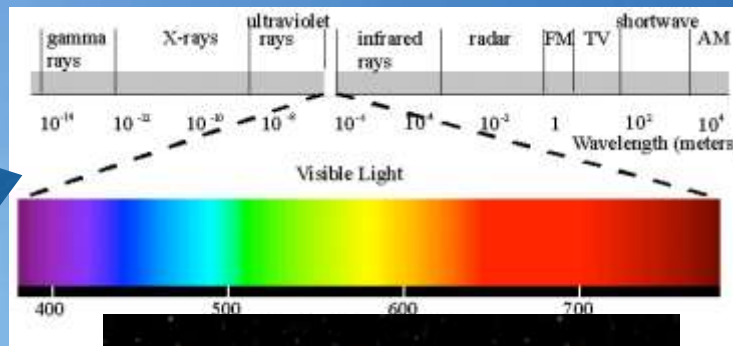
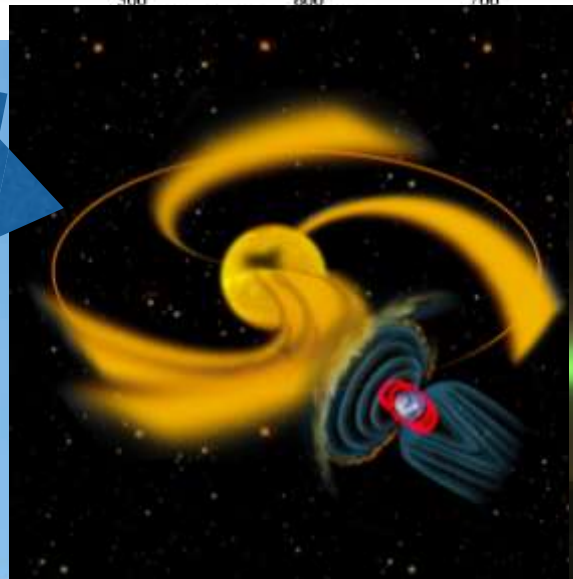


Light
(X-ray to radio)

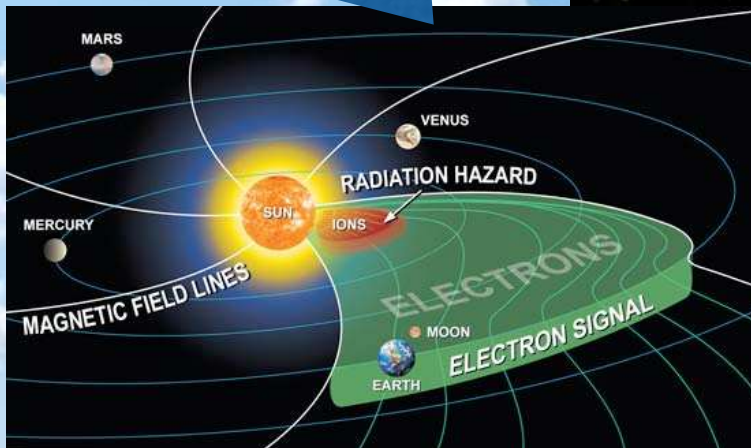


Radio blackouts;
satellite drag; problems for
dayside satellite
navigation
[R scale]

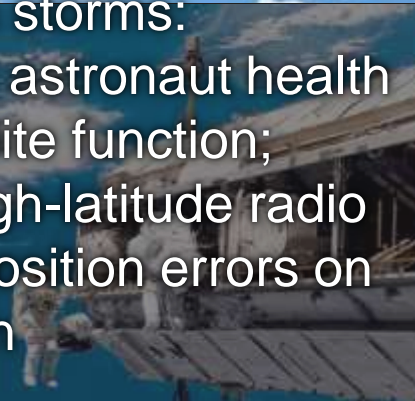
Magnetized wind
Particle radiation



Geomagnetic storms:
couple into power grids,
cause ionospheric
disturbances affecting
satellite navigation;
aurorae
[G scale]



Radiation storms:
hazard to astronaut health
and satellite function;
affects high-latitude radio
comm.; position errors on
navigation
[S scale]



Executive Order -- Coordinating Efforts to Prepare the Nation for Space Weather Events

EXECUTIVE ORDER

COORDINATING EFFORTS TO PREPARE THE NATION FOR SPACE WEATHER EVENTS

By the authority vested in me as President by the Constitution and the laws of the United States of America, and to prepare the Nation for space weather events, it is hereby ordered as follows:

(d) Within 60 days of the date of this order, the Secretaries of Defense and Commerce, the Administrator of NASA, and the Director of NSF, in collaboration with other agencies as appropriate, shall identify mechanisms for advancing space weather observations, models, and predictions, and for sustaining and transitioning appropriate capabilities from research to operations and operations to research, collaborating with industry and academia to the extent possible.

Sec. 2. Objectives. This order defines agency roles and responsibilities and directs agencies to take specific actions to prepare the Nation for the hazardous effects of space weather.

(c) The Secretary of Commerce shall:

(i) provide timely and accurate operational space weather forecasts, watches, warnings, alerts, and real-time space weather monitoring for the government, civilian, and commercial sectors, exclusive of the responsibilities of the Secretary of Defense; and

(ii) ensure the continuous improvement of operational space weather services, utilizing partnerships, as appropriate, with the research community, including academia and the private sector, and relevant agencies to develop, validate, test, and transition space weather observation platforms and models from research to operations and from operations to research.

(f) The Administrator of the National Aeronautics and Space Administration (NASA) shall:

(i) implement and support a national research program to understand the Sun and its interactions with Earth and the solar system to advance space weather modeling and prediction capabilities applicable to space weather forecasting;

(ii) develop and operate space-weather-related research missions, instrument capabilities, and models; and

(iii) support the transition of space weather models and technology from research to operations and from operations to research.

(g) The Director of the National Science Foundation (NSF) shall support fundamental research linked to societal needs for space weather information through investments and partnerships, as appropriate.

Understanding space weather to shield society: A global road map for 2015–2025 commissioned by COSPAR and ILWS

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“Review current space weather capabilities and identify research and development priorities in the near, mid and long term which will provide demonstrable improvements to current information provision to space weather service users”

Space Weather

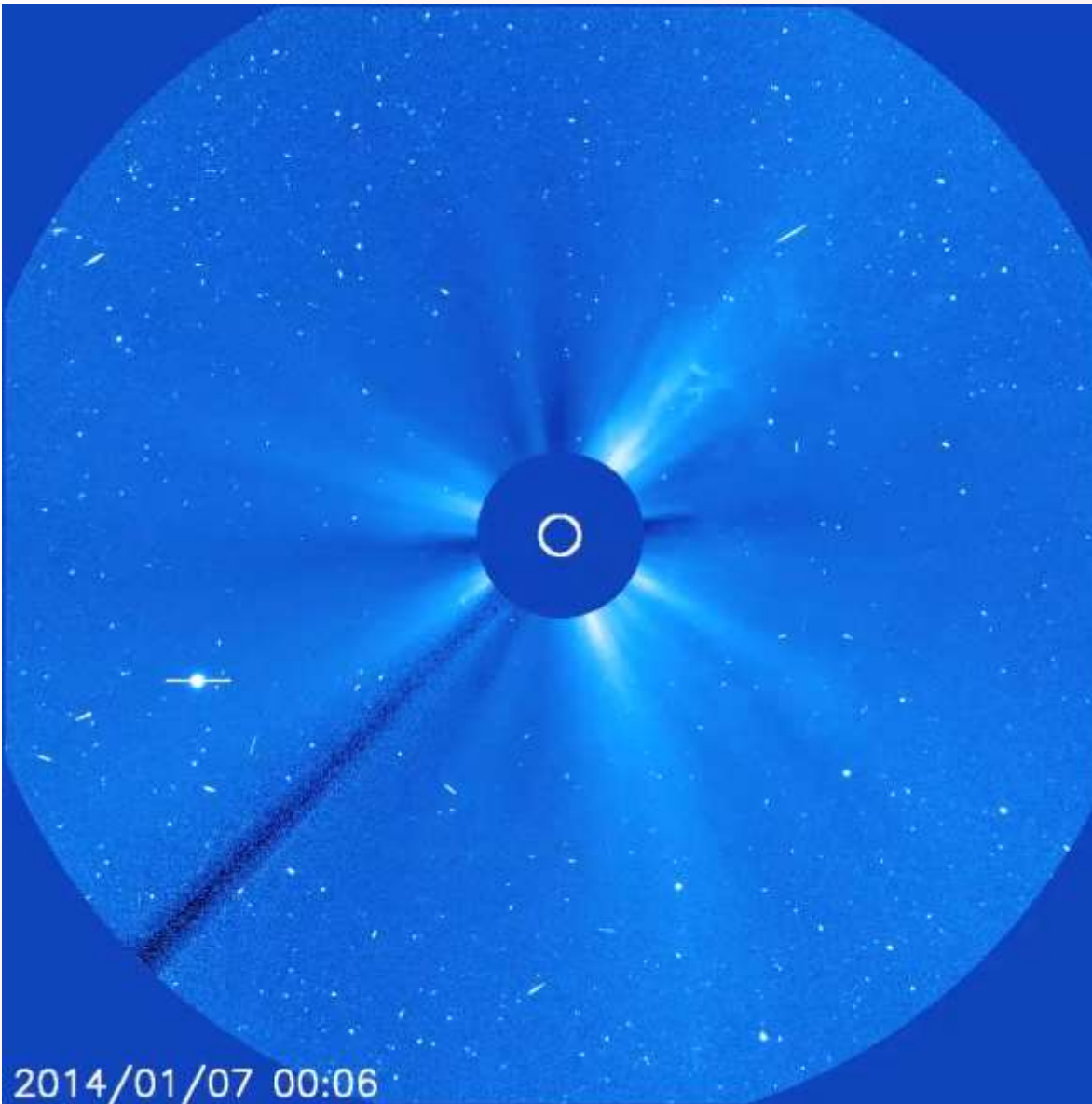
There is ALWAYS Space Weather and Climate

Hazardous Space-Weather-Event Causes:

- **Flares generate radiation**
- **Flares & CMEs accelerate particles**
- **CME's Impact Earth's magnetosphere**

Space Weather Effects

- **Communications & Navigation**
- **Satellite Damage & Astronaut Radiation**
- **Ground Induced Currents Affect Power**
- **Drag, CR, etc.**



Space Weather Study Motivation

- Effects of extreme space weather events can impact critical societal infrastructure
- A diverse user community exists with various SW requirements
- Space Weather is of national importance
- Space Weather is of scientific interest
- Current science, measurements, modeling, forecasts are inadequate – on all time scales
- Impediments to progress can be identified

Space Weather Stakeholders

- NASA
- NOAA
- NSF
- DoD
- DoE
- Other Government Agencies
- Commercial - power, communications, aerospace, insurance, prospecting, travel,
- Researcher community
- Space Weather product providers

Space Weather Programs/Plans

- SWAP (Space Weather Action Plan)
SWORM (SW Operations, Research, Mitigation)
OSTP/NSTC Subcommittee
- National Space Weather Program
- Living With a Star
- **SSP Decadal Survey**
- COSPAR Roadmap
- NSF Space Weather Program

Space Weather was a major topic for CSSP. Sessions Focused on Six Impediments to Progress in Space Weather. There was lively discussion.

- **Vision:** What are the horizon goals that drive our strategic and tactical programs?
- **Science:** What gaps exist in measurements, modeling, and forecasting tools?
- **Policy:** Is there a program to support Research to Operations and Operations to Research?
- **Implementation:** How are community models best developed, maintained and improved?
- **Awareness:** What really are the important requirements and who is responsible for them?
- **Culture:** How can we overcome the persistent apparent conflict between pure and applied science?

Space Weather Impediment

Vision: Are There Horizon Goals for Space Weather That Drive our Tactical Objectives?

- **Significant work has been done to articulate strategies for space weather. The space-weather community needs to formulate a set of clear and persuasive 'horizon' goals that translate into priorities for near-term strategic and tactical objectives. At another level, R2O and O2R practitioners should agree on quantifiable measures of skill that can inform progress. An integrated vision must be developed.**

Space Weather Impediment

Science and Technology Gaps: Known Gaps Exist in Measurements, Modeling, and Forecasting

- Real gaps, many known and some unknown, exist in our measurement capabilities, our modeling expertise, and our forecasting abilities on long and short time scales. Some are well characterized by SWAP, others by SWPC, and still others by the decadal survey. Others are not. What is the low-hanging fruit? What items are most important?

Space Weather Impediment

Policy: Support for Research to Operations (R2O) and Operations to Research (O2R)

- **There is not currently an effective national U.S. R2O/O2R Space-Weather community, though various groups are supporting certain successful efforts. Leadership in this area is fragmented, and consistent funding from national agencies for this specific purpose is not available. This suggests there is a gap in policy that must be addressed.**

Space Weather Impediment

Implementation: Development and Maintenance of Community Space Weather Models

- **Models for various elements of the space-weather system exist and are to varying degrees available. However, unlike terrestrial weather, no national space-weather reference models exist that can be used effectively by the community for further development. National, commercial, and academic needs must be balanced. Is there a gap that needs to be filled by community space weather models? How are models best developed, maintained and improved?**

Space Weather Impediment

Awareness: Disparate Requirements and Diffuse Responsibility Lead to Uncertainty

- **The science community is unsure how it can best contribute to progress in space weather operations. Disparate user requirements for power distribution, communication & navigation, and the radiation environment are not identical to the goals of basic space science research related to radiation, particles, the solar wind, and ITM. NASA has unique space weather requirements beyond Earth. Despite LWS, SWPC, and the COSPAR Roadmap, a gap exists in our awareness of what needs to be done by whom, and who will support and make use of achievements.**

Space Weather Impediment

Culture: SW Forecasting Must Be Incorporated into Solar & Space Physics Culture

- **The artificial distinction between pure and applied science persists despite nearly two decades of assault. The community and the funding agencies must learn how to integrate science and operations. This gap is not unlike the awareness gap, but focuses on the discipline's internal science culture.**

Setting an Agenda for Space Weather Research and Forecasting

Draft Statement of Task (1/4)

Space weather, driven by changes in the Sun and solar wind and by interactions with the Earth's magnetic field and upper atmosphere, substantially impacts critical technological systems. Understanding, prediction, and mitigation of space weather are national priorities.

An ad hoc committee will conduct a study to assess user-driven requirements for effective prediction of space weather, the impediments that the research and operations communities face in scientifically addressing these requirements, and opportunities for scientific and technological progress. An overarching purpose of this exercise is to establish useful horizon goals to help prioritize strategic and tactical activities.

Setting an Agenda for Space Weather Research and Forecasting

Draft Statement of Task (2/4)

The committee will:

- **Review current scientific understanding of the physical processes underlying space weather, along with existing observational, modeling, and forecasting capabilities.**
- **Understand the user-driven requirements for space-weather products, taking into account national priorities and the distinct needs of the diverse set of users.**
- **Define a set of concise and compelling horizon goals based on user requirements, such as specifying forecasts of a given accuracy on a certain time scale.**

Setting an Agenda for Space Weather Research and Forecasting

Draft Statement of Task (3/4)

The committee will:

- **Identify current gaps in scientific understanding and missing capabilities (observational, modeling, technological...) measured against space-weather requirements and horizon goals.**
- **Identify current impediments to Research to Operations (R2O) and Operations to Research (O2R) associated with a lack of explicit programs bridging operations and research, with diffuse and competing multi-agency responsibilities, with conflicts between applied and basic science culture, and with the adoption of standard metrics.**

Setting an Agenda for Space Weather Research and Forecasting

Draft Statement of Task (4/4)

The committee will:

- **Identify opportunities for scientific and technical progress toward achieving the horizon goals and make prioritized recommendations for addressing them.**

The committee will draw upon existing strategic documents such as the Solar and Space Physics Decadal Survey, the COSPAR space weather roadmap, and the National Space Weather Action Plan. The committee will consider international efforts and partnerships. The committee will not make any budgetary or government organization recommendations.

DISCUSSION

- Scope
- Sponsors

CSSP Highlights - SWX

Two pieces of space-weather news:

- President Obama issued an executive order assigning responsibility for Space Weather to a permanent subcommittee of the National Science and Technology Council.
- NOAA has taken responsibility for solar and solar wind observations at L1 with a 2022 follow-on mission, allowing other agencies to focus on L5.