



SPACE WEATHER OBSERVATIONS



SOLAR-1 observatory
Credit: BAE Systems

HOW DO WE OBSERVE THE SUN?

Scientists collect space weather observations using specialized instruments aboard satellites and on the ground. Common instruments on satellites include coronagraphs, magnetometers, solar wind plasma sensors, and suprathermal ion sensors.

WHAT IS SPACE WEATHER?

Space weather refers to variable conditions on the sun and in the space environment due to solar activity. These conditions can adversely impact the performance and reliability of space-based and ground-based technological systems, as well as endanger life or health.

Space weather can damage the electrical grids that power our communities, interrupt radio and satellite communications, and cause our GPS navigation to fail. Predicting when and how much space weather could hit the Earth's atmosphere is important to protecting people and property.

SPACE WEATHER IMPACTS:

- GPS
- SATELLITES
- AVIATION
- COMMUNICATIONS
- ELECTRIC POWER GRID
- AGRICULTURE
- NATIONAL SECURITY AND DEFENSE
- EMERGENCY RESPONSE
- RESOURCE EXTRACTION
- SPACE COMMERCE AND EXPLORATION

Image : The Aurora Borealis is the most visible manifestation of space weather. Credit: NASA

These physical phenomena that make up space weather include large amounts of radiation and high-energy particles emitted during solar radiation and geomagnetic storms.

SOLAR FLARES

CORONAL MASS EJECTIONS

RADIO BURSTS

ELECTROMAGNETIC RADIATION

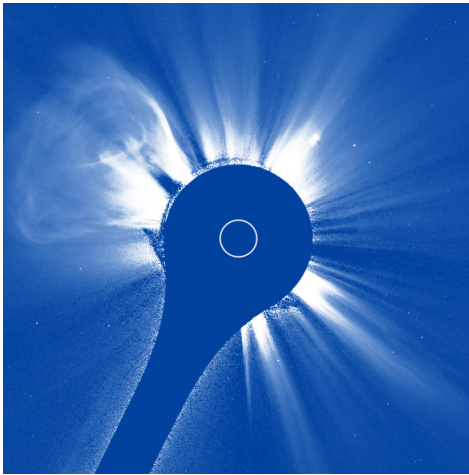
HIGH-ENERGY PARTICLES

Image Credit: SOHO/LASCO (ESA & NASA)



SPACE WEATHER PROGRAMS

SWO develops and deploys operational satellite systems that study space weather and safeguard society.



NOAA's compact coronagraph (CCOR-1) view of the sun helps detect and characterize CMEs. *Credit: NOAA/NASA*



The nation's first operational coronagraph integrated onto NOAA's East satellite. *Credit: Lockheed Martin*

SWFO

SPACE WEATHER FOLLOW ON



SWFO is NOAA's first program purpose-built for operational space weather monitoring. It follows successful research missions like the European Space Agency (ESA)-NASA's Solar and Heliospheric Observatory (SOHO), NASA's Advanced Composition Explorer (ACE), and NOAA's Deep Space Climate Observatory (DSCOVR), which faithfully served as space weather data sources for many years beyond their design life.

THE SWFO PROGRAM INCLUDES:

- Compact Coronagraph – 1 (CCOR-1): World's first operational, space-based coronagraph. Launched in June 2024. Onboard GOES-19 satellite.
- Space weather Observations at L1 to Advance Readiness – 1 (SOLAR-1) observatory: First U.S. satellite designed exclusively for continuous, operational space weather observations. Launched in September 2025. Formerly referred to as SWFO-L1.
- Dedicated operational ground segment

SW Next

SPACE WEATHER NEXT

To meet growing demands from users for additional space weather data and services to safeguard our nation, the Space Weather Next (SW Next) program is developing instruments and spacecraft to collect observations from different vantage points near Earth and the Sun, in addition to expanding capabilities to new orbits using new and improved instruments.

The SW Next Space weather Observations at L1 to Advance Readiness (SOLAR) project includes two new space observatories, called SOLAR-A and SOLAR-B. NOAA has transitioned to the U.S. commercial sector for their coronagraphs. Together with SOLAR-1, these spacecraft will provide uninterrupted images of the sun and solar wind measurements, helping forecasters better predict space weather.

NOAA's partnership with ESA on their Vigil mission to L5 will deliver a significant improvement in space weather forecasting. The Vigil data will provide two key benefits: (1) up to 4–5 days earlier detection of solar storms that send solar winds streaming toward Earth, and (2) an enhanced ability to predict when Coronal Mass Ejections (CMEs) will impact our planet. NOAA's contribution is a copy of the Compact Coronagraph. Vigil is planned to launch in 2031.



Visit the website for more information about NOAA's Space Weather Programs
www.nesdis.noaa.gov/about/our-offices/office-of-space-weather-observations