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Statement of
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before the
House Subcommittee on the Environment and the
House Subcommittee on Space
Committee on Science, Space and Technology
United States House of Representatives

Chairmen Biggs and Babin, Ranking Members Bonamici and Bera, and members of the Subcommittees:

As the Heliophysics Chief Scientist for NASA's Science Mission Directorate (SMD), I am honored to appear before this Committee to discuss NASA's contributions to understanding space weather phenomena.

Space weather is complex, involving intricate interactions between the Sun, solar wind, Earth's magnetic field, and Earth's atmosphere. NASA serves as a research organization for our nation's space weather efforts, working with the National Science Foundation to enhance our scientific understanding of space weather. Together, we help the operational organizations of National Oceanic Atmospheric Administration (NOAA) and the Department of Defense (DOD) incorporate that understanding into operational models and space weather predictions to better prepare us for potential impacts.

Our ability to understand the Sun-Earth system is of growing importance to our nation's economy and national security. While the Sun enables and sustains life here on Earth, it produces radiation and magnetic energy that can have disruptive impacts to astronauts and spacecraft in space, airline passengers in the air, communications and positioning devices, and the electrical power grid on Earth. Understanding the Sun-Earth system has practical implications for life on Earth. For example, the electric power industry is susceptible to geomagnetically-induced currents, which can overload unprotected power grids and result in widespread power outages. With warning, power grid operators may be able to adjust operations to counteract such effects. In the spacecraft industry, intense geomagnetic and radiation storms have the capacity to disrupt normal operations such as satellite communication and television service. Space weather can cause irregularities in signals from Global Positioning System satellites, which can adversely affect our warfighters, first responders, long-haul truckers and outdoor enthusiasts. Finally, the aviation industry is particularly susceptible to space weather events from both an operational and safety perspective. Communications between flights taking polar routes and air traffic control could be disrupted due to interference between the radio waves and the effects of space weather in the ionosphere. In addition, flight routes may be re-routed further south during solar weather events to reduce the radiation exposure to passengers and crew.

NASA's Heliophysics missions all contribute to understanding the physical processes that drive the environment of the connected Sun-Earth system. With locations throughout the solar system, we observe the Sun-Earth system everyday using NASA's Heliophysics System Observatory, with 18 active missions comprised of 28 spacecraft.

At NASA, we are excited to see how new missions will revolutionize our understanding of the Sun-Earth System and space weather. The recently launched Global-scale Observations of the Limb and Disk (GOLD) mission and the upcoming Ionospheric Connection (ICON) mission will improve our understanding of what is happening in the ionosphere. The ionosphere is a little-understood region where the Earth's uppermost atmosphere meets the space that surrounds us — a critical boundary that responds both to terrestrial weather below and space weather above. Placed in different orbits, GOLD and ICON will each get a unique snapshot of the same region in the ionosphere. This overlap will enhance our ability to identify what causes certain changes to the upper atmosphere that cause space weather impacts.

This summer, we will send the Parker Solar Probe closer to the Sun than any human-made object has ever gone, and it will dive into the Sun's hot corona to provide the closest-ever observations. Throughout its seven-year mission, while facing brutal heat and radiation, the mission will reveal the fundamental science behind what drives the solar wind, which is the constant outpouring of material from the Sun that affects space weather near Earth. Parker Solar Probe will explore the Sun's outer atmosphere and make critical observations necessary to improve forecasts of major eruptions on the Sun and the subsequent space weather events that impact our technology dependent lives.

Also launching this summer, the Space Environment Testbed 1 mission, a technology demonstration mission developed in partnership with the Air Force, will improve the engineering approaches to mitigation and accommodations for the effects of solar variability on spacecraft design and operations. The mission will also provide important data to improve hardware performance in the space radiation environment.

NASA's Heliophysics Division is in the process of selecting its next strategic mission, a Decadal Survey priority, the Interstellar Mapping and Acceleration Probe (IMAP). IMAP will observe the boundary of our solar system and investigate acceleration processes critical to understanding space weather. NASA and NOAA are exploring a potential partnership to use the same launch vehicle for IMAP and a NOAA space weather monitoring payload. The partnership would provide NOAA access to the L1 Lagrange point for future space weather monitoring.

These new missions will join our existing fleet to enhance the already vibrant Heliophysics System Observatory, which all contribute to better understanding the physical processes that are driving the space environment around Earth and throughout the solar system. The following missions are particularly focused on improving our understanding of space weather: the Advanced Composition Explorer and NOAA's Deep Space Climate Observatory, which observe the solar wind; the Solar Dynamics Observatory, the Solar and Terrestrial Relations Observatory, the joint ESA/NASA Solar and Heliospheric Observatory, which can all observe solar eruptions on the Sun; and the Van Allen Probes, which observes the radiation belts around Earth.

NASA supports world-class research based on these missions and other sources, to understand the connections within the Sun-Earth system, for science and human safety, both on Earth and beyond. Heliophysics research provides a foundation to build predictive models of space weather events, mitigate the hazards posed to assets both in space and on the ground, and understand space weather impacts throughout the solar system. NASA continues to develop and improve predictive models through enhanced fundamental understanding of space weather through funding basic and targeted research opportunities. NASA research opportunities reflect the general and focused science topics that are associated with space weather phenomena, which include understanding solar variability, and how it drives phenomena in the space environment near Earth, where space weather can have its most significant impacts on spacecraft, communications, and positioning devices. NASA, in coordination with NOAA and NSF, has developed a cross-agency plan to enhance the transition of research models to operations and models in operations to researchers.

The NASA Community Coordinated Modeling Center (CCMC), is a successful multi-agency partnership that provides space science simulations to the research community. The CCMC plays a key role in supporting our sister agencies by transitioning space research models to space weather operations. Furthermore, in coordination with NOAA and NSF, we have initiated a pilot program to expand the interagency capability and improve space weather products and services for Research to Operations and Operations to Research (R2O2R).

NASA appreciates the continued support from this committee, which ensures that the United States maintains a superior position in understanding space weather, and looks forward to the continued collaboration with our sister agencies, international partners, academia, and industry.

NASA Heliophysics has a big year in front of it. The data we receive from upcoming NASA's Heliophysics missions and data we already collect from the Heliophysics System Observatory, will vastly improve our understanding of this challenging phenomena. The research these missions enable continues to develop and improve predictive models through enhanced understanding of the science of space weather. Heliophysics research is intrinsically the science of space weather. NASA is committed to remain the leader of that research.

Thank you for the invitation to be here with you today, and I look forward to answering any questions you may have.