NASA ADVISORY COUNCIL

HELIOPHYSICS ADVISORY COMMITTEE

November 14-16, 2023

Virtual/In-Person Meeting

MEETING MINUTES

Paul Cassak

Paul Cassak, Chair

Janet Kozyra

Janet Kozyra, Executive Secretary

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Prepared by Deborah Eby
Tom & Jerry, Inc.

Tuesday, November 14, 2023

Welcome

Dr. Janet Kozyra, Executive Secretary and Designated Federal Officer (DFO) of the Heliophysics Advisory Committee (HPAC), called the meeting to order. Dr. Kozyra, of NASA's Heliophysics Division (HPD), introduced Dr. Paul Cassak, HPAC Chair, and turned the meeting over to him.

Introduction of Committee Members; Overview of Agenda

Dr. Cassak welcomed HPAC members and asked them to introduce themselves, starting with those attending in person, and then members attending virtually online.

Dr. Cassak next went over the day's agenda, which included a briefing on HPAC operating procedures for new members; and reports from HPD, the Space Weather Action Group (SWAG), Space Weather Council (SWC), Space Weather Program (SWP), Heliophysics Research & Analysis (R&A) Program, and the Solar Max/Heliophysics Big Year (HBY). He said the rest of the day would be devoted to open and closed sessions to discuss HPAC possible findings and recommendations.

For New Members: HPAC Charter; Briefing on HPAC Operating Procedures

Dr. Kozyra opened the session by explaining that HPAC is an advisory committee under the Federal Advisory Committee Act (FACA). FACA obligations include providing objective information on issues affecting federal policies and programs, and ensuring that committee proceedings occur in a public forum, including formal minutes taken for the public record.

The HPAC charter directs the committee to draw on the expertise of its members to advise the HPD Director concerning heliophysics programs. Dr. Kozyra explained that although HPD carefully considers HPAC input, the agency is not required to respond. All HPAC findings and recommendations require consensus among members. Meeting agendas are created by HPD in collaboration with the HPAC chair. Dr. Kozyra said that concise, clear, actionable recommendations receive the best agency response.

She noted that HPAC meetings typically occur three times a year, but due to major turnover in HPAC membership and outside obligations of committee members, only one meeting occurred in 2023. The panel is committed to three meetings in the coming year, she said.

Other HPAC meeting requirements include:

- Meetings must stick to the agenda. Presentations may fall behind schedule, but may not occur earlier than the time listed on the agenda.
- Each meeting must include a public comment period. At any other time during the meeting, only HPAC members may ask questions.
- The committee may break into subgroups to prepare materials, but all findings and recommendations must be discussed publicly by the full committee.

SWC is a standing subcommittee of HPAC that provides the panel with scientific and programmatic input. Dr. Nicole Duncan is the current SWC Chair.

Duties of the HPAC DFO include calling, attending, and adjourning the meetings; approving meeting agendas; maintaining cost records; ensuring the proper number of HPAC members; overseeing ethics

training; and ensuring committee approval of meeting minutes.

HPAC members must recuse themselves if they may benefit personally or professionally from the discussion of a given topic, she continued. HPAC does not discuss the policy or budget details of specific programs to avoid ethics violations.

Before opening the discussion to member questions, Dr. Cassak thanked Dr. Kozyra for returning to her post as Executive Secretary/DFO. Topics discussed during a brief Q&A session included:

HPAC member interaction with the outside scientific community – Members are free to discuss HPAC-related issues, but not as official HPAC representatives. Members may bring information from outside discussions to the committee, but are not obligated to be a messenger. The HPAC member uses his/her discretion about relaying information to the committee, if the topic does not raise a conflict of interest.

Government Performance and Results Act Modernization Act (GPRAMA) – Dr. Kozyra said that in addition to HPAC findings and recommendations, the other main committee duty is to assess HPD's achievement of its science goals using the GPRAMA process. She noted that GPRAMA would be discussed in more detail the following day.

SWC – The SWC reports its activities to HPAC, explained Dr. Kozyra, and HPAC can charge SWC to look into particular topics. She noted that the SWC report would come later in the day and the panel's next meeting would be in February 2024.

FACA rules prohibit committee deliberations at informal gatherings or through email.

Heliophysics Division News, Updates, Senior Review, and New Initiatives

Dr. Cassak opened the session by thanking Dr. Peg Luce for stepping in as Acting Director of HPD. Dr. Luce introduced the other HPD presenters: Dr. Nicole (Nicky) Rayl, Associate Director for Flight, and Dr. Therese Moretto Jorgensen, Acting Deputy Division Director. The HPD presenters were joined by Nicola (Nicky) Fox, Associate Administrator for the Science Mission Directorate (SMD). Dr. Luce predicted that HPD would announce a new director by year's end.

Dr. Luce presented an overview of HPD's objectives: solving the fundamental physics mysteries of heliophysics, building knowledge to forecast space weather, and understanding the connections that link the Sun, Earth, and planetary space environments in the solar system. She said the work of the heliophysics division touches all other areas of NASA science. Dr. Luce highlighted the relatively new Heliophysics Strategic Technology Office (HESTO) and SWP.

She then presented heliophysics budget history from fiscal year (FY) 2013, the year of the last heliophysics Decadal Survey. She noted that heliophysics Decadal Surveys are timed for solar cycles rather than set 10-year periods, with the next survey scheduled for 2024. She pointed out the steady increase in heliophysics budgets, from $600M in FY 2013 to just above $800M by FY 2025. She noted, however, that the President's proposed FY 2024 budget has flattened out. She added that Congress has yet to approve the President's FY 2024 budget request.

Dr. Luce presented a chart of heliophysics missions as well a launch timeline, with seven launches scheduled in 2024 and 2025. She said that HPD is fulfilling one priority of the last Decadal Survey to increase the number of competitively selected primary investigator (PI)-led missions. The division has a "vibrant portfolio" of 19 operating missions with 26 spacecraft, 13 missions in development, and more to

come. HPD is taking advantage of advances in cube satellites, small satellites, and rideshare opportunities to advance its science goals. Mission highlights included:

- Launch of the Atmospheric Waves Experiment (AWE) in November 2023, which attaches to the International Space Station (ISS) to study space weather in Earth's upper atmosphere. AWE is the first dedicated heliophysics mission on ISS.
- Escape and Plasma Acceleration and Dynamics Explorers (ESCAPADE)—two spacecraft that will observe how energy and momentum are transported by the solar wind through Mars' magnetosphere.
- Interstellar Mapping and Acceleration Probe (IMAP) to study the local interstellar medium, solar system boundaries, and acceleration of particles to high energies in space.
- Views of energetic particle jets from Solar Orbiter.
- A still from Parker Solar probe during its closest pass of the Sun so far (5M miles).
- Geospace Dynamics Constellation (GDC) and Dynamic Neutral Atmosphere-Ionosphere Coupling (DYNAMIC), which are complementary missions to provide a whole-system study of Earth's atmospheric dynamics. Although funding is uncertain, HPD is evaluating phase study proposals, with congressional support, for DYNAMIC to study lower atmosphere variability on the upper atmosphere. GDC is on pause in the President's FY 2024 budget proposal.

Heliophysics Operating Mission – HPD completed its latest Triennial Senior Review in 2023, evaluating missions in extended operations. An increasing number of missions could have much longer lives than their primary missions, and HPD must evaluate whether to continue them. Aeronomy of Ice in the Mesosphere (AIM), Geotail, and Ionospheric Connection Explorer (ICON) are no longer part of the extended mission portfolio. HPD created a new category in its 2020 triennial review for missions with enduring value to the scientific community that have insufficient funds to pursue new project-funded science investigations. This new category makes long-term compelling measurement capabilities available to the broader community.

Programmatic Updates (more details in upcoming presentations)

R&A – The Research Opportunities in Earth and Space Science (ROSES) overall 2022 selections rates were ~28%. with three Space Centers of Excellence. ROSES 2023 provides the greatest scope ever for NASA heliophysics, including a growing number of cross-divisional programs.
HESTO – Held the first annual NASA Heliophysics Technology Symposium in October 2023.
Transform to Open Science – An SMD initiative with NASA declaring 2023 as the Year of Open Science.
IDEA (Inclusion, Diversity, Equity, and Accessibility) – SMD activities encompass an inclusion plan pilot and expansion, and the SMD Bridge Program to develop partnerships among historically under-resourced institutions.
Decadal Survey – Expected to be completed in fall 2024. Resources provided for the survey can be accessed at https://go.nasa.gov/HelioDecadal.
HBY – The partial and total eclipses and other events provide an opportunity to capture the public's attention and share information about what HPD does.

Q&A
Dr. Fox welcomed new HPAC members and said the committee's input is invaluable and HPAC members are the ambassadors to the scientific community. She welcomed a frank discussion with tough questions and congratulated HPD on the AWE launch as a kickoff for the HBY. Dr. Fox added that working with partner agencies and presenting solar eclipse activities provide the opportunity to increase awareness of all NASA missions. She thanked those who contributed to the upcoming Decadal Survey.

Dr. Barbara Thompson asked Dr. Fox to comment on the upcoming unprecedented period of new mission launches at the same time as future operating budgets seem set to decrease. Dr, Fox replied that there are no easy answers to the question and she cannot guarantee funding relief. She said the upcoming Decadal Survey and HBY provide opportunities to talk about the need to support NASA science and what it takes to operate missions. She added that there is also an opportunity to streamline operations, reduce overhead, and free up more money for science, including through the Senior Review process.

Dr. Matina Gkioulidou asked Dr. Fox about the challenges in converting missions into infrastructure during the review process when that infrastructure may not be seen as a science mission. Dr. Fox replied that Senior Review proposals must emphasize that new information will be brought forth. HPAC members discussed wording about science support that leads the contract office to declare mission contracts null and void. Dr. Fox suggested that HPAC discuss whether to write a finding and request for more information.

Dr. Lisa Upton raised the issue of flat science and research budgets in the face of inflation. Dr. Fox acknowledged that a flat budget during inflation amounts to a funding decrease. She said that SMD is protecting funding as much as possible and as in the past, must make tough budget decisions. She said it is a last resort to cut the R&A budget to fund mission support.

HPAC members discussed with Dr. Fox how lack of funding for heliophysics could result in students taking a career path in a different field. Dr. Fox acknowledged that there are still many great missions to be proposed, but it is tough to get a new mission started when there are other missions much further along. She suggested the topic might be taken up at a future HPAC meeting. She said that SMD has a review team headed by Deputy Director Sandra Alba Cauffman looking at ways to do missions differently to make the most of funding. Dr. Fox said it is important to maintain a balanced portfolio across all divisions.

Dr. David Brain raised the subject of a larger fraction of R&A funding going to large centers at the expense of traditional heliophysics programs and the resulting impact on choices made by early career scientists. Dr. Luce said that the drive centers and space weather have been areas of growth that offer opportunities for students and new collaborative ways of conducting science integrated across divisions. This includes consideration of a guest investigator-like program.

HPAC members continued the discussion of collaborative science between HPD and other divisions. Heliophysics already participates in some cross-divisional activities, such as the Habitable Worlds research led by the Astrophysics Division and whole atmosphere modeling in collaboration with Earth Science researchers. Cross disciplinary work is a positive goal, but requires a lot of commitment to find areas where it works. Dr. Brain noted that HPD is a “good citizen” in seeking collaboration and hoped that other divisions step up as well. One example is GDC as part of the Living With a Star (LWS) mission. Committee members brought up the possibility of developing a finding/recommendation on GDC’s value to other stakeholders, since heliophysics’ value to society can be more difficult to visualize than other areas.

HPAC members discussed the difference between the LWS and space weather programs, noting they do overlap and can be synergistic. Although the programs have different drivers, current user-focused space weather work has grown out of what started in LWS. Dr. Duncan broadened the discussion to encompass how information and lessons learned are shared between the divisions and programs and how they can influence HPD decision making and inform the scientific community.

Other discussion topics included how to categorize programs under Senior Review that also support an upcoming mission, and funding for independent research scientists who are not part of centers or traditional programs.

Space Weather Action Group and Space Weather Council Report
Dr. Duncan reported on SWC and SWAG, of which she is member. She reminded HPAC that the SWC is a FACA subcommittee and community-based forum to solicit input and provide advice to HPAC. Dr. Kelly Korreck is SWC DFO. HPAC provided SWC with four tasks in August 2022, and the council finalized a report on these tasks in May 2023. Dr. Duncan provided a summary of that report, including:

Task 1 – Coordination Between SWx Groups, particularly Space Weather Operations, Research, and Mitigation Activity (SWORM) and SWAG, by researching activities to identify overlaps and gaps and determine how SWC can complement and leverage ongoing efforts. Dr. Duncan said that the SWC report explains the roles/responsibilities of the three groups mentioned, plus the Roundtable; describes how the groups coordinate activities; and summarizes each group's activities that HPD should be aware of. She said that SWC will improve coordination by sharing HPAC-assigned tasks with the other groups and ask the groups to notify SWC when they address topics related to NASA.

Dr. Duncan provided some details about SWAG not included in the SWC report, emphasizing the SWAG input for SWORM's National Space Weather Strategy/Action Plan/Implementation Plan. SWAG gathered broad community input through a series of speakers, panels, and public comment at its January 2023 meeting. The audience for the SWAG report is SWORM, Congress, and the Space Weather Enterprise (SWE). Dr. Duncan highlighted five of the 11 priority recommendations relevant to HPAC:

- Fund SWE.
- Create and fund an applied research program for space weather within NOAA.
- Protect space weather sensors from spectrum interference.
- Provide long-term support for operational ground-based and airborne sensors and networks.
- Quantify the societal benefits of addressing risk from space weather by performing national and industrywide economic assessments and considering space weather in the context of national risk.

Task 2 – Space Weather Gap Analysis – Comprehensive efforts took place over the last decade by various agencies to identify measurement and infrastructure gaps, said Dr. Duncan. She said it is now time to take action toward filling those gaps through a "gap-filler" analysis. A gap analysis focused on the needs of space weather analysts in support of human exploration may be necessary, as well as a modeling gap analysis for long-term, multi-event historical reanalysis and dedicated models for extreme events.

Task 3 – Address Artemis and Space Biology Programs – Determine the potential of lunar-focused space weather measurements and studies. Recommendations include continue R2O2R and other Artemis proposal calls, continue collaborations across NASA directorates, leverage instrument opportunities onboard Artemis infrastructure, and explore cost sharing and risk reduction.

Task 4 – Develop Specific Suggestions for Interagency NASA-National Oceanic and Atmospheric Administration (NOAA)-National Science Foundation (NSF)-Department of Defense (DoD) Cooperation – The report focuses on the SWx research-to-operations-to-research process. Report recommendations include investigate development of a single location to collect interagency space data and continue exploring collaboration opportunities, especially with the NSF Technology, Innovation, and Partnerships (TIP) Program.

Dr. Duncan concluded by noting that SWC will meet in February 2024. She requested input from HPAC on NSF TIP opportunities, the Decadal Survey's output, and joint funding for flight missions and ground missions. She also suggested continuing to coordinate with other space weather programs and report on

progress, and welcomed any other HPAC suggestions.

During a Q&A session, Dr. Farzad Kamalabadi and Dr. Duncan discussed metrics included in the space weather gap analysis by the National Academies. Dr. Duncan said that SWAG has conducted an extensive look at those benchmarks and provided advice to SWORM on updating them.

Dr. Eric Zirnstein asked for more detail on Roundtable activities. Dr. Duncan confirmed that *ex officio* agency members form discussion groups and rather than issue formal reports, share results with various organizations via email and other informal means. Dr. Cassak added that the Roundtable does not fall under FACA requirements.

Space Weather Program Update

Dr. Jamie Favors, SWP Director, explained that NASA plays a vital role in space weather research and is a critical partner for operational agencies like NOAA, NSF, Space Force, as well as the ROSES Space Weather solicitations. He highlighted the Space Weather Tabletop Exercise, an interagency collaboration to ensure the nation's resilience to an extreme space weather storm. SWP works to enable safe human and robotic exploration of the solar system and provides space weather decision support. Program highlights include:

Research to Operations/Operations to Research (R2O2R) – Dr. Genene Fisher explained that NASA works with partner agencies to determine the Space Weather ROSES solicitation topics and discuss proposal recommendations during the annual review process. In 2023, R2O2R added a "transition step"—an optional third year added to a two-year R2O2R award to make a research product ready for transition to operations. Proposals that are not selected to be funded by NASA can be funded by the other agencies. The 2023 topic is data assimilation for neutral density forecasting.

SWORM Working Group – NASA is a voting member in this group and collaborates with NOAA and others on the Space Weather R2O2R Framework.

Space Weather Centers of Excellence – Centers provide long-term investment in research and infrastructure development to address major challenges in space weather in an integrated, multidisciplinary fashion. This year's centers are: the Space Weather Operational Readiness Development (SWORD) center at University of Colorado, Boulder, to create a sea level to solar wind forecasting model, Space Weather Research & Technology Applications (SPARTA) at Boston University to better forecast ionospheric irregularities, and All Clear Solar Energetic Particle Prediction (CLEAR) at the University of Michigan to provide timely and accurate predictions of the space radiation environment. NASA partnered with the Department of Commerce on joint selection of a fourth proposal with the center at West Virginia University that addresses forecasting of orbital drag.

European Space Agency (ESA) Vigil Mission – NASA is soliciting for a PI-led instrument (extreme ultraviolet imager or EUV) to be part of the Vigil payload, with a planned launch date of November 2029.

Heliophysics Environmental and Radiation Measurement Experiment Suite (HERMES) – This space weather instrument package will be placed on the Gateway, an orbital outpost to support Artemis lunar operations. The planned launch date is October 2025.

Dr. Fisher concluded by presenting a chart of SWP's leadership team.

One focus of the Q&A session following the presentation focused on the amount, availability, and use of data and other information. Dr. Fisher clarified that SWP supports NOAA with information but does not

make official space weather predictions. Dr. Thompson commended SWP on a stronger connection between operations and fundamental research, the gap analyses conducted so far, and the collaborative work on getting communities working together. She added, however, that it would be useful to get even more information on how it all connects. Dr. Duncan noted that SWP and HPAC can keep each other informed of future developments.

Dr. Laura Peticolas brought up the need to educate Congress about the distinct roles of agencies such as NASA and NOAA, and asked about communication channels to do so. The SWP representatives replied that NASA has supporters in Congress who understand the distinctions. Agency and congressional staff communicate regularly through informal channels and debriefings. The NOAA's SWAG also increases Congress' insight.

Dr. Kamalabadi and other committee members discussed how to make data more available from SWC under the White House Office of Science and Technology Policy's (OSTP's) mandate to make federally-funded research available to the public.

Other topics included making applications available to users early on so they are part of the data collection and evaluation, possible funding for the next low latency data stream, and the challenge of transitioning results from the research state to the operational state. NOAA, for example, facilitates this process by requiring communication between researchers and the operational entity before considering a proposal. NASA could improve by establishing a more formal process to help researchers make that transition. The process will require culture change, including making solicitations clearer so researchers understand what is being asked for.

R&A Update

Dr. Patrick Koehn, R&A Lead, defined a "healthy" research proposal acceptance/selection rate at >20 percent. He highlighted the three space weather centers of excellence, the DRIVE initiative, cross-divisional programs in exoplanets, multidomain reusable artificial intelligence tools, and solar orbiter guest investigators in ROSES23.

Dr. Koehn also highlighted the process of dual-anonymous peer review (DAPR), where proposers do not know reviewers' identities and reviewers do not have explicit knowledge of proposing teams' identities. He explained that this process mitigates bias by putting the emphasis on the science and methodology. R&A program scientists are trained to identify bias. Dr. Koehn said that DAPR will be the norm by ROSES25.

Dr. Kamalabadi asked if there is data to support DAPR's effectiveness. Dr. Koehn replied that the R&A program does not have a history of apparent biases in its selections. He encouraged HPAC members to check out the R&A yearbook for preliminary award statistics. DAPR is only in its fourth year at R&A, Dr. Koehn explained, so numbers are small, but metrics do not indicate a trend one way or the other. R&A has measured the number of selections based on underrepresented groups, gender, and career status. HPAC members discussed the possibility of the unintended consequences of DAPR. These might include removal of information that might have been useful in other ways. An example is withholding information about the investigator that speaks to the person's level of experience. Members discussed a possible controlled experiment to evaluate the effect of unintended consequences.

Dr. Koehn displayed the R&A budget from FY 2016 ($75M) – FY 2023 ($150M), noting that funding doubled from the 2016 budget in some years. While funding has trended upward, Dr. Koehn acknowledged the "bumpy" ups and downs in certain years. He also broke down funding by open research, targeted research, and flight technology. In commenting on the funding variation, he noted that not every program runs every year (e.g., the theory modeling and simulation program). He said this type

of funding will be the last on the budgetary chopping block.

Dr. Koehn also displayed selection percentages for FY 2022 in open research (25 percent), targeted research (32 percent) and modeling and simulation (28 percent). He pointed out that selection rates often fell into single digits prior to 2012. When selection rates are examined at a more granular level, however, they range from 15 percent to 60 percent, depending on funding, number of proposals received, the size of awards and—in recent years—the effect of the pandemic. HPAC members requested information on the length of time from proposal submission to award notification, which seems to be increasing in some cases and decreasing in others.

Dr. Koehn concluded by presenting the ROSES23 programs currently running. He said that ROSES24 will be released in February, including Research and Development Initiatives of Advanced New Technologies (RADIANT).

During a Q&A period following the presentation, Dr. Koehn noted that anonymization has improved over time and researchers can find information online about how to produce an anonymized NASA proposal. Dr. Cassak asked whether R&A staffing is adequate. Dr. Koehn replied that R&A could always use more people, but no tasks are "falling off the plate."

Solar Max/Heliophysics Big Year

Dr. Kozyra declared that the huge solar storms that have already occurred have raised exciting issues that can help attract interest in HBY, including innovations in citizen science and new discoveries.

HPD is looking for worldwide collaboration and synergies among the activities and phenomena of HBY 2023-24, including citizen science (which plays major role in rural regions), new ways to analyze Big Data from the Solar Dynamics Observatory, solar eclipses, sun-geospace system focus, approach to solar max, and solar superstorm dynamics.

Strategic elements of implementing HBY- Solar Maximum include finding synergies among programs, creating international synergies to tackle research questions raised by the latest storms, and a NASA workshop in early 2024. The workshop would encompass pilot studies of the solar events, how to integrate citizen science, and brainstorming sessions on infrastructure needed based on pilot studies. Another strategic element is optimizing existing tools and developing others, including system-level data products for the Heliophysics Systems Observatory (HSO) and algorithms to stitch together auroral images.

Dr. Kozyra presented a selection of HBY activities, including three-year ROSES opportunities for citizen science investigations:

Themes – Solar Cycle 25 – Observers are watching whether the solar cycle maximum will occur earlier (April 2024 vs. July 2025) and be more intense than predicted.

Event Study of Dangerous Superstorms – Interesting and Unusual Features – An example is the March and April 2023 filament eruptions that occurred 31 days apart in the vicinity of the same recurrent coronal hole. They were the 7th and 8th strongest storms as measured by heating of the thermosphere observed by Sounding of the Atmosphere Using Broadband Emission Radiometry (SABER) in the past 21.5 years.

Folding in Superstorm Anomaly Detection Results – A joint NASA-Amazon Web Services (AWS) use case was based on the principle that changes in dynamics may be identified through emergent or anomalous features. Examples include the fact that soft ions can penetrate to unusually low latitudes, and

a drop in the average energy of auroral electrons was detected as a characteristic feature of superstorms. How this is related to storm severity and other storm processes requires further study.

Dr. Kozyra concluded by presenting a list to show that compelling questions can be designed to engage all heliophysics discipline areas as well as citizen scientists. During a Q&A session after the presentation, HPAC members asked what organizations might get involved and what resources are available for such efforts. Dr. Kozyra replied that the HBY team is at the early stages of figuring out how to move forward and welcomes input on the science and possible collaborators. NSF is already on the list. Dr. Elizabeth McDonald, Program Scientist, said the team has set good precedents for running citizen science workshops.

HPAC members discussed whether the HBY team has enough support for engaging the public, including data collection for extreme events. Members also supported the idea of a journal highlighting extreme/unusual events that is understandable to the public as well as NASA staff.

HPAC Discussion (potential issues for findings & recommendations)
Dr. Cassak briefly explained the process to develop findings and recommendations and began with the Solar Max/HBY topic as an example. He explained that a finding is an observation and a recommendation is a specific and actionable statement of how things could be done differently.

HBY – HPAC members noted that heliophysics staff are already overcommitted to HBY activities, so it would be beneficial to leverage collaboration with other internal and external organizations. This might include events already planned by other heliophysicists and educators—including the outer heliosphere science community, citizen science programs, NSF, and private industry affected by space weather.

[HPAC members decided to report out findings and recommendations to HPD in the form of PowerPoint slides. Dr. Cassak noted that reports from previous meetings are available at https://science.nasa.gov/researchers/nac/science-advisory-committees/hpac/]

Dr. David Brain volunteered to be lead writer for HBY findings/recommendations.

HSO Infrastructure – HPAC members said there is confusion about the process of missions transitioning into HSO Infrastructure. The broader community needs clearer messaging on the implications of this process. Dr. Matina Gkioulidou and Dr. Eric Zirnstein agreed to lead the findings/recommendations effort.

SWC – During SWC's presentation, Dr. Duncan discussed coordination efforts among various space weather groups, including SWAG and SWARM. HPAC members favored a finding that this coordination is an important role and a recommendation that this coordination should continue. Members discussed the topics of how and where to pass along SWC reports, the tasks to assign SWC in the coming year, and making the R2O2R process easier to navigate for proposers. HPAC decided it would be more efficient to take up findings/recommendations on these topics the following day when Dr. Duncan would rejoin the meeting.

R2O2R – HPD should be commended for improving cross-agency cooperation on R2O2R, but HPAC members found that the process is hard for researchers to navigate. A recommendation would be appropriate for a streamlined how-to guide or other ways to improve the process. Dr. Lisa Upton said she would take the lead on this topic.

Reporting Proposal Success Rate – Committee members noted that in addition to reporting overall R&A proposal success rates to HPAC, HPD could also include the specific success rates for proposals that got the highest ratings. This would spotlight how many high-quality proposals could not be funded due to

budget constraints.

HDRL – HPAC discussed HDRL creation of a searchable database of selected and funded proposals. This would be especially useful to new researchers so they could see the types of projects that win funding. HPAC debated whether such a database would be better funded by HPD or NASA. Dr. Brain cautioned against overtaxing NASA (or any) staff with requests, and urged the committee to differentiate between "really want" and "nice to have" recommendations. Members discussed the fact that although HPAC has no power to enforce recommendations, they can help HPD protect valuable programs or rally the community behind needed changes. HPAC tabled discussion of HDRL until after the following day's presentation.

GDC and DYNAMIC – Committee members noted that GDC is paused due to HPD funding delays and remains the only unaddressed mission concept from the 2013 Decadal Survey. Members decided that a finding was warranted expressing the value of GDC and DYNAMIC, but decided to revisit GDC/DYMANIC the following day.

DAPR – HPAC members agreed that success criteria for DAPR would shed light on how it affects intended objectives, such as supporting first-time and early-career PIs in heliophysics. Committee members recognized that with the relatively small number of helio-specific researchers, NASA/HPD would need to develop metrics for DAPR appropriate to its circumstances. The committee decided to create a finding that commends HPD on implementing DAPR and a recommendation on developing success criteria.

HPAC then entered a closed work session before adjourning for the day.

Wednesday, November 15, 2023

Welcome to Day 2

HPAC members received brief instructions on how to turn their microphones on and off so they could be heard by online meeting participants. Dr. Kozyra opened the meeting, welcomed HPAC members and other attendees, and turned the meeting over to Dr. Cassak.

Overview of Agenda

Dr. Cassak noted that all agenda times were Eastern Standard Time. The day's activities included GPRAMA procedures to assess NASA Heliophysics Division performance for the past year, a public comment period, and open and closed sessions on HPAC findings and recommendations.

GPRAMA Procedures

Ms. Jennifer Kearns, SMD, provided background on the GPRAMA evaluation and presented the actions required of all federal agencies under the act:

- Develop and publish a strategic plan every four years.
- Develop an annual performance plan consistent with the agency budget.
- Produce an annual performance report.

She said that most of SMD's performance plan falls into two main categories—the progress of missions in formulation and development, and progress toward science objectives.

Ms. Kearns presented a chart of FY 2023 GPRAMA Science Performance Goals (see below), commenting that there were no changes to the chart from the previous year. Interdisciplinary goals show a green dot for the leading contributor and a yellow dot for supporting contributor(s). Goals highlighted in dark blue are those for which HPD is the leading contributor (1.2.1 and 1.2.6) and which require

HPAC review. Ms. Kearns read out a subcategory under 1.2.6 from HPAC's guidance letter that also required committee review: "Advancing scientific understanding of background solar wind, solar wind structures, and coronal mass injections, which can be integrated into key models used to predict the arrival time and impact of space storms at Earth."

FY23 GPRAMA Science Performance Goals

PERFORMANCE GOALS	APD	ESD	HPD	PSD	BPSD
1.1.1 NASA shall demonstrate progress in characterizing the behavior of the Earth system, including its various components and the naturally-occurring and human-induced forcings that act upon it.		●			
1.1.2 NASA shall demonstrate progress in enhancing understanding of the interacting processes that control the behavior of the Earth system, and in utilizing the enhanced knowledge to improve predictive capability.		●			
1.2.1 NASA shall demonstrate progress in exploring and advancing understanding of the physical processes and connections of the Sun, space, and planetary environments throughout the Solar System.		○	●	○	
1.2.2 NASA shall demonstrate progress in exploring and probing the origin, evolution, and destiny of the galaxies, stars, and planets that make up the Universe.	●		○	○	
1.2.3 NASA shall demonstrate progress in exploring, observing, and understanding objects in the Solar System in order to understand how they formed, operate, interact, and evolve.			○	●	
1.2.4 NASA shall demonstrate progress in discovering and studying planets around other stars.	●		○	○	
1.2.5 NASA shall demonstrate progress in improving understanding of the origin and evolution of life on Earth to guide the search for life elsewhere, exploring and finding locations where life could have existed or could exist today, and exploring whether planets around other stars could harbor life.	○		○	●	
1.2.6 NASA shall demonstrate progress in developing the capability to detect and knowledge to predict extreme conditions in space to protect life and society and to safeguard human and robotic explorers beyond Earth.			●		
1.2.7 NASA shall demonstrate progress in identifying, characterizing, and predicting objects in the Solar System that pose threats to Earth or offer resources for human exploration.				●	
1.2.8 NASA shall demonstrate progress in understanding the properties of physical and biological systems in spaceflight environments to advance scientific knowledge, enable space exploration, and benefit life on Earth.					●

● Leading contributor ○ Supporting contributor

To aid the discussion, HPD provided HPAC with a document containing examples of science results from the past year. The Committee was free to add any relevant items of their own as long as they 1) clearly advance the existing body of knowledge, 2) result in whole or in part from NASA funded programs/data, and 3) be from the period aligning roughly with FY 2023. Ms. Kearns said that SMD preferred examples from peer-reviewed literature. HPAC's evaluation was intended to be a high level—not comprehensive—assessment. She added that the evaluation should be an objective assessment, not an advocacy exercise.

The GPRAMA color ratings are:

- GREEN: Expectations for the research program fully met or exceeded in the context of resources invested.
- YELLOW: Some notable or significant shortfalls, but some worthy scientific advancements achieved.
- RED: Major disappointments or shortfalls in scientific outcomes, uncompensated by other unusually positive results.

Assigned color ratings are key to meeting GPRAMA requirements, Ms. Kearns explained, but the

accompanying text that the Committee provides is also helpful to SMD in preparing the agency's annual performance report, especially in identifying the results that HPAC finds to be the most important. The exception is a result seen as being much too technical for an intelligent lay audience to grasp. Ms. Kearns welcomed suggestions for images to include in the report. She said the character limit for text in the annual performance report has been raised from about 300 words to up to 500 words. She said that SMD likes to include links where readers can find additional information. Ms. Kearns concluded that she would remain online to answer questions as the Committee went through the GPRAMA process. At the request of HPAC, Ms. Kearns said she would resend the guidance letter containing the text for the third area requiring GPRAMA review.

GPRAMA Discussion

Dr. Cassak opened the HPAC discussion of Science Performance Goal 1.2.6:

1.2.6 NASA shall demonstrate progress in developing the capability to detect and knowledge to predict extreme conditions in space to protect life and society and to safeguard human and robotic explorers beyond Earth.

Dr. Cassak noted that NASA provided examples as evidence of success toward reaching GPRAMA performance goals. Dr. Chris Englert, HPAC Vice Chair, commented that while it might be more natural to have a solar example for an extreme condition, he resonated with the example during which several SpaceX satellites were launched into very low Earth orbit and were lost. He said the public visibility of this event would help an audience of informed non-experts recognize the importance of predicting extreme conditions.

Dr. Lisa Upton highlighted the example of applying data analysis to quasi periodic oscillations in the near surface solar shear layer to get a better look at the flows on the surface of the sun and understand the solar activity cycle.

Dr. Gkioulidou pointed to a study of long-term space weather effects investigated for much longer periods of time over a solar cycle.

Dr. Cassak explained that when citing evidence for HPD's progress toward a goal, HPAC need only include one summary from one research result. However, multiple pieces of evidence make the HPAC report more representative of different areas in the field. Dr. Englert commented that it might be useful to state that HPAC is not trying to be comprehensive, but simply provide examples to back up its findings.

Dr. Zirnstein said that an item under Performance Goal 1.2.1 concerning the Parker Solar Probe's detection of a possible source driving the solar winds would fit better under the subcategory of 1.2.6 on advancing understanding of solar wind structure and space storm prediction. Dr. Cassak explained that HPAC would vote first on 1.2.6, then vote separately on the subcategory. He said the vote on the GPRAMA goal is based on open discussions and independent of the final write-ups, which HPAC would work on after the vote. He noted that issues that have stood in the way of voting green include missions not being launched on time and large overruns. He emphasized the importance of HPAC members raising any concerns they may have.

HPAC voted unanimously to give a green ranking to Science Performance Goal 1.2.6 as follows:

GPRAMA 1.2.6 Vote:
Green: 13
Yellow: 0
Red: 0

(1 abstained due to absence)

HPAC members raised no objections to the three pieces of evidence showing HPD progress toward the goal. Dr. Cassak said the Committee could wordsmith its GPRAMA report during the upcoming closed work session.

HPAC next discussed Science Performance Goal 1.2.8., which Dr. Cassak pointed out was labeled by old numbering:

1.2.8 Advancing scientific understanding of background solar wind, solar wind structures, and coronal mass injections, which can be integrated into key models used to predict the arrival time and impact of space storms at Earth."

Dr. Zirnstein again brought up his example of the drivers of solar winds as evidence of HPD achieving this goal. Dr. Brain asked if anyone could share expertise on the second half of the goal—integration into predictive models. Dr. Upton commented that researchers are working on integrating observations into models.

HPAC voted unanimously to give a green ranking to Science Performance Goal 1.2.8 as follows:

GPRAMA 1.2.8 Vote:
Green: 13
Yellow: 0
Red: 0
(1 abstained due to absence)

Committee members raised no objections to the evidence of progress.

HPAC next discussed Science Performance Goal 1.2.1:

1.2.1 NASA shall demonstrate progress in exploring and advancing understanding of the physical processes and connections of the Sun, space, and planetary environments throughout the Solar System.

Dr. Lisa Danielson joined the discussion as a representative of the Planetary Science Division. Dr. Zirnstein presented as evidence of progress a recent study that reanalyzed measurements of the interstellar magnetic field from the Voyager spacecraft. As the Voyager spacecraft move further and further away from the heliosphere, there is supposed to be an undraping of the magnetic field into a uniform pristine field, and the measurements of the two Voyagers should approach each other. The Voyager spacecraft are showing that this is not happening when the data are taken at face value. The scientific community is trying to understand why. The study shows that if researchers consider previously unknown uncertainties and reanalyze the evolution of the field direction and strength from the Voyager spacecraft as they move further away from the heliosphere, results do agree with existing models.

Dr. Zirnstein said that these are the first results that help researchers understand these measurements from the Voyagers. Scientists can now predict how far away in different directions in the sky interstellar missions must go to measure the pristine interstellar medium and how the heliosphere affects the local and interstellar media at different distances and in different directions.

Dr. Laura Peticolas commented that a lot is said about magnetic reconnection in heliophysics papers and now a wonderful observatory is taking measurements right within the area where this magnetic release happens. This year, researchers are starting to look at how turbulence affects magnetic reconnection. There has been compelling evidence that turbulence does not impede magnetic reconnection and in fact, enhances it.

Dr. Aroh Barjatya discussed his write-up on the effect of the measurement of interplanetary and interstellar dust clouds by the Wind spacecraft to predict the meteor smoke and material entering the Earth's atmosphere that led to the discovery of an unexpected two-year solar magnetic cycle. This shows the integration between the heliosphere and the mesosphere. He said he wanted to highlight the fact that space weather also comes from stratospheric and mesospheric sources and connects NASA's GOLD and Aeronomy of Ice in the Mesosphere (AIM) missions and their contributions to the understanding of lower atmospheric effects propagating up. He suggested acknowledging that there is a space center of excellence focused on these effects from below.

Dr. Danielson provided two references that highlight 1.2.1—a paper on the moon in the magnetotail of Earth and a comparative study of the magnetic flux ropes in the nightside induced magnetosphere of Mars and Venus. She said the paper shows the planets' localized magnetic phenomena to be surprisingly similar.

HPAC voted unanimously to give a green ranking to Science Performance Goal 1.2.1 as follows:

GPRAMA 1.2.1 Vote:
Green: 13
Yellow: 0
Red: 0
(1 abstained due to absence)

HPAC members agreed that the interplay of Earth's weather and space weather needs to be represented in the goal's support section. They supported an effort to convey that this is an important region where things are happening that influence Earth on multiple levels.

HPAC then went into closed session to craft paragraphs of evidence supporting their green rankings of the three performance goals in a way that is understandable by an intelligent lay person, defined as someone with a non-science college degree.

IDEA

Dr. Kelly Korreck briefed HPAC members on NASA's focus areas from its 2022 Equity Action Plan: expand use of contractors from underserved communities, enhance grants and cooperative agreements to advance opportunities for underserved communities, leverage Earth science and socioeconomic data to mitigate environmental challenges in underserved communities, and advance civil rights compliance.

She also outlined SMD IDEA strategic priorities for 2022-2023. Within SMD, these include: expand entry and career pipelines, develop a robust infrastructure for IDEA implementation, and commit to accessibility. Community-facing priorities are building a science team that reflects the nation, and strengthening relationships with underserved communities through initiatives such as the SMD Bridge Program.

The HPD IDEA Working Group is committed to specific IDEA goals, including sponsoring activities, such as DRIVE centers, that engage youth and the rest of the public with SMD science; continuing the early- and mid-career support pilot; and using best IDEA practices for recruiting efforts. 2023 IDEA efforts include workshops, communications, and research projects in a broad range of heliophysics. Dr. Korreck also shared that the Interstellar Mapping and Acceleration Probe (IMAP)/Student Collaboration passed its instrument Critical Design Review (CDR). SMD's Diverse Leadership – Career Growth Group, led by Dr. Katya Verner, established an SMD mentor-mentee network and is preparing for Mentor Day in early 2024.

Dr. Korreck outlined ways in which HPD is supporting inclusion in ROSES, among them DAPR expansion. She discussed DAPR's implications for IDEA, remarking that unconscious bias is not

discrimination or prejudice, but a part of the human psyche that can be mitigated through awareness, policies, and practices. She described DAPR's "expertise and resources (E&R) reveal phase," designed to determine through a non-anonymized appendix whether the availability of expertise and resources are as promised in the proposal text. The E&R assessment does not change the score or affect the science evaluation.

Ms. Denise Hill highlighted IDEA's focus on outreach and engagement activities. She commented that IDEA is about more than race, gender, and ethnicity, and must encompass areas such as making SMD science accessible in rural communities. She noted that HPD is also working to broaden who does outreach, so that representatives showcase different faces, jobs, and points of view at NASA.

Heliophysics outreach and engagement also includes the NASA international, completely virtual, Space Apps Challenge. The heliophysics eclipse challenge attracted the second highest number of participants in the history of Space Apps. Ms. Hill said that IDEA is an integral part of HBY. Examples include Braille books, materials in multiple languages, and a wide range of engagement sites.

During a Q&A session after the presentation, Dr. Thompson brought up the topic of how to measure IDEA goals and successes, acknowledging that there are limitations on providing metrics. Dr. Korreck said that the ultimate IDEA goal is to have NASA science reflect the American public. She acknowledged that intermediate steps will be necessary and her team has not fully worked out how to assign numbers. Dr. Thompson replied that to aim to look like "the American public" suggests there is a way to assess and quantify the balance in the NASA team. Dr. Korreck said that at the SMD level, there are staff who are looking at numbers, metrics, and demographics of recently collected information. The numbers are small and there are only a few years' worth of data. She suggested that HPAC may want to make a recommendation to look at available numbers. Dr. Thompson said that measurements for the recruitment, retention, and promotion pipeline would help those interested in implementing IDEA.

Dr. Cassak asked when SMD inclusion plans would be expanded to encompass other elements, noting that the Department of Energy (DOE) recently strengthened its IDEA program to encompass every proposal. Dr. Korreck said that a small number of programs are included while the IDEA team determines how to make it most effective. DRIVE Centers and centers of excellence can have more extensive plans because they have more resources. The goal is to find a balance between IDEA and the level of resources available. Dr. Koehn reiterated that SMD is still trying to figure out next steps to partition funding for inclusion plans into ordinary grants. Implementing IDEA for a $250k grant is much more challenging than for larger scale operations such as SWC and centers of excellence. He added that in ROSES24, inclusion provisions will be added for citizen scientists. The focus right now is on inclusion.

Heliophysics Big Year – Solar Eclipse

Dr. Korreck, who is Program Manager for the 2024 Solar Eclipse, cited safety as NASA's number one priority, through actions such as distributing one million eclipse viewing glasses to partners, producing safety flyers, and engaging celebrities to make safety announcements. She also listed engagement activities, noting 11M views of the HBY broadcast in English and 2.1M in Spanish. Evaluators gauged the impact of outreach activity attendance by speaking to festival attendees about what they learned and evaluated the effect of talks in schools on the Science, Technology, Engineering, and Math (STEM) pipeline. NASA priorities for 2024 include the same emphasis on safety, engagement, and promoting science. Dr. Korreck noted that Earth is the only planet in the solar system with a moon large enough to create a total eclipse.

Dr. Korreck said that three sounding rockets were launched before, during, and after the peak eclipse in 2023 and three will be launched in 2024 to explore how the eclipse shadow promotes irregularities in the

ionosphere, and how the ionosphere responds to changes in local density, temperature, and conductivity. She said this beautiful project answers many scientific questions and encourages citizen science. NASA also plans to launch high-altitude research planes to study a dust ring around the sun and search for asteroids and launch spectrometers to study the constant stream of particles emitted from the Sun. Dr. Korreck concluded by discussing other science and citizen science research scheduled for 2024 and presenting a list of how HPD scientists can get involved in outreach.

Dr. Duncan asked during a Q&A session after the presentation whether the HBY team has a metric-based goal for participation. Dr. Korreck said that she does not have an overall metric, but those offering individual activities often have goals for how many people they want to reach. Dr. Englert asked how many outreach efforts are "train the trainers." Dr. Korreck said she challenged her team to reach as many of the 31.5M people as possible who are along the eclipse's direct path and the 200M people within a six-hour drive. HBY staff are rising to the goal with efforts such as outreach training for anyone with grants or other involvement in the eclipse, and outreach aimed at universities for both graduate and undergraduate students. The Office of Student Engagement has relationships with school boards in all 50 states and offers workshops. Dr. Korreck said there is agency-level support for all these efforts.

Heliophysics Strategic Technology Office (HESTO) Update

HESTO was put in place in 2020 to expand the limits of what is measurable and observable in heliophysics through investment in novel and transformative space-based advanced instrument technologies and mission concepts, said Dr. Roshanak Hakimzadeh. HESTO seeks to publish and patent results for others to pick up and develop further.

Two ROSES technology elements have been brought into HESTO's program line:

ROSES Heliophysics Technology and Instrument Development for Science (HTIDS) – The solicitation is updated annually to incorporate new initiatives. In 2023, for example, non-heliophysics technologists were solicited to expand the small heliophysics scientific community to encompass innovation outside the box. HESTO also seeks to develop high risk/high impact transformative technologies, Dr. Hakimzadeh told HPAC members.

ROSES Heliophysics Flight Opportunities Studies (HFOS) – The program provides seed money for one year to develop mission concepts so they are ready for proposal in a much larger mission.

HESTO does not manage the funding of the Small Business Innovation and Research (SBIR) program, explained Dr. Hakimzadeh, but contributes to the proposal selection process for remote instruments and space weather. The Future Investigators in NASA Earth and Space Science Technology (FINESST) solicits proposals for graduate student projects to help their technologies not only be considered for HESTO's portfolio, but for infusion into future missions. The ROSES Heliophysics Low-Cost Access to Space (HLCAS) is released annually with ROSES, and although it is not a technology program, it is relevant to HESTO through maturation of sounding rockets and balloons.

Dr. Hakimzadeh provided a narrative of HESTO's establishment at the Wallops Flight Facility (WFF). HESTO provides oversight of each technology investigation, including quarterly meetings with PIs to review their progress. Periodic technology gap and trend analysis steers HESTO toward investing in the right technologies. The first analysis was published in June 2023, with feedback from the scientific community encouraged. She emphasized that HESTO does not want to conduct its work in a silo and welcomes community engagement. To that end, HESTO is developing a collaborative website and will conduct annual hybrid technology symposia at WFF. One goal is for mission and technology PIs to collaborate. HESTO has its first annual technology highlights report in the works and is putting in place the Heliophysics Technology Program Analysis Group (H-TPAG), with the chair already chosen. H-

TPAG will be a community-run group (not a FACA committee) that will meet one or two times a year, possibly in conjunction with conferences, and provide an annual report to mission management.

Dr. Hakimzadeh concluded by presenting a chart of 2023 HESTO statistics on its 56 active projects, including six non-heliophysics PIs and 30 first-time PIs. She said that HESTO wants to grow both groups.

During a Q&A session following the presentation, Dr. Hakimzadeh explained that SMD has a Technology Federation Group where HESTO meets with Earth Science, Astrophysics, and the Planetary and Biological Sciences to share technologies, highlights, and collaborative initiatives. She was asked if HESTO plans to expand its scope to include computational and data technologies or material science. She replied that the office does not prohibit PIs from proposing computational science or tools. As far as material science, she says HESTO is encouraging material scientists and mechanical and electrical engineers to propose projects that can be morphed into a larger instrument measurement technique or hardware. There is extensive collaboration with the Space Technology Mission Directorate (STMD), including through the SMD Technology Federation and on solicitations. STMD primarily funds platform technology, while HESTO primarily funds instrument technology.

Dr. Zirnstein asked Dr. Hakimzadeh to elaborate on HESTO's non-U.S. collaborators. She said that HESTO does not fund international scientists, but it collaborates with them. Dr. Koehn confirmed that international scientists cannot be paid participants unless affiliated with a U.S. institution.

Dr. Hakimzadeh responded to an HPAC query that due to time constraints, the first gap analysis was more of a data mining analysis. The next gap analysis will include an archive and the intent is to come out with a request for proposals (RFP). Proposals will specifically address the technological gaps to advance heliophysics science.

Heliophysics Data Library

Mr. Matthew McClure told HPAC members that the Heliophysics Digital Resource Library (HDRL), also known as the archives, is managed by the Heliophysics Science Division at Goddard Space Flight Center. He said that HDRL is where the Heliophysics System Observatory (HSO) comes together. He explained that the HDRL allows scientific analysis of the HSO by curating big data, supporting data analysis and modeling, and designing and implementing a collaborative open science infrastructure. He said all HDRL components—the Space Physics Data Facility (SPDF), Solar Data Analysis Center (SDAC), and the HP Data and Model Consortium (HDMC)—are interrelated and include outside collaborators.

Program highlights include:

- The HelioCloud pilot program, with more than 600TB of data, including the SPDF and SDAC.
- HDRL workshops on how the community is using the data.
- The Python in Heliophysics Community (PyHC) program.
- HDRL Open Science, including new staff for Open Science Support.

SPDF archives *in situ* data from NASA heliophysics missions and other divisions and partners. SPDF archives 563TB of data in 174M files, with about 2300 datasets in Coordinated Data Analysis Web (CDAWeb) and 1000 not in CDAWeb. SPDF also builds the critical infrastructure that makes HDRL useful, including the Common Data Format (CDF) and metadata standards. SPDF and its services were cited by 40 percent of the main space journals in 2022.

SDAC supports data curation and analysis from the solar side, with about 2PB of total data. It is integrated with the National Center for Climate Simulation. SDAC is also starting to develop the

Heliophysics Event Knowledgebase to include non-solar event data.

Dr. McClure told HPAC members that Open Science is a high priority of HPD and in developing HDRL capability. He said that Open Science must be accessible, reproducible, and inclusive. He noted that papers published openly and freely end up being cited more often and have a longer shelf life. The White House declared 2023 the Year of Open Science. This multi-agency initiative across the federal government addresses issues such as unifying metadata standards so researchers can access a variety data in more than one archive.

SPD-41a is SMD's updated Scientific Information Policy to consolidate existing federal and NASA policy on sharing scientific information. The policy spells out how SMD will implement Open Science principles. HDRL updates its own policies to make sure they align with SPD-41. Updates include:

- Peer-reviewed publications are openly available with no embargo period.
- Research and data software are shared at publication time or the end of the finding award.
- Mission data are released as soon as possible (six months for HPD) and unrestricted mission software is developed openly.
- NASA-funded science workshops and meetings are held openly to allow broad participation.

Dr. McClure noted that many links on the heliophysics data webpage are broken, but being fixed. He added that HDRL is developing a data handbook as a practical how-to guide on HDRL data policy. He presented HDRL future priorities as continued outreach, including through workshops and the website; Open Science initiatives; and data discovery. This encompasses improved data search and integration, and improvement of metadata standards.

During a Q&A session following the presentation, Dr. Zirnstein confirmed that Open Science includes codes and algorithms in research publications. He also asked Dr. McClure whether HDRL will have one point of entry for data access. Dr. McClure said one point of entry would be ideal. He continued that over the next year, HDRL will work to consolidate its presence on scattered websites to create this single point of entry. Earth Science data has done a great job of this, he said, and HDRL is working with those developers.

Dr. Upton commented that she is particularly excited about services that allow researchers to easily share their videos. She said that as a scientist who produces a vast amount of model data, she has struggled with unwieldy online resources. Dr. McClure said that HDRL is working with the Office of Chief Science Data to develop technologies that can cross divisions to improve the experience for all researchers. HDRL is also working to use different computer resources to help researchers where they are, including in the cloud or on-premises. He said a solution will be coming within the next year and improvement will be continuous.

Dr. Duncan asked about progress on interagency data accessibility. Dr. McClure said that NASA is already working with DoD and has hosted its data. Dr. Thompson asked if HDRL plans to make research funding information searchable. Dr. McClure said that although it was a great idea, no such searchable information exists right now. Dr. Thompson said she would send a sample format, noting that it would be especially useful for early career people to see the type of research that gets funded. Dr. McClure also informed HPAC that HDRL is not currently set up for access to low latency data in real time, but it could be done with the proper infrastructure.

Public Comment

The meeting was opened for comment from members of the public, but no one came forward.

Recommendations & Findings

IDEA - HPAC members discussed Dr. Thompson's suggestion that HPD needs metrics to quantify the success of IDEA. Dr. Cassak said that developing metrics for success are challenging, such as setting a number for desired attendees for one-time outreach events and comparing that number to actual attendance. Dr. Thompson said there are gradations to quantifying success and one size does not fit all. The four steps to strong metrics are to make it possible, make it easy, make it standard, then make it required. Requiring metrics for a random public outreach event may not make sense, but there needs to be some means of evaluating progress on IDEA. If inclusion plans are going to be part of evaluation criteria for proposals, there should be some guidelines.

Dr. Cassak said an HPAC recommendation would have to be actionable and specific. HPAC could recommend that the IDEA team take action to set metrics rather than have the Committee attempt to set specific metrics. Dr. Barjatya commented that according to his understanding, proposals are required to have inclusion plans, but they are not a factor in selection. NASA headquarters knows that big institutions with deep pockets have staff who can write good plans, and they should not have an advantage over smaller entities. Proposals are judged on the science, with discussions on improving inclusion plans after the selection is made.

Dr. Marco Velli asked if getting feedback from the public should be part of an assessment. That is one option for assessing outreach, said Dr. Cassak, but it is very difficult to get feedback from teachers. Dr. Thompson suggested that HPAC could make a brief finding or recommendation on assessment metrics, then request a more in-depth discussion at the next meeting as part of the agenda. Another possibility would be for HPAC to recommend that HPD investigate steps that can be done right now to gather relevant data, said Dr. Englert.

HPAC took up the topic of implicit bias training before participation in DAPR. It was suggested that slides on implicit bias could be included in the packages sent to potential reviewers. Dr. Cassak pointed out that at NSF, once a person agrees to be a reviewer, they do not get access to the proposal before watching an implicit bias training video. HPAC members discussed the fact that some evidence suggests that training can increase bias, depending on the timing of when it is given. The factor affecting implicit bias the most is to avoid rushing reviewers into snap decisions.

According to the earlier presentation, the ultimate goal of the IDEA program is to have the NASA workforce represent the nation. HPAC members discussed how indicators could measure progress toward that goal. Such metrics could be applied to areas such as post-doctoral or recruiting programs. Several HPAC members emphasized that inspiring people to seek a NASA career begins with outreach to the young in their communities. Rather than trying to evaluate the effects of this outreach after it takes place, it might be useful to set targets to communicate in the first place and ensure the quality of those communications. Teacher feedback might also produce some data, although elementary school teachers are busy.

Dr. Englert volunteered to write a recommendation on IDEA metrics and exploring how data gathering could be done in the short and medium term. Dr. Duncan voiced support for the IDEA team's actions, calling them broad-based and on point. She said kudos should be included in the Committee recommendation. Dr. Cassak added that IDEA can also be included in the final report section commending various HPD activities.

HESTO – Dr. Kamalabadi said that the "strategic technology" in the name HESTO is currently interpreted as sensing technology relevant to space hardware. There are many other technologies—such as scientific inference based on data and computational technique—that can advance the science mission of the division. HPAC members discussed expanding the focus of what technology means, since many

types of technologies can contribute to HPD's goal of advancing heliophysics science.

Dr. Kamalabadi agreed to take the lead on writing findings and recommendations for HESTO.

HDRL – Dr. Zirnstein suggested a recommendation that HDRL continue to improve its website to make data more accessible, so that users can find links to the specific kind of data they need. Dr. Thompson added her suggestion that HDRL have the capability to manage cross-queries to databases on selected and funded proposals.

Dr. Zirnstein agreed to take the lead on findings and recommendations, with Dr. Thompson's assistance.

Dr. Duncan added that HDRL should be encouraged to engage with the space weather community and partner agencies to develop a plan to address data accessibility across their numerous datasets.

SWC - HPAC members tabled the topic of sending up the SWC report to HPD so that Committee members have time to read it, formulate comments, and conduct discussion at the next meeting.

The Committee then discussed recommendations to the SWC on tasks to take up in 2024:

- Continue to coordinate among other space weather groups. Expand discussion to include international entities.
- A key to coordination has been having members that are on two or more relevant groups, which ensures tighter communication. Continue this joint membership model even after current members move out of their roles.
- Continue R2O2R discussions and continue to make the process more accessible to proposers.
- Discuss the possibility of a space weather gap filling analysis and provide recommendations from HPAC on the study's scope.
- Continue to report on space weather aspects of the Moon to Mars program and provide recommendations on space weather needs and opportunities.
- Emphasize lessons learned that can be passed among divisions; for example, the space weather program to Earth science applications.

Dr. Duncan said she would take the lead on SWC recommendations.

HPAC members went into a closed session to conduct preparatory work before adjourning for the day.

Thursday, November 16, 2023

Welcome to Day 3
Dr. Kozyra brought the HPAC meeting to order and turned proceedings over to Dr. Cassak.

Overview of Agenda
Dr. Cassak said that HPAC members would first conduct a closed work session to complete materials for the Committee's final report, take a break, conduct a discussion session, and report out to the HPD Director.

HPAC Work Session Preparatory Material (Closed)

HPAC Discussion
HPAC returned from the closed session to discuss findings and recommendations. Topics discussed included:

- HESTO - HPAC members discussed a finding commending HESTO for its role in cultivating innovations in sensing technologies for space flight hardware and a recommendation that HESTO broaden its exploration of additional strategic technologies, such as data-enabled computational technologies. Dr. Duncan suggested adding a sentence about the fact that SWAG made a similar recommendation to SWORM, with a citation. HPAC members also suggested that a sentence be added about the transformative potential for heliophysics science of inherently multi-disciplinary research themes. HPAC members agreed that their recommendation should not attempt to micromanage how HESTO implements consideration of new technologies.
- DAPR – HPAC members concluded that the recommendation to track DAPR's impact should include effects on both the intended objectives and how unintended consequences might affect areas such as scientific return or achievement of project success.
- HSO Infrastructure – HPD needs to communicate to the broader community the implications of missions' transition to HSO infrastructure, HPAC recommended. One possible effect of these transitions may be budget burdens placed on R&A programs that use data from those missions.
- GDC and DYNAMIC – Before approving a recommendation, HPAC members discussed the need for something actionable that does not micromanage the solutions or attempt to tell NASA what its priorities are.
- IDEA – HPAC members approved a simple recommendation that the IDEA team lead development of metrics to measure the success and/or impacts of their activities within the limits of the Paperwork Reduction Act and present that information at a future HPAC meeting. Committee members also emphasized the importance of the finding that the IDEA team is highly capable, enthusiastic, and dynamic.

HPAC Report Out to HPD Director
HPAC reported out findings and recommendations to HPD Acting Director Peg Luce and HPD Acting Deputy Director Therese Jorgensen. This included a letter read aloud by Committee members that explained the HPAC's process for GPRAMA review, the results of the Committee's rating of performance goals, and accompanying evidence demonstrating that goals were met. Dr. Luce commended the Committee for capturing the excitement of the science in clean language that is perfect for the audience.

Dr. Cassak presented The Heliophysics Advisory Committee Report, including a meeting summary, a listing of HPAC members, and thanks to speakers for preparing material for the meeting. He said that HPAC welcomes requests from HPD for clarification or elaboration on the report's findings and recommendations. He read a list of successes for which HPAC commended HPD since the last Committee meeting, expressed gratitude to Drs. Luce and Jorgensen for their acting leadership roles at HPD in a time of community need, and thanks to Dr. Kozyra and the HPAC team for organizing the meeting.

HPAC members then read aloud the findings and recommendations. Brief synopses follow:

- GDC and DYNAMIC – A finding commending HPD for implementing GDC and DYNAMIC despite difficulties and a recommendation that HPD explore all options for pursuing GDC and DYNAMIC science.
- HSO Infrastructure Missions – A finding that mission transfer to HSO is reasonable and recommendations on better communicating with the broader community the implications of a

mission's transfer and whether such transfers put a budget burden on R&A programs.

- R&A Funding Level – A finding that commends HPD for working to preserve the R&A budget and a recommendation to share this process more broadly with the community.
- SWC – A finding that lists the impressive array of SWC activities over the past year and recommendations for activities in the following year.
- R2O2R – A finding that commends HPD for its efforts to improve cross-agency cooperation on R2O2R and a recommendation that HPD explore ways to streamline this proposal process.
- Reporting Proposal Success Rates – A finding that HPD reported R&A proposal success rates to HPAC and a recommendation for ways to improve the information content in the messaging.
- DAPR – A finding that commends HPD on implementing DAPR and ongoing efforts to assess DAPR impacts on intended objectives, and a recommendation that HPD continue this assessment to attain statistically significant data that allow meaningful comparisons.
- IDEA – A finding commending IDEA activities and a recommendation that the IDEA team develop metrics to assess the success and/or impact of their activities.
- HBY – Findings that HBY is an exciting and potentially important theme for the heliophysics community and that HBY's plans to capitalize on heliophysics events in various ways are good ideas, and recommendations for ways to capitalize on other resources.
- HESTO – A finding that commends HPD on the forward-looking activities that culminated in the establishment of HESTO and its valuable role in cultivating innovations in sensing technologies for spaceflight hardware. A recommendation to consider broadening exploration of additional strategic technologies, including data-enabled computational technologies.
- HDRL – A finding that commends the HDRL for its effort to unify access to HSO data resources and recommendations to continue improving users' ability to search for data from specific missions and selected proposals, upgrade the website to track the usage of data analysis tools, and engage with the space weather community to address space weather data accessibility across numerous datasets.

Dr. Cassak concluded by thanking HPD for quickly assembling a great Committee that accomplished a lot. Drs. Luce and Jorgensen called HPAC's findings, recommendations, and observations on point and helpful. The report gave a fresh perspective to topics that HPD leadership thinks about every day. They commended the Committee for accomplishing so much in such a short amount of time and giving helpful advice from a group with a broad variety of backgrounds.

The Committee went over some minor edits, and had a preliminary discussion about the date for the next HPAC meeting.

Adjourn

The meeting adjourned at 12:00 p.m.

Appendix A
Participants

Heliophysics Advisory Committee Members

Paul Cassak, West Virginia University, Chair
Christoph Englert, U.S. Naval Research Laboratory, Vice Chair
Janet Kozyra, NASA Headquarters, Executive Secretary
Aroh Barjatya, Embry-Riddle Aeronautical University
David Brain, University of Colorado, Boulder
Nicole Duncan, BALL Aerospace
Malamati Gkioulidou, Johns Hopkins University
Farzad Kamalabadi, University of Illinois at Urbana-Champagne
Laura Peticolas, Sonoma State University
Chadi Salem, University of California, Berkeley
Barbara Thompson, Goddard Space Flight Center
Lisa Upton, Southwest Research Institute
Marco Velli, University of California, Los Angeles
Jia Yue, Catholic University of America
Eric Zirnstein, Princeton University

Other

Jay Albert
Nathan Boll
Joe Borovsky
Pontus Brandt
Maria Busuioceanu
Christopher Caisse
Tyler Cingle
Tammy D
Lisa Danielson
David Darbouze
Shaun Deacon
Tammy Dickinson
John Dyster
Deborah Eby
VF
Susanna Finn
Griffin Farris
Jamie Favors
Galen Fowler
Nicola Fox, *Heliophysics Division Director*
Lindsay Goodwin
Ha-Hoa Hamano
Denise Hill
Russ Howard
Bethany Johns
Therese M. Jorgensen
Jennifer Kearns
Kelly Korreck
Jared Leisner Int
Devri Intrilligator
Skylar Kleinschmidt
Jared Leisner
James Lochner
Margaret Luce
Liz MacDonald
Amy Marshall
John McCormack
Monty
John Moses
Tetsuo Motoba
Asai Naseri
Jeffrey Newmark
Kennedy Novak
Gareth W. Perry
Carol Peterson
Simon Plunkett
Arik Posner
Ursula Rick
Kayla Rillo
Tara Roberts
Alvin Robles
Carolina Ravinskas
Nicki Rayl
Amy Reis
Roger Sanchez
Elizabeth Shume
Bishwas Shrestha
Derek Surka
Walter Twetten
Angelos Vourlidas
Joe Westlake
Matthew Zajac

Appendix B
Advisory Committee Membership

Paul Cassak, Chair
West Virginia University

Christoph Englert, Vice Chair
U.S. Naval Research Laboratory

Janet Kozyra, Executive Secretary
NASA Headquarters

Aroh Barjatya
Embry-Riddle Aeronautical University

David Brain
University of Colorado, Boulder

Nicole Duncan
BALL Aerospace

Malamati Gkioulidou
Johns Hopkins University

Farzad Kamalabadi
University of Illinois, Urbana-Champaign

Laura Peticolas
Sonoma State University

Chadi Salem
University of California, Berkeley

Barbara Thompson
Goddard Space Flight Center

Lisa Upton
Southwest Research Institute

Marco Velli
University of California, Los Angeles

Jia Yue
Catholic University of America

Eric Zirnstein
Princeton University

Appendix C
Agenda

Tuesday, November 14, 2023		
10:00	Welcome	Janet Kozyra, DFO, NASA
10:05	Introduction of Committee Members; Overview of Agenda	Paul Cassak, Chair
10:20	For New Members: HPAC Charter; Briefing on HPAC Operating Procedures	Janet Kozyra, NASA
10:45	BREAK	
11:00	Heliophysics Division News, Updates, Senior Review, and New Initiatives	Peg Luce/Therese Jorgensen/Nicki Rayl, NASA
11:30	Q&A	
12:00	LUNCH	
1:00	Space Weather Action Group and Space Weather Council Report	Nicole Duncan, SWC Chair
1:20	Space Weather Program Update	James Favors/Genene Fisher, NASA
1:50	R&A Update	Patrick Koehn, NASA
2:20	Solar Max/Heliophysics Big Year	Janet Kozyra/Elizabeth McDonald, NASA
2:50	BREAK	
3:00	HPAC Discussion (Potential Issues for Findings & Recommendations)	Paul Cassak, Chair
4:00	HPAC Work Session for Writing Preparatory Material	Closed Session
5:00	ADJOURN	

Wednesday, November 15, 2023		
9:30	Welcome to Day 2	Janet Kozyra, NASA
9:35	Overview of Agenda	Paul Cassak, Chair
9:45	GPRAMA Procedures	Jennifer Kearns, NASA
10:00	BREAK	
10:15	GPRAMA Discussion (including a representative from Planetary Science	Paul Cassak

	Division	
11:00	GPRAMA Work Session on Preparatory Material	Closed Session
12:00	LUNCH	
1:00	IDEA	Kelly Korreck/Denise Hill, NASA
1:30	Heliophysics Big Year – Solar Eclipse	Kelly Korreck, NASA
1:40	Heliophysics Strategic Technology Office (HESTO) Update	Roshanak Hakimzadeh, NASA
2:10	Heliophysics Data Library	Matthew McClure, NASA
2:30	Public Comment	
2:40	BREAK	
2:55	Recommendations & Findings	Paul Cassak
3:30	HPAC Closed Session for Preparatory Work	Closed Session
5:00	ADJOURN	

Thursday, November 16, 2023		
9:30	Welcome to Day 3	Janet Kozyra, NASA
9:35	Overview of Agenda	Paul Cassak, Chair
9:45	HPAC Work Session on Preparatory Materials	Closed Session
10:45	BREAK	
11:00	HPAC Discussion	Paul Cassak
11:30	HPAC Report Out to HPD Director	HPAC to Peg Luce/Therese Moretto-Jorgensen
12:00	ADJOURN	