2.1

THE NATIONAL SPACE WEATHER PROGRAM

Mr. Samuel P. Williamson
Federal Coordinator for Meteorological Services and Supporting Research

Michael F. Bonadonna and Michael R. Babcock*
Office of the Federal Coordinator for Meteorological Services and Supporting Research, Silver Spring, MD

ABSTRACT

The 2008 National Research Council workshop report on severe space weather events heralded wider public understanding of the societal and economic impacts of space weather and the value of interagency coordination to improve services and knowledge. This interagency coordination is accomplished through the National Space Weather Program (NSWP), a U.S. federal government initiative sponsored by the Office of the Federal Coordinator for Meteorological Services and Supporting Research. The NSWP Council, through its Committee for Space Weather and Committee for Space Environmental Sensor Mitigation Options, seeks to speed improvement of space weather products and services through research, transition of research to operations, and improvements in operational capability to better prepare the United States for the effects of space weather on technological systems, activities, and human health. In 2009, the Council organized and hosted the third Space Weather Enterprise Forum, drawing more than 240 international attendees from government, industry, academia, and the public. The forum provided a venue to explore strategic partnering, facilitate scientific advances and transition of research to operations, and to continue education and outreach. It also gathered actionable information to move the enterprise forward, particularly by illuminating user needs, requirements, and priorities to inform a new strategic plan. Key points included improving communication with the public, closing seams at the interfaces between specialties and regions of atmosphere and space, ensuring operations feedback to researchers, and applying test bed approaches for moving research to operations. The forum also supported a coordinated approach to sustain solar wind monitoring and low Earth orbit space environmental sensing. To address this area, the Council led development of options and recommendations presented to the U.S. Office of Science and Technology Policy to maintain continuity of solar wind measurements from the L1 Lagrange point and to mitigate reduced capability now planned for the National Polar-orbiting Operational Environmental Satellite System. The study engaged more than 75 people from 19 government offices to develop a set of consensus recommendations. In 2010, the Council plans to complete a new NSWP strategic plan, host the next enterprise forum, continue to advance the goals of the NSWP, and raise awareness of space weather effects on society.

* Corresponding author: Michael F. Bonadonna, Office of the Federal Coordinator for Meteorological Services and Supporting Research, 8455 Colesville Rd. Ste 1500, Silver Spring, MD 20910. E-mail: michael.bonadonna@noaa.gov

1. INTRODUCTION

The effects of space weather reach ever further into an increasingly technology-dependent society, affecting safety, security, and the global economy with impacts reaching potentially into trillions of dollars. (NRC 2008) As Solar Cycle 24 begins, increasing numbers of solar events are harbingers of the coming deleterious effects on communications, navigation, spacecraft operations, and human health, and serve to motivate the space weather community to improve space weather products and services. The NSWP is a U.S. federal government interagency program established in 1995 to coordinate, collaborate, and leverage capabilities across the stakeholder agencies, including space weather researchers, service providers, users, policy makers, and funding agencies to improve the performance of the space weather enterprise for the United States and its international partners. This paper briefly reviews the history of the program and summarizes recent and planned activities, including education and outreach through various forums, developing a new strategic plan, and devising options and recommendations to address shortfalls in observing systems.

2. BACKGROUND

The Office of the Federal Coordinator for Meteorological Services and Supporting Research, more briefly known as the Office of the Federal Coordinator for Meteorology or OFCM, is an interdepartmental office established in 1964 because Congress and the Executive Office of the President recognized the importance of full coordination of federal meteorological activities. The U.S. Department of Commerce formed the OFCM in response to Public Law 87-843 and Bureau of the Budget (now Office of Management and Budget) Circular A-62, establishing the interagency coordinating infrastructure which continues in updated form today.

In the mid-1990s, the emerging space weather community mobilized to establish a coordinated federal effort, creating the interagency National Space Weather Program under the auspices of the OFCM. To guide the program, the OFCM established the National Space Weather Program Council within the federal meteorological coordinating infrastructure and,

in 1995, the Council approved and the OFCM published the NSWP Strategic Plan. (OFCM 1995) The plan documented goals to improve observing, analysis, and forecasting of space weather, necessarily with a foundation of improved fundamental understanding of the physical processes. The plan also sought to advance the transition of research into operations, improve forecast accuracy and reliability, and develop new products and services aimed at user needs. Another goal was education and outreach to communicate to a widening circle of users the definition of space weather, its effects, and means to mitigate those effects.

In 1997, the OFCM published the first National Space Weather Program Implementation Plan (OFCM 1997) and followed with the Second Edition in 2000. (OFCM 2000) The implementation plan provided a synopsis of current capabilities and defined more specific direction for the community to achieve program goals. It described from both the operational and research perspectives various spacecraft, sensors, observational capabilities, specification and forecast models, and basic metrics against which to measure progress. Finally, it defined program management through the Program Council and the Committee for Space Weather (CSW), defined federal agency roles and responsibilities, and described the roles and contributions of others such as the international space weather community. The Second Edition also formally incorporated into the program the detailed analysis and planning prepared by the National Security Space Architect during the same period.

Today, the Council continues to set policy and provide guidance for the NSWP, coordinate agency roles and activities, and oversee the preparation of plans, strategies, and operational concepts. Member agencies include the U.S. Departments of Commerce, Defense, Energy, Interior, State, and Transportation as well as NASA and the National Science Foundation. The White House Office of Science and Technology Policy and Office of Management and Budget are observers.

In 2009, two committees operated under the Council. The CSW provides: (1) a forum for each agency to report activities, challenges, and achievements; (2) a mechanism for coordinated change and problem solving; (3) a medium for collection, documentation and consolidation of agency requirements and inventories; (4) oversight for coordinated system development; (5) a vehicle for coordinating with other groups; and (6) a mechanism for the preparation of studies, agreements, standards, protocols, reports, and national plans. And in late 2008, the OFCM established the Committee for Space Environmental Sensor Mitigation Options (CSESMO) to conduct the specific studies described in Section 3.3.

Previously, in 2005 the Council formed an independent review committee to assess the progress of the NSWP. The committee, composed of six highly regarded science and operational experts, reported that, “The highly successful NSWP should continue as an interagency program” and provided 23 recommendations for improvement. (OFCM 2006) The recommendations fell into four key areas:

1. Centralize program management, set funding priorities, and increase effectiveness.
2. Maintain continuity of critical data sources.
3. Strengthen the science-to-user chain.
4. Emphasize public and user awareness.

Since publication of the assessment report in 2006, the CSW has been working steadily to address the recommendations through a variety of activities.

3. ACTIVITIES

3.1 NSWP Strategic and Implementation Plans

One recommendation from the independent assessment calls for the publication of a new strategic plan and the CSW continued refining a new plan in 2009. The plan’s vision and goals will set a course for the next decade to help the United States prepare for and respond to space weather effects on a space-enabled society. The new plan also addresses other recommendations from the 2006 assessment and other key documents from across the enterprise. The Committee plans to finalize the new strategic plan in the summer of 2010 after interagency review and public comment.

The new strategic plan will provide a vision and overall framework for the program, and a new implementation plan will define the specific actions to achieve the vision. The CSW will begin preparing the new implementation plan immediately following publication of the strategic plan.

3.2 Space Weather Enterprise Forum

In 2007, the National Oceanic and Atmospheric Administration’s Space Weather Prediction Center organized the first Space Weather Enterprise Forum as a Washington, DC-based extension of their long-running annual Space Weather Workshop in Boulder, Colorado. The annual forum helps bring policymaker attention to the growing space weather service needs of a technological world. Stakeholders from across the enterprise gather to discuss concerns, hazards, and new capabilities and highlight the need for research and services today and into the future. The forum also extends outreach efforts to an expanding user community.

In 2009, the NSWP Council organized and hosted the third forum, drawing more than 240 international attendees from government, industry, academia, and the public to hear 43 speakers in 9 sessions. Congresswoman Donna Edwards from the U.S. House of Representatives provided the keynote address and Dr. Neil DeGrasse Tyson, world-renowned astrophysicist, addressed the forum on the challenges of communicating complex scientific information to the public. The forum provided a venue to explore strategic partnering, facilitate scientific

advances and the transition of research to operations, and to continue education and outreach. The OFCM also gathered actionable information to move the enterprise forward, particularly by illuminating user needs, requirements, and priorities to inform the new strategic plan. In the final session, Dr. Louis Lanzerotti summarized the key ideas and outcomes to emerge from the forum discussions. First, the forum recognized the positive influence of the White House Office of Science and Technology Policy's engagement in the NSWP and the need to continue such engagement. It also recognized and supported the positive, collaborative, interagency action to develop a coordinated approach to solar wind measurement continuity and space environmental sensing in low Earth orbit (see Section 3.3 below). Other key ideas included the following: support for a developmental test bed approach to link the Community Coordinated Modeling Center to operations; the need for operations feedback to researchers; the value of requirements reviews in opening lines of communication across organizations; the need to build on space weather disaster reduction efforts already underway; the value in establishing true two-way partnerships between agencies; and the need to ensure the education and development pipeline produces the necessary space weather expertise to sustain future improvements. Particularly thought-provoking discussions emerged around three additional important areas. First, how can the enterprise improve its communications with the public, stakeholders, and decision makers to raise understanding of space weather and the potential for high-impact events? Second, is the community organized properly to provide the best research and develop the most effective services? And third, how can the community close the seams at the interfaces between research specialty areas as well as across the various regions of the atmosphere and space. The NSWP Council has documented these issues and ideas for use in the new strategic plan and for charting future activities of the NSWP.

Plans are progressing for the 2010 forum to be held in Washington, DC, in June. Raising public and policymaker awareness of space weather effects, improving services for the spectrum of users across the economy, and facilitating the transition of research to operations will be areas of emphasis. The forum will also provide an opportunity to gather final comments and feedback on the draft NSWP Strategic Plan before publication.

3.3 Studies for the White House Staff

In 2007, the White House Office of Science and Technology Policy (OSTP) asked the OFCM to lead an interagency assessment of the operational and research impacts of reduced space environmental sensor capability planned for the National Polar-orbiting Operational Environmental Satellite System (NPOESS). The OSTP also asked for a review of both operational and research uses of solar wind data from the Advanced Composition Explorer (ACE) spacecraft at the L1 Lagrange point approximately 1.5 million kilometers from Earth along the Sun-Earth line.

The OFCM formed a Joint Action Group to perform this assessment under the auspices of the NSWP and the Committee for Space Weather, subsequently submitting its report to the OSTP in January 2008. The report identified significant impacts on national infrastructure and activities, including satellite operations, GPS-based navigation, and global satellite communications. (OFCM 2008)

Based on the results of the assessment, the OSTP subsequently asked the NSWP Council to develop reasonably executable options and recommendations to mitigate the unmet NPOESS space environmental requirements and ensure continuity of solar wind monitoring.

In December 2008, the OFCM established a new short-term committee under the NSWP Council to lead this study. Chaired by senior leaders from the U.S. Air Force Space Command and the National Environmental Satellite, Data, and Information Service, the interagency Committee for Space Environmental Sensor Mitigation Options (CSESMO) brought together more than 75 people from 19 federal offices to develop options, recommendations, and preliminary cost estimates.

The Committee developed two briefings and two summary reports, each fully reviewed by and coordinated with the NSWP Council member agencies before delivery to the OSTP. The first briefing and summary report addressed continuity of solar wind monitoring and the Committee presented its results to staff from the OSTP, the Office of Management and Budget (OMB), and the National Security Council in August 2009. The second briefing and summary report addressed unmet requirements following the removal of most space weather sensing capability from NPOESS. The Committee presented its results to staff of the OSTP and OMB in September 2009. Because of the pre-decisional, budgetary nature of the material, the results are not publicly releasable at this time.

3.4 Emerging Activity Areas

As the NSWP moves ahead in its goals to advance the science, improve products and services, and continue education and outreach, emerging new areas will bring additional attention and opportunity to the space weather enterprise. Frequent sub-orbital flights of space tourists will soon be a reality as entrepreneurs such as Virgin Galactic and its SpaceshipTwo begin operations. Space weather considerations will be important for the safety of both crews and passengers and new space weather experiments may be possible with this expanded access to space and the upper atmosphere. Another area of interest is the emergence of commercial providers of space environmental data. The community must begin to examine this new paradigm, develop business cases, and assess the potential for increased efficiency, effectiveness, and cost savings

compared to the traditional government-funded programs and platforms.

4. SUMMARY

Since 1995, the OFCM through the National Space Weather Program has facilitated a cooperative approach to identify and apply relevant research, focus new research, improve space weather products and services, and educate a diverse and rapidly growing user community. In the last year, the program provided the White House an interagency coordinated set of options and recommendations to sustain solar wind monitoring and restore space environmental sensing capability removed from the NPOESS program. It also organized and hosted the Space Weather Enterprise Forum to explore strategic partnering, facilitate scientific advances and the transition of research to operations, and to continue education and outreach. The OFCM also gathered actionable information to move the enterprise forward, particularly by illuminating user needs, requirements, and priorities to inform the new strategic plan. The Committee for Space Weather continued to refine the new NSWP Strategic Plan for the next decade and address recommendations from the 2006 independent assessment. In 2010, the NSWP Council will organize another enterprise forum, finalize the new strategic plan, and begin work on a new implementation plan. Throughout the year, the NSWP will continue to address improvements in products and services and foster the transition of research results into operational capability to better meet today's societal demands and tomorrow's emerging needs.

REFERENCES

National Research Council, 2008: *Severe Space Weather Events—Understanding Societal and Economic Impacts Workshop Report.* Committee on Societal and Economic Impacts of Severe Space Weather Events. National Academy Press, 131 pp.

Office of the Federal Coordinator for Meteorological Services and Supporting Research (OFCM), 1995: National Space Weather Program Strategic Plan. OFCM Publication FCM-P30-1995, 18 pp. [Available online at http://www.ofcm.gov/nswp-sp/text/a-cover.htm]

OFCM, 1997: National Space Weather Program Implementation Plan. OFCM Publication FCM-P31-1997, 84 pp.

OFCM, 2000: National Space Weather Program Implementation Plan 2d Edition. OFCM Publication FCM-P31-2000, 196 pp. [Available online at http://www.ofcm.gov/nswp-ip/tableofcontents.htm]

OFCM, 2006: Report of the Assessment Committee for the National Space Weather Program. OFCM Publication FCM-R24-2006, 100 pp. [Available online at http://www.ofcm.gov/r24/fcm-r24.htm]

OFCM, 2008: Impacts of NPOESS Nunn-McCurdy Certification and Potential Loss of ACE Spacecraft Solar Wind Data on National Space Environmental Monitoring Capabilities. Prepared for the Office of Science and Technology Policy, Executive Office of the President, 85 pp. (For Official Use Only)

OFCM, 2009a: Summary Report on Solar Wind Monitoring Continuity Options and Recommendations. Prepared for the Office of Science and Technology Policy, Executive Office of the President, 70 pp. (For Official Use Only)

OFCM, 2009b: Summary Report on NPOESS Space Environmental Sensor Mitigation Options and Recommendations. Prepared for the Office of Science and Technology Policy, Executive Office of the President, 99 pp. (For Official Use Only)