

NASA Goddard's Heliophysics Science Division

America's Line of Defense Against Space Weather Threats

The U.S. relies on NASA's Heliophysics Science Division (HSD) for the science and technology that powers America's space weather defenses. NOAA, the military, and private industry build their solutions on decades of HSD expertise and ongoing innovation. By integrating solar, heliospheric, geospace, and atmospheric research and technology in one location, we provide efficient, coordinated solutions to protect U.S. infrastructure, national security, and space missions from solar storms and geomagnetic disruptions.

WHAT NASA GODDARD'S HSD DOES FOR AMERICA






Protects U.S. Military & Homeland Security	Help understand failures of GPS-guided systems, surveillance, and critical communications systems to mitigate dangerous disruptions.
Ensures Power Grid & Infrastructure Resilience	Without NASA's research, a major solar storm could cause a nationwide blackout lasting from days to possibly months.
Supports U.S. Space & Technology Leadership	SpaceX, Blue Origin, and the growing commercial space industry depend on NASA's heliophysics research to shield satellites and deep-space missions.
Keeps America First in Space	China, Russia, and the EU are ramping up space weather research. The U.S. cannot afford to fall behind.
Delivers Real-Time Space Weather Monitoring	NASA Goddard's observations and models feed NOAA, DoD, and the private sector with critical space weather information.

What happens if this work stops? The U.S. loses the foundation of critical space weather research and forecasting, putting the economy, defense, and future space missions at risk.

Heliophysics Data is essential for all aspects of space weather research and forecasting, approximately 65% of which is **provided due to NASA's HSD data and model infrastructure.**

THE POWER OF 5 HELIOPHYSICS LABS WORKING TOGETHER

- **Efficiency** = Critical foundational work that coordinates with agencies, private sector & academia
- **Innovation** = Developing & combining cutting-edge models and technology to predict solar storms
- **Synergy** = Centralized teams & partners collaborating seamlessly across multiple research areas

 Solar Lab	Studies the Sun's activity and magnetic fields to predict solar eruptions that can cripple power grids and critical communications.
 Heliospheric Lab	Tracks solar wind, solar eruptions and its effects to enhance early-warning systems for incoming space weather threats.
 Geospace Lab	Monitors Earth's magnetic shield to prevent GPS, and satellite disruptions. Analyzes data to improve forecasting models.
 Space Weather Lab	Analyze solar storms in near real-time to prevent satellite damage, impact on humans in space, and national security threats.
 ITM (Ionosphere, Thermosphere, Mesosphere) Lab	Studies upper atmosphere changes that disrupt technology to strengthen navigation, communication, and disaster readiness.

NASA GODDARD'S HSD IS THE CRITICAL PART OF AMERICA'S LINE OF DEFENSE.


Space Weather Intelligence to Protect Against Threats

Even moderate storms cost billions—extreme events could set civilization back decades.


The Space Weather We Must Defend Against	
1859 Carrington Event	The most powerful geomagnetic storm on record. Telegraph systems caught fire , auroras were seen as far south as the Caribbean, and if it happened today, it could wipe out satellites, disable the grid, and devastate global infrastructure.
AD 774–775 Superstorm	10 to 15 times stronger than Carrington. Left a massive radioactive signature in tree rings. A repeat event today could cause civilization-level consequences.
1989 Québec Blackout	A solar storm collapsed Hydro-Québec's grid in 90 seconds , leaving millions without power for 9 hours and causing hundreds of millions in damages.
2003 Halloween Storms	Disrupted GPS, satellites, airline communications , and caused a blackout in Sweden. Some satellites suffered permanent damage , and ISS astronauts had to shelter from radiation.
May 2024 Solar Storms	U.S. farmers alone lost up to \$1 billion from GPS disruptions affecting precision agriculture. Aerial drones experienced loss of stability, control and some crashes.
Continuous Losses	Space weather happens all the time. On February 8, 2022, 40 of the 49 Starlink satellites were lost due to atmospheric drag caused by small solar storms.
Hostile Space Environment	Solar radiation and space weather pose extreme risks to deep space travel. Missions to the Moon and Mars, and satellite operations, require advanced shielding and forecasting to protect astronauts and critical assets from deadly exposure.


NASA Goddard's Heliophysics Science Division conducts space weather intelligence to provide real-time early warnings and safeguard national security.

 **NASA IS THE FOUNDATION:** The military, government agencies, and private space industry—SpaceX, Blue Origin, and others—rely on **60+ years of NASA research** to operate safely in space.

 **NASA Heliophysics provides the fundamental research and development needed** to enhance space weather prediction capabilities. Without NASA Heliophysics:

 **We Lose Critical Space Weather Forecasting** – NOAA and the military rely on NASA's data to predict and prepare for solar storms.

 **Private Industry Suffers** – SpaceX and other companies **can't develop reliable space systems** without NASA's long-term research.

 **America Falls Behind** – China in particular is investing heavily in space weather research. **The U.S. must lead or risk losing competitive advantage in the field.**

THE BOTTOM LINE: SPACE WEATHER RESEARCH IS A NATIONAL IMPERATIVE

 **WE CAN'T PREVENT SOLAR STORMS—BUT WE CAN PREPARE!** 