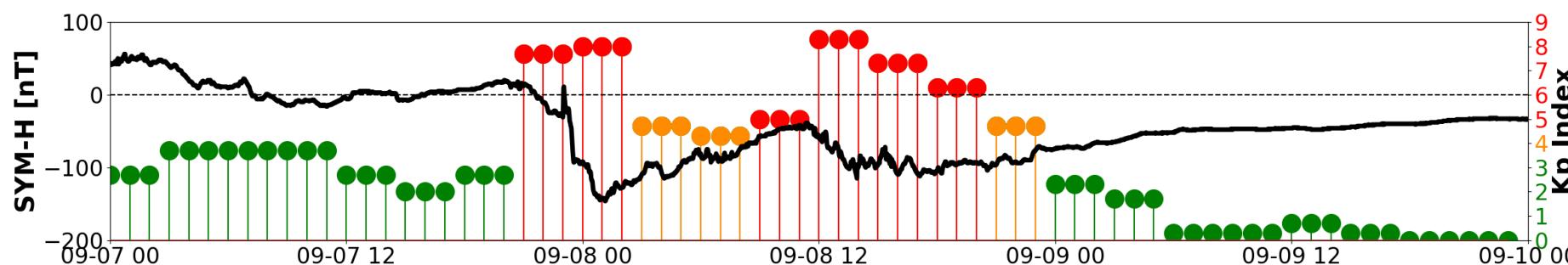
Geomagnetic Storms

- Fast CMEs and CIR/HSSs can lead to geomagnetic storms.
- Defined by negative excursion in
 - Dst (Disturbance Storm Time Index)
 - Sym-H Indices (High resolution version of DST)

Sym-H Magnetometers



http://isgi.unistra.fr/indices_asy.php

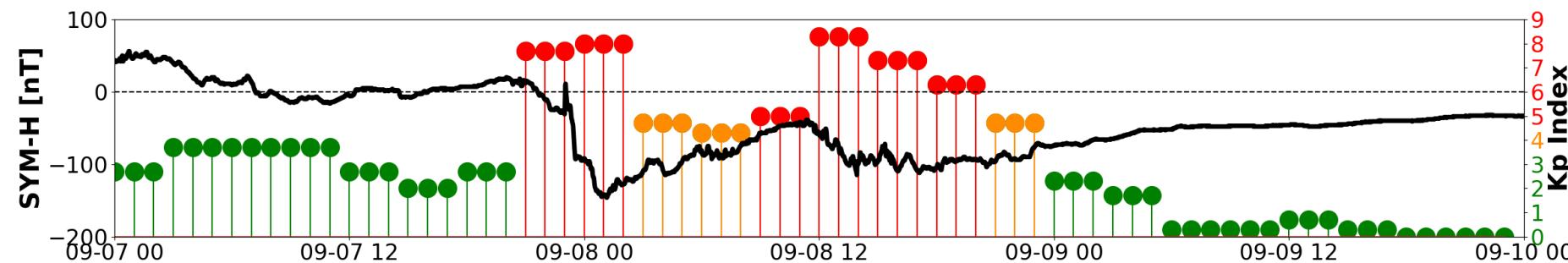
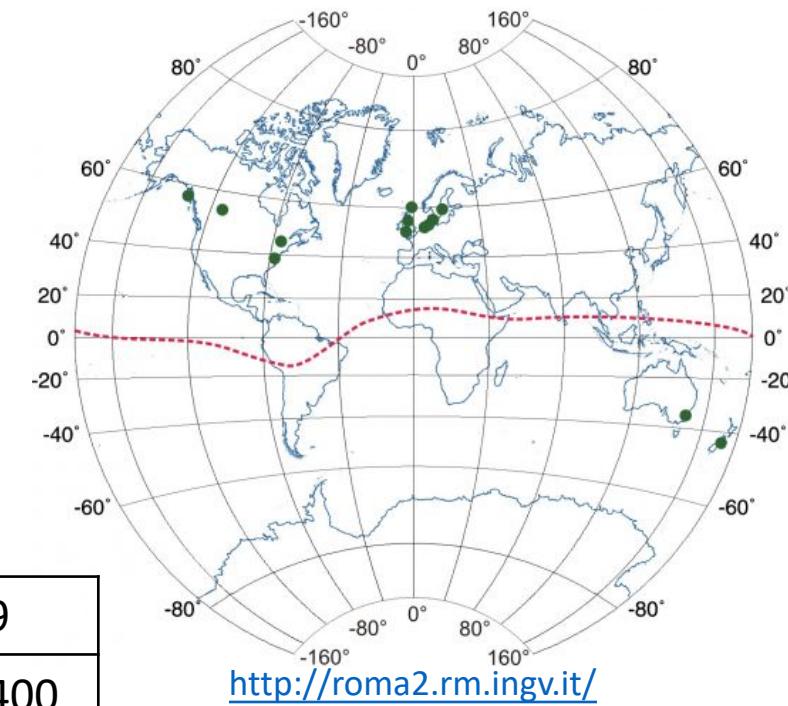


Kp/ap

- Index of geomagnetic perturbation
- Kp is logarithmic, ap is linear
- 3-hour resolution
- “p” stands for planetary
- Perturbations are normalized for each station before being combined into a planetary value.

Kp	0	1	2	3	4	5	6	7	8	9
ap	0	4	7	15	27	48	80	132	207	400

Kp/Ap Magnetometers

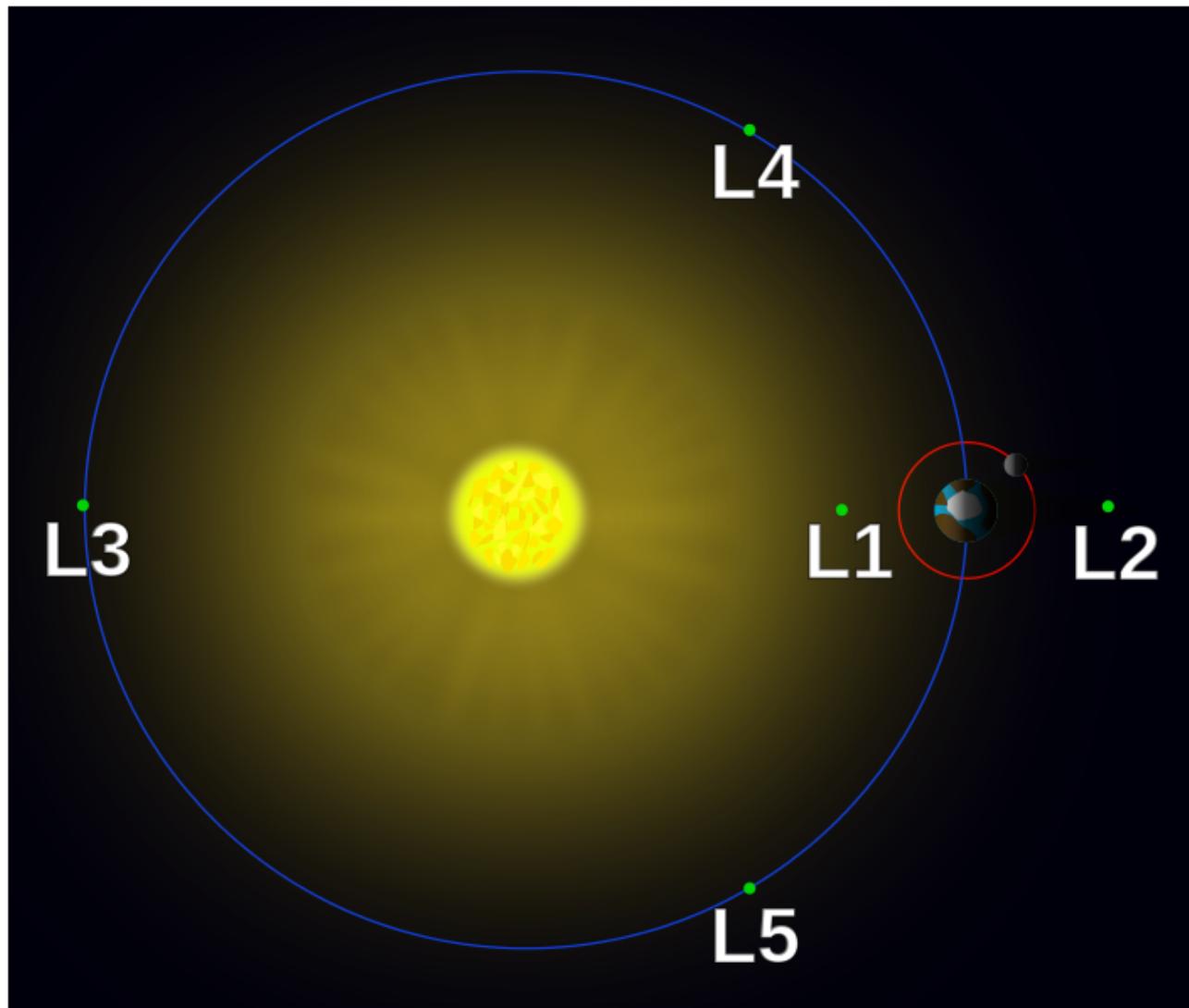


Solar Wind Measurement

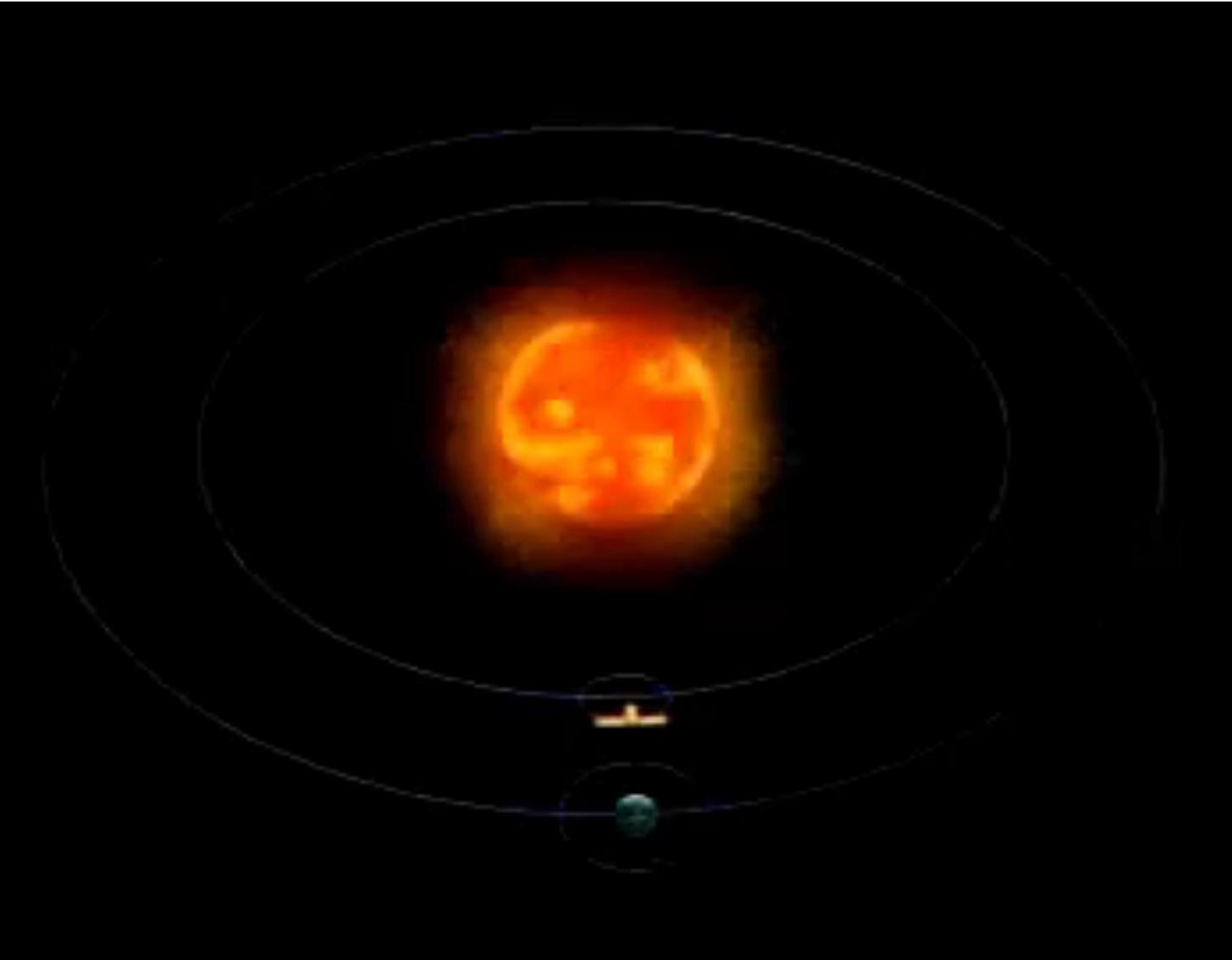
- The Solar Wind is measured by interplanetary spacecraft at the Lagrange (L1) point.
- L1 is about 1.5 million kilometers from Earth towards the Sun.
- This is still roughly 1 AU (150 million km) from the Sun!

Lagrange points in the Sun–Earth system (not to scale) – a small object at any one of the five points will hold its relative position.

https://en.wikipedia.org/wiki/Lagrange_point



SOHO Orbit Around L1 Point

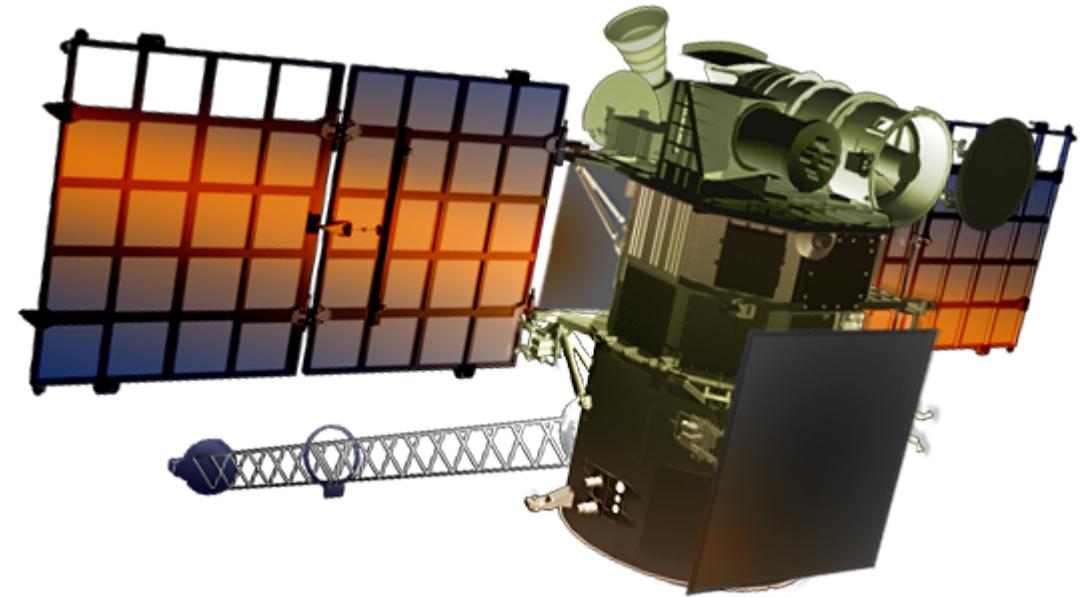


**SOHO's orbit
around the
Lagrangian L1
point and the
Sun**

[\[NASA\]](#)

Current Spacecraft at L1

1. The Solar and Heliospheric Observatory (SOHO)
2. The Advanced Composition Explorer (ACE)
3. Wind Spacecraft
4. The Deep Space Climate Observatory (DSCOVR)



Artist's rendition of NOAA's Deep Space Climate Observatory.

https://en.wikipedia.org/wiki/Deep_Space_Climate_Observatory

Typical Solar Wind Parameters at L1

Parameter	Symbol	Average Value at 1 AU
Velocity	v	400 km s ⁻¹
Number Density	n	10 ⁷ m ⁻³
Mass Density	ρ	10 ⁻²¹ kg m ⁻³

What are the solar wind conditions right now?

Visit <http://spaceweather.com> to find out!