2018 SPACE WEATHER ENTERPRISE FORUM

SUMMARY REPORT

Sponsored by the National Space Weather Partnership

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Image courtesy of NASA.

Note: Speaker and audience remarks are paraphrased and not to be used as quotations.

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SUMMARY REPORT

OFFICE OF THE FEDERAL COORDINATOR FOR
METEOROLOGICAL SERVICES AND
SUPPORTING RESEARCH
(OFCM)

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Washington, D.C.

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2018 SPACE WEATHER ENTERPRISE FORUM

SUMMARY REPORT

This document provides a synopsis of the 2018 Space Weather Enterprise Forum (SWEF)—an event sponsored by the National Space Weather Partnership (NSWP) and hosted by the Honorable Ed Perlmutter, U.S. House of Representatives. This year's theme was "Advancing National Space Weather Research and Forecast Capabilities."

Meeting Location: Montpelier Room, Madison Building, Library of Congress, 101 Independence Avenue SE, Washington DC.

Motivation

Just like weather of the Earth's atmosphere, space weather is always present and constantly changing. Both have effects that can range from mild impacts to broad devastation. The threat posed by an extreme space weather event continues to be an issue of National concern. A number of actions by the Administration and Congress are evidence that the U.S. government is taking the threat very seriously and making measured progress to address the issues. The Space Weather Enterprise Forum organized by the National Space Weather Partnership is more vital than ever in its recognition that the challenge posed by space weather requires a coordinated response from government, industry, academic and international organizations. Although progress is being made, much more needs to be done.

The Forum

The Space Weather Enterprise Forum brought together the space weather community to share information and ideas among policymakers, senior government leaders, researchers, service-provider agencies, private-sector service providers, space weather information users, media, and legislators and staff from Capitol Hill to raise awareness of space weather and its effects on society. The outreach continued this year, but the focus was sharpened on critical infrastructure protection, with the necessary underpinnings of research, improved products and services, and applications to serve a broad and growing user community. The ultimate goal is to improve the Nation's ability to prepare for, avoid, mitigate, respond to, and recover from the potentially devastating impacts of space weather events on our health, economy, and national security.

Forum Objectives

- Share information across the enterprise and raise awareness for new users, decision makers, and policymakers.
- Identify effective approaches to build resilience across society, particularly in critical infrastructure protection and support.
- Identify effective approaches to raise awareness in the broader society.
- Improve communications within and external to the enterprise.
- Collect information to support the development of new National Space Weather Plans.

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Format

The 2018 SWEF was the first time we conducted this event as a half-day forum on Capitol Hill specifically planned to inform and support Congressional interest in space weather. We will return to the full-day format in 2019 to have more time to discuss matters in greater detail. The NSWP plans to alternate these formats in future years.

The 2018 SWEF was planned to coincide with the annual Space Weather as a Global Challenge (SWGC) meeting conducted by the U.S. Department of State and hosted by the Embassy of Japan in Washington, DC. This arrangement provided synergistic benefits for both the SWGC and SWEF events.

A panel format was used, which included presentations by the expert panelists followed by time for questions from a diverse group of attendees. The agenda was developed by the interagency SWEF Organizing Committee. Forum presentations can be found on OFCM's SWEF webpage.

Forum Sponsors

The National Space Weather Partnership organized the 2018 SWEF through the Office of the Federal Coordinator for Meteorological Services and Supporting Research (OFCM). U.S. Representatives Ed Perlmutter and Mo Brooks provided Congressional support, the National Aeronautics and Space Administration provided financial support, and the Secure World Foundation provided hospitality funding as well an audio recording of the event which are available online at: https://swfound.org/events/2018/space-weather-enterprise-forum.

Additionally, the 2018 SWEF marks the beginning of a close partnership with the Johns Hopkins University Applied Physics Laboratory who provide planning and logistics assistance.

Session 1: Opening and Welcoming

Mr. Michael Bonadonna from the Office of the Federal Coordinator for Meteorological Services and Supporting Research (OFCM) serving as the Executive Secretary for the NSWP and the Space Weather Research and Mitigation (SWORM) Subcommittee of the National Science and Technology Council (NSTC) opened the Forum. After thanking the organizers, supporters and participants of the 2018 SWEF, he gave a brief description of space weather and its importance to the nation. He then introduced the Keynote speaker United States Representative Ed Perlmutter.

Congressman Perlmutter represents the Colorado 7th Congressional District which includes the western and northern suburbs of Denver. He was first elected to represent Congress in 2006 and is currently serving in his sixth term. In the 115th Congress, he serves on the House Science, Space and Technology Committee and the Space and Oversight Subcommittees. Representative Perlmutter has a particular passion for supporting Colorado and the nation's aerospace industry, including getting our astronauts to Mars by 2033 and improving collaboration on space weather. He introduced H.R. 3086, the House-companion to the Space Weather Research and Forecasting Act which passed the Senate last year, and is working with Rep. Mo Brooks and others on the Science Committee to pass this legislation in the House.

The Congressman highlighted the evolution of H.R. 3086, which had passed the House subcommittee the day before the SWEF (July 24, 2018). He expected their dialog with the Senate sponsors of the "Space Weather Research and Forecasting Act" would help them pass a full-congressional bill by the end of the year. The new bill emphasizes coordination and cooperation between

the government, academic, and commercial space weather stakeholders. It also provides guidance for improving the Research to Operations / Operations to Research cycle.

Session 2: Understanding and Managing Risks and Impacts Associated with Space Weather

Moderator: Mr. Benjamin Reed, Executive Office of the President, National Space Council

Mr. Reed opened the second session giving an overview of the relevancy of space weather and the potentially devastating impact it poses.

He provided a brief summary of the background of the National Space Council, which was first established as the National Aeronautics and Space Council in 1958. It became the National Space Council in 1989 and disbanded in 1993. The current Administration revived the Council under the direction of Vice President Michael Pence. They have produced three important Space Policy Directives (SPDs) since that time. In short, SPD-1 reoriented space exploration to the Moon and then to Mars; SPD-2 will help reform the commercial space regulatory framework and; SPD-3 focused on space traffic management. Mr. Reed pointed out that all three SPDs will rely on accurate space weather observations and forecast to achieve success. Hence, the National Space Council considers space weather information to be a key enabler for our national space agenda.

Mr. Reed also mentioned that the new National Space Weather Strategy (NSWS), currently being developed by the SWORM Subcommittee will focus on the Administration's priorities, critical infrastructure resilience to space weather, national security, safety of human and robotic space flight, and cooperation with industry.

Panelists:

Ms. Devon Streit, Deputy Assistant Secretary for Infrastructure Security and Energy Restoration

Ms. Streit described space weather impacts to the electricity sector and power distribution. She discussed how geomagnetic disturbances (GMD) can cause geomagnetically induced currents that can couple into the power distribution grid. Citing statistics, she made the point that the most severe GMDs (G5-level) were very rare and the impacts to the power grid were even more rare. However, impacts from the two largest geomagnetic storms have been very serious and are a concern for the industry. Conservative operational monitoring and reaction can mitigate the issue from the vast majority of geomagnetic storms. The industry is taking steps to address the worst case scenarios.

Mr. Ralph Stoffler, U.S. Air Force Director of Weather

Mr. Stoffler stated boldly the world has changed significantly since the days of the Cold War. New technologies and new capabilities have become a key aspect of national security and these same advances have yielded new vulnerabilities. Old peer-to-peer revivals are on the rise and pose a significant threat. Cybersecurity has become vital to all aspects of the infrastructure and operations. These new challenges demand a modernization of space weather observing and forecasting capabilities. He noted that it was particularly important to decrease anomaly assessment response time and improve their utility to support operational decisions. We must maintain and protect our technical advantage. Mr. Stoffler discussed the importance of understanding the impacts of the full range of space weather effects on national security systems. We have entered a new age where space is no longer just an area of scientific interest. Space is a vital national

interest and critical component of our daily lives. The ability to accurately observe and forecast space weather must be enhanced and improved.

Dr. James Spann, Acting Heliophysics Chief Scientist, Headquarters National Aeronautics and Space Administration

Dr. Spann described how NASA is preparing to support more extensive human presence in space. The current heliophysics system observatory composed of several science and research spacecraft, is being extended and augmented to provide new and exciting capabilities. NASA is supporting the development of the new National Space Strategy that will contain a specific priority on human spaceflight. The SWx Science Applications Project (SnAP) will serve to effectively transition heliophysics science investigation output to products that enhance the user communities' ability to address impacts caused by the dynamic space environment. The NASA Heliophysics Division continues to support and develop international partnerships to improve global space weather understanding and service capabilities.

Dr. William Lapenta, Director, National Centers for Environmental Prediction (NCEP), National Oceanic and Atmospheric Administration.

NCEP manages the Space Weather Prediction Center (SWPC) in Boulder, CO, which is responsible for providing space weather services to the nation. The customer base for SWPC has steadily grown over the decade with subscriptions for direct internet-based services soaring past 54,000 customers. Adapting to consumers evolving needs, the space weather community must anticipate and manage the needs of a rapidly evolving technological society. New technologies such as autonomous vehicles, advanced rail technologies - positive train control (GPS-based safety system), supersonic and hypersonic transport aircraft / spacecraft, space tourism, drone technology, and deep space exploration will drive demand for new services in the near future.

NOAA is responding in a variety of ways from improving space-based space weather observing systems, space weather models, and new products leveraging these capabilities. Additionally, they are building strong partnerships with the academic, commercial, and international space weather communities. These efforts will enhance national preparedness and speed the creation of a space-weather-ready Nation.

The Question and Answer period yielded interesting discussion on the following topics:

- The audience stated concerns that we have been meeting and discussing the challenges of space weather for many years but much of the dialog has not changed over time. Although we have developed numerous plans and studies, they perceived that little action has followed. The panelists agreed that not enough has been achieved, however, steady progress is being made. The government, academic and industry space weather enterprise elements are more united than ever and we are working from sound, documented requirements. There is a growing recognition by those controlling the funding of the need to support space weather programs.
- Another significant discussion occurred following a question on space weather observations. The panel stated that the L-1 solar wind monitor and coronagraph are the highest priority but multipoint observations of all types are required to characterize the space environment in order to provide accurate forecasts and services. The National Academy of Sciences Decadal Survey for Solar and Space Physics is a very important input for determining space weather observational requirements and priorities.

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Session 3: Implementation of Activities Across the Space Weather Enterprise for the Protection of Critical Infrastructure

Moderator: Mr. Mike Ryschkewitsch, Head, Space Exploration Sector at Johns Hopkins University Applied Physics Laboratory discussed the importance of fundamental science to the eventual development of useful capabilities. He highlighted the upcoming launch of the Parker Solar Probe mission to study the mechanism of coronal heating and solar wind acceleration.

Mr. Steven Clarke, Deputy Associate Administrator for Exploration, Headquarters National Aeronautics and Space Administration

Mr. Clarke provided insights into activities during his tenure at OSTP leading the SWORM Subcommittee. Over the past year, a number of policy actions were completed that will significantly shape our space weather posture including:

- 2017 National Security Strategy - Emphasized infrastructure resilience
- Space Policy Directive -1 (SPD-1) - Focus on Human and robotic exploration
- The 2019 President's Budget Request (PBR) - Called for space weather funding to support research
- The 2019 Consolidated Appropriations Act - Support a broad range of space weather needs
- Passage of the "Space Weather Research and Forecasting Act" by the Senate and (S-141) and progress an equivalent bill in the House "Space Weather Coordination" (H.R. 3086)

Mr. Clarke stated that the Executive Office of the President considered the National Space Weather Strategy, National Space Weather Action Plan, and the SWORM Subcommittee to be a model of interagency and interdepartmental cooperation. The continuation of the SWORM Subcommittee is a testament to the Administration support for space weather cooperation and progress.

The new National Space Weather Strategy and Action Plan will address new Administration priorities, and broaden the scope from the 2015 NSWS with a greater emphasis on commercial and academic sector involvement.

Additionally, the SWORM Subcommittee completed and the White House published the Phase 1 Benchmarks for extreme space weather. OSTP and SWORM.GOV. Work on the Next Step Benchmarks (NSB) will begin this coming this fall.

Dr. Conrad Lautenbacher, CEO, GeoOptics Incorporated and American Commercial Space Weather Association.

Serving as the voice of the American Commercial Space Weather Association (ACSWA) at the SWEF this year, Dr. Lautenbacher provided valuable insights from the commercial sector. There have been many important and positive developments in the space weather business both nationally and internationally. The international Space Weather as a Global Challenge event hosted on July 24th at the Embassy of Japan featured significant commercial sector involvement. The formation of the NWSP and conduct of the SWEF has resulted in a cohesive and comprehensive approach for working together for a safer national future. Congress, as well, has recognized the importance of space weather to the health and safety of our nation and the world. The current legislation is a watershed recognition of space weather importance.

The commercial space weather industry continues to make significant contributions along the value chain from research to advanced tailored space weather services. Each element of the space weather community provides unique and complementary capabilities. The key to successful and

effective collaboration is for the three major sectors of the Space Weather Enterprise: government, academia, and commercial to work together closely to define and operationalize "swim lanes" i.e. roles and responsibilities of each.

Dr. Daniel Baker, Director Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder.

Dr. Baker identified three problems in the space weather field where the academic sector could make significant contributions:

- Space weather (SWx) forecasting is not accurate, reliable, or timely enough to allow mitigating actions by users of the information
- Transition of new research models, mission data, and tools to operational forecasting is inefficient
- "R2O problem"; and Researchers are unaware of the requirements (and shortcomings) of operational models and tools and cannot help. "O2R problem"

He stated the establishment of more robust space weather "testbeds" and better education at various levels could improve effectiveness in all these areas. Additionally, he described the benefit of re-architecting the R2O-to-O2R cycle and the introduction of dedicated R2O-to-O2R centers.

Dr. Christopher Cannizzaro, Office of Space and Advanced Technology in the Bureau of Oceans, Environment and Science, Department of State.

The U.S. State Department plays a facilitation, coordination, and clearance role in international space cooperation. In its coordination role, State leads on government-to-government framework agreements, and in its clearance role on agency-to-agency implementing agreements. The 2015 National Space Weather Strategy contained a specific goal to foster international cooperation on space weather. Of the many accomplishments supporting this goal, establishment of the Space Weather as a Global Challenge (SWGC) series has yielded significant results.

Other international space weather activity supported by the State department includes the substantive efforts within the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS), the International Space Weather Initiative (ISWI), and the International Civil Aviation Organization (ICAO).

Dr. Mizuhiko Hosokawa, Vice President of National Institute of Information and Communications Technology (NICT), Japan.

As a result of careful planning and coordination between the organizing committees of the SWEF and the SWGC, the two events were conducted on consecutive days. This resulted in broader international participation at SWEF and more opportunity for U.S. speakers to address an international audience.

The NICT is the lead government agency for telecommunication research in Japan. It is also the provider of operational space weather services in the country. The NICT space weather center is a member of the International Space Environmental Service (ISES) organization coordinating operational space weather support around the world.

Dr. Hozokawa completed his remarks recapping the SWGC event. It was the 3rd meeting of SWGC and held at Embassy of Japan on July 24, 2018 hosted by Embassy of Japan, NICT, the

Japan Aerospace Exploration Agency (JAXA) and U.S. Department of State. Seventy seven people attended from various countries to discuss the following agenda topics:

- Japan's space weather efforts and outlook
- Perspectives from around the globe
- Toward improved space weather services and preparedness
- Perspectives from the private sector
- Preparedness for severe space weather disaster with international collaboration and activation of private sector
- Dr. Mamur Iishii, Director NICT, joined the dais for panel discussion

The Question and Answer period yielded interesting discussion on the following topics:

The audience asked what the commercial sector represented by the American Commercial Space Weather Association (ACSWA) hoped to get from increased interaction with their government space weather partners. Dr. Lautenbacher responded that they wanted an ongoing dialog and insight into planning the way forward for the space weather enterprise. He also felt there was a strong case for commercially provided, tailored space weather services.

It was pointed out that the most space weather modeling work is proprietary owned. How can we move to community open modeling? Dr. Baker replied that this is, indeed, a thorny issue. Researchers need that protection to sustain their livelihood but we need to find a way to migrate to community modeling. The National Academies of Sciences, Engineering, and Medicine study "Fair Weather" has served the meteorological community very well and should be used as a guide for a similar space weather community vision.

The audience asked about the nature of the International Space Weather Initiative (ISWI) observing network. Dr. Cannizzaro answered that the network included hundreds of report sites with a wide variety of sensors, data quality, and timeliness.

One audience member noted that there was no mention of electromagnetic pulse in the latest space weather bill (H.R. 3086 /S. 41). Would EMP be considered separately? Although panelists could not address the new legislation, Mr. Clarke stated the EMP is an issue being considered by the National Security Council (NSC). They should be able to use space weather knowledge to support EMP preparedness, response decisions, and mitigation actions. He mentioned that there is very good coordination between NSC and NSTC on the issue.

The panel session wrapped up on a discussion about the manufacturing and procurement pipeline for large transformers that may still be vulnerable to geomagnetic disturbances. Are there requirements on utilities for preparedness and are there international cooperation efforts ongoing? Several panelists responded that these issues were addressed in the current NSWS and NSWAP. Work is in progress in all these areas and progress is being made.

Session 6: Summary and Wrap-up

Mr. Bonadonna (OFCM) summarized the proceedings with the following remarks:

- We are living in a new era where space is no longer merely a matter of scientific curiosity, it has become integrated into our daily life.
- Space has become a vital national interest that is a contested environment and must be protected.
- Space weather services are needed now more than ever and will be needed even more in the near future than they are today as new technologies arise.

Note: Speaker and audience remarks are paraphrased and not to be used as quotations.

- Space weather is and will increasingly be a key enabler for National Security.
- The threat posed by extreme space weather is real and must be taken seriously. Although the events are very rare the impacts can be devastating.
- All elements of the National Space Weather Enterprise (government, commercial, Academic) play key roles. Partnership is essential. It's important to abide by the "swim lanes" for everyone to be successful.
- Space weather is a global phenomenon and must be addressed at the international level as well as the national level. Excellent progress is being made.
- The U.S. has taken important steps to address the impacts of space weather. Although significant progress has been made, much more needs to be done. Key areas include:
- Improving the R2O to O2R cycle
- Enhancing homeland security through preparedness mitigation, and response
- Improving space weather services for national security
- Preparing the space weather community to provide new and better services to support an expanded human presence in space

This report, the presentation slides, and an audio recording of the SWEF proceedings are available on OFCM's SWEF webpage.

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2018 Space Weather Enterprise Forum Agenda

"Advancing National Space Weather Research and Forecast Capabilities"

July 25, 2018
Montpelier Room
Madison Building.
Library of Congress
101 Independence Avenue SE, Washington DC, 20540

Session 1: Welcome and Opening Addresses

Forum Welcome and Introduction

Mr. Michael Bonadonna, Executive Secretary Space Weather Operations Research and Mitigation (SWORM) Subcommittee and Office of the Federal Coordinator for Meteorology

Congressional Perspective

The Honorable Ed Perlmutter, United States Representative

Session 2: Understanding and managing risks and impacts associated with space weather

Moderator: Mr. Ben Reed, National Space Council

Panelists:

- Ms. Devon Streit, Deputy Assistant Secretary for Infrastructure Security and Energy Restoration.
- Mr. Ralph Stoffler, Director of Weather, Deputy Chief of Staff for Operations, Headquarters, U.S. Air Force.
- Dr. James Spann, (Acting) Heliophysics Division Chief Scientist, Headquarters National Aeronautics and Space Administration (NASA).
- Dr. William Lapenta, Director, National Centers for Environmental Prediction, National Oceanic and Atmospheric Administration.

Q & A Panel Discussion

Session 3: Implementation of activities across the space weather enterprise for the protection of critical infrastructure

Moderator: *Mr. Mike Ryschkewitsch, Head, Space Sector at Johns Hopkins University Applied Physics Laboratory*

Panelists:

- Mr. Steven Clarke, Senior Policy Analyst at Office of Science and Technology Policy, Executive Office of the President.
- Dr. Conrad Lautenbacher, Chief Executive Officer, GeoOptics Incorporated and American Commercial Space Weather Association.

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- Dr. Daniel Baker, Director Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder.
- Dr. Christopher Cannizzaro, Office of Space and Advanced Technology in the Bureau of Oceans, Environment and Science, Department of State.
- Dr. Mizuhiko Hosokawa, Vice President of National Institute of Information and Communications Technology, Japan.

Q & A Panel Discussion

Session 4: Forum Summary and Wrap-Up

Mr. Michael Bonadonna, Executive Secretary Space Weather Operations Research and Mitigation (SWORM) Subcommittee and Office of the Federal Coordinator for Meteorology

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