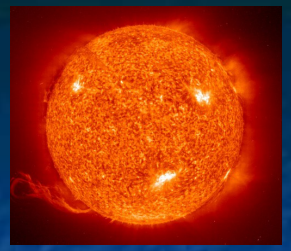
Unit 2: The Sun and Other Stars

Objective:

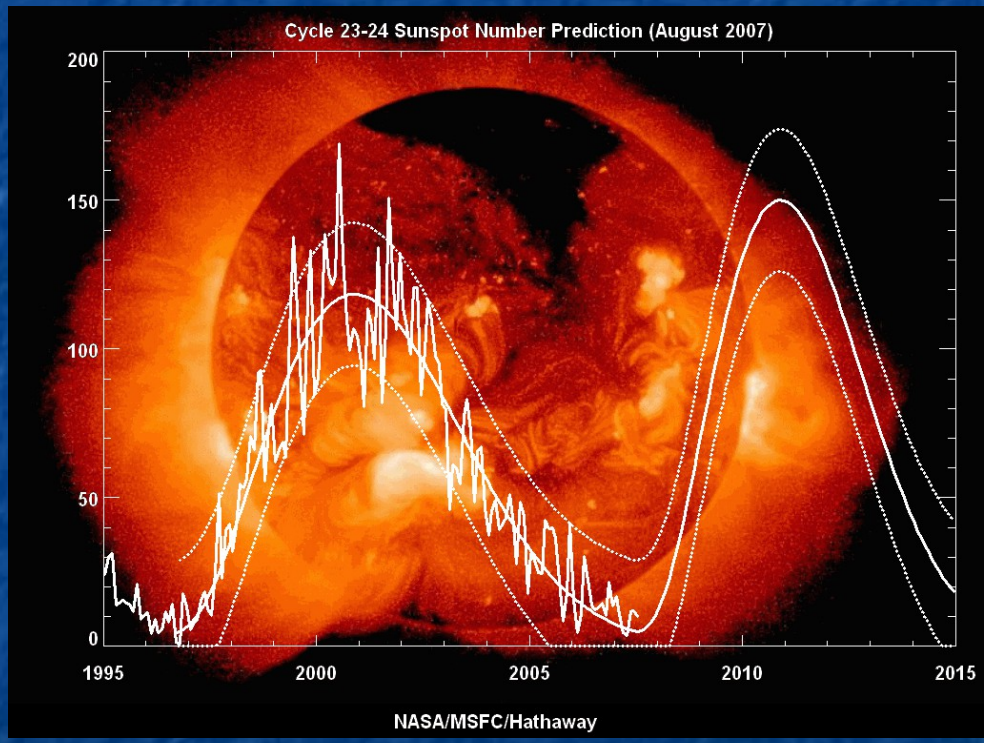
E5.2A - Identify patterns in solar activities (sunspot cycle, solar flares, solar wind).

E5.2B - Relate events on the Sun to phenomena such as auroras, disruption of radio and satellite communications, and power disturbances.

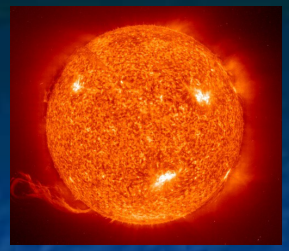
Sunspot Cycle*



Sunspots have been monitored since the time of Galileo. The variation in the number of sunspots is cyclic, with a period of approximately 11 years. This is better known as the ***sunspot cycle***.

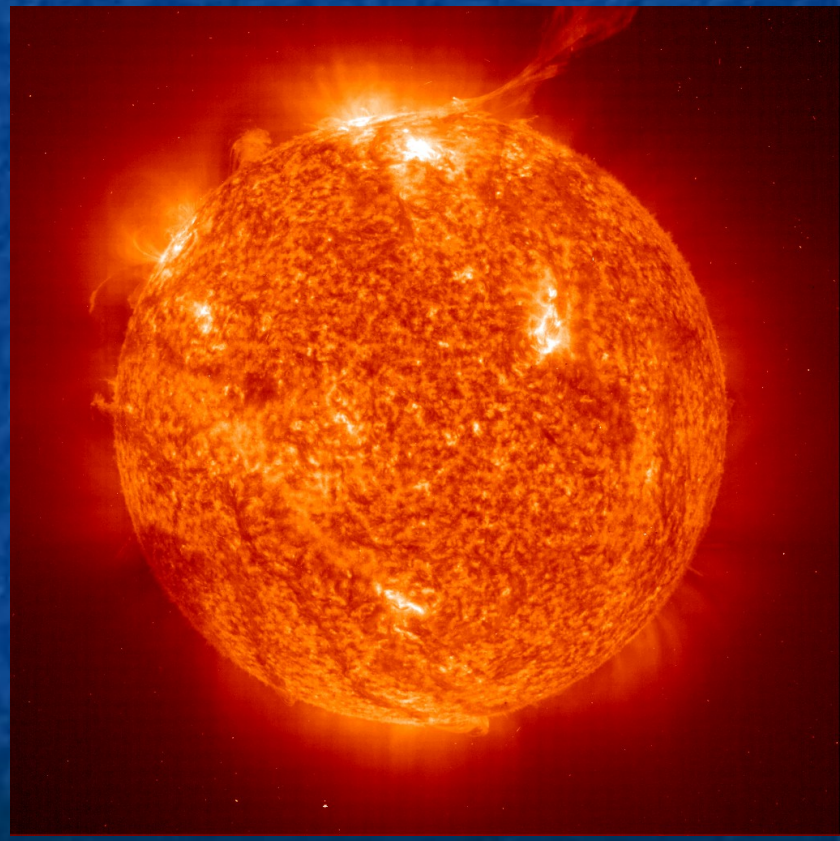


Solar Flares*

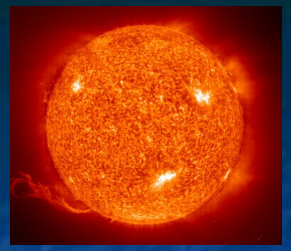


A ***solar flare*** is defined as a sudden, rapid, and intense variation in brightness on the Sun. A solar flare occurs when magnetic energy that has built up in the solar atmosphere is suddenly released.

Solar flares occur in active regions of the Sun where sunspots (and strong magnetic fields) are found. The frequency of solar flares coincides with the Sun's 11-year sunspot cycle.

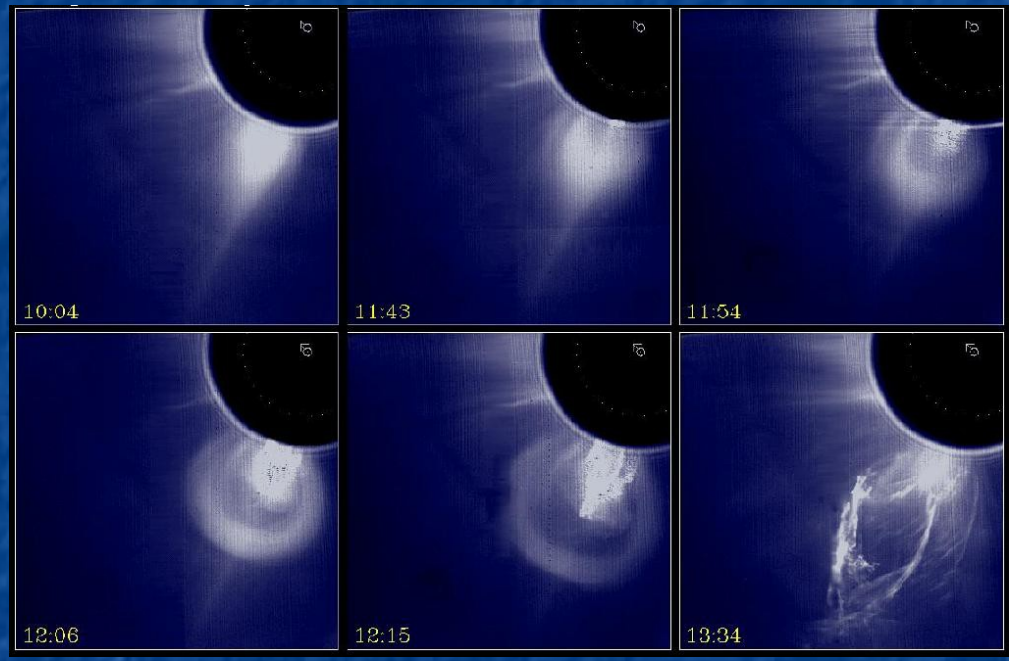


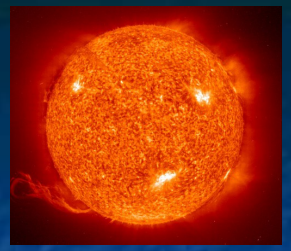
Coronal Mass Ejection*



Coronal Mass Ejections (CME) are huge clouds of gas (weighing as much as Mount Everest) that could be 10 million km across and travel up to 8 million km/h.

When the CME occurs, a large mass of ionized gas (or plasma) is ejected from the Sun, which we see as a spectacular eruption.



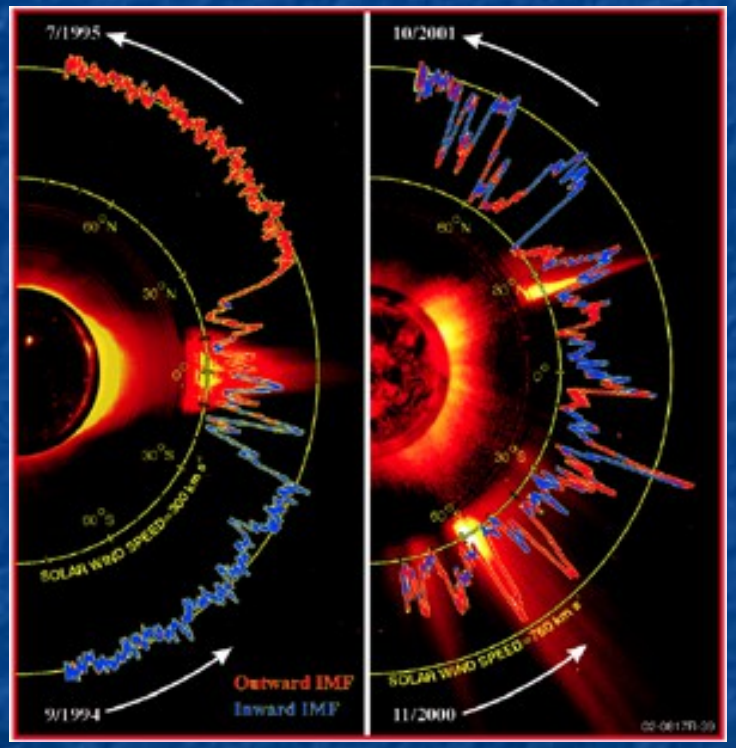


Solar Wind*

Solar wind consists of high-speed charged particles (electrons, protons, and a few heavier ions) constantly blowing off the Sun in all directions. The average velocity of the solar wind is 400 km/s.

Solar wind escapes the Sun primarily through coronal holes, which are found predominately near the Sun's poles.

The solar wind varies routinely through the 27-day rotation of the Sun, as well as sporadically, in response to violent eruptions in the corona.



Solar minimum (left) and solar maximum (right)

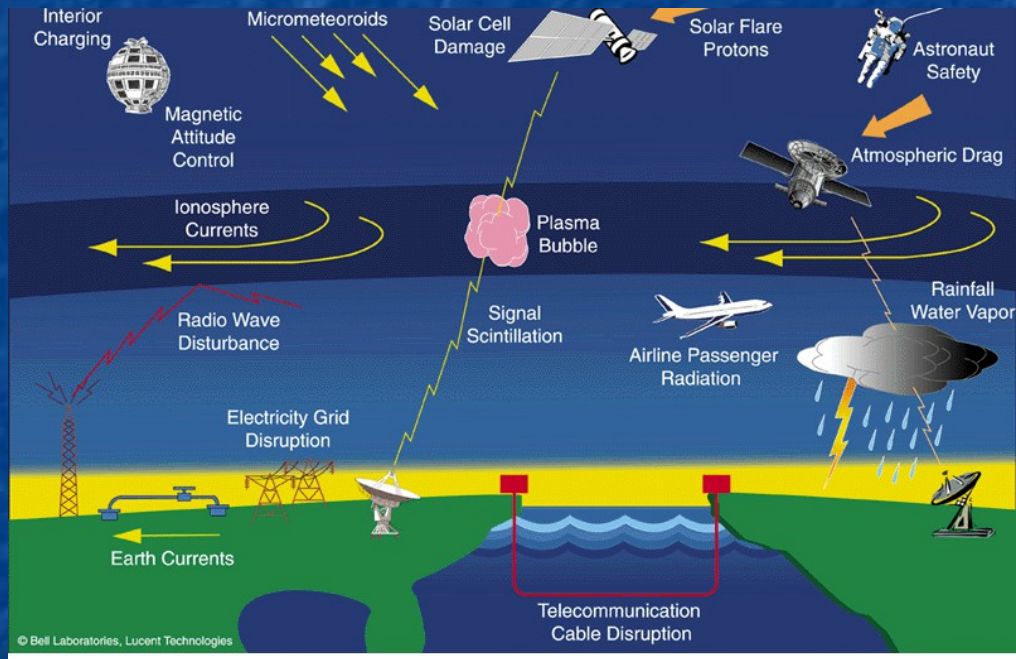
Auroras*

Auroras are believed to be caused by charged high energy particles from the solar winds that are trapped within the atmospheric magnetic field of the Earth. The bright colors are a result electrons colliding with oxygen (green and red) and nitrogen (blue) molecules in Earth's atmosphere.


QuickTime™ and a
decompressor
are needed to see this picture.

Problems From "Space Weather"*

Solar storms are known to be responsible for major electrical disruptions and satellite failures. Even radio signals can be disturbed, and not broadcast properly.



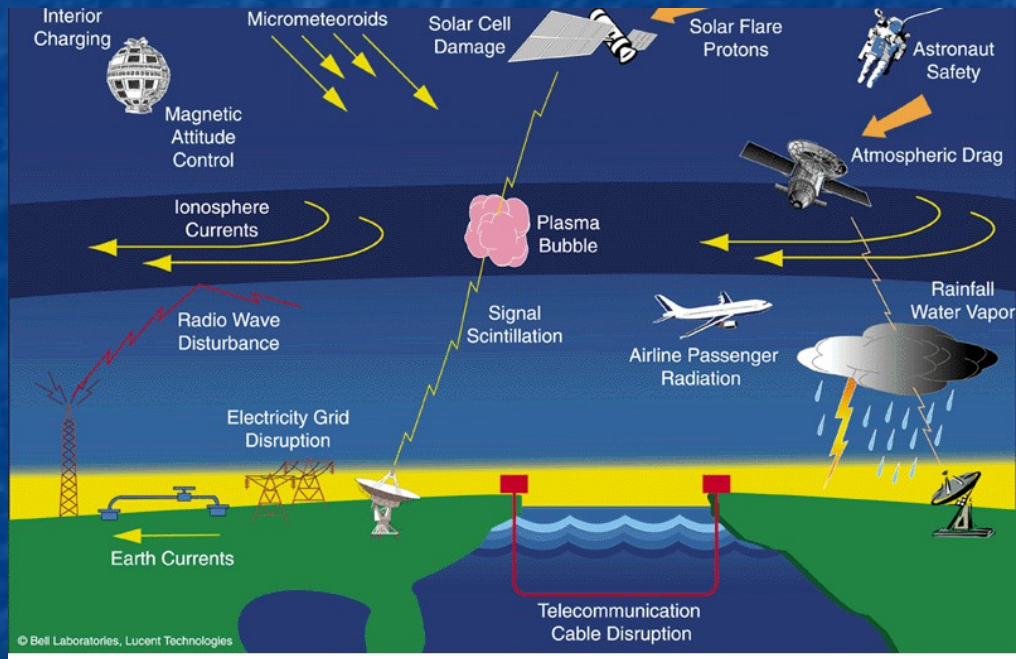
The effects of magnetic storms - what scientists call space weather - extend from the ground to geostationary orbit and beyond.

Problems From "Space Weather"

Satellites are particularly vulnerable to electrical effects of Space Weather as they are buffeted by the incoming gas and radiation.

The charged particles and ionizing radiation causes our atmosphere to expand, which in turn, creates extra drag on our satellites. This causes a loss of altitude.

Too many charged particles can cause electrical components to burn out.



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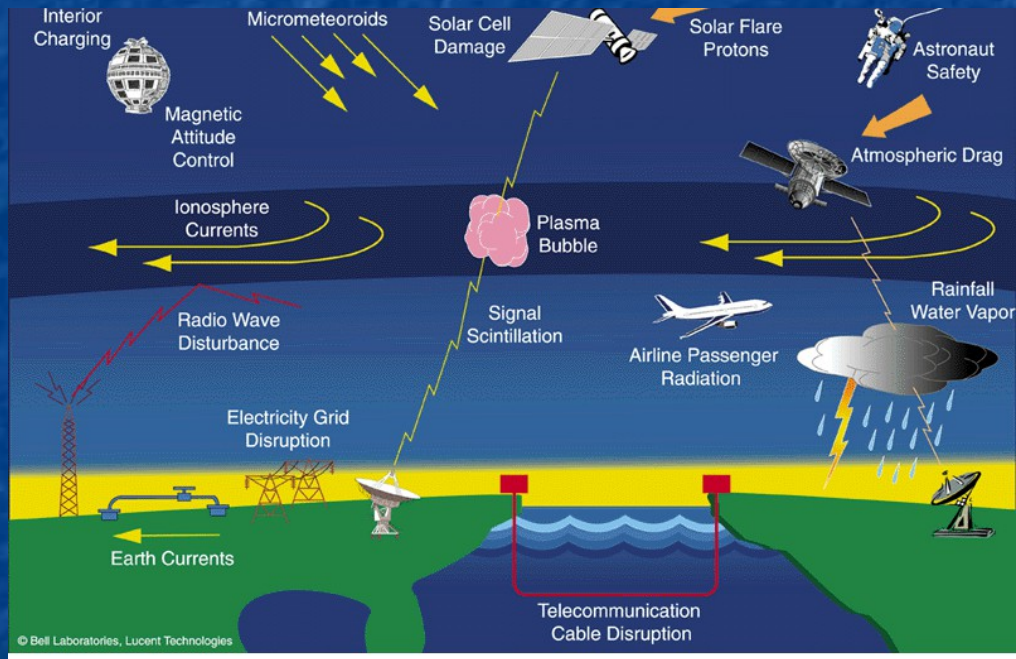
Problems From "Space Weather"

The effects of solar storms on the ground can also be expensive. Surges in power lines and long uninterrupted oil and gas lines can occur. The extra current in the power lines can burn out transformers, leading to large-scale brown-outs or blackouts.

Electricity in pipelines can enhance the rate of corrosion.



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