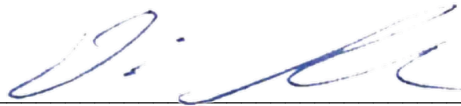


NASA ADVISORY COUNCIL

EARTH SCIENCE
APPLIED SCIENCES ADVISORY COMMITTEE

NASA Headquarters
Washington, D.C.
December 7-9, 2021
Virtual Meeting

MEETING REPORT



David Saah, Chair



Emily Sylak-Glassman, Executive Secretary

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December 7, 2021

Pre-Meeting: ASAC Annual Ethics Training

Ethics Training

(closed session)

The ASAC sat for an annual ethics training exercise.

Session 1: Overview and Meeting Objectives

Welcome and Meeting Overview

Dr. Emily Sylak-Glassman, Executive Secretary of the Applied Sciences Advisory Committee (ASAC), called the meeting to order, made administrative comments, and outlined Federal Advisory Committee Act (FACA) rules. Mr. Lawrence Friedl, Director of the Applied Sciences Program (Applied Sciences) within the Earth Science Division (ESD), welcomed ASAC members and called roll. ASAC Chair, Dr. David Saah, provided logistical information and welcomed members. Members of ASAC introduced themselves and provided backgrounds. The ASAC welcomed new members Mr. Albert Momo, Mr. Ian Schuler, Dr. Ed Kearns, and Dr. Danielle Wood.

Mr. Friedl noted that since its last meeting in July 2020, all ASAC members have either been renewed or onboarded. He introduced Ms. Kathryn Carroll, reminded ASAC of its charter and focus on Applied Sciences, and also that the purview of ASAC is broader than that in terms of scope of activities. Mr. Friedl reviewed the agenda and noted that ASAC is planning for a future joint session with the Earth Science Advisory Committee (ESAC). Dr. Sylak-Glassman made further logistical comments regarding Webex usage, and reminded members of the criteria for conflicts of interest.

Session 2: Earth Science, ESD, and Applied Sciences

ESD and Applied Sciences Program Updates

Mr. Friedl provided brief ESD and Applied Sciences updates to provide context for the meeting. Ms. Sandra Cauffman has moved on to become Deputy Director (DD) of the Astrophysics Division (APD), and Mr. Dan Woods is now in an acting role as ESD's DD. ESD hopes to have a new DD in early 2022. ESD Director Dr. Karen St. Germain and other members of the ESD leadership have been focusing on new directions and priorities, such as climate; Open Source Science; usable science; and diversity, equity, and inclusion. ESD has celebrated some successful launches such as Landsat 9, which saw first light on 31 October, and will be handed over to the US Geological Service (USGS) in about 6 weeks. The Earth System Observatory (ESO) program has made announcements on five Designated Observables (DOs) from the 2017 Decadal Survey. The NASA-ISRO Synthetic Aperture Radar (SAR) NISAR mission, a collaboration with the Indian Space Research Organization (ISRO), will be the first mission of the ESO to launch. NASA's new Open Source Science policy is focused on creating a collaborative culture through sharing tools, data, etc. In addition, NASA has released a policy statement on Inclusion, Diversity, Equity, and Accessibility (IDEA), including definitions; there is strong interest in all of NASA SMD as to

how the Agency can do better on IDEA issues. There is now an SMD IDEA Working Group that has initiated new activities, following public statements made by NASA and SMD leaders on the identification of existing exclusion and lack of participation by all communities at NASA, and a commitment to better inclusion going forwards. IDEA could be a major topic for the next ASAC meeting.

The recently released Executive Order (EO) 14008 regarding climate change contains two major sections: how the order's goals and objectives are connected internationally, and also how the US is tackling the climate crisis at home. It is recognized that NASA's Earth Science data and modeling capabilities will be critical to addressing the needs of climate science and policy. ESD sees direct key, connections to EO 14008, such as in support for general policy alignment, infrastructure and climate risk analysis, and coastal resilience. In addition, the National Space Council recently came out with a Space Priorities Framework, and one of its sections discusses using Earth Observatory capabilities to help address climate change, and how to respond to extreme weather. The Framework has been out less than a week, but discussions are already going on.

The NASA Fiscal Year 2022 (FY22) President's Budget Request (PBR) calls for an increase to the NASA budget, accompanied by a rising five-year profile. The ESD is slated for about a 10% increase over 2021, equivalent to a ~\$700M increase. The Applied Sciences budget has also been increased. In recent years, Applied Sciences has receives about \$45-55M annually, but received a big increase in the PBR in 2021-22, with funds growing significantly through the five-year budget runout to 2026. Applied Sciences feels that the funding increase validates the importance of Earth Science to society. The budget increases have also enabled Applied Sciences to add new elements to the program. Major items from the past year that have influenced Applied Sciences include a number of Congressional hearings related to wildfires, flooding, and agriculture, as well as community review panels, and internal NASA discussions. Applied Sciences must accommodate a good deal of external influence and input, and start thinking about how it can do better at such as scaling its projects according to need.

Applied Sciences has completed a Strategic Plan, which governs the three lines of business in Applied Sciences: applications, development, and mission engagement. Thematic areas reflect where the budget is assigned: Agriculture, Disasters, Ecosystems, Health & Air Quality, and Water Resources. There are three new, emerging program areas: Wildfires, which is a re-start of a previous program thanks to the planned increase in budget, and which includes the pre- and post-phases, in addition to active fires; Environmental Justice, a huge issue for the current Administration and one of the objectives of EO 14008; and Climate and Resilience, some areas of which are already incorporated into Applied Sciences. In the latter area, Applied Sciences is considering how Earth Science data and modeling can support assessments of climate-related risk to supply chains and infrastructure, and also contribute to policy analysis and implementation. Applied Sciences and ESD are talking with the Office of Management and Budget (OMB) about how to advance some objectives, understand where the needs are, and what boundary organizations are involved. To that end, ESD and Applied Sciences are looking at feasibility projects, and data fusion efforts, and have issued a ROSES-21 solicitation to advance socioeconomic assessments of Earth science information.

Applied Sciences also has introduced a new organizational structure and new roles: Dr. Sylak-Glassman is the new Lead for Applications, Dr. Nancy Searby is the new Lead for Development, and Ms. Christina

Moats-Xavier is the new Lead for Missions as well as Program Manager (PM) for Mission Engagement. Dr. Keith Gaddis is the new Program Manager for Ecological Forecasting. One big item for this year is the launch of an evapotranspiration (ET) application, OpenET, which will help farmers and water management offices. From a communications standpoint, it has been a tremendous year for Applied Sciences, which has released many stories, news features, and profiles, and has now incorporated its formerly many disparate websites into the one website. Applied Sciences is still trying to consolidate its efforts. The Food and Drink Campaign: NASA at Your Table project has enjoyed wide recognition through Reddit, YouTube cooking shows, and Instagram Live, and engagement with the project was described as having numbers that were “huge and not normal.” These efforts are helping to show citizens how NASA connects to their lives.

Applied Sciences will also continue a socioeconomic assessment effort to help guide Earth Science-data based decision-making, with two sub-elements, socioeconomic assessments of Earth Science information for real-world applications, and Community and Capacity Development, both in the ROSES-21 solicitation to advance socioeconomic assessments of Earth science information. Applied Sciences is expecting proposals in mid- to late-March 2022, which may overlap with the current Valuables Consortium. Some additional endeavors in Applied Sciences include engagement with philanthropies and foundations, to determine areas where there might be mutually beneficial collaborations. Applied Sciences has identified seven organizations to further explore, including the Gates Foundation, and is now looking at specific interests and collaboration opportunities. Some of these organizations take on higher-risk efforts than the government can afford to do. They also have unique communication apparatuses and different audiences as compared to NASA. Applied Sciences is also talking with the Moore foundation actively, and considering the cross benefits of research and applications. ESD Director Dr. St. Germain has also been making efforts to connect the two communities. ESD is pursuing a pilot effort to augment Research and Analysis (R&A) projects for applications-oriented activities, in which Applied Sciences is being tapped to share applications knowledge. For the tenth year, NASA held its Space Apps Challenge, which has broken 2020 records in all categories. NASA has also uplifted licenses for commercial satellite providers (Planet and Spire), making their data more accessible and freely available to the R&A community. Responding to Decadal Survey recommendations, ESD has started a new Earth Venture (EV) study based on Lessons Learned in the EV Mission and Instrument elements. Also in 2022, there will be a focus on the EV Suborbital program in the mid-Decadal review. Mr. Friedl also indicated that the Pecora-22 Conference is highly focused on Earth Science applications, and he encouraged the community to participate in the call for abstracts.

Status on ASAC Recommendations

Dr. Sylak-Glassman presented a status on previous ASAC recommendations to Applied Sciences. In response to a December 2019 letter report containing multiple recommendations, Applied Sciences has released an interactive Applications Guidebook that is now in beta testing, aimed at launch in the first quarter of 2022. The guidebook documents lessons learned about effective ways for the community to conduct applications, work with users, and manage projects. Applied Sciences has also developed a strategic planning effort on private sector engagement. In addition, Applied Sciences and USGEO are leading a Task Team on engaging with accelerators and incubators; and Earth Science Observatory (ESO) mission studies. Responding to the letter’s recommendations on technical content strategy, Applied Sciences has made strong communications efforts in past years (e.g., the successful Food and Drink

Campaign), and in the future, will continue to push boundaries and diversify. The most recent letter report of September 2020 contained five topics (Consortium Models; the ESD R&A Program; ESD Earth Science Data Systems Program; Earth Science, Equity and Diversity; and Future Plans). Dr. Sylak-Glassman reported that Applied Sciences work on leveraging existing consortia is ongoing: a Lessons Learned paper on consortia had been delayed by COVID, but is now going forward as planned. As to the engaging with the ESD R&A element, Applied Sciences is supporting work in the Global Council on Science and the Environment (GCSE) to document and coach researchers in doing applications. Work on Artificial Intelligence/Machine Learning (AI/ML) is ongoing in the ESD Data Systems element. Work on Earth Science Equity and Diversity is also ongoing. Applied Sciences/ESD has started a Diversity, Equity, Inclusion, and Accessibility (DEIA) Working Group and is actively incorporating DEIA considerations into solicitation language, peer review panels, etc. As to future plans, including a recommendation to reconsider a Wildfires program, Applied Sciences will be re-starting its Wildfires program, pending appropriations, due to the most recent PBR, as mentioned in Mr. Friedl's presentation.

Questions & Discussion

Dr. Saah opened the floor for discussion. Dr. Lisa Dilling asked if Applied Sciences was considering energy in its focus on the climate crisis, or any kind of work on energy transitions or carbon emissions. Mr. Friedl said that Applied Sciences has been looking for some time at data on solar radiation and solar incidence and their influence on siting efforts and building design; the new budget will let the program get to the next level. The ESD R&A program has been looking at methane emissions, but it is not part of Applied Sciences currently. Dr. Saah noted that there is a public/private methane hub that is on Applied Sciences's radar. Dr. Sarewitz asked about the nature of Applied Sciences's collaborations with philanthropic organizations, which he felt had fewer lines of accountability, as well as agendas that drive their missions. Dr. Saah suggested discussing this subject at a future meeting, to which Mr. Friedl agreed, adding that there will also be more information on the effort at future meetings. Dr. Sarewitz agreed to capture the recommendation in his notes.

Dr. Danielle Wood said that she appreciated Mr. Friedl's description of how Applied Sciences links to science, and that it is good to know that the Earth Science Technology Office (ESTO) is well aligned with Applied Sciences's goals. She pointed out that in the outyear opportunities going forward, that Climate and Environmental Justice are powerful subjects being presented to a set of researchers that does not usually think about NASA. EJ is an opportunity to build brand-new relationships with people "on the ground," and a great opportunity to first slowly build strong relationships with people in this area, before worrying about outcomes. Mr. Friedl agreed completely, adding that while there will be issues of scale, EJ already touches many areas in Applied Sciences. Mr. Albert Momo said he was excited about plans for private sector involvement, and liked the idea of an Applied Sciences private sector "ambassador." He cautioned that engaging the private sector is a two-way street, and that partnership needs to start early in the process. As for IDEA, many organizations talk about it, and want to check the boxes. He recommended having a baseline to show metrics on progress, and suggested NASA/Applied Sciences think more about what can be done in the K-12 educational timeframe to create a more diverse community. He also liked the application areas listed, but wanted to know where Big Data, AI/ML, and digital transformation fit in. Ms. Rhiannan Price commented on the breaking down of siloes in EJ and in other areas, and agreed that there is a trend where many organizations are looking for partners. She suggested NASA tread carefully because some of these organizations are quite lean. She wanted to know

what NASA's role would be: broker or mediator between technical and nontechnical communities? And how will Applied Sciences decide where to put its priorities in the tradeoff between depth and breadth? Dr. David Wilkie said he loved the connections, the concept of science for policy formulation, and the implementation of President Biden's "30 by 30" plan (to conserve 30% of land and water in the US by 2030); the EJ side is also wonderfully connected to NASA efforts. Mr. Ian Schuler suggested that Applied Sciences identify "meta" themes, and where Applied Sciences can create infrastructure to make it easier for the private sector to engage, and lower the barriers by creating data products and tools. In addition, as NASA itself makes changes in how it moves and distributes data, thereby opening opportunities, the Agency should be thoughtful about ways to increase engagement. Dr. Kearns applauded how Applied Sciences has grown to the scope it has. There is a big role for industry and private sector to play in increasing the value chain, and translating science to the nontypical users. Open science will be key to this effort; the legal community has also made much progress in providing licensing to commercial data providers. NASA and Applied Sciences should think about what can be done with government data throughout the value chain, end to end. Dr. Saah asked how Applied Sciences was planning on balancing the breadth and focus of Applied Sciences, and whether there was a plan to maintain the success of Applied Sciences. Mr. Friedl said he would touch on this in the Strategic Plan presentation, and thanked everyone for their comments.

Session 3: Applied Sciences Strategic Plan

Introduction to Topic

Mr. Friedl introduced the Strategic Plan, with the intention of soliciting ASAC feedback.

Summary of the Strategic Plan

Dr. Sylak-Glassman briefly summarized the new Strategic Plan, which was kicked off in January 2020 and released on 9 August 2021. The plan uses the term "Earth Science information," because it is trying to enforce the utility of many types of Earth science knowledge, whether it comes directly from observations, from research, or from models. The last clause of the vision statement, "and people want more," gets to the idea that Applied Sciences wants to drive demand for more Earth science information. The Plan is guided by four principles intended as a "North Star" and meant to carry through all of Applied Sciences: Innovation, Integrity, Inclusion, and Collaboration. The Plan's three goals, Impactful Applications, Knowledgeable and Skilled Communities, and Thriving Partnerships and Private Sector Partners, are meant to cross all lines of business, and each has their own set of objectives to be carried out by 2026. Impactful Applications objectives include the pursuit of efforts to apply and integrate Earth science throughout communities' value chains, and the expansion of engagement of user communities with NASA Earth Science Teams and enhance applications throughout missions' lifecycles. Knowledgeable and Skilled Communities objectives include tapping networks to build thriving partnerships and private sector ventures to expand the reach of the Applied Sciences, and developing the capacities of, and avenues for, scientists, project teams, partners, and users to craft engaging stories about how NASA data, other Earth observations, and related information benefit people and society. Thriving Partnerships and Private Sector Partners objectives include the formulation of partnerships with incubators, accelerators, and other entities aligned to support our engagement aims. The Plan calls for Applied Sciences to help broadcast information about Earth science-related career paths, helping students,

young professionals, and especially under-represented groups identify opportunities, and to turn Earth science information into products and services that people turn to. The Plan discusses the approaches to developing applications, which are described as user-centered, market-oriented, community leading, and impact-focused.

Strategic Plan Discussion

Asked how the Strategic Plan would be implemented, Dr. Sylak-Glassman said that in the case of private sector engagement, Applied Sciences is developing a roadmap and plan, which will require a lot of background knowledge. For example, Applied Sciences funds work with academic institutions within the program elements. Mr. Friedl, referring to various ways that Applied Sciences works (Creating Tools, Creating Spaces, and Creating Capacity), said that in some cases Applied Sciences creates and develops tools to fund such items as OpenET. In other cases, particular communities might have tools and knowledge to carry out their aims, and just need the space to work on problems together, and don't need grants or workshops. Applied Sciences is trying to fit activities to their purpose. Dr. Saah asked: within NASA, have other programs besides Applied Sciences leveraged consortium approaches or funding mechanisms to implement the things Applied Sciences is trying to do? Mr. Friedl said he had heard clearly from some participants that the ROSES solicitation process is cumbersome, so Applied Sciences has been thinking beyond ROSES. Other vehicles such as Broad Area Announcements (BAAs) and SBIRs within NASA SMD, have been used on the technology office side, so Applied Sciences has been looking there too. Consortia don't seem to be commonly used outside Applied Sciences. Ms. Price commented that it seems like a portfolio approach, and was curious about what success looks like; how do you know which components feed success? How has COVID shifted the thinking here? Does the capability of remote access lower barriers? Dr. Sylak-Glassman said that there is a whole page in the Strategic Plan that is dedicated to what success looks like; one key thing for success is how Applied Sciences is viewed. Recognition also means Applied Sciences is reaching people. Additionally, there are metrics that measure the demand for Earth Science information and high-quality applications. Virtual work has caused NASA and Applied Sciences to question the way they do things. Virtual presence at meetings and conferences absolutely lowers barriers, and Applied Sciences is mindful of the things learned during the pandemic. There have also been impacts to relationship-building; it's a continual re-evaluation process. Mr. Friedl added that the barriers to reaching out have lowered, because a virtual phone call can easily replace an initial face-to-face meeting, which can eventually be followed up in person. Remote access can help broaden Applied Sciences's reach beyond the "usual subjects." Dr. Wood noted that a strength of ROSES is that it allows people to make medium and long-term plans, and creates a sense of connecting to communities over multiple years. A one-year experiment can become a longer term project in a collaborative space, creating a comfort level to bring forward ideas. Dr. Wilkie commented on the "unknown unknowns"—how do you reach out to really desperate marginalized communities? Inuit communities are losing sea ice and hence the basis of their livelihood: how do you guide their future planning? How do you connect marginal communities to Earth Science information? There are conservation and rights organizations that have very deep connections to marginalized communities, and as such can be a conduit for Applied Sciences. Mr. Friedl said he was hearing two key things: attention to connections internally and externally, which plays into partnerships, and the other was the enabling piece, the brokering between technical and nontechnical communities, such as through colleagues in the ES Data System. When it comes to disadvantaged communities, Mr. Friedl credited Applied Sciences partnerships with Mercy Corps and the philanthropies; he said it had taken a lot for

Applied Sciences to learn to work with them, and there still needs to be further understanding of modes of engagement, to build on current knowledge. Dr. Sylak-Glassman commented that this also gets to the scaling issue: what is the best niche for Applied Sciences? Where do we make the one-to-one connections? Where is our expertise most useful? She agreed that building up partnerships takes a large amount of resources and time, and a real commitment. It's hard to fit such activities into the government budget cycle. The goals of some consortia are to enable and sustain continuity beyond budget cycles.

Mr. Schuler said that in order to achieve the goals of the Strategic Plan, it will be necessary to involve the entire community. Online events haven't been as good as pre-pandemic sessions, and there are not a lot of groups situated to fill that gap. It seemed to him that Applied Sciences is best situated to fill that gap: how is Applied Sciences thinking about community alignment, or problem definition? It seems like the natural, informal conversations are not happening as much because people are not gathering as they once did, having sideline discussions during conferences, for instance. It seems like Applied Sciences might be qualified to fill that gap. Dr. Sylak-Glassman said she had witnessed side conversations occur at hybrid meetings. Her concern was that these were more siloed conversations. Mr. Friedl offered to take the discussion item as a topic, as Applied Sciences did not have a specific answer. Dr. Saah agreed that once an in-person relationship is established, it's easier to carry forward. Mr. Momo asks how Applied Sciences intended to reach the users. There should be mechanisms for feedback, and also for needs assessment. Applied Sciences should not prescribe. How do you understand the needs of the user? How do you assess the application readiness level (ARL)? Mr. Friedl said that for all projects, Applied Sciences requires the partner to be part of the project; some PIs and teams do it better than others. Applied Sciences usually develops an application with the partner. SERVIR's co-development model has been very successful, and Applied Sciences has discussed using components of SERVIR's model in other parts of Applied Sciences. The impact-oriented statement is part of the program plan: does it help improve decision-making? ARLs may not necessarily be measuring impact; ARL's are intended to be a communication tool, to determine the level of maturation. Applied Sciences does use ARLs as a reporting tool because they communicate progress to OMB. He agreed with Mr. Momo that ARLs are not a scale to measure impact, but asked how Applied Sciences could square ARLs with impact.

Dr. Dilling came back to the question of how communities can know to come one another over Zoom meetings; there is a "conditioning activity" non-pandemic situations; the team goes to farm bureau meetings, water conservation meetings, and gets to know these people over a year's time. This seems to be the only way to expand the equity part. The idea is to "seed the ground," and the process helps to understand stakeholders a lot better. Dr. Saah agreed, adding that the SERVIR approach is similar. Ms. Price asked if the Applied Sciences reorganization had been intended to accelerate strategic priorities. How much of this reorganization is incorporating trends from partner organizations, such as locally led development? Mr. Friedl said that assigning the new Lead roles was a recognition of the need to reach out more to external organizations, to do more "up and out" – the Leads could then concentrate more on the internal needs of Applied Sciences, instead of being "rate-limited" by the Director. Examining the trends in Applied Sciences's partner organizations led Applied Sciences to reconsider the best mechanisms to use (e.g. ROSES vs. SBIR). Each PM was also looking at these trends, collectively, leading to Applied Sciences considering other mechanisms. Mr. Friedl welcomed more thoughts from ASAC on the subject.

Dr. Saah asked: How are the Strategic Plan goals outlined measures of success for the different elements? How is Applied Sciences prioritizing where to put its focus at different times? Is there an overarching command? Mr. Friedl said that because the Strategic Plan is so newly launched, it is taking some time for the Program managers (PMs) to think about it as the planning goes from program level down to individual program elements; to some degree, it's too early to expect the PMs to have redesigned their programs according to Strategic Plan goals. Discussions must continue in order to achieve a more deliberate identification of each item in a program area. Dr. Kearns asked: What will be the integrating function for these goals? How will Applied Sciences align with private industry, e.g.? It took 10-15 years for NASA to pull off Commercial Crew, for instance. In Applied Sciences, the currency is Earth Science data and information. How do you generate a community that generates useful information? How do you assemble a fertile environment in which to achieve these goals? There is a lot of talk about data collaboratives; Applied Sciences might be well situated to pull that off. Mr. Friedl agreed, and said he was excited to think through what that might look like. Dr. Dilling asked if there was room in the Strategic Plan for a thrust on energy transitions and emissions, in terms of reaching societal climate goals. Mr. Friedl said that although the subject area has not been identified as an immediate priority for NASA, Applied Sciences has not ruled it out. If ASAC thinks Applied Sciences should be doing this, he said he would welcome a finding or recommendation. Dr. Dilling asked if there were any NASA satellites looking at methane emissions. Dr. Sylak-Glassman thought a portion of how NASA approaches the topic of emissions is covered under the purview of NASA's Climate Advisor, adding that NASA also has a Climate Action Plan that deals with the issue at a more holistic level. Dr. Dilling felt there were numerous applications for remote-sensing data, as it is critical for climate scientists to get a handle on the real measurements in the atmosphere. This could represent a huge opportunity for Applied Sciences. Mr. Friedl noted that Dr. Nancy Searby had put into the chat a link on carbon dioxide and methane training, while also reiterating that these are not applications area at the moment. Dr. Sarewitz commented that it seems unclear where the responsibilities for such monitoring lies; while there is a huge amount of federal money going to this effort, the problem could eat Applied Sciences's lunch if not considered carefully. Dr. Saah said that states are responsible for their carbon reporting, which then goes up to the US Geological Survey (USGS); there's a whole ecosystem that Applied Sciences is directly and indirectly involved with. He added that the Department of Energy (DOE) has two programs that are addressing the issues that Dr. Dilling has raised.

Session 4: Public Comment Period I

Public Comments

No comments were noted.

Review Day 1 Outcomes, Findings, and Recommendations/Preview Day 2 Activities

Dr. Saah led a discussion of the day's proceedings, suggesting that the ASAC letter highlight three major successes and three major areas needing a recommendation. Dr. Wilkie said he liked the discussion around the Strategic Plan, and the idea of reaching out to the stakeholders that are really struggling; sending representatives to attend farmer's group meetings, etc. is a good way to approach the problem. Dr. Dilling agreed that this was a practical way to overcome the problem, that being a "fly on the wall" was more useful than being an ambassador. If NASA has the resources, she felt Applied Sciences should pick some meetings to go to each year, and become the trusted point of contact. Dr. Wood, referencing

Dr. Brad Doorn's work with the Water Council community in the Western states, agreed that similar outreach activities can be very powerful, and highlighted the inherent opportunities in Environmental Justice (EJ) and climate. Dr. Dilling commented that there are so many states that don't have the people available to gather the data that's needed, and that there needs to be a better way to work with the frontline communities. She emphasizes that the EJ issue is so important that NASA and Applied Sciences should really put in the time, and figure out where the Agency can add value to communities that do not have the resources. Citizen science has shown over and over that it can be valuable in revealing important EJ data, such as lead in the tap water. Community need should drive the studies.

Dr. Saah asked ASAC to consider whether to highlight any one thing in the Strategic Plan. Ms. Price felt that Applied Sciences should strive to understand the gaps and where the lack of leadership is, to be thoughtful about the degree of change, and to be aware that breaking down the siloes can also introduce a lot more complexity. Mr. Schuler cautioned Applied Sciences to address the scale of the challenge that the Strategic Plan aspires to; it will have to consult many entities in the private sector, including NGOs and the like. The scope of the Plan has much in common with NASA's development of Commercial Crew. Dr. Wilkie said he liked the idea of fast-tracking equity and EJ, in the manner of NASA's Food Campaign. Dr. Kearns noted that while the Strategic Plan is well-written, tasks like market research are typically done very poorly by the government; Applied Sciences needs to embrace finding out where the markets exist. Users don't necessarily need to know where their information is coming from. The exciting thing about the current Administration is that it is approaching climate change in collaboration with the financial sector.

Adjourn Day 1 of Meeting

Dr. Sylak-Glassman adjourned the meeting for the day.

December 7, 2021

Opening of Day 2

Dr. Sylak-Glassman re-opened meeting.

Session 5: ESD Flight Program and Applications

Introduction to Session

Mr. Friedl introduced the session, and reviewed the five main elements of ESD focus areas, as well as some common terms related to mission phases and cycles.

Flight Program Overview

Dr. Charles Webb, Associate Director of ESD for the Flight Program, opened the briefing by mentioning the newest Deputy Director, Dr. Katie Boggs, who came onboard in May 2020, and who has added much needed bandwidth to the program, enabling more regular meetings with Applied Sciences, which is helping to incorporate more applications earlier in the mission cycles. The Flight Program is part of NASA's effort advance Earth Science from end to end, with four other elements, Technology, Flight, R&A, Data and Compute, and Applications, linked together like puzzle pieces. He displayed the Earth fleet, with missions shown in order of launch, all in varying phases. Further out in time are the ESO missions, the next generation of "Flagship" missions for ESD. There are currently 23 missions in

operations, and 19 in development. The highlight of 2021 was the successful launch of Landsat 9, which went off on schedule and without a hitch. The latest launch continues the Landsat legacy; the Landsat series will be 50 years old in July 2022. Landsat 8 continues to take measurements, while Landsat 7, which is out of fuel, will be decommissioned, and will be subject to an experiment aimed at preventing the satellite from becoming orbital debris. The next mission to launch will be Time-Resolved Observations of Precipitation Structure and Storm Intensity with a Constellation of Smallsats (TROPICS). The vendor for this mission is Astrospace, and was selected through the Venture class program. The entire cost for the three launches is \$9M (March, April, May 2022). Prior to this, TROPICS Pathfinder, a single cubesat developed at MIT, was launched in June 2021 by SpaceX. Pathfinder was viewed as a risk reduction exercise, and was an experiment that involved ways to debug the satellite and accelerate science return.

Dr. Webb reviewed missions with international involvement: Surface Water Ocean Topography (SWOT), NASA-ISRO Synthetic Aperture Radar (NISAR), and Plankton, Aerosol, Cloud, ocean Ecosystem (PACE), the latter of which will fly two polarimeters, one Dutch and one US. Sentinel 6B, the follow-on to Sentinel-Michael Freilich, is a partnership with the National Oceanic and Atmospheric Administration, (NOAA), the European Space Agency (ESA) and EUMETSAT, the European meteorological satellite constellation. Additional missions in implementation, many of which are PI-led, include TEMPO (Earth Venture Class), the Geostationary Carbon Observatory (GEOCARB), which will launch on a commercial communications satellite, and Multi-Angle Imager for Aerosols (MAIA) (Venture Class). Due to vendor challenges, both GEOCARB and MAIA are now looking for rides in 2022. Other missions in development include Polar Radiant Energy in the Far-Infrared Experiment (PREFIRE), which will look at the radiation budget in the polar regions; Earth Surface Mineral Dust Source Investigation (EMIT), which will look at the mineral composition of Earth's arid regions, from aboard the International Space Station (ISS); and Climate Absolute Radiance and Refractivity Observatory (CLARREO) Pathfinder, which will launch to ISS in late 2023. Missions in formulation include Total and Spectral Solar Irradiance Sensor-2 (TSIS-2) (2023-24); the Libera instrument on JPSS 3, a follow-on to Clouds and the Earth's Radiant Energy System (CERES) instruments (2027); and Geosynchronous Littoral Imaging and Monitoring Radiometer (GLIMR), an ocean color/biology/ecology instrument that will be hosted on a geosynchronous satellite. The latest selection in Venture Class Missions is Geosynchronous Littoral Imaging and Monitoring Radiometer (INCUS), which will study convective thunderstorms. This mission is a Decadal Survey objective. Missions in pre-formulation phase are in the areas of Decadal Survey Designated Observables Surface, Biology and Geology (SBG); and Aerosol and Cloud, Convection and Precipitation (ACCP); Mass Change (MC), which is designed to continue GRACE measurements, in possible coordination with ESA and DLR; and Landsat Next (2028-29), which at present is the subject of different trade studies, and is driven by expected lifetime of Landsat 8.

The Earth Science Observatory (ESO) is made up of overlapping and interconnected core missions that won't launch at the same time, and are intended to support system science. Using Lessons Learned from NISAR, ESO is currently addressing Designated Observables (DOs), as defined by the Decadal Survey. Earth Explorer Missions are a new line for ESO, and will cover a full range of DOs. An Announcement of Opportunity (AO) in this new line is expected soon for seven DOs. ESO Explorers studies for ACCP, MC, and SBG are in pre-phase A, with Mission Concept Reviews scheduled for early to mid-2022. The Earth System Explorer Missions are PI-managed, with a cost cap of \$310M. NASA provides the launch. The missions undergo a two-step selection process; four missions are down-selected to two missions, under a staggered phasing and funding regime. Earth Science Flight opportunities are continuing to leverage and maintain the cadence of the Earth Venture program. EVI-6 (Earth Venture Instruments) is

the next AO in the program, with selection expected by end of 2022. The community was disappointed that only \$37M was available for this AO, and that only class D instruments and cubesats were possible, but ESD feels that it is still a good opportunity, especially for new PIs.

The Applications and Flight programs are increasing their interactions, with ESO really paving the way. ESD has commissioned a review of the Earth Venture Program by the National Academies, and is also looking at ways to engage more easily with PIs and commercial vendors within that program.

Discussion

Mr. Friedl thanked Dr. Webb for his efforts in engaging with Applied Sciences. Dr. Saah asked if there were mechanisms that help make the integration among the PEs, PSs, and PALs more effective. Dr. Webb said that the integration is just starting, and observed that in the study phase, everything usually goes smoothly, but that he did anticipate that there may be conflicts in pre-phase A, at which time he would probably look to Mr. Friedl for adjudication. Thus far, it is working well, however, and the “three-legged stool” is reinforced all the time. COVID has been a challenge to the integration process, though, and has drowned out some conversations that are typically held during the study process. Dr. Webb said Flight had been working hard to make sure people stay engaged, but since it isn’t possible to walk down the hall and pull people into meetings, new ways of engagement are being explored. Mr. Friedl agreed, and noted that to some degree the working relationships are personality-driven. In the efforts for the four DO missions, he felt it had come a long way. In some cases the PALs are wholly integrated into the team, and in other cases, not. He thought that there may be some opportunities for the PALs to be at the table with the standard PE and PS as time goes on. Dr. Dilling asked how the review process works for Applications in Applied Sciences. Dr. Sylak-Glassman said that there were several components: first, applications are called out in the AO for the Earth Venture Class missions, and in the selection criteria (items or requirements that reviewers must consider); then NASA must make sure the reviewers are qualified to assess the selection criteria. In a proposal, just saying that “there are applications” is not enough. The applications need to be reflected in the planning and the budgets. Mr. Friedl added that the proposal evaluations provide the final feedback for whether a project has done applications well or not.

Mr. Schuler asked how ESD interacts with industry in terms of commercial value of data, and if there were any more information about data latency goals, time reduction goals, or particular missions. Dr. Webb said that it is an evolving process, determining how to balance what commercial should be doing and NASA should be doing. NASA is beginning to understand the things industry does well. At present, there is an emphasis on procuring instruments, while NASA builds the things NASA should build. Even in large projects like the James Webb Space Telescope (JWST), NASA has a major contractor involved, but NASA itself will focus on anything unusual or complicated. There have been challenges in getting rides to space, as NASA has been trying to learn how the market changed in the cases of MAIA and GEOCARB. Mr. Kevin Murphy addressed the latency question; he said ESD is conducting a mission-by-mission study to determine if there are architectures that can address latency more efficiently. Study teams have been asked to consider what the community wants to achieve in terms of latency, and what it will cost. Once determined, NASA and the community will have to make hard decisions. ACCP is already addressing latency for some of the products. Applications have latency needs too, so mission must think about how to build it in. Dr. Wilkie asked if the Airborne Science group could be called upon to do something like flying a 100-kilo payload for 12 hours, a pilot project that could have great potential for

the conservation community. Dr. Webb said that the Flight program hadn't formally addressed the issue yet. Earth Venture-Suborbital (EV-S) has some ties to Applied Sciences, thus could serve as a possibility. Mr. Friedl felt that Airborne would require a lot of discussion time, as it has not traditionally been under EV-Suborbital, but could be considered. He offered to prepare some charts on the philosophy of Applied Sciences's approach to Airborne. Dr. Wood commented that sometimes science and applications may align naturally, and sometimes not. She asked if there were any obvious pattern so far as to the difference between the requirements for science and applications. Dr. Webb said that applications are usually related to wanting things sooner. Mass Change (MC) is inherently impossible to accelerate, because you need a 30-day flight to measure a gravity field. Some data about the atmosphere, e.g., might be accelerated. A Latency Working Group is currently discussing these subjects. Mr. Friedl said that much had been learned in the ESO's four DO studies, and offered to follow up with a presentation at a future meeting. Dr. Saah requested a deep dive into how the PALs have been integrated into a mission, also for a longer, future conversation.

Session 6: Private Sector Engagement Introduction to Topic

Mr. Friedl introduced the topic of Private Sector Engagement (PSE), which had been the focus of several prior ASAC findings and recommendations. Dr. Sylak-Glassman further elaborated on recent Applied Sciences guidance, including recent Congressional justifications, Decadal Survey, and Earth Science Advisory Committee (ESAC) recommendations on PSE. Applied Sciences began engaging with RTI in December 2019, and since that time has worked with the organization to come up with a Private Sector Engagement plan. Applied Sciences sees the potential to get to nonlinear growth by taking advantage of private sector reach. PSE is the gist of Goal 3 of the Strategic Plan. Applied Sciences has also contracted with RTI to frame the planning process, and initial implementation of PSE.

Guest Speaker, RTI International

Ms. Molly Dix, Senior Director of Innovation and Strategy, Innovation Advisors, at RTI International, gave a perspective on how RTI has been involved with Applied Sciences's development strategies. RTI has advised many major corporations (Medtronic, Pepsico, Hershey's) and NGOs on how to innovate and adapt, based on the precept that understanding and connection are key to growing impact. RTI has also done a fair amount of user-centered work in NASA ESD through work on the DOs. RTI is helping Applied Sciences improve its engagement with the private sector through strategic consideration around whom, why, and how to engage. For its work with Applied Sciences, RTI examined the landscape across federal agencies and researched how federal agencies [NOAA, Census, and the National Geospatial-Intelligence Agency (NGA) Accelerator] engage with the private sector, and used each agency's model to curate usable data; co-create solutions; and develop dual-use tools, respectively. RTI also looked at where NASA is trying to go that the private sector can help, and how NASA can augment the value chain. RTI also landscaped private sector interests in alignment with ESD's DO mission teams, and facilitated a series of focus groups with NASA and industry on opportunities for Earth Observation (EO) data. During the strategic planning work, RTI brought in speakers to add the voices of realists, advocates, and illustrative partners to Applied Sciences stakeholders, which helped Applied Sciences consider how to broaden its approach. Applied Sciences and RTI also engaged in brainstorming sessions for projects and applications, and held several strategy workshops to collectively reflect on specific challenges, and to create and communicate Applied Sciences's overall vision and purpose. Private sector engagement requires recognition of the differing needs and approaches of the private and public sectors, while also

recognizing that NASA has limited resources. A core team is now working to address a number of areas and continues to move forward with helping Applied Sciences meet its PSE goals.

Dr. Sylak-Glassman added a brief commentary, noting that there are many challenges as Applied Sciences takes on this task, and the team will have to crystallize a “Why” statement across the program. Success will come from the passion about this work, while Applied Sciences will also have to identify metrics for success, and criteria for down-selection in a robust and unbiased way. Mr. Friedl reiterated that during the stakeholder interviews, Applied Sciences clearly heard that the stakeholders needed access to ES data, which helped Applied Sciences to redirect some of its efforts to ES Data Systems; the key thing here will be to work out what the Applied Sciences role will be in serving a slightly different user base than it is accustomed to serving.

Discussion (*Led by Saah*)

Dr. Kearns commented, when he was previously a federal employee/scientist on the data access side of NOAA, that Applied Sciences has access to the experts that understand the science well, and while it’s easy to get hands on the data, it is still hard to get a subject matter expert (SME) on the phone to discuss the data. Unless there is an agreement in place, federal employees are reluctant to engage with someone on the “outside.” Mr. Momo, also from his former position as a government employee that is now in the private sector, said he liked the “Why” question, but would push for more “What” questions. In his view, the best way to do PSE was to approach groups differently, because at some point Applied Sciences will want approaches to be targeted to each group. NASA must ask itself what it wants from the private sector, and conversely, what NASA has to offer. In the offer piece, NASA must consider the user vs. provider perspectives. The private sector is not always there just for the money; there are other reasons the private sector wants to be engaged, and there are other models to consider for interaction between public and private sectors. Asked what rules of engagement are given to NASA scientists for interacting with the private sector, Mr. Friedl noted that Applied Sciences does need to broadcast the rules of engagement, and that there is plenty of allowance for that, and that it may be necessary to document that federal employees may well have concerns over giving advantage to one company over another. He added that part of the government’s role is to enable economic growth, and when Applied Sciences looks at the organizations responding to solicitations, it is seeing huge growth outside the federal government and academia, and has been trying to respond to that growth. Ms. Dix commented on the unique needs of the different entities. Dr. Saah said that diversity is a huge part of the growth in the private sector, and noticed in RTI’s presentation that the “voices” were all white men. Mr. Schuler asked how Applied Sciences would manage to figure out how it will engage with the community on data formats, products, and cadence of data creation; there are user populations that didn’t exist just a few years ago. Mr. Friedl noted that ESD has had a real change on the data vision side, which is driving the broader issues about its relationship with the private sector. Applied Sciences has been taking cues from the ROSES solicitations, which is why Applied Sciences has been looking at other mechanisms, and has used some one-offs. Through OpenET, Applied Sciences is pursuing a different approach, not through the DAACs, but through a nonprofit consortium. Historically, the identification of data products has been through a science team effort. Applied Sciences is now having a discussion on re-thinking that whole activity, and as it identifies information products that serve a particular industry sector, will have to research what enabling data products will be for that industry, and what will be part of the PSE strategy with RTI. Ms. Dix added that OpenET is a good example of the “several to many” strategy, and that there are constant

opportunities to engage the broader world. She pointed out that when RTI connected to the different voices, people became very excited, and NASA needs to think about optimizing that energy.

Dr. Saah commented that in addition to the data itself, there is also the matter of the infrastructure to be built around the data analytics. Dr. Wood asked if operational scale is what will be expected from NASA. She noted that there is also a lot of expertise in the Applied Sciences group, ESTO, and knowledge about the “real cost” of data, such as maintenance, upgrades, etc. It is changing as cloud computing becomes more widespread, but there is now a lot of experience about what those real costs are. There are creative ways to cover those costs. Documenting this might confirm how Applied Sciences can do more. Dr. Kearns said that there is also diversity in the community; wildfire information goes beyond scientists further on to insurance companies, financial sector, etc. Can Applied Sciences provide an “enterprise service,” or set up quick agreements to enable communities of practice to do the things that are so hard to do. There may be some examples that Applied Sciences could copy and scale up. Mr. Momo suggested Applied Sciences engage with a large organization that has ties with various companies rather than going to each company individually; it is another way to see what the private sector is already doing. Or Applied Sciences could hold an event where the private sector can present its activities, so that Applied Sciences can learn from them. Dr. Saah commented that going after the aggregate organizations still leaves out the smaller entities. Ms. Price suggested that to focus on impact, it might be helpful to get a return on investment from consortia that already have the private/public partnerships baked in. Applied Sciences must also balance impact with inclusion, determine if there are operational workflows in place, document and be transparent around decision points, and avoid picking winners and losers. Applied Sciences can be an honest-broker intermediary among these communities. Private sector development is where the rubber meets the road. Mr. Friedl expressed agreement with the general commentary.

Dr. Saah asked ASAC members to comment from “around the room.” Dr. Kearns cited enabling expert analyses to translate NASA data to take to other communities. Mr. Momo said he would love to see a table that showed the “What” of public/private sector interactions, as presented by RTI. Ms. Price agreed with Mr. Momo’s comments, and that she would love to see some market analysis to see the gaps and overlaps, market trends, and where NASA priorities are. Dr. Wood suggested linking the discussion with the types of information that users need, case studies, and identification of both positive achievements and who bore the costs of each component. Dr. Wilkie said he was a huge fan of rapid-cycle learning, and thought it would be interesting to do a pause and reflect on PSE, re: what to change and what to continue, and to do this exercise regularly. Mr. Schuler suggested that NASA try a lot of cheap, quick things to make science knowledge accessible; data products can provide a lot of value for a fairly small investment. Dr. Sarewitz pointed out that the private sector has a kind of promiscuity in finding out how to monetize data products; it is an opposite approach to that taken by NASA and government, and NASA needs to keep this separate, especially in the interests of Environmental Justice. Applied Sciences has limited resources. Dr. Dilling emphasized the role of people interpreting the data; it’s great to have free data, but the real value comes from the scientists who understand the data. People can be an infrastructure in the application space. Dr. Sarewitz mildly rebutted that you don’t need a year-long relationship to get to know people, but you do need experience in the system.

Dr. Saah noted that Applied Sciences has gone through non-ROSES approaches to get more people involved, targeting financial sectors, and development sectors. Applied Sciences seems to do very well at

the tip of the spear; the next thing to tackle is compute/analytics, and the need to enable distribution of data, information, etc. Mr. Friedl said the big question was how to go to scale, and how to identify other impact-oriented approaches (besides ROSES). It's an interesting experimental time. He acknowledged Mr. Momo's comments on the heterogeneity of industry.

Session 7: Reward Structures for Applications Introduction to Topic

Mr. Friedl introduced the purpose and intent of the topic. Applied Sciences is time-intensive, hands-on work, and suffers from a perception within the research community that time devoted to applications is time taken away from the publications/tenure process. This session is intended to examine the perceived barriers. There seems to be a disincentive for societal applications in the current rewards structure for science and research, which is problematic, particularly since pseudoscience is on the rise. Within Goal 2 of the Action Earth Strategic Plan document, there is the intent to strengthen the strategic benefit of Applied Sciences.

Guest Speakers

Reshaping Academic Research Incentives: Opportunities for Funders

Ms. Angela Bednarek, Director of the Evidence Project at The Pew Charitable Trusts, focused her talk on how her organization worked to mobilize funders, as there are shared challenges with Applied Sciences. The Evidence Project was sparked by a collaboration between Pew (ocean research) and the William T. Grant foundation, (reducing inequality in the K-12 space), which focused on the overarching challenges common to each area. This led to the establishment of the Transforming Evidence Funders Network (TEFN), which unites a global community that shares research and expertise about how evidence is made and used, across policy and practice domains. Within the Governance part of this effort, members found some shared frustrations over the lack of focus on the evidence base, and over time, developed a TEFN Theory of Change. Through the process of tackling Theory of Change, the network came up with some Evidence Grand Challenges as big next steps. One of three Grand Challenges, which is to reshape and reform the academic research reward and incentive structure, is particularly relevant for the Applied Sciences conversation, as it involves trying to understand what keeps grantees engaged. Some successful models to emulate are in the form of entities such as the Spencer and Doris Duke foundations, which have begun to formulate collaborations, and Carnegie Corporation, which has started the Bridging the Gap effort. NSF has also begun a program aimed at reshaping rewards for innovation. Other incentive-funding models to build include the William T. Grant Institutional Challenge Grant. The Carnegie Corporation's Bridging the Gap brings together different actors with the goal of promoting the value of and support for policy-relevant research, including partnership centers and university leadership convenings. TEFN has formed a working group to develop an initial strategy and identify near-term actions, as well as longer-term activities to transforming academic research incentives. The initial strategy is to fund institutional challenge grants around the world, support systems for assessing the social impact of research, create a network of university and other institutional leader, and transform academic research incentives.

Dr. Julie Vano continued the presentation, sharing her perspective in the engaged science space of Applied Sciencesen Global Change Institute (AGCI) and the American Geophysical Union (AGU) Science and Society, and as a scientist exploring components of the "science to action conversation." She noted that the meeting's discussions had been timely, because the matter of how AGU does awards is

coming up for reevaluation. She reflected on her experience as a hydrologist and a research director. Historically, rewards for scientists have taken the form of publications, honors, awarded funding, and service in leadership positions or prestigious committees. Dr. Vano noted she had had a good mentor early in her career, and worked in an unusual niche that was based on turning applied work into journal articles, which led to four publications, helping her to establish an early publication record. As a Project Scientist at the National Center for Atmospheric Research (NCAR), she noted that funded proposals became as important as publications, but there were challenges. However, today at AGU Science and Society, the organization is better situated to work to lower transaction costs for others. Dual purpose publishing and job transitions are fine, but there should be a systematic way to represent achievements. AGU has developed a new Strategic Plan, which has three different areas that align with doing and valuing applied science. There is also a new community science platform, and a new peer-reviewed open access journal around community science aimed at output that benefit communities, as well also a new Science & Society Team Award at AGU, which will be open for nomination this award season; the award is for translating scientific knowledge to benefit society. It is AGU's first team award, and the goal now is to spread awareness. Dr. Vano reflected that the ongoing effort to develop a new journal and an award represents work on an ongoing basis, and that there will be hiccups that go with acknowledging people. She hoped AGU's efforts could help Applied Sciences build a similar model to reward its own practitioners, as these new structures are intended to accelerate what already works well. In summary, Dr. Vano posited two ways to effect change: one is to add fuel, the other is to remove barriers.

Discussion

Dr. Wilkie countered some of Ms. Vano's commentary, saying that there is much applied research that does get published (wildlife, cultural anthropology); the issue is really about evidence. He said that other than education and public health, the incentives for academia are misaligned. In the public health sector, the impact evaluation is done by the doctors. Ms. Vano thought it was important to think about the opposing responsibilities of researchers: a report for a municipality can't be published in peer review literature because the vocabulary is too different. Dr. Wilkie said that academic journals are just one channel of communication. A two-minute video is sufficient to impart useful information. A single peer-reviewed journal can't be expected to answer all questions. Ms. Bednarek noted that there are a number of ways in which to assess other kinds of output besides journal articles, and build them into a package that can be used to reward a researcher. Narrative TV can be used to capture the output; for instance, and there are all kinds of experiments going on right now. Dr. Vano felt that changing the reward structure might work, but that there should also be a space in which to share work.

Dr. Dilling said she loved the creativity of AGU in its efforts, and felt that choosing a sustainable career is a big issue; if you have to work twice as hard, the career is not an attractive draw. In contrast, societal issues are actually what draw many people to the sciences. Dr. Vano thought that the AGU Strategic Plan could open the door to thinking about new tenure criteria; one recommendation is to look at an extension's tenure process. It seems the time is right to propose different ways. Dr. Dilling said it would be beneficial to share new tenure criteria more widely. Dr. Saah posed a question to Dr. David Green on what he viewed as the main challenges of being a scientist in applied research. Dr. Green felt it was an issue of time balance between research vs. applied activities; there is not enough flexibility or recognition given to those who are doing both, which is likely an institutional bias. The other issue is the question of evaluates the work. Non-academics are typically not on review panels: do we need PhD scientists to

review the work? The quality standards for science also present a different set of expectations for what's important for application decision-making. Young researchers are not able to put the time in to achieve both their science and applications research. In some cases, people have had to make career decisions based on these things. There is lack of flexibility on both sides. Dr. Sarewitz found the Evidence Project to be very interesting, but thought the rationale was the frustration that they didn't know whether their investments were actually achieving their ends.. Ms. Bednarek said that TEFN had been working on getting better at using the evidence base to inform grant-making, and has spent the last year comparing grant practices, scoping criteria, etc. In terms of academic incentives, at times it was hard for TEFN to find grantees, and getting output on evidence of use, which is different from publications. TEFN is also thinking about it as an ecosystem.

Ms. Price commented on the adoption of Open Science, where there is always a tension between wanting to publish and releasing data; that is big dilemma to solve for. What is the role of a researcher in the applied sciences? Can there be an intermediary (individual and organizational level) between science and applications? Mr. Schuler thought that shared data environments would open the possibilities for implementers, but that incentives are still necessary. In some cases, a huge jump in funding could provide opportunities. Dr. Saah said that there might be an opportunity in ROSES22 to move forward some of this work. Ms. Bednarek agreed with Ms. Price's comment on the need for an intermediary role, which had initially been raised in TEFN's grant-making discussions. Building the intermediary role will be an important step. TEFN also works with a National Academy of Sciences (NAS) committee focused on building a workforce of intermediaries. Dr. Vano said that valuing the professional skills of the intermediary is also important, and a place must be made for people who have a science communication skill set. The science community must value them as equals in the process. Dr. Wood said there were practical mechanisms for valuing the intermediary skillset, and that it was exciting to hear that students are responding to the EJ discipline. She thought that the opportunities already exist with program manager in Applied Sciences, as groups in conservation disciplines tend to be multi-generational. She thought that these groups could serve as a model for more visibility. There could be an opportunity to construct a career path for an Applications Specialist (path from engineering, science, education, etc.), for example, which Applied Sciences could co-host or co-sponsor. Dr. Wilkie commented that the Wildlife Conservation Society (WCS) partners with many communities in the US and overseas, and that often faculty come to the WCS and ask what sort of research could be done to inform government policy. Intermediaries could help guide research and provide translation of the science to the policy makers. Academics and civil society are powerful tools for doing this job.

Dr. Kearns noted that another pathway to help academics is the commercialization of their data products, and that putting research results into practice usually involves industry. Ms. Bednarek was excited about the growth of dedicated intermediaries in big government who are building relationships with state universities to support research that is relevant to state needs; this is the type of role that can withstand political and funding cycles. Dr. Wilkie noted that conservation agencies are tightly connected to land-grant universities for the solution of problems. Ms. Bednarek added that community colleges are connected as well. Dr. Dilling observed that the transaction costs for community partners can be very high, and that small awards can be eaten up by overhead. The timescale for outcome is much longer than for the cycle of a grant or performance period. There are professional scientists who are not on a tenure track, but they do have a path for doing engaged science; these opportunities need to be expanded and

rewarded. Academics can be quite snobbish; they need to be taught to recognize the value of other career paths. Dr. Saah asked if NASA had an equivalent career path. Dr. Dilling said that NOAA still struggles to make room for people who manage scientific processes; the community has to listen to the signals and not ignore people who are falling off the career path. Institutions have to do that work to make the ecosystem function. Ms. Bednarek agreed with Dr. Dilling, but worried that there is a rise in fellowships without an accompanying long-term trajectory for careers; there is a lack of consistency. Funding for partners is also a big issue: how do we achieve balance and avoid skewing the power dynamics? Dr. Wood suggested that solicitations in NASA's Citizen Science program, or projects that mix NASA data with locally produced data, could provide a way to figure things out by trying them. Once figured out, this can be powerful knowledge. There are years of experience within NASA that perhaps has not yet been tapped. The Audubon Society, as just one example, has trained so many volunteers in acquiring amazing science skill sets. Volunteers now actively contribute to science through many organizations. Dr. Saah invited ASAC to think about next steps, as this seems to be a larger community challenge that NASA might be able to take the lead on. Mr. Friedl noted that NASA occupies a quasi-bully pulpit, that can be used for signaling and modeling.

Session 8: Public Comment Period II

Public Comments

Ana Prados, of the Battelle Memorial Institute, contributed a comment related to the Applied Sciences Strategic Plan, saying she was surprised that Applied Sciences did not include target areas it might be interested in over the next few years, perhaps through market studies. Applied Sciences is relatively small, and it is a challenge to cover so many areas; urban flooding is one example. Such studies might help externals understand where the program is going. Mr. Friedl said that Applied Sciences purposely avoided identifying target areas, so that over the course of five years Applied Sciences could have flexibility, because things evolve and change. He certainly understood and agreed with the point, and noted that Applied Sciences has talked about other items like remote sensing for algal blooms, wildfires, and coastal inundation. There are many items on PM's plates, and it is easy to focus on things that are within the PM's control. Applied Sciences is planning to prioritize items for 2022 and beyond.

Day 2 Synthesis

Review Day 2 Outcomes, Findings, and Recommendations

Dr. Saah reviewed the day's presentations, and went around the table for comments. Dr. Sarewitz said he was stunned and disappointed at the absence of user demand in the Flight presentation, and thought that some of ESD Flight missions should be demand-driven. The program sounded more like NSF, which is disappointing given the new emphasis on EJ and neglected communities. Mr. Friedl noted that the demand signal for NASA ESD Flight missions is the Decadal Survey, and that NASA also has to answer to Congress and the Executive Branch as well. The place to address those concerns is the Decadal Survey, although NASA is certainly weighing the signals from the current Administration. Dr. Sarewitz said that one theme of ASAC's over the years has been that when scientists drive decisions, they are often oblivious to the needs of the demand sector. ASAC feels that these missions would be open to other advice involving user needs, and solving problems. Dr. Saah thought that the PAL's role, if the PAL has an equal footing with the PS and the PE, would be useful here. Mr. Friedl thought there was more activity within the DOs than was represented by Dr. Webb's briefing. Information about users is usually addressed in the pre-phase A timeframe. Dr. Wood thought there were opportunities to consider

applications in the Airborne program. Technical requirements on missions are evolving in the technology offices in ESD; there are nontraditional data sets alongside science data in missions, and alignment of measurements between satellite and Airborne missions; these efforts raise visibility of all the actors (science, tech, applications).

Dr. Saah wrapped up the meeting discussion. Dr. Sylak-Glassman adjourned the meeting.

Opening of Day 3

Dr. Sylak-Glassman called the meeting to order and made administrative announcements.

Mr. Friedl introduced the discussion session, and announced that Applied Sciences had just released a solicitation for the advancement of equity and EJ, and that proposals would be around three elements: landscape analyses to support characterization of EJ communities; community-based feasibility projects; and data integration projects. Proposals will be due in mid-March 2022.

Session 9: Additional Discussion on Day 2 Topics Discussion

Dr. Saah opened the discussion and went around the table for comments. Dr. Wilkie asked: how do we bring in the demand side to help guide the suborbital/Airborne missions in the ESD Flight program? He thought discussions about incentives for applications, and the pathway to practice and policy, should constitute the subject of a future meeting. Mr. Schuler said it seemed like that the Applied Sciences is defined by the funding, and that there are many new asks that must depend on leveraging existing funds, rather than new funding. He worried that the asks are too massive for Applied Sciences's current staffing and structure, and that may strain the team. Dr. Sarewitz endorsed Mr. Schuler's thoughts, and said he thought ASAC has tried to be sensitive to these constraints, while one wonderful thing is how the culture of Applied Sciences has evolved under Mr. Friedl's leadership. The key now is to figure out how to institutionalize the efforts. He thought ASAC had been trying to evolve Applied Sciences without completely overwhelming the staff, and appreciated the way Applied Sciences had identified RTI as a node by which it could address private sector targets. He wondered if something similar could be done on the community outreach end, to "outsource the job." Mr. Momo applauded NASA's embrace of the IDEA topic, and was especially pleased with the addition of accessibility, and was looking forward to the content of the new Earth System Explorer program. He noted that it was also good to employ the IDEA principle in the way Applied Sciences works with the private sector; e.g., considering woman-owned, minority-owned businesses.

Dr. Saah observed that Applied Sciences is becoming a multidimensional boundary organization, and that its Strategic Plan objectives will depend on a lot of externals in order to be successful; the relationship is also a two-way street. On the private sector side, diversity of engagement will be critical to leverage whatever request or need comes up. Applied Sciences could be a thought leader in building new reward structures through diverse funding structures, and it seems like there will be a variety of journeys to choose from. Dr. Dilling agreed that Applied Sciences must not be overburdened, and was concerned about transaction costs. Applied Sciences needs to target some other organizations as intermediaries to widen the connections with people on the ground. Dr. Wilkie liked the idea of restructuring the system to allow applications scientists to get rewards, but he cautioned against making generalists out of specialists. At Applied Sciences, it is the combination of scientists engaging with the civilian side that will support good science with a pathway to policy and practice. Mr. Schuler said that a space needs to be created for

that reward structure change, perhaps through a venture capital approach to getting funding, by opening up the Rolodex. Having relatively higher staffing makes a program more successful, so ASAC might want to consider the staffing needed at Applied Sciences to do this well. Dr. Kearns noted that NASA has the convening power, as well as powerful missions, to help create an aggregation of people from multiple disciplines. DOD and NOAA have different approaches; there may be ways to make it easier for private industry to join NASA in some of its applications work. Financial incentives might include creative ways of using data licenses. Dr. Saah quoted a need for “a coalition of the willing.” Ms. Price felt it important to think of designing exit strategies, as one can’t expect new donations to materialize. She also welcomed IDEA, and felt ASAC should continue to prioritize it so that the adaptation would improve with time. Dr. Wood commented re: reward structures, that there is a specialty in being an intermediary, but it is sometimes not recognized as a skillset. The specialty requires listening, and some celebration of the act of being the bridge between science and applications. The Decadal Survey might shift applications to a different position with respect to science, and will continue to play a key role. It might be useful to allow more input for some intermediaries in white paper submissions to the Survey, as well as to the mid-decadal review.

Mr. Friedl revisited the topic of Flight program and EV-Suborbital opportunities and reviewed the Applied Sciences connection to Suborbital and Airborne overall. General guiding aspects for appropriate use of Airborne for applications include identification of a sustained need (is the partnering organization prepared to fund Airborne flights for the continued collection of data?); or one-time collection (is the Airborne data collection a one-time event to support a process or study that enables a partner’s application?). Additionally, collections of Airborne data can serve as proxy data sets for partners to “try out.” Funding for proxy data usually comes from the Flight program in the runup to a particular ESD mission. For Earth Venture-Suborbital, Applied Sciences has not had specific requirements in the past, but it has had *ad hoc* cases. For example, in the Biodiversity program in R&A, there is a field campaign (led by Mr. Woody Turner) that might well take advantage of the close relationship with Applied Sciences and with Dr. Keith Gaddis, which might enable Applications spillover; this could be a pathfinder project. Mr. Turner said he was excited about the campaign, and thought there were other opportunities in Airborne that might be catalysts for such things as longer-term serial collection of airborne data, and to make that data available for Applications. Dr. Wilkie noted that a key value of the airborne program is that civil society can’t develop projects beyond their means; if Applied Sciences could help one of these groups get at least a proof-of-concept project, that would be great. Having both Applied Sciences and users co-designing the mission would help. Mr. Friedl felt that a proof-of-concept project seemed consistent with the Applied Sciences mission.

Session 10: Applications and Open Source Science

Introduction to Topic

Mr. Friedl introduced the topic of Open Source Science, and its opportunities and implications for ES applications and users.

NASA and Open Source Science

Mr. Kevin Murphy, NASA SMD Chief Data Officer, described the aim of Open Source Science (OSS) at NASA, which is to expand participation, improve reproducibility, and accelerate scientific discovery for societal benefit. The initiative sprang from the establishment of the SMD Strategy for Data Management and Computing. Open Science is defined as a collaborative culture enabled by technology that empowers the open sharing of data, information, and knowledge within the scientific community and the wider public, to accelerate scientific research and understanding. Open Source Science is based up on concepts gleaned from the Open Source Software revolution. ESD has been leading in some areas of data distribution and accessibility for a long time, and has fully established the principles of OSS in ESO.

The OSS policy states that:

- All mission data, metadata, software, databases, publications, and documentation shall be available on a full, free, open, and unrestricted basis starting in Phase B with no period of exclusive access.
- Open-source science Software shall be developed openly in a publicly accessible, version-controlled platform using a permissive software license allowing for community use and contributions.
- Scientific data, metadata, software, publications and documentation shall be archived and made available by NASA and/or [Partner] starting in Phase B.
- Manuscripts shall be published with open access licenses; versions of as-accepted manuscripts shall be made available as open preprints and deposited in a NASA or [Partner] repository upon publication.
- NASA and [Partner] software, documentation and data shall be properly marked, cited, and/or attributed.
- Metrics to measure and acknowledge open-source science contributions will be developed.
- All mission data, calibration information, and simulated products supporting development and validation of algorithms shall be made available without any conditions to use.
- NASA and [Partner] will mutually develop an Open-Source Science Plan that specifies details of collaboration.

NASA needs “all hands” on deck to look at the increasing volume of new data and information, and to apply OSS principles to help more people participate. The Agency is now in the process of building an open-source science ecosystem, through initiating new missions, research and applied activities as open-source science projects; implementing clear policies for software, publications and data; integrating and improving data management, access, computing, analytics and scientific collaboration; and building the community through open science team meetings, training, workshops, competitions, awards and prizes.

The OSS policy, instantiated in SMD Policy Directive-41, is built on the foundation of legislative and internal direction. Highlights of the policy include establishing infrastructure for development, maintenance; management of data products and software tools, provision of accessible paths to large-scale research infrastructures, and an emphasis on community and collaboration. There is an RFI on street right now to elicit feedback from the community on the contents of the policy document. As ESD moves towards SBG or ACCP or other groups, users will be identified early on. Publicly accessible Cloud is a big part of the strategy; it doesn't mean that everything is open, but will be as open as possible (there will be obvious exceptions for International Traffic in Arms Regulations (ITAR) and classified information). An OSS for ESO Mission Processing Study held its first workshop in October; the second workshop will be in March 2022, and the third will be in August 2022 ESD has also started evolving the DAACs to support OSS, beginning this year. Transform to Open Science (TOPS), a five-year effort, has been initiated to prioritize OSS activities for 2022.

Dr. Wood requested a high-level view of how NASA was adopting cloud computing. Mr. Murphy explained that the use of Cloud will help improve costs; the intention is to recognize that some groups do software better than others, and to harmonize NASA capabilities with those experts, and then transform that data into data products/formats. This approach will reduce the number of times data needs to be stored, especially given NISAR-size databases. Dr. Kearns asked: how about downstream products of commercial entities? Mr. Murphy said NASA was not planning to impose downstream restrictions on products, and was concerned with just making NASA data open for any use. Ms. Price asked about ethics and privacy issues associated with OSS. Mr. Murphy said that as yet it is not an issue, as human data has not been involved; it might pop up in AI/ML projects. However, privacy is a significant issue for astronaut genomes, and possibly with EJ and climate/environmental information. Dr. Wilkie cautioned that when working with indigenous peoples, remote-sensing data collection can be tricky with respect to territorial rights, culture, and indigenous voice.

Guest Speaker

Dr. Christine Lee, of the Jet Propulsion Laboratory (JPL), offered her perspective on the challenges and opportunities associated with Open Source Science and Applications (OSSA) implementation. Drawing on her experience as a principal investigator (PI), she observed that under OSSA implementation, projects typically take on a lot of the responsibilities (including financial responsibility) for balancing the number of publications, capacity-building (which requires routine, ongoing engagement between the team and stakeholders/users), workshops, sharing code and workflows (bureaucratic reviews, etc. before information can be released), and post-transition (updates, maintenance). She shared some specific examples on sharing code, during which the process for clearing code presented huge challenges, one in the case of temperature retrievals and water quality products. Another instance was a challenge in sharing some data to Google Earth that required clearance. When sharing software and during the post-transition period, teams need to define what it means to maintain accessibility to a data set when there are no resources to provide support. Use of Cloud computing is an important part of access, and in the case of some Soil Moisture Active Passive (SMAP) data products, there have been instances in which JPL could not provide additional user support and maintenance services.

Thus far in the Ecosystem Spaceborne Thermal Radiometer Experiment on Space Station (ECOSTRESS), a mission studying evapotranspiration, which adopted an OSSA approach to Early Adopters, the team had over 200 people looking at initial data sets in the first round, which provided extremely valuable

feedback. Dr. Lee summed up by saying that missions will need to partner extremely closely with the DAACs, from a maintenance viewpoint, to carry out OSSA tenets.

Discussion

Dr. Wilkie commented that 200 didn't seem like a high number for Early Adopters. Dr. Lee said that there was a balance between quality and quantity; in the instance of ECOSTRESS, the users were expert, and not at all a reflection of public users. However, Early Adopters are helpful in providing feedback on making data more accessible, what platforms are needed, etc. Mr. Schuler echoed that he had heard similar stories, and that it seems like there is one process for clearing code, despite its origin. Can this be different? Taking one year to make code available is too long. Mr. Murphy said that the current guidance is that any new projects must have their legal counsel approve release within a given time period. NASA will have to do further work to get its policies in line with government policies, which does take time. Anything new (ROSES, contract, AO, grant) will have in its language a shall statement indicating that Open Source is a requirement within a year from the inception of the project. The disposition of software that is initially commercial but is "touched" by NASA will depend on the terms of each license. Dr. Saah asked: how can ASAC help the DAACs push forward OSSA? Dr. Murphy said that there is already a whole-ESD approach to OSSA. He said that really integrating Early Adopters with missions and data systems would be a great recommendation from the ASAC. The other thing is that when DAACs start working with missions in phase B, the missions will need equitable input from Applied Sciences representatives; little things like that have a big impact. Dr. Lee echoed Mr. Murphy's comments on fuller integration of all parties, and added the issue of considering at an early stage the post-transition elements that require maintenance. Dr. Kearns asked about the effect of Bayh-Dole Act restrictions. Mr. Murphy said that he was not aware of any issues yet. Dr. Wood asked: how does ESTO play in? Dr. Murphy said that ESTO is certainly a part of the effort as they invest in a variety of areas; it would be helpful to make available data from some of their incubator projects. The Advanced Information Systems Technology (AIST) program is also working to align investments, and is doing more collaboration now than before the Decadal Survey. Ms. Price commented that the post-transition piece yields opportunities for new roles, customer support, and non-scientist roles outside of the project, to field common questions. It would be a good model for Applied Sciences to think about. Mr. Murphy added that the DAACs do like to try to make the long-term commitment, and could use more ideas. Dr. Wilkie asked how Open Science would work for non-scientists (otherwise it is not really Open Science). Mr. Schuler asked how cloud would be used as a part of the strategy for the application of data. Mr. Murphy said that in going from missions to measurements to data products, cloud can help reduce the start-up costs of such efforts, and applications can grow out of those efforts. Mr. Momo warned that Open Science can be a delicate subject, and that the cost of ownership for Open Source software is higher than for closed source. Mr. Murphy noted that this was a great point, and that Open Science is a government investment; there are ways to propose projects that will allow long-term maintenance. Dr. Kenton Ross commented that when it comes to a large number of small projects, it is not possible to deliver coded tools at all because it takes so long. The community is really looking for those policy changes that can smooth the way. Dr. Lee said there was a gradient of users in the Applications community that can bring knowledge and experience to help identify the challenges of OSS.

Session 11: Discussion with ESD Leadership

Dr. St. Germain acknowledged the helpful and interesting comments, and said she did recognize that when ESD is trying to move into a new area, having patience is important. Dr. Wilkie said that Mr. Friedl's team is doing "crackerjack" stuff, and that he always feel bad pushing them to do better; ASAC is already nibbling at the edges of perfection. Dr. Wood offered a perspective on the meeting's Flight discussions, saying she had been struck by the fact that the connections across ESD are strong, internally and externally, and observed that there is ongoing learning about data requirements with respect to science and user populations. This outcome seemed to be a product of a long-term culture shift. She added that airborne science can have key impacts in applications for validation of algorithms, and experiments that can demonstrate proof-of-concept designs. Dr. Wilkie added that because civil society needs to get to the intermediate stuff, and doesn't have the resources to do such things as fly a vehicle 18 hours carrying a mini-SAR instrument, he thought NASA had a great intermediate space that can change the way we think about Earth Science information. Civil society can use this space to prototype ideas, and figure out proof-of-concept stuff. Dr. St. Germain agreed, citing a recent long-endurance capability exercise in the Arctic that could have applications for lower latitude. She agreed with Dr. Wilkie that leveraging Airborne flights could prevent poaching of rhinos, illegal deforestation, identify the variables of greenhouse gas emissions, and increase the safety of indigenous conservation activists. These issues are also connected to continuity of Earth imagery.

Dr. Saah described ASAC's discussion about private or nonpublic sector engagement (big and small businesses, nonprofits), and RTI's involvement. Dr. Kearns added his perspective, saying that access to NASA experts can be difficult, which may be a scale problem. The nonpublic sector needs to be able to have its questions answered, and data products need to be modified from expert-level formats to useful information. The value chain is very long and must leverage the human skill in the system. ASAC would like to see more diversity in surveys and requirements. Dr. Kearns also noted that there other ways to reward engagement with Applied Sciences, and NASA must be careful not to pick winners and losers. Mr. Momo said that he valued the work of RTI, which really answered the question of "Why" to engage with the private sector, but that Applied Sciences still needs to identify the "What," as in What can each side get from one another. He expected RTI to find answers to the "What." Mr. Momo added that it's much easier for large entities to go after a consortium. Organizations such as the World Geospatial Industry Council (WGIC) are doing some work in publishing studies on private satellites, which may pave the way to public/private partnership, in which the private sector may provide a framework for engaging with government. Ms. Price commented that in order for Applied Sciences to be impact oriented, it must also be inclusive and transparent in that process; the values of partnership building won't necessarily be obvious in the short term. Applied Sciences can be the tip of the spear, and thus should listen closely to the end users. Mr. Schuler said that feedback from users will help in the more effective application of Earth Science; such data must be contextualized for decision-making, and the vehicle for that is the private sector. Applied Sciences should consider doing things that deliver value early, and to just try things out in general.

Dr. Saah introduced some ASAC ideas for changing the reward structure for applications career paths. Dr. Wilkie framed the discussion by saying that it is a fool's errand to make specialists generalists, and that the whole point (of Applied Sciences) is to connect the scientists to policy makers and practitioners. Dr. Sarewitz observed that the decline of tenured lines has precipitated changes in academia, and younger scientists want to make a difference. Philanthropists are frustrated at the reach of their investments

(papers, not impact). Given its small size, how can applied sciences be one kind of provocation within the academic system to do great science that matters? People do respond to incentives, and grant-making is one of them. Dr. Dilling noted that NASA can ensure the right people are on review panels, and also have to make sure transaction costs are not too high when looking for ways to make connections happen. For EJ and other efforts, Applied Sciences will need to reach the people who don't know where or how to propose. There needs to be a viable career path for applied science practitioners. Dr. Wilkie reiterated that NASA/Applied Sciences should encourage academic scientists to engage and connect with policy makers and practitioners.

Dr. Saah briefed the high points about the meeting's OSSA discussion. Ms. Price added that opening science should take note of what communities need and of privacy issues, in a holistic way that Applied Sciences has been exhibiting. Dr. Saah said he had gleaned from the OSSA presentations that the concept needs to get into the conversation early, and that there also needs to be an exit strategy or long-term maintenance plan at the front end of the development cycle. Dr. Wilkie cautioned that sharing information about indigenous communities can also be thought of as infringing rights and privacy, which could be an unintended consequence. Dr. St. Germain noted that maintaining code is a real problem, such as in the case of MODIS code, but said that NASA continues to implement OSSA thoughtfully, the benefits will be enormous. She said she was not deterred by the challenges, and appreciated ASAC's thoughts on unintended consequences. Dr. Wilkie offered information on some indigenous alliances that NASA could engage with. Dr. Kearns raised the issue of the private sector monetizing products, and challenges presented by the Bide-Dole Act. Dr. Wood said she had appreciated the DAACs adaptation of Cloud computing, the highlights of connections across the data communities, and wonderful trends that should be made more visible. Dr. St. Germain expressed her appreciation for the ASAC's input and fruitful discussion.

Session 12: Meeting Synthesis

Meeting Outcomes, Findings, and Recommendations

Committee Report Development

ASAC held a general discussion on remaining issues. Mr. Schuler said there seemed to be a disagreement about the challenge of Applied Sciences' staffing and structure. Mr. Friedl said he recognized that the current team is most familiar with ROSES, and is working with RTI to get out of comfort zone with other mechanisms. Applied Sciences is also looking for a new hire for EJ, as well as some new application areas, and is trying to identify new skill sets. These actions may be some combination of transition of staff and new hires. Another key thing is that Applied Sciences wants to know how it can articulate its impact beyond outcome-focused measures, which may take more training and work. People tend to identify with their individual programs, and need to integrate more between programs, and engage with outside organizations. Dr. Sylak-Glassman credited the Applied Sciences program management with great creativity in developing different mechanisms (e.g., Disasters program), but added that there are probably places where the current structure doesn't work well. Mr. Friedl asked ASAC to bring in trends they are seeing in their communities, and suggested having some Applied Sciences PMs come to the meeting and walk the ASAC through the substance of mission engagement.

Dr. Wood suggested for future discussion the role of the PAL vis-à-vis the realities of the Decadal Survey process, and needs assessments; and to identify what will be necessary to get to bring societal considerations to the Survey process. Dr. Dilling noted that there could be sticky issues with Environmental Justice, and cautioned that NASA implement it thoughtfully. What are some things NASA can do in EJ in practical terms, and how it can translate to advantages for Applied Sciences? Dr. Sarewitz added that Open Science can be sticky too, as open science can misfire and become distorted in an age of rising disinformation. Scaling is also sticky, moreso for the public sector. Human stuff takes money and time. Mr. Schuler said that if PSE is not a goal for its own sake, and is indeed a vehicle for getting more impact for Applied Sciences, it would be great, but it should not just be a checked box. Dr. Dilling commented that equity and access to open data has the potential to widen the gap between haves and have-nots because access is inequitable to begin with.

Future Meetings

Mr. Friedl and the ASAC briefly discussed future topics: follow-up with what's going on with science teams and what they look like in the ESO era; foundations and philanthropies; Early Adopters and engaging with missions; review of application-related recommendations in light of the mid-decadal review; cross-benefits between Applied Sciences and R&A; the decline in dedicated satellites/vehicles, and insufficient commercial opportunities for ride-alongs; new opportunities in satellite; and a joint ASAC/ESAC meeting.

Meeting Wrap-up

Mr. Friedl thanked everyone for their participation. Dr. Sylak-Glassman thanked everyone and adjourned the meeting at 4:01pm.

Appendix A Attendees

David Saah, Chair, University of San Francisco
Lisa Dilling, University of Colorado
Ed Kearns, First Street Foundation
Albert Anoubon Momo, Trimble Inc.
Rhiannan Price, DevGlobal Partners
Daniel Sarewitz, Arizona State University
Ian Schuler, Development Seed
Emily Sylak-Glassman, Designated Federal Official/Executive Secretary, NASA
David S. Wilkie, Wildlife Conservation Society
Danielle Wood, Massachusetts Institute of Technology

Webex Attendees

Lawrence Friedl	Christina Moats Xavier
Kathy Carroll	Laura Rogers
Joan Zimmerman	David Borges
John Haynes	David Green
Woody Turner	Tom Culver
Keith Gaddis	Mayra Montrose
Nancy Searby	Carmen Blackwood
David Green	Sara Tucker
Brad Doorn	Rochelle Williams
Shanna McClain	James Lochner
Dan Woods	Tammy Dickinson
Karen St. Germain	Sophia Skoglund
Kate Becker	Kate Becker
Kevin Murphy	Gabriel Bellott-McGrath
Charles Webb	Diane Hamm
Katie Boggs	Helen Amos
Christine Lee	Helena Chapman
Julie Vano	Kim Locke
Molly Dix	Kirsten Rieth
Ana Prados	Andrew Rowe
Angela Bednarek	Karen Allsbrook
Argyro Kavvada	Rochelle Williams
Sydney Neugebauer	Diane Hammons
Elizabeth Hammons	Christine Joseph
Zdenka Willis	Kathleen Baynes
Eboni Whitfield-Miles	Kenton Ross
Shanna McClain	David Borges
Michael Ruiz	Maudood Khan
Amy Truong	Stephanie Uz
Amanda Clayton	Ryan Hammock
Lauren Childs-Gleason	

Appendix B Agenda

Summary Agenda

Background

The Applied Sciences Advisory Committee (ASAC) serves as a community-based, multi-sector forum to discuss Earth science applications and provide strategic and programmatic guidance to the Earth Science Division (ESD) and the Applied Sciences Program. The ASAC provides analysis, findings, advice and recommendations to inform decisions on the programmatic scope, ambition, and priorities regarding applied research, knowledge utilization, and applications.

Within ESD, the Applied Sciences Program focuses on expanding Earth science applications, building applications knowledge and capacity, and enhancing the applications value of satellite missions. There are some topics, such as data access and continuity, that are ongoing issues and cut across ESD overall.

Purpose & Objectives

The meeting serves to inform the ASAC of key issues facing ESD on applications, discuss key topics, formulate ASAC findings and recommendation, receive ASAC advice, and identify matters needing special analysis. The primary topics for this meeting include:

- Earth Science and Applied Sciences Program updates
- Applied Sciences Strategy
- Applications and the Flight Program
- Applications and Open Source Science
- Private Sector Engagement

The primary objective is to discuss efforts to broaden Earth science applications and to formulate findings and recommendations. A product of the meeting is a draft summary or outline of the ASAC's findings and recommendations.

Day 1: December 7, 2021 • 11:00 am – 4:00 pm ET

Set-up

Times ET

<u>Session 0: ASAC Annual Ethics Training</u>	11:00 – 12:00
<u>Session 1: Overview and Meeting Objectives</u>	12:00 – 12:10
Opening of Meeting <i>(Sylak-Glassman)</i>	
Introductions <i>(ASAC Members, Executive Secretary, Executive Recorder)</i>	
Welcome and Meeting Overview <i>(Friedl, Saah)</i>	
<u>Session 2: NASA Earth Science</u>	12:10 – 13:45
ESD and Applied Sciences Program Updates <i>(Friedl)</i>	
Status on ASAC Recommendations <i>(Friedl, Sylak-Glassman)</i>	
Questions & Discussion <i>(Led by Saah)</i>	
<i>Break</i>	13:45 – 14:15
<u>Session 3: Applied Sciences Strategy</u>	14:15 – 15:25
Introduction to Topic <i>(Friedl)</i>	
Details <i>(Friedl)</i>	
Discussion <i>(Led by Saah)</i>	
<i>Break</i>	15:25 – 15:35
<u>Session 4: Public Comment Period I</u>	15:35 – 15:40
Public Comments <i>(Led by Sylak-Glassman) – extend time as needed</i>	
<u>Day 1 Synthesis</u>	15:40 – 15:55
Review Day 1 Outcomes, Findings, and Recommendations <i>(led by Saah)</i>	
Preview Day 2 Activities <i>(Saah, Friedl)</i>	
<i>Adjourn Day 1 of Meeting</i> <i>(Sylak-Glassman)</i>	15:55 – 16:00

Day 2: December 8 • 11:00 am – 4:00 pm ET

<i>Set-up</i>	<i>Times ET</i>
<u>Opening of Day 2</u>	11:00 – 11:05
Opening of Day 2 (<i>Sylak-Glassman</i>)	
Day 2 Overview (<i>Saah</i>)	
<u>Session 5: ESD Flight Program and Connections to Applied Sciences</u>	11:05 – 12:05
Flight Program Overview (<i>Webb/Boggs</i>)	
Mission Applications Overveiw (<i>Friedl</i>)	
Discussion (<i>Led by Saah</i>)	
<i>Break</i>	<i>12:05 – 12:15</i>
<u>Session 6: Private Sector Engagement</u>	12:15 – 13:30
Introduction to Topic (<i>Friedl, Sylak-Glassman</i>)	
Guest Speakers	
- Molly Dix (RTI International)	
Discussion (<i>Led by Saah</i>)	
<i>Break</i>	<i>13:30 – 14:00</i>
<u>Session 7: Aligning Reward Structures</u>	14:00 – 15:30
Introduction to Topic (<i>Friedl, Sylak-Glassman</i>)	
Guest Speakers	
- Angela Bednarek (The Pew Charitable Trust)	
- Julie Vano (Applied Sciencesen Global Change Institute)	
Discussion (<i>Led by Saah</i>)	

Session 8: Public Comment Period II

15:30– 15:35

Public Comments (*Led by Sylak-Glassman*) – extend time as needed

Day 2 Synthesis

15:35 – 15:55

Review Day 2 Outcomes, Findings, and Recommendations (*led by Saah*)

Preview Day 3 Activities (*Saah, Friedl*)

Adjourn Day 2 of Meeting (*Sylak-Glassman*)

15:55 – 16:00

Day 3: December 9 • 11:00 am – 4:00 pm ET

<i>Set-up</i>	<i>Times ET</i>
<u>Opening of Day 3</u>	11:00 – 11:05
Opening of Day 3 (<i>Sylak-Glassman</i>)	
Day 3 Overview (<i>Saah</i>)	
<u>Session 9: Additional Discussion on Day 2 Topics</u>	11:05 – 11:45
Discussion (<i>led by Saah</i>)	
<u>Session 10: Open Source Science and Applications</u>	11:45– 13:00
Introduction to Topic (<i>Murphy</i>)	
Guest Speakers	
- Christine Lee (Jet Propulsion Laboratory)	
Discussion (<i>Led by Saah</i>)	
<i>Break</i>	<i>13:00 – 13:30</i>
<u>Session 11: Discussion with ESD Leadership</u>	13:30 – 15:00
Preparation for ESD Leadership Discussion (<i>30 min; led by Saah</i>)	
Discussion with ESD Leadership (<i>60 min; led by Saah</i>)	
<u>Session 12: Meeting Synthesis</u>	15:00 – 15:55
Meeting Outcomes, Findings, and Recommendations (<i>led by Saah</i>)	
Committee Report Development (<i>Led by Saah</i>)	
Future Meetings (<i>Led by Saah</i>)	
Meeting Wrap-up (<i>Saah, Friedl, Sylak-Glassman</i>)	
<i>Adjourn Day 3 of Meeting (Sylak-Glassman)</i>	15:55 – 16:00

Appendix C

Presentations

1. ESD and Applied Sciences Program Updates; *Lawrence Friedl*
2. Status of ASAC Recommendations; *Emily Sylak-Glassman*
3. Summary of Applied Sciences Strategic Plan; *Emily Sylak-Glassman*
4. ESD Flight Program Overview; *Charles Webb*
5. Private Sector Engagement/RTI, International; *Molly Dix*
6. Reward Structures for Applications; *Angela Bednarek, Julie Vano*
7. NASA and Open Science; *Kevin Murphy, Christine Lee*

Appendix D

ASAC Membership

Dr. David Saah (Chair)
University of San Francisco

Dr. Lisa Dilling
University of Colorado

Dr. Ed Kearns
First Street Foundation

Mr. Albert Anoubon Momo
Trimble Inc.

Ms. Rhiannan Price
DevGlobal Partners

Dr. Daniel Sarewitz
Arizona State University

Mr. Ian Schuler
Development Seed

Dr. Emily Sylak-Glassman
Designated Federal Official/Executive Secretary, NASA

Dr. David S. Wilkie
Wildlife Conservation Society

Dr. Danielle Wood,
Massachusetts Institute of Technology

Appendix E Chat Transcript

[Note: Chat transcript for 12/07/2021 was not captured]

12/08/2021 10:53:45 AM from David Saah (Ext) to Everyone: Good morning

12/08/2021 11:03:13 AM from Danielle Wood (Ext) to All Panelists: Hello Eboni, may I request that you please promote me to Panelist to allow me to share my video? Thank you

12/08/2021 11:04:16 AM from Emily Sylak-glassman (Int) to Everyone: Hi Danielle-- I just promoted you to panelist.

12/08/2021 11:05:28 AM from Danielle Wood (Ext) to Everyone: Thank you!

12/08/2021 11:56:49 AM from Emily Sylak-glassman (Int) to Everyone: Just a time check that we have 9 minutes left before our break.

12/08/2021 11:58:07 AM from Kevin Murphy (Int) to All Panelists: I'm here

12/08/2021 11:59:00 AM from Emily Sylak-glassman (Int) to Everyone: We are going to shorten our break to 5 minutes to allow for further questions.

12/08/2021 11:59:18 AM from Emily Sylak-glassman (Int) to Everyone: Kevin, I promoted you to a panelist in case David would like to call on you.

12/08/2021 11:59:29 AM from Kevin Murphy (Int) to Everyone: copy. happy to address latency question

12/08/2021 11:59:38 AM from David Saah (Ext) to Everyone: Kevin, can you add to the latency conversation

12/08/2021 11:59:52 AM from David Saah (Ext) to Everyone: great

12/08/2021 11:59:56 AM from David Saah (Ext) to Everyone: your next

12/08/2021 11:59:56 AM from Albert Momo (Ext) to Everyone: My question was answered

12/08/2021 12:00:02 PM from David Saah (Ext) to Everyone: thank you

12/08/2021 12:00:04 PM from David Saah (Ext) to Everyone: you

12/08/2021 12:04:26 PM from WILLIAM TURNER (Int) to Everyone: Good question David. There's a lot on unexplored potential for applications in NASA Airborne Science

12/08/2021 12:05:22 PM from WILLIAM TURNER (Int) to Everyone: Just had a short presentation this AM about a new NASA airborne asset that can fly for ~8 days

12/08/2021 12:07:25 PM from David Saah (Ext) to Everyone: amazing

12/08/2021 12:52:39 PM from Emily Sylak-glassman (Int) to Everyone: Just checking-- is everyone able to hear audio?

12/08/2021 12:52:55 PM from Christina Moats xavier (Int) to All Panelists: no problem here

12/08/2021 13:05:20 PM from David Green (Int) to Emily Sylak-glassman (Int) (privately): Emily, can someone ask about the concerns that NASA is not operational and data streams/satellites do not have operational continuity.... so are there limitations in what should be expected from NASA

12/08/2021 13:06:38 PM from Emily Sylak-glassman (Int) to David Green (Int) (privately): Hi David, if you'd like David S. to call on you, you can certainly raise your hand.

12/08/2021 13:12:12 PM from david wilkie (Ext) to Everyone: @Woody thanks for the info. I would love to learn more about the * days flight time UAV

12/08/2021 13:12:45 PM from david wilkie (Ext) to Everyone: @Woody 8 days flighttime UAV

12/08/2021 14:29:45 PM from Julie Vano (Ext) to Everyone:
https://news.agu.org/files/2020/05/Final_AGU_Strategic_Plan_2020_Final.pdf

12/08/2021 14:31:04 PM from Julie Vano (Ext) to Everyone:
<https://onlinelibrary.wiley.com/journal/26929430>

12/08/2021 14:43:24 PM from david wilkie (Ext) to Everyone: @Angela agreed promotion through valuation of different outputs. But with academia that is like steering a container ship with a spoon

12/08/2021 14:44:02 PM from Angela Bednarek (Ext) to Everyone:
<http://wtgrantfoundation.org/how-we-embraced-the-challenge-of-institutional-change-to-pave-the-way-for-community-engaged-research>

12/08/2021 14:45:12 PM from david wilkie (Ext) to Everyone: @Angela thanks fpor the link

12/08/2021 14:49:40 PM from david wilkie (Ext) to Everyone: Remember that even teaching counts little in the tenure process in most universities. That is why they have non-tenure teaching tracks and tenure research tracks

12/08/2021 14:52:00 PM from Angela Bednarek (Ext) to Everyone: From NSF: <https://ptie.org/>

12/08/2021 14:52:38 PM from Angela Bednarek (Ext) to Everyone:
<https://www.carnegie.org/news/articles/bridging-the-gap-carnegie-corporation-of-new-york-awards-5-million-to-universities-for-innovative-programs-linking-academia-and-policy/>

12/08/2021 14:54:32 PM from Angela Bednarek (Ext) to Everyone: From my colleague at Swiss NSF: <https://www.nature.com/articles/s41599-021-00929-0>

12/08/2021 14:56:43 PM from david wilkie (Ext) to Everyone: @Angela nice paper on CV thanks

12/08/2021 15:04:59 PM from david wilkie (Ext) to Everyone: @Rhiannan yes university researchers could partner with civil society who could help inform the direction of research that might best influence policy and practice and might also translate research results for policy makers and practitioners

12/08/2021 15:06:31 PM from Rhiannan (Ext) to All Panelists: ^agreed David. Some are naturally doing that but need more of them, especially as those folks/orgs can focus on applications for what - policy, operations, etc.

12/08/2021 15:07:21 PM from Emily Sylak-glassman (Int) to Everyone: A reminder to please focus conversation to the dialogue rather than the Webex chat.

12/08/2021 15:07:25 PM from david wilkie (Ext) to Everyone: WCS partners with lots of uni researchers who are keen to make sure that their science has a chance of influencing policy and practice

12/08/2021 15:07:57 PM from david wilkie (Ext) to Everyone: @Emily ooops sorry I forgot

12/08/2021 15:12:07 PM from David Green (Int) to Everyone: Would appreciate advancing that recognized career path of "Academic Specialist" who can be interdisciplinary, less competitive and not necessarily PhDs

12/08/2021 15:13:32 PM from David Green (Int) to Everyone: woops;;; "Application Specialist"

12/08/2021 15:17:28 PM from WILLIAM TURNER (Int) to Emily Sylak-glassman (Int) (privately):
Talking Farm Bill money here

12/08/2021 15:23:16 PM from Ana Prados (Ext) to All Panelists: Hi Emily - I am herehappy to contribute during the public section

12/08/2021 15:27:23 PM from Angela Bednarek (Ext) to Everyone: A paper summarizing our attempt at Pew to look back at how our coproduction projects led or didn't lead to use. It was hard to do and we learned just how much we weren't tracking the right measures along the way:
<https://www.frontiersin.org/articles/10.3389/fmars.2021.704495/full>

12/08/2021 15:31:17 PM from Ana Prados (Ext) to All Panelists: I have a comment

12/08/2021 15:31:46 PM from Julie Vano (Ext) to Everyone: Thank you all - this was a great conversation. I look forward to hearing what those next steps/opportunities might be.

12/08/2021 15:32:04 PM from Ana Prados (Ext) to All Panelists: can you hear me?

12/08/2021 15:32:33 PM from LAWRENCE FRIEDL (Int) to Everyone: Many, many thanks Angela and Julie!!

12/08/2021 15:36:18 PM from Angela Bednarek (Ext) to Everyone: Happy to participate, great discussion!

12/08/2021 15:36:24 PM from david wilkie (Ext) to Everyone: @Angela @Julie very cool stuff and a great discussion

12/08/2021 15:51:06 PM from Molly Dix (Ext) to Everyone: The reports I referenced will share the work that was done in gaining user insights for the DO missions.

12/08/2021 15:53:48 PM from Emily Sylak-glassman (Int) to Everyone: David, you can take this until 4 pm.

12/08/2021 15:58:32 PM from Lisa Dilling (Ext) to All Panelists: thanks Julie and Angela!!!

12/08/2021 15:59:10 PM from David Saah (Ext) to Everyone: Please do your homework :)

12/08/2021 15:59:22 PM from David Saah (Ext) to Everyone: Thank you everyone

/09/2021 12:20:40 PM from Kevin Murphy (Int) to Everyone: David Wilkie - happy to chat about your comments after this meeting.

12/09/2021 12:21:47 PM from David Wilkie (Ext) to Everyone: @Kevin it was not a criticism, just a caution based on my work with IPLCs. Ping me at dwilkie@wcs.org

12/09/2021 12:25:14 PM from Kevin Murphy (Int) to Everyone: I'll reach out soon.

12/09/2021 12:29:09 PM from David Wilkie (Ext) to Everyone: Peer review helps us to believe that information is credible. Currently peer review is offered free to journals that charge for publication and open access. That is weird

12/09/2021 12:31:42 PM from David Wilkie (Ext) to Everyone: Journals have copyright over published articles not over pre-submitted articles - so lets all make our pre-submitted articles open access

12/09/2021 12:33:22 PM from David Saah (Ext) to Everyone: How much time is left? I would like to keep time for a conversation

12/09/2021 12:35:15 PM from Christine Lee she/her (Ext) to Emily Sylak-glassman (Int) (privately):
 ok I'll stop it at 936 PT, lawrences info did not show up in participants list but if you can let him know

12/09/2021 12:41:58 PM from David Wilkie (Ext) to All Panelists: @Christine perfect and clear and credible answer - awesome

12/09/2021 12:43:00 PM from Christine Lee she/her (Ext) to Everyone: thank you David

12/09/2021 12:45:37 PM from David Wilkie (Ext) to Everyone: Number one idea for popularizing open science - avoid using acronyms

12/09/2021 12:47:31 PM from David Wilkie (Ext) to Everyone: Open science is about reaching out to the non-cognoscenti

12/09/2021 12:54:06 PM from Lisa Dilling (Ext) to Everyone: +1 David Wilkie on reaching the non-highly technical

12/09/2021 12:54:51 PM from Emily Sylak-glassman (Int) to Everyone: DEVELOP folks, stand-by because I will unmute you shortly.

12/09/2021 12:58:04 PM from David Wilkie (Ext) to Everyone: @Kevin thanks that was a great clarification

12/09/2021 12:58:38 PM from Albert Momo (Ext) to Everyone: Thank you Kevin for the clarifications

12/09/2021 13:01:49 PM from Christine Lee she/her (Ext) to Everyone: thanks for the chance to discuss!

12/09/2021 13:09:43 PM from David Saah (Ext) to Everyone: I will be there as well

12/09/2021 13:35:16 PM from Danielle Wood (Ext) to All Panelists: I'd like to speak on the Flight Program topic

12/09/2021 13:38:13 PM from Emily Sylak-glassman (Int) to Everyone: Danielle-- apologies that I didn't realize you were in the attendee section. Just added you as a panelist.

12/09/2021 13:38:44 PM from Danielle Wood (Ext) to Everyone: Thank you, Emily!

12/09/2021 13:41:29 PM from LAWRENCE FRIEDL (Int) to Everyone: I'm going to go off camera for a lil bit (as I have some lunch)

12/09/2021 14:51:55 PM from David Wilkie (Ext) to Everyone: @Rhiannan yup applied science needs to fill demand not just create supply

12/09/2021 14:52:30 PM from Rhiannan (Ext) to Everyone: ^yes - we can make that point during our open science comments :)

12/09/2021 14:52:47 PM from David Wilkie (Ext) to Everyone: claro

12/09/2021 14:55:04 PM from Albert Momo (Ext) to Everyone: Thank you all. It was good spending the last three days here learning so much about the great work of the Applied Sciences team. I enjoyed the discussions too. Thank you for having me and I'm looking forward to next interactions. Bye all

12/09/2021 14:55:33 PM from Lisa Dilling (Ext) to Everyone: Great to meet you Albert. safe travels.

12/09/2021 14:55:35 PM from Rhiannan (Ext) to Everyone: Thanks, Albert. Safe travels!

12/09/2021 14:55:35 PM from Emily Sylak-glassman (Int) to Everyone: Thank you so much, Albert. I'm so glad to have you on board, and wish you safe travels!

12/09/2021 14:55:48 PM from Ian (Ext) to Everyone: Thanks much Albert! So great to reconnect

12/09/2021 14:55:57 PM from LAWRENCE FRIEDL (Int) to Everyone: Thank you Albert! We're so glad to have you on ASAC!

12/09/2021 14:56:05 PM from KAREN St Germain (Int) to Everyone: Thank you, Albert! I'll look forward to our next conversation.

12/09/2021 14:56:34 PM from David Wilkie (Ext) to Everyone: @Dan ooof I would never have said that most scientists are not great scientists

12/09/2021 14:58:36 PM from David Wilkie (Ext) to Everyone: NASA ASP could simply fund scientists to walk outside their ivory towers

12/09/2021 14:59:59 PM from David Wilkie (Ext) to Everyone: Incentivize academics to meaningfully engage with policy and practice experts

12/09/2021 15:02:43 PM from LAWRENCE FRIEDL (Int) to Everyone: it was just getting good ... ;-)

12/09/2021 15:03:04 PM from Daniel Sarewitz (Ext) to Everyone: And then Saah muzzled me!!

12/09/2021 15:03:25 PM from LAWRENCE FRIEDL (Int) to Everyone: ASAC thoughts, findings, recommendations here would be great

12/09/2021 15:03:43 PM from LAWRENCE FRIEDL (Int) to Everyone: (here was rewards conversation)

12/09/2021 15:08:10 PM from David Wilkie (Ext) to Everyone: Is MODIS fire product on Paiute lands appropriate?

12/09/2021 15:11:56 PM from David Wilkie (Ext) to Everyone: Karen I have COBOL code is that mine when I die

12/09/2021 15:13:03 PM from David Wilkie (Ext) to Everyone: Open data is awesome and we should aspire to this. But we need do this with respect

12/09/2021 15:16:43 PM from David Wilkie (Ext) to Everyone: Remember that open license means that someone has agreed to ownership of these data

12/09/2021 15:18:51 PM from David Wilkie (Ext) to Everyone: Does NASA own data on land use within Takana territory captured without consent?

12/09/2021 15:40:11 PM from Ian (Ext) to Everyone: I want to +1 Lisa's point that we have 20 more mins to muddle through sticky issues. what else is on the list?

12/09/2021 15:40:35 PM from David Wilkie (Ext) to Everyone: agreed

12/09/2021 15:43:51 PM from David Wilkie (Ext) to Everyone: @David - sorry i have about 5 more minutes

12/09/2021 15:45:21 PM from David Wilkie (Ext) to Everyone: @All My CEo is calling me early I need to jump off sorry

12/09/2021 15:45:38 PM from Emily Sylak-glassman (Int) to Everyone: Thank you so much, David!

12/09/2021 15:50:33 PM from LAWRENCE FRIEDL (Int) to Everyone: Applied Sciences Roadmap/Strategy
Progress on Private Sector Efforts
Progress on Diversity, Equity and Inclusion
Status of Guidebook and User Conference
Missions: Applications Recommendations
Cross-Benefit of Science & Applications
ESD Science Teams
NASA Earth Science and GIS
Foundations, Philanthropies, Trusts
Science Teams Early Adopters

12/09/2021 15:53:43 PM from LAWRENCE FRIEDL (Int) to Everyone: Decadal Survey Recommendations on Applications

12/09/2021 15:57:14 PM from LAWRENCE FRIEDL (Int) to Everyone: We're also talking about a joint meeting of ASAC and ESAC (Earth Science Advisory Committee)

12/09/2021 15:59:19 PM from Lisa Dilling (Ext) to Everyone: @thank Danielle! it's so important.

12/09/2021 15:59:22 PM from Daniel Sarewitz (Ext) to Everyone: Gotta go, folks--congrats Lawrence, Emily, and team for fantastic work; ASAC colleagues, see you on the rebound!

12/09/2021 16:00:34 PM from BRADLEY DOORN (Int) to Everyone: thank you ASAC! Off to another meeting.

12/09/2021 16:01:05 PM from Ian (Ext) to Everyone: Now I do need to run actually. Thanks so much all!!

12/09/2021 16:01:12 PM from Joan Zimmermann (Ext) to All Panelists: great meeting!