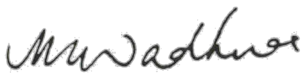
NASA ADVISORY COUNCIL

SCIENCE COMMITTEE

April 14-15, 2021

Virtual Meeting
Washington, DC

MEETING REPORT



June 23, 2021

Meenakshi Wadhwa, Chair

June 24, 2021

Jason Callahan, Designated Federal Officer

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Opening remarks

Mr. Jason Callahan, Designated Federal Officer for the NASA Advisory Council (NAC) Science Committee (SC), opened the Spring 2021 meeting and delineated Federal Advisory Committee Act (FACA) rules for the participants. He added that participants could use the Chat feature on the Webex application to ask questions; the Chat transcript will be made a part of the meeting minutes for future reference. He introduced Dr. Meenakshi Wadhwa, Chair of the SC, and member introductions were made. Dr. Wadhwa welcomed members of the SC and other meeting participants. Members introduced themselves around the Virtual Room. Dr. Wadhwa reviewed the goals of the meeting.

Planetary Science Advisory Committee (PAC)

Dr. Amy Mainzer, Chair of the Planetary Science Advisory Committee (PAC), reported on the results of the PAC's March meeting. Topics on the agenda included a Planetary Science Division (PSD) update and reports from the Exploration Science Strategy and Integration Office (ESSIO), Astrobiology, Planetary Defense Coordination Office (PDCO), and progress reports from the Planetary Science Decadal Survey effort, PSD Research and Analysis (R&A), the Anti-Racism Working Group, and the discipline Analysis Groups (AGs).

The Origins-Spectral Interpretation-Resource Identification-Security-Regolith Explorer (OSIRIS-REx) mission has completed its sample collection from the asteroid Bennu and will depart on May 10 for its return to Earth. There are several PSD launches pending, including the Lucy mission preparing to launch in October 2021 to the Jovian Trojan asteroids. The Double Asteroid Redirection Test (DART), a Planetary Defense mission, has experienced a launch delay due to some technical/engineering challenges, but the delay is not expected to affect the mission's ability to arrive at the target double asteroid, Didymos, within the mission's scheduled timeframe. NASA granted extensions to three missions via the Senior Review process: Juno received an extra five years to tour the moons Ganymede and Io; InSight's mole has been turned off, but the lander will continue to report on seismic activity on Mars; and the Near-Earth Object Wide-Area Infrared Survey Explorer (NEOWISE) satellite received a two-year extension.

PAC Findings

- PAC offers its congratulations on the great success of the Mars 2020 Perseverance mission.
- The PAC expresses continued concern about low selection rates in R&A, noting that while it is fortunate that the PSD budget has grown overall, the absolute dollar amount of funding for R&A has remained flat. As a result, the program has become oversubscribed, and it becomes inefficient for researchers to write so many proposals. (Dr. Mainzer noted here that the PAC had a good discussion during the March meeting about ways to mitigate bias in the review process and expressed the PAC's appreciation of SMD's efforts to mitigate COVID impacts).
- The PAC wishes to ensure the community is involved in developing science requirements for the proposed directed mission, Mars Ice Mapper (MIM).
- The PAC is very concerned about the high cost of the Mars Sample Return (MSR) Mission and wants to ensure that the Astrobiology discipline is incorporated into the process of designing the laboratories that will assay the returned samples.
- The PAC finds that decisions need to be made soon on the fate of the Near-Earth Object (NEO) Surveyor mission [Dr. Mainzer is the Principal Investigator (PI) for the NEO Surveyor, and recused herself for this finding].
- **The PAC recommends that NASA create a Chief Executive for its Inclusion, Diversity, Equity and Accessibility (IDEA) efforts, and wishes to elevate this latter finding to the SC at large.

Dr. Wadhwa said there had been some discussion within the community about other ideas on how to

support Early Career scientists (ECs) such as partnering with professional societies and the broader science "ecosystem." She noted that Dr. Lori Glaze, Director of PSD, had communicated with Dr. Mainzer and the PAC to help ECs achieve the next step through meet-and-greet sessions and workshops. Dr. Chick Woodward asked Dr. Mainzer to clarify the PAC's finding on MIM. Dr. Mainzer said the finding stemmed from the nature of the mission's sudden appearance. The community is interested in whether MIM has science objectives and what other instruments it might carry in addition to a radar. MIM is a directed/strategic mission that also supports future human missions. Dr. Wadhwa asked about the status of the Planetary Decadal Survey. Dr. Mainzer said that the Planetary Science Decadal Committee is on track to deliver the Survey in 18 months. She noted that while there had been some initial delays in white paper submissions due to COVID, the Committee granted extensions. The Survey meetings are open meetings; Dr. Mainzer encouraged people to listen in and added that the planetary community is delighted that Astrobiology and Planetary Defense will be newly incorporated as an integral part of the Planetary Science Decadal Survey.

Astrophysics Advisory Committee (APAC)

Dr. Chick Woodward, Chair of the Astrophysics Advisory Committee (APAC), reported on the results of its March meeting. The Committee just concluded its letter including formalized findings and recommendations. The meeting agenda included operating mission reports, the status of the division budget, receipt and approval of the Balloon Roadmap (a growth area for the Astrophysics portfolio), and the status of missions in development. The APAC also discussed the status of the profession. The Astrophysics Division (APD) has led discussions and developed efforts to address inclusion and equity, recommending that inclusion be introduced as a "fifth pillar" of the NASA mission. APAC notes that APD has been taking a leadership role in this regard and has asked the division to add language to the Dual-Anonymous Peer Review (DAPR) process to query the panels about professional conduct of proposal teams. APD also requests that future APAC meetings contain the fifth pillar concept. Dr. Woodward briefly reviewed some budget changes surrounding the (now perennial) requested cuts for the Nancy Roman Space Telescope and the Stratospheric Observatory for Infrared Astronomy (SOFIA). In the appropriations process, APD eventually received $525M above the Presidential Budget Request (PBR), including restoration of funds for both missions that had been targeted for cuts. There are some strategic and programmatic uncertainties as APAC and APD await the release of the new Astrophysics Decadal Survey in May 2021. Dr. Woodward noted some APD program highlights in the 2020 Pioneers selections that have the ability to provide mission development opportunities. The four selected missions (three small satellites and a balloon mission) represent a real growth area in the portfolio.

The Astrophysics community is eagerly awaiting the launch of the James Webb Space Telescope (JWST) in October 2021; its critical milestones have been met despite the impacts of COVID. JWST just completed its second Launch Readiness Review and is on track for launch. The JWST Cycle 1 release included 1,084 Guest Observer proposals from 44 countries. There have been recommendations to forensically investigate the history of the Webb mission, including issues surrounding the current framework of NASA's five key agency goals. The Nancy Roman Space Telescope Wide Field Instrument (WFI) has passed its Critical Design Review (CDR), and a new K-band filter has been added to its filter suite, expanding the scientific capabilities of the mission.

Dr. Woodward asked to bring forward one particular APAC finding that raises a concern about a soon-to-be-released Science Mission Directorate (SMD) Information Policy. The new SMD Information Policy has the potential to impact research programs and impose additional cost to researchers. The APAC has advised the APD on this matter with a finding. There is also a parallel activity on the Planetary Data System (PDS) that the community should be aware of. APAC is requesting a full briefing on the new information policy as soon as it is released.

Dr. Woodward closed his presentation with a science highlight on a famous core-collapse supernova (SN) event, which is now demonstrating new evidence of the presence of a neutron star, based on data from Chandra's NuSTAR instrument. This supernova remnant, located in the Large Magellanic Cloud, has become one of the most studied objects in the sky.

Dr. Vinton Cerf said he would like to learn more about the SMD Information Policy, as he is a huge proponent of data collection and preservation. He asked for clarification of the APAC's specific concerns about the policy. Dr. Woodward acknowledged that proper curation and accessibility of data products are highly valuable features. However, APAC's issue is based on a currently unclear view of the scope and scale of the new policy, and concerns about how to ensure fidelity and understand the long-term commitments on what information must be made formally available to the community under the new policy. Secondly, the APAC has concerns about interoperability in the databases. Dr. Cerf commented that the Digital Archive Ingest (DAI) Working Group has defined an Open Archival Information System (OAIS), which has addressed the interoperability issue. He noted that the APAC's second concern might be more of an infrastructure issue; there are those who might feel put upon and might take some of these proposed information functions out of the mission budget. Dr. Woodward commented that balloon data, for one example, have no centralized repositories, and that there are also some general questions about robustness, software fidelity, and dual use, etc. Mr. Marc Weiser agreed that, typically, somebody has a specific issue in mind when such policies are written, and that there may be some unintended consequences in applying the requirements to each individual PI and research group; he agreed with Dr. Cerf that it seems to be an infrastructure question. Dr. Michael Liemohn commented on the importance of preserving code, because programming languages change over time. Dr. Wadhwa agreed that the SMD Information Policy could be the subject of a SC finding once the policy is released. Dr. Cerf noted that the National Science Foundation (NSF) also has requirements for preservation of science data and plans for data preservation that are written into each contract; these requirements, however, are often not executed. Dr. Cerf offered an anecdote to illustrate the importance of data preservation regarding a twenty-year-old tape containing satellite control commands; preservation by accident is not a plan. Dr. Woodward noted that this is especially important for some large databases that require Artificial Intelligence (AI) algorithms for data management. Dr. Cerf said that Google has been supporting interesting work on drawing disparate data into a common framework, which can unleash some powerful methodologies in data analysis and processing. Dr. Mainzer commented that the discussion ties back to some PSD concerns, being that it takes much more effort to process data as the databases become much larger; it's going to get harder to deal with these programs as resources continue to lag in R&A. Dr. Cerf felt that aggregating new information requirements across multiple missions may yield more efficiencies about processing.

Asked if the APAC had discussed Cloud Computing, Dr. Woodward said that the APAC had done so, and had advised APD management to look at those models, given that missions producing very large databases will start to return data in the near future. Mr. Weiser cautioned that platforms can be sunsetted, thus data must be immutable and distributed; in that light, would NASA consider an open source blockchain infrastructure, or is this thinking too far ahead? Dr. Cerf thought that blockchain is the new Brylcreem, as it doesn't always scale as one wants it to. He suggested concentrating on distributed databases that can be run across multiple Cloud systems such as Google Anthos. Digitally signing data to make it certifiable is another approach.

Public comment period
No public comments were noted.

Earth Science Division Update

Dr. Karen St. Germain, Director of the Earth Science Division (ESD), noted that the Division is very busy these days, meeting the criteria of one of the key SMD science themes: protecting and improving life on Earth and in space. The climate is changing rapidly—temperatures are increasing, but not uniformly. Climate change is not just about temperatures; it is also about the broader implications of what these changes mean. Each Earth Observing Satellite (EOS) component looks at a piece of the Earth system, but also contributes to uncovering data on how each part of the system works synergistically. Changes in precipitation and sea level come with attendant biological and physical effects. Why does it matter? Global risk forecasts include in their deliberations the idea that environmental risks are the top risks to global well-being. Society needs to be able to predict the effects of climate change and must prepare and mature natural hazard warning and recovery systems, plan for sea level rise mitigation, support economic prosperity, ensure food security, and more effectively manage water supply and quality. At the end of this decade, the Earth's population will increase by a billion, enlarging the importance of these issues.

ESD looks to the 2017 Decadal Survey to guide its missions. The Survey puts a strong emphasis on partnerships: international, interagency, public/private, and philanthropic. The Survey also stresses innovation and an approach to Earth Science that allows for innovative mission development opportunities. ESD is pursuing the Decadal Survey's key questions and observations in climate variability and change; weather and air quality; hydrogeological cycles and water resources; ecosystems and natural resource management; and solid Earth dynamics and hazards, while also advancing Earth Science System science end-to-end. NASA is one of the few organizations that has the necessary programs under one roof (Technology, Flight, Research, Data Systems, Applied Sciences), without stovepipes, making sure ESD can pull threads through that value chain.

ESD maintains a fleet of satellites that range in size from large to small, with instruments in a variety of orbits, including on the International Space Station (ISS) and the Joint Polar Satellite System (JPSS). Satellite observations underpin much of what ESD does, but the story is in discovery and understanding how the various elements in the Earth system work—and work together—ultimately integrating this data to provide actionable information.

Recent science highlights include results from the Oceans Melting Greenland (OMG) project that is studying how ocean warming is driving the retreat of the Greenland glacier. The project is demonstrating that not all glaciers are the same and that there is "memory" in the freeze-and-thaw system driven by ocean temperature. Another highlight involves results from a study on air quality in Houston that has shown how airborne pollutants (such as NO_2) disproportionately affect low-income, non-white and Hispanic neighborhoods.

ESD is also working on applications and dissemination of data with the goal of accelerating uptake of new information; scalability has come mostly through partnering with organizations that already have the access and trust in targeted populations. Dr. St. Germain invited SC members to visit Space for U.S. [https://www.nasa.gov/SpaceforUS/?page=home], an Earth Science Applications website that illustrates NASA's efforts in protecting the environment and improving human lives. In February 2021, ESD also launched the Earth Observations Toolkit for Sustainable Cities and Human Settlements, putting data and tools into context, for use by analysts and decision makers, using more than 25 data sets. One tool of note is the Popgrid viewer, and another, called Trends.Earth, illustrates land consumption. The Cyanobacteria Assessment Network, a mobile phone app on Google Play, provides early identification of harmful algal blooms in both coastal and inland waters. NASA developed this tool and provided it to the Environmental Protection Agency (EPA), allowing water management organizations to use it as needed.

Urgency demands action and innovation, which means ESD will have to operate differently in the next decade using commercial partnerships, international partnerships, and U.S. government partnerships to create an open science ecosystem that is broadly available and supported by a diverse, inclusive

workforce. The work ahead will demand best efforts, and this includes the recognition that diverse teams are stronger teams that make better decisions. In addition, people from diverse backgrounds ask diverse questions.

The Decadal Survey identified the most important observations to be made in the pursuit of Earth Science goals, called Designated Observables (DOs). By presenting recommendations in terms of DOs rather than flight missions, the Survey provides NASA with great latitude on how to pursue the scientific data. The data gathering capabilities, when taken together, will constitute an Earth System Observatory; this data collection provides a core view of the whole Earth system. It is akin to the investment in the Aqua/Terra/Aurora satellites, and the "A Train" platforms of the past. ESD views these DO systems as the next-generation version of these past platforms. The Earth Explorer missions, meant to encourage innovation and competition, are on their way to amassing a diverse portfolio of observations on features such as snow depth and water content. ESD is also employing principles designed to maximize science per dollar, such as the Venture Class series of missions, as well as expanding the use of SmallSats and CubeSats. Using SMD principles for commercial partnerships, ESD is continually assessing and evolving the market to ensure it can take advantage of areas where commercial is leading, such as in Cloud Computing. Earth Venture opportunities seek to maintain a steady approach to infusing innovation into the portfolio with a steady cadence of opportunities. ESD just closed out an Earth Venture Mission 3 call in which it partnered with the National Oceanic and Atmospheric Administration (NOAA); NOAA has set aside funds to augment certain NASA Venture Class missions. Not all experiments are successful, however; Dr. St. Germain noted that a major market shift in geostationary satellite hosting has left two missions, Tropospheric Emissions: Monitoring of Pollution (TEMPO) and the Geostationary Carbon Cycle Observatory (GeoCarb), in some difficulty.

ESD is developing an open science ecosystem designed to shorten the time it takes for a new user to find and learn how to use data; increase the community of hands-on contributors; explore and exploit data in new ways; and incentivize and energize innovation through prizes and challenges. This initiative is being led by a senior officer to oversee the execution of the strategy for ESD, but also for the rest of SMD. ESD is taking a lead in this SMD-wide approach. ESD is an appropriate leader because it has a particularly high demand for its products. ESD also plays a significant role in interagency activities. In addition to leadership roles that it already holds in several organizations such as the U.S. Group on Earth Observations (USGEO), ESD has begun to support the Climate Security Advisory Council (CSAC), a partnership between the U.S. Intelligence Community and the Federal Science community, and the Intergovernmental Panel on Climate Change (IPCC) Subpanel on Climate Risk Analysis; both of these initiatives were called out by Executive Orders. NASA ESD and Decadal missions also continue to support existing Earth Observations, as well as U.S. actions that relate to rejoining the Paris Climate Agreement.

Dr. Cerf asked if the bulk of NASA data were treated as publicly available and discoverable. Dr. St. Germain affirmed that this was the case, as it has been for a very long time. However, the current question is how to make the databases much easier to find and use, and NASA is collaborating with NOAA on this effort. Asked if she was familiar with the National Ecological Observation Network (NEON) project at NSF, which develops standards for data, Dr. St Germain said she did not have specific knowledge of NEON but was aware of a generalized drive for standardized metadata. Dr. Cerf suggested consulting with SCHEMA.org, which focuses on representation standards. Dr. Woodward asked if continuity of observations/measurements over long timelines constituted a core competency that NASA must maintain. Dr. St. Germain noted that ESD's principal core competency of sustaining and advancing certain types of radar and electro-optical instruments that support Earth observations was a given. Continuity of a particular observation, however, is a different question. ESD takes its guidance from the Decadal Survey, but the needs identified in the Survey are not framed around continuity. NASA attains continuity through international and interagency partnerships. Dr. Sara Tucker asked about the status of atmospheric winds

as an observable within the Explorer mission line. Dr. St. Germain said that it was indeed a targeted observable for the Explorer missions and had been mistakenly omitted from the briefing slides. She added that ESD is working with NASA Headquarters on how to move forward on Explorer. In addition, NASA is working with the National Academies of Sciences, Engineering and Medicine (NASEM) to analyze the first decade of Venture-class missions that should yield some answers on where ESD might go in the future. The intent is to continue to experiment with new ways to get instruments to orbit. There are new business models emerging all the time that may well provide some solutions to current challenges.

Question & Answer Session with the SMD AA

The SC held a discussion with Dr. Thomas Zurbuchen, Associate Administrator for SMD. Dr. Wadhwa asked Dr. Zurbuchen what he had been most proud of this year, and what he was most worried about. Dr. Zurbuchen said he was most proud of the strong NASA team and its determined path forward, as well as the Centers and companies that are building hardware for the missions. COVID-19 has magnified the challenges that already existed. He said he was most worried about the disparate impacts of COVID-19 on different populations, such as employees who require child care and other support. He also identified local problems such as R&A selection rates and the long-term consequences of COVID-19. There are subtle changes happening below the surface. The question SMD must ask is: how do we make sure that five years from now we do not become a weaker community due to the amplified impacts? NASA needs to know now what road it is on to avert future problems. Mr. Weiser lauded Dr. Zurbuchen's forward-thinking approach to equity as critical, noting that the many recommendations on the topic of equity that have been authored by the SC are a reflection of his efforts. Dr. Woodward felt that APAC appreciated SMD efforts in COVID-19 mitigation that have given the community a boost of confidence, but that the community remains concerned about science loss, capability loss, and how to recover from these losses. Dr. Zurbuchen said the issue was not confined to just science loss, but in the subtle differences in who is affected. Socioeconomic and family pressures on different genders and Black, Indigenous, and People of Color (BIPOC) are very different, and these differences need to become a part of how NASA thinks about the issue. One way to approach the topic is through regular community Town Hall meetings. COVID-19 is ugly—some missions are beginning to reach Nunn-McCurdy breaches— so it becomes very important to label what is caused by COVID-19 and what is not. COVID-19 impacts will be with us for years, notwithstanding.

Dr. Mainzer commented that at its last meeting, the PAC had appreciated hearing from SMD's Anti-Racism/Inclusion Diversity Equity and Accessibility Working Groups and had also talked a lot about early career researchers; the community appreciated SMD's efforts in both these areas. The PAC issued a finding stating that one way to infuse the ideals underpinning equity and inclusion would be through the appointment of an Executive-level position for the whole Agency. Dr. Zurbuchen said that that there is already an Associate Administrator at the Headquarters level who is tasked with the responsibility; it could be useful to have him brief the SC. However, he agreed a new Executive-level position would be a good thing to consider.

Dr. Mainzer asked how the Presidential Administration transition was going. Dr. Zurbuchen remarked that the transition was going well, and that NASA had been receiving good support from the incoming team. Also, given the "skinny budget" situation, bipartisan support has been helping greatly in all areas of SMD, as well as in Aeronautics. There is much positive motion as new teams are being built at the "speed of trust."

Dr. Cerf commented that NASA tends to avoid building multi-mission infrastructure and that more efficiency might result if more attention was paid to a common infrastructure. He felt that the mission-centric focus did not serve NASA well. Dr. Zurbuchen agreed that a portfolio-wide view on these issues would create more science per dollar. He added that he had been very deeply involved with the commercialization drive for the Deep Space Network (DSN) and the Space Communications and

Navigation (SCaN) Program. He and Ms. Kathy Lueders, AA for the Human Exploration and Operations Mission Directorate (HEOMD), have recently reinstituted the SCaN Board of Directors and issues like optical communications are now Agency-wide in scope. Geodesy is also becoming an important issue. In addition, NASA needs to rethink its data infrastructure and computation capabilities in order to shorten the time between discovery and dissemination. Dr. Zurbuchen thought that alignment is increasing and expected the NAC to hold NASA accountable for its results. As APD in particular is moving into the Big Data world, he agreed NASA should get rid of data "zip codes."

Dr. Liemohn asked Dr. Zurbuchen to comment on a proposed NASEM study on Equity and Inclusion. Dr. Zurbuchen said that NASA is eager to build excellent teams; thus far, there have been training exercises and boot camps to increase awareness of the problem. The community is taking NASA at its word and is trusting the Agency to do the right thing. The PI pool is diversifying, although it is recognized that improvements must continue. NASA would like NASEM to look at what the Agency is doing and to weigh in on what sort of data it should be collecting. The intent is to get input from experts on the subjects.

Mr. Weiser asked if it were possible to get NASA's commercial partners to evaluate which delays are due to COVID-19 and which are not. Dr. Zurbuchen said he expected to receive an independent assessment in every case. Commercial partners are in the same boat as the Agency. The discussions are hard, but they are being held. Ultimately, the data must drive the narrative.

SMD Future Communications Network Needs Task Status Report

Dr. Jeff Volosin, Deputy Director for Astrophysics, and Mr. Greg Heckler, Acting Director of the Commercial Services Office in SCaN, reported on efforts to modernize the SMD communications space networks in response to an SMD-driven request to identify future network needs and how they align with SCaN infrastructure.

Dr. Volosin provided the task description, which was to clearly define future needs for overall SMD Communication and Navigation Network support in three categories:

- Near-Term Needs (operational missions in the next 5 years): In most cases these "requirements" are already captured and being actively worked between SCaN and SMD.

- Mid-Term Needs (operational missions in 5 to 10 years): Less clarity on specific missions, though needs can be derived from current trends, focus areas, Decadal priorities, science instrument development efforts, technology investments.

- Far-Term Needs (operational missions >10 years): Some general areas can be speculated upon based on Decadal priorities.

Each SMD division worked to draft reports that were then collated at the Directorate level to determine the various needs and requirements. SMD is working with SCaN now to look at implementation options and is hoping to have a Program Implementation Review (PIR) by August 2021.

Preliminary Findings – Earth Orbit

- Overcrowding at North Pole – continued increase in data-volume/day
- Need additional NASA and commercial assets
- Potentially drive toward multi-mission/aperture approach (like DSN)
- Ensure SMD missions are not driven to costly space-segment solutions/redesigns due to overcrowding and/or reduced downlink opportunities

• Growing need for CubeSat and SmallSat support (including constellations/swarms of 30+ spacecraft)
• Need Low Earth Orbit (LEO) global support (equatorial and polar) as well as capability to support non-LEO SmallSats and CubeSats
• Need for increased capacity and site diversity
• Continued low latency mission needs (weather monitoring)
• Possible transfer to commercial relay support

NASA will continue to leverage polar orbits and missions such as NISAR. The study also looked at proliferation of SmallSats, CubeSats and constellation missions for science, which require communication between satellites and between satellites and the ground.

Preliminary Findings – Cross-Network Needs

- Increasing spacecraft autonomy – need for intermittent/unscheduled links to Earth
    - Applies to both near-Earth and deep space
        - Potential commercial relay service for LEO
    - Requires flexible scheduling and available assets
    - Need "911" service similar to Space Network multiple access (MA), demand access for non-LEO missions and commercial relay capability for LEO missions
- Increase apertures operating at 26GHz as more missions design to this band
    - True for both near-Earth and DSN 34m assets
    - Concurrently - work longer term path to optical
- Investment and commercial tech-transfer in advanced flight transponders/transmitters for deep-space and low-Earth applications
    - Focus on new capabilities (26GHz and optical example)
    - Other potential flight technology investments include data compression

Mr. Heckler reviewed NASA's road to commercialization that began in the 2000s with Commercial Crew and Cargo. Since that time, NASA has been making headway in engendering a commercial LEO market and meeting associated challenges. For near-Earth customers, NASA uses ground stations (antennae on the ground, generally). For a decade, SCaN has been using ground station networks that are about 50% commercial in nature to serve these customers. The other leg of communication is relay; NASA is continuing to use the existing Tracking and Data Relay Satellite System (TDRSS) for communications relay. As part of the future commercialization effort in relay, a demonstration project will be employed. Plans for expanding commercial communications services include a measured transition to commercial satellite communications (SATCOM) services followed by a rapid commercialization of Direct-to-Earth (DTE) communications (the latter task assigned to GSFC). Glenn Research Center (GRC) has been assigned responsibility for the demonstration and initial planning for acquisition of SATCOM services.

NASA is working on a Communications Services Project draft solicitation, to be released soon. Challenges for commercial space communications include interoperability, as commercial SATCOM usually operates in different spectra. NASA envisions a "universal radio" that can tap into all these spectral divisions. Thus far, the commercialization plan is already well aligned with emerging SMD trends and challenges.

Dr. Tucker commented that there is tremendous potential for enhancing DTE and asked if NASA had been working with other agencies to bring this forward. Mr. Heckler said the project is still in the socialization period, but that the Agency is starting to reach out to the U.S. Space Force and NOAA. Most agencies are moving in the same direction and areas of natural convergence are to be expected. Dr. Woodward asked if both NASA and commercial entities were moving away from radio frequency to optical communications. Mr. Heckler said that optical communications will take some time. Right now,

NASA is focusing on microwave capability because that's where the market is. He noted that Starlink and Space Realm, and the Department of Defense, are investing heavily in optical communications. It is not a decision to make today, but probably within the next two to three years. Dr. Volosin said that a mission like the NASA- Indian Space Research Organization (ISRO) Synthetic Aperture Radar (NISAR) might push optical communications forward for science use: both the Astrophysics and Heliophysics Divisions are planning long-term for missions at Lagrange Points 1 and 2 (L1 and L2), which would also advance the technology. Dr. Woodward commented that balloon missions are also encountering the limits of communications. Dr. Cerf suggested that there may be some aerostat solutions available for the balloon program and took an action to follow up the discussion off-line with Dr. Volosin and Mr. Heckler.

Heliophysics Advisory Committee (HPAC)

Dr. Mike Liemohn reported briefly on the status of the Heliophysics Advisory Committee (HPC), which has not met since December 2020, and is still onboarding new members. Dr. Liemohn focused on science highlights in the absence of new findings or recommendations. The Parker Solar Probe (PSP) is doing well, and Solar Orbiter (SO) is now in orbit and starting its progression to higher latitudes. The Ionospheric Connection Explorer (ICON) mission is also doing well. The new Heliophysics Decadal Survey is about to start. The community had planned to hold a "Heliophysics 2050" conference in 2020; it is now scheduled for May 2021. The Global-scale Observations of the Limb and Disk (GOLD) mission, the first HPD instrument to be flown on a commercial vehicle, has been greatly beneficial and has produced three papers to date. GOLD images the Earth every half hour and was able to examine the Equatorial Ionization Anomaly (EIA). There are equatorial "bubbles" of depleted density that rise through the atmosphere, and remain there for many hours, provoking questions on why the phenomenon occurs. GOLD has found that EIA variability is not just spatial, it is also temporal. Dr. Wadhwa asked if there were any HPC issues to bring forward. Dr. Liemohn said the community has been experiencing negative effects from COVID-19 and is struggling to go forward. Dr. Mainzer commented on the staggered deadlines used for the Planetary Decadal Survey might be helpful for the Heliophysics community in their preparation for a new Survey. Dr. Liemohn agreed.

Earth Science Advisory Committee (ESAC)

Dr. Sara Tucker, Acting Chair of the Earth Science Advisory Committee (ESAC), reported that ESAC has not met since the last Science Committee meeting, is planning to add new members to the committee, and has had some dialogue about future topics.

Discussion and Wrap-up

Dr. Woodward asked the Committee Chairs what they felt should be the ideal number of committee members. Dr. Lucia Tsaoussi noted that the Advisory Committee charters allow for 12-20 members, and that ESAC had had 20 members prior to the last Executive Order (EO) limiting membership. With the expiration of this EO, ESAC is looking again for about 16 members. Dr. Mainzer noted that the PAC is down to 10, from 13. Mr. Callahan noted that many charters are up for renewal, and that it is a good time to align the Division Advisory Committees to make them equivalent; NASA is now shooting for a maximum of 15 members. Dr. Wadhwa asked what the rationale had been for having 20 members on the ESAC. Dr. Tsaoussi explained that the membership was usually reflective of the number of disciplines, cross-cutting elements, flight missions, technology, as well as the Applied Sciences Program.

The SC began a discussion of potential findings and recommendations. Dr. Woodward suggested an information architecture finding to expand on the APAC finding, and obtaining a presentation from the appropriate parties for the next meeting. Dr. Cerf endorsed the finding. Mr. Weiser said that when the SMD Information Strategy paper comes out in May it would be good to have time to digest it before the July meeting. Dr. Mainzer suggested a finding on the impact of COVID-19, looking to agencies to alleviate effects, and on R&A selection rates; the community can't maximize science return from the missions effectively if it can't analyze data properly. Dr. Wadhwa supported a finding on assessing

longer-term COVID-19 impacts across SMD, but as to R&A selection rates, she assumed that the other divisions are having similar problems. Dr. Woodward said that the APAC was waiting for ideas from the Decadal Survey on portfolio balance and R&A selections.

Dr. Cerf commented that the issue of diversity, equity and inclusion (DEI) is complicated by many other issues, and that the community should be careful not to place too much onus on NASA in this area. He said he was intensely interested in information preservation and software analysis and felt that this was another area in which NASA shouldn't have to be totally responsible. He supported the idea of Cloud Computing for NASA, especially in terms of scaling, and expressed interest in hearing what that type of infrastructure might look like. Also, a data transmission network architecture for the SCaN systems would be an important long-term investment for the Agency. Dr. Cerf requested more information from SCaN on what the long-term view is on this matter. Dr. Liemohn observed that the last Heliophysics Decadal Survey recommended establishment of the DRIVE program, which had the effect of augmenting the R&A program in HPD, and in NSF. Agencies took the program to heart, and it might help other divisions if they put the R&A issue to the Decadal Survey for evaluation. He praised the Space for U.S. website as being very well done, and wondered if other divisions should develop similar websites, given adequate resources. Mr. Weiser agreed and suggested that the SC receive a data infrastructure presentation as soon as possible. Another issue of interest to the SC should be the sharing of best practices on dealing with COVID-19; it's a harder problem with commercial companies, and as NASA expands its relationship with companies, it could be helpful to use NASA Lessons Learned to spread to commercial partners in order to retain good commercial relationships. Dr. Tucker commented on the intersection of DEI and the long-term impact of COVID-19, saying that it was important for NASA to look at the issues that have been around for centuries affecting scientists and proposers. At the same time, she expressed her admiration for the energy that Dr. Zurbuchen and SMD have put into the problem. She also looked forward to hearing more about DTE communications plans. Dr. Woodward felt that the whole issue of NASA's communications needs to be assessed. The other area he would like to see addressed is Blue STEM; these are the machinists that help construct missions. It would be interesting for the SC to hear Dr. Zurbuchen's opinion of Blue STEM's place in the science enterprise. Dr. Cerf mentioned that the National Science Board has supported STEM education for the "builders," and that this could represent a huge opportunity to expand this part of the NASA workforce. Dr. Mainzer suggested that the SC request a briefing from the Office for Diversity and Equal Opportunity (ODEO).

Dr. Wadhwa reviewed the next day's agenda. Dr. Woodward asked: does NASA value as a core competency the ability of scientists at Centers to be leaders in the field, and to give good feedback on proposed missions? This would be a good question to ask during the briefing on the Internal Scientist Funding Model (ISFM).

April 15, 2021

Mr. Callahan re-opened the meeting and made administrative announcements per FACA rules. Dr. Wadhwa made brief introductory comments.

Agency Science Workforce Study

Ms. Ellen Gertsen and Ms. Lori Simmons shared major findings and recommendations from the Agency Science Workforce Study. Ms. Gertsen provided background for the study, which came about due to SMD concerns about the workforce:

- Members of the space science workforce have little insight into the varied career paths leading to science leadership roles, including organizational leadership, technical leadership, and programmatic leadership
- There is a lack of consistency in the workforce development and readiness assessments for key leadership positions

- There is a lack of clearly understood roles, accountability, and authority within the programmatic leadership roles, especially for strategic/Flagship missions.

Given these concerns, the SMD AA commissioned a team to look at different ways to develop science workforce strategies: specifically, to formalize the career paths available for NASA's science community; identify systemic developmental gaps that may impede advancement or limit preparedness for key science positions and career paths; identify developmental strategies for key positions that may broaden the scientist's knowledge, skills, and experiences to better prepare them for senior level roles and responsibilities; and clarify science leadership roles, accountability and authority and the optimal policy guidance needed for these key positions, especially for strategic-level missions.

The first phase of the study is now complete, and the second (implementation) phase is about to begin. Ms. Simmons described how the study was conducted. The study took about six months, during which time input was obtained from about 100 scientists across NASA, including the Jet Propulsion Laboratory (JPL) and the Applied Physics Laboratory (APL). The study encompassed 16 interviews with NASA senior scientists, about 10 focus groups with early and mid-career scientists, and six focus groups with senior and supervisory scientists across NASA. The study team was mindful to not talk strictly about line management and took care to look at other forms of leadership roles. The study also looked at Systems Engineering (SE) program development, an APL space career program, and NASA policy documents with respect to mission leadership policies. The team was very diverse across organizations and disciplines. The study produced 11 recommendations, all of which were accepted. At present, three teams are being formed to implement the recommendations. The study examined Civil Servant data as related to the science workforce, and the science workforce was compared to the total workforce by center. Essentially, the study collected a "snapshot" of demographics in October 2020 and did not include students or contractors within the scope of the study.

The study produced findings and recommendations in three key areas: Career Paths, Leadership Development, and Project Scientist Role.

Career Path Findings

- A common understanding of career path options and requirements for NASA scientists is not documented
- The Science community would benefit from a shared understanding of the career paths available for NASA scientists
- There was team consensus around five distinct career tracks and the key positions associated with each, preliminarily suggested to be included in an online career path tool: Line Management; Mission; Research, Analysis & Application; Technology Development; and Science Program Management
- Most agreed that scientists typically perform in more than one career track at any given time and move between the tracks over time

Career Path Recommendations

- Adopt the nomenclature of the five career tracks identified in the NASA science workforce. The identified career tracks should become the common language for career conversations and guidance. Recommend they be incorporated into workforce development strategies and serve as the foundation of the online Career Path tool
- Develop a web-based Career Path tool that outlines each science career track and the associated key positions within each track. For each position, a summary description of the roles and responsibilities, ideal competencies and experiences, recommended training for the position, and

transition possibilities to other positions will be provided. (See example at: https://careerpath.gsfc.nasa.gov/code500/)

Project Scientist Role Findings (specific to GSFC, JPL and APL)

- The Project Scientist role is a critical leadership role for NASA missions and varies based on the type of mission
- For strategic/flagship (directed) missions, the Project Scientist is the lead scientist and the role is defined in the Project Plan
- For competed missions, the Principal Investigator (PI) is the lead scientist, and the Project Scientist supports the PI. The role of the Project Scientist is typically defined by the PI and documented in the Project Plan
- This project leadership role does not benefit from Agency policy/governance documents similar to other project leadership roles (Project Manager/Systems Engineer)
- GSFC, JPL, and APL have developed their own policies/practices for the role. There is some minor variance in policy/practice in non-mission critical areas
- There is consistency in the attributes that make a good Project Scientist:
    - Science expertise in the science of the mission
    - Good leadership, management, and communication skills
    - Project experience and knowledge commensurate with the mission
- There is variability in the level of transparency for aspiring project scientists to compete for opportunities
- There is no standardized NASA strategy for developing Project Scientists
- Current development strategy centers around mentoring
- In comparison, there are several formal programs designed to develop PMs and SEs

Project Scientist Role Recommendations

- *Codify the roles and responsibilities of the Project Scientist*

Ensure NPR 7120.5F (currently in development) includes a high-level description of the Project Scientist roles, authorities, and accountabilities. Also, recommend updating the NPR 7120.5 Handbook to provide greater clarity to the roles, authorities, and accountabilities of the PS and PI for directed and competed missions.

- *Wherever possible, ensure a deputy project scientist is funded for missions*

For flagship/strategic missions, recommend the funding of a deputy project scientist. For competed missions, suggest using language in the Announcements of Opportunity (AOs) encouraging the funding for a deputy project scientist. This ensures the development of the next generation of project scientists and expands the pool of experienced candidates for future opportunities.

- *Develop a Project Scientist training course*

Recommend conducting a Developing a Curriculum (DACUM) exercise to develop a training course specific to the Project Scientist role. The course can be offered as an option for those who aspire to become a project scientist and should be required, within a certain time frame (~one year), of being appointed as a new project scientist. Scientists at JPL and APL should be included in this training.

Three teams, headed by Ms. Gertsen, Ms. Simmons, and Dr. Michael New, will lead the implementation of recommendations.

Dr. Woodward asked if the study had considered increasing demand for AI and Big Data with regard to science roles. Ms. Simmons said that the study teams have reached out to each Center, and will fine-tune these needs as implementation proceeds, letting the scientists identify these roles. Dr. Tucker asked if the statistics had been gathered on federally employed NASA staff only. Ms. Simmons said the subjects had all been federal civil servants, excluding contractors or students. Scientists were defined using the 1300, 400, and 1500 series, as well as Human Capital partners. About 140-150 scientists supporting divisions other than SMD were not included. The study also focused on organizational alignment to identify scientists. Dr. Tucker said she was interested in identifying the difference between scientists and technologists. Dr. Cerf commented that people don't often choose career paths consciously but rather respond to opportunity. According to some biennial studies that mapped what people studied in school and where they ended up, there were some quite striking results— physicists often ended up as computer jockeys, for instance. Dr. Cerf cautioned against efforts that might trap people in career "tracks." Ms. Gertsen said that one goal of implementing the Workforce Study recommendations is to expose available options and help connect people with possibilities and mentors. Ms. Simmons said that another goal was to show visually that each of these paths are interconnected, with transition opportunities along the way. One aim of the career path tool is to demonstrate the flexibility of the paths. Dr. Mainzer commented that making the process accessible and identifying job types is a worthy pursuit; she added that she thought the study was a great idea, as it will help to remove the mystery of navigating the career path. Dr. Wadhwa also commended SMD for the self-awareness demonstrated by the study She asked if the recommendations will be implemented in an outward-facing way and whether the study dealt with how to potentially incentivize some of the talents to seek out and develop these pathways. Ms. Simmons said the website will be outward-facing and that leadership development workshops will be open to anyone in NASA, lab partners, and (maybe) NASA contractors. Recommendations on leadership roles are mostly focused on Goddard, JPL and APL. Ms. Gertsen thought there were a number of ways to engage the outside, with new ways to engage IPAs, for instance. Incentivizing scientists will be an interesting challenge. There is usually a hesitancy to step into these new roles. Mr. Weiser commented that the critical item is training the mentors and coaching the coaches; if the mentors don't buy in, the effort won't work. Ongoing feedback is also essential.

Internal Scientist Funding Model

Dr. Michael New gave an update on the Internal Scientist Funding Model (ISFM), first providing background for its establishment. The ISFM was created as a result of an internal 2015 study that concluded:

- NASA employs about 1,000 Civil Servant Scientists; about 150 (full-time equivalents (FTEs)-worth (spread over about 350 scientists) are funded through competed research awards
- Unlike other government agencies, internal (NASA civil servant) and external scientists (such as university researchers) compete for the same funding
- NASA spends significant resources competing for already appropriated research funding dollars
- Early career scientists have a hard time competing with older, more established researchers, and face a system that doesn't nurture them
- Scientists spend too much time writing proposals that only cover a small fraction (0.1 FTE) of their time, forcing them to write many proposals
- There has previously been no strategic hiring of scientists

Based on the outcomes of internal discussions, the study also noted that NASA's civil servant scientists play a number of roles they are stewards of mission science and success requirements including instrument team leadership; they are stewards of NASA mission science requirements and mission success including instrument team leadership; they lay the foundations for future strategic missions through focused technology and scientific methodology development, and through performing essential precursor science activities; they serve in inherently governmental leadership roles within NASA science

organizations and in the broader scientific community; and they generate new knowledge through their leadership of large, complex collaborations with the breadth of the scientific community and the performance of "as only NASA can" research and analysis. Thus, it is in the national interest that the many activities performed by civil servant scientists be conducted and supported in a way that optimizes the NASA workforce's productivity and realizes its leadership potential.

The ISFM operates on five key principles: there is a national interest to host certain capabilities at NASA Centers; ISFM work must provide value to the community; work that could be competed should be; ISFM work may also involve contractors and external collaborators; and external peer review is a core element of directed work. Each of the science divisions initiated their own implementation of these principles and finally adopted a common implementation program in 2019. Each ISFM Directed Work Package (DWP) is subjected to an external review at midpoint and is reviewed regularly, at which point it can be altered, halted, extended, etc. At first, new DWPs were not requested every year, which had caused some confusion Therefore, starting in September 2021, an annual SMD-wide announcement will be distributed to Centers describing each division's ISFM plans.

The Office of the Chief Scientist (OCS) has evaluated the first three years of the ISFM. There are 51 total work packages, the largest number being at Goddard. Overall, SMD has spent $62 million on DWPs, which in turn supports 108 CS FTEs. SMD spends close to $1 billion annually on R&A, thus ISFM represents about six percent of the total research budget. In terms of the internal/external funding balance, there has been no significant change due to the introduction of ISFM according to the data thus far.

Dr. Woodward asked if ISFM has succeeded in having the desired impact, serving an end goal that can be quantified. Dr. New affirmed that this was the case. ISFM develops agreements with Centers regarding the model's priorities, but NASA has not yet completed negotiations on every Center's Tiers document. Dr. Mainzer asked if there was a sense of the fixed costs associated with contractors in the civil servant scientist "ecosystem." Dr. New said that at many Centers, civil servant scientists are always supported by a number of contractors doing a lot of work; he didn't know if it's the right thing to be doing, but it is the situation. He also pointed out that civil servant scientists do not have students or post-docs, as is the case with academic scientists. Dr. Cerf asked how ISFM would measure the success of the programs; he noted that JPL has a practice of bringing in extraordinary interns. Dr. New noted that the Centers do use the Pathways program, but it is harder to bring in interns at a NASA Center than at JPL-Caltech. NASA Centers do not have the armies of graduate students that are available at Caltech. Dr. Cerf thought the ISFM could serve as a kind of morale builder and asked if there was any evidence that this is happening. Dr. New said that OCS had come up with about 10 measures of success. Each year there is a federal survey on job satisfaction, which has demonstrated a minor uptick; however, COVID has confounded these results. NASA has also looked at publications and found that the numbers are static. ISFM seems to have decreased the number of proposals and has maybe slightly decreased proposals from co-Investigators. Dr. New suggested that the SC invite Louis Barbier, Associate Chief Scientist for OCS, to come and discuss some of the quantifiable statistics.

Dr. Liemohn said he calculated the general cost to be about $600,000 per FTE and that there can be several contractors per FTE. Dr. New said the situation depends on the type of science. Experimental work requires completely different funding than theoretical work, for instance. Dr. Wadhwa asked how ISFM funding differs at each division level, commenting that it seemed like PSD costs were higher. Dr. New said NASA hasn't shifted any funding, and that the SC should consult individual Division Directors. Mr. Weiser asked if ISFM was bringing about higher-risk, higher-impact research, and engaging more people from the broader community. Dr. New commented that high-risk, high-impact research was not necessarily a criterion for ISFM, although NASA has certainly tried to use ISFM to do this, and also to break down research siloes. The plan is to start the assessment of high-risk, high-impact research more broadly. As to the secondary effects of ISFM, some work packages have been focused on engaging the

outside community and coalescing groups of leaders. Dr. New felt that ISFM was fostering more discussion between disparate individuals and groups at the Centers. Dr. Mainzer asked how NASA decided what to put into each DWP. Dr. New responded that there are things NASA thinks are best done through ISFM, whether due to available facilities, or the knowledge and experience of the NASA civil servant scientist. He said he would be happy to provide more analyses with more preparatory time. Dr. Wadhwa asked if ISFM was successfully meeting the challenges it was designed to address. Dr. New said that ISFM has been successful in funding NASA scientists because proposals to R&A have dropped. There have also been several DWPs that were created expressly to include early career scientists. There has also been some success in reducing proposal-writing tasks. In terms of strategic hiring, NASA has become much more deliberate and integrated in the hiring process at centers. It is not a formal process, but it is expected that before a Center hires a civil servant scientist, the Center has a conversation with the appropriate Division Director. Dr. Tucker asked how NASA decides what work is distinct and when it should be competed or not competed. Dr. New said that each decision is made differently in each Division, depending on each Division's needs. Such decisions do not require a blue-ribbon panel. There is a wide range of research areas at NASA, and they are not necessarily allocated to external or internal researchers.

Discussion

The SC reviewed suggestions for findings and recommendations.

Drs. Woodward and Cerf joined in writing a finding on SMD Information Strategy/Policy and how it might impact universities. Dr. Woodward reflected on Dr. Zurbuchen's comment that SMD was not where it needs to be in terms of Cloud Computing, especially with the advent of high-data missions (such as the Nancy Roman Telescope). Dr. Cerf felt NASA could benefit from having a deep look at functional capabilities for data planning and mission planning; maybe NASA or some of the labs should host meetings with those who are using Cloud resources for scientific work. There may also be some valuable program management ideas about Cloud Computing that could be plumbed. Dr. Mainzer expressed concern that the new SMD Information Strategy may obligate ROSES grantees to provide data management or distribution tasks. Mr. Weiser agreed that there may be unintended consequences. Dr. Wadhwa said she had requested that Mr. Callahan relay the SMD Information Strategy to the SC as soon as it is released in May to allow the membership to read it in advance of the next meeting.

The SC considered the PAC finding regarding a Headquarters Executive for DEI. Dr. Mainzer requested that it be made an SC finding. Dr. Wadhwa agreed it should be made a finding for the record. Dr. Woodward commented that DEI should be infused into the fiber of the organization, described as a "fifth pillar" in a similar APAC finding. He agreed that DEI needed a point person at NASA. Dr. Mainzer thought there should also be a similar executive at the SMD level. Dr. New noted that the NASA ODEO has its roots in Equal Opportunity Employment law and has been around for a while. Dr. Wadhwa recommended that the SC host a briefing from the ODEO AA. Dr. Mainzer offered to write up the finding as a two-fold one, both Agency-wide and SMD-wide. Dr. Woodward noted that the APAC has been communicating that SMD has taken a leadership role. Mr. Weiser commented that there is still a problem on the upstream side, and thought that at some point, the efforts in IDEA and STEM should converge. For now, the SC can start identifying what that fifth pillar looks like in SMD.

Dr. Tucker thought it important to recognize that the opportunity to become a Program Scientist, or to receive ISFM funding, was a privilege. Are the scientists in ISFM aware of this, and are they using this privilege to lift others? Dr. Wadhwa said she would like to see a finding that recognizes the nature of the opportunities at NASA, or a statement about providing training to the mentors, and offered to write a draft with Dr. Tucker and Mr. Weiser. Dr. Mainzer said she was glad to hear about the focus on the science ecosystem, as there are many different, important jobs within this ecosystem and it is good to understand all the ways to be part of a team. Dr. Tucker noted that leadership is not just about the PI. Dr. Cerf hoped

that the roles of the technicians and others are brought into the discussion, as science simply cannot be accomplished without these other support roles.

Dr. Wadhwa suggested a finding on metrics relative to the success of the ISFM, and how to determine whether it is doing what it is supposed to do. Dr. Cerf requested clarity on the program goals, the metrics to show that it meets goals, and ways in which the program can be observed. There might be very valuable side effects to the ISFM that are more social in nature, giving people an opportunity to do things they would like to do. Dr. Liemohn asked: is the ISFM freeing or stifling? Does it allow the scientists to go in bolder directions? It may be valuable to request some case studies. He also recommended a finding in support of the Workforce Study.

Dr. Woodward addressed a potential finding on SCaN commercialization and the question of the right balance between commercial and NASA in-house solutions for communications. Can 100 percent commercial coverage be expected to support Artemis, or missions to Lagrange points such as L1 and L2? What is the intent and vision of commercialization? Dr. Wadhwa felt that the briefing could have been more in-depth, particularly regarding Artemis and future lunar missions. Dr. Woodward thought the SC should get more information as well, particularly with respect to issues of bandwidth and frequency allocations. Dr. Tucker remarked that there are risks but also opportunities, especially for ESD; will these commercial providers reduce costs or make new mission ideas possible?

Dr. Mainzer supported a finding on COVID's impact to science community, and possible SMD augmentations to R&A grantees as has been done in PSD. The SC recognized this as a clear priority that is already well-recognized by the SMD AA but supported a finding for the record.

Dr. Woodward suggested a finding on the ESD Space For U.S., as the site is very powerful and penetrates to a wide variety of stakeholders. It answers the question: what does NASA do for me? It is a good and innovative approach for the Agency. Mr. Weiser supported the comment.

Mars Perseverance and Ingenuity

Dr. Wadhwa, newly appointed as the Mars Sample Return (MSR) Program Scientist (PS), recused herself from the discussion. Dr. Mainzer presided as Chair.

Mr. Matt Wallace presented a report on the progress of the Mars 2020 Perseverance mission. The Perseverance rover has an array of capabilities providing the ability to perform transformative science. It is comprised of a complex and clean sample caching system, a new suite of sophisticated instruments, and new surface navigation artificial intelligence (AI) and autonomy. The mission also includes cross-directorate payloads such as the Mars Oxygen In-Situ Resource Utilization Experiment (MOXIE). The rover is also carrying microphones, commercial cameras, and a technology demonstration, the Ingenuity helicopter. Perseverance is part of a multi-decade mission to return samples to the Earth; Mars Sample Return (MSR). Perseverance's immediate predecessor, the Curiosity rover, is still on the surface and operating. The Chinese space agency will be releasing a rover and lander onto the Mars surface shortly. The ExoMars rover and surface platform will be launched by the European Space Agency (ESA) in 2022.

Mars is of great astrobiological interest as it once was warm and harbored surface water, an atmosphere, and a magnetic field. The real question of whether life also evolved on Mars at one time is a scientifically compelling one. The landing site, Jezero Crater, is an ancient lakebed and once had significant riparian inflow. The crater shows evidence of a delta and an outflow valley and has been high on the list of scientifically interesting sites for a long time, but it initially presented a difficult landing site. Mr. Wallace reviewed aspects of the rover descent stage, landing radar, Sky Crane, entry capsule, and heat shield. The heat shield slowed the incoming capsule down to 1000 mph; a parachute reduced the speed to Mach 2, and eventually the rover touched down gently at the end of the Sky Crane's tether. Displaying a video of

the Entry, Descent and Landing (EDL), Mr. Wallace noted that the Perseverance touchdown was the first one that could be viewed in detail thanks to ruggedized commercial cameras. The landing also had good support from the Mars Reconnaissance Orbiter (MRO) that was able to image the parachute.

In terms of publicity of the landing, the two-day media coverage registered 12 billion views and made the front page of 157 newspapers around the world. It made a huge impact on students and STEM education. A million students registered for the Mars student challenge. There was much support internationally. The Empire State Building, Eiffel Tower, and pylons at the Los Angeles airport were lighted orange in celebration. An image of the mission was projected onto the Matterhorn. World leaders weighed in, including President Joseph Biden, French president Emmanuel Macron, and Queen Elizabeth. At present, the mission is now studying the possible exploration traverses to the delta and the crater wall; the first target will be at the base of the delta. The mission team must decide which circuitous route to follow as there are too many terrain hazards to allow the rover to approach the targets in a straight line.

The team is currently troubleshooting software issues for the Ingenuity helicopter that was stowed in the underbelly of the rover and is preparing for the first powered flight on another planet. Once finished with the Ingenuity technology demonstration, Perseverance will start its core mission of sampling and caching. The sample caching system consists of a rotary percussive drill, bit carousel, and an arm that can articulate with five degrees of freedom. Samples will be collected by coring or by scooping regolith. To transfer the sample from the surface to the rover caching system, the bit comes off and rotates to the inside of the vehicle. There are also spectrometers and a microscope on the end of the arm. The sample is imaged and assessed for volume before being stored. The rover will collect 20 samples for the primary mission, with a potential for 23 more in an extended mission. At least one set of tubes will be set down at a site in the crater to await future retrieval. At JPL, there are about 2000 people working in support of this mission along with 400 scientists from around the world and 44 states in the US. Perseverance is a truly cross-directorate mission and a cross-Agency effort. A plaque was included on the rover to recognize the health care community during the COVID pandemic and the EDL parachute was color-coded to read out "Dare Mighty Things," a principle motto adopted by the mission team.

Dr. Cerf applauded the presentation and asked if gravity were in part responsible for the loss of atmosphere at Mars. He said he also hoped there would be a lot of metadata for the samples. Mr. Wallace said that several things changed on Mars at some point—including its orbit—that may have accelerated atmospheric loss. As far as samples and documentation are concerned, it is recognized that each sample will have to be understood in context—that is the objective of the sampling process. The rover will record stratigraphy, mineralogy, microscopic imagery, and subsurface radar to understand the geology. There is the ability to do some *in-situ* analysis. The rover will provide a lot of data and has new resolution capabilities, especially for the spectroscopy aspects of the mission. Extraordinary evidence will be necessary to demonstrate any sort of biosignature, and the mission will need the full power of terrestrial science. Dr. Mainzer asked what the primary challenges are going forward. Mr. Wallace cited the sample caching activity—it is largely single string, vulnerable to dust, and it must survive wide temperature swings. Dr. Mainzer asked about potential problems with the drill, given the difficulties that InSight had encountered. Mr. Wallace said that the architecture is similar to that of Curiosity, and that the new mission benefitted from this. The drill investment started well before mission development began. It is the most complex drill built by NASA and developers had to adhere to a higher cleanliness standard than with Curiosity. He thought the team felt confident about its reliability. Dr. Woodward asked if the hazard avoidance system had been developed in-house, and about the scale of the "Kodiak" feature at Jezero Crater. Mr. Wallace reported that the delta feature is 20 meters high, and Kodiak about 10 meters. Hazard avoidance was mostly a JPL task; the algorithm was developed as a result of several technology programs. This necessitated the build of a new high-powered processor, which was extensively tested. Aspects of the hazard avoidance system are also being shared with Blue Origin. Dr. Tucker asked if winds had affected the operation of the Sky Crane and what weather conditions on Mars the rover has

encountered since the landing. Mr. Wallace said that there was a lot of dust pushed out during EDL, and while he did not know the exact velocity, the winds during EDL were much more significant than local winds. Overall, the weather on the surface has been as expected; winds do vary during the day, providing important data for the Ingenuity helicopter. Asked how the rover communicates, Mr. Wallace said it uses both direct-to-Earth (DTE) and satellite relay via an ultra-high frequency (UHF) link to the orbiters. The current communication scheme is working very well, even with the high data volume.

Outbrief to SMD AA

The SC discussed its findings with Dr. Zurbuchen. First, addressing Diversity, Equity, and Inclusion (DEI), Dr. Wadhwa explained that the Committee would like to better understand the function of the ODEO AA and how ODEO policies affect SMD in particular. Dr. Zurbuchen said he had asked Mr. Stephen Shih, the ODEO AA, to brief Committee members as he did not wish to speak for Mr. Shih. Dr. Zurbuchen was aware, however, that ODEO has launched a Unity Campaign and he was in the process of learning how it affects the NASA workforce. NASA has implemented some of NSF's Title IX practices and Dr. Zurbuchen credited Mr. Shih for this accomplishment.

Dr. Wadhwa noted that the SC recognized the Workforce Study as a fantastic effort and expressed SC interest in seeing the effort expanded to focus on the importance of Blue STEM, the technical folks at the Centers, and incentivizing mentors. Dr. Cerf commended Dr. Zurbuchen for spearheading the study and expressed excitement about several of the programs. He said he was still very curious about creating infrastructure for supporting multiple missions. Dr. Zurbuchen explained that the reason SMD spent the Workforce Study effort on science was because in all Centers, the scientists are in a minority. He very much agreed that it matters for all career groups, but at NASA there was very little throughput for scientists to the leadership level. There was a lack of deliberate thought that SMD wanted to address. Dr. Cerf reiterated his comment about careers being guided by opportunity and that it was important to emphasize flexibility about career tracks. Mr. Weiser commented that the senior scientists must buy in to the notion of mentoring. Dr. Zurbuchen said he agreed completely with these sentiments. Dr. Mainzer also commented on the importance of mentoring in her own career experience. Dr. Cerf posed a general question: how does NASA figure out who is doing what in a large organization? Google maintains a database that contains such information for its company; is there a similar effort at NASA? Dr. Zurbuchen said NASA has struggled with this. He has spent time thinking about a mentorship network that allows people to self-identify and was actively pursuing this conversation with the American Geophysical Union (AGU) and others. He did not think NASA should own it, specifically.

Dr. Wadhwa addressed the ISFM finding, noting that it constituted a substantial fraction of the R&A budget. She asked whether the intended effects are occurring, whether there were metrics, and if so, were they being met? Dr. Cerf asked if, aside from quantitation, the model is allowing better morale for the younger scientists. Can they do things that they wouldn't ordinarily do? Is there more NASA can do to empower younger scientists to deliver in innovation earlier than they might otherwise? Dr. Zurbuchen agreed that more feedback would be useful but that it was also necessary to let the experiment play out. He felt the Divisions had done an excellent job thus far. Scientists are in charge of the pipeline. Also, the Centers have the charge to do research and to accomplish things that can only be done at NASA. Morale is one point, but ISFM is also about enabling specific capabilities and making the community better as a whole. Dr. Cerf noted that Google has "20 Percent Time"—it is a different way of spending resources, but it might be a way for people to contribute. Dr. Zurbuchen felt it was also important to look at the matter through the eyes of others. ISFM is about how to use the precious talents of the NASA workforce. It is not as liberal as Google 20 Percent Time, which he said he would adopt if he could figure out how.

Dr. Woodward addressed the finding on the new SMD Information Strategy, saying there is concern in the SC with the open software environment and potential requirements on PIs, especially as the databases become larger. SC also reacted to the use of Cloud Computing and feels it should be examined carefully

in a strategic way. Dr. Zurbuchen said he would value a follow-up discussion and direction from the SC. NASA is in a hyper-learning mode regarding Cloud Computing and there is much subtlety that needs to be further understood. He agreed that he and SMD needed to learn more. Dr. Cerf said that maybe NASA should help create this aggregate view in terms of data and make it a sort of Flagship mission. These are hard problems to solve. Dr. Mainzer added that the community is sensitive to the policy's impact on R&A and wants to better understand what is expected of PIs regarding data collection, storage, and management.

Regarding SCaN commercialization, Dr. Tucker commented that the work has risks and opportunities and that the opportunities had the potential to reduce cost for Earth Science and many PI-led missions. She hoped to see the effort expanded while understanding the risks associated with frequencies. Dr. Woodward added that the SC would like to understand how this dovetails with Artemis and L1/L2 missions. Dr. Zurbuchen recommended that SC hear another briefing from Mr. Volosin and added that he himself was co-chairing a project with Kathy Lueders to bring both views to bear; he agreed, however, that NASA has to move the ball a little faster.

Dr. Wadhwa noted that the SC finding on long-term impacts of COVID-19 contains an understanding and appreciation of the actions Dr. Zurbuchen has already taken.

Asked for last comments, Dr. Liemohn requested a look at both qualitative and quantitative metrics on ISFM, when available.

Dr. Wadhwa adjourned the meeting at 4:52pm.

Appendix A
Meeting Attendees
(Virtual Meeting)

Science Committee Members

Dr. Meenakshi Wadhwa, **Chair,** Arizona State University
Dr. Vinton G. Cerf, Google Inc.
Dr. Michael W. Liemohn, University of Michigan
Dr. Amanda Mainzer, Arizona State University
Mr. Marc Weiser, RPM Ventures
Dr. Chick Woodward, University of Minnesota
Mr. Jason Callahan, **Designated Federal Officer,** NASA Headquarters

Webex Attendees
Richard Arnold
Louis Barbier
Dominic Benford
Linda Billings
Francesco Bordi
Julie Campbell
Stephen Clark
Nick Cummings
Laura Delgado-Lopez
Tammy Dickinson
Daniel Evans
Sylvie Espinasse
Kelly Fast
T. Jens Feeley
Robert Ferraro
Jeff Foust
Karen Fox
Nicola Fox
Ellen Gertsen
Lori Glaze
Chelsea Gohd
Jeffrey Grossman
Lewis Groswald
Brian Harvey
William Harwood
Hashima Hasan
Jeffrey Hayes
Gregory Heckler
Dan Hirsch
Jeffrey Hoffman
Marchel Holle
Grace Hu
Heidi Jensen

Van Kane
Linda Karanian
Joel Kearns
Jennifer Kearns
Rick Kendust
Jackie Keshian
Ben Kim
Irene Klotz
Janet Kozyra
Kelly Korreck
Craig Kundrot
William Latter
James Lochner
Alana Johnson
Margaret Luce
Diane Malarik
Gene Mikulka
David Millman
Amanda Moore
Michael New
Son Ngiem
Marion Norris
Lucas Paganini
Joel Parriott
Andrea Peterson
Kirsten Petrie
Peter Pilewsie
Chris Randall
Kurt Retherford
Stephen Rinehart
Ursula Rick
Richard Rogers
Andrew Robinson
Alvin Robles
AndrewSchurr
Joel Scott
Lori Simmons
Yolanda Shea
Kartik Sheth
Mary Sladek
Marcia Smith
Karen St. Germain
George Tahu
Jonathan Timmons
Lucia Tsaoussi
Sara Tucker
Jeffrey Volosin
Matt Wallace
Shoshana Weider
Ashlee Wilkins
Alexandra Witze

James Wolfenbarger
Joan Zimmermann
Thomas Zurbuchen

Appendix B
Science Committee Membership

Dr. Meenakshi Wadhwa (Chair)
Arizona State University

Dr. Vinton Cerf
Google, Inc.

Dr. Michael Liemohn
University of Michigan

Dr. Amanda Mainzer
Arizona State University

Mr. Marc Weiser
RPM Ventures

Dr. Charles Woodward
University of Minnesota

APPENDIX C
PRESENTATIONS

1. Planetary Science Advisory Committee; *Amy Mainzer*
2. Astrophysics Advisory Committee; *Chick Woodward*
3. Earth Science Division Update; *Karen St. Germain*
4. SMD Future Communications Network Needs Status Report; *Jeff Volosin, Greg Heckler*
5. Heliophysics Advisory Committee; *Mike Liemohn*
6. Earth Science Advisory Committee; *Sara Tucker*
7. Agency Science Workforce Study; *Ellen Gertsen, Lori Simmons*
8. Internal Scientist Funding Model; *Michael New*
9. Mars Perseverance and Ingenuity; *Matt Wallace*

Appendix D

AGENDA

Agenda
(Eastern Time)

Wednesday, April 14, 2021

1:00- 1:10	Opening Remarks / Introduction of Members	Mr. Jason Callahan Dr. Meenakshi Wadhwa
1:10 – 1:15	Goals of the Meeting	Dr. Meenakshi Wadhwa
1:15 - 1:45	Division Advisory Committee (DAC) Chair Reports Planetary Science Advisory Committee Astrophysics Advisory Committee.	 Dr. Amy Mainzer Dr. Charles Woodward
1:45 – 2:00	Public Comments	
2:00 - 3:00	Earth Science Overview	Dr. Karen St. Germain
3:00 - 3:30	Q&A with SMD AA	Dr. Thomas Zurbuchen
3:30 – 4:00	SCaN Commercialization of Near-Earth Communications Services	Mr. Jeff Volosin Mr. Jeff Heckler
4:00 - 4:30	Division Advisory Committee (DAC) Chair Reports Heliophysics Advisory Committee Earth Science Advisory Committee	 Dr. Michael Liemohn Dr. Sara Tucker
4:30 - 5:00	Wrap-up Discussion	All

Thursday, April 15, 2021

1:00 – 1:10	Re-open Meeting	Mr. Jason Callahan Dr. Meenakshi Wadhwa
1:10 – 2:00	Agency Science Workforce Team Study	Ms. Ellen Gertsen Ms. Lori Simmons

2:00 – 2:30	Internal Scientist Funding Model	Dr. Michael New
2:30 – 3:30	Discussion, Findings and Recommendations	All
3:30 – 4:15	Mars Perseverance and Ingenuity	Mr. Matt Wallace
4:15 – 4:30	Outbrief to SMD AA	Dr. Meenakshi Wadhwa Dr. Thomas Zurbuchen
4:30	Adjourn	

Thursday, April 15, 2021 – Non-public Session

4:30 – 5:00	Discussion with SMD AA	Dr. Thomas Zurbuchen

Appendix E
Chat Transcripts

April 14, 2021

from Mini Wadhwa (Ext) to all panelists: 1:04 PM
SC Members: Please feel free to note your questions in the chat here so that I can call on you later to ask these of the presenter.
from marc Weiser (Ext) to all panelists: 1:06 PM
Are the DART delays tied to COVID delays, or are there engineering challenges to overcome still...help us understand if we have a sense of confidence in making the secondary window.
from Chick Woodward (Ext) to everyone: 1:12 PM
what is the unclear scope and cost with the Mars Ice Mapper?
from vinton cerf (Ext) to everyone: 1:27 PM
is it considered commonplace to fly at TRL 6?
from vinton cerf (Ext) to everyone: 1:30 PM
I would like very much to learn more about the data collection, preservaion, and curation of data from the NASA missions.
from Michael Liemohn (Ext) to everyone: 1:36 PM
Analysis or modeling software preservation is difficult, because it is computer-language specific, which come and go over time.
from Michael Liemohn (Ext) to everyone: 1:38 PM
If I am understanding the comment on the slide about "expect upward pressure", it is because there is a Data Management Plan requirement on all R&A grants, which need to be budgeted for.
from Chick Woodward (Ext) to everyone: 1:38 PM
ok finding
from Chick Woodward (Ext) to everyone: 1:40 PM
I believe the SMD information policy is to be released soom for public comment (May) prior to final writting of requirmenets. There is a notional time line in the slide.
from sara tucker (Ext) to all panelists: 1:46 PM
In ESD (and at NOAA) there has been a lot of discussion on the use of cloud computing. Is this something discussed in APD or at APAC?
from Karen St.Germain (Int) to everyone: 1:47 PM
I will actually speak to this a bit during my presentation
from vinton cerf (Ext) to everyone: 2:02 PM
treating the entire weather/climate ecosystem must be a computational challenge - how critical might new computational capabillities be in modeling more generally the atmosphere, ocean and land weather/climate systems and modeling of their interactions?
from Chick Woodward (Ext) to everyone: 2:06 PM

@vinton jere is were long term curation and interoperability / access to NASA data bases demonstrates the need we discussed -- several decades of observations ane there continually dynamic interpretation is paramount
from Chick Woodward (Ext) to everyone: 2:11 PM
Wasn't there a pre-pandemic and pandemic stuides of pollution / particulates correlations in urban areas also?
from vinton cerf (Ext) to everyone: 2:14 PM
if a lot of this data is publicly available there are groups very intrerested in being able to map date into census districtis, etc.
from vinton cerf (Ext) to everyone: 2:23 PM
NSF nas a National Ecological Obseevation Network which has data that might be relevant also.
from Chick Woodward (Ext) to everyone: 2:24 PM
Do the two *NAS / NSF) networks "network?"
from Chick Woodward (Ext) to everyone: 2:24 PM
NASA / NSF
from sara tucker (Ext) to all panelists: 2:24 PM
@Karen - w.r.t. Explorer - Where is the Atmospheric Winds targeted observable (in contrast with Ocean Surface Winds)?
from Chick Woodward (Ext) to everyone: 2:26 PM
@Karen .. is there a coordinated interagency approach to Earth system observatories and a nation intersectional need under the adminstration's forwarded looking plans?
from Chick Woodward (Ext) to everyone: 2:37 PM
#Karen is the graphic chart 32 right (the wheel) the visual logo that encasulates the whole of the SMD information policy roll-out?
from Amy Mainzer (Ext) to everyone: 2:55 PM
Thanks for the excellent presentation, Karen.
from vinton cerf (Ext) to everyone: 2:56 PM
back in a moment
from vinton cerf (Ext) to everyone: 3:06 PM
I have a question for Thomas about pan-NASA infrastruture support.
from Michael Liemohn (Ext) to everyone: 3:15 PM
I'd like to ask Thomas about the currently-convened NAS committee on "increasing diversity and inclusion in the leadership of competed space missions."
https://www.nationalacademies.org/our-work/increasing-diversity-in-the-leadership-of-competed-space-missions
from marc Weiser (Ext) to everyone: 3:17 PM
Going back to a comment you made earlier about differntiating between COVID/Non-Covid delays that effect missions over the long term, are you able to challenge your outside partners to do the same?
from Chick Woodward (Ext) to everyone: 3:20 PM
Those are called PI Luanchpads in APD
from Michael Liemohn (Ext) to everyone: 3:22 PM
I am working with Erika Hamden to plan the next PI Launchpad (virtual, in June), and we just stumbled across this NAS committee page!

from Chick Woodward (Ext) to everyone: 3:24 PM
Michael .. APD in our March 2021 letter discussed directly PI luanch pad ... the APAC letter should be posted soon on the NASA committee URL
from sara tucker (Ext) to all panelists: 3:47 PM
@ Greg - Is NASA working with NOAA (or other agencies) on any of these potential changes? The enhanced availability from DTE commercialization could significantly improve (reduce) latency for weather-related observations - thus improving forecast skill.
from Chick Woodward (Ext) to everyone: 3:50 PM
@Greg Balloon program (APD) are running into telementry and coverage issues (these are platforms below LEO) are these being folded into conversations?
from vinton cerf (Ext) to everyone: 3:51 PM
had to step out - was Artemis needs covered in this talk?
from Chick Woodward (Ext) to everyone: 3:51 PM
@von .. .not directly now lunar environment
from vinton cerf (Ext) to everyone: 3:51 PM
thanks
from Chick Woodward (Ext) to everyone: 3:51 PM
@greg status of moving away from RF to optical laser
from vinton cerf (Ext) to everyone: 3:51 PM
vint has a question
from Michael Liemohn (Ext) to everyone: 4:10 PM
Is 12-20 also true for this committee?
from Michael Liemohn (Ext) to everyone: 4:13 PM
There is also the Applied Sciences Advisory Committee, which I think is affiliated with Earth Science Division, right?
from Chick Woodward (Ext) to everyone: 4:13 PM
expansion of science topics, combined with nexus of NASA and commerical enterprize, combined with Arteimis and the lunar evnornment complicated commttee memberships anc size
from Chick Woodward (Ext) to everyone: 4:14 PM
10mins?
from Michael Liemohn (Ext) to everyone: 4:14 PM
yes
from Chick Woodward (Ext) to everyone: 4:32 PM
i concur 100% on DEI
from Chick Woodward (Ext) to everyone: 4:34 PM
@Vint T.Z. did make a comment that NASA's position in computation and data structures need to get into a different place in the future; and commerical entrepriseze have davances thet exceed NASA apabilities
from Chick Woodward (Ext) to everyone: 4:35 PM
advances (sorry hard to type and listen)
from Amy Mainzer (Ext) to everyone: 4:47 PM
sorry - speaking of telecom issues - poor internet connection
from Amy Mainzer (Ext) to everyone: 4:47 PM

Sounds great - thanks
from Chick Woodward (Ext) to everyone: 4:50 PM
out of gas !

April 15, 2021

from Chick Woodward (Ext) to everyone: 1:16 PM
Do "big data" and/or AI career tracks fit in w/ tech dev or R&A
from Sara Tucker (Ext) to all panelists: 1:25 PM
Adding on to Chick's question - how does NASA define "Scientist" (1300 Job series).
from Sara Tucker (Ext) to all panelists: 1:28 PM
I understand that one objective was to “formalize the career paths available for NASA’s science community”, and that the study was limited to NASA federal employees, but how many scientists work at centers, but are contractors that could become a project scientist? Also wondering about many NASA PI’s who are not federal employees.
from vinton cerf (Ext) to everyone: 1:31 PM
"planning career path" is an infrequent outcome - mostly the path is definied by the (unexpected) arrival of opportunity....
from vinton cerf (Ext) to everyone: 1:32 PM
What does OCHCO mean again?
from vinton cerf (Ext) to everyone: 1:32 PM
What about non-scientist, technician development
from Amy Mainzer (Ext) to everyone: 1:32 PM
As a former Deputy Project Scientist and now mission PI, I can personally attest to the importance of mentorship, and it was very much a "word of mouth" process. It is really great to see NASA undertaking ways to make this career path more accessible and formalized.
from vinton cerf (Ext) to everyone: 1:33 PM
Natonal Science Board Science Engineering Indicators report has illustrations showing educational focus and ending job - many trained in discipline A end up in B (physicists turning into computer jockeys....)
from Chick Woodward (Ext) to everyone: 1:35 PM
@Amy -- Reccoomendation PS2 -- Depity project scientist role is a key implementation step in developing leadership and scientific excellence
from Ursula Rick (Int) to everyone: 1:35 PM
OCHCO = Office of the Chief of Human Capital
from Marc Weiser (Ext) to everyone: 1:40 PM
a crticial item in the succes of any program like this is training the mentors as well, you've touched on it, but its critical to the long term success.
from Mini Wadhwa (Ext) to everyone: 1:48 PM
Thanks so much, Ellen and Lori -- that was great to hear about!
from Ursula Rick (Int) to everyone: 1:54 PM
My apologies. I missed the last "O". Office of the Chief Human Capital Officer.
from vinton cerf (Ext) to everyone: 1:56 PM
thanks Ursula - happy acronym land....

from Chick Woodward (Ext) to everyone: 2:05 PM
Is ISFN gas curretly costructed and implemented having the impact that insures that NASA maintains critical scientific/technological competancies ar centers and the agency more broadly?
from Amy Mainzer (Ext) to everyone: 2:06 PM
What is the fraction that is spent directly on the civil servant scientists vs. contractors and/or subcontracts, materials and supplies, etc.?
from vinton cerf (Ext) to everyone: 2:08 PM
any sense of successes? by what metrics?
from Michael Liemohn (Ext) to everyone: 2:09 PM
To follow Vint's question, how does the productivity of ISFM projects compare with that from other R&A funding?
from vinton cerf (Ext) to everyone: 2:10 PM
I hope that's "tiers" and not "tears"....
from Chick Woodward (Ext) to everyone: 2:21 PM
Is there sufficient resources in ISFM that enables the wrk to be done, and has the ISM funding model had the intended effect of reducing the number of proposals the CS have to compete for to justify their support?
from Mini Wadhwa (Ext) to everyone: 2:22 PM
Chick, I believe Mike said that there were fewer proposals submitted.
from Chick Woodward (Ext) to everyone: 2:23 PM
@mini copy
from Amy Mainzer (Ext) to everyone: 2:24 PM
How do you quantify which tasks can only be done by civil servant scientists vs. non-civil servants (e.g. scientists at places like JPL, APL, and other institutions)?
from Chick Woodward (Ext) to everyone: 2:29 PM
@mini -- micheal just better artoculated what i asked aboiut proposal# and reason why proposal$s dropped.
from Mini Wadhwa (Ext) to everyone: 2:29 PM
@Chick agreed
from Sara Tucker (Ext) to all panelists: 2:45 PM
Is this the position? https://www.nasa.gov/offices/odeo/about/office-AA
from Michael New (Int) to everyone: 2:47 PM
Did Thomas talk about an AA for ODEO or a Deputy Associate Administrator for ODEO? The former would/does report to the NASA Administrator; the latter would report to Thomas.
from Chick Woodward (Ext) to everyone: 2:52 PM
or how their fole has to vbe renvuagsed
from Chick Woodward (Ext) to everyone: 2:52 PM
role might be renviaged
from Jason Callahan (Int) to everyone: 2:57 PM
The person leading on DEIA issues in SMD and reporting to Thomas is the Deputy AA for Management Karen Flynn.
from Chick Woodward (Ext) to everyone: 3:03 PM
agreed vint: Blue Stem is important as it supports science

from Chick Woodward (Ext) to everyone: 3:07 PM
anthing Re; SCN .. comment that by 2023 100% lien on commericial services for exsiting and new mission? is tis the balance?
from Chick Woodward (Ext) to everyone: 3:07 PM
ScaN commercialization..
from Chick Woodward (Ext) to everyone: 3:07 PM
no plan for Artimes and lunar (letr alone L2 / L1) as i understand it
from Chick Woodward (Ext) to everyone: 3:16 PM
yes break :-)
from Chick Woodward (Ext) to everyone: 3:17 PM
congrats !
from vinton cerf (Ext) to everyone: 3:29 PM
is mars water and oxygen loss mostly attributable to lower gravity?
from Chick Woodward (Ext) to everyone: 3:31 PM
@ vint: lack of magntic field and solar wind stripping is believed to be a factor
from Chick Woodward (Ext) to everyone: 3:41 PM
what is eth scale heigtof the deltascarp?
from vinton cerf (Ext) to everyone: 3:49 PM
assume tube samples have plenty of metadata available?
from Chelsea Gohd (Ext) to host (privately): 3:52 PM
Is Ingenuity still on track to fly next week? Do we have information about how the team is preparing for this flight following the delay announcement?
from Chick Woodward (Ext) to everyone: 4:02 PM
was the hazard-aviodanve-nav system an intenal mission devloped capablity or was this a commercial applications that was adapted for rover use?
from Chick Woodward (Ext) to everyone: 4:10 PM
congrats to the mars team!
from Chick Woodward (Ext) to everyone: 5:10 PM
mini i have to drop off in 5 mins