NASA ADVISORY COUNCIL

HELIOPHYSICS ADVISORY COMMITTEE

May 5 & 6, 2022

Virtual Meeting

MEETING MINUTES

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Michael Liemohn, Chair

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Janet Kozyra, Executive Secretary

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Tom & Jerry, Inc.

Thursday, May 5, 2022

Welcome

Dr. Janet Kozyra of the NASA Heliophysics Division (HPD) welcomed the members of the Heliophysics Advisory Committee (HPAC). She was continuing to serve as HPAC's Designated Federal Officer (DFO) and Executive Secretary while Dr. Kelly Korreck of HPD went through the approval process to take on those roles. This was a Federal Advisory Committee Act (FACA) meeting and therefore open to public, with a public comment period on the second day. Formal minutes were being taken for the public record and all discussion was on the record. Dr. Kozyra turned the meeting over to Dr. Michael Liemohn, HPAC Chair.

Overview of Agenda

Dr. Liemohn welcomed the HPAC members and other meeting participants. The agenda had shifted a bit from the original version. HPAC members would have a couple of work sessions during which they could craft findings and recommendations to HPD. He then had the members briefly introduce themselves.

Space Weather Council Update

Ms. Patricia Doherty, HPAC member and Chair of the Space Weather Council (SWC), thanked HPAC for this opportunity to introduce the Council. SWC had an introductory meeting in March. The Terms of Reference (TOR) state that SWC reports to HPAC and is to be responsive to requests for actions. SWC may seek input from the heliophysics and space weather communities in the course of implementing charges from HPAC. Ms. Doherty gave examples of the broad range of activities that SWC might address. The Council currently has its maximum of 12 members, who Ms. Doherty listed along with their institutions and areas of expertise. The plan is for one third of the members to rotate off every 3 years. As the group is responsive to HPAC, it will meet biannually or as needed in order to carry out its work.

At the March meeting, Dr. Nicola Fox, HPD Director, spoke about NASA's Space Weather Strategy, which seeks to advance the science of space weather to empower society while also expanding into space. To that end, NASA is establishing space weather capabilities that support robotic and human space exploration and meet national, international, and societal needs by advancing measurement and analysis techniques. The Agency is also dedicated to expanding the knowledge base necessary for transitioning improved operational space weather forecasts. Dr. James Spann, HPD Space Weather Lead, gave the SWC meeting an update on what NASA currently does in the area, emphasizing the unique observations and data streams, as well as efforts to transition information knowledge to operations and applications through collaborations with academia, government, and industry. The Agency works with the National Oceanic and Atmospheric Administration (NOAA) and Department of Defense (DoD) in these efforts. Ms. Doherty noted the space weather instrument pipeline as a potential area for SWC activity.

In discussion, SWC noted that the Space Weather Centers of Excellence (COEs) solicitation has potential overall, but the draft seemed unclear and perhaps insufficient in its level of funding. The Council wondered if it might discuss the optimal levels of effort needed for a COE. Existing capabilities constitute another issue. SWC talked about extending the lives of NASA missions that are no longer scientifically viable but still operable, and whether some U.S. Space Force (USSF) missions might have a secondary purpose for space weather. There was concern about the extent to which ground- and space-based assets are under-utilized, with data from the Van Allen Probes being an example. Similarly, NOAA has operational space weather data that cannot be used due to processing limits. There is a need for rapid prototyping for research to operations (R2O), which takes too long and could be insufficient for the upcoming solar maximum.

SWC is interested in determining whether existing gap analyses are current and, if they are not, whether SWC should initiate an update in order to identify what might be needed in the instrument pipeline. Emphasis should be on what is available in the next 3 to 5 years, given that a NASA space weather goal is to travel with other missions where possible. It would also be useful to coordinate with other space weather councils, such as the Space Weather Advisory Group (SWAG). Members of SWAG who listened in told SWC that they would welcome this discussion. HPAC has not charged SWC with any actions thus far. However, with the approaching solar maximum, timeliness is a concern and SWC members are eager to support HPAC, HPD, and NASA.

Dr. Liemohn said that if HPAC had any specific topics for SWC to address, this was an opportunity to identify them. He noted that all SWC findings and recommendations to NASA will have to pass through HPAC. Dr. Tomoko Matsuo said that the instrument pipeline discussion came up at a National Academy of Sciences (NAS) workshop on infrastructure. NOAA is interested in this area to enable instruments and missions. Dr. Liemohn said they would talk about this and the gap analysis. Dr. Therese Moretto-Jorgensen liked that SWC hoped to coordinate with other groups and suggested making a connection to the exploration parts of NASA as well. Ms. Doherty thought that was a good idea. Dr. Larisa Goncharenko noted the need for better management of collaboration of both space- and ground-based on an interagency basis. Ms. Doherty agreed, adding that there does not seem to be a comprehensive list of activities yet. In addition, data availability is important but some data are being lost. Dr. Rebecca Bishop advised SWC to look at a NAS rideshare document that has a list of instruments for the pipeline.

R&A Program Trends

Dr. Patrick Koehn, acting R&A lead for HPD, said that the Division has a healthy R&A program, with 23 programs in total, 17 of which have active competitions this year. The Diversify, Realize, Integrate, Venture, Educate (DRIVE) initiative is strong and NASA has selected three centers to operate for the next 5 years. HPD is addressing Diversity, Equity, and Inclusion (DEI) via Dual Anonymous (Dual Anon) reviews, along with additional diversity and inclusion efforts. New elements in Research Opportunities for Space and Earth Sciences (ROSES) include open science and citizen science, along with an element for the 2024 eclipse.

Dr. James Klimchuk had asked about funding between traditional R&A programs and the subdivision between open and directed research. His own investigations of HPD's R&S funding indicate that the true directed research is about 10 percent of the R&A budget, and 25 to 30 percent goes to Living with a Star (LWS), for which the community provides the topics. Open research is another 45 to 50 percent, and the Guest Investigator (GI) program gets about 20 percent. While the percentages are relatively stable despite federal budget fluctuations, it has been frustrating to see the actual dollar amounts in his own budget investigations and he hoped that people understood the value in looking at real numbers. He would love to see the numbers broken out by program over years, subdivided by traditional R&A, technology R&A, and open versus directed R&A. A lot of people are in the dark about this. It can be challenging, but it is important to know how much money goes into R&A. He has created a chart showing a decline in funding when corrected for inflation. Dr. Thomas Zurbuchen, Associate Administrator (AA) of NASA's Science Mission Directorate (SMD) was even surprised by this. Dr. Koehn agreed, noting that the numbers are set by those outside NASA. Dr. Moretto-Jorgensen said she had a similar question about DEI, because if there are no data showing what they are trying to improve upon, it is not possible to know if or how they have improved. The self-reporting is not accurate. Dr. Koehn said that SMD may have some data. Dr. Korreck added that there was a talk planned on the topic of Inclusion, Diversity, Equity, and Access (IDEA) in which the presenters would talk about how to move forward with the metrics.

Dr. Liemohn shared his screen to show a request to NASA that HPAC had made at its previous meeting. He highlighted the following statement: "It would be useful to release a separate supplemental document that tracks R&A program funding across several years." He also read a couple of sentences in which

HPAC requested a presentation on this and on IDEA. Dr. Klimchuk noted that that was not the first time HPAC had sought the R&A information.

Division Update

Dr. Fox began the HPD update by paying tribute to the late Dr. Eugene Parker and his tremendous legacy. A chart depicting the Heliophysics System Observatory (HSO) included 20 operating missions with 27 spacecraft, 14 missions in formulation or development, and 1 under study. Among recent HPD accomplishments were the selection of three investigation teams to join the Geospace Dynamics Constellation (GDC) mission science team, down-selection of two Medium Explorer (MIDEX) missions, release of the Small Explorer (SMEX) announcement, support for Helio 2050, finalization of the Statement of Task for the 2023 DS with NAS, and selection of DRIVE Science Centers. HPD confirmed seven missions for implementation and advanced three in formulation, while also investing in multiple high-priority, cross-cutting programs and initiatives.

Dr. Fox presented a science highlight, explaining that the Parker Solar Probe (PSP) entered the solar atmosphere for the first time, which is a completely uncharted region in which intertwined particles and fields are still bound to the Sun's atmosphere. She then described the two MIDEX selections. The Multi-slit Solar Explorer (MUSE) will use a multi-slit spectrometer to observe the Sun's extreme ultraviolet radiation and obtain the highest resolution images ever captured of the solar transition region and the corona. The second mission, HelioSwarm, is a constellation of nine spacecraft that will capture the first multiscale in-space measurements of fluctuations in the magnetic field, as well as solar wind turbulence.

DRIVE was a huge priority in the 2013 DS. In March, NASA selected three DRIVE centers despite having planned on only two. Consequences of Flows and Fields in the Interior and Exterior of the Sun (COFFIES) will help better understand the solar dynamo and magnetic activity, as well as the fundamental physics of the solar interior. The Center for Geospace Storms (CGS) will help build a detailed computer model of geospace. Finally, Our Heliospheric Shield will help develop a predictive model for the heliosphere.

NASA announced the GDC science team and has made three instrument selections, which Dr. Fox described. An additional five instruments have been selected for a competitive Phase A, with a late 2022 down-selection. There is a lot of activity around Solar Cycle 25, as NASA would like to do a better job of anticipating solar activities that affect our lives and technology. Dr. Fox gave the example of a recent Coronal Mass Ejection (CME) a few months ago that drove energy into the upper atmosphere but was not anticipated. Related to this is growing emphasis on space weather. SWC will advise HPAC and focus on the NASA role in space weather. The Heliophysics Environmental and Radiation Measurement Experiment Suite (HERMES) recently passed Key Decision Point C (KDP C) and interdisciplinary scientists have been selected. NASA is working with NOAA and DoD on a framework transitioning NASA research to operational products; anything that shows promise will receive extra funding. In addition, HPD has selected four space weather cubesats. Upcoming activities include Promoting Research and Observations of Space Weather to Improve the Forecasting of Tomorrow (PROSWIFT), the space weather instrument pipeline, and engagement with international partners on future collaborations. PROSWIFT plays to NASA's strengths in heliophysics by enabling new missions, technology development, and research and modeling. Dr. Fox described specific NASA actions under PROSWIFT.

While everyone wants more R&A funding, HPD must work with what it has. Overall, the Division has been maintaining a healthy R&A program and funding the DRIVE initiative, while also soliciting for the Early Career Investigator Program (ECIP) every 2 years, working to increase diversity in research, and participating in cross-divisional programs. ROSES-2022 will include new elements to address open data and open source science initiatives, as well as the 2024 eclipse and the space weather COEs. In the area of citizen science, HPD hopes to have a robust program focused on the upcoming eclipses.

The Global-scale Observations of the Limb and Disk (GOLD) mission found space weather heating up Earth's hottest and highest atmospheric layer. In another science highlight, the Ionospheric Connection Explorer (ICON) determined that strong winds associated with atmospheric tides power electric fields in the upper atmosphere.

While some IDEA actions are longer-term, there are things that can be done in the near- and mid-term. In addition, initiatives can advance in parallel. HPD has incentivized newly selected mission teams to expand outreach to minority groups and to work to increase diversity. Among the nontraditional audiences specified are rural groups. New grant programs include the Heliophysics Innovations for Technology and Science (HITS) program, which solicits proposals to advance heliophysics falling outside of traditional categories. Grant programs include language to broaden diverse participation on investigation teams. Early career scientists have expressed a strong desire to have IDEA training at many levels, including for those already in positions of power; HPD is exploring this recommendation.

The Heliophysics Big Year ties together three major heliophysics events in 2023 through 2025 to encourage citizen science in a coordinated campaign. There will be more on this as the time approaches. Meanwhile, HPD has begun planning for the next DS, which will include NOAA for the first time. Specifically, the Statement of Task has been sent to NAS. Dr. Fox said that while she does not know the timeline, she believes it is important for members of the heliophysics community to start writing white papers now instead of waiting for a formal call from NAS, as the turnaround time could be tight. The goal is to advance and expand the field of heliophysics with an ambitious but realistic science strategy.

She next turned to the Fiscal Year 2023 (FY23) President's Budget Request (PBR) for HPD. Overall, the PBR supports science missions already in operation or development along with a robust research program and investments in data archives. However, there have been some significant changes from FY22. In addition to funding MUSE, HelioSwarm, the additional DRIVE center, plus the new space weather program, the budget invests in orbital debris detection technology and confirms the Escape and Plasma Acceleration and Dynamics Explorers (EscaPADE). On the other hand, the budget could lead to a delay in GDC, and there is no funding for a future DYNAMIC mission.

Dr. Fox noted some Division staffing additions. HPD staff have won an impressive number of awards, which she listed. She then summarized the points of her presentation, adding that HPD is advancing several missions in development. There are plans to release the SMEX Announcement of Opportunity (AO) soon, and a call for the 2023 Senior Review is being crafted. The Sounding Rocket Program has made great strides in catching up after a series of covid-induced delays. It is important that the community become involved in activities such as panel reviews. NASA is making a number of outreach efforts and is always open to input.

Q&A with Division Director

Dr. Aroh Barjatya thanked Dr. Fox for her work on the sounding rocket program. He asked if the plan for GDC is to select fewer instruments than recommended. Dr. Fox said the AO was written with primary and secondary parameters, and NASA has selected instruments that map to all those measurements. Dr. Barjatya said he would have expected more overlap among GDC instruments and expressed his surprise at not seeing double-probe instruments, for example. Dr. Fox acknowledged that. Dr. Liemohn asked for more detail on the GDC instrument selection process. Dr. Fox replied that there were constraints on resources and a cost cap, which led NASA to look at measurements that map to the science goals and priorities. The Agency is pleased with the selected payloads.

Dr. Paul Cassak asked for more about the HITS program and how it fits into the IDEA strategy. Dr. Fox replied that it is a different way of thinking about inclusion, to create a space for those who cannot find an

existing category. This is part of an effort to make sure that HPD does not focus solely on traditional lines of R&A. In a recent gap analysis, NASA found that there are proposers who say that their research does not fit in anywhere. The Agency needs to make sure they have an opportunity to propose.

Dr. Bishop asked if there had been any progress in open data/open software. Dr. Fox said that while work continues, there is nothing to share yet. The team is determining what unique things they want for heliophysics, what NASA does well, and what goes into the call. A call will come out on Artificial Intelligence (AI) -ready data sets. However, not everyone has access to AI, and this will help with the transition. There will be tools and methods oriented to open science. She asked those with suggestions or thoughts to contact her. Dr. Bishop asked about the implementation rules in SMD. Dr. Fox said she would try to get an answer. There is a lot of work going into this area and she hoped to learn more about community interests.

Dr. Matsuo thanked Dr. Fox and said she appreciated the emphasis on interconnections. She could see where they were going with the GDC down-selections in trying to maximize science data. She wondered about synergies, especially since she had thought that DYNAMIC was to have been part of a coordinated effort and now it appeared that GDC will be delayed. She asked what guidance HPD would be giving to the community. Dr. Fox replied that a community announcement on GDC was coming out soon, but she was not at liberty to discuss it yet. She was excited about GDC and its science and had wanted to have it fly with PSP. While the PBR excludes DYNAMIC, she did not expect HPD to give up on that mission. The DS panel is likely to re-evaluate it. She emphasized that this is the time for the community to write white papers on what they consider the highest priorities. These can be new ideas.

Dr. Klimchuk said that because the DS process got off to a slow start, people in the community are worried. A rumor is going around that the panels will be selected quickly. Dr. Fox had not heard this. She doubted that the people at NAS would rush and do a bad job. She also believed the co-chairs would be identified first, and they will have insight into who is on the panel. Dr. Klimchuk explained that on the mid-term review, some of the choices were outrageous, not representative at all. Dr. Fox replied that while the nominating deadline is past, members of the community could still call NAS and mention people who might serve on panels. She did not mean to minimize this issue and would share these concerns. She believes that NAS is committed to doing it right. However, she did anticipate a tight deadline for white papers. Three other NASA Decadals had had to come out quickly, and NAS has lacked the people to do all this during covid. The National Science Foundation (NSF) and NOAA are also involved in the DS. Dr. Moretto-Jorgensen suggested that NAS delay it a bit in order to do it right. Dr. Fox explained that it is a difficult decision and NASA will have to talk to all of the agencies involved.

Dr. Cora Randall asked about the specifications for the white papers, such as the format, length, etc. When she looked, she found conflicting information. Dr. Fox promised to find out as quickly as possible. Further discussion indicated a range of 1 to 12 pages. Dr. Fox thought that a single page would be too short. Dr. Jared Leisner of HPD placed the following information in the WebEx chat: The Decadal Survey White Paper FAQ, including page limits, has been released:
https://nationalacademies.org/docs/DC459497C1AAFFB841F8221165878AE1DA04F96C5805

Dr. Matina Gkioulidou asked for clarification on the budget for the SMEX call that was announced in December. Dr. Fox explained that the budget was $115 million in 2016. It is now $150 million if the mission uses a NASA launch vehicle. If the investigation brings its own launch vehicle, NASA will provide another $14 million. This reflects changes in the overall state and availability of launch vehicles. The draft AO will have a lot more on that.

Dr. Liemohn asked for more details about the internal review of GDC. Dr. Fox said that this would involve an independent review board (IRB), which is not unusual for a mission of this size at this point in

the cycle. The IRB will help ensure the best and right resources and timing. Heliophysics does not have that many large missions, but this is normal practice within NASA. The IRB co-chairs will talk to representatives of the community. The turnaround is quick, only a couple of months, and much of the work is done in verbal interviews. If HPAC members wanted to suggest people for interviews, they could email her to pass along the contact information. She will not tell the IRB what to do, but she will say these names came up. This is a good IRB and the members know the community very well. They are also familiar with the GDC science. If HPAC generated a finding or recommendation to pass to the IRB, she would communicate it to them.

Dr. Cassak said that HPAC did not receive information on R&A program trends despite a number of requests for it made over a period of time. He asked if there was something that was preventing HPD from sharing this. Dr. Fox said that the presentation with that information did not get cleared by NASA's attorneys. She asked that HPAC be very clear about what it wanted. Dr. Klimchuk countered that HPAC had been quite clear. He thought they would see something, as Dr. Fox had said it was done and that she had the report. HPAC wants the relative budgets and the bread and butter programs. Dr. Fox explained that it was not that HPD did not want to share the data, it was that the Division could not get it cleared. She had the information on her desk and promised to figure it out.

Dr. Barjatya said that her first slide with all the missions was exciting and amazing, and he was happy to see lots of cubesats in development. Dr. Fox agreed, noting that in 2016 there was nothing new. This is a credit to the community and HPD staff. She also agreed with Dr. Liemohn's observation that there is always room for more missions. Dr. Goncharenko expressed concern about the GDC delay, which has translated into community concern about DS implementation. She asked how the community might best communicate with NASA about this. Dr. Fox agreed that GDC is a high priority, but she wanted HPAC members to be careful when advising the community, because they risked doing so in a way that might exclude their institutions. However, she is always happy to get findings. HPAC might concur with her comments on the importance of GDC, for example.

HPAC Work Session

Dr. Liemohn led the review of preliminary topics for findings and recommendations. The trend analysis of R&A programs seemed ripe for a recommendation. Dr. Moretto-Jorgensen expressed frustration that HPAC keeps asking for it and the NASA legal department keeps denying it. Dr. Korreck said it was unlikely there would be anything cleared by time this meeting ended, so a finding might be the best route to take. Dr. Liemohn emphasized that HPAC could finalize wording after the meeting but needed to decide on the content before adjourning the next day.

In addition to the R&A trends recommendation, he had GDC instrument concerns and open data/open software implementation on his list. Ms. Doherty reminded him that SWC needed concepts and actions from HPAC. It was still not clear how SWC is to interact with other space weather organizations, so they need to learn the parameters. Dr. Moretto-Jorgensen said that she is on SWAG, which wants to engage with other groups. It is a process question. Ms. Doherty wondered if SWC might talk with someone at NASA about how to do this, even if they need to go to the Ethics Committee. They are trying to avoid excessive overlap. Dr. Bishop advised looking at the studies that have already been done to ensure SWC is not redoing work. Ms. Doherty agreed, saying that the group will be most helpful by moving forward. Dr. Matsuo wondered about the instrument pipeline concept. Ms. Doherty said that while SWC is in a good position to do some of this, it is not clear how to talk to some of these groups and determine what is feasible. Solar activity is intensifying and they want to figure out what can be developed quickly. Dr. Bishop noted that each group has deliverables. A table of what is being done and the overlap might be helpful. Ms. Doherty liked that as a way of identifying gaps and potential action areas. Dr. Liemohn asked that HPAC members think about this further.

Dr. Matsuo was concerned about the impact covid and other factors might have on the way the DS is conducted. Dr. Moretto-Jorgensen said that the finding should be that HPAC is concerned that it might be rushed, which could have an undesirable impact. The DS needs to be done right. It is even more important now that NOAA is part of the DS. Dr. Klimchuk said that sorting through the nominations takes time. There needs to be broad input. Dr. Bishop asked about how SWC would factor into the HPAC report to HPD. Dr. Liemohn noted that HPAC has not had this kind of structure for a while. After some discussion, Dr. Korreck suggested that the DFOs of the various groups could communicate with each other. HPAC was charged with directing SWC. Dr. Bishop wanted to acknowledge the international missions, the momentum of the HSO, and the work it took to get all the operating missions launched.

Dr. Kozyra said that on the GDC finding, it would be wise to learn the level at which HPAC can address the situation without the members creating conflicts of interest (COIs). It might be helpful to bring in the Ethics Committee. Dr. Bishop stated that she has recused herself from GDC discussions. Dr. Liemohn said that HPAC should not mention the selection process at all and should instead look at larger scale issues. Dr. Randall asked if the GDC issues included concerns about DYNAMIC, and if HPAC might recommend that NASA address community disappointment that the DS recommendation for DYNAMIC is not going forward. Dr. Matsuo agreed that this was important, but thought they should urge people to continue to propose. Dr. Liemohn said that a possible finding was that HPAC is disappointed and the community is discouraged. Such a statement would not create COIs. Dr. Goncharenko observed that the community is worried that a lot of high priorities have shifted to become low priorities.

Dr. Allison Jaynes said she did not have much to add, but held that the DYNAMIC issue is bigger than GDC. Therefore, she would separate them, with hard language on the former. Dr. Mari Paz Miralles said she agreed with this discussion. Dr. Kristin Simunac said that the lack of information about why the R&A trends are not available was frustrating. She would like to know why this happens. She also looked forward to the next day's Diversity, Equity, Inclusion and Accessibility (DEIA) discussion.

Dr. Liemohn reviewed the agenda to determine when HPAC might resume this discussion and work together. He then read out the assignments to the members.

Adjourn
The meeting adjourned for the day at 6:11 p.m.

Friday, May 6, 2022

Introduction
Dr. Kozyra opened the second day of the meeting. She reminded participants that this was a FACA meeting, welcomed the HPAC members, and turned the meeting over to Dr. Liemohn.

Overview of Agenda
Dr. Liemohn greeted the participants and reviewed the agenda.

DEIA Efforts
Dr. Korreck began this presentation by acknowledging her colleague, Ms. Denise Hill, who could not attend this meeting but had done a lot of work on this project. The Heliophysics IDEA Working Group (HIWG) follows the NASA Equity Action Plan of 2022. Within SMD, focus is on expanding access; developing a robust IDEA infrastructure; and ensuring that all team members can meet the demands of their work and raise challenges safely. In the community, SMD seeks to ensure that NASA science teams reflect the nation, while also creating and strengthening relationships with underrepresented communities. ROSES-2022 supports inclusion in a number of ways, such as Dual Anon, a bridge program, due date

pilots, expansion of requests for inclusion plans in proposals, the Transform to Open Science Program (TOPS), and more.

Dr. Korreck read the charge to the HIWG. All HIWG members participate in other SMD IDEA groups and try to bring the activities, information, and discussions back to HPD. One of the HIWG initiatives is a survey of programs that are affiliated with HPD and have some level of IDEA activity. Examples include DRIVE centers, mission outreach programs, Low-Cost Access to Space (LCAS) projects, and others. The goal is to determine whether these programs are really taking action or just making statements. Another effort is the 30-60-90 Day Plan, which sets goals for the near term, long term, and in between. The 30-day plan is in development and could involve defining metrics, discussing specific HPD goals, listening sessions, and more.

Dr. Cassak asked if there was anything to share about the discontinuation of the Goddard Space Flight Center (GSFC) initiative on pronouns. Dr. Korreck explained that she was not involved in it. A press release stated that the pilot program had ended. However, NASA employees typically use pronouns in their email signatures. Dr. Cassak said that the concern was that the program was stopped because it made some people uncomfortable. Dr. Korreck replied that she did not know about that. She had heard that pronouns matter to the heliophysics community, however, and thought that HPAC might write a finding asking HPD to make sure that pronouns are accessible. Dr. Fox said that the GSFC program was a trial specific to that location, and the trial ended. It was not simply cancelled, it was ended as planned, and there is now an effort to compile lessons learned. She has raised the issue of pronouns within SMD and encourages pronouns in email even if there is no official program.

Dr. Goncharenko was concerned about the longer term of state of the profession and the relative interest among young people. There is more and more evidence of difficulties in access, alongside a decline in younger people participating. These mounting challenges call for discussion. Dr. Korreck agreed, noting that recruitment and retention are issues. NASA is looking at various points of outreach as well as the environment. Dr. Goncharenko stressed that this goes beyond the pipeline. Access to understandable information is a problem that factors into the lack of participation. More should be done to address the larger developmental issues.

Dr. Simunac asked how the survey will recruit participants. She was especially curious about those who have left the profession and what might induce them to return. She also wanted to know how the HIWG is defining diversity. Dr. Korreck explained that the survey team is first looking at what information exists and the people they can track readily. It would indeed be interesting to learn more about people who have left and why. The science activation teams are another resource, and they might have some thoughts on how to track these individuals. Dr. Matsuo said that she is working hard on the same thing. There are huge enrollment spikes in data science and aerospace, to the point where it is not clear how to fit in all these students. Perhaps heliophysics could align some of its programs with these two areas. For example, it might be helpful to show ties with cubesats and data science in order to attract students to heliophysics. Dr. Korreck said that there are student collaborations with some missions, and those are opportunities. There is a surge of interest in getting into space. This is something the team can capture in order to determine if there are scaling possibilities.

Dr. Cassak asked about implicit bias training for panel reviews. Dr. Korreck said that there is some training in the panel introductions. Dr. Koehn added that there is a small discussion in the plenary session and the topic usually comes up during panels. NASA does mock panels as training at headquarters to familiarize staff with the issues. Dr. Cassak pointed out that panelists have already done the reviews at home by time this training occurs. NSF requires panelists to watch a video before they receive proposals. Dr. Koehn said this was a good idea.

Dr. Jaynes said that she disagreed with the idea that LCAS offers sufficient training for PIs. There is an entire world of difference between rocket and balloon missions versus larger missions. She would like to see more specific training beyond the low-cost efforts. Dr. Korreck agreed and said that that is being discussed. Dr. Liemohn noted that the PI Launchpad took place twice and there are hopes to have it at least every other year. Dr. Jaynes said she heard that it was not sufficient to reach the higher purpose of preparing PIs. Dr. Klimchuk said that past PI training seems to have involved mentoring. Dr. Randall agreed. Dr. Gkioulidou noted that NASA cannot force PIs to choose teams a certain way, but the deputy positions are good training for the next step. There is nothing like the real practice of following a mission. Dr. Fox said that NASA looks at team make-up closely in the proposals. It has been a soft evaluation criterion up to now, but new calls will emphasize broadening participation and enriching the field.

Dr. Bishop said that while sounding rockets and balloons are a part of training, the cubesat program gives a better idea of what it is like to be a PI. An ongoing support mechanism would be helpful. Some early career people do not understand the relationships and what questions to ask of whom. There is a need to help people once they are in the roles. Dr. Fox said this was a great point, and cubesats might be more realistic. She noted that the University of Iowa has a great system for this and surpasses some of the more experienced teams. Dr. David Miles is especially impressive and HPAC should invite him to speak. She added that sometimes training occurs in working with an instrument. Dr. Bishop agreed that it is incremental. Dr. Liemohn said it would be good to have a future assessment of the DEI approaches. Dr. Fox emphasized the importance of not overselling what NASA is doing. It is important to determine if the Agency is actually pulling in the people it wants in these programs. Dr. Goncharenko noted that programs should reach beyond the major universities. She was concerned that the COEs might make it more difficult to reach smaller schools that serve under-represented students.

Living with a Star Program Analysis Group (LPAG)

Dr. Anthea Coster explained that Dr. Sabrina Savage is her co-chair and will lead LPAG when Dr. Coster steps down at the end of the year. Six new members joined the executive committee in 2021; there will be no change in membership in 2022. LPAG had only one virtual meeting in 2021 due to covid; another virtual meeting took place in March of 2022. Most of the discussion centered on Focused Science Topics (FSTs). Further discussion is planned regarding the strategic role of Sun-climate in LWS. Dr. Jeff Morrill of NASA had been the advisor; Dr. Simon Plunkett has taken over now that Dr. Morrill has retired.

LPAG is not an advisory board, but rather provides community information to NASA. The group can examine how to optimize the LWS program and is looking at team reporting and traceability. It has the ability to offer community input on LWS proposals and infrastructure. FSTs offer the science community a means of influencing NASA research topics. While little was done in 2021, LPAG provided 22 new topics in 2020. There is similar work done on Strategic Science Areas (SSAs), the long-term targeted areas of system science. In 2019, LPAG proposed 10 SSAs, up from the previous seven. Dr. Klimchuk asked how often NASA rejects the recommendations. Dr. Coster said that the Agency revises them, and some have rolled over. Dr. Koehn explained that HPD receives more topics than it can use but does not reject any per se. Dr. Coster added that assembling them is a lot of work, so this is not an annual project.

LPAG and HPD have been discussing whether to form a team to evaluate progress on FST themes beyond just listing them in ROSES solicitations. Cadence and logistics are concerns, however, and it is not yet clear whether there should be a plan imposed on any such teams. Covid has made this all more difficult. Nonetheless, LPAG and HPD are considering forming a task force. Also under discussion are training, team mentorship, and tools for coordination and collaboration in order to help the teams become cohesive and function well.

In the discussion of FSTs, LPAG has been looking at how to estimate and improve the effectiveness of FST reporting and topic selection. In 2018, it was recommended that FST team leads prepared final

reports that LWS could use on the Targeted Research and Technology (TR&T) website. Current thinking is to have both brief and extended summaries. It is important to try to capture this in order to avoid duplicating efforts. Dr. Coster showed an example of what is on the FST website.

There is still more to do. LPAG is trying to come up with better ways to do the reporting forms. The search function does not work well and needs to be refined. There is also a need to determine how best to cite data sets. As the FST reporting forms are required by ROSES, future solicitations should start mentioning them. An LPAG goal is to finalize reporting procedures this year.

Cross-disciplinary and system science are important in LWS. There has been a lack of clarity about what science LWS covers. The budgeting is also unclear for projects that cross areas; research topics such as Sun-climate are inter-divisional, creating further complications. A possible solution might be a mechanism for inter-divisional proposals that are truly innovative. It was suggested that LPAG formulate a plan of action for improving the science related to Sun-climate questions. LPAG will be revisiting how to address this inter-divisional topic within LWS. Among the questions generated during the discussion of this are the atmospheric boundaries and time scales.

Another topic of interest to LPAG is data science, more specifically the pros and cons of using AI, machine learning (ML), and other advanced statistical methods in LWS. The LWS data are unique and may help data scientists advance their tools and models, so it is important to engage with that community. This is still being discussed, but the community is moving ahead, and ROSES-2021 emphasized AI/ML with 12 selections.

LPAG currently supports four Jack Eddy postdoctoral fellows. Plans for 2022 are to finalize the LPAG 2021 report and complete FST reporting and modifications to themes and team formation.

Dr. Matsuo thanked Dr. Coster for mentioning the impact of covid on LPAG's work because it has not always been clear how people have interacted during the pandemic. She asked if LPAG is thinking of incorporating principles of IDEA and mentioned the need for this in training scenarios. Also, in the area of open data and science, the greater discussion has been about how to go forward and the tools needed, and LPAG might consider mapping to this. She also wanted to know about access to constellation data, especially among the communities that are not funded for this work. Dr. Coster said that the last question is more for NASA. She liked the idea of DEI discussion in training. However, LPAG makes recommendations to NASA, which decides what to do.

Dr. Gkioulidou explained that she had worked on the SSAs. If expansion is a goal, it has to begin with grants and opportunities to propose. This might be an area of opportunity should NASA do more cross-disciplinary work. Dr. Coster said that there were strong feelings about this. The main issue is cross-disciplinary budgeting. Dr. Savage added that Dr. Gkioulidou wrote the habitability SSA, which applies to the solar system. LPAG wants to determine how to fund it. A traceability tree might call for a science interest group (SIG) or science analysis group (SAG), as it is a difficult topic.

Public Comment

The meeting was opened to the public for comment.

Dr. John Bonnell said that the community has talked about open data/open software, and the NASA request for comment was difficult to deal with. Nothing was allowed on how or what was to be done or how it was to be evaluated. It was off-putting. Investigators are trying to figure out the best way to share data and algorithms. The request for comment might have been written more like that. This is a suggestion to HPAC or whichever group is in charge that before this goes out as a generic requirement, it needs to be structured. Otherwise, responses will muddy the waters.

Dr. Liemohn asked if this came from HPD or SMD. Dr. Bonnell replied that it might have been the latter, but it was mentioned during the previous day's open data/open software discussion. He also wanted to follow up on Dr. Barjatya's comment from the previous day regarding the process of proposing and selecting instruments on GDC. He appreciates that there will be an IRB. As someone involved in a proposal that was shut down due to uncertainty about the spacecraft, he believes it will be important to have this discussion. It is easy for instrumentalists or community members to say they need things, and the IRB will help with growing pains in this area.

There were no further comments from the public.

LWS Architecture Committee

Dr. Christina Cohen began her presentation of the LWS Architecture Committee by identifying the members. She listed the three main LWS objectives, noting that there are some related missions in operation. These include the Solar Dynamics Observatory (SDO), the Space Environment Testbed, PSP, and the Solar Orbiter Collaboration. Upcoming missions include HERMES and GDC.

The last DS said that LWS should be distinct from other research areas and charged NASA with defining its architecture, science goals, etc. HPD asked the 10-member Architecture Committee to assess the current state of the mission aspect of the program and to propose a future mission architecture, while specifically not addressing the TR&T program. The Committee was not recommending specific missions or payloads, but worked with GSFC and the Applied Physics Lab (APL) at Johns Hopkins to perform a few mission concept studies.

Dr. Cohen listed the SSAs, which were used to formulate science objectives and identify the various measurement and implementation needs. The Committee created a large spreadsheet for each SSA. Looking at areas of overlap helped the team create Focused Mission Topics (FMTs), which are combined LWS science objectives and implementation strategies. To the extent possible, the Committee tried to differentiate these from what is in STP, but the science sometimes overlaps. Dr. Cohen then showed a flow chart of SSAs and goals. The Committee expects NASA to periodically select a few FMTs as areas needing progress. These could lead to investigations across the entire range of mission sizes, from balloons to flagships. The Committee tried to create a body of current FMTs, though their product is not exhaustive. In order to elicit community input on the spreadsheets, the Committee created a web page with a form for each SSA and the initial thoughts on measurement strategies, etc., and space for comments on how to enable these. The team collected the responses and folded them into the analysis. An LWS townhall held remotely in January brought in further feedback. Ultimately, they formulated 12 FMTs. Of these, GSFC studied four, while APL studied two and looked at the orbits for one more. The Committee did not rank the FMTs but did identify synergies between them and existing missions. While ground assets might be helpful in some investigations, they were not included in the architecture.

The Committee refers to the 12 FMTs by number because names seem to imply endorsement. The centers named the studies anyway, however. The numbers do not relate to any kind of ranking or priority. Dr. Cohen added that there was not time to study everything. The final report includes orbits and tradeoffs. Dr. Cohen did a quick review of some of the concepts and showed how the FMTs map to the SSAs. Typically there are multiple connections; some are primary and others are secondary. The study team also examined the connections in reverse.

Some of the FMTs had augmentations should there be money and/or shifts in priority that allow more science coverage. Support for data analysis and modeling are necessary in order to maximize science return. The group also identified some technology developments. Dr. Cohen pointed out that all of the concepts are constellations, and the technology is moving in this direction. Data communication is key, as

is onboard processing. The architectures included a wide variety of spacecraft, which LWS currently lacks. The effort did not address data buys. Dr. Cohen emphasized that these were not full concept studies. She closed with the report timeline.

Dr. Randall was puzzled by how they managed to leave out the instrument design. Dr. Cohen agreed that it was hard to do a concept study without instruments, but that was what the Committee tried to do. The labs asked for instruments, however, so the team had to give them some ideas. APL was more flexible than GSFC in this regard. The Committee gave the labs what they needed to work with but emphasized the importance of tradeoffs. They did not want to tell NASA to do certain missions. NASA asked for examples, and the Agency and the community will decide what gets implemented. Dr. Randall asked if she anticipated that NASA will choose among the architectures and take those to the community. Dr. Cohen explained that they struggled with terminology, and the Committee envisions a parallel effort with the TR&T group that looks at SSAs and identifies topics for progress. That could be the point at which community input is sought. It is helpful to know if the community has different ideas from NASA.

Dr. Fox pointed out that this is an input to the DS panel, as it was a recommendation in the midterm report. Dr. Liemohn asked why HPAC was hearing it and whether they had a role to play. Dr. Fox explained that the presentation was meant to show what NASA is doing as a DS input and to get the HPAC reaction. Dr. Cohen added that the Committee's impression was they were giving a report to NASA to determine what parts the Agency might want to give to the DS. That was one reason they did not prioritize any of the FMT. Dr. Fox added that there was a lot of community input on this.

Dr. Matsuo cited an infrastructure workshop she attended the previous month. She hoped there might be some synergy and that that would go to the DS. The LWS program needs to be aware of any unique infrastructure that is required, and this needs to be monitored continually. Dr. Cohen said that the Committee struggled with this a bit. They looked at LWS's overlap with STP and space weather. It also touches planetary and human exploration and astrophysics, however. So the group tried to focus on missions that lead to understanding the systems they need to make progress on predictability, but not monitoring missions. This is in the report. Some NASA missions may transition to NOAA monitoring platforms.

Dr. Jaynes found this exciting. In the architecture map Dr. Cohen showed, a line went to FMTs to Explorers. She asked if that was meant to constrain or to illustrate an area for potential Explorers ideas. Dr. Cohen replied that it was the latter. The map was not intended to be comprehensive. However, the Committee tried to convey that FMTs go beyond flagship missions. It could also be part of an STP mission, perhaps an augmentation. Dr. Jaynes then noted that while the Committee did not want to rank the studies, it did select two for the mission concept report. That could be taken as a de facto prioritization of those studies. So Dr. Jaynes wanted to know why the two studies were selected. Dr. Cohen explained that the only reason for the selection of the two studies was that the Committee felt they had a direct impact on LWS science specifically. Some of the others were less focused and might apply to STP or space weather.

HPAC Work Session

HPAC went into closed session in order to develop its findings and recommendations.

HPAC Report Out to HPD Director

Dr. Klimchuk read the first recommendation, on R&A trends. The recommendation stated that it is difficult to know whether current R&A investments align with priorities. Therefore, HPAC sought a detailed analysis of the R&A budget and its trends. Specifically, this would entail the budgets of the individual R&A programs subdivided into traditional R&A (data, analysis, theory, modeling) and technology development. A further subdivision should distinguish between open and directed programs.

The ultimate result should be four distinct categories. Furthermore, to identify trends, data should go back a minimum of 5 years, preferably longer, and be presented in both real and inflated dollars. HPAC recommends that these data be presented to the Committee in both graphic and tabular form, and that they be updated and shared with HPAC annually. HPAC specifically wants to see spreadsheets that can be modified for further insights.

Dr. Fox liked that this was so specific and said that HPD will do exactly as HPAC asked.

Dr. Liemohn then read a finding on GDC. HPAC commended HPD on its progress with this mission. The development approach involved identifying the physical parameters that will achieve the science objectives, then evaluating the spacecraft implementation strategy without first specifying the measurement strategy. HPAC wants to hear more about this process, as the traditional approach is to develop the measurement strategy and spacecraft implementation strategy in parallel. HPAC also expressed confidence in the IRB.

Dr. Fox appreciated the acknowledgement of the IRB. NASA had to be careful with the GDC definition team, which led to the focus on measurement instead of the traditional approach. There have been many lessons learned from this.

Dr. Bishop read two findings on open science and open software. The first congratulated HPD on its growing number of observatories. The second applauded the planning activities that have taken place and the community engagement, along with the growing list of near-term missions involving international collaborations. Dr. Bishop then read a recommendation, which pointed out that implementation details for open data and open software policies at NASA and within HPD remain unclear. HPAC recommended that HPD expand dissemination of its policy and implementation plan as soon as possible, while soliciting community input at the same time. The Division should also offer the community more opportunities to discuss associated topics and share advice related to implementation. HPAC appreciates the inclusion of programs related to open data and open software in ROSES-2023 and looks forward to learning more about the successes and challenges of each. Dr. Fox thanked HPAC and said that the findings and recommendation will move forward.

Dr. Liemohn explained that the next statement had to do with SWC, but he was not sure whether to categorize is as a recommendation, finding, or something else. After providing some background and noting that both the SWAG and the Space Weather Operations, Research, and Mitigation Subcommittee (SWORM) are already operating in this space, the statement said that it is important for SWC to define its role supporting HPD interests and to determine how best to complement SWAG and SWORM activities.

Ms. Doherty then read four actions that HPAC was recommending for SWC. First was to research SWORM and SWAG activities, identify overlaps and gaps, and determine how best to proceed without duplicating efforts. Second, HPAC sought an analysis of the gaps in space weather fundamental research and space weather impacts. This will help HPD make informed decisions in this area. The third recommendation was to address NASA's Artemis and space biology programs to determine the potential to extend Agency knowledge with lunar-focused space weather measurements and studies. Finally, HPAC advised SWC to develop specific suggestions for NASA, NOAA, and NSF cooperation.

Dr. Fox said that this sounded like a lot of work. Regarding the second action, APL has been tasked with a gap analysis, and their report might be delivered to SWC before the next meeting. Dr. Goncharenko said that some of the other committees have done similar gap analyses and it would be worthwhile to contact them to discuss the results in order to move forward. Dr. Fox agreed. Ms. Doherty noted that SWC already plans on looking at the APL study. Dr. Klimchuk said there was a thought of having modeling in

addition to implementation. Dr. Fox said she would add DOD to the fourth action, as NASA is working on an agreement with them.

Dr. Simunac read the IDEA findings and recommendations. HPAC commends HPD for its efforts and wants updates at future meetings. The Committee recommends that bias training occur before review panelists receive proposals. HPAC noted the potential of LCAS programs in attracting under-represented groups, and stated that there is a need to bridge the gap in professional development from low-cost to larger-scale efforts. An ongoing question is how to reach certain stakeholders, such as those who have left the profession. Dr. Fox was particularly interested in the last concern and is open to ideas on how to accomplish the outreach. She appreciated the recommendation to do the bias training before the proposals are read. She also agreed with the idea of having updates at every meeting.

Dr. Randall read a finding and recommendation on DYNAMIC. The finding explained the importance of the mission, noting that it was a DS priority. The recommendation was for NASA's pending announcement to address concerns about community discouragement and the impact this might have on the next DS. Dr. Fox said that the announcement is almost cleared and she wants to get it out, but NASA could send out an additional clarification. She shares the disappointment that DYNAMIC was not in the PBR, which still contained a lot of good. She hopes there will be a way to continue DYNAMIC. Dr. Randall asked if Congress could decide to allocate the funds anyway. Dr. Fox said that there are examples of that happening, and Congress funded DYNAMIC in FY21 despite the PBR seeking no money for it. The Astrophysics Division (APD) has a similar example with the Roman Space Telescope. However, it is too early to tell if this might happen with DYNAMIC for FY23.

There were no more findings and recommendations. Dr. Fox thanked everyone for the productive meeting and expressed hope that they can meet in-person soon. A discussion of meeting cadence and timing led to the suggestion of a September gathering. Dr. Korreck said she would follow up with a poll. Ms. Doherty added that SWC hopes to meet during the summer.

Adjourn

The meeting was adjourned at 4:52 p.m.

Appendix A
Participants

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

Other
Steven Arnold
Meghan Bartels
Sky Bischoff-Mattson
John Bonnell
Traci Case
David Cheney
Christina Cohen
Anthea Coster
Craig DeForest
Monty DiBiasi
Annie Dickens
Elizabeth Esther
Shannon Ewan
James Favors
Susanna Finn
Shannon Fitzpatrick
Galen Fowler
Nicola Fox, *Heliophysics Division Director*
Heather Futrell
Lewis Groswald
Lika Guhathakurta
Ha-Hao Hanano
Jeffrey Hayes
George Ho
Esyas Hume
Jason Kalirai
Patrick Koehn
Kelly Korreck
Harri Laakso
Jared Leisner
James Lochner
Margaret Luce
Amy Marshall
John McCormack
Donna Nelson
Kate Petersen
Robert Pfaff
Simon Plunkett
Arik Posner
Christian Ranicki
Nicole Rayl
Tara Roberts
Richard Rogers
Roger Sanchez
Washito Sasamoto
Elizabeth Sheley
Katie Spear
Gerard Visner
Daniel Walsh
Jesse Woodruff

Appendix B
Advisory Committee Membership

Michael W. Liemohn, Chair
University of Michigan

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

Janet Kozyra, *Executive Secretary*
NASA Headquarters

Aroh Barjatya
Embry Riddle

Rebecca Bishop
Aerospace Corporation

Paul Cassak
West Virginia University

Pat Doherty
Boston University

Matina Gkioulidou
Johns Hopkins University

Larisa Goncharenko
MIT Haystack Observatory

Allison Jaynes
University of Iowa

James Klimchuk
NASA Goddard Space Flight Center

Tomoko Matsuo
University of Colorado at Boulder

Mari Paz Miralles
Harvard-Smithsonian Center for Astrophysics

Cora Randall
University of Colorado at Boulder

Kristin Simunac
St. Petersburg College

Appendix C
Agenda

Thursday, May 5, 2022		
2:30	Welcome	Dr. Janet Kozyra, NASA Dr. Kelly Korreck, NASA
2:35	Overview of Agenda	Dr. Michael Liemohn, Chair
2:40	Space Weather Council update	Ms. Patricia Doherty, Space Weather Council Chair
3:00	R&A Program Trends	Dr. Patrick Koehn, NASA
3:30	Division Update	Dr. Nicola Fox, NASA
4:30	Break	
4:45	Q&A with Division Director	Dr. Nicola Fox, NASA
5:15	HPAC Work Session	
6:00	ADJOURN	

Friday, May 6, 2022		
11:00	Introduction	Dr. Janet Kozyra, NASA Dr. Kelly Korreck, NASA
11:05	Overview of Agenda	Dr. Michael Liemohn, Chair
11:15	DEIA Efforts	Ms. Denise Hill, NASA Dr. Kelly Korreck, NASA
11:50	Living with a Star Program Analysis Group (LPAG)	Dr. Anthea Coster
12:20	Public Comment	
12:25	Break	
2:10	LWS Architecture Committee	Dr. Christina Cohen
2:30	HPAC Work Session	
3:40	Break	
4:00	HPAC Report out to HPD Director	
5:00	ADJOURN	