

Title: SpaceweatherFX 2:

Connecting the Sun and Earth

[Visual: the Sun in space]

[Visual: an aerial view of Haystack Observatory]

Space weather is something we experience because we live near a star. Out in the countryside near Boston Massachusetts, scientists at MIT's Haystack Observatory work to understand what happens when that star, our Sun, stirs up a little space weather.

[Visual: opening sequence with title]

Dr. Philip Erickson studies the effect of space weather on Earth's upper atmosphere.

[Visual: Dr. Philip Erickson speaks at his desk]

There are several ingredients which make up space weather. One is the Sun. Another is the solar wind. And, you need plasma, which is an ionized gas.

[Visual: animation of cool gas molecules and electrons floating in space]

To make plasma, you start with a neutral gas made up of atoms and molecules floating free in space.

[Visual: atoms and molecules move faster as the scene heats up]

When the gas gets heated by a nearby source, it becomes energized. This causes the atoms or molecules which make up the gas to become excited. If there is enough energy pumped in, this can break

apart the atoms or molecules and release their negatively charged electrons. They swarm around with the ions, the positive nuclei they've left behind. That's a plasma.

[Visual: an image of the Sun showing plasma along the limb]

The Sun is made of plasma. In fact, plasmas are everywhere, not just in stars.

[Visual: a series of neon signs]

Neon and fluorescent lights glow because the gases sealed inside their tubes are converted to charged plasma by electrical currents.

[Visual: two animated bolts of lightning flash across the screen]

A bolt of lightning is also plasma.

[Visual: an animated flame]

So is a fire.

[Visual: Dr. Philip Erickson speaks from his desk]

Plasma conducts electricity. Electrical currents generate magnetic fields. Both the electric and magnetic fields affect plasma by heating it and shaping it. Electric currents in the Sun generate its overall magnetic field, which extends far into space.

[Visual: a SOHO video of solar outbursts]

Magnetic fields and their motions convey much of the power that causes the heating and outburst activity we see at the Sun's surface.

These magnetic fields extend out from the Sun's surface and heat plasma to super high temperatures.

[Visual: magnetized loops of plasma reaching up from the Sun's surface]

They channel streams of it into giant loops that stretch up into the Sun's atmosphere.

[Visual: an animation of the solar wind traveling through the solar system]

The Sun's magnetic field is carried out into space as it magnetizes a steady stream of plasma called the solar wind. It flows out past all the planets, and eventually thins out into interstellar space.

[Visual: video of a solar flare]

Occasionally, the Sun sends giant outbursts into space.

[Visual: video from SOHO of a coronal mass ejection]

These can be solar flares which contain high-energy particles and radiation, or coronal mass ejections that send large clouds of slower-moving plasma out through space.

[Visual: an animation of the solar wind hitting a planet's magnetic field]

Space weather effects happen at planets when their magnetic fields act as obstacles to those plasma clouds.

[Visual: animation showing Earth and the core region where the magnetic field is generated]

The magnetic field of Earth is generated deep beneath our feet. The center of our planet is surrounded by a shell of liquid rock. It moves around as the planet spins on its axis, and just like a generator creates electricity, this motion creates the electric current that powers our magnetic field. That field extends out into space through our atmosphere.

[Visual: an animation showing Earth and its magnetosphere]

It forms the magnetosphere, a region of space around Earth that is filled with charged particles created from interactions with the Sun.

[Visual: Jupiter and Saturn and their magnetic fields]

Jupiter and Saturn also experience space weather. Like Earth, they have magnetic fields that interact with the solar wind.

[Visual: Dr. Philip Erickson speaks from his desk]

Space weather isn't just something that happens to us on Earth – it's a solar system phenomenon, and one that we are working every day to understand.

[Visuals: Credit slides]