SPACE WEATHER MODELING FRAMEWORK

Caused by magnetic and electrically charged phenomena traveling from our sun, space weather affects life on Earth and our ability to explore the solar system. Space storms have created power outages, diverted airplanes, knocked out satellites, interrupted spacecraft communications, and forced astronauts to take cover.

To study and ultimately predict space weather, scientists are building a software tool called the Space Weather Modeling Framework (SWMF). By coupling a series of computer models, the SWMF can simulate space weather phenomena over vast regions of space—from the surface of the Sun to the upper atmosphere of Earth, the Moon, Mars, and beyond. The SWMF harnesses some of the world’s most powerful supercomputers to model space storms faster than reality, a key to reliable forecasting.
SPACE WEATHER FRAMEWORK

Confronting Monster Space Weather Events with Modeling

Three examples, including the most sizable and impactful event of recent memory, are selected for analysis. Global geo-electromagnetic oscillations and sudden spatial reorganization of space-time structures are observed. The large-scale space plasma anaphoric structures are explored, and a compact and comprehensive model is proposed.

The Magnetic Storm Solar-Centric Model (MSSCM) describes the source, detection, and mitigation of fast space-time structures. The model is based on the analysis of fast waves, plasma instabilities, and ionospheric effects. It is a comprehensive model that integrates multiple scales and interactions. MSSCM is able to predict and mitigate the impact of space weather events.

The Magnetic Storm Global Model (MSSGM) describes the global electric circuit, the long-term effects of fast waves, and the impact on power grids. This model is based on the analysis of slow waves, magnetic instabilities, and ionospheric effects. It is a comprehensive model that integrates multiple scales and interactions. MSSGM is able to predict and mitigate the impact of space weather events.

The Magnetic Storm Anomalous Model (MSAM) describes the impact of anomalous events on power grids and the impact on space-time structures. This model is based on the analysis of anomalous waves, magnetic instabilities, and ionospheric effects. It is a comprehensive model that integrates multiple scales and interactions. MSAM is able to predict and mitigate the impact of space weather events.

Relay Antennas

Constructing a Magnetometer

You can build a simple magnetometer to detect changes in the Earth's magnetic field. You will need a bar magnet, thin wire, and a galvanometer. First, loop the wire around the magnet in a figure-eight pattern. Then, connect the ends of the wire to the galvanometer. When a field passes through the loop, a current is induced. You can use this current to determine the strength and direction of the magnetic field.

Collecting Data with Your Magnetometer

When you use your magnetometer, you should record the data in a table or a graph. You will need to do this in order to determine the strength and direction of the magnetic field. You will also need to do this if you want to compare the data from different locations or times. The magnetometer can be used to measure the Earth's magnetic field, which is constantly changing. This information can be used to study the Earth's magnetic field and its effects on the environment.

A Sample of U.S. Space Weather Programs

The United States has several programs dedicated to monitoring and mitigating space weather events. These programs include the National Oceanic and Atmospheric Administration's (NOAA) Space Weather Prediction Center, which provides real-time space weather forecasts, and the Department of Defense's Space Based Infrared System (SBIRS) program, which detects and tracks space objects.

Space Weather Event Report

NOAA's Space Weather Prediction Center provides real-time space weather forecasts and alerts to help protect critical infrastructure. The center issues alerts and warnings for solar storms, geomagnetic storms, and radiation belt storms, which can affect power grids, communications, and transportation systems.