Space Weather

Space Climate Initiative:
Analyzing the Sun's long-term behavior and its impacts on Earth

Spring 2013

I. Description

Communication devices, satellites, and other key aspects of 21st-century technology are vulnerable to damage and disruption from solar storms produced by bursts of energy emerging from the Sun. Just as these storms represent "space weather," their long-term trends can be considered "space climate." NCAR’s High Altitude Observatory, which has developed methods to simulate and potentially predict long-term variation of the Sun’s magnetic field and potential impacts on Earth, is proposing a Space Climate Initiative to explore how extremes of solar variability can affect us. For example:

What happens to the atmospheres of the Sun and Earth when energy from the Sun’s interior emerges only on scales too small to form sunspots? One such period of quiet sunspot activity lasted from about 1640 to 1710.

What sort of conditions below the Sun's surface are likely to foster solar superstorms with major impacts on society? The "Carrington flare," a powerful solar storm in 1859, knocked out telegraph systems worldwide.

II. Stage of Research

This effort will connect recently expanded models of processes evolving over multiple decades within the Sun to models of the impacts of solar radiation and solar storms on Earth. It will require further development of models that link magnetism in the lower solar atmosphere to the Sun’s output of radiation and charged particles. The work will be guided by comparison with comprehensive solar observations.
III. Advantages

• First project to analyze the long-term response of Earth’s space climate to extremes in solar variability
• Unprecedented blending of state-of-the-art models to simulate solar processes, Earth’s upper atmosphere, and Earth’s climate.
• Brings strong collaboration involving multiple disciplines and institutions to bear on specific science questions (the Sun without sunspots, conditions that foster superstorms)

IV. Applications

• Improved quantification of potential effects of extreme solar conditions on Earth’s climate throughout all layers of our planet’s atmosphere
• Creation of techniques that can be used to examine a broad range of potential space climate conditions
• Enhancement of our nation’s resilience and infrastructure to deal with extreme space climate conditions.
• Advancement of fundamental science on the Earth-Sun system

V. Funding and IP Status

Primary: National Science Foundation (core funding)
Now seeking additional funding in support of research partners and project scientists

VI. Research Partners

Colorado State University  University of Hawaii
New Jersey Institute of Technology  University of Wisconsin
University of California, Los Angeles  and others
University of Colorado Boulder

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