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HELIOPHYSICS ADVISORY COMMITTEE

October 1-3, 2019

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MEETING MINUTES

Michael Liemohn, Chair

Janet Kozyra, Designated Federal Official

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Welcome

Dr. Janet Kozyra, Designated Federal Officer (DFO) and Executive Secretary for NASA's Heliophysics Advisory Committee (HPAC), opened the meeting.

Overview of Agenda

Dr. Michael Liemohn, HPAC Chair, welcomed the members and reviewed the meeting agenda.

Heliophysics Division News, Updates, and New Initiatives

Dr. Nicola Fox, Director of NASA's Heliophysics Division (HPD), welcomed the HPAC members. This is the dawn of a new era for heliophysics, with exploration of uncharted territory, a great deal of fleet research, continuing advances in Earth and space weather, collaborations, public engagement, and development of the next generation of heliophysicists.

Much of the work in HPD follows the 2013 Decadal Survey (DS). The DS mid-term panel is concluding their report, which is due in January. Dr. Fox is confident that the Division aligns well against the DS recommendations. HPD is planning the next Senior Review (SR) for early 2020. The Global-Scale Observations of the Limb and Disk (GOLD) mission and the Space Environment Testbed (SET) were recently launched. The Ionospheric Connection Explorer (ICON) and the European Space Agency's (ESA's) Solar Orbiter Collaboration (SOC) are in development, with SOC scheduled to launch in February, 2020. The Diversify, Realize, Integrate, Venture, and Educate (DRIVE) Program budget wedge is up to the full profile and has become part of HPD's baseline Research and Analysis (R&A) program. The Division is launching Explorers every 2 to 3 years, a cadence the DS recommended. The Solar Terrestrial Probes (STP) line is now a moderate, Principal Investigator (PI) -led program. The meeting is to include a report from the Geospace Dynamics Constellation (GDC) Science and Technology Definition Team (STDT).

For the DS mid-term review, Dr. Fox asked the National Academy of Sciences (NAS) for guidance on implementation of the rest of the DS, not just a scorecard on what HPD has done thus far. The Atmospheric Waves Experiment (AWE) is a Mission of Opportunity (MO) Explorer that will go onto the International Space Station (ISS). The Division has selected two Small Explorers (SMEXes): the Polarimeter to Unify the Corona and Heliosphere (PUNCH) as a primary and the Tandem Reconnection and Cusp Electrodynamics Reconnaissance Satellites (TRACERS) as a rideshare. The Sun Radio Interferometer Space Experiment (SunRISE) was selected for a 7-month extended formulation study; this would be an array of six cubesats studying space weather acceleration. Two MOs are under concept study to ride with the Interstellar Mapping and Acceleration Probe (IMAP): the Spatial/Spectral Imaging of Heliospheric Lyman Alpha (SIHLA) and the Global Lyman-alpha Imagers of the Dynamic Exosphere (GLIDE).

Two missions were recently selected for an STP technology demonstration MO, the Science-Enabling Technologies for Heliophysics (SETH) and the Solar Cruiser, with a down-selection in 2020. Making the recent SMEX down-selection from five to two (PUNCH and TRACERS) was difficult, as all candidates were strong. Dr. Fox described their science, with PUNCH seeking to understand the evolution of coronal mass ejections (CMEs) in order to facilitate predictions, and TRACERS focused on how magnetic fields around Earth interact with those from the sun.

Dr. Fox described another three MOs seeking to advance understanding of heliophysics. The Extreme Ultraviolet High-Throughput Spectroscopic Telescope (EUVST) Epsilon Mission would fly on the Japanese Space Agency (JAXA) Solar-C mission to observe how magnetic fields and plasma interact. Aeronomy at Earth: Tools for Heliophysics Exploration and Research (AETHER) would be based on ISS and explore the Ionosphere-Thermosphere (I-T) system and its response to geomagnetic storms. The Electrojet Zeeman Imaging Explorer (EZIE) would focus on the auroral electrojet. In partnership with the Planetary Science Division (PSD), the recently selected Escape, Plasma Acceleration, and Dynamics Explorer (EscaPADE) will use two spacecraft to look at spatial and temporal variability. Of the 12 science and technology investigations selected to go to the moon through NASA's Commercial Lunar Payload Services (CLPS) project, three address heliophysics: the Lunar Surface Electromagnetics Experiment (LuSEE), the Lunar Environment heliospheric X-ray Imager (LEXI), and the Lunar Demonstration of a Reconfigurable, Radiation Tolerant Computer System.

SET-1 and the Enhanced and Tandem Beacon Experiment (E-TBEx) launched in June aboard a Falcon Heavy rocket. The latter mission involves cubesats measuring radio signal distortions. The Van Allen Probes were decommissioned, however, and SET had been meant to interact with that mission. The Parker Solar Probe (PSP) completed its first year in August and has accomplished three solar encounters, with plans for a second Venus flyby in late December. PSP performance has been well beyond what was expected, so the team has reduced the RF margin and is bringing down two to three times the data originally anticipated. The mission is now testing support for running some instruments constantly. PSP will be the subject of a special edition of Nature this fall. The Van Allen decommissioning was due to fuel depletion. Passivation activities have been completed on Spacecraft B and will be conducted on Spacecraft A soon. Almost all operating missions are "green," but a power issue with SET during commissioning has led the team to temporarily power off all of its instruments. PSP had an anomaly that is still being analyzed.

Previously, practice was to ask mission teams to propose new science objectives with every SR, which had occurred every 2 years and are now done every 3 years. HPD is modifying that to allow for a more strategic approach, so that missions in extended phase can come in under one of two options: science investigation or Heliophysics System Observatory (HSO) infrastructure. Essentially, long-lived missions will no longer be required to develop new science justifications if they can provide sufficient rationale for long baseline measurements. Dr. Lynn Kistler asked why the Cluster mission is not on the list. Dr. Fox replied that this is an ESA mission, with NASA as secondary. Therefore, NASA informed ESA three cycles ago that Cluster is no longer going to be in the SR. The archives will support Guest Investigators (GIs), as the data are publicly available.

ICON is on its spacecraft and will launch next week. For the SOC collaboration with ESA, NASA is providing instruments, specifically the Heavy Ion Sensor (HIS) and the Heliospheric Imager (SoloHI). This mission should launch in February, 2020. IMAP was selected in June, 2018, and is working its way through the Key Decision Point (KDP) process. It will carry MOs, as well as the National Oceanic and Atmospheric Administration's (NOAA's) space weather follow-on. The GDC report was to be released and discussed the next day. This will be the next LWS large strategic mission.

The Medium-Class Explorer (MIDEX) cost cap was increased to $250 million, and proposals have just had their due date. NASA's Science Mission Directorate (SMD) is developing rideshare policy and processes. HPD hopes to have another ESPA port on the IMAP mission, and is developing a mission-unique ESPA systems interface specification. The NAS Committee on Solar and Space Physics (CSSP) sought community input on rideshare and would issue its report soon. The next step will be a community workshop on rideshare at the Applied Physics Lab (APL) in late February. Dr. George Ho added that the announcement for the workshop had gone out to the community and there was to be an abstract after the American Geophysical Union (AGU) conference in January.

In order for HPD to have a unifying strategy, Dr. Fox established eight Strategic Working Groups (SWGs), addressing archives, citizen science, communications, mission size mix, R&A, STP and LWS, space weather, and technology. Three key themes have emerged as priorities: maximize the impact of HPD missions and research; ensure sustainable management and innovative expansion of HPD science; and diversify the future of the science community. Dr. Fox said that she hoped to give a full briefing on these at the next HPAC meeting. Another initiative is the Heliophysics Vision 2050 workshop. This is a Headquarters-enabled, community-led workshop to lay the groundwork for the next DS. There were to be community announcements in the near future, and HPD plans to coordinate with other agencies for input and participation. For example, the Division will seek input from the National Science Foundation (NSF) and NOAA on space weather.

HPD is currently funding six Jack Eddy Fellows. The Division also selected 12 Future Investigators in NASA Earth and Space Science and Technology (FINESST) in 2019 and 11 awardees of the Early Career Investigator Program (ECIP) from Research Opportunities in Space and Earth Sciences (ROSES) 2018. IMAP has a heliophysics future leadership program in which scientists are paired with diverse and high-achieving graduate students and post-docs. IMAP also supports the Student Collaboration Cubesat Development, which pairs the University of New Hampshire (UNH) and Howard University. There were 35 students in the recent Heliophysics Summer School in Boulder, CO, and HPD plans a mission formulation summer school for individuals at the PhD level, to take place at the Jet Propulsion Lab (JPL) in 2020. Close to 200 students took part in sounding rocket programs as well. HPD also participates in SMD early career and diversity efforts. Finally, two undergrads worked with the Division at Headquarters over the summer, developing catalogues.

HPAC is to hear about HPD R&A efforts the next day. Dr. Fox noted progress with the Internal Scientist Funding Model (ISFM). This is directed work that can only be done at NASA centers. DRIVE is now part of the R&A baseline, and the first HPD DRIVE Science Centers (DSCs) were to kick off soon. HPD received 39 proposals and will collaborate with NSF. The LWS Program Analysis Group (LPAG) provides the community perspective on various issues related to LWS. There are plans for international collaboration on PSP, Solar Orbiter, and GDC. ROSES 2019 has five focus science topics related to LWS. ROSES 2020 will include strategic capabilities and tools, among others.

Dr. Fox next showed the breakdown of ROSES 2018 proposals, which had some delays as a result of the government shutdown. Some ROSES 2019 calls have gone out, with pending calls in six areas. Three new R&A programs are among the ROSES 2019 programs: HSO Connect, in which interdisciplinary teams use HSO as an end-to-end system; HSO data support, which targets ground-based observations, and for which four of the six proposals were selected; and Outer Heliospheric Guest Investigators, which focus on data from Voyager, the Interstellar Boundary Explorer (IBEX), and other space assets to study the outer heliosphere. HPD is always seeking volunteers for proposal review panels, and this is an especially good way for early career individuals to learn what does and does not work in a proposal.

The Division is reviewing the current state of the heliophysics archives in order to determine future needs. This effort covers data curation beyond 50 years, open source code and algorithms, keeping data accessible over time and techniques, machine learning/AI to enable new science, and high-end computing (HEC) needs for modeling. HPD is exploring Public Private Partnerships (PPP) with Amazon Web Services (AWS), studying the viability of collocating data and analysis code on the cloud, and assessing how to enable machine readability. This was spurred by an SDO data issue and the need to not lose data. HPD wants to be ready for this in the future.

HPD now has a technology development program. ROSES 2019 restructured Heliophysics Technology and Instruments Development for Science (HTIDeS) into two distinct programs: Laboratory Nuclear,

Atomic, and Plasma Physics (LNAPP), and Instrument and Technology Development (ITD). Heliophysics Flight Opportunities for Research and Technology (H-FORT) now encompasses Low Cost Access to Space (LCAS) and SmallSats and Rideshare Opportunities (RSO). A graphic illustrated the HPD technology strategy to enable science, with the risk and investment progressions as the Technology Readiness Levels (TRLs) move forward. Suborbital and cubesat missions provide low-cost access to cutting-edge research. Dr. Fox reviewed the 2018-20 HPD suborbital program launches and plans, and described some of the missions. Examples of technology infusion that grew out of the sounding rocket program show the value of this work.

There is to be a presentation on HPD's space weather efforts, and Dr. Fox mentioned the Space Weather Science and Applications (SWxSA) program, which has an expanding focus on investigations that advance the understanding of space weather. This progress enables more accurate characterization and predictions with longer lead times. NASA has met with NOAA, the Office of Science and Technology Policy (OSTP), and the Office of Management and Budget (OMB) about piloting some test-bed processes in support of the second objective from the National Space Weather Strategy and Action Plan. The Department of Defense (DOD) will be part of a four-agency Memorandum of Understanding (MOU). As noted, SunRISE, a space weather MO, was selected for a 7-month, $100,000 extended formulation study. This mission would have six cubesats operating as a single, large radio telescope to investigate how giant weather storms from the sun are accelerated and released into planetary space. There were three targeted calls between ROSES 2017 and 2018 in Space Weather Operations to Research (SWO2R); the ROSES 2019 call has no focus topics.

The Small Business Innovation Research (SBIR) program for space weather selected two proposals for Phase 2 in 2018, and four for Phase 1 in 2019. Ongoing work includes the efforts of the space weather SWG, the transition framework to implement the pilot test bed with the NOAA Space Weather Prediction Center (SWPC), development of a lunar space environment capability with NASA's Human Exploration and Operations Mission Directorate (HEOMD) to safeguard human and robotic explorers beyond low-Earth orbit (LEO), and participation in the lunar payload working group. HPD is defining both strategic instrument development for an ESA L5 mission and a multipurpose space weather package for additional rideshare opportunities. The Division is also working with OSTP's Space Weather Operations, Research, and Mitigation (SWORM) Working Group. NASA is using data from the Time History of Events and Macroscale Interactions during Substorms (THEMIS) mission to gain insight on the moon's environment.

HPD has been active in partnering with PSD, the Astrophysics Division (APD), NOAA, NSF, and the U.S. Geological Survey (USGS). There are numerous international partnerships, as well. Dr. Liemohn pointed out that Dr. Paul Cassak had noted that Europeans complain that heliophysics is not well-represented in ESA, and are looking to NASA to urge ESA to be more inclusive of the discipline. Dr. Fox replied that it is always good to encourage the community to be vocal. NASA is trying to work with ESA on partnerships, engaging in bilaterals in which heliophysics participates. The Division partners with three distinct ESA divisions, which can be challenging.

The HPD communications team wants to know about upcoming papers, mission events, outreach events, etc., which it can feature via numerous outlets. The Division's internal team is strong, one of the best teams she has ever worked with. HPD continues to look for individuals to spend time working in the Division on detail, under the Intergovernmental Personnel Act (IPA), and other routes.

Dr. Vassilis Angelopoulos praised HPD for the work Dr. Fox had reported. He asked about launch vehicles, specifically the Pegasus. Dr. Fox said that there were issues, but Northrop Grumman has done a lot to address them. Pegasus will still be in the plans. Rideshares will call for larger vehicles, and APD is looking for rideshares on its Imaging X-ray Polarimetry Explorer (IXPE). The middle class of launch vehicles is a bit of a worry, but there are things coming on line. HPD will select the launch vehicle for

IMAP earlier than normal in order to lower the risk. Dr. Ho asked about the community, grassroots-led campaign. Dr. Fox replied that it is going quite well, with a lot of data. HPD is planning a community workshop in April, hosted in Boulder. There will be a look at data and on modeling challenges.

Advanced Concepts in Data Management and Computing

Dr. Jeffrey Hayes explained that an SMD working group on data and modeling has been developing findings and recommendations that will inform much of how SMD does open science. This will be a different paradigm from what the science community has been used to. Algorithms will also be made public. The intent is to prevent the field from entering an era of irreproducible science. Missions will be required to update their data management plans, and SMD is adapting the ESD system for documenting and archiving algorithms. Curation will ensure that the information does not go away as media evolve. This is a difficult problem, because there is the intellectual property aspect, and yet the taxpayers have a right to access because they paid for it. It is early, but this is the direction being taken. There are unresolved issues with AI, storage, and security as well. Dr. Tomoko Matsuo cited a NAS study on this, noting that NSF, universities, and other entities are grappling with the same issue. Dr. Hayes replied that there had been a roundtable on the issue. The amount of data is so enormous as to be incomprehensible, and it is unclear how to map it. After ESD, HPD is the second largest holder of data in SMD. Dr. Lika Guhathakurta noted that the National Institutes of Health (NIH) had to deal with this, which could offer a good model.

She then explained that the Frontier Development Lab (FDL) is a PPP for applied AI for space science and exploration. Tools such as telescopes and microscopes have allowed us to understand our natural world by showing us things the eye cannot see on its own. AI is a tool as well, allowing us to digitize and uncover patterns we could never intuit. Deep learning (DL) uses machine learning (ML) concepts to simulate information processing and adaptation patterns seen in biological nervous systems. DL is taking over from ML. It can often model complex systems from beginning to end. NASA pulls in a massive amount of data, and DL provides a framework for dealing with it. DL can often discover features and see high-level features without initial training from human experts. FDL is an applied AI research initiative to solve challenging problems, to leverage AI and ML to advance basic research questions. However, ML is very expensive, and scientists in the field are difficult to recruit, with enormous salaries. ML has a high failure rate as well. Therefore, private sector involvement is crucial to pull in the experts and the sophisticated tools. NASA's FDL is 4 years old and has generated a number of papers. It is currently based at the Ames Research Center (ARC) and administered by the SETI Institute. Dr. Guhathakurta noted the international partner space agencies, NASA centers, and others involved in FDL.

FDL's working model involves an 8-week "research sprint" during the summer, although the work goes on all year. The problems that benefit are those that use large data sets, require numerous tools and ongoing learning, etc. Dr. Guhathakurta listed six demonstrated capacity areas and showed the mapping between NASA's strategic capabilities and FDL research results. The topic that was about to be published concerned the loss of a sensor in SDO/EVE that left an observational gap in the most energetic part of the EUV spectrum. The question was whether those data could be reproduced based on what NASA did have. Dr. Guhathakurta used music as an analogy: if part of a piece were missing, could the human mind fill in what should have been there? The FDL effort involved experimenting with three UV filters. The team found they could do calibration that would correct for SDO EUV instrument degradation. Almost 20 FDL topics map very closely to NASA's strategic goals. Papers are continually coming out. This is a pipeline for young, talented experts. There have been ongoing discussions with industry partners. FDL is beginning to show the power of AI as a tool. Dr. Liemohn said that heliophysics needs AI-ready data sets, as well as sufficient computing resources. Dr. Rebecca Bishop said that while these are promising results, many important details are missing, and she was concerned that it gave the impression of being further along than is the case. Dr. Guhathakurta replied that a longer presentation is more specific.

GPRAMA

Ms. Jennifer Kearns of SMD provided background on the Government Performance and Results Act Modernization Act (GPRAMA), which requires each Federal agency to provide a strategic plan, as well as annual performance plans, and reports to address progress made in key areas. For SMD, the majority of the performance measures address either (1) milestones for missions in formulation and development, or (2) science progress. While the achievement of mission milestones is objectively verifiable, the assessment of science progress calls for review by external experts. In the case of heliophysics, HPAC conducts that review, which is a very high-level assessment based on the year's published scientific results.

HPAC is to consider three Annual Performance Indicators (APIs):

- HE-19-1: Demonstrate planned progress in exploring the physical processes in the space environment from the Sun to Earth and throughout the solar system.
- HE-19-2: Demonstrate planned progress in advancing understanding of the connections that link the Sun, Earth, and planetary space environments, and the outer reaches of the solar system.
- HE-19-3: Demonstrate planned progress in developing the knowledge and capability to detect and predict extreme conditions in space to protect life and society and to safeguard human and robotic explorers beyond Earth.

The goal is to determine the appropriate rating and provide some supporting material indicating the rationale. Any accomplishments cited in the supporting material should represent growth in the body of knowledge, and HPAC should also note any relevant disappointments. The time period under consideration does not need to follow the fiscal year precisely, but rather covers the approximately 12-month period since the last evaluation. Any accomplishments considered must have resulted in whole or in part from a NASA-funded activity. That funding did not need to come from HPD specifically. Dr. Kozyra had sent the members a document with items that they could consider, though they were not restricted to using those examples. The only requirement for the HPAC material was that it be sufficient to back the conclusions. There are typically three or four items per API.

The key requirement was for a color rating, as follows:

- A rating of Green meant that the expectations for the research program were fully met in context of the resources invested;
- Yellow meant that there were some notable or significant shortfalls, but some worthy scientific advancements were achieved; and
- Red meant that there were major disappointments or shortfalls in scientific outcomes, uncompensated by other unusually positive results.

Ms. Kearns requested that the text be particularly clear on rationale for any rating other than Green so that the result could be accurately reflected in the Agency's performance report, for which the HPAC's examples would be used. Dr. Liemohn advised holding a vote the next day, but starting on a preliminary discussion of source material.

GPRAMA Discussion

Dr. Kozyra explained that the 87 pages of material sent as examples of accomplishments came from satellite teams and ISFM teams at Goddard Space Flight Center (GSFC). HPD did not eliminate anything that was submitted. Dr. Liemohn said that HPAC could move examples to different categories if they preferred. He suggested that the members break into small groups prior to discussing what to include. The groups were:

1. Mr. Filipi and Drs. Matsuo and Liemohn
2. Drs. Ho, Kistler, and Cassak (participating by phone)

3. Drs. Angelopoulos, Bishop, and Randall (participating by phone)

After conferring, the groups reported back. Dr. Matsuo explained that API HE-19-1 is about physical processes in the space environment, and her group discussed three candidate studies as examples. For solar, they liked the Interface Region Imaging Spectrograph (IRIS) observations on how plasma is heated during solar flares. The THEMIS direct evidence that the Earth's dayside magnetosphere vibrates like a drum in response to solar wind inputs was also strong. Finally, the AIM Solar Occultation for Ice Experiment (SOFIE) instrument found key differences in the nitric oxide peak in certain regions. The recommendation was for a rating of Green.

For API HE-19-2, on understanding connections linking the sun and other parts of the solar system, the group selected three results, which Dr. Kistler described. First was IBEX showing changes within the solar wind. The group also liked the THEMIS work with citizen scientists on the auroral phenomenon, Strong Thermal Emission Velocity Enhancement (STEVE). Finally, the Van Allen probes were involved in measurements confirming fast radiation belt loss. The group recommended a Green rating.

The third group addressed API HE-19-3, on detecting and predicting extreme conditions in space in order to protect human life. Dr. Bishop described an effort involving GOLD and the discovery that solar minimum ionospheric depletions are more prevalent than initially thought. A second example demonstrated the synergy between CME observations from Earth, Mars, and the STEREO mission. The final example was development of a geospace index that provides context and insight into solar variability effects on Earth's thermosphere. The recommendation was for Green.

LWS Program Analysis Group Update

Drs. Mark Linton and Sabrina Savage provided an update on LPAG activities, along with input from Dr. Jeff Morrill, the LWS program officer. Dr. Linton explained that the LPAG coordinates LWS community input, with discussions throughout the year. The year 2018 was busy, and a lot of its work flowed into 2019. LPAG solicited community input to Targeted Research and Technology (TR&T) science topics that summer, receiving 46 distinct inputs. The Executive Committee (EC) then drafted 20 Focused Science Topics (FSTs), which were included in a report sent to NASA in October, 2018. NASA used these to develop four FSTs for ROSES 2019. A fifth FST will be added to the list, and the remaining 15 topics will remain as input for ROSES 2020 FSTs. With all of these topics from 2018, LPAG reviewed the Strategic Science Areas (SSAs) developed in 2014 for the TR&T program. SSAs are long-term, targeted areas of system science that guide LWS activities. The EC revised the SSAs, released them for community review, held town halls for even more input, and is now finalizing SSA writeups for an LPAG report to NASA, to be submitted by the end of November.

Dr. Linton then described the revised SSAs:

- SSA-1. Origins and Variability of Global Solar Processes, revised from SSA-0, Solar Electromagnetic, Energetic Particle, and Plasma Outputs.
- SSA-2. Solar Eruptive and Transient Heliospheric Phenomena, extracted from many original SSAs.
- SSA-3. Acceleration and Transport of Energetic Particles in the Heliosphere, a broader version of the previous SSA-3, on Solar Energetic Particle Forecasting.
- SSA-4. Variability of the Geomagnetic Environment , revised from the original SSA-1, Geomagnetic Variability Forecasting.
- SSA-5. Dynamics of the Global Ionosphere and Plasmasphere, revised from the original SSA-4, TEC Forecasting.
- SSA-6. Ionospheric Irregularities, revised from SSA-5, Ionospheric Scintillation Forecasting.

- SSA-7. Composition and Energetics of the Upper Neutral Atmosphere, revised from the original SSA-2, Satellite Drag Forecasting.
- SSA-8. Radiation and Particle Environment from Near Earth to Deep Space, revised from the original SSA-6, Radiation Environment Forecasting and extended to deep space.
- SSA-9. Solar Impacts on Climate, a new SSA derived from the original sun-climate theme that was separate from SSAs. LPAG will be taking comments on this through Nov. 15.
- SSA-10. Stellar Impacts on Planetary Habitability, an entirely new topic, focused on other planets, not just Earth. This reflects community interest; it will not pull funds from other areas.

Dr. Morrill explained that when PSD and APD study habitability, they have a different perspective from HPD. The proposed SSA-10 would bring heliophysics processes to this area. As a new SSA, it may evolve further. Dr. Liemohn said that it was great to take on exoplanets, as heliophysics has a lot to offer. He wondered if this is truly an LWS task, or something that belongs in a different part of HPD. Dr. Fox said that she would appreciate an HPAC finding or recommendation. She is fine with it in LWS. HPD has contributed to exoplanet research with astrophysics and planetary research, so she would like feedback on where it belongs. Dr. Liemohn said that his concern was about its placement in HPD. Ms. Margaret Luce said that it overlaps with ESD, and one consideration is the implications of that overlap. Dr. Matsuo was concerned that there was a diminished emphasis on forecasting. Dr. Linton said that HPD has a number of places for this to feed into, like ROSES 2020, and it would come up in the space weather discussion. Dr. Savage added that LPAG was looking at this as systems, and the SSAs progress outward from the sun.

Dr. Linton said that in addition to the work on SSAs, LPAG also assessed how to measure FST progress. Informal notes were given to NASA; these will be formalized in the annual report. The start of the FST project should develop measures of success for the team, which should decide on their annual research highlights, to be part of the annual reporting requirement. In addition, an annual team progress report should detail movement toward measures of success and updates. At the conclusion of the FST projects, there should be publicly releasable extended and brief summaries, an exit survey to team members, and a team lead meeting with LWS program scientists. Dr. Angelopoulos asked if the proposer gets additional resources to cover these reporting requirements. Dr. Linton said that they do. He believes the funds are commensurate with the work, but LPAG will revisit this to ensure the amount is fair. For 2020, LPAG will solicit and develop a new set of draft FSTs, and will assess progress of the FST teams. It seems like this is a good 2-year cycle. LPAG has given NASA a lot of input on this but wants to stay on top of whether this works for various parties.

Dr. Matsuo liked the idea of surveying team members. She noted that it is important to not lose the elements of the learning curve, observing that most publications just focus on successes. However, a larger picture could present a mechanism to implement in other R&A proposals. Dr. Liemohn agreed, adding that there is not sufficient coverage of failures. AGU has a publication that addresses space and Earth science, and the new editor wants the lessons learned, not just the successes. There might be other journals that take a similar approach. It has been hard to capture that, but it could be useful to proposers.

Dr. Fox thanked Dr. Linton for his outstanding leadership of LPAG working along with Dr. Anthea Coster as co-chairs. Dr. Savage will join LPAG as a new co-chair.

HPAC returned to discussion of SSAs 9 and 10, focusing on SSA-9's overlap with Earth science, and the interaction of SSA-10 with other divisions, along with how it fits within the LWS scope. Dr. Randall said she was glad to see SSA-9, and considers it an important part of LWS. There should be some overlap with ESD, which now emphasizes the tropopause and below. That means the transition region tends to get lost. Therefore, LWS is an appropriate place for it due to the impact of the sun and energetic particles. Dr. Matsuo agreed, pointing out that what happens in the troposphere is key for forecasting, and it is indeed

lost between ESD and HPD. In addition, it is hard to propose in heliophysics in the area of forecasting, and this is an interdisciplinary area that allows HPD to expand its reach.

Dr. Ho agreed on the need for SSA-10, but he was concerned that not enough people outside of Heliophysics know about LWS yet. HPD may want to publicize this heavily to the community. Dr. Bishop said that while she understood why SSA-9 is included, "climate" can be a charged word, and she does not want to see HPD getting into tropospheric meteorology. She would suggest rephrasing it. Dr. Morrill said that comments are being taken through November, and she could comment there in addition to at this meeting. LPAG must consider all comments. Dr. Liemohn specified that while HPAC was giving comments to NASA, the comments to LPAG should go through their comment process. Dr. Bishop said that her comment to NASA would be that it makes her uneasy seeing SSA-10 under LWS. NASA should do this research, but she was concerned about diluting LWS.

Dr. Randall said that SSA-9 does belong with HPD rather than ESD due to the solar impact on the middle atmosphere. ESD does not cover that, and yet a lot of the particle effects are in the middle. Dr. Angelopoulos agreed that heliophysicists know best how to do this work. In that sense, it is in the right place. He wondered about collaboration options with other divisions. Dr. Ho said that part of the reason to do this is to apply and extrapolate from the heliophysics perspective. At the same time, he was concerned about diluting the program. He, too, wanted to know how to join forces with other divisions on this topic.

Space Weather Program Updates

Dr. James Spann discussed HPD's space weather program. The SWxSA program is a new one in the HPD portfolio. It reflects all of the HPD goals, but does not affect the research and mission resources. It is not part of DRIVE, but rather, through the SWORM working group, has established NASA as having an expanded role in space weather science under a single budget element. Space weather is involved in the Artemis program and the National Space Weather Capability, seeking to transition to the operational environment. Space weather strategic activities have recently involved NASA, NOAA, OSTP, and OMB. Dr. Matsuo asked whether there is a dedicated budget line for this effort, which could be significant. Dr. Spann said that the strategic plan does require resources. OMB was part of the discussion because both NASA and NOAA need additional resources to accomplish these goals. The meeting helped plan the process and establish the framework. As Dr. Fox noted in the morning, there is an MOU among NASA, NSF, and NOAA, to which the parties seek to add DOD in order to have a stronger framework, more visibility, and greater support.

Dr. Spann next described SunRISE, which is a response to a space weather MO. SWxSA made eight selections for ROSES 2017, nine for ROSES 2018, and will do four or five for the second ROSES 2018. (ROSES 2019 does not include a space weather focus topic.) Ongoing steps include developing an implementation plan for NASA space weather, and defining a transition framework to implement the pilot test-bed with NOAA. Dr. Spann noted the HEOMD collaboration in crew and robotic safety, and opportunities for science payloads to be on the moon. One goal is to have a solar wind package to go onto the first phase of the Lunar Gateway.

Should ESA select and fund an L5 mission, it is possible that NASA will provide a science instrument. The Agency also wants to define a robust, multipurpose space weather package for additional rideshare opportunities. With some uncertainty about launch dates inherent in the rideshare program, the space weather program wants to have the package ready. It is also important to secure community expertise. NASA is working with other agencies and international partners, which Dr. Spann listed.

Dr. Matsuo expressed concern about models. Because of the open source standards, contrasted with the facts that researchers put a lot of effort into the models, it can be sticky. This should be made clear. Dr.

Spann agreed. In ROSES calls, they encouraged proposers to move to open source code, but this is not a requirement. This is in the transition area of protecting intellectual property while maintaining the engagement of the code developer. The program is discussing having a mechanism to keep the originator of the source code all the way through. Deciding what to transition is less of an issue. Dr. Matsuo pointed out that this goes beyond just space weather. It is something everyone faces.

Dr. Bishop said that as NASA has someone on detail from NOAA, it might also be beneficial to have a NASA person at NOAA. She also wondered if the exchange could expand or be made permanent. Dr. Spann agreed, citing the MOU as extending these possibilities, especially after DOD comes in. Dr. Ho asked about the space weather instruments for rideshare or the Gateway. Space weather is in the research phase, and he wanted to know how to specify that an instrument is meant for science. Dr. Spann replied that there is a lot of science that could be done with simple measurements in different places. In addition, part of the value of rideshare is that it allows trying new technologies and instruments that could open up a lot of science. These will be science instruments, not NOAA instruments. Dr. Ho agreed, but asked how to write a call with a component on space weather monitoring. Dr. Spann said that the program will have to figure out how to mesh those things together. He is always amazed at the ingenuity and resourcefulness of the community. He knows they will be clever in responding.

Dr. Liemohn advised seeing how ESD deals with this, as they have more applied program elements. Ms. Luce explained that, over time, ESD has been approaching and embracing monitoring more than before, as there is a need to know long-term trends. HPD needs to keep its science as the highest priority and put in context anything that could benefit space weather. The real issue is that having data that are available quickly with a high standard of accuracy will drive up the cost. However, if that overhead is not placed on NASA research assets, they can provide many benefits. On the other hand, monitoring to understand the environment is a key to understanding the science. Dr. Matsuo pointed out that while NOAA cannot rely on NASA data for operations, the information can be used. Ms. Luce added that if HPD assets help provide space weather measurements for human exploration, it will be crucial to understand the use of those measurements. Dr. Liemohn said he liked the idea of keeping it from being required for operations.

Dr. Liemohn asked if it would be useful for space weather to have a PAG. Dr. Fox thought it would be.

<u>HPAC Work Session</u>

Dr. Liemohn listed potential findings and recommendations, some of which generated discussion:

- Congratulations on the many recent spaceflight opportunities.
- HPAC would like more information on PI diversity in applicant and selection pools.
- Dr. Matsuo noted that HPD has taken HPAC advice and is doing more with early career development, which was grounds for congratulations.
- Dr. Liemohn cited the need for further HPAC conversation on SSAs 9 and 10. He noted that HPAC can give Headquarters advice separate from LPAG.
- There could be a PAG for space weather.
- Dr. Bishop asked that HPAC be given clearer definitions of the boundaries between LWS, space weather, and other programs that constitute the key HPD elements. It would help the evolving programs.
- Dr. Angelopoulos noted that, regarding the SR, the continuing mission budget is being stressed. Dr. Angelopoulos said that the issue is that NASA centers typically operate large, one-of-a-kind projects, but other operations are more efficient because they have a different system. He wondered if other organizations could run the fleet operations more efficiently, given that this is not NASA's strength. Dr. Randall said that lengthy extended missions sometimes have more difficult operations. Dr. Kozyra replied that Dr. Fox wants more time to look at it, and the HPD information was not yet ready.

- Dr. Ho pointed out that the budget chart peaks, but then drops. It would be helpful to have a new baseline and know how to keep it higher. Part of that would involve identifying strengths. HPAC members reviewed Dr. Fox's "sand chart" of annual budgets. All of the numbers went up significantly starting in FY17, and the budgets have been significantly higher than in FY15 and FY16 ever since. Dr. Liemohn thought this warranted congratulations in the letter.
- Dr. Matsuo advocated reaching out to other divisions for collaboration on topics like the proposed SSA-10. This might help create new opportunities to maintain the higher budget. Dr. Bishop wondered if HPD should take the lead in this, for example, working with PSD so they support heliophysics. The broader question is who should lead the interdisciplinary efforts? Dr. Liemohn said that while the supporting research line does include some of this, it is a good question and an important conversation to have. It is not always clear that Headquarters and the centers each know what the other is doing, and it would be good to have clearer delineations, as well. PSD and APD are leading programs in which HPD participates, and there are internal politics about who's running what. The Division perspective is that HPD leads none of it at the moment. It might be helpful to learn more about the programs on exoplanets and habitable worlds.

Dr. Liemohn suggested they revisit some of these items during the upcoming work sessions. He wanted to go around the room and get comments on a few things. First was SSA-9, solar impacts on climate.

- Mr. Filipi declined comment.
- Dr. Bishop said it should not be in LWS, as the point of LWS was to capture areas not included elsewhere. She was concerned the entire portfolio of heliophysics research would be included in LWS, and she had an issue with the climate part.
- Dr. Ho said that climate has a legitimate place in LWS.
- Dr. Cassak was fine with including it.
- Dr. Randall said that LWS is the right place for it, though she agreed that there is a need to define boundaries.
- Dr. Liemohn said it belongs in LWS. It was included there in the beginning, fell off, and now should come back. There is a need to define it better.
- Dr. Angelopoulos agreed, but said that "climate" could be off-putting. He suggested that ESD might be part of the call when it comes out.
- Dr. Kistler said that LWS has always been about the impact on life and society, so it seems appropriate.
- Dr. Matsuo said she sees it as part of LWS. Couplings with different layers of the atmosphere are core issues.

Dr. Bishop said that she would be fine to have it in LWS if they addressed the use of "climate," and if there were a more purposeful statement on the LWS boundaries. Her real concern is program creep.

HPAC again went around the room for SSA-10 and habitability.

- Dr. Matsuo said that this is also part of LWS. It might be a stretch, but heliophysicist skills and expertise can be applied here.
- Dr. Kistler said she does not see it as LWS. It is an interesting topic, but it is also a separate topic
- Dr. Angelopoulos said that heliophysics benefits from exoplanet work and has its own experts. It benefits the community to collaborate with PSD. He would keep it as LWS and join with PSD.
- Dr. Liemohn said that he likes it as an HPD topic but is torn as to whether it belongs in LWS. He thought it could be in LWS as a topic to start, then move to its own element eventually.
- Dr. Randall said it could be part of LWS. She suggested talking to PSD.
- Dr. Liemohn said that he wanted a sense of what the other divisions are addressing, and how much funding HPD can contribute to the discussion compared to them.

- Dr. Ho pointed out that there are two programs in ROSES Section E, so that this is already included as LWS in something that is already out. However, he was concerned about who will run the panels and who the reviewers might be. Dr. Kozyra said that LWS contributes a small amount to the interdisciplinary program, but the panels always toss the heliophysics proposals back to HPD.
- Dr. Bishop considered habitability to be an outlier that should be separate. Nonetheless, she would be okay with including it for a couple of years as long as it was specified that HPD would then re-evaluate it. She also thought it might be best as a community-driven decision.
- Mr. Filipi said he would have the other divisions describe what they are doing.

Dr. Liemohn suggested having a recommendation that there be a round to see if there is an FST in the next cycle that percolates up. They could then gauge proposal pressure after a year or two. Dr. Bishop said she would prefer having it specified that this is optional or temporary.

Dr. Matsuo had to leave the meeting. Dr. Liemohn then asked for opinions on PAGs, which enable community advocacy. All members agreed there should be one for space weather. In addition:

- Dr. Randall suggested exploring other groups.
- Dr. Cassak said they should be strategic on others.
- Dr. Ho said they should look into others.
- Dr. Kistler advised waiting on others.
- Dr. Bishop asked if the sounding rocket working group still exists; that was not determined. She then said she would recommend a cubesat PAG and a hosted payload PAG.
- Dr. Angelopoulos said that other topics would be well-served but did not specify them.
- Dr. Liemohn wondered if there might be a need to subdivide H-FORT. He would suggest something like an LCAS PAG.

Adjourn

The meeting was adjourned for the day at 5:18 pm.

Wednesday, October 2, 2019

Welcome to Day 2

Dr. Kozyra welcomed participants to the second day of the meeting.

Overview of Agenda

Dr. Liemohn explained that there was to be a change in the agenda, as Dr. Hayes would give a presentation on strategic data management, following the public comment session.

New Programs in ROSES; Review Process (including Dual-Anonymous experiment, directed vs undirected research)

Dr. Mona Kessel explained that the DS advised greater funding for R&A. Subsequently, the R&A budget has more than doubled, and staying up during notional years. This is a good sign for the field. Some of this is technology funding, as there is an increase in instruments and cubesats, with specific budget lines. Space weather is strong in the applications area. ECIP and FINESST also have significant funding. The new steady state number is about $140 million, much more than the $45 million of FY16. While it is never certain what Congress will do, the requests are for the sustaining level. Dr. Cassak noted that the Senate markup suggests that heliophysics should have 25 percent of the budget toward DRIVE, which would be more than $180 million. He asked if HPD is prepared for that large a number. Dr. Kessel said

that there are absolutely places for such funds to go should they appear, probably to more selections in existing programs, although there might also be targets.

Among the established annual programs for 2018, Supporting Research, GIs, LWS, and HTIDeS are the big four. They have also seen the biggest increases in budget, along with Heliophysics Data Environment Enhancement (HDEE) and FINESST. HPD will now support 12 graduate students per year with funds from each of the four core programs. An established triannual program is Theory, Modeling, Simulation (TMS), with funds set aside through DRIVE. A new annual program is SWO2R. There are also the ECIP, DRIVE Centers, and ISFM programs. HPD is evaluating the outcomes of the first run of ECIP, which the Division will probably recompete in 2021. Dr. Kozyra thoroughly researched the DRIVE Centers and defined a program that can benefit the community and work synergistically. HPD hopes to have the announcements about selections out around the time of AGU.

The DRIVE Center awards will be for 2 years in Phase 1, and there may be eight of those. Next will be a competition among the Phase 1 awardees for Phase 2. Dr. Kessel anticipates selecting two Centers, which will be funded for 5 years. After that, HPD will have proposers recompete. The next cycle may go straight into 5 years, depending on what the Division learns, what succeeds, and what the community reaction is.

ISFM is a NASA-only program. HPD took award money that GSFC had been winning, had a separate competition among GSFC civil servant scientists, and selected teams. Those teams have done extremely well and HPD has had presentations on what they accomplished. SMD is standardizing ISFM across all divisions, and there will be a review. Prior to implementation of this program, NASA was spending millions of dollars making its paid scientists compete for funds. Now the Agency is more focused on the scientists working on strategic science and service. The reason HPD's ISFM funds are all going to Goddard is that it is the only center that does significant heliophysics research in the HSR, HGI, and TMS programs – Marshall Space Flight Center (MSFC) has significant hardware efforts related to heliophysics, but ISFM does not include hardware at this time.

For 2019, SWO2R will join the established annual R&A programs. ECIP, the DRIVE Centers, and ISFM are now with TSM as established multi-annual programs. New programs are HSO Connect/HSO Data Support, Outer Heliosphere GI (OHGI), and probably GOLD/ICON GI. GOLD has been up for a while, but GOLD and ICON are usually considered together. Data must be available 30 days before selection for GIs to be brought in. PSP data will be available in November; HPD has selected four ground-based telescopes to support PSP, in conjunction with NSF. The data availability requirement will be relaxed on HSO Connect in order to obtain the perihelium pass information. HSO data support announcements had just been made. The HSO Connect ROSES Element was pending, but proposals will not be due for a while.

Dr. Kessel showed the ROSES 2018 due dates, notification, days since received, number of proposals received, number selected, and percent selected. Some calls were affected by the shutdown, but the goal remains having all announcements out within 180 days. The selection rates are good. Dr. Hayes added that HDEE was an anomaly because it was closing out a data recovery exercise and received only four proposals, all of which were funded. Fifteen proposals came in for 2019. Dr. Kessel said that the LWS selections were imminent. There was a second review of space weather to ensure the panels covered the science fully, and those were due out soon. The DRIVE Center program had not been reviewed.

Dr. Matsuo asked if there were any data on diversity among PIs. Dr. Kessel said that the calls do not seek gender or ethnicity information. Collection of those data would be an SMD decision. It is not a ROSES question. Dr. Angelopoulos noted that some universities collect the data voluntarily. Dr. Kessel added that SMD uses a tool that matches first names to gender with about 90 percent accuracy. And information offered voluntarily would be incomplete by definition. Dr. Ho urged HPD to try to do better. Ms. Luce

explained that HPD is working with SMD on this. It is an evolving process. When asked, she said that it would not hurt for HPAC to have a finding. Dr. Hayes said that there are limits on what NASA can do, and HPD would have to set up an infrastructure to keep information safe. Ms. Luce said she would investigate further. Dr. Kessel added that the SMD Associate Administrator, Dr. Thomas Zurbuchen, wants to know how many selected proposers are new PIs.

HPD will implement the Dual Anonymous (Dual Anon) review format in the GI program, and Dr. Kessel described how the Space Telescope Science Institute (STScI) does it. At a workshop she attended, there was a study on the impact of gender in getting tenure. One example described how women are, or are not, given credit when writing a paper alone, with a man, or with another woman. There was also a study showing that women's coding is accepted when gender is unknown, but there is less acceptance when it is known that they are women. The big takeaway is that to eliminate bias, there needs to be a structure to help. The Dual Anon system keeps the reviewers from knowing the identity of the proposer, including their gender. There is also institutional bias, which comes up in proposal resource sections, and it is often obvious where hardware and modeling come from. That is why HPD is starting with GI.

In an astrophysics call, STScI ran a pilot test that removed names. While preliminary data do not show a lot of differences regarding gender, they do show an age bias. Dr. Kessel was not sure she agreed with the findings, but the project has just begun. There are more younger women in the field, and they won more often under Dual Anon. The data on men and age do not lead to an easy conclusion at this point. It is important to note that this was in astrophysics, and heliophysics could be different. Dr. Hayes explained that an astrophysics analysis shows that x-ray astronomers are younger and there are more female x-ray astronomers. Dr. Kessel explained the process of preparing the community to write proposals and how to review them. This will need to be modified, and SMD will have to start a dialogue with the community, mitigate concerns, and provide guidelines to the community for writing and reviewing proposals.

Dr. Kistler noted that some proposers might want to give themselves away. Dr. Kessel replied that if it looks intentional, HPD may declare a proposal noncompliant. Dual anonymous reviewing could be a game changer. That remains to be seen, but it has some possibilities and HPD is going to try it. Dr. Matsuo raised the issue of the difficulty in finding nonconflicted reviewers. She wondered about tracking conflicts of interest. Dr. Kessel said that HPD will have that information, and track and address it. There is concern about institutional reveals. Much of this remains to be worked out. There will be a separate place in the proposal for team expertise and background. While Hubble review panels are sometimes shown this information after decisions have been made, HPD has not yet decided what to do. The Division always has a Headquarters person in the room, who will shut down guessing about the PI and institution. Slip-ups are one thing, but HPD will watch for egregious violations. However, there will be no prescreening the first time; noncompliance will be declared only if proposers totally ignore the requirement.

Dr. Cassak said that, regarding mail-in reviews, proposers keep resubmitting and they need feedback to know what they did wrong. Dr. Kessel said that HPD tries to provide comprehensive feedback. But there are proposers who keep re-proposing the same thing, and it was not yet clear how to counter that. She described some of the concerns from the astrophysics community, noting that heliophysics will probably have some of the same concerns, like how to write. It is not yet clear if the Dual Anon will mitigate bias; it probably will, but it will take time.

She next addressed High-Risk/High-Impact (HR/HI) research, another SMD area of activity. ROSES calls now ask PIs to note if they think their proposal is HR/HI. SMD found that about 10 percent of proposals come in that way, and the divisions are selecting 35 percent of those. While it looks good, the concern remains that the percentage trends toward a specific discipline. Therefore, ROSES 2020 will have this as a modification to the solicitation process across all of ROSES. Dr. Bishop observed that this seems

subjective and asked about how they might deal with bias. Dr. Liemohn explained that HPAC had discussed the topic a couple of years before and found that many in the community consider their work to be HI. Dr. Kessel said that one of the first things HPD does in its panels is to evaluate the impact. She outlined the process. On a quarterly basis, SMD will reconsider HR/HI proposals that are not funded. Dr. Kessel did not know where the funding for those might come from, or how many, if any, will be funded. There is not a separate competition for citizen scientists, but that is being encouraged because NASA wants the general public involved.

There is not currently evidence of bias in the selection process for HPD. Dr. Arik Posner said that he presented on this topic previously and found gender bias that was mild but statistically significant. Dr. Kessel added that there is an effort to set a baseline from 10 years of SMD data; this must be done by hand for HPD. Dr. Kozyra cited a Google implicit bias workshop that referenced a modeling study with a 1 percent bias toward men at each step as individuals were promoted or not through hierarchal levels in a company. As it was cumulative, at the top level of the company, the end result was bias of 60/40. Dr. Ho asked if there is compliance with the data archive requirements in ROSES calls. Dr. Hayes said that that will only become general in ROSES 2020. There were not a lot of problems in heliophysics. NASA needs to set the expectations, and this will become far more systematic. No one has been rejected on the issue yet. Dr. Liemohn observed that the prior HPAC discussion of HR/HI led to no conclusion on whether to have separate programs or self-declare. It sounds like SMD is doing both, which is a good solution.

GPRAMA Discussion

Dr. Liemohn described the process HPAC went through to develop the material for the APIs. The preliminary vote was that all three were rated Green. He wanted to take this time to discuss the summary paragraphs and take a formal vote.

Mr. Filipi read the text for API 19-1. IRIS observations revealed how plasma turbulence plays a vital role in converting magnetic energy to heat, challenging the current model. THEMIS provided the first direct evidence that the Earth's dayside magnetosphere vibrates like a drum in response to single plasma jets. The AIM SOFIE instrument observed nitric oxide oscillations in the upper atmospheres and identified overestimates of the molecule's absolute abundance.

After wordsmithing, the formal vote was taken. It was unanimous for Green, with nine members voting.

Dr. Kistler read the summary for API 19-2. The first example involved NASA's Van Allen probes and the Japanese Arase mission, showing that spatially localized waves on Earth's magnetic field can significantly reduce the number of charged particles in the electron radiation belts on timelines as short as 10 minutes. THEMIS work demonstrated that the phenomenon known as STEVE, a feature of the auroral lights, is due to the enhanced motion of charged particles in the ionosphere. Finally, IBEX observed high-energy neutral atoms formed when a high-energy charged particle from interstellar space captures an electron from a cold neutral particle at the solar system boundary.

The formal vote was unanimous for Green.

Dr. Bishop read the summary for API 19-3. GOLD observations show that severe ionospheric plasma depletions can occur 10 times more often than previously measured during solar minimum. A study of a CME used observations from Earth, Mars, and solar environments, demonstrating a new capability to detect space weather events across the entire heliosphere. Finally, the Thermosphere Climate Index was created, quantifying the impact of solar variability on the thermosphere.

After wordsmithing, the formal vote was taken. It was unanimous for Green, with nine members voting.

Dr. Liemohn then shifted discussion to the Dual Anon pilot program. Another possible place for bias is in the post-panel selection process, which occurs internally at NASA. He wondered if that is also going to be blind, and if it can be. Dr. Ho advised collecting and analyzing the data first. Dr. Bishop said that factors include the percentage of Excellent ratings from the panels, what is funded, and what is pending. Dr. Randall asked if they were headed in the direction of not considering PI experience. Dr. Liemohn said that the 2020 GI call will state that it will be double blind, with special requirements to anonymize proposals to the panel. There will be a workshop at AGU to help PIs get familiar with the process. However, they have not discussed PI experience. Dr. Kistler said that in prior tests of this methodology, panels have looked at team experience once the decisions are made. Dr. Liemohn observed that GI proposals involve only publicly available data, which are used for analysis. Dr. Angelopoulos pointed out that in the final selection, there are so few people involved that they operate under a self-imposed standard. Dr. Liemohn described the process at journals with triple-blind processes; this involves an extra step. He liked the idea of pulling data from a couple of years, then seeing the results. The panels will just be assessing the science.

Lunch Presentation: GOLD Update and First Science Results

Dr. Richard Eastes, the PI for GOLD, explained that the mission characterizes I-T system weather from a geostationary satellite. GOLD is on SES-14, a geostationary orbit over South America, and has two identical independent imaging spectrographs taking measurements on Earth's disk and limb. GOLD uses whiskbroom imaging to build spatial-spectral image cubes. Dr. Eastes showed a disk imaging simulation and what the full disk observation looks like over 1 day of observations. It is a 30-minute cadence for the whole image. He also showed the second channel in special mode, which indicates differences in the limb. During checkout, GOLD looked at atmospheric waves, where both channels observed at fixed locations for 6 hours. The data indicate that there are obvious waves, which the two channels see at slightly different times. The team might look for more of this during a hurricane. He also described geomagnetic storm data, demonstrating storm-time changes in the middle thermosphere and showing how a storm can alter the O densities. The observations and models are not in complete agreement. In pre-storm, the model missed mid-latitude enhancement, and during the storm, the observed decrease in O at high latitudes is greater than those modeled. Pre-storm wave forcing may be an important factor during the storm. This asymmetry needs to be studied further. However, the "offspring" of the dayglow matches the model well. When there is a mismatch, the model tends to be lower.

Dr. Eastes provided a graphic of the nightside observing mode. The spectrographs alternate in a cadence that begins at 30 minutes and goes down to 15 minutes. GOLD observes plasma depletions, which initially appear as the lack of emission on equatorial edges of the bright crests. Another question concerns planetary wave coupling of the ionosphere. In the winter of 2018-19, there was a sudden stratospheric warming event. Dr. Eastes described analysis of the crest locations and showed the northern versus southern latitude crest brightnesses vary with a period of ~16 days. Further observations and analysis show planetary wave periodicities, at lower altitudes, of ~16 days. This all makes a case for a connection. Storm-time changes in oxygen densities in the thermosphere could be as much as 40 percent greater than models predict. Nightside emissions show more structure than anticipated. GOLD is synchronized with the AWE mission launching in 2022 to ISS. GOLD was also the first rideshare. Despite some uncertainty, it appears that the mission has not lost any sensitivity. GOLD was a secondary payload, but the primary mission kept it close to the planned schedule.

Senior Review

Dr. Jared Leisner explained that his role with the SR is that of Program Scientist, and Mr. Bill Stabnow is the Program Executive. The 2020 SR will have some changes, largely driven by results of the 2017 SR, subsequent discussions, and various entities' needs and desires. HPD is adjusting the process to maximize science return, ensure data management, reduce the burden on missions in assessing continued operations,

and ensure that stakeholders have a better view of the process. The notional schedule has proposals due in February, panels in the spring, and announcements and the out-brief to HPAC in the summer. In 2017, the SR was an HPAC subcommittee, but that is not the case this time.

Missions invited to the SR may propose either a science investigation or move into HSO infrastructure. They must address code and computing, as well. While there are no requirements in that area at this time, it is likely that there will be for the 2023 SR. Should NASA establish a requirement in this area, the Agency will fund it. In addition, if NASA has funded code development, that is covered. The SR is asking that for all funded code, NASA receive plans on how to open source it. Dr. Hayes said that this has grown out of the NAS report on open source and what the NASA approach should be. Certain types of information is not on the table; NASA is more concerned about data analysis pipelines and other factors that prevent the science from becoming irreproducible. Dr. Leisner described the Project Data Management Plan (PDMP), which supplants the Mission Archiving Plans. PDMPs must be updated for the SR; a sample format will be provided. The PDMP has an Algorithm Theoretical Basis Document appendix. Data archiving must be in the Space Physics Data Facility (SPDF) and Solar Data Analysis Center (SDAC), rather than exclusively in non-NASA archives. Real-time data must be preserved in original down-linked forms, and revised data sets must be archived separately. Requirements are to migrate code to open source, and to include open algorithms; these are in anticipation that this area will be evaluated in the 2023 SR.

Dr. Bishop noted that much of the software on smaller missions is not that well-written. She asked if there will be quality control to make sure it does not crash people's computers. Dr. Hayes said that he is more interested in the algorithms than the code. Everyone defines these differently. He needs the algorithms first. Dr. Leisner said that the requirements will apply to things that already operate now. Going forward, there are parts of SMD requiring open code. This is not yet applied universally, but HPD wants to get ahead of it. Dr. Aaron Ridley said that he was on the NAS committee, and noted that one option is to create a license saying to use at one's own risk. Dr. Matsuo said that it is possible to document the steps to avoid having to release end-to-end code. Dr. Hayes said that this is new, and HPD is trying not to be too restrictive. If HPAC were to have findings on this topic, it could be useful.

Regarding infrastructure missions, Dr. Leisner explained that those teams will write a proposal to make the shift in category. If accepted, that then becomes a programmatic issue with a code degradation. Over time, these concerns will be taken care of at the front end. A lot will be captured by the open algorithms. NASA is not asking for the codes behind the algorithms. They are asking that all mission data be archived in SPDF and SDAC. Real-time data sometimes gets overridden, but the requirement will be for the original, downlinked form. This is mostly a concern in space weather.

Dr. Leisner next discussed Science Objectives (SOs), which will take the place of Prioritized Science Goals (PSGs). SOs will define what the mission will do during the extended mission period, and must be achievable within the budget NASA provides. The SOs must also be accompanied by Level-1 science requirements. There will be fewer SOs than there were PSGs. Dr. Leisner gave examples of the levels of science requirements. Dr. Ho asked about the heliophysics observatory data inputs. Dr. Leisner said that when NASA provides data for use by a mission, the Agency assumes the risk. Dr. Kistler noted that the SOs assume a single mission can achieve them. Dr. Leisner said that investigators can use their mission data and anything else NASA allows them to use.

Regarding SR panel structure, it will not be a subcommittee of HPAC like it was in 2017. SMD wants to take another route. One option is to pay the panelists for their work through a contract. Therefore, the SR will have one panel review mission proposals, and another panel review the archived data. There will be only evaluation, no recommendations. Then HPD will make the decisions. After the process is complete, HPD will brief HPAC, which will not be able to affect the outcome. Essentially, NASA will hire

reviewers. The proposals will have science that can be done within "in-guides." There will be options for "over-guides" as well. The final decisions will be programmatic. Dr. Hayes explained that if NASA requires a mission to do something, the Agency will pay for it. Dr. Leisner said that this plan addresses three of the six recommendations from the last SR panel. GOLD will be in its first SR, while the Van Allen Probes mission is not included. In addition, the Advanced Composition Explorer (ACE) joins the Solar and Heliospheric Observatory as infrastructure.

Geospace Dynamics Constellation Science and Technology Definition Team Report

Introduction

Dr. Leisner explained that the DS recommended GDC as the next LWS strategic mission. NASA formed a GDC STDT as a subcommittee under HPAC, and the report was being delivered to HPAC at this meeting. Once HPAC delivers its recommendations and the report to HPD, the STDT will be disbanded, and preformulation studies will be able to proceed. Because of the STDT structure, the scope of work did not include mission implementation, but instead had a tight focus on the science. The STDT determined parameters and discussed what kind of implementation spaces would and would not be valuable to discuss. As the STDT's executive secretary and DFO, he was present for all discussions. The FACA process made the team's work more difficult, but the science discussions were much stronger as a result of not having to consider implementation.

Overview

Dr. Ridley and Dr. Allison Jaynes, STDT co-chairs, presented the report. Dr. Jaynes, participating by phone, thanked the team, then showed a graphic of the GDC going through the I-T region. GDC was recommended by the 2013 DS, to help address compelling questions about the upper atmosphere, and especially to explore the upper atmosphere reaction to energy input, which drives significant space weather. The STDT was formed to refine the science goals and objectives.

Goal 1 is to understand how the high latitude I-T system responds to variable solar wind/magnetosphere forcing. Goal 2 is to understand how internal processes in the I-T system redistribute mass, momentum, and energy. Within Goal 1, there are four objectives, and there are six objectives for Goal 2. The STDT set priorities in order to give NASA flexibility, categorizing them as Core, Core Comprehensive, and Core Enhancing. Core objective 1.1 is to determine how high-latitude plasma convection and auroral precipitation drive thermospheric neutral winds. This is the most significant thing GDC can do, and it will involve different types of measurements. There are five Core Comprehensive objectives, and four Core Enhancing objectives, which Dr. Jaynes reviewed. She explained that the Core Enhancing objectives are important, but they are not as key to the mission as the others.

Dr. Ridley said that to determine how to address these objectives, the STDT did modeling through CCMC. The aim was to find the optimum number of satellites within an orbit plane, the optimum number of orbit planes, and the magnitude of temporal and spatial gradients that need to be resolved. CCMC analysis determined that three to six is the best number of orbit planes, four to six is optimal for global scales, and for smaller scales, the mission needs remeasurement times of 10 minutes or less. The March 2015 storm used in the modeling represents a first pass; he was not sure if other storms would be similar. It was one of largest from the last solar cycle, however, and the team examined the quiet time before the storm. The local, regional, and global scales vary by local time and remeasurement intervals. The inclination requires going to high latitudes; 80 degrees is optimum. Altitudes of 300-400 km are strongly desired for most objectives. Some Core Enhancing objectives require measurements through 50-150 km.

The STDT looked at four possible architectures as ideas. These include:

1. N x M, with M being different local time planes and N the satellites in each plane;
2. With cubesats: with M motherships and N "sacrificial" cubesats;
3. High-Low Circular: Having satellites at two different altitudes;

4. Over-Under: Having slightly elliptical orbits offset by 180°.

These can be mixed and matched. The key is to have a phased mission to close the GDC science objectives. Satellites need to be clustered and spread out, depending on the scales being measured. Implementation could come from campaigns of fixed and transitions, or there could be a constantly evolving constellation that covers a variety of scales. Dr. Jaynes presented a table of some of the analyses done in this exercise. The science goals and objectives can be addressed via a constellation mission with demonstrated technologies. GDC will need 3 years minimum to reach the science objectives, which will be enhanced by data assimilation. Cubesats used to augment the main measurements could offer significant advantages.

The various ITM missions that NASA has flown do not overlap GDC much. Dr. Jaynes described what each mission does and does not cover compared to GDC. SDO will be a good augmentation. The GDC report's appendix on contributions to national interests will cover recommendations from the NASA IG to address space weather, in collaboration with DOD and the commercial space industry.

In summary, the STDT recommendations are:

1. Support GDC as the next HPD mission;
2. Accept the STDT prioritization of objectives, with emphasis on neutral winds measurement;
3. Emphasize the need for ground-based observations, lab calibration activities, modeling resources, and new technology development alongside the main GDC effort;
4. Have 3+ satellites per orbit plane and 4+ orbit planes; and
5. Have NASA include GDC in cross-agency collaborations.

Mr. Filipi asked if there is a preference in the solar cycle for launch. Dr. Ridley said that it would be nice to launch based on solar maps, but it is not required. Dr. Jaynes added that there are good storms in any phase of the solar cycle. Dr. Angelopoulos asked how NASA should move from science requirements to implementation, and what needs to be developed to make that achievable. Dr. Ridley said that the report includes a science traceability matrix that addresses each needed measurement. Regarding the cubesats, they are disposable, though they could last a year. The STDT did not analyze frequency of storms because the GDC launch is an unknown. It would be good to have a range of weather, including storms, but the storms are not necessary to address the objectives. Dr. Jaynes said that solar storms occur all the time, and a lot can be learned during less active times. The smaller storms can help elucidate the processes.

Dr. Leisner explained that NASA wanted HPAC to provide comments on the process and note items that NASA should consider in preformulation. Any comments on the recommendations would help, as well. Given that HPAC operates under the same restrictions as the STDT, implementation should be avoided. Dr. Jaynes said that the FACA process was painful at first, and people were expecting something else. However, she felt the process required them to go in the right direction. It would have been nice to discuss the feasibility of measurements, but she liked having it about the science only. Dr. Ridley agreed. There was potential to hand over a report on something that was insanely expensive, so they tried to walk the line of achievability. It was difficult. Dr. Matsuo said that the FACA rules made it difficult to communicate freely, and restrained the flow of information. That has to be clarified if this goes forward again. Dr. Ridley added that the meeting schedule and timing could have been better, and they could have used another in-person meeting. Dr. Bishop thought that part of the problem was communications, and suggested that the team might have been a bit larger than it needed to be.

Public Comment

The meeting was opened for public comment. Dr. Spiro Antiochos had a question for Dr. Ridley, noting that it seemed that Objective 1.1 would require a minimum of eight, possibly nine, satellites. He was concerned about redundancy and how to address a situation in which a satellite goes bad. Dr. Bishop said

that the chart he cited showed the comprehensive architecture to which he was referring, but it also showed other architectures that would address various elements. The 12 satellites would have built-in redundancy. The team wanted to not have to rely on other missions, additional satellites, etc.

Dr. Fox said she appreciated the thought across the broader scale. She was assuming the HPAC report the next day would include the response on the STDT. Dr. Leimohn said that Dr. Leisner had asked HPAC to provide a separate letter on the GDC findings and recommendations, and the Committee wanted to hand that over in final form rather than as a draft.

Strategic Data Management Discussion

Dr. Hayes introduced Dr. Dominique Chamely, who works with him on the Strategic Data Management plan. HPAC members had the draft report via email. It had been approved by SMD and was in the editing process. He began reviewing the findings and recommendations. Recommendation 1A states that SMD should develop a standardized policy, but policies will be at division level, so HPD will be in charge of the heliophysics policy. Part of the thinking is that perhaps there should be ways for people to access science outside of their niche. This is a long-term project, but the earliest implementation would be in FY21. He was the HPD representative in the working group. SMD will have a full-time person on the effort. The intent is to standardize the interface, not the archives, and to make it possible for nonspecialist experts to seek information across all specialties. HPD is in front on this, which is evident in the approach to the SR. The Division has been evolving its data environment to reflect a more modern data accessibility approach. Thus far, HPD has captured most of the old data.

Dr. Chamely, who is working on redesigning archives, said that this effort is one of the eight strategic planning SWGs, and it is early in the process. She built a methodology for the initiative. The idea is to do strategic thinking with tangible solutions. There are principles, tools, and templates she has employed, but the methodology is customized. The methodology has five stages, with subtasks: initiate and align; define the challenge; set goals and ideate; solution and validate; and, iterate. The effort is currently focused on setting goals and ideating, which involves identifying the ideal state and how to get there. An HPD working group has had some preliminary discussion of four goals: revise and expand data policy; modernize HPD data storage; increase access and analysis of legacy data; and create long-term sustainable curation standards. The working group will help identify key topics for solutions. There will be a half-day workshop for each topic. One of the first topics is accountability, which encompasses cleaning data, verification and validation, incentives for planning for archives, etc. Next is storage, the third topic centers on analysis, and the fourth emphasizes sustainability.

Dr. Hayes said that there will be additional briefings in the future. This effort will roll out in ROSES 2021. The draft revised policy is stronger than the prior one. He, Dr. Kozyra, and others have been working on an Amazon Web Services (AWS) project that uploaded the stored data from the GSFC archive into the Amazon Cloud environment, and they found that the upload cost all of $72. Egress is the problem, however, and it could be significant. SDO data will require a cloud solution, and that may reside on both a government and a public cloud. Dr. Matsuo told of a data access situation she confronted. There is a hierarchy in data, the data that one needs to access and the data that one needs to save, and it must be standardized. Dr. Hayes agreed. The priorities have not yet been set, but there are things that will need to be saved.

When asked about controlling downlink, Dr. Hayes repeated that the struggle is with egress. The solution space will be broad, and he does not anticipate that there will be a single solution. The private sector brings a lot to this, and NASA should not reinvent it, but his question is how to pay for it as a government manager. He wants to be able to access data to answer compelling questions without having to wait 8 months. HPD is talking to ESD, which has the most data in SMD and is further along. Dr. Bishop said that clean data is a concern, because taxpayers should have access to everything. Some demonstration

data can be junky. She is also concerned about backup. It makes her nervous to have data all in one location, especially since there have been space science databases that were shut down or had data removed. Dr. Hayes thought that sounded like a finding. He does not believe in data expiring. Dr. Bishop said that she knows of datasets removed because they were not used enough. Dr. Hayes said he was very concerned about that. Interest will wax and wane over time.

Dr. Matsuo described her experience with searchable images on the cloud. With the data and computing on the provider's server, it was very expensive, even for a university. She had hoped to train students in that environment, but it was costly. Dr. Hayes thought that was an extremely useful example, noting that cost is a factor in sustainability. This is a brave new world, all across NASA. Nor is it clear what to do with journals. Processes for research are fundamentally changing.

Dr. Liemohn said that archives is one of the eight SWGs, and he was interested in hearing from the other seven. He thought HPAC could generate a recommendation based on the presentation. Dr. Chamely pointed out that the archives SWG was further along than the others.

HPAC Work Session

Dr. Liemohn made HPAC writing assignments.

The first topic was R&A. He thought they should congratulate HPD on the increased selection rates, and there were still questions about accessing diversity information. Dr. Cassak said that while the overall funding rate looks nice, the two biggest programs had the lowest rates. Dr. Liemohn suggested comparing the rates to those of the previous year. Dr. Cassak replied that HPAC had asked for funding rate as a function of proposal rating, but he did not see that. He also wanted to congratulate HPD for no longer using proposers as mail-in reviewers, and to ask that they not do that ever again. Dr. Larisa Goncharenko pointed out that funding rates in the mid-20s constitute a significant increase in some areas, as a number of programs had had rates below 20 percent. Dr. Bishop wanted to acknowledge that the program started new funding lines. However, she thought it would be nice to have a statement of what each line covers and the boundaries. Dr. Liemohn said HPAC could ask for this to be put in the HPD overview of ROSES.

On the SR, features of note included the code and algorithm requirements, and the SR not being an HPAC subcommittee. Dr. Angelopoulos said that there is a need to have not just source code but also open source language. There is no standardization, however, and Drs. Hayes and Leisner said different things. No one wants to be in the dark ages of not being able to use data. Perhaps HPAC should reinforce what NAS said. Dr. Matsuo agreed, but observed that there is a nervousness about requirements to be open. This has to be done carefully. Dr. Kistler pointed out that even demanding it for new missions can be a problem. Dr. Bishop said that they were using "code" and "algorithm" interchangeably, creating ambiguity. HPD needs to be consistent, and definitions would help.

Dr. Liemohn then asked for each member's thoughts on the GDC STDT process and report:

- Dr. Matsuo said that it hurt to have the FACA requirements.
- Dr. Kistler said they should commend the STDT on the report.
- Dr. Randall said there was a core group that sacrificed a lot to get the report out. NASA needs to think about how these things are done, as it is an enormous amount of work.
- Dr. Ho thought the time was inadequate.
- Dr. Bishop said that while the time should have been sufficient, they lost 3 months replacing the chairs. In addition, it was a too large group, so they broke into subgroups, which took time.
- Dr. Goncharenko said she did not completely agree with Dr. Bishop. It was difficult to organize and communicate. Everyone was copied on all emails, and many members felt drowned in emails, some of which were minor communications. It was hard to manage. The small groups

helped, but the overall communications were a problem. Dr. Bishop explained that the FACA rules required that all discussions involve the whole committee. The subgroups were useful, but once the work returned to the larger group and report writing, everyone had to be included.
- Dr. Randall said that it was huge undertaking and constituted a full-time job for some people on the committee.

In further discussion, Dr. Bishop explained that STDT members were prohibited from discussing their work with members of the community; they had to refer would-be commenters to Dr. Leisner. Dr. Goncharenko agreed, noting that they could not get community feedback, which was a limitation. Dr. Liemohn observed that community feedback is essential. He thought STDTs should go back to being non-FACA. Dr. Ho added that HPAC should have a finding that this mission should be implemented quickly, and that the next ROSES call should fund GDC-related technology development.

Another round-robin discussion raised the following points:
- Mr. Filipi said that the STDT should receive lots of kudos for great work. NASA should think carefully about the scope and organization of future groups. He wondered if a NASA lawyer might brief HPAC on what is and is not allowed. Dr. Kozyra said that was a good point, noting that Dr. Leisner was in constant contact with NASA OGC.
- Dr. Bishop advised accepting the report, with support of the science goals. To accomplish additional tasks, the next phase should begin as soon as possible. The process needs improvement.
- Dr. Cassak agreed with the previous statements. He wanted to laud the STDT for their efforts and see if there are better ways to do it.
- Dr. Goncharenko thought they might ask to communicate to NASA the lessons learned. People volunteered their time, and it was not well-managed because of FACA. Someone needs to find a better way of managing the human resources.
- Dr. Randall agreed with everyone else.
- Dr. Liemohn also agreed, adding that NASA needs an implementation process as soon as possible, and should push technology development requirements through ROSES soon after that.
- Dr. Angelopoulos said the process should be made more manageable.

Dr. Liemohn asked if anyone objected to the science goals and objectives as they were written and prioritized. No one did, so HPAC officially accepted the report.

On the SR, he had in his notes that HPAC seeks definitions of "code" and "algorithms," and that the Committee thanks HPD for making the next SR standalone. For R&A, his statement was going to include a congratulations on the new program elements and funding rates, and a request to look at proposal rates over time. There was some discussion about what to measure, and how. Dr. Ho thought they should get the rates by panel grade. He also wanted HPAC to acknowledge the new $140 million R&A baseline, which enables many more activities, including greater collaboration. He advised making the point that HPD could do even more work of greater significance with additional funds. It would be good to note DRIVE and Explorer as part of this.

Dr. Liemohn then reviewed what was going into the letter.
- Congratulations on the many recent spaceflight opportunities, and a request for more on PI diversity on the missions. Regarding the latter point, HPAC would like to know what SMD is doing, and urge the Directorate to do more. Dr. Cassak volunteered to write this finding.
- Congratulations on ECIP and other early career opportunities.
- Regarding LPAG's SSA-9, HPAC found that the word "climate" is charged. Still, most members voted in favor of having that SSA. HPAC also seeks a better definition of LWS boundaries. Dr.

Bishop said that since she was the only holdout against approval of SSA-9, she would be fine with HPAC saying it should be included. She also volunteered to write a finding on it.

- In discussing SSA-10, HPAC split on the inclusion of stellar within LWS and seeks more information. Dr. Bishop also volunteered to write this finding.
- On the subject of PAGs, HPAC would like to see more of these, and supports a space weather PAG. Dr. Ho said he would write the recommendation.
- Regarding the Heliophysics Vision 2050 workshop, that would be a statement of approval in the letter.
- Next was the need to make sure the numbers are comparable on the R&A information on funding rates as a function of proposal rating. Dr. Angelopoulos agreed to work on this.
- For the SR, HPAC sought definitions of "code" and "algorithm" before the actual review takes place. Dr. Angelopoulos volunteered to write this.
- HPAC was commending the GDC STDT on a comprehensive report, urging quick action toward implementation and technology development, and noting the issues involved in the STDT being a FACA committee. Of particular concern was the fact that the Team could not obtain community feedback. Dr. Angelopoulos took on this statement.
- Finally was a comment on the archiving SWG. HPAC would like to hear from this group at least annually, and hear from the other seven SWGs as they progress. Dr. Ho volunteered to write this.

Adjourn

The meeting adjourned for the day at 5:35 p.m.

Thursday, October 3, 2019

Welcome to Day 3

Dr. Kozyra welcomed the meeting participants.

Overview of Agenda

Dr. Liemohn asked the HPAC members to continue their work session.

HPAC Work Session

Dr. Liemohn said that he wrote three letters. One was on GPRAMA with the ratings and the supporting materials. Second was the GDC STDT report letter. The third was the letter to Dr. Fox.

Regarding GDC, HPAC found the STDT's work to be comprehensive and laudable. The FACA requirements were an impediment to committee operations, as STDT members could not interact with the community and each other as done in the past. The letter noted that this focused them on the science goals and measurement requirements, however. In addition, HPAC recommends that an implementation team be formed expeditiously and the technology development be done as soon as possible. Dr. Bishop added that about a quarter of the white papers from the community to the STDT had redactions, and two were almost entirely blacked out due to FACA restrictions.

The HPAC letter report is to congratulate HPD on the programs focused on early career scientists. The letter would commend HPD on its numerous space flight operations. Also mentioned in the letter would be the completion of GPRAMA, the LPAG briefing and HPAC reaction, and the reaction to the space weather activities. Dr. Angelopoulos was working on the response to the R&A presentation, and had

written a piece on the SR. The GDC report was covered in another document, and HPAC fully supported release of that report. Still pending was a section on SWGs and the archives SWG presentation.

Assessing the funding rates of the grants program was brought up again. Dr. Cassak said that the goal is around 30 to 33 percent. He did not want HPAC to send mixed messages. Dr. Liemohn added that the Dual Anonymous discussion was to be folded into the R&A section that Dr. Angelopoulos was composing. Dr. Cassak said that he liked the idea of the pilot program. Regarding logistics, one thing that came up was what to do with conflicted panel members, and it was suggested they not be identified, but instead sit in the room and not comment. If a panelist has to leave or is told to be quiet, it identifies them. He was skeptical about that approach. Dr. Ho said he was willing to wait and see. He wanted a diversity baseline to compare with the new approach. Dr. Bishop agreed about the need to set the metrics. After the GI results come in, HPD and HPAC can examine the details before rolling out the effort to other programs. Dr. Liemohn raised the issue of institutional bias, explaining that formal and informal internal reviews are common, creating a conflict situation. Dr. Bishop said that it is a difficult issue for the reviewers. She was concerned about removing the identifying information and having the panel determine if proposals are compliant. Proposers can reveal themselves with a single word. Dr. Liemohn suggested noting the cause for concern. Dr. Kozyra wondered if the enhanced ability to identify experienced PIs might disadvantage early career proposers. Dr. Bishop said that because senior people have written so many proposals, they have distinct writing styles and other ways to be identified. Dr. Liehmohn said HPAC would mention the pros and cons.

Dr. Kozyra said that there are other ways to minimize unconscious bias. She asked if anyone knew of research on how to diminish unconscious bias without the double-blind methodology, which is problematic in a small field. Dr. Cassak said that he had looked into this but not found much. Mr. Filipi asked if HPAC could request a briefing on the data and impacts. Dr. Kozyra said that it has been mandated that they do this experiment. Dr. Ho said that while SMD has been discussing this among the various divisions, he would still like a baseline. He believed SMD had already called in a sociologist or someone with similar expertise at one point. Dr. Angelopoulos suggested that rather than pointing out existing issues, HPAC could recommend that SMD explore other methodologies in parallel, for a multi-pronged approach. Dr. Kozyra said that panels are already shown a video on unconscious bias. Other information highlighting how diversity offers a competitive advantage might be added to it. She noted that, as with Dr. Hayes reporting that each division is handling archives differently, it could be that the approach to addressing unconscious bias should be more tailored to each discipline, especially with heliophysics being smaller than the others. Working with approaches in parallel is a neutral way of suggesting that SMD try other techniques.

Once the writing was done, Dr. Liemohn reviewed the sections to be included. The GDC letter praised the STDT's exemplary and laudable work. It then stated that HPAC found that FACA rules enforced a structure to discussions that focused on science and measurement traceability, which was positive, as it removed implementation specifics. While the large STDT membership provided considerable diversity, HPAC also found that FACA rules ultimately constituted an impediment to efficient interactions. Even with the use of subgroups, the process was unwieldy, as everyone had to be involved in discussions. Therefore, HPAC was recommending that NASA review FACA rules to see how those rules might be relaxed. HPAC further recommended that an implementation team be formed expeditiously and that any potential technology infusion/maturation related to GDC be incorporated into the upcoming calls for technology development proposals. HPAC also thanked the GDC participants, particularly Drs. Jaynes and Ridley.

The GPRAMA letter had been reviewed the previous day.

The meeting report letter recommended that HPD develop an approach to obtain representation data on applicants for new missions. The letter also made recommendations to LPAG on the SSAs. Among these is to review SSA-10 with PSD coordination. Dr. Ho pointed out that ROSES Section E is cross-divisional and includes astrophysics in addition to planetary. The contact is in PSD, but the scope goes further. The letter also noted Dr. Spann's space weather presentation. HPAC recommended that HPD form a PAG for space weather, and believed additional PAGs could benefit the Division.

Dr. Angelopoulos' R&A finding was included in the letter. All programs have selection rates of 20 percent or higher. HPAC discussed the percentage necessary for viability. They agreed that 20 percent is the floor, and 33 percent has been cited as optimal. Dr. Cassak wanted the letter to recommend that HPD examine and report back on selection rates based on panel rating, in addition to the overall selection rates regularly reported. Dr. Kozyra wondered whether, given that selection rates vary among programs, there might be a way to look at it as a whole. Regarding the Dual Anon pilot and options for reducing unconscious bias, Dr. Cassak pointed out that NIH has done something on this and could be another resource.

HPAC Report Out to HPD Director

Dr. Liemohn told Dr. Fox that HPAC had written three letters: one on GPRAMA, one on GDC, and the meeting letter.

Dr. Bishop read the findings and recommendations on GDC:

- The work was exemplary and laudable, and HPAC thanked the members.
- The FACA rules enforced structure, but they were also an impediment to efficient interaction and inhibited timely progress and communication with the community, thus risking the loss of valuable input. HPAC wants a NASA representative to provide community updates in the future.
- HPAC recommended expeditious implementation of GDC, to include the needed technology development calls.

HPAC fully accepted the report and approved its full release.

Dr. Liemohn said that for GPRAMA, HPAC used the provided source material to come up with examples. The Committee assessed and voted on the three science APIs, voting unanimously for a rating of Green on all three.

He then reviewed the points of the main letter, addressed to Dr. Fox.

- HPAC thanked Dr. Fox for her presentation and the time she spent with them.
- The new early career programs such as ECIP, FINESST, etc., are laudable.
- HPAC commends HPD on its numerous flight programs. Mr. Filipi read this section, which discusses diversity in new mission operations and the challenges of tracking, which is needed nonetheless. HPAC recommended that HPD encourage SMD to obtain the representation data on applicants for new missions. Dr. Liemohn added that HPAC knows the program is SMD-wide, so the solution might be SMD-wide as well.
- The FDL presentation was pertinent regarding AI-ready data sets and the need for sufficient computing resources.
- HPAC had a number of LPAG findings and recommendations:
    - The Committee accepted SSAs 1 through 8 as baselines, with no change.
    - On SSA-9, there was some concern that "climate" will overlap with ESD. Therefore, HPAC asked that LPAG clarify the boundaries.
    - LPAG should coordinate with the cross-divisional programs referenced in ROSES sections E.3 and E.4 prior to permanent inclusion of SSA-10. At the same time, LWS should coordinate with APD and PSD.

  - If SSA-10 is included, there should be a review after 2 years.
- HPAC heard from Dr. Spann on NASA space weather efforts and applauds this work. HPAC recommended that HPD form a PAG for space weather. HPAC also recommended that HPD look at forming PAGs in other areas, as these groups enable additional community feedback.
- There were several points to be made about R&A.
  - HPAC commended Dr. Kessel on her presentation, and praised the R&A funding increase, the ISFM and other programs, the DSCs, and other efforts.
  - Selection rates are improved, and HPAC wants to see movement toward a 33 percent selection rate.
  - HPAC recommended that HPD examine and report back on selection rates based on panel rating.
  - HPAC had concerns about the Dual Anon reviews. The Committee commends the experimentation and efforts to remove bias. However, the small heliophysics community could have some unique issues that preclude complete success by using the one-size-fits-all solution being discussed within SMD. Therefore, the Committee recommended:
    - HPD (and SMD, as appropriate), should provide diversity information, establish metrics, and try other methods of diminishing unconscious bias.
    - SMD should seek expertise from other disciplines to research and implement additional innovative methods in parallel.
  - While HPAC is concerned about making reviews truly blind within the small heliophysics community, the Committee is glad to see this going forward.
- HPAC commended Dr. Eastes on the GOLD presentation and the mission.
- Regarding the new SR process, HPAC was glad to hear it will not be an HPAC subcommittee. In addition:
  - HPAC commended NASA on simplifying the review for legacy missions and streamlining the requirements for continuing missions providing science in addition to system observatory support.
  - HPAC noted the important issues concerning source code preservation requirements, cautioning against making those requirements too broad. Therefore, HPAC recommended that NASA revisit the rationale behind the requirements, and recommended that "code," "algorithm," and similar terms be defined up front to avoid confusion among the proposers.
- As mentioned, HPAC heard from GDC, and Dr. Liemohn read that letter.
- HPAC also heard from the Archives Strategic Working Group and appreciated the briefing. The Committee applauded the SWG approach and wanted more briefings from the SWGs at future HPAC meetings.
- HPAC thanked HPD for their work in organizing the meeting.

Dr. Fox thanked HPAC for their efforts.

Adjourn

The meeting was adjourned at 11:45 a.m.

Appendix A
Attendees

Heliophysics Advisory Committee Members
Michael W. Liemohn, University of Michigan, *Chair*
Janet Kozyra, NASA Headquarters, *Executive Secretary*
Vassilis Angelopoulos, UCLA
Rebecca Bishop, Aerospace Corporation
Paul Cassak, West Virginia University (via teleconference)
Darko Filipi, BizTek International, LLC
Larisa Goncharenko, MIT Haystack Observatory (via teleconference)
George Ho, Applied Physics Lab
Lynn Kistler, University of New Hampshire
Tomoko Matsuo, University of Colorado at Boulder
Cora Randall, University of Colorado at Boulder (via teleconference)
Bill Matthaeus, University of Delaware (via teleconference)

NASA Attendees
Deborah Amato
Spiro Antiochos
Ralph Beatty
Sky Bischoff-Mattson
Veronica Brueli
Chris Caisse
Dominique Chamley
Li-Jen Chen
Galen Fowler
Nicola Fox, *Heliophysics Division Director*
Heather Futrell
Lika Guhathakurta
Roshanak Hakimzadeh
Jeffrey Hayes
Jennifer Kearns
Mona Kessel
Patrick Koch
Jared Leisner
David Long
Margaret Luce
Jeff Morrill
Daniel Moses
Michael New
Simon Plunkett
Arik Posner
Avita Power
Sean Robins
Douglas Rowland
Sabrina Savage

Joe Smith
William Stabnow
Ekaterina Verner

Other Attendees
Lamont Di Biasi, L. Di Biasi Assoc.
Richard Eastes, Colorado University-Boulder
Scott England, Virginia Tech
Mary Floyd, Electrosoft
Grace Hu, OMB
Ben Kallen, Lewis-Burke
C. David Lewis, DARPA
Mark Linton, NRL
Larry Paxton, APL
Aaron Ridley, University of Michigan
Elizabeth Sheley, Electrosoft
Jesse Woodruff, DARPA

Remote Attendees
Chris Caisse, NASA
Dominique Chamely, NASA
Art Charo, NAS
Chelsea Cho, University of Michigan
Tammy Dickenson, Science Matters
Monte DiBiasi, SWRI
Tom Gardner, Advance Space
Samantha Haurie, NASA
Allison Jaynes, University of Iowa
Teresa Jensen, Space Dynamics Lab
Ben Kallen, Lewis-Burke Associates
Jennifer Kearns, NASA SMD
Lilly Larson, Ball Aerospace
Rachel Marrow, Booz-Allen
Lindsay Milliken, Lewis-Burke
Dan Moses, NASA
Robert Pfaff, NASA Goddard
Sean Robbins, Booz-Allen
Bill Stabnow
Allen Thurgood, SDL
Ashley Wilkins, HSC
Lisa Wood, Ball Aerospace
Estyhia Zesta, NASA Goddard
Shasha Zou

Appendix B
Advisory Committee Membership

Michael W. Liemohn, Chair
University of Michigan

Janet Kozyra (Executive Secretary)
NASA Headquarters

Dr. Vassilis Angelopoulos
UCLA

Rebecca Bishop
Aerospace Corporation

Paul Cassak
West Virginia University

Darko Filipi
BizTek International LLC

Larisa Goncharenko
MIT Haystack Observatory

George Ho
Applied Physics Lab

Lynn Kistler
University of New Hampshire

James Klimchuk
NASA Goddard Space Flight Center

Tomoko Matsuo
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Appendix C
Presentations

1. *Heliophysics Division Overview*, Nicola Fox
2. *Advanced Concepts in Data Management and Computing*, Lika Guhathakurta/Jeff Hayes
3. *GPRAMA*, Jennifer Kearns
4. *LWS Program Analysis Group Update*, Mark Linton/Sabrina Savage
5. *Space Weather Program Updates*, James Spann
6. *New Programs in ROSES; Review Process*, Mona Kessel
7. *GOLD Update and First Science Results*, Richard Eastes
8. *Senior Review*, Jared Leisner/Bill Stabnow
9. *Geospace Dynamics Constellation Science and Technology Definition Team Report*, Jared Leisner/Allison Jaynes/Aaron Ridley
10. *Archives Strategic Working Group*, Jeff Hayes/Dominique Chamely

Appendix D
Agenda

Heliophysics Advisory Committee (HPAC) Meeting
NASA Headquarters, Washington, DC
October 1-3, 2019

Tuesday October 1, 9:30AM – 5PMRoom 9H40		
9:30	Welcome	Dr. Janet Kozyra, NASA
9:35	Overview of Agenda	Dr. Michael Liemohn, Chair
9:45	Heliophysics Division News, Updates, and New Initiatives	Dr. Nicola Fox, NASA
10:45	BREAK	
11:00	Q&A	Dr. Nicola Fox, NASA
12:00	LUNCH Advanced concepts in data management and computing	Dr. Lika Guhathakurta / Dr. Jeff Hayes (NASA)
1:00	GPRAMA	Ms. Jennifer Kearns (NASA)
1:10	GPRAMA Discussion	
2:00	BREAK	
2:15	LWS Program Analysis Group Update	Dr. Mark Linton (NRL)/Dr. Sabrina Savage (MSFC)
3:15	Space Weather Program Updates	Dr. Jim Spann, NASA
4:15	HPAC Work Session	
5:00	ADJOURN	

Wednesday October 2, 9:30 AM – 5PM Room 9H40		
9:00	Meeting Room Open	
9:30	Welcome to Day 2	Dr. Janet Kozyra (NASA)
9:35	Overview of Agenda	Dr. Michael Liemohn, Chair
9:45	New Programs in ROSES; Review Process (including Dual-Anonymous	Dr. Mona Kessel (NASA)

	experiment, directed vs undirected research)	
10:45	BREAK	
11:00	GPRAMA Discussion	
12:00	LUNCH Presentation: GOLD Update and First Science Results	Dr. Richard Eastes (LASP/CU)
1:00	Senior Review	Dr. Jared Leisner/ Mr. Bill Stabnow (NASA)
2:00	Introduction: Geospace Dynamics Constellation Science and Technology Definition Team Report	Dr. Jared Leisner (NASA)
	Overview: Geospace Dynamics Constellation Science and Technology Definition Team Report	Co-Chairs: Dr. Aaron Ridley (University of Michigan) and Dr. Allison Jaynes (University of Iowa)
3:00	BREAK	
3:15	Public Comment	
3:25	HPAC Work Session	
5:00	ADJOURN	

Thursday October 3, 9:30AM – 12PM , Room 9H40		
9:30	Welcome to Day 3	Dr. Janet Kozyra (NASA)
9:35	Overview of Agenda	Dr. Michael Liemohn, Chair
9:45	HPAC Work Session	
10:45	BREAK	
11:00	HPAC Report Out to HPD Director	
12:00	ADJOURN	