NASA ADVISORY COUNCIL

HELIOPHYSICS ADVISORY COMMITTEE

October 27, 2021

Teleconference

MEETING MINUTES

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Michael Liemohn, Chair

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Janet Kozyra, Executive Secretary

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Wednesday, October 27, 2021

Overview of Agenda

Dr. Janet Kozyra, Executive Secretary for NASA's Heliophysics Advisory Committee (HPAC), opened the meeting. Dr. Michael Liemohn, HPAC Chair, welcomed the participants and reviewed the agenda, noting that there would be a public comment period between 6:00 and 6:10 p.m. The primary purpose of this virtual meeting was do to the annual Government Performance and Results Act Modernization Act (GPRAMA) performance review, which would include discussion and voting. There would also be an update on NASA's Heliophysics Division (HPD) from Dr. Nicola Fox, HPD Director, along with a question and answer session.

Dr. Liemohn then called roll of the HPAC members. Joining the meeting for the GPRAMA review were Dr. Sara Tucker, Acting Chair of the Earth Science Advisory Committee (ESAC), and Dr. Conor Nixon of the Planetary Science Advisory Committee (PAC).

Welcome Remarks

Dr. Fox welcomed the Committee members and thanked HPD staff for their work. She made special mention of Dr. Kozyra, who is stepping down as HPAC Executive Secretary. After this meeting, Dr. Kelly Korreck will serve in that role.

GPRAMA Process

Ms. Jennifer Kearns of the NASA Science Mission Directorate (SMD) provided background on GPRAMA, which requires each Federal entity to provide a strategic plan, an annual performance plan, and an annual performance report to evaluate progress made in key areas. In SMD, the performance measures address milestones for missions and development. For each of the nine science performance goals, one SMD division's advisory committee leads the performance review and committees from designated divisions provide input. The SMD science performance goals with primary and secondary review responsibilities are in Table 1, below.

Table 1

PERFORMANCE GOALS		APAC	ESAC	HPAC	PAC
1.1.1	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.		●	●	●
1.1.2	NASA shall demonstrate progress in exploring and probing the origin, evolution, and destiny of the galaxies, stars, and planets that make up the Universe.	●		●	●
1.1.3	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.			●	●
1.1.4	NASA shall demonstrate progress in discovering and studying planets around other stars.	●		●	●

1.1.5	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.	●		●	●
1.1.6	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.			●	
1.1.7	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.				●
1.1.8	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.		●		
1.1.9	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.		●		

Green = lead. Yellow = secondary.

HPAC had already contributed to the PAC and Astrophysics Advisory Committee (APAC) reviews.

Key to the GPRAMA evaluations are the color ratings:

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

HPAC was to take a recorded vote on the color rating for each of the performance goals. Ratings other than Green needed to have a clear rationale in the text.

Dr. Kozyra had already sent HPAC members a document with examples of science results from the past year. The Committee was free to add any relevant items to their own document, which was to support the color ratings. Examples were to represent a clear advancement and be the result of full or partial NASA funding. The time period under consideration was roughly Fiscal Year 2021 (FY21) or the time since the last HPAC meeting. SMD preferred examples from peer-reviewed literature, and this was to be a high-level document rather than anything comprehensive. SMD and the NASA CFO would use the HPAC document as the basis of a much shorter report.

Dr. Tomoko Matsui noted that HPAC had been told to evaluate a component of Goal 1.1.6, “Advance scientific understanding of background solar wind, solar wind structures, and coronal mass ejections, which can be integrated into key models used to predict the arrival time and impact of space storms at Earth.” She asked how the Committee was to address this. Dr. Liemohn said that the summary would include a sentence on it, and Ms. Kearns asked that HPAC take a separate vote on the item.

Discussion of Performance Goals, Accomplishments, and Voting

Dr. Liemohn explained that he had set up subgroups for targeted writing assignments. The Committee had not yet reviewed the material from ESAC or PAC. HPAC was free to write to the length they considered appropriate.

Performance Goal 1.1.1

> *"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. Therese Moretto-Jorgensen led the team that evaluated Performance Goal 1.1.1. The preliminary list included the following five examples:

- Interstellar Boundary Explorer (IBEX) observations over time have enabled 3D mapping of the full heliosphere.
- Multiple missions taking coordinated measurements provide new insights into how solar processes are coupled with conditions in the inner heliosphere for a range of events.
- The Magnetospheric Multiscale (MMS) mission made multiple findings related to the acceleration of charged particles.
- Observations from the Ionospheric Connection Explorer (ICON) continue to provide insight and strengthen understanding of thermosphere-ionospheric coupling.
- The Thermosphere-Ionosphere-Mesosphere Energetics and Dynamics (TIMED) mission supports citizen scientists in explaining a newly discovered form of aurora.

HPAC members suggested wordsmithing on most of these and more specificity on the ICON example.

Dr. Nixon then read the examples from the Planetary Science Division (PSD):

- Airglow and shocks in the upper atmosphere of Venus revealed.
- Progress on identifying the origins of density variability in the aerobraking region of Mars atmosphere.
- Distinctive summer clouds form from the ripples of a bumpy atmosphere near Mars's surface.

He explained that the Venus example was the result of NASA-funded modeling. It was possible that the first two might be more relevant. Dr. Matsui was not so sure about the modeling but thought the second one could relate to ICON and particle coupling. She suggested combining it with the other ICON example. Dr. Larisa Goncharenko wanted it to stand alone. She thought the second and third examples showed good cross-pollination between SMD divisions. Dr. Liemohn thought the second example was receiving more support.

Dr. Tucker read the Earth Science Division (ESD) contribution:

- Solar activity and responses observed in Balmer lines.

She said this looked at how emissions would vary by solar activities. Dr. Tucker added that she was impressed by all the HPD work that has had an impact on Earth science. There is a lot of important overlap. Dr. Liemohn said that he was not sure how SMD determined the lead and secondary designations, but Earth science had no secondaries. Dr. Tucker said she enjoyed learning about what HPD is doing. The example shows the use of ESD instruments in predicting solar events. Dr. Matsui added that this conversation illustrated the need for dialogue.

Dr. James Klimchuk had represented HPAC during APAC's GPRAMA review and thought a couple of its science highlights really belonged with heliophysics. He was surprised to not see them. Dr. Liemohn said that HPAC could add them later.

After further discussion, the initial draft included the following examples:

- IBEX observations over time have enabled 3D mapping of the full heliosphere.
- Multiple missions taking coordinated measurements provide new insights into how solar processes are coupled with conditions in the inner heliosphere for a range of events.
- MMS made multiple findings related to the acceleration of charged particles.
- Observations from ICON continue to provide insight and strengthen understanding of thermosphere-ionospheric coupling.
- TIMED supports citizen scientists in explaining a newly discovered form of aurora.
- Progress on identifying the origins of density variability in the aerobraking region of Mars atmosphere.
- Solar activity and responses observed in Balmer lines.

HPAC voted in the WebEx chat window, with Dr. Liemohn calling for it to be simultaneous so that there was no influencing. The vote was unanimous to give Performance Goal 1.1.1 a rating of Green.

Performance Goal 1.1.6

> *"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."*

Moving on to Performance Goal 1.1.6, Dr. Liemohn said that there were no other advisory committees involved in its review. HPAC was to vote twice on this one, for the overall goal and the subset.

Dr. Matsui led the subgroup, which voted to select the four examples below for HPAC:

- On the topic of geomagnetically induced currents (GMC), the Time History of Events and Macroscale Interactions during Substorms (THEMIS) mission provided the first coordinated observations of intense geoelectric fields and their magnetospheric origin during space weather events.
- Multiple missions combined to identify solar energetic particles (SEPs), along with Parker Solar Probe (PSP) measurements of solar origin particle events.
- The TIMED mission, with the Sounding of the Atmosphere using Broadband Emission Radiometry (SABER) instrument, observed the coldest mesosphere and lower thermosphere in over 250 years, which has implications for satellite drag and lifetime of space debris.
- Several missions in coordination predicted Coronal Mass Ejection (CME) arrival at Earth, combined with build up of magnetic energy in the corona that leads to eruptive events.

The THEMIS example had the strongest support, followed by the coordinated observations of SEP. The group struggled with the third example and did not have a consensus, but they ultimately chose TIMED/SABER. The fourth example, on CME, combined two studies.

Dr. Allison Jaynes said that the THEMIS example highlighted the intense geo-electric field and the prediction. Dr. Goncharenko added that it emphasized the understanding of space weather's impact on society, rather than being science for the sake of science. There was some wordsmithing on this and the SEP example.

For the TIMED/SABER example, Dr. Rebecca Bishop noted the overlap with Earth science, which Dr. Liemohn said he could mention in his cover letter. Dr. Bishop asked that he also refer to the national Space Weather Action Plan (SWAP). NASA is taking this seriously, and it is relevant to society and technical systems. Others agreed.

Subset of 1.1.6

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

The fourth example discussed above, on CME, was responsive to the subset of 1.1.6.

The vote on 1.16 was done in the WebEx chat simultaneously again, and was unanimous to give Performance Goal 1.1.6 a rating of Green. The Committee similarly voted for the subgoal, which also received a green rating from all members.

HPD Update

Dr. Liemohn announced that HPAC had a newly appointed Vice Chair, Dr. Moretto-Jorgensen. She will become Chair when Dr. Liemohn's term expires.

Dr. Fox presented an update on HPD activities, explaining that the Division was completing recommendations from the 2013 Decadal Survey (DS) and the subsequent mid-term assessment. HPD is expanding the Heliophysics System Observatory (HSO) with new missions, a robust suborbital program, and creative rideshare strategies. Twelve missions are in formulation or development and another six are under study. The Tandem Reconnection and Cusp Electrodynamics Reconnaissance Satellites (TRACERS) mission is going through Critical Design Review (CDR). Also of note are two missions of opportunity (MOOs), the recently confirmed Escape and Plasma Acceleration and Dynamics Explorers (ESCAPADE) mission to Mars, and 14 cubesats in development with another 4 on orbit. Dr. Fox showed a detailed DS implementation chart and a graphic of the entire heliophysics fleet by development and operational phases.

In the area of space weather, HPD is working with the Department of Defense (DOD) and National Oceanic and Atmospheric Administration (NOAA) on a framework to transition relevant NASA research, techniques, and technology to operations, and has issued a solicitation with the National Science Foundation (NSF). Dr. Fox reviewed accomplishments in this area, then focused on activities under the Promoting Research and Observations of Space Weather to Improve the Forecasting of Tomorrow (PROSWIFT) Act. PROSWIFT plays to NASA's strengths in heliophysics by enabling new missions, technology development, and research and modeling. Dr. Fox described specific NASA actions under PROSWIFT.

There has been a lot of activity in R&A, including a new strategy on citizen science incorporating the heliophysics Big Year (2023-2024), which focuses on three major heliophysics events in 2023-2025 (two solar eclipses and the solar maximum) to boost participation in a coordinated citizen science campaign. This builds on the success of the 2017 solar eclipse effort. HPD joined with the NSF Geospace Program for a summit that covered a range of topics and will lead to stronger collaboration. The Sounding Rocket Office has rescheduled and restarted Covid-delayed launches. HPD covers sounding rockets for all of SMD and has begun a series of launches from Australia.

To plan for the next DS, HPD and NSF held a preparatory workshop, which had a tremendous level of involvement. Among the areas of emphasis were inclusion, diversity, equity, and access (IDEA) within the community, and ways to develop and sustain healthy, multi-generational approaches for teaming.

Workshop sponsors received proposals for mission concept studies, some of which have been selected as the agencies move forward in developing the Statement of Task. HPD has expanded its early career (EC) roundtables to include mid-career participants. Dr. Fox listed some recent roundtable topics. The issue of EC scientists struggling as a result of pandemic led to the creation of Mentoring 365, which supports mentoring to foster a robust community, promote DEI, and help fill gaps. The program encourages everyone to be both a mentee and a mentor, and is examining different approaches to mentoring. Slides listed some of the IDEA approaches HPD can take and included some of the activities at Diversify, Realize, Integrate, Venture, Educate (DRIVE) centers.

In a step toward modernizing the data archives, HPD issued an RFI to address current and future needs. The Heliophysics Data Archives Strategic Working Group seeks to maximize the utility of HSO data while also supporting sustainability of the archives and public access to the data. The Working Group will use RFI responses to inform NASA's restructuring, expansion, and evolution of HPD's data archiving infrastructure. Dr. Fox introduced some new HPD employees, then closed by encouraging members of the science community to stay in touch with the Division and link to their publications.

Q&A with Nicky Fox

Dr. Matsui raised the issue of cooperation with ESD, explaining how Dr. Tucker and the HPAC members saw connections during the GPRAMA discussion. Dr. Fox said that while there is no formal program, the two divisions do work together and she has regular conversations with her ESD counterpart. She asked that HPAC stay on top of this and that members send her any suggestions they might have.

Dr. Klimchuk expressed his frustration with trying to piece together actual R&A funding from the NASA budget. When he first looked, R&A appeared to have been cut in the President's Budget Request (PBR), but that is not the case – instead, there are pockets of funds scattered throughout the budget adding up to a more satisfactory total. Some of these budget lines are hard to trace, however. He recommended that in addition to the official budget there be a supplemental document that shows what really is in R&A. He raised this issue a few years ago as well. Dr. Fox said that such a budget document does exist in the detail he requested, but it has to be cleared before she can send it out. She will distribute it as soon as she can. Dr. Paul Cassak said that he had encountered similar confusion and that the budget appeared to have decreased. Dr. Fox replied that the appropriated funds for the previous fiscal year were higher than the PBR, which has been the pattern. Sometimes a flat budget appears to be cut due to shifts in funds. For example, HPD created a technology program as directed, and that came out of R&A. The line itself is only a piece of R&A, and it is a component of other programs. She has to do it this way, but she can also pull together the document that Dr. Klimchuk requested.

Dr. Cassak thanked HPD for all the DEI and IDEA work. APAC has spent much more time on IDEA than HPAC has. He wondered if HPD would find it helpful for the Committee to discuss this. Dr. Fox said that there is a lot to discuss, HPD takes it seriously, and she would love a long conversation. She speculated about bringing in more of the team for briefings, and noted some activities in specific missions. NASA needs to reach out beyond the larger programs.

Dr. Liemohn asked about the status of in-person meetings at NASA Headquarters. Dr. Fox replied that there are occupancy limits but they could do something with advance planning. Some mission review meetings have been in-person already, for example.

Public Comment

The meeting was opened for public comment, but no one came forward.

HPAC Report on GPRAMA Results

Dr. Liemohn officially reported that everything was rated green on GPRAMA.

Discussion continued
Dr. Goncharenko said she had hoped to hear that the DRIVE initiative has expanded to support sustained research. She referenced a Chinese discovery, which was distressing because better funding might have allowed those research goals to be attained in the United States. DRIVE can help fund U.S. scientists on this longer-term work. Dr. Fox acknowledged the comment. Dr. Klimchuk said that while he supported what Dr. Goncharenko said, "long-term" and "big" are not the same things. A lot of great science can come from smaller groups. He would advocate for longer duration work. He also recommended that for any future HPAC discussions about IDEA, the Committee consider bringing in someone from APAC, where they have talked about unintended consequences. He specifically suggested that they ask for a presentation from the APAC Chair, Dr. Charles Woodward.

Dr. Matsui wanted more about the extent to which NASA and the European Space Agency (ESA) coordinate on space weather. Dr. Fox replied that NASA collaborates with all four ESA divisions and has ongoing activities with each. She gave examples, also noting other international partnerships. Dr. Goncharenko observed that there have been some exciting developments over the last several years and HPAC is seeing good changes in HPD, which is wonderful. Dr. Fox praised her team.

Adjourn
Dr. Liemohn said he looked forward to an in-person meeting at NASA in the spring. HPAC thanked Dr. Kozyra for her work with them.

The meeting adjourned at 6:15 p.m.

Appendix A
Participants

Heliophysics Advisory Committee Members
Michael W. Liemohn, University of Michigan, *Chair*
Therese Moretto-Jorgensen, Ames Space Flight Center, *Vice Chair*
Janet Kozyra, NASA Headquarters, *Executive Secretary*
Aroh Barjatya, Embry Riddle
Rebecca Bishop, Aerospace Corporation
Paul Cassak, West Virginia University
Pat Doherty, Boston University
Matina Gkioulidou, Johns Hopkins University
Larisa Goncharenko, MIT Haystack Observatory
Allison Jaynes, University of Iowa
James Klimchuk, Goddard Space Flight Center
Tomoko Matsuo, University of Colorado at Boulder
Mari Paz Miralles, Smithsonian Astrophysical Observatory
Cora Randall, University of Colorado at Boulder
Kristin Simunac, St. Petersburg College

Other
Sky Bischoff-Mattson
Katrina Bossert
Chris Caisse
Phillip Chamberlain
Stephen Clark
Thils Copp
Galen Fowler
Nicola Fox, *Heliophysics Division Director*
Ryan Fredo
Holly Gilbert
Lewis Groswald
Lika Guhathakurta
Raha Hakamdavar
Roshanak Hakimzadeh
Larry Haxston
George Ho
Teresa Jensen
Ben Kallen
Patrick Kane
Jennifer Kearns
Kelly Korreck
Jared Leisner
Margaret Luce
Janvrug Mann
Margaret Moose
Jeff Morrill
Donna Nelson
Conor Nixon
Kate Petersen
Nicole Rayl
David Shanning
Elizabeth Sheley
James Spann
Allen Thurgood
Walter Trinton
Sara Tucker
Jesse Woodruff

Appendix B
Advisory Committee Membership

Michael W. Liemohn, Chair
University of Michigan

Therese Moretto-Jorgensen, *Vice Chair*
Ames Space Flight Center

Janet Kozyra, *Executive Secretary*
NASA Headquarters

Aroh Barjatya
Embry Riddle

Rebecca Bishop
Aerospace Corporation

Paul Cassak
West Virginia University

Pat Doherty
Boston University

Matina Gkioulidou
Johns Hopkins University

Larisa Goncharenko
MIT Haystack Observatory

Allison Jaynes
University of Iowa

James Klimchuk
NASA Goddard Space Flight Center

Tomoko Matsuo
University of Colorado at Boulder

Mari Paz Miralles
Harvard-Smithsonian Center for Astrophysics

Cora Randall
University of Colorado at Boulder

Kristin Simunac
St. Petersburg College

Appendix C
Agenda

Wednesday, October 27, 2021		
2:00	Overview of Agenda	Dr. Michael Liemohn, Chair
2:10	Welcome Remarks	Dr. Nicola Fox, NASA
2:15	GPRAMA Process	Jennifer Kearns, NASA
2:30	Discussion of Performance Goals, Accomplishments and Voting	Dr. Michael Liemohn, Chair
3:30	BREAK	
3:40	Continuing GPRAMA Discussion and Write-ups	Dr. Michael Liemohn, Chair
4:40	BREAK	
4:50	HPD Update	Dr. Nicola Fox, NASA
5:35	Q&A with Nicky Fox	Dr. Nicola Fox, NASA
6:00	HPAC Report on GPRAMA Results	Dr. Michael Liemohn, Chair
6:30	ADJOURN	