

NASA ADVISORY COUNCIL

Space Weather Council

March 2, 2022

Teleconference

MEETING MINUTES

Patricia Doherty, Chair

Jesse Woodroffe, Designated Federal Officer

NASA Space Weather Council Meeting Minutes, March 2, 2022

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*Prepared by Elizabeth Sheley
Tom & Jerry, Inc.*

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Wednesday, March 2, 2022

Welcome

Dr. Jesse Woodroffe, a NASA Heliophysics Division (HPD) Program Scientist and the Executive Secretary of the Space Weather Council (SWC), opened the Council's inaugural meeting. SWC is a Federal Advisory Committee Act (FACA) committee, and therefore the meeting was open to the public, minutes were being taken, and a public comment period was on the agenda. This meeting had three purposes: to introduce the members, establish the SWC purpose and processes, and provide background information.

The purpose of SWC is to secure the advice of community experts on matters relevant to space weather at NASA. The Council is a standing subcommittee of the Heliophysics Advisory Committee (HPAC), to which it reports. As needed, SWC may seek input from the heliophysics and space weather communities. HPAC had yet to meet since the establishment of SWC and therefore had not been able to give any direction to the Council, which is why this day's meeting was informational only.

Dr. Woodroffe then introduced the SWC Chair, Ms. Patricia Doherty.

Opening Remarks and Committee Introductions

Ms. Doherty first thanked Dr. Woodroffe, then thanked NASA for assembling this group and asking her to be chair. She is also an HPAC member and hoped to connect with the HPAC Chair, Dr. Michael Liemohn, before the next HPAC meeting. She would like SWC to convene shortly after that.

Ms. Doherty asked the SWC members to each give a short bio. She began with herself:

- *Ms. Patricia Doherty* has had a long history with space weather and serves as the Director of the Institute for Scientific Research at Boston College, where she is also a Senior Research Scientist and Principal Investigator. Her research focus is on the effects of space weather and ionospheric conditions on Global Navigation Satellite Systems (GNSS). She is also a member of the Scientific Committee on Solar-Terrestrial Physics (COSTEP).
- *Dr. Daniel Baker* of the University of Colorado described himself as working across multiple disciplines. He is interested in solar-terrestrial couplings and has been involved in a number of HPD missions such as the Van Allen Probes, the Magnetospheric Multiscale (MMS), and smaller missions involving cubesats. He does data analysis and modeling and has been active in policy matters, including serving as chair of the last heliophysics Decadal Survey (DS). He wants to help clarify the role of NASA in space weather.
- *Dr. Michele Cash* is at the National Atmospheric and Oceanic Administration (NOAA) Space Weather Prediction Center (SWPC), where she is lead for the research section and is working on the new testbed SWPC is developing. She is interested in the Research to Operations (R2O) and Operations to Research (O2R) processes. Her background is in the magnetosphere and solar physics and solar wind, though she now works across all space weather.
- *Dr. Angelos Vourlidas* is currently at the Johns Hopkins University (JHU) Applied Physics Lab (APL). He has been involved in a number of NASA heliophysics missions, including the Solar Terrestrial Relations Observatory (STEREO). His expertise is in the solar boundary and the chromosphere.
- *Dr. Janet Green* was at NOAA for about 10 years in the space weather prediction and data centers. She now has her own company, Space Hazards Applications, focused on providing tools and products for satellite companies to understand space weather impacts to their assets.

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- *Dr. Valeriy Tenishev* of the University of Michigan researches solar weather, solar electric particles, and cosmic rays within specific ranges. He is also concerned with solar magnetic particles and the magnetosphere.
- *Dr. Alexa Halford* of NASA's Goddard Space Flight Center (GSFC) was unable to attend this meeting. Dr. Woodroffe read a bio that explained her work. Dr. Halford's professional focus has moved from magnetospheric waves to geomagnetic storms and back again. She works in GSFC's ionosphere-thermosphere-mesosphere lab.
- *Dr. Piyush Mehta* is an assistant professor in the department of mechanical engineering at West Virginia University, with a specialty in satellite modeling. He was awarded a 2021 National Science Foundation (NSF) grant to study machine learning (ML) and artificial intelligence (AI) in satellites. His current work pushes the use of ML in space weather operations.
- *Dr. Ronald Turner* works for ANSER, a not-for-profit company that supports activities related to homeland security. He has also worked with NASA for more than 30 years. His space weather research has been directed at radiation risk mitigation for astronauts. He supports the NASA Innovative Advanced Concepts (NIAC) Program as a senior science advisor.
- *Ms. Sage Andorka* of the U.S. Space Force (USSF) was unable to participate in the meeting due to conflicts. Dr. Woodroffe read her bio, noting that she is a lead systems engineer for USSF. She has worked on space characterization missions for the Department of Defense (DOD).
- *Dr. Joachim (Jimmy) Raeder* has retired from teaching at the University of New Hampshire (UNH) but is still conducting research. He described himself as a magnetosphere and ionosphere modeler, and he is also a co-investigator on the Time History of Events and Macroscale Interactions during Substorms (THEMIS) mission.
- *Dr. Paul O'Brien* of The Aerospace Corporation has a background in magnetospheric physics with emphasis on the radiation belts. He is involved in transitioning research knowledge into tools and applications for satellite designers. He also works on models related to radiation specifications.

Ms. Doherty and Dr. Woodroffe thanked the SWC members for their participation.

Remarks from NASA Leadership

Dr. Nicola Fox, Director of HPD, thanked the SWC members and reviewed HPD objectives: to solve the fundamental physics questions of heliophysics; to build a knowledge base from which to predict space weather; and to better understand Earth's place in the solar system and space. The goal is to apply the knowledge from fundamental physics studies in an effort to protect life and society in context of space weather events.

Dr. Fox presented a graphic showing the Heliophysics mission suite, then discussed the Multi-Slit Solar Explorer (MUSE) and HelioSWARM, which are new Medium-class Explorer (MidEX) selections. MUSE observe extreme ultraviolet (UV) radiation using a multi-slit spectrometer, while HelioSWARM will employ a hub and eight smallsats to measure solar wind turbulence and fluctuations in the magnetic field.

Recent HPD mission highlights include Parker Solar Probe (PSP) entering the solar atmosphere for the first time, deployment of the Daily Atmospheric Ionospheric Limb Imager (DAILI), and the launch of the Miniature X-Ray Solar Spectrometer 3 (MinXSS-3). The Global Lyman-alpha Imagers of the Dynamic Exosphere (GLIDE) and the Heliophysics Environmental and Radiation Measurement Experiment Suite (HERMES) missions recently passed Key Decision Point C (KDP-C). GLIDE will launch with the Interstellar Mapping and Acceleration Probe (IMAP) and HERMES will be on the Lunar Gateway. HPD also released a call for the Small Explorer (SMEX) and Heliophysics Explorer (HEP) programs at the end of calendar year 2021. In addition, PSP captured images of Venus during a flyby. The mission is about to exit perihelion, at which point more information will be available.

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Dr. Fox turned to NASA's Space Weather Strategy, which has been in the works for a couple of years. The vision is to advance space weather science in order to protect Earth and expand into space. To do so, NASA will establish a space weather capability supporting both robotic and human space exploration. This capability will advance measurement and analysis techniques while expanding the knowledge and understanding necessary for improved operational space weather forecasts.

The Promoting Research and Observations of Space Weather to Improve the Forecasting of Tomorrow (PROSWIFT) initiative will help NASA focus on its areas of strength in space weather by supporting new missions, technology development, and research and modeling. The effort will help transition information, models, and technology to operations and will enable partnerships.

The "Heliophysics Big Year" – really more than 1 year – will link three major heliophysics events starting in 2023: two solar eclipses and a solar maximum. One of the goals is to encourage citizen science. Dr. Fox closed her presentation by providing links and a list of resources for information and participation in NASA Heliophysics activities.

Status Report on NASA Space Weather

Dr. James Spann, NASA Heliophysics Space Weather Lead, said he appreciated all those who agreed to be on the SWC. He addressed what NASA is doing in space weather and where it is headed. In order to understand the space weather environment and its impacts, NASA provides unique observations and data streams for a range of purposes, including modeling, research, and operations. Through HPD, the nation's space weather research arm, NASA seeks to transition knowledge to operations and applications through collaborations with academia, government, and industry. PROSWIFT codifies the national Space Weather Action Plan (SWAP).

Dr. Spann described the six goals of NASA's space weather efforts. The first three, to observe, analyze, and predict, are intrinsic to NASA's approach to heliophysics. The fourth goal is to transition R2O environments, with support and partner being the final two goals. NASA hopes to improve modeling and theory associated with its observations and to transition those capabilities where appropriate. A graphic representation of the space weather program pillars presented four themes: observing and modeling, which address the first three goals; transitioning, with activities aimed at the fourth and sixth goals; exploration, focused on the fifth and sixth goals; and application, emphasizing the fourth and sixth goals. HPD wants to go beyond predictive models into observational and monitoring capabilities. Dr. Spann noted that the applications theme differs from operations in that it addresses elements that some organizations need for success.

Recent accomplishments of NASA's space weather program include working closely with NOAA and DOD to transition NASA research, techniques, and technologies. Together with NSF, NASA issued a Space Weather Quantification of Uncertainty (SWQU) grant solicitation. The Agency has an annual Research Opportunities in Space and Earth Sciences (ROSES) call for Research to Operations to Research (R2O2R), which is done on behalf of multiple agencies through a formal agreement. HERMES will be on the Lunar Gateway as a pathfinder, providing a capability for Earth-independent space weather information. Finally, APL conducted a gap analysis on behalf of NASA's space weather science.

Moving forward, the Agency is developing a space weather instrument pipeline for future opportunities. This will address the issue of the short turnaround time for rideshares by having packages ready to fly. Dr. Spann suggested that SWC consider this as a topic for discussion. He noted the many international collaborations NASA has in space weather. On Mars, the Radiation Assessment Detector (RAD) instrument on Curiosity Rover measures the planet's radiation, and NASA is transitioning the instrument

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from the Planetary Science Division (PSD) to HPD in order to engage the space weather community in forecasting research on Mars. Funding of R2O2R work continues in conjunction with DOD, NOAA, and NSF, and HPD is preparing a solicitation for Space Weather Centers of Excellence (COEs).

Dr. Spann next reviewed HPD's actions under PROSWIFT. Among these are participation in the Space Weather Operations, Research, and Mitigation (SWORM) Subcommittee under the National Science and Technology Council (NSTC), a group within the Office of Science and Technology Policy (OSTP). NOAA established a Space Weather Advisory Group (SWAG) in which NASA participates, and the National Academy of Science (NAS) is putting together a Space Weather Roundtable. HPD works with the European Space Agency (ESA) to maintain operations of the Solar and Heliospheric Observatory (SOHO) Large Angle and Spectrometric Coronagraph (LASCO) instrument. The Division is also making plans for space weather monitoring capabilities on future NASA missions such as HERMES on the Lunar Gateway and the Geospace Dynamics Constellation (GDC). A number of collaborations with other federal agencies fall under HPD's PROSWIFT initiative, as do international partnerships. The Space Weather COE will advance solar and space weather R2O, possibly leading to development of products that can be transitioned through the framework.

Dr. Spann described the HERMES suite, which will operate on the Lunar Gateway in conjunction with an ESA package focused on radiation. HERMES will observe solar particles and the solar wind. The goal is to launch in 2024. Six Interdisciplinary Science (IDS) teams, which include international partners, have been selected to work with HERMES instrument teams to develop advanced data products and address a range of science objectives.

NASA will be releasing a ROSES-22 amendment soon. As with ROSES-21, there will be an R2O2R "Transition Step" – an optional third year to support the most promising activities that facilitate transition to operations. The Space Weather Applied Research Challenges (ARCs) are being developed to support early-stage research to enable better downstream results in space weather. The current research structure does not provide a place for such work. The COEs will be large and have a structure similar to that of the DRIVE Science Centers, though this is not "DRIVE for space weather." Instead, the Centers will provide significant long-term investment in multidisciplinary research and infrastructure development to address major challenges in space weather, with an emphasis on R2O2R. A diagram of the R2O2R process illustrated the various initiatives in relation to each other and according to Readiness Levels (RLs).

As part of the effort to move space weather into a mission posture, HPD recently selected four cubesats focused on space weather research. The hope is that this will evolve into having space weather missions. As noted earlier, HPD also wants to have space weather observation systems ready to go on rideshares throughout the solar system. The Small Business Innovation Research (SBIR) program has a space weather R2O2R technology development subtopic in its most recent call, emphasizing technologies that enable space weather forecasting and commercial and decision-making applications, along with advanced data-driven discovery techniques and space weather instrumentation. SBIR projects must be led by a small business, but academic participation is allowed.

There was a Coronal Mass Ejection (CME) in late January, which NOAA and NASA quickly identified and tracked. This CME drove significant energy input into the upper atmosphere, changing the orbital drag environment substantially. SpaceX launched the Starlink satellites about 12 hours into this storm, but the satellites were not designed to operate in an environment with this kind of heating and expansion, resulting in a loss of 38 satellites at a cost estimated to exceed \$12 million. This was a minor storm, of the type that occurs about once a month, and as we approach the 2025 solar maximum, there will be more frequent and larger storms. Had real-time data been available, SpaceX might have been able to postpone the launch. NASA and NOAA continue to discuss this event and its implications.

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Dr. Baker thanked Dr. Spann for his presentation. About 10 years ago, he co-chaired a study on impediments to interagency collaboration. Since PROSWIFT seems to direct such collaboration, he wondered about the impediments and the involvement of the Office of Management and Budget (OMB) in accomplishing it. He wanted to know if things are going well in this regard, if the budgets will be there, and if NASA will get what it needs. Dr. Spann said that over the last 5 years or so, collaboration has gone very well. There were previously some rough spots and it is not all smooth, but everyone is at the table now to discuss working together. There are a lot of joint research announcements, and there are space weather advisory groups that engage all agencies. The federal entities do bump up against each other but the parties are communicating and talking things out. He could not comment on the budget other than to say that space weather is getting great support, including bipartisan support in Congress. OMB is in there with SWORM and is aware of the discussions. There is an environment in which people are willing to talk and get things done, and that is a reason to have SWC, in order to formalize it.

Dr. Woodroffe said that in the chat, Dr. Art Charo asked about the relationship between the CCNC and the COEs. Dr. Spann explained that the COEs will be openly competed. CCNC is a resource for the community and a key element in transitioning some of the more complicated tools and models to the SWPC. NASA is not hard-wiring CCNC to the COEs. The COEs will be expected to leverage what is in the CCNC, but it is not a requirement.

Committee Discussion

Next was SWC discussion time, an opportunity for the members to discuss what they heard and provide input for future through Ms. Doherty, who led the session.

Dr. Baker suggested that funding for the COEs, \$1.5 million per year, does not go very far. He wondered if SWC might discuss what is optimal for a multi-institution organization with these objectives. Ms. Doherty agreed with his observation. Dr. Cash asked if she should recuse herself from this discussion if she planned to propose. Dr. Spann said that she could continue to participate because the Council was discussing what a science team needs, not specific proposals. He said that rather than debate a dollar amount, they could discuss the level of effort needed to go into this, and whether the draft solicitation addresses it.

Dr. Vourlidis said that he was concerned about the difference between what was expected and the draft. The draft is not quite clear in all respects. Dr. Spann noted that the draft has language about providing capabilities, not confining it to modeling. Dr. Vourlidis repeated that the draft did not mesh with community expectations. Ms. Doherty asked if SWC might take to HPAC concerns about funding or lack of clarity on how to respond. Dr. Spann said that that would be appropriate and HPAC might want to address it. The next HPAC meeting was scheduled for early May. Dr. O'Brien said that the program will be more successful if there is a clear path for transitioning to NOAA and DOD, beyond just journal articles. NASA should take responsibility for establishing those pathways. Dr. Spann explained that transitioning research is different from research and from operations, it is its own activity. R2O2R is a first step. Dr. Baker said that NASA offers tremendous assets, but he has seen examples of information that is made available but not sufficiently utilized. Those at the higher levels need to make sure this goes beyond good intentions and that the pieces are there. It is important to pay attention to the dual-use aspects. Others have to take advantage of what NASA offers. Dr. Cash said that another element is determining which things to put into operations. The R2O process is a funnel. Dr. Baker added that they need to ensure that the funneling process provides the right throughputs. That calls for a lot of coordination among many participants.

It was noted that NASA has a limited ability in implementation, and the boundaries among the agencies are unclear. Dr. Vourlidis said that it is clear that there is a move toward working together among the agencies, and the good thing is that this will help mature the space weather program. Dr. Baker added that

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there should be a way to extend the lives of NASA missions that are no longer scientifically viable but still operable. It would be good for SWC to hear more about that so that they might advise the government on how to better exploit existing capabilities. Dr. Vourlidas mentioned the USSF, suggesting that some of its missions might have a secondary purpose for space weather.

In answer to a question, Dr. Woodroffe explained that while SWC is a NASA committee, it includes representatives from multiple agencies. Similarly, advisory groups at other agencies, such as NOAA, have representation from outside federal organizations. Dr. Mehta said that in regard to capabilities, he wanted a better feel for the tolerance of taking nontraditional models to operations. He has not seen any conversion to operations and wondered about the agencies' take on that. Dr. Spann said that NASA is investing in ML for space weather and some R2O2R activities. It takes a long time to transition to operations because the process has requirements, such as validation to ensure robustness. The operations agencies provide the pull for that, however, and this is a conversation to have with them. NASA can develop capabilities, but at some point the research and operations people need to talk. Maybe ML is an example of something being used that has not been brought in. Dr. Mehta said that a feedback loop should inform investments, so that NASA invests where there are concerns. Dr. Cash added that NOAA is looking at ML, but it is all at low readiness levels, such as prototypes. Her agency has not yet gotten to requirements validation. Dr. Woodroffe said that he has seen an increase in interest in ML as a forecasting tool. The researchers believe it will be beneficial. But the challenge is sometimes lengthy, while the push is at the early stages. NOAA probably wants any good capabilities, but if this work has not been going on long enough for their to be a hand-off as yet. Dr. Cash agreed, adding that NOAA can use a range or combination of models. Dr. Baker felt that this is taking too long. As a new solar maximum approaches, there will be great need for forecasting tools that do not yet exist. It seems to move too slowly given the urgency. The field needs more rapid prototyping.

Dr. Cash said that this is where the partnership comes in, as it will help speed things up. It was suggested that the right model is the one that is ready today, and what exists now should be transitioned. Instead, there seems to be a desire to do everything in one model and postpone implementation of useful things until they reach an ideal rather than using segments that are available. Researchers want to build big complex things that include a lot of physics, which is not always the most practical. Nor should the focus be solely on large events. Improvements can be incremental. Dr. Baker said that it comes to who SWC will advise. They should know if they are wasting their time or exceeding their authority. If they are encouraged to advise where they see it, they should know that as well. Dr. Woodroffe said that SWC's tasking comes from HPAC, and the primary purpose is to advise HPAC and, through it, NASA. While they cannot count on the advice being binding or having an impact on other groups, the other federal agencies interested in space weather are represented on SWC.

Dr. Turner wanted more on the pipeline slide. There is also a time lag between deciding to do a mission and doing it. Dr. Spann said that the idea is that if anyone goes anywhere, NASA space weather wants to go along to make observations. To do so, they will need a "pantry" of different items to add to a pool of instruments that can be put on rideshares. These will be more general instruments. Having a variety of incomplete but partial instruments that can be finished quickly will be helpful. A pipeline instrument will compete to build instruments to a level where they are ready to deploy once flight opportunities are identified for them. This means that NASA will be soliciting instruments that do not have designated rides, but the need is for a quick turnaround. These do not have to be the best observations, but they will be something.

Ms. Doherty asked if SWC can explore the platforms that might be available to space weather instruments. She also wanted to know the gaps. Dr. Spann said that this would be a good idea, and SWC may want to comment on the existing science gap analysis. Some platforms might be more worthy of focus than others. Dr. Baker asked if SWORM has done an inventory of what is and can be available to

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help with the space weather assessment and forecasting problems of the upcoming solar maximum. Dr. Spann replied that SWORM and its predecessor did an inventory that is outdated. NOAA might not have all of its gap analysis done in time for the solar maximum. The APL gap analysis addresses that in part but not entirely. Dr. Baker said the emphasis should be on what is available and in development during the next 3 to 5 years. Dr. Vourlidas noted that in looking to the future, NASA should have a solid plan for the rideshare opportunities. Dr. Baker replied that his concern is about what will be available for the next solar maximum. It could be that some of the opportunities discussed will be too late.

Dr. Cash said that there is also operational space weather data that cannot be used due to processing limits. While some of this is a NOAA problem, she was concerned about how to ensure that data can be used. Ms. Doherty said she could pass that along to HPAC. Dr. Baker observed that NASA is often seen as having funds other agencies do not, so action might be needed at a higher level. Space weather is either a national priority or it is not, and resources reflect that.

Ms. Doherty observed that she now saw how and why this particular group was assembled, and its strength was evident. She asked that everyone review the terms of reference if they had not already done so. She and Dr. Baker asked if it might be possible for the other federal space weather committees to meet with SWC. Dr. Spann believed it would be allowed and promised to check. He added that the SWAG advises all agencies, but it would be helpful to have the groups aware of what they are all doing. SWC is to work with HPAC, but nothing is done in isolation, so it is wise to have good situational awareness.

[It was noted that Dr. O'Brien recused himself during the pipeline discussion.]

Ms. Doherty thought they had had an enlightening conversation, and Dr. Woodroffe said that she could take their ideas to HPAC. In addition, the HPAC Chair, Dr. Liemohn, was listening to the meeting, and a member of the SWAG will take information about SWC to that committee. They can attend each other's meetings. In answer to a question, he said that FACA limits discussion among members outside of the meetings, and he would get further clarification on the boundaries. The slides will be made available through the SWC website. He and Ms. Doherty would discuss timing of the next meeting, to be after the next HPAC meeting in early May. SWC is required to meet at least twice a year but can meet more often and for longer periods of time. This was a short meeting because it was introductory. Eventually, these will likely be in-person meetings, but it remains to be seen when that can begin.

Public Remarks

The meeting was opened for comments from the public. Dr. Jinni Meehan said that she was very excited about SWC. She wanted to address how SWC could interact with SWAG. She is a member of SWAG, which was to meet in mid-March. The agenda includes a slot for Dr. Spann to outbrief this meeting. Trying to figure out how they are working together is very important and exciting. Dr. Tammy Dickinson said that the SWAG chair had been listening to this meeting. She complimented the SWC for its makeup and meeting. Dr. Woodroffe said that Ms. Doherty had done a great job of running the meeting.

Closing Remarks

Ms. Doherty again thanked everyone for attending. This was a soft meeting and she expects future meetings to be more active. She would let them know once she has a charge from HPAC. She then thanked Drs. Fox, Spann, and Woodroffe for their work and guidance.

Adjourn

The meeting was adjourned at 2:52 p.m.

Appendix A Participants

Space Weather Council Members

Patricia Doherty, Boston College, *Chair*
Jesse Woodroffe, NASA Headquarters, *Executive Secretary*
Sage Andorka, U.S. Space Force ** was on call-in list but didn't participate**
Daniel Baker, University of Colorado
Michele Cash, NOAA Space Weather Prediction Center (SWPC)
Janet Green, Space Hazards Applications, LLC
Piyush Mehta, West Virginia University
Paul O'Brien, The Aerospace Corporation
Joachim (Jimmy) Raeder, University of New Hampshire
Valeriy Tenishev, University of Michigan
Ronald Turner, Analytic Services Inc.
Angelos Vourlidas, Johns Hopkins University Applied Physics Lab

Other

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|---|----------------------|
| Rosh Anak | Neal Hurlburt |
| Cameron Anderson | Michael Liemohn |
| Sky Bischoff-Mattson | Margaret Luce |
| Rebecca Bishop | Kelly Klorack |
| Brittany Bridges | Janet Kozyra |
| Stacy Burdo | Jennifer Meehan |
| Art Charo | Rachel Morro |
| Meredith Danowski | Donna Nelson |
| Aroh Darjutra | Kate Peterson |
| Rahakim Davar | Nicole Rayl |
| Lamont Di Biasi | Griffin Reinecke |
| Tammy Dickinson | Washito Sasamoto |
| Jamie Favors | Elizabeth Sheley |
| Susanna Finn | Walter Twinn |
| Galen Fowler | Daniel Walsh |
| Nicola Fox, <i>Heliophysics Division Director</i> | Brad Daniel Williams |
| Ryna Fredile | |
| Lika Guhathakurta | |
| Jeffrey Hayes | |
| George Ho | |

Appendix B Council Membership

Patricia Doherty, Chair

Boston College

Jesse Woodroffe, Executive Secretary

NASA Headquarters

Sage Andorka

U.S. Space Force

Daniel Baker

University of Colorado

Michele Cash

NOAA Space Weather Prediction Center
(SWPC)

Janet Green

Space Hazards Applications, LLC

Alexa Halford

NASA Goddard Space Flight Center (GSFC)

Piyush Mehta

West Virginia University

Paul O'Brien

The Aerospace Corporation

Joachim (Jimmy) Raeder

University of New Hampshire

Valeriy Tenishev

University of Michigan

Ronald Turner

Analytic Services Inc.

Angelos Vourlidas

Johns Hopkins University

Applied Physics Lab

Appendix C
Agenda

| Time | Topic |
|-------------|---|
| 12:00 PM | Welcome Jesse Woodroffe, NASA Heliophysics, SWC DFO |
| 12:05 PM | Opening Remarks and Committee Introductions Patricia Doherty, Chair |
| 12:35 PM | Remarks from NASA Leadership Nicola Fox, Director NASA Heliophysics |
| 12:55 PM | Status Report on NASA Space Weather James Spann, NASA Heliophysics Space Weather Lead |
| 1:25 PM | Break |
| 1:40 PM | Committee Discussion Patricia Doherty, Chair |
| 2:40 PM | Public Remarks |
| 2:50 PM | Closing Remarks Patricia Doherty, Chair |
| 3:00 PM | Adjourn |