PowerPoint Notes for Solar Activity and Space Weather

Slide 1: Introduces space weather by showing the Sun, the Earth and its atmosphere. It looks peaceful….Ah! But it isn't!

Slide 2: This defines space weather—how the Sun affects the Earth. Shown (not to scale) is the Sun sending out a CME which hits the magnetosphere, particles cascade down to the poles and ricochet around the Earth coming in from the night side.

Slide 3: A definition of space weather by Charles Young, 1896, American astronomer who was the first to see the green spectral line of solar corona. Shown in order are: 1) A sunspot with magnetic lines of force, 2) A coronal mass ejection (CME) and solar flare, 3) A CME and magnetosphere (See Slide 2) and finally, 4) A CME and its effect on Earth, an aurora.

Slide 4: The importance of magnetism and magnetic field lines is seen. The field lines from a simple bar magnet are analogous to the field lines surrounding Earth. Magnetism involves field lines going from north to south.

Slide 5: The connection between Earth's magnetic field and the magnetosphere are depicted. It is important to see how far out in space the magnetosphere is.

Slide 6: The Sun-Earth system is dynamic! The Solar wind is always present extending far beyond Pluto. Plasma, charged particles, electrons and positive ions, are the most common form of matter that we can see.

Slide 7: The solar wind squashes and stretches the Earth's magnetosphere. Here we see a CME hitting the magnetosphere and deforming it.

Slide 8: Reemphasizing space weather and its connection to the Sun-Earth through the solar wind. **A video link helps enforce this concept.**

Slide 9: Introduces Solar flares and shows their magnitude and power. **The video link depicts a solar flare.**

Slide 10 This slide introduces CMEs, their power, and effects on Earth **A video link shows a powerful CME.**

Slide 11: Earth has two defenses, its magnetosphere and atmosphere. The slide shows the Earth's defenses at work. The magnetosphere deflects 99% of the charged particles. But Auroras are formed and are the harbingers of a space storm. Electromagnetic waves are not affected by magnetosphere but will be absorbed in the atmosphere, for example, in the ozone layer. Charged particles are also neutralized in the atmosphere, for example, by auroras.

Slide 12: The effects of solar weather (See slide 3).

Slide 13: Introduces Auroras, a warning system that tells us that solar storms are occurring.

Slide 14: This slide introduces solar storms and shows their effect.

Slide 15: A great slide! It shows a detailed view of the impact of solar storms on our current technology and communications. Point out the diverse happenings that could cause havoc today that were not even there 30 to 50 years ago like cell phones, GPS, and computers.

Slide 16: This slide shows Millstone's incoherent scatter radar, the most powerful ground-based system for studying space weather. The IS Radar measures what goes on in the ionosphere. Shown is MIT Haystack Millstone's two antennas.

Slide 17: This shows the Millstone Incoherent Scatter Radar with twin antennas, one steerable, one fixed. Note the cars in the lot next to the ISR. This gives you an idea of its size of the radar and its antennas.

Slide 18: Lists the complex parameters and filters available from Madrigal, the software data base manager. Madrigal makes space weather data available to researchers worldwide.

Slide 19: The slide shows the Madrigal data set that was selected for analysis. The data set looks simple, yet it has a degree of complexity to show space weather. Basically we wanted to examine the brightest time of day.

Slide 20: The yearly solar cycle during a minimum. Note the fairly flat temperatures during the winter and summer months for both electrons and ions.

The data is fairly raggedy with vacant holes due to the fact that the radar was not running around the clock.

Slide 21: The yearly solar cycle during a maximum. Note the difference from the previous slide that showed a minimum, especially during the summer months. An upsurge during the summer. The data is fairly raggedy with vacant holes due to the fact that the radar was not running around the clock. However, note the violent and famous Quebec/Hydro solar storm in March 1989 that caused several billions of dollars in damage.

Slide 22: Shows the first 24 hour around the clock run on IS radar ever. It was done at Millstone. Note the following: High Temperatures during the day and a relaxation of temperatures at night. Electrons show much more temperature differences than ions. Electrons weigh much less! There are three solar activities occurring during the month, as shown by the red arrows--around the 5th, 14th and 24th. An unusual happening is observed: a baseline shift occurs on the 24th. Why?

Slide 23: Summary of the slide show that ties in what we saw in space weather and how the data can make sense.

Slide 24: You can see a **28 minute video on space weather,** if you wish.