

NASA ADVISORY COUNCIL
SCIENCE COMMITTEE

September 10, 2020

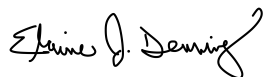
Virtual Meeting

MEETING REPORT



December 9, 2020

Meenakshi Wadhwa, Chair



December 9, 2020

Elaine Denning, Designated Federal Officer

NAC Science Committee Meeting, September 10, 2020

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*Prepared by Elizabeth Sheley
Electrosoft*

Thursday, September 10, 2020

Opening Remarks / Introduction of Members

Ms. Elaine Denning, Executive Secretary of the NASA Advisory Council (NAC) Science Committee (SC) opened the meeting by welcoming the participants. She then turned the meeting over to Dr. Meenakshi Wadhwa, Chair of the SC. Dr. Wadhwa began the meeting with a remembrance of Dr. Michael Freilich, the retired Director of NASA's Earth Science Division (ESD), who had passed away recently. The European Space Agency, NASA and other partners have renamed the Sentinel-6A observing system in his honor, to be Sentinel 6-Michael Freilich. Dr. Wadhwa then asked the SC members to introduce themselves.

SC Member Q&A with SMD AA

Dr. Thomas Zurbuchen, Associate Administrator (AA) of the NASA Science Mission Directorate (SMD), thanked the SC members for their participation and contributions. He had provided a science overview at the SMD Town Hall immediately preceding the SC meeting. Dr. Wadhwa asked if any Committee members had follow-up questions.

Dr. Jeffrey Hoffman asked about the cuts in the Mars exploration budget. Dr. Zurbuchen replied that in making the decision to launch the Mars 2020 mission in 2020, priorities had to be set. Primarily, the mission needs to work. There were issues that led to Mars 2020 being more expensive than anticipated, and there remains uncertainty about the outcome of the Fiscal Year 2021 (FY21) appropriations process. SMD is trying to absorb the overage and do other work while hashing out the details. Some trades need to be made, as the Decadal Survey (DS) for the Planetary Science Division (PSD) designated the Discovery missions and other areas as important. NASA allocated some of the funds for sample return to addressing Mars 2020 issues. Some of this was management, and some was related to COVID-19. Dr. Hoffman agreed that maximum science return is important; he appreciated hearing this and noted that this information does not always trickle down to the science community. Dr. Zurbuchen said he is open to other ways of disseminating information, and people should contact SMD with concerns. There are constraints, but SMD is not going to spend a lot of money and not do it right.

Dr. Michael Liemohn asked about NASA moving the Biological and Physical Sciences (BPS) Division from the Human Exploration and Operations Mission Directorate (HEOMD) to SMD. Dr. Zurbuchen said that this is an exciting development, and he is learning new things, reading, and trying to become informed. The move came about through an initiative by Dr. James Green, the NASA Chief Scientist, who asked if BPS and SMD would be a good fit. The Agency and stakeholders agreed, so the move was made over the summer.

Dr. Wadhwa said that she appreciated SMD highlighting the importance of equity and inclusion in NASA programs and in Principal Investigator (PI) selection processes, and wanted to know how the dual anonymous peer reviews are going. Dr. Zurbuchen said that he tries to open up doors. Dual anonymous peer reviews are a way to address biases in the review process. He expects that SMD will keep pushing on this because excellence is about continuous improvement, so he wants to keep moving and recognizing where to improve. Not everything SMD has tried has worked, and that is okay, they will try to do better. Dual anonymous peer reviews are here to stay.

Dr. Amy Mainzer asked how to generate enthusiasm for NASA Science. Dr. Zurbuchen replied that his job is not to ask for more money but to spend the funds SMD has been given responsibly and in the best way possible. He appreciated that research partners communicate to their communities. Science has become separated from our lives, and we should communicate to our stakeholders that science is part of

life. He urged scientists to keep doing amazing research and to communicate the value of it for their local communities.

Dr. Charles Woodward asked about opportunities with the Commercial Lunar Payload Services (CLPS) program. Dr. Zurbuchen replied that this is a high-risk endeavor, but one of NASA's strengths is in learning to leverage, so he expects this to turn into novel types of missions, landed and orbital, to use for a variety of areas including astrophysics. An example would be gravitational wave science. The focus is to create strategic guidance.

Dr. Wadhwa thanked Dr. Zurbuchen for his time, noting that the Committee would have another opportunity to speak with him at the end of the meeting.

Goals of the Meeting

Ms. Denning reviewed the Federal Advisory Committee Act (FACA) rules. As the SC is a FACA committee, this meeting was open to the public, minutes were being taken for the public record, and all statements made during the meeting would be on the public record. There also would be opportunities for public comment. Each SC member was appointed on the basis of his or her subject matter expertise and must comply with Federal ethics laws applying to Special Government Employees (SGEs). Members with questions or concerns about possible conflicts of interest (COIs) were to talk to Ms. Denning.

Dr. Wadhwa then went over the meeting agenda.

Division Advisory Committee (DAC) Chair Reports

The SC heard reports from the Division Advisory Committees (DACs).

Heliophysics

Dr. Liemohn, Chair of the Heliophysics Advisory Committee (HPAC), provided an update on recent activities. HPAC last met virtually in late June/early July, with a teleconference soon and a full virtual meeting scheduled for later in the calendar year. The June/July meeting resulted in nine findings and recommendations, which Dr. Liemohn listed before discussing two in more detail: Diversity in STEM, and Rideshare.

Regarding Diversity in STEM, the last Heliophysics DS, its midterm evaluation, and the NASA response to the midterm report all point towards the importance of Diversity, Equity, and Inclusion (DEI). HPAC made several suggestions on how to address STEM pipeline issues, including:

- Heliophysics Division (HPD) sponsorship of summer teacher training programs for elementary and high school teachers at university labs and NASA centers;
- Heliophysics summer camps for middle and high school students;
- Greater resources for undergrad and graduate-level training in heliophysics science and technology subjects for students majoring in K-12 teaching; and
- Funding for programs to present assembly-style STEM recruitment presentations at K-12 schools, possibly involving HPD-supported researchers.

HPAC asked that the SC consider commenting on this to SMD.

HPAC received a Rideshare briefing from Ms. Aly Mendoza-Hill, a program executive in HPD and the Rideshare lead for all of SMD. HPAC was pleased to see the HPD and SMD work in this direction, especially with EELV Expendable Secondary Payload Adapter (ESPA) rings. The Committee further discussed fueled/motored ESPA rings, which were new to some members. These ESPA rings present exciting capabilities that put an upper stage solid motor in the center of the ESPA ring, or in one of its

ports, allowing secondary payloads to reach orbits well beyond the primary payload destination. HPAC asked that SC to consider commenting on this to SMD.

Dr. Pat Patterson asked for more details on the Space Weather Council, which Dr. Liemohn had said will be a new subcommittee to HPAC. NASA has recently released the call for nominations for members. The Council will target activities centered on space weather and the environment for space effects on astronauts and NASA assets. Dr. Hoffman spoke in support of the powered ESPA rings; using these could open up the solar system for more investigations, sparking a Renaissance. Dr. Vinton Cerf expressed concern about SmallSats launched from ESPA rings going beyond current communications capabilities. Dr. Hoffman noted that MIT has a study group on how to open up laser communications for SmallSats. Both Drs. Cerf and Hoffman also agreed that pointing is challenge, and that is where the state of the art lies. Dr. Wadhwa thanked Dr. Liemohn for his report and said the SC would come back to review the points of discussion.

Astrophysics

Next, Dr. Charles Woodward reported on the Astrophysics Advisory Committee (APAC). At a virtual meeting in June, APAC had a major discussion about Black, Indigenous, People of Color (BIPOC) in the profession, focused on the systemic failure to engage BIPOC and to address needs identified by astrophysics communities in confronting systemic racism. Several findings and recommendations came from this discussion, which Dr. Woodward reviewed:

- APAC sought a clear statement that the NASA Astrophysics Division (APD) values the well-being and lives of BIPOC and recognizes their contributions to advancing APD's strategic scientific, education, and technical enterprise. Dr. Woodward said the town hall addressed this.
- APAC recommended that APD critically assess current programs and initiatives within its portfolio directed toward DEI. The Division should examine why these efforts have not produced the desired results and assess what needs to change to break exclusive and, specifically, racist structures within these. This will be a topic at the next APAC meeting, scheduled for October.
- APAC also recommended that NASA immediately consider including an evaluation criterion on "promoting diversity, equity, and inclusion in the field" in the review for all APD proposals and directed work.

Dr. Woodward noted several science highlights, which he did not review because Dr. Paul Hertz, APD Director, had discussed them in the town hall.

The impact of COVID-19 was another topic APAC discussed, with the following findings:

- APAC is grateful that NASA has continued operating all astrophysics missions, as well as the proposal solicitation and review process for funding Research Opportunities in Space and Earth Science (ROSES) and Guest Observer (GO) proposals.
- APAC appreciates that so much mission work was done during the pandemic shutdown. Related to that, the Committee requests a status update on the impact that COVID-19 has had on the James Webb Space Telescope (JWST) schedule, along with further clarification on the impacts of schedule erosion on the currently funded reserve resources.
- Discussion at the meeting resulted in APD walking back its initial decision to cancel the 2021 Astrophysics Data Analysis Program (ADAP) solicitation. The impact of the proposed cancellation on segments of the science community, especially women and early career scientists, would have been extremely deleterious. APAC is grateful that APD and SMD reversed this move.

Dr. Woodward presented several mission overviews, including the Extreme Ultra-Violet Stellar Characterization for Atmospheric Physic and Evolution (ESCAPE) mission concept; NASA's contribution to the European Space Agency's Athena mission, about which APAC has some concerns; the

Galactic/Extragalactic Ultra Long Duration Spectroscopic Stratospheric Terahertz Observatory (GUSTO) balloon mission; the Compton Spectrometer and Imager (COSI) small Explorer (SMEX) mission; and the CASE/ARIEL mission. Many balloon missions have been delayed due to COVID-19.

Dr. Wadhwa noted that the proposed DEI evaluation criteria were the primary piece of APAC advice that stood out and asked Dr. Woodward if he thought that there were any others. Dr. Woodward noted that one other important piece of advice was carrying out a critical assessment of APD's current DEI program and initiatives to assess what mechanisms and means have not fully worked, which would enable APD to move forward in an effective manner. APAC will be hearing back from the APD Division Director and his leadership team on how to do the assessment. Dr. Wadhwa thanked Dr. Woodward for his report.

Entrepreneurs Challenge/Discussion

Mr. Michael Seablom and Mr. Marc Weiser reported on the Entrepreneurs Challenge. Mr. Seablom explained that SMD kept hearing that startups did not understand the NASA process and found it to be slow. Startups are appealing partners, as they are agile and bring fresh ideas. The goal of the Entrepreneurs Challenge was to provide them an on-ramp via three topic areas: quantum sensing; novel, high resolution spectrometers; and physics-based transfer learning and artificial intelligence.

There were 76 proposals for Round 1; 15 of these made it through to the second round, which involved "Shark Tank" style pitches. This resulted in 10 proposals receiving awards of \$20,000 each. Round 3 will follow evaluation of the concepts by program managers, at which point those who move on will receive another \$80,000 to link to a NASA problem. Mentors will help the awardees understand what NASA seeks in a ROSES proposal, and there will be support from the Small Business Innovation Research (SBIR) program. Mr. Seablom used AI as a detailed example.

SMD found a lot of interest in this effort, with 336 unique sign-ins to the virtual event. Of these, 138 were government, 88 were investors, 67 were corporate entities, 99 were general public, and 2 were media. Nineteen countries were represented. A survey taken after the event showed almost unanimous approval, and nearly all of the proposals were of high quality. The Challenge was successful in bringing new companies and ideas to the table. However, few of the companies were familiar with NASA programs or priorities, and few knew how to prepare their instruments for a space environment. In addition, few companies have reported follow-up with venture capitalists (VCs). Six have been contacted by NASA field managers who were not part of the event. Also, a large company that was present subsequently did a similar challenge and selected two of the companies in the Challenge. SMD would like to figure out how to engage the VCs better for the next round. Proposals must address NASA priorities, but commercialization potential is important as well.

Mr. Weiser added that some of the proposals could be game changers, such as in the area of spectrometry. The point is to create a path for startups that would not normally engage with NASA or SMD, a first step. These events may inspire startups and investors to meet SMD needs, for instance by applying technology that they are building for other purposes. Mr. Weiser had shared a sense of scale with Challenge participants, in that annual investment either directly in space startups or companies adjacent to them is approximately 10-15 billion. He applauded the fact that nineteen different countries participated, and that there were great proposals received in all three of the areas that were relevant to NASA needs. A lot of follow-up work is being done by NASA to take the companies through the mentoring stage, and any NASA interest would provide greater validation of the technology for the startups. Mr. Weiser said he would answer specific questions but recused himself from the discussion and any formulation of advice as he works in the commercial sector.

Dr. Woodward asked how this related to current NASA technology gaps. Mr. Seablom said that the focus is on gaps and broadening the solution space while addressing DS priorities. Dr. Amy Mainzer asked

whether this was high risk/high reward. Mr. Seablom answered that risk is low. The idea was to lower the barriers for participants, by providing awards for fresh ideas. In answer to a question from Dr. Wadhwa about mentor selection and pairing, Mr. Seablom said that the mentors volunteer to work with the companies, and some were judges in the event. The mentors provide an important bridge. Dr. Cerf commended the execution of this new effort, especially during the pandemic.

DAC Chair Reports (Continued)

Planetary

Dr. Mainzer presented the Planetary Science Advisory Committee (PAC) report, noting that the Committee met so recently that the findings were still drafts. A major focus is plans for the upcoming DS, which will include planetary defense and astrobiology this time. The timeline was delayed due in part to COVID-19, and white paper deadlines have been pushed back. There is a lot of concern that the pandemic will affect the participation of groups who are heavily impacted by caregiving needs and communities that have been disproportionately suffering from the virus. The Astrophysics DS included a dedicated State of the Profession panel with inputs from professionals who study sociology, etc., but the Planetary DS statement of task has already been given to the National Academies of Sciences, Engineering, and Medicine (NASEM). While the statement of task includes questions about the state of the profession, PAC was concerned that there was no plan for a specific panel on this topic. However, NASA has asked NASEM to do two additional studies on the state of the profession.

A key area of concern is R&A, selection rates, and due dates. Selection rates have dropped to about 11 percent in many Planetary ROSES programs, while the average budget request per proposal has increased by about 40 percent over the past 5 years. Borrowing from future years has affected selection rates as well. There will be a call for augmentations to complete work impacted by COVID-19, and the priority is early career individuals such as students and postdocs – it is good to see NASA recognize this area of need. PSD has proposed moving some programs to a “no due date” mode of proposal solicitation, which could increase flexibility for PIs, more evenly disperse the workload at the proposing institutions, and ease the burden on NASA program officers. However, the community is concerned about possible unintended consequences, and so PAC wants to see details of the implementation plan. The Committee would also like PSD to address stakeholder concerns.

There is concern that the FY21 President’s Budget Request (PBR) does not move the Near Earth Object (NEO) Surveillance Mission forward to a full launch date; delays will increase costs. In addition, a new mission, the Mars Ice Mapper, has recently appeared in the Mars mission portfolio with an unclear scope and cost. The lack of transparency and community involvement in the mission definition process is an issue. PAC also notes support for strengthening Participating Scientist programs. Emerging areas for possible future findings are astrobiology, and the need to ensure that mission data standards are uniform.

In answer to a question from Dr. Wadhwa, Dr. Mainzer explained that the “no due date” mode of proposal solicitation would be tried with a few ROSES programs at first to increase flexibility for PIs. Dr. Woodward asked about what the interplay of astrobiology and exoplanets will look like in the future. Dr. Mainzer noted that it will be interesting to see how astrobiology is mapped to planetary science studies, and how all of the science coming out of astrobiology can be used by our missions in areas such as Ocean Worlds. She also looked forward to hearing from BPS to hear whether their biological work can increase life detection.

Earth Science

The Vice Chair of the Earth Science Advisory Committee (ESAC), Dr. Thomas Herring, explained that the Committee had not met for a while, so he was reporting on recent activities of NASA’s Earth Science Division (ESD). The Division has a new Director, Dr. Karen St. Germain, and ESAC looks forward to

working with her. In response to COVID-19 impacts, ESD announced augmented funding for the Rapid Response and Novel Earth Science (RRNES) element (A.28) in ROSES 19. There were 30 Proposals, with 7 selections to date. Several additional tasks have been funded or augmented through existing programs. Studies are focused on understanding how COVID is progressing, as well as other factors such as flight traffic and how people are moving around. ESD has implemented a COVID-19 dashboard that uses Earth observations. One can look at different places around the world and discover the types of Earth observations being used.

Most of the last ESAC meeting was about the recently issued DS. Continuity of measurements is a very high priority. In particular, the ESAC had advised that the radiation budget mission should go forward so that continuity was not lost. Another main meeting topic was the need to amplify the cross benefit of Applications and Research. Dr. Herring described some of the opportunities and listed priorities. The ESD leadership team continues to address additional DS topics, and a community forum on DS implementation is scheduled for mid-November.

With regard to the COVID studies, Dr. Cerf commented that when an experiment is done and it doesn't work, sometimes it reveals new science; Dr. Herring completely agreed.

Public Comments

Members of the public were given the opportunity to speak. No comments were made.

Biological and Physical Sciences (BPS)

Dr. Craig Kundrot and Ms. Diane Malarik briefed the SC on BPS and high-priority topics the Division may raise in the future. Dr. Kundrot explained that BPS uses spaceflight environments such as the International Space Station (ISS) to study biological and physical systems, taking terrestrial systems into space in order to study them under extreme conditions such as microgravity. BPS currently is guided by its 2011 DS and a 2017 mid-term assessment. The Division now is planning for its next DS.

The Space Biology Program is very broad, covering plants, animals, and microbes down to the molecular level. The overarching objective is to learn how biological organisms respond to the spaceflight environment, then tease out the mechanisms of those responses. This promotes understanding of the impact of space travel and life on humans, and some of these discoveries apply to life on Earth. The Physical Sciences Program covers fundamental laws of physics and research that cannot be done on Earth. This Program emphasizes mechanistic understanding and helps develop cutting-edge technologies. There are many research platforms in addition to the ISS, and not all require actually going to space.

Dr. Kundrot described a number of projects, such as swabbing ISS surfaces for microbial samples to study the microbiome of the ISS and the astronauts; crew microbial inventory; long-distance plant defense signaling; Bose-Einstein condensate in orbit; and a burn rate emulator that has been used to discover things about the combustion process that we cannot otherwise measure.

Dr. Wadhwa asked what the BPS DS recommended. Dr. Kundrot explained that the BPS mid-term assessment for the DS was broad-ranging, with no recommendations for changing direction, though there were suggestions on improving various aspects of the program. The Division also was urged to not forget fundamental physics given all of the attention on enabling exploration. The next DS will be challenging because of the breadth of the program, and NASA will ask for transformational science. Dr. Cerf asked about plans for providing oxygen given the Mars biosphere. Dr. Kundrot replied that the Environmental Control and Life Support System (ECLSS) is essentially chemical, with closed-loop recycling, which is likely to be the main approach to Mars. While there might be some oxygen benefit coming from plants, they are water-intense, which creates resource issues. Also, if used at a large scale to generate oxygen, we would need to deal with the great amount of water that the plants would transpire. Thus, plants are not

expected to be a major part of the system. It is likely that human exploration will require missions to close the oxygen loop and carry extra oxygen as well.

Dr. Hoffman, agreeing with the move of BPS to SMD, asked how BPS will now interact with HEOMD, especially with regard to crew health. Dr. Kundrot said that the Division retains strong ties at multiple levels of the Human Research Program and that the science collaborations and interests remain intact and are the subject of solicitations. Dr. Wadhwa asked about BPS' interplay with astrobiology and space biology. Dr. Kundrot said that he would add planetary protection research to the mix, as well. This first year that BPS is in SMD will be one of getting to know each other. It may be that by next summer there will be a much better understanding of how to coordinate and collaborate. Some of the microbial work, for example, could be tied to planetary protection research. There is a lot of potential, and those discussions are just starting.

Moon to Mars /Artemis Science

Dr. David Burns and Dr. Debra Needham discussed activities of the Exploration Science Strategy and Integration Office (ESSIO), the SMD unit dedicated to Artemis exploration. ESSIO formulates and executes an integrated strategy for exploration science. The Lunar Discovery and Exploration Program (LDEP) oversees much of the implementation strategy. The goal is to make sure NASA obtains the greatest science benefit from the Gateway and other efforts.

Dr. Burns described the CLPS Program, which will use commercial services to enable access to the lunar surface. NASA expects to issue two Task Orders (TOs) each year, with 14 companies on the list eligible to provide deliveries and payloads. The first four TOs are for non-polar delivery (Astrobotic and Intuitive Machines; TOs 2A and 2B) in 2021; polar delivery (Masten; TO 19C) in 2022; and Volatiles Investigating Polar Exploration Rover (VIPER) to the Moon's south polar region (Astrobotic; TO 20A) in 2023. There were 238 responses to the Payloads and Research Investigations for the Surface of the Moon (PRISM) RFI. PRISM Stage 2 solicitations will state the location for each delivery, allowing PIs to propose science optimized for those locations. There are agreements with other NASA mission directorates to enable payloads where space exists. CLPS does not specify the launch vehicle. Dr. Needham described CLPS deliveries for 2021-24. NASA is about to announce two more opportunities, which will go to Reiner Gamma and Schrodinger Basin in 2023-24.

After Dr. Burns provided more information on the four TOs, Dr. Needham discussed the importance of the Moon in enabling scientific exploration. The Moon is a cornerstone of solar system and exoplanet science, as well as a training ground and lab for learning how to conduct research and learn about planetary processes. She closed with a slide on the phases of the Artemis campaign.

Dr. Mainzer asked how ESSIO sees the CLPS program objectives fitting within the Planetary DS that is underway. Dr. Burns replied that ESSIO referred to the DS when putting out the call, and uses the DS as a focus in the panels. Because they do not always get proposals in DS areas, the Office developed a program to elicit such proposals. Dr. Needham added that the DS tends to focus on larger missions, and these are smaller missions. However, this is a new capability, so it will be interesting to see how the upcoming DS addresses it. They expect the science objectives to be addressed, and plan to tie back to them. Dr. Woodward noted that many of the assets will be on the lunar surface. He wondered how the Gateway folds into all of that, noting that the SC had not heard much about the Gateway. Dr. Needham replied that the Gateway represents a challenge for lunar science because of its orbit, but there are science objectives that can be addressed on it. The Gateway program is defining its objectives. Dr. Burns said that ESSIO is working with NASA's Space Communications and Navigation (SCaN) Program on the communications relay function for a number of different options, and some international partners are also interested.

It had been announced earlier that day that NASA is seeking commercial operators to collect and return regolith from the Moon. Dr. Wadhwa said that while HEOMD will issue the solicitation, SMD will be interested in the materials brought back. She would like SMD to engage with HEOMD sooner rather than later. Dr. Burns agreed, noting the innovative approach of having industry come up with solutions for obtaining obtain samples in different regions. Dr. Needham added that having samples from multiple places on the lunar surface would be of high value to the science community. Dr. Cerf expressed interest in the communications for CLPS, especially regarding the diversity of devices and their distribution on surface of the Moon. He added that this would bring to light interesting communication opportunities and needs on Mars which has more delay. He and Dr. Burns agreed to take this up offline.

Discussion, Findings, and Recommendations

Dr. Wadhwa asked the SC members to suggest findings and recommendations. Dr. Mainzer said that it is important that NASA keep pushing in the area of diversity. She wanted a finding on that, as not enough is being done and it needs more emphasis. Also, NASA plays an important role in serving the public through its research, which she would like to have emphasized. Finally, she wanted to applaud ESD for its rapid responses to crises, showing the application of NASA data to everyone's lives. Dr. Woodward agreed about diversity. NASA is addressing it and the SC should encourage the Agency to be very aggressive in that area. He thought that the response to COVID-19 impacts on early career investigators was laudable. Lastly, SMD should be on the ground floor in getting access to lunar samples.

Dr. Hoffman said that he is excited about sending nanosats beyond Earth, which would be transformative. Dr. Liemohn said that HPAC liked the possibility of SMD fostering the opportunity for investigators to go beyond the primary payloads; a powered ESPA ring allows that. Dr. Patterson agreed that propulsed ESPA was valuable and noted applicable work by the U.S. Air Force that allows SmallSats to venture further to do great things. He added that there is a lot to learn about the communications architecture around the Moon, and he is interested in seeing how CLPS turns out. Dr. Herring seconded the diversity piece. He noted that ESD has been working with commercial data buys and wondered if there are lessons from that to transfer to the commercial regolith collection. Mr. Weiser said that communications is another area for engagement with innovative companies to work on problems; for instance, in deep space, pointing will be a challenge. Regarding CLPS, COVID-19 is causing challenges and delays, and affecting priorities. Program managers need to be included in communications about these things.

Dr. Wadhwa heard that broader participation of underrepresented groups and ways to engage with them more effectively might warrant a finding or recommendation. Dr. Mainzer agreed to work on that with input from Drs. Liemohn, Woodward, and others. Dr. Wadhwa then suggested another finding about the lunar samples, and one on ESPA rings and rideshare. Dr. Liemohn agreed to write those. Another finding could note the Entrepreneur Challenge, and Ms. Denning noted that she would provide a first draft to Dr. Wadhwa.

Next, Dr. Wadhwa advised having a finding about the interplay between BPS and other parts of SMD, as well as other parts of NASA. She also heard that members wanted a recommendation to add a new member to the SC to represent BPS. Dr. Hoffman said that while the two fields covered by BPS are very different, he would start with a biology expert, as it is the largest area. He agreed to craft a recommendation to add a member to the SC, and to address the interplay with other areas of SMD, such as astrobiology and planetary protection. Dr. Wadhwa explained that there was no longer a need to provide all the structured verbiage to the NAC as done before; they have leeway to move away from the three-part recommendation format. However, she still would like to see the consequence of not implementing the recommendation stated. This would be the SC's one recommendation, and the rest were findings. Ms. Denning noted that recommendations receive a written response from the NAC.

Dr. Woodward agreed to write a finding on the NASA response to COVID-19, Dr. Cerf said he would write one on communication in the lunar environment looking forward to Mars exploration. Dr. Mainzer said she would write the lunar sample finding.

Outbrief to SMD AA

When Dr. Zurbuchen returned to the meeting, Dr. Wadhwa led the Committee in summarizing their conclusions. Some of the DEI discussion will go into a finding. Dr. Liemohn added that HPAC had findings with specific suggestions about the education pipeline, aimed at K-12 teachers, teachers in training, summer camps for students, and more resources for reaching out to assemblies at schools. Dr. Mainzer said that the SC appreciates that NASA data are being applied in rapid response situations, and it is important that NASA continue to address these issues.

Mr. Weiser said that the Entrepreneurs Challenge was a great first step toward engaging startups, and this kind of program could address emerging areas. Dr. Wadhwa noted the announcement that NASA will seek lunar samples from commercial companies. Although this program will be done through HEOMD, SMD should engage early because of the huge scientific interest in any samples. Another issue is communications at the Moon and taking advantage of the opportunity to ensure that the infrastructure is strong enough to use for future exploration. Finally, SMD heard its first BPS report and was making a recommendation to add a new member to the SC to give appropriate advice in this area. The Committee members were also thinking about the interplays between BPS and astrobiology and planetary protection.

Dr. Zurbuchen said that in recommendations and findings, it would be useful to focus on what NASA could do best or exclusively. Regarding the announcement about lunar sample collection, SMD should look at that as enabling science from the DSs, and also take the perspective of space policy. BPS science is very important, and it will be useful to leverage specific knowledge on the SC, especially with the BPS DS beginning soon.

Dr. Wadhwa thanked Dr. Zurbuchen and the meeting participants.

Adjourn Meeting

The meeting was adjourned at 5:16 p.m.

Appendix A

**NAC Science Committee
Membership**

Dr. Meenakshi Wadhwa (Chair)
Arizona State University

Dr. Vinton G. Cerf
Google

Dr. Jeffrey A. Hoffman
Massachusetts Institute of Technology

Dr. Michael W. Liemohn
University of Michigan

Dr. Amy Mainzer
University of Arizona

Dr. Pat Patterson
Space Dynamics Laboratory

Mr. Marc Weiser
RPM Ventures

Dr. Charles Woodward
University of Minnesota

Ms. Elaine Denning (Designated Federal Officer)
NASA SMD

Appendix B
Presentations

1. HPAC: Heliophysics Advisory Committee Report to the NASA Science Committee; *Michael Liemohn*
2. APAC: Astrophysics Advisory Committee Report to the NASA Science Committee; *Charles Woodward*
3. Update on the Entrepreneurs Call; *Michael Seabloom, Marc Weiser*
4. PAC: Planetary Science Advisory Committee Report to the NASA Science Committee; *Amy Mainzer*
5. ESAC: Earth Science Advisory Committee Report to the NASA Science Committee; *Thomas Herring*
6. Biological and Physical Sciences Division; *Craig Kundrot, Diane Malarik*
7. Moon to Mars /Artemis Science; *David Burns, Debra Needham*

Appendix C

Attendance

Science Committee Members

Meenakshi Wadhwa, **Chair**, Arizona State University
Vinton G. Cerf, Google
Thomas Herring, Massachusetts Institute of Technology (*ESAC Chair designee*)
Jeffrey A. Hoffman, Massachusetts Institute of Technology
Michael W. Liemohn, University of Michigan
Amy Mainzer, University of Arizona
Pat Patterson, Space Dynamics Laboratory
Marc Weiser, RPM Ventures
Charles Woodward, University of Minnesota
Elaine Denning, **Designated Federal Officer**, NASA Headquarters

NASA Attendees

John Allen, NASA
Meagan Ansdell, NASA HQ
Sharmila Bhattacharya, NASA HQ
David Burns, NASA HQ
Sandra Cauffman, NASA HQ
Lin Chambers, NASA HQ
Sandra Connelly, NASA HQ
Doris Daou, NASA HQ
Christopher Dateo, NASA
Kristen Erickson, NASA HQ
Elizabeth Esther, NASA HQ
Gamble Gilbertson, NASA HQ
Devon Griffin, NASA Goddard
Douglas Gruendel, NASA
T. Jens Feeley, NASA HQ
Nicky Fox, NASA HQ
Mark Fonda, NASA Ames
Hashima Hasan, NASA HQ
Michael Henry, NASA HQ
Paul Hertz, NASA
Jeffrey Hollingsworth, NASA Ames
Melinda Kahre, NASA Ames
Jennifer Kearns, NASA HQ
James Klimchuk, NASA Goddard
Craig Kundrot, NASA HQ
Janet Kozyra, NASA HQ
Christy Layton, NASA HQ
Diane Malarik, NASA HQ
Peter Meister, NASA HQ
Michael Meyer, NASA HQ
Debra Needham, NASA
Michael New, NASA HQ
Kirsten Petree, NASA HQ
Ursula Rick, NASA HQ

Stephen Rinehart, NASA HQ
Tara Ruttley, NASA
Kevin Sato, NASA HQ
Michael Seablom, NASA HQ
Kartik Sheth, NASA HQ
Mary Sladek, NASA HQ
Gerald Smith, NASA HQ
Karen St. Germain, NASA HQ
Florence Tan, NASA HQ
Azita Valinia, NASA Goddard
Thomas Zurbuchen, NASA HQ

Telecon/Webex Attendees

Linda Billings, NIA
Francesco Bordi, Aerospace
Steven Clark, Space Flight Now
Monty DiBiasi, L. DiBiasi Associates
David Eisenman, JPL
Philip Ely, DRS Technologies
Sylvie Espinasse, ESA
Jeff Foust, Space News
Tom Hammond, U.S. House of Representatives
Allie Hannigan, Xplore
Brian Harvey, BA&Associates
Peter Hill, WHOI
Andy Hoskins, Aerojet
Doug Isbell, JPL
Ben Kallen, Lewis-Burke Associates
Theodore Kronmiller
Kelsie Krafton, AAS
James Lochner, USRA
Dillon MacInnis, SpaceX
Robins Mdoka, Constanellis Aerospace, Inc.
Mark Muzilla, DRS Technologies
Richard Rodgers, Steller Solutions
John Rummel, ECU
Arianna Sanchez, Stellar Solutions
Elizabeth Sheley, Zantech
Marcia Smith, spacepolicyonline.com
Adrian Thompson, Aerospace
Paul Voosen, Science Magazine
Monica Washington, Total Solutions, Inc.
Ashlee Wilkins, U.S. House of Representatives
Alexandra Witze, Science News

Appendix D

Agenda



Dial-In (audio) & WebEx (view presentations online) information for the SC meeting is located on p. 2.

**NASA Advisory Council
Science Committee**

Thursday, September 10, 2020

Telecon Meeting

**Agenda
(Eastern Time)**

Preceding the Science Committee Meeting – SMD Community Town Hall

Go To: <https://www.nasa.gov/press-release/nasa-science-to-host-public-town-hall-meeting>

12:00	Community Town Hall	Dr. Thomas Zurbuchen SMD Leadership Team
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Science Committee Meeting

1:00 – 1:10	Opening Remarks / Introduction of Members	Ms. Elaine Denning Dr. Meenakshi Wadhwa
1:10 – 1:55	SC Member Q&A with SMD AA	Dr. Thomas Zurbuchen
1:55 – 2:00	Goals of the Meeting	Dr. Meenakshi Wadhwa
2:00 – 2:20	Division Advisory Committee (DAC) Chair Reports Heliophysics Advisory Committee Astrophysics Advisory Committee	Dr. Michael Liemohn Dr. Charles Woodward
2:20 – 2:50	Entrepreneurs Challenge/Discussion	Mr. Michael Seablom Mr. Marc Weiser
2:50 – 3:10	DAC Chair Reports (Continued) Planetary Science Advisory Committee Earth Science Advisory Committee	Dr. Amy Mainzer Dr. Thomas Herring
3:10 – 3:20	<i>Break</i>	
3:20 – 3:30	Public Comments	



Dial-In (audio) & WebEx (view presentations online) information for the SC meeting is located on p. 2.

3:30 – 4:00	Biological and Physical Sciences (BPS)	Dr. Craig Kundrot Ms. Diane Malarik
4:00 – 4:30	Moon to Mars /Artemis Science	Dr. David Burns Dr. Debra Needham
4:30 – 5:00	Discussion, Findings and Recommendations	All
5:00 – 5:15	Outbrief to SMD AA	Dr. Meenakshi Wadhwa Dr. Thomas Zurbuchen
5:15	<i>Adjourn Meeting</i>	

Dial-In and WebEx Information

For SC meeting:

Dial-In (audio): Dial the USA toll free number 1-888-469-3144 or toll number 1-517-308-9289 and then enter the numeric participant passcode: 8932597. You must use a touch-tone phone to participate in this meeting.

WebEx (view presentations online): The web link is <https://nasaenterprise.webex.com>, the meeting number is 199 497 6344 and the password is SC@Sept2020 (case sensitive).

* All times are Eastern Time *