From Solar Flares to Power Scares: What Is Space Weather and How Does It Affect Us?

By Victoria Woodburn | November 20, 2019

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NASA's Solar Dynamics Observatory captured these images of a solar flare on Oct. 2, 2014. The solar flare is the bright flash of light on the left limb of the sun.
CREDIT/NASA

The American Astronautical Society (AAS) has recently relaunched our "Future in Space" series of monthly virtual hangouts with our host, Tony Darnell. Each hour-long hangout is broadcast live and features Darnell interviewing specialists on assorted topics regarding aerospace advancements. The first of the new series of hangouts took place on August 29 and focused on the subject of space weather and its effects on humans both on Earth and in space.

Darnell was joined by Mitzi Adams, a solar scientist with the Heliophysics and Planetary Science Branch of NASA Marshall Space Flight Center and Frank Koza, Electric Subsector Coordinator of the Electric Infrastructure Security (EIS) Council.

For some, the term "space weather" conjures up images of impossible rain storms and blizzards happening far outside the Earth's atmosphere. However, space weather is a very real phenomenon that can have significant effects within the solar system, including damaging the power grids here on Earth. Understanding the effects of these solar events is critical to mitigating their impacts when they happen.

Adams, a solar scientist who graduated from Georgia State University with a B.S. in physics, went on to earn her M.S. in physics from the University of Alabama in Huntsville. Her passion for exploration and thirst for knowledge surrounding the Sun brought her to NASA Marshall Space Flight Center (MSFC), where she currently studies the turbulent behavior of the Sun and the effects that it can have on Earth.

Koza earned his B.S. in mechanical engineering from the University of Pennsylvania and spent several years as executive director of PJM Interconnection. Currently, Koza is the Electric Subsector Coordinator for the EIS Council, where he actively works to address and mitigate potential threats to lifeline infrastructures, known as Black Sky Hazards.

Adams and Koza's specialized backgrounds provide for a unique perspective into the effects of space weather.

"Future in Space" Hangout Logo
CREDIT/TONY DARNELL, FUTURE IN SPACE

"The Sun's magnetic field has an influence that extends throughout the solar system and is dragged out because the solar system is moving through the galaxy," said Adams. "Space weather is how the interplanetary medium reacts to influences from the Sun like solar flares and coronal mass ejections."

Coronal mass ejections (CMEs), are large ejections of plasma, electrons, and protons that carry with them the Sun's magnetic field, and vary in frequency based on the 22-year solar cycle. The combination of these CMEs with solar flares results in a complete flip of the Sun's magnetic field every 11 years.

Oftentimes, space weather events happen with no significant effects. However, problems occur when CMEs have a magnetic orientation that couple with the Earth's magnetic field. This can create a powerful magnetic field that allows charged particles from the Sun to flow directly into the Earth's atmosphere. These extreme ground induced waves have the capability to induce severe currents in electrical wires, disrupt power lines, and cause wide-spread blackouts with the potential to become a Black Sky Hazard, a catastrophic event that severely disrupts the normal functioning of our critical infrastructures. Additionally, they can cause damage to satellites in orbit. If this occurs, the satellites might lose their ability to complete the important work they were designed for, whether that be carrying out commercial communications, global positioning, intelligence gathering, or weather forecasting.

"The reason the EIS Council is so concerned about the power system is if you have a wide-scale blackout, you not only lose the power system, but you also very likely lose a number of the human support infrastructure, like water, gas and oil, because they're all basically powered by electricity in some way," explained Koza. "Any type of large scale electricity blackout or outage is catastrophic because of the potential of those kinds of ripple effects. You're talking about loss of human lives right out of the gate."

Despite the catastrophic potential of space weather events, our Earth is not completely defenseless. The magnetosphere that surrounds the planet provides a layer of protection from the harmful radiation in space. As for human made protections, detection equipment is installed regularly, forecasting tools continue to improve, and the American Transmission Company (ATC) has managed to successfully install a reduction device for geomagnetic induced currents in Wisconsin.

Ultimately, the lack of human exposure to space weather creates a safety problem for future deep space missions. Scientists are working to advance their understanding on the effects of space whether in deep space. This knowledge will play a crucial role in the creation of future spacecraft and missions, such as the Lunar Gateway, which will play a key role in NASA's mission return to the Moon and journey on to Mars.

"This is not a done deal," said Darnell in reference to NASA's Artemis mission. "Space weather is a crucial part of being able to understand whether we can even do this or not."

The full recording of this hangout can be found online here. For more information on our "Future in Space" Hangout series visit https://astronautical.org/events/hangouts.

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