Space Weather Advisory Group Meeting 5

March 20, 2023

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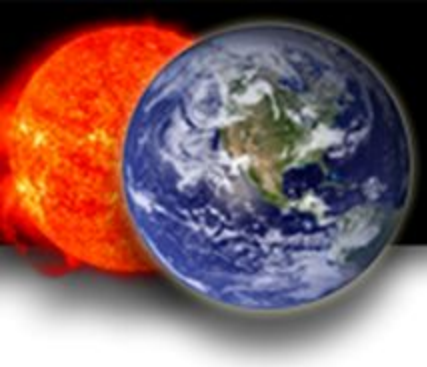


Welcome!

- In accordance with section 60601 of the PROSWIFT Act - NOAA established the SWAG to advise the White House SWORM Interagency Subcommittee

- All 15 non-governmental representatives of the SWAG, were appointed by the SWORM Subcommittee with 3-year terms beginning on October 1, 2021

- Each SWAG member here today serves as a representative member to provide stakeholder advice reflecting the views of the entity or interest group they are representing. The PROSWIFT Act directs SWAG members to receive advice from the academic community, the commercial space weather sector, and space weather end users that will inform the interests and work of the SWORM

Roll Call

SWAG Nongovernmental End-User Representatives

Tamara Dickinson, SWAG Chair
Science Matters Consulting

Mark Olson
North American Electric Reliability Corporation

Michael Stills
United Airlines (retired)

Craig Fugate
One Concern

Rebecca Bishop
Aerospace Corp.

SWAG Commercial Sector Representatives

Jennifer Gannon
Computational Physics, Inc.

Conrad Lautenbacher
GeoOptics, Inc.

Seth Jonas
Lockheed Martin

Kent Tobiska
Space Environment Technologies

Nicole Duncan
Ball Aerospace

SWAG Academic Community Representatives

Tamas Gombosi
University of Michigan, Ann Arbor

Delores Knipp
University of Colorado, Boulder

Scott McIntosh
National Center for Atmospheric Research

Heather Elliott
Southwest Research Institute

George Ho
Johns Hopkins University Applied Physics Laboratory

Welcoming Remarks from the Chair

Dr. Tamara Dickinson

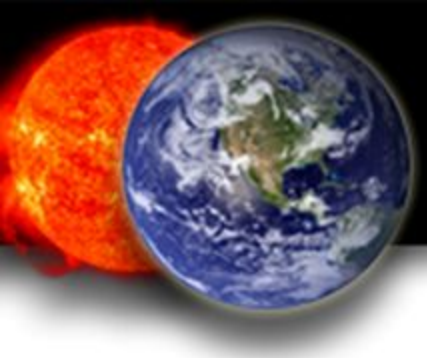
SWAG Chair

Nongovernmental End User Representative

President, Science Matters Consulting

Recap of Meeting 4

- First hybrid meeting
- Focused on getting input from the broader space weather community and the public.
- Thanks to all of our speakers. You helped make our report better.



Agenda

- Overview of Meeting
- Overarching Recommendations
- Ground-Based and Airborne Sensors and Networks
- In-Space Architectures and Space-Based Observations
- Data and Computing Infrastructure for Space Weather Operations
- BREAK
- Space Weather Risk to Evolving Infrastructure Systems and Services
- Improving Benchmarks, Metrics, and Scales for Space Weather End-Users

Agenda Day 1 (continued)

- Economic Assessments on The Costs of Space Weather and the Value Of Forecasting and Mitigation
- Promote Focused and Continued Engagement Across Industry and Government Space Weather Stakeholders
- Other Key Findings and Recommendations
- Priority recommendations
- Committee Discussion and Approval of Report
- Closing Remarks
- Adjourn

Background

- Input for the report - SWAG members, meeting (speakers and public),
- Implementation plan progress report, national space weather policy and statute
- Walk through the recommendations
  - Discussion of recommendations
  - Finding followed by one or more recommendations
- Space weather enterprise = government, commercial, and academic sectors
- Purpose of document - input to SWORM, Congress, Enterprise
- Look forward to briefing SWORM and other interested stakeholders
- Can do a deeper dive on any of the issues at request of SWORM

Overarching Recommendations

Funding the implementation of PROSWIFT

R.1.1. Fund the Federal Space Weather Enterprise.

Enabling NOAA to achieve their space weather priorities and accomplish their space weather mission

R.2.1. Create and fund an applied research program office for space weather within NOAA to coordinate, facilitate, promote, and transition applied research across the national space weather enterprise.

R.2.2. Develop NOAA strategies to ensure agency-wide coordinated implementation of PROSWIFT and their national space weather policy responsibilities.

R.2.3. Expand NOAA R2O2R functionality to enable the transition to full operations.

Overarching Recommendations

Ensuring coordination of space weather across the Federal Government

R.3.1. Ensure OSTP staffing and White House led prioritization coordination across the national space weather enterprise.

A national risk register

R.4.1. Consider space weather in the context of broader national risk.

Protecting space weather sensors from spectrum interference

R.5.1. Protect space weather sensors from spectrum interference.

Ground-Based and Airborne Sensors and Network - Jenn Gannon

R.6.1. Assess and publish the prioritization of ground-based sensors needed for current and future space weather products.

R.6.2. Provide long-term support for operational ground-based sensors and networks.

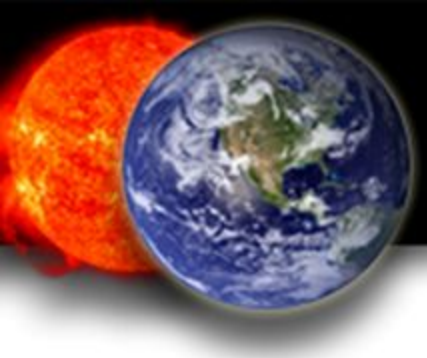
R.6.3. Fund the transition of NSF research sensors and networks to operations.

R.6.4. Coordinate support for ground-based sensors and networks that are essential to space-based missions.

Ground-Based and Airborne Sensors and Networks - Jenn Gannon

R.7.1. Expand the use of CRADAs to improve collaboration across the academic and commercial sectors.

R.8.1. Prioritize the addition of underutilized, existing real-time magnetometer data streams over new MT survey campaigns.



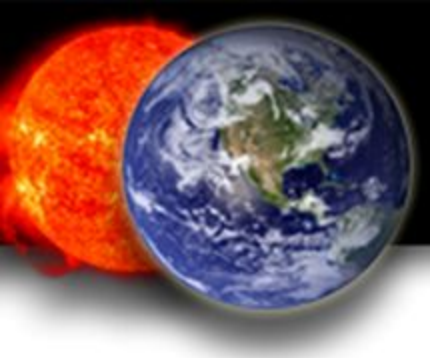
In-Space Architectures and Space-Based Observations - Nicole Duncan

R.10.1. Fund NASA foundational space weather research missions.

R.10.2. Use a coordinated approach to develop and deploy foundational space weather missions.

R.10.3. Establish O2R traceability in the NASA mission formulation process.

R.10.4. Develop a prioritization of space-based sensors to enhance space weather products.



Data and Computing Infrastructure for Space Weather Operations - Delores Knipp

R.13.1. Fund, formalize, and expand the NOAA space weather prediction testbed.

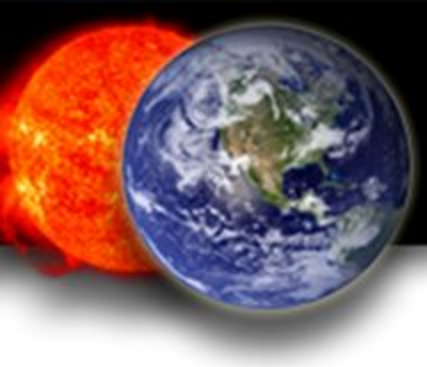
R.13.2. NOAA should ensure and maintain a relevant and coordinated online portal that compiles space weather data from across the enterprise.

R.13.3. Improve interagency coordination of models and data.

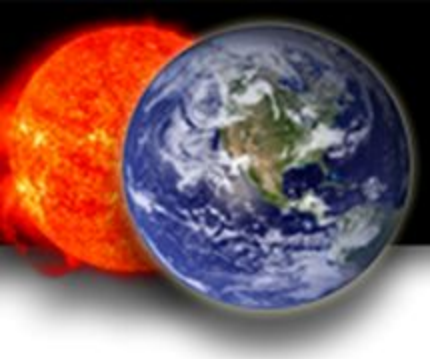
R.13.4. Promote and prepare for the use of AI/ML algorithms as a complement to traditional empirical and physics-based models.

R.13.5. Continue to identify and release novel and underutilized data sets that improve space weather products

R.13.6. Promote career pathways for interdisciplinary technologists supporting the space weather enterprise.



BREAK
12:45 – 1:00 PM ET



Improving Benchmarks, Metrics, and Scales for Space Weather End-Users - Seth Jonas

R.14.1. Coordinate benchmark development or improvement with industry.

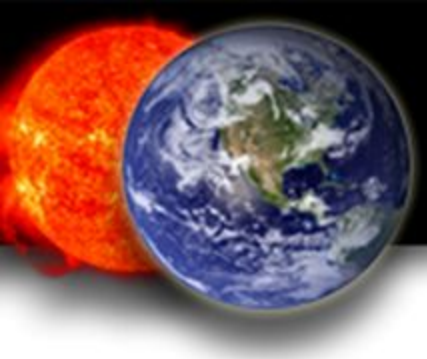
R.14.2. Promote industry participation in workshops and meetings to inform the mitigation of space weather hazards.

R.14.3. Use multiple approaches to validate benchmarks.

R.15.1. Identify and prioritize the development of key space weather metrics.

R.15.2. Update and expand NOAA space weather scales.

R.15.3. Maintain historical space weather indices.



Space Weather Risk to Evolving Infrastructure Systems and Services - Jenn Gannon

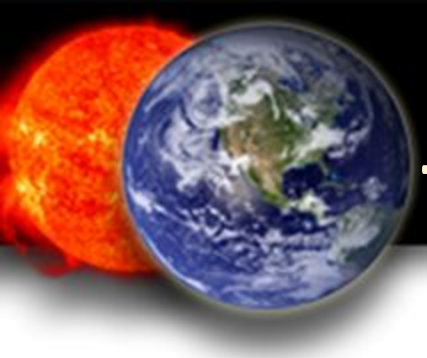
R.16.1. Develop an enduring process to understand evolving infrastructure needs.

R.16.2. Leverage industry assessments and applications of magnetotelluric data and geomagnetically-induced current data to improve Earth conductivity models and geomagnetically-induced current assessment tools.

R.17.1. Promote the development of vulnerability assessments by sector owners and operators.

R.17.2. Prioritize addressing space weather risks in sectors other than electric power and aviation.

R.17.3. Address interdependencies of and cascading risks to critical infrastructure.



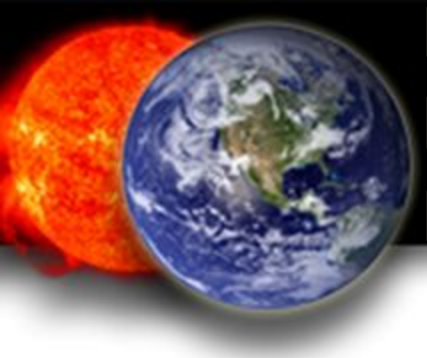
Economic Assessments on the Cost of Space Weather and the Value of Forecasting and Mitigation - Delores Knipp

R.18.1. Quantify the societal benefits for addressing risk from space weather by performing national-level and industry-wide economic assessments.

R.18.2. Develop and curate data necessary for effective economic assessments.

R.18.3. Broaden the scope of economic assessments.

R.18.4. Engage additional stakeholders for economic assessments.



Promote Focused and Continued Engagement Across Industry and Government Space Weather Stakeholders - Rebecca Bishop

R.19.1. Enhance distribution of space weather products.

R.19.2. SWORM should increase transparency by ensuring the publication of foundational documents, studies, and policies.

R.20.1. Develop standing MOUs or MOAs across and between all SWORM agencies.

R.21.1. Develop and implement broader participation in tabletop exercises.

Other Key Recommendations - Seth Jonas

Assessing and addressing national security risks from space weather

R.22.1. Develop a national security annex or policy on space weather.

Promoting public awareness and education for space weather

R.23.1. Improve public awareness, education, and engagement regarding space weather application effects.

Other Key Recommendations - Seth Jonas

Enhancing global engagement

R.24.1. Foster and lead a global space weather enterprise.

R.24.2. Promote Five-Eyes space weather collaborations.

R.24.3. Formalize bi-lateral or multilateral agreements to support coordinated messaging, mutual resilience, and to further the global space weather enterprise.

R.24.4. Increase and improve coordination between domestic and international government and non-government stakeholders.

R.24.5. Participate in and leverage the international standards development relevant to space environment and space weather.

Other Key Recommendations - Seth Jonas

Critical need for thermospheric density specification to aid operational systems

R.25.1. Support coordinated applied research for the thermosphere (between 100-600 km altitude) which is critical for space traffic coordination.

R.25.2. Support coordinated R2O2R workshops and testbed activities for space traffic coordination.

R.25.3. Support and encourage new processes for the incorporation of data and observations to characterize the thermosphere (between 100-600 km altitude) environment.

Priority Recommendations

1. Fund the Federal Space Weather Enterprise. (R.1.1.)

2. Create and fund an applied research program office for space weather within NOAA to coordinate, facilitate, promote, and transition applied research across the national space weather enterprise. (R.2.1.)

3. Ensure OSTP staffing, prioritization, and White House led coordination of the national space weather enterprise. (R.3.1. and more)

4. Protect space weather sensors from spectrum interference. (R.5.1.)

5. Provide long-term support for operational ground-based sensors and networks. (R.6.2.)

Priority Recommendations

6. Support and fund additional space weather data and services beyond near-Earth. (R.9.3.)

7. Fund NASA missions that impact foundational space weather research. (R.10.1.)

8. Coordinate benchmark development or improvement with industry. (R.17.1.)

9. Quantify the societal benefits for addressing risk from space weather by performing national-level and industry-wide economic assessments and put space weather in the context of broader national risk. (R.21.1.) and (R.4.1.)

10. Foster and lead a global space weather enterprise. (R.29.1-5.)

11. Support coordinated applied research within the thermosphere (between 100-600 km altitude) which is critical for space traffic coordination. (R.30.1-3.)

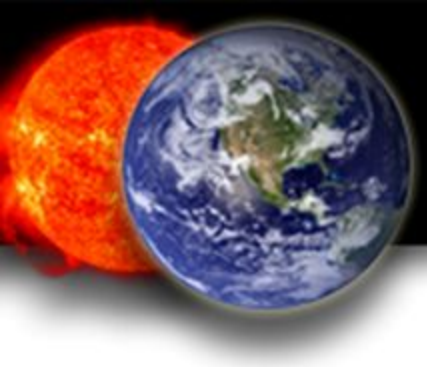
Public Comments
2:15 – 2:20 PM ET

Committee Discussion

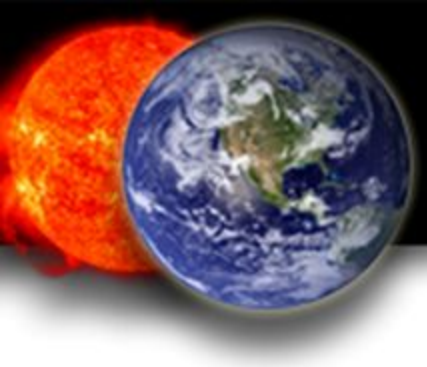
- Discussion of the recommendations
- Showstoppers?
- Finishing the report
  - Work session next week
- Approval of the report

Next Meeting

- Space Weather Workshop plans
  - Monday April 17 meeting
    - Training on how to run a focus group
    - Run some focus groups
  - Roll out report - Tuesday morning
  - SWAG/Roundtable/Council/Decadal panel



Closing Remarks



Adjourn