

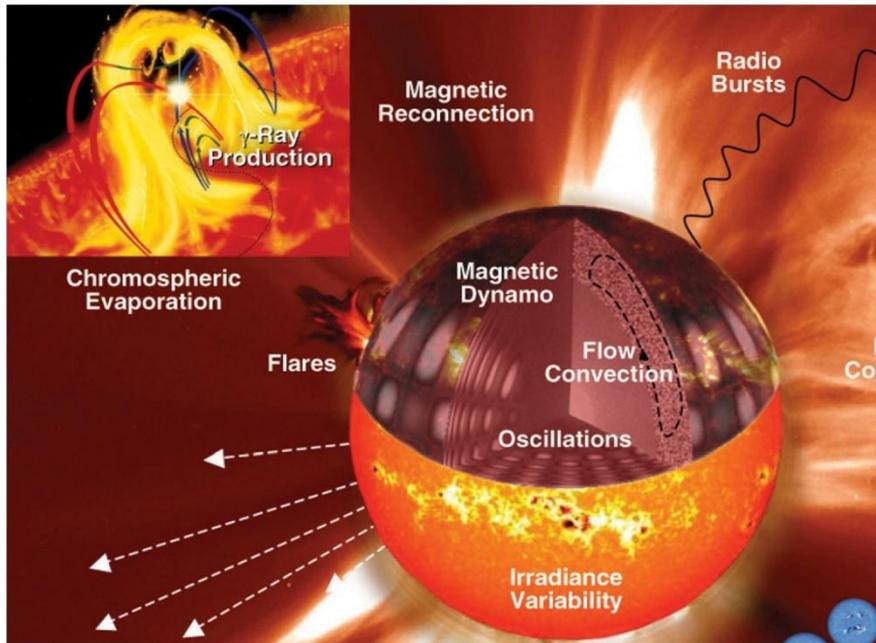
Thumbnail Sketch of Heliophysics

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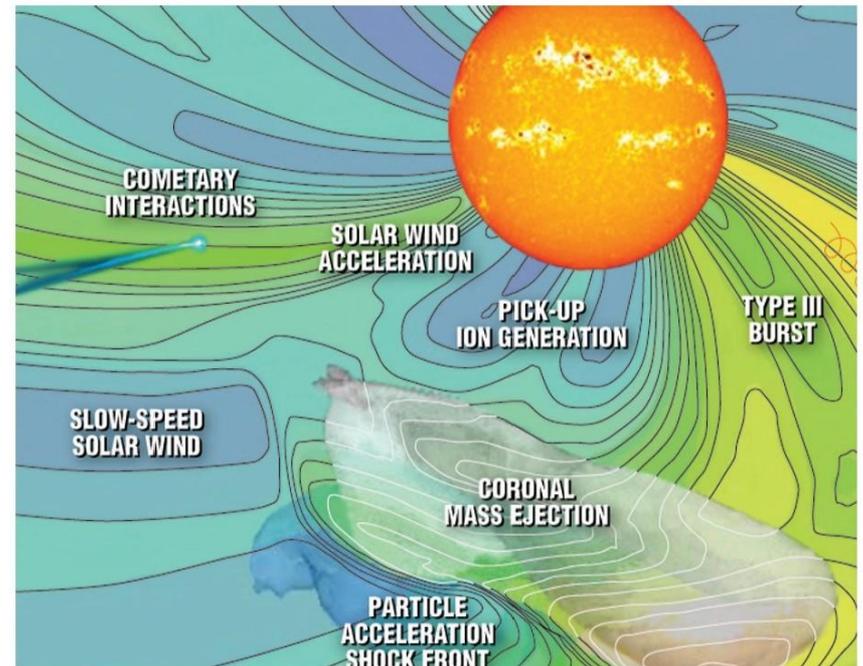
What is Heliophysics?

- Heliophysics is the study of the domain of the Sun: the *Heliosphere*
 - from the Sun's core where nuclear reactions produce the energy that drives changes throughout the entire solar system
 - to the edge of interplanetary space where the solar wind and magnetic fields cede control of the local physical conditions to the interstellar medium.
- Heliophysics is one of the four disciplines that form the backbone of NASA's Strategic Plan for Earth and Space Science.

Journey through the Heliosphere

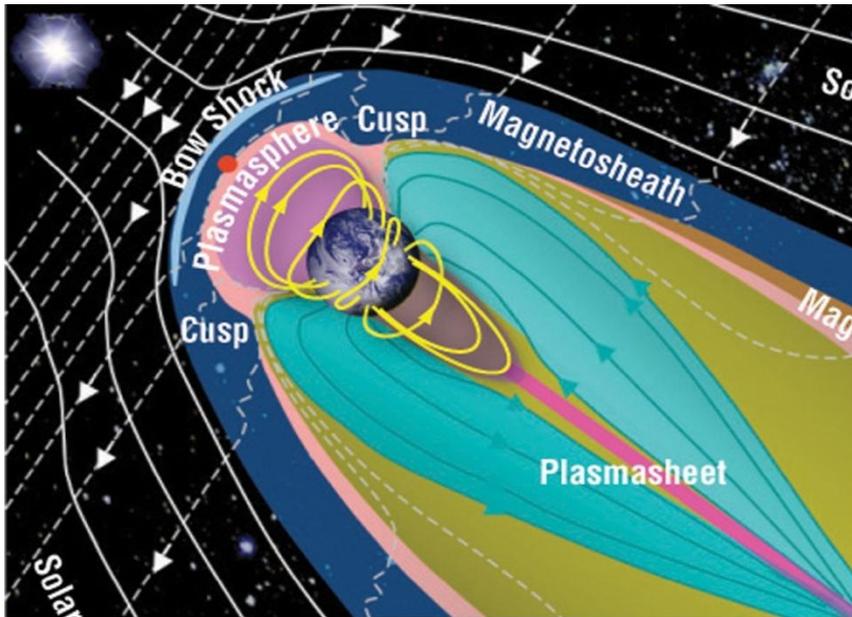


The dynamic Sun drives ...

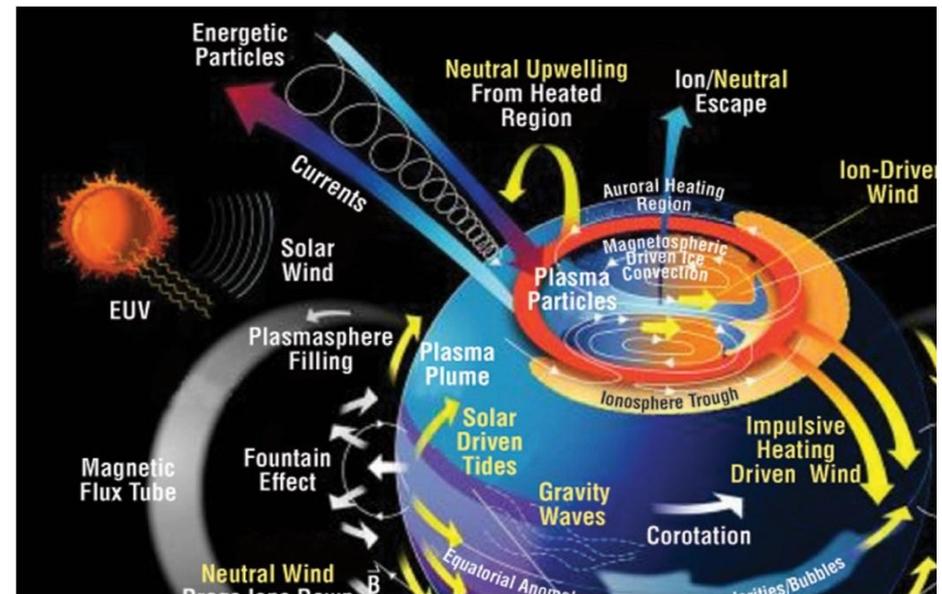


... flares, coronal mass ejections,
and the solar wind.

Journey through the Heliosphere

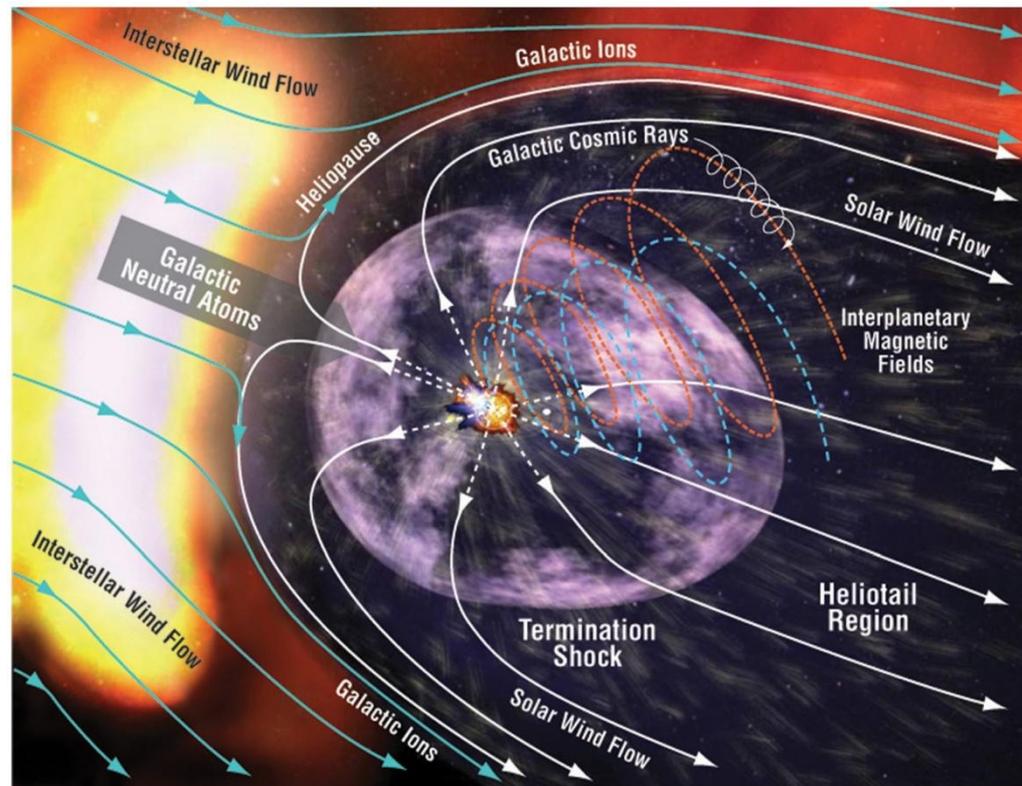


Heliospheric disturbances
impact the
Magnetosphere ...



... and the Earth's Outer
Atmosphere.

Journey through the Heliosphere



The Sun finally gives way to the interstellar medium.

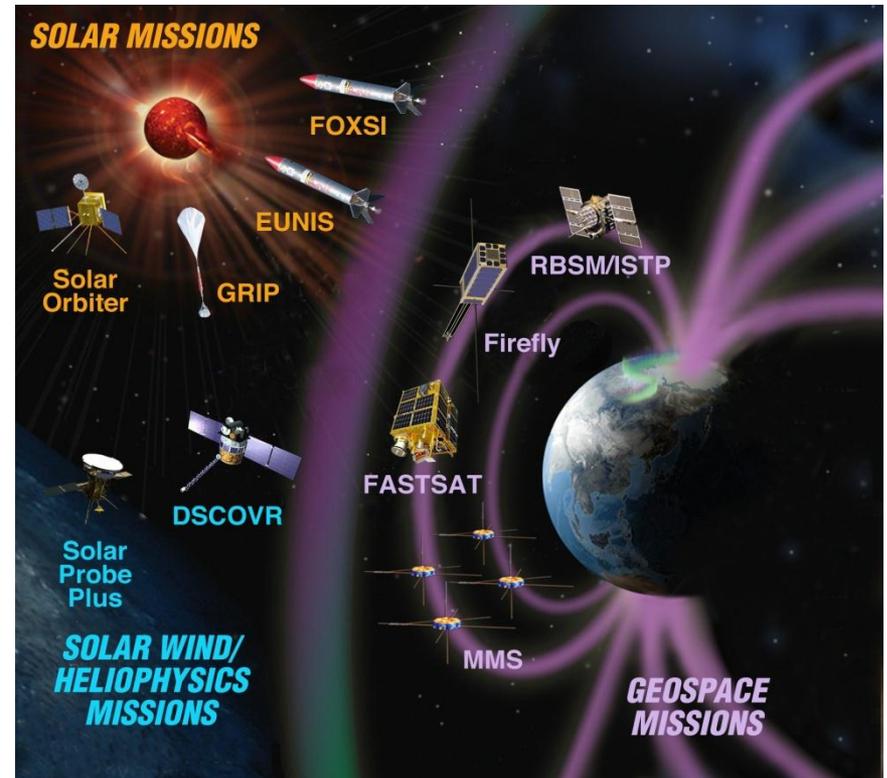
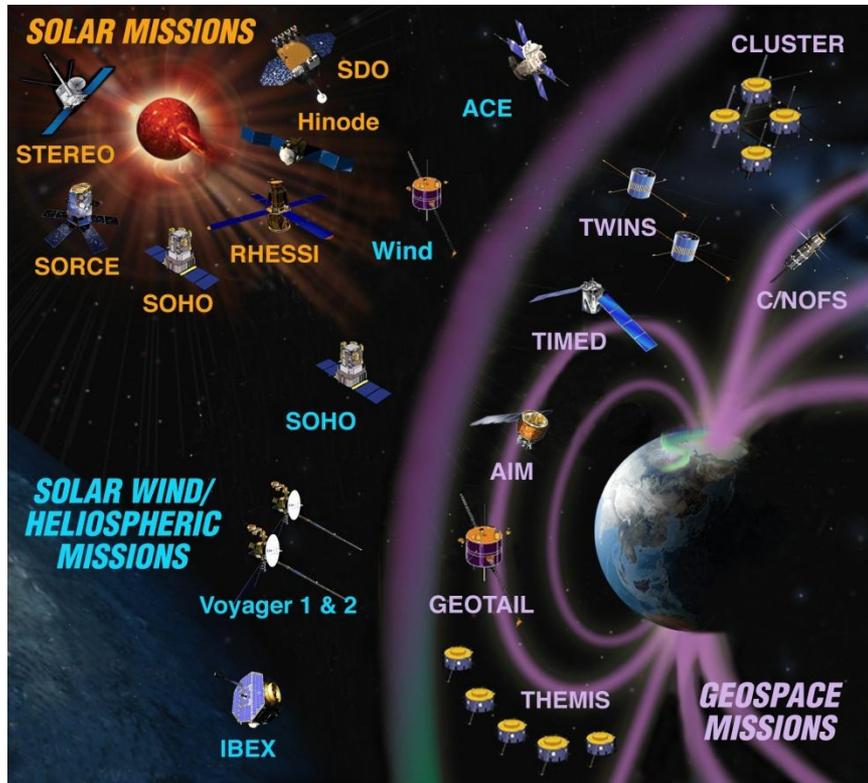
What do we measure?

- In short, everything:
 - Radiation (radio waves to gamma rays)
 - Particles (mass, energy, charge, phase-space distribution)
 - Temperature, density, elemental composition
 - Waves of all kinds
 - Turbulence

How do we measure?

- We use both remote sensing and in situ measurements.
 - Telescopes (conventional and exotic)
 - Spectrographs
 - Charged particle detectors/spectrometers
 - Neutral atom detectors
 - Electromagnetic probes

What platforms do we use?

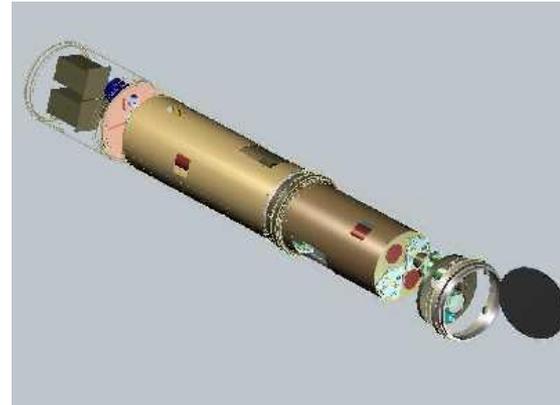


Heliophysics Great Observatory

Missions in Development

Satellites, from CubeSats to \$B missions

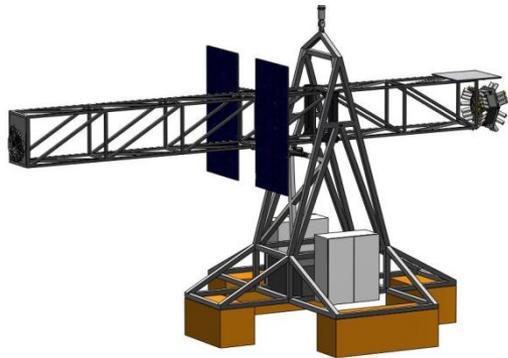
What platforms do we use?



Extreme Ultraviolet Normal Incidence Spectrograph (EUNIS)
Length 3.0 m Mass 165 kg



Black Brant IX carrying
EUNIS (300 km apogee)

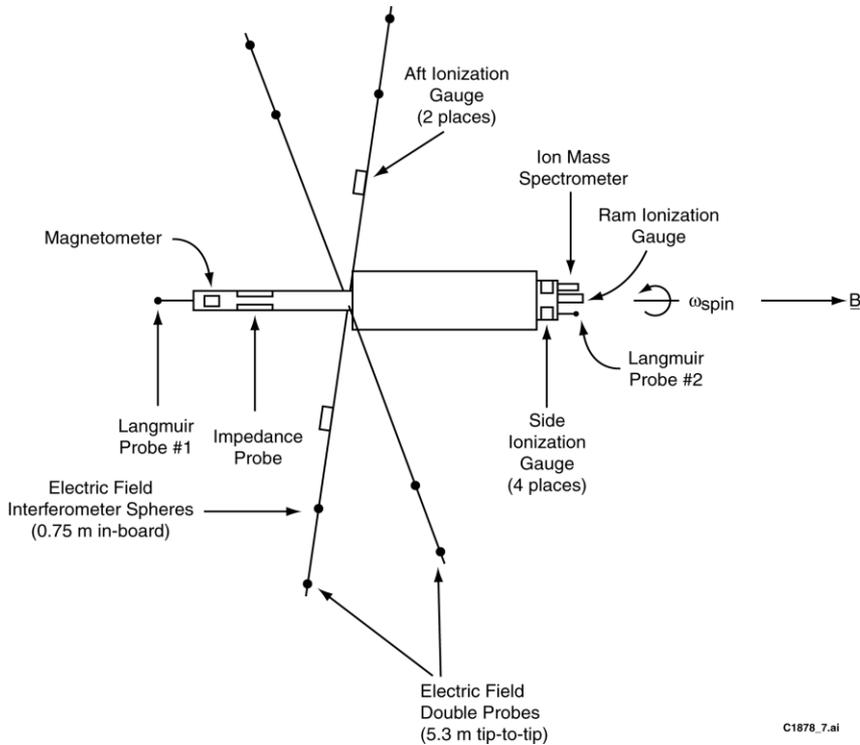


GRIPS Gondola with 8-meter boom

What do we need from a suborbital platform?

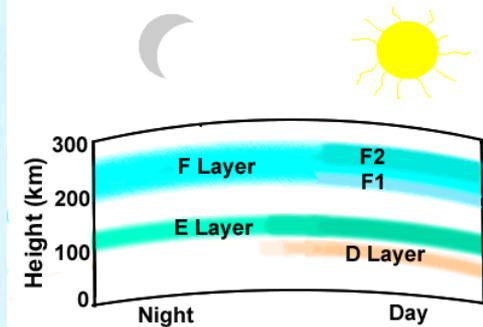
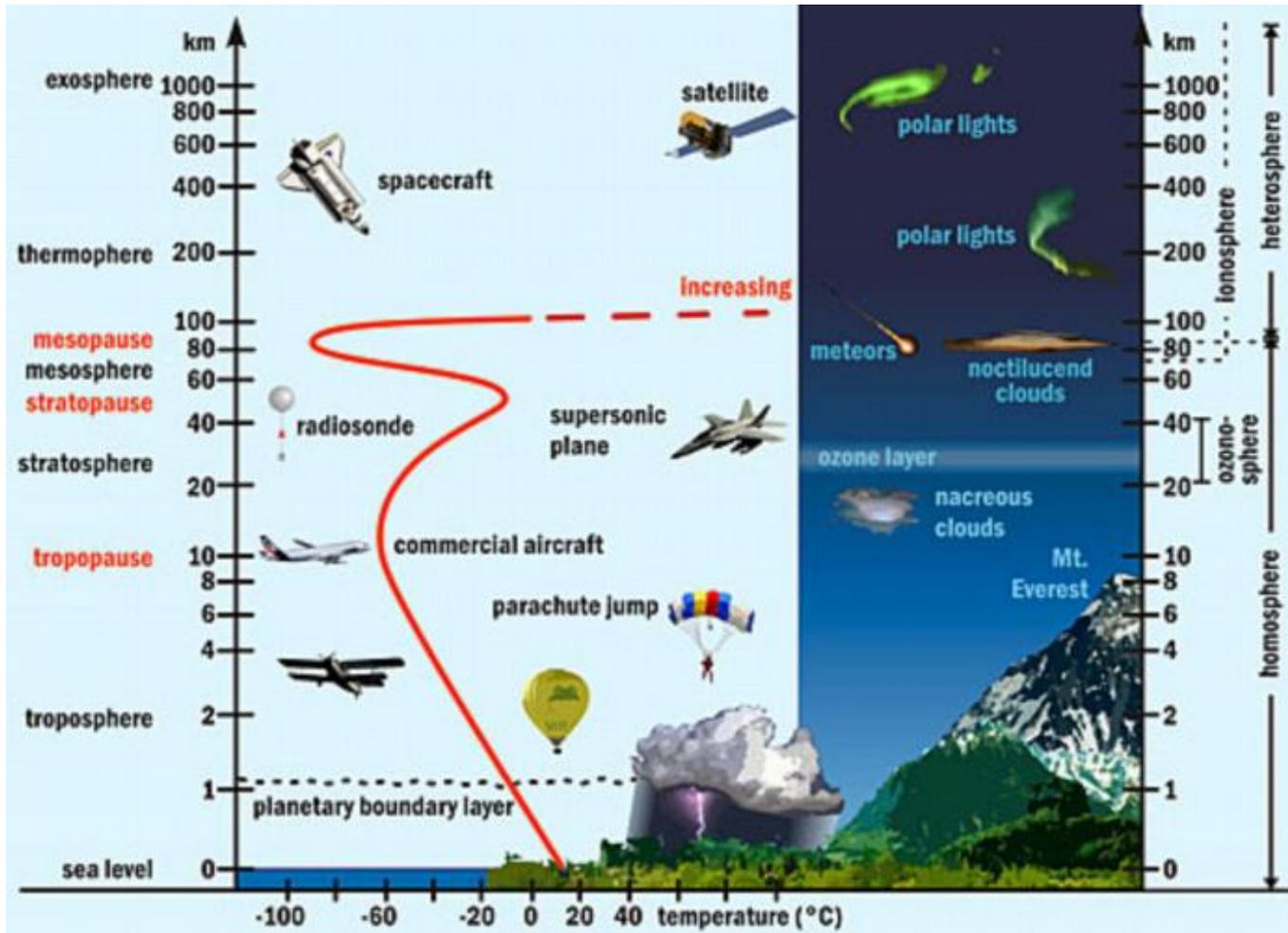
- Some of our instruments are small and light.
 - < 1 kg, $< 10 \times 10 \times 10$ cm³ (CubeSat size)
 - All are designed for autonomous operation.
- Almost all require *access to space*.
 - Instruments externally mounted or through-hull
 - Some require deployment (antenna, boom).
- Many photon-sensing experiments can only be done from > 100 km (atmosphere blocks).
- Some experiments need spinning; others need 3-axis attitude control.
- Some measurements need access to high latitudes.

Fingers into Space



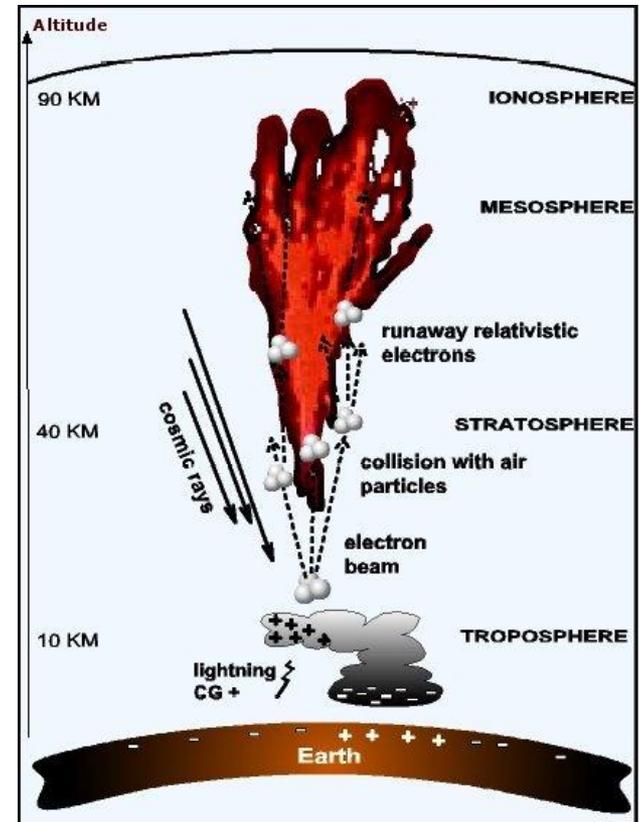
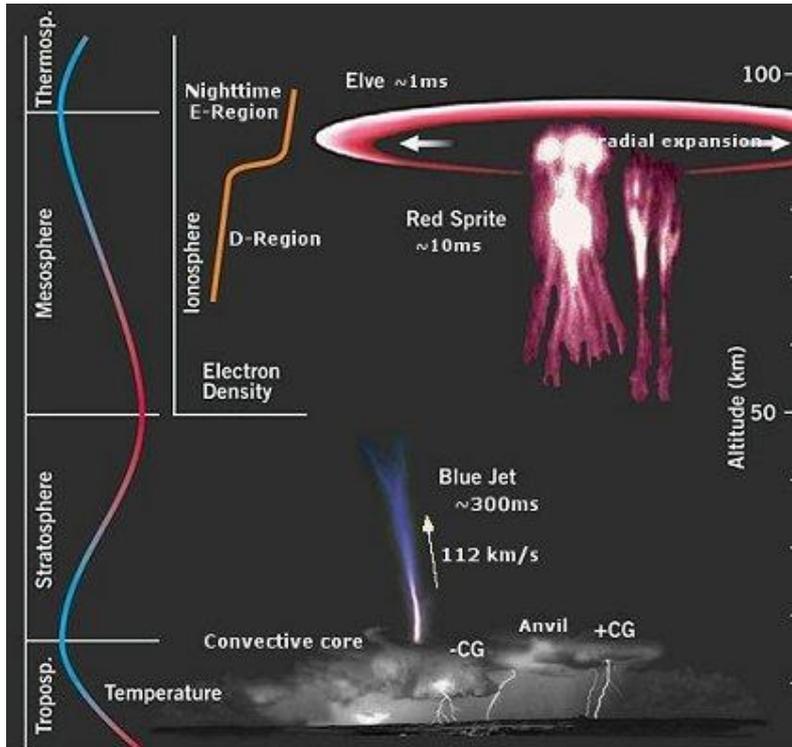
Tip-to-tip length of four deployed booms is 5.3 m.

From the Atmosphere to Space



Ionospheric layers

Sprites, Jets, Elves, Trolls, TGFs ...



Thunderstorms can spawn remarkably high-energy effects, including relativistic electrons, positrons, and gamma rays.

Some science from <100 km

(courtesy of D. Rowland)

- Mesospheric physics
 - Dust, gravity-wave braking, D-region chemistry and ionization / loss processes, noctilucent cloud properties and related radar echo
- Lightning physics
 - Formation of Terrestrial Gamma-ray Flashes (TGFs) sprites and Transient Luminous Events (TLEs)
- Neutral winds (chemical release)
 - Dynamics of thermospheric winds; dispersal patterns

Let the conversation begin ...