

NASA ADVISORY COUNCIL

EARTH SCIENCE  
APPLIED SCIENCES ADVISORY COMMITTEE

NASA Headquarters  
Washington, D.C.  
July 28-30, 2020

MEETING REPORT

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David Saah, Chair

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Emily Sylak-Glassman, Executive Secretary

*NAC Earth Sciences Applied Sciences Advisory Council, July 28-30, 2020*

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***Prepared by Joan M. Zimmermann***

***Zantech IT, Inc.***

**July 28, 2020**

**Federal Advisory Committee & Ethics Training**

The Committee received its annual ethics briefing prior to the meeting.

**Session 1**

**Introduction and Announcements**

Dr. Emily Sylak-Glassman, Executive Secretary of the Applied Sciences Advisory Committee (ASAC), called the virtual meeting to order, and prefaced the meeting with a summary of Federal Advisory Committee Act (FACA) rules governing the conduct of the participants, and the open nature of the public meeting. Dr. Sylak-Glassman introduced Dr. David Saah, ASAC Chair, who thanked everyone for their participation, and made brief remarks reminding members to utilize Google Docs for recording their individual observations.

**Overview and Meeting Objectives**

Mr. Lawrence Friedl, Director of the Applied Sciences Program (the Applied Sciences Program), reviewed the Applied Sciences Program charter. He thanked ASAC members for their service, and reviewed the meeting agenda. He asked that ASAC reflect on the concerns of their respective communities, to enable the Applied Sciences Program to benefit from two-way communications, i.e. to hear what the community is hearing and seeing, and bringing back to the community what NASA is doing in the Earth Science Division (ESD). Mr. Friedl welcomed public commentary and asked that emails be directed to Dr. Sylak-Glassman during the course of the meeting

**Session 2**

**Earth Science, ESD, and Applied Sciences Program Updates**

Mr. Friedl introduced an overview of recent ESD and Applied Sciences Program activities. ESD has welcomed its new Director, Dr. Karen St. Germain, who started her tenure in early June. Dr. St. Germain brings to NASA her extensive experience in architecture design for observing systems and strategy development, and is very familiar with how Earth science data is applied in a variety of operational and research contexts. Ms. Sandra Cauffman has resumed her role as Deputy Director of ESD, and Dr. Paula Bontempi has returned to academia.

Among the more recent developments, the Science Mission Directorate (SMD) released its Science Plan earlier this year. The Plan contains four cross-cutting priorities: Exploration and Scientific Discovery, Innovation, Interconnectivity, and Partnerships, and Inspiration, all of which factor into the Applied Sciences Program and ESD strategies. In May, NASA held a Space Applications Challenge related to COVID-19. This Challenge was held entirely virtually. Mr. Friedl reported that NASA was pleased with the successful outcome, and will announce winners of the Challenge in mid- to late August. The most Earth Science Senior Review, which is held every three years, was concluded in June. The Senior Review makes decisions on which missions to keep in operation, based on numerous criteria that fall under the headings of Science, National Interest, Technical, and Cost. Missions reviewed included Aqua, Aura, and Terra; however Suomi-National Polar-orbiting Partnership (NPP) and Landsat were not included in this latest review. Other missions that are due to end their prime operations phase will undergo out-of-cycle

reviews. ESD expects to receive the full Senior Review report in August. Mr. Friedl noted that the Applied Sciences Program is particularly interested in the feedback from the National Interest Senior Review panel, because it represents the views of other federal agencies, commercial entities, associations, and non-governmental organizations (NGOs). The panel's rich representation enables cross-fertilization of ideas, and allows a look at how a variety of communities use Earth science data.

The ASAC will be hearing a presentation from ESD's Data Systems Program Executive (PE) Mr. Kevin Murphy, who will address the preparations necessary to handle the expected increase in data volume over the next five to six years, due to the high data volumes that will be collected by new and upcoming missions. ESD is actively anticipating how to efficiently store data, and recognizes that NASA will also have to help partners and user organizations deal with large data volumes and derived data products.

Mr. Friedl presented historical trends in the requested vs. enacted budgets, wherein ESD saw an increase in 2016-2017, followed by a decrease, but overall, appropriation has remained consistently in the \$1.9-2B range. The Presidential Budget Request (PBR), at the enacted level for Fiscal Year 2020 (FY20), is just under \$2B for ESD. Features of the new budget include the initiation of the first mission related to the Designated Observables (DO), a flight program element recommended in *Thriving on Our Changing Planet: A Decadal Strategy for Earth Observation from Space* (referred to as the Decadal Survey), as well as the funding for the national Satellite Needs Process, which was established to support satellite data requests from other agencies. Two missions, Surface Water and Ocean Topography (SWOT) and NASA-ISRO Synthetic Aperture Radar (NISAR) have been delayed due to the impact of COVID. The Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) and Climate Absolute Radiance and Refractivity Observatory (CLARREO) Pathfinder missions were once again zeroed out in the FY21 PBR. In previous years, this funding has been restored in appropriations. In FY21 and beyond, there is a gradual rise for the Applied Sciences Program's budget in the PBR.

The Decadal Survey is a major influence on ESD, and this is supported by the NASA, by member of Congress, and others. They look at the Decadal Survey as an indicator of what the community wants ESD to do. Following the recommendations in the Decadal Survey, ESD has undertaken a major effort over the last several years for the **DOs** in terms of missions planning, including working on the architecture. At the same time, ESD also recognizes that there are also many Research & Analysis (R&A) and Applications activities that need to be done with our current observations and observational platforms. Other major element of the 2017 Decadal Survey in addition to the DOs are Earth Venture Continuity, Earth System Explorers, Decadal Incubation; the budget has curtailed some of these activities, ESD has been able to start three of the four activities. The Applied Sciences Program's role has been in trying to help DO study teams consider a broader range of users. The DO teams already have strong partnerships with academia and government stakeholders, but ESD looks to broaden these relationships to help build an advocacy base, and to obtain feedback on such matters as how to provide data in such a way that it will be most useful to a wide range of users (which requires understanding needs related to data frequency, latency, etc.). For each of the DOs, Research Triangle Institute (RTI) is developing a Community Assessment Report, which will characterize current and potential user communities. Mr. Friedl said the Applied Sciences Program would share the final study results with ASAC, when available. Also in support of Decadal Survey recommendations, Metropolitan Group is conducting a study to explore nontraditional partners for NASA such as philanthropic organizations and foundations.

Mr. Friedl reviewed some examples of recent the Applied Sciences Program efforts:

The Satellite-Based Sargassum Watch System (SaWS) was established to monitor Sargasso seaweed, a macroalgae that floats on the sea surface; when its blooms land on beaches, they can cause severe environmental problems. The Applied Sciences Program supported the development of SaWS with the University of Florida to help utilities and communities to prepare for beaching events. SaWS has already earned praise from a utility company.

An Applied Sciences Program effort in concert with a University of Puerto Rico medical science team created an early warning system for the Caribbean basin, to alert communities to the arrival of major Saharan dust plumes, which can impact human health. The University held a live broadcast on Facebook that helped to warn the local population of impact. The system relies on data from the Moderate Resolution Imaging Spectrometer (MODIS), Visible Infrared Imaging Radiometer Suite (VIIRS), and GOES-16 satellites.

The MODIS, Aqua, and Global Precipitation Measurement (GPM) missions contributed to efforts in assessing the impact of Cyclone Amphan on the Bay of Bengal. This data greatly aided in evacuation efforts and damage assessment, demonstrating a very successful use of assets to raise situational awareness, and to help the affected population.

The island nation of Togo took drastic measures to inhibit the spread of COVID-19, and created a digital loan system to help the communities affected by the shutdowns. This loan system used NASA-generated maps, created in 10 days, to help distribute monetary relief.

MODIS data has also been instrumental in creating drought forecasts that influence water allocation plans in California, whose water availability is very dependent on seasonal snowpack volume in the Sierra Mountains. State forecasters have been integrating MODIS data on water into their forecasts. Satellite (remote-sensing) data is now especially important given COVID-19 restrictions on fieldwork and in situ measurements.

the Applied Sciences Program is currently reviewing programmatic and projects needs related to the use Geospatial Information Systems (GIS) technologies, and based on some study results, is considering ways to improve the way that the Applied Sciences Program projects access NASA data and provide information products. The Applied Sciences Program is also conducting an assessment of the Early Adopters Programs, which provide users the opportunity to work with simulated mission data in their own applications prior to the launch of new missions.

It has been a busy year for communications. ASAC has endorsed the Applied Sciences Program's communications strategy. The Applied Sciences Program launched an updated website in April 2020, and regularly pushes out stories via social media. The Applied Sciences Program is also profiling specific people; these profiles are proving to be the most popular stories. There is also an effort under way to teach NASA staff to tell stories more compellingly, using character, conflict, and story arcs. In April, the Applied Sciences Program held a "story slam," in which each PM was given seven minutes to tell an oral story. Each PM had an opportunity to get feedback on their performances, and received some coaching.

The Applied Sciences Program plans to continue this practice. Dr. Saah asked how this new communications effort (finetuning stories, updating the website, focusing on people, etc.) has helped the Applied Sciences Program. Mr. Friedl felt it might be a little early to make a true assessment, but noted that as the Applied Sciences Program puts out stories about how organizations use Earth science data, it might prompt other organizations to ask what the Applied Sciences Program or ESD is doing or how they can do similar work. While the program needs to accumulate more data, the Applied Sciences Program is looking to see these connections rise.

### **Status on ASAC Recommendations**

Mr. Friedl gave a status on the Applied Sciences Program responses to recommendations from the ASAC's May letter report. Regarding a recommendation for the Applied Sciences Program to conduct a landscape analysis of the private sector, some work has begun in this realm through the Decadal Survey work. In addition, the Applied Sciences Program is pursuing a private sector strategy. Regarding a recommendation for an update on NASA's Small Satellite Data Buy Program, there is a current solicitation on Commercial Smallsat Data Analysis; Mr. Friedl offered to have a more in-depth conversation on the subject via teleconference, to which Dr. Saah agreed. Regarding ASAC's recommendation related to analyzing the use of consortia, the Applied Sciences Program has been gathering information which will be presented later in the meeting. Regarding ASAC's recommendation to investigate the use incubator models: an interagency U.S. Group on Earth Observations (USGEO) task team is looking at this. Mr. Friedl noted that he is co-chair for the USGEO Subcommittee. Regarding ASAC's recommendation to increase ASAC's size to ten members, the Applied Sciences Program has received permission to pursue new ASAC members, and is aiming to increase diversity.

In response to ASAC's November 2019 letter, the Applied Sciences Program has made some progress on several items, but recognizes that more needs to be done. Dr. Saah asked if it would be helpful to curtail recommendations to two or three concise ones. Mr. Friedl said he preferred the way the letters are currently structured, and that while the May 2019 letter contained many recommendations, he didn't think ASAC needed to curtail greatly; maybe it could find a happy medium.

### **Questions & Discussion**

Ms. Rhiannan Price asked whether the Applied Sciences Program has attained a sense of the diversity of its user population, and their geographic distributions, and whether these data would be part of the findings from RTI. Mr. Friedl thought some of this information would be contained in the Community Assessment Reports that RTI is working on, though they will not be doing very broad market research but more targeted. He thought that they are looking at attitudes toward data (technographics) rather than demographics, and additionally, the Community Assessment Reports will be primarily domestic-focused. When we have a private sector strategy and have completed more market research, then the Applied Sciences Program will get a better look at the demographics. Ms. Price felt that the Applied Sciences Program was defaulting to the more comfortable stakeholders like RTI, and government-led accelerators and incubators, and that it would be good to get a broadened diversity of voices beyond the usual suspects. Mr. Friedl noted that the RTI selection resulted from an open call, as they had provided the best proposal. He noted the validity of the point, however. Dr. David Wilkie asked why there had been no

progress on a recommendation for a dedicated wildfires management area. Mr. Friedl said that the lack was mostly due to a budget issue; however, the Applied Sciences Program regularly assesses some pre- and post-fires data in the Disasters program. Each time the Applied Sciences Program has proposed a dedicated program, it has not received funding or an approval to proceed.

### **Session 3: Consortium Approaches**

#### **Introduction to Topic**

Dr. Sylak-Glassman introduced the topic, which would include presentations by a series of speakers: the Applied Sciences Program is seeking to understand the efficiency and effectiveness of consortia, and hoped that ASAC would respond to the presentations by providing findings and topics for future meetings. As a program, the Applied Sciences Program has pursued consortia because in general, the consortium is greater than the sum of its parts. After having reached out to the consortium community to determine traits that are important to a consortium's success, the Applied Sciences Program found that the top three traits were: Other questions the Applied Sciences Program was curious to learn about consortium-building: what had been easier than expected? Some respondents indicated that working together had been harder than expected, highlighting the need for stronger internal communication. What advice for future? It's useful to spend the time upfront in (slide). Dr. Sylak-Glassman introduced the individual speakers and provided their backgrounds. Dr. Saah added that they were interested in hearing about the effectiveness of self-selected vs "contrived" types of consortia, and Ms. Price said she was interested in hearing about instances of collaboration across consortia.

#### ***NASA Harvest***

Dr. Inbal Becker-Reshef discussed the merits of the NASA Harvest Consortium. NASA Harvest was launched in 2017 and implemented as a self-selected consortium, with the aim of trying to be end-user driven, and always having end-users in the process. NASA Harvest also feeds into the international program, Group on Earth Observations (GEO).

Harvest measures successes in a number of different ways, include seeing increased demand for Earth observations to help support decision-making and agricultural monitoring and development of bridges across siloed communities. Harvest is putting a lot of effort now into how to effectively do public-private partnerships. They take a long-term view, and are trying to ensure long-term continuity given that they've built up trusted relationships. Agility is a high priority for Harvest. Being run out of the University of Maryland, they can easily engage with foreign ministries and the private sector. They try to have the flexibility to take on new partners and projects. External funding allows them to grow their program. They are trying to ensure that each project has impact and that comes from working with end users from the beginning. They try to have leading experts in complementary fields. Given limited resources to engage with a broad group of experts, they can give limited amounts of funding to each of those researchers but can leverage existing work. They are viewed as a leading but also as a neutral voice in the field.

Challenges include level of funding relative to the needs, ensuring long-term continuity for projects' successful outcomes. It can be difficult to respond to all the new opportunities that come up. The consortium model has alleviated some challenges by drawing on a huge amount of expertise and domain knowledge, and being able to draw on an extended network of partners with their own funding and relationships. An advantage and a challenge is that they do not have control over all the projects because they are one of multiple partners.

Dr. Becker-Reshef advised that a consortium have a focused and strategic vision, empowering all members of the organization to bring their best to a concerted effort is important. She also recommended that a consortium should be comprised of partners who are leaders in their fields with strong domain expertise and who have a range of complementary capabilities. She also advised that a consortium should be end user/policy-driven, with agile, strong, flexible, and creative project management. Communication is key; good inter-partner communication and a strong program outreach communication component are both important. Providing funding opportunities that enable the Consortium to add high visibility/impact activities, and ensuring that the structure of the consortium benefits its partners so that they see the value of contributing to are both important. Spending the time to forge strong multi-sectoral partnerships and trusted relationships is also key. Overall, she feels that the consortium approach has been very successful.

### ***SERVIR***

Dr. Dan Irwin, presented a briefing on SERVIR, a NASA effort with the United States Agency for International Development (USAID). Dr. Irwin said he had been trying to connect “space to village” for 25 years. Satellite data has been invaluable in this area, as satellite data clearly shows how development is encroaching on the environment. SERVIR has a number of consortium models. Dr. Irwin felt it best that each region design its own consortium according to its needs. SERVIR has five hubs, three of which use different consortium models: SERVIR-Mekong, SERVIR-West Africa, and SERVIR-Amazonia.

For SERVIR, the main measure of success is service delivery. Having a consortium increases bandwidth and flexibility, as different problems require different solutions at different scales. The consortia have been able to do hub-to-hub transitions to share knowledge. For example, Amazonia and West Africa had similar problems with illegal gold mining, and were able to collaborate in a “super consortium” to address the issue. The main advantages of employing consortium models in SERVIR regions are that they encourage collaborative science, provide access to additional networks and governments, leverage great variety of skill sets and expertise, foster both technical and institutional capacity development, and provide opportunities to which individual organizations would not normally be exposed. Consortia are well-suited to regional projects, which can be better implemented through multiple partners.

Dr. Irwin presented his view of the primary challenges of consortia: they take time and often additional resources. They need to be transparent and democratic. Not everyone carries their weight equally, so consortium participants need to be prepared to deal with this unevenness of effort. SERVIR hubs that do not use consortium models have a single point of failure; they lack robustness. Consortia also alleviate perceptions of favoritism, and allow demand in a region to be assessed through multiple lenses. Dr. Irwin's principal advice was to be ready for the fact that consortia take more up-front investment, be patient for the fact that consortia take time to get going, be specific (clearly define roles and

responsibilities), and be visionary, i.e. let the consortium help you strengthen and sustain the “Why” of the consortium.

### **Terrestrial Ecology**

Dr. John Battles, a professor at the University of California, Berkeley, presented his insights from his work in terrestrial ecology, in which he has been a part of multiple consortia, including the Hubbard Brook Ecosystem Study and the Sierra Nevada Adaptive Research Project (SNAMP). Dr. Battles expressed that he felt the primary advantage of using a consortium model was that it enabled science without the need for big money. This is almost a necessity in ecological projects. Citing a whole tree harvest experiment (1983-2014), which looked at the recovery of ecosystems after extensive tree harvesting, success was measured by knowledge production (i.e. publication of journal articles), Dr. Battles said each study was able to be built on previous studies. With SNAMP, successes included the mitigation of conflict between land management stakeholders and integrating research at management-relevant scale which is helpful in studying complex environments (owl territories, firesheds), and having intentional continuity of a project. Dr. Battles viewed the main challenges to consortium models as governance, integrating products between teams, difficulty in recruiting talent, lack of funding, differences in institutional cultures, and clashes between the new guard vs. the old guard. He likened the integration of multiple teams and managing work flow to disputing the desire for ham vs. turkey at Thanksgiving dinner. Dr. Battles’ advice for developing a successful consortium is having “radical transparency.” He advised consortium participants to have explicit expectations, to determine roles and responsibilities upfront, and to establish appropriate and strong team leadership, with community engagement. He felt that the inclusion of many voices was well worth the effort.

The ASAC debated the various merits and disadvantages of consortia. Dr. Wilkie thought that consortia of NGOs, university staff, and foundations were remarkable, but he felt that consortia needed to be composed of the willing. He thought that “contrived” consortia were not useful and had observed them to often fail. Coercing cooperation through a funding stream typically does not work. Ms. Price remarked that transparency, and the expectations of partners, were critical to success. She was happy to see that the presentations had validated the importance of communication, and felt it important to have insights, lessons learned, and guidance, captured. Captain Fuyuen Yip agreed with Ms. Price’s comments on lessons learned, and asked if it would be possible to capture the impact on building internal program capacity, when it is part of a consortium. In response to Capt. Yip’s question, Dr. Becker-Reshef said she had seen some evidence of strengthening internal capacity. Dr. Irwin noted that SERVIR had benefited greatly from its relationship with USAID, as it had better “organizational capacity” at the institutional level. There are many examples of this, but he hasn’t quantified the relative level of capacity of development between consortium and non-consortium models, specifically.

Based on chat conversations in the Webex platform about this use of commercial analytical tools and cloud providers, Dr. Saah asked how SERVIR had integrated Google and others into its program. Dr. Irwin felt it was important to figure out the best capabilities with multiple partners; as such, private sector collaborations have been valuable. He emphasized that it is important to focus on many partners rather than a with a single company. The consortium and hub models allow them to increase the capacities in the different countries in which they work. Dr. Battles commented, on the question of contrived vs self-

selected consortia, that consortia need to have a core of team players, to take advantage of the synergies between hubs and spokes; when spokes become too different, they need to be detached. Dr. Jahn remarked that consortia can be positive for government-to-government relationships, and wondered if the Applied Sciences Program could do this more intentionally: Is there a way to pursue better interfaces or expanded and accelerated interfaces with government partners? Dr. Battles commented that it is important to have some neutral territory- often the team that leads the consortium needs a third party. Dr. Saah asked the speakers: what happens when you have more willing participants than available resources, and how do you effectively include those participants without resources? Dr. Becker-Reshef said that while there are participants in Harvest that are not funded (and the majority of partners are not funded by Harvest), they may either bring their own funding or have some non-monetary resources that are valuable. (such as access to ground data); there are different levels of engagement among partnerships. That being said, it is a struggle since there are always more partners that they would like to bring in to the partnership. She also noted that being a neutral party helped facilitate access with different partners and manage different projects. Dr. Irwin felt that you get more bang for the buck with consortia. When a consortium reaches a critical mass, it needs to be clear about relationships—what are you contributing, what are you receiving? Transparency is necessary. Perhaps it makes sense to have different tiers of engagement. For SERVIR, they have regional partners, which have the mandate to engage the whole region, and national partners, which can go deeper in supporting engagement in their country. Dr. Saah said that consortia should avoid creating an “exclusive club.” Dr. Battles said that active recruitment is critical for continuity; leaders must bring in junior staff and empower them so that can eventually step into leadership roles. Dr. Becker-Reshef recommended creating a budget line to support new partners. A fellowship program is also helpful. Dr. Battles added that it should be incumbent on senior leadership to step down when appropriate. Consortium leaders need term limits or some other mechanism to allow others to lead, and that having this turnover occur before leaders enable continuity. Dr. Irwin added that small grants programs enable other players in the region to come to the table and be part of the broader consortium.

Dr. Saah asked: which approach (consortium vs. traditional grant) is more productive for products per dollar spent? Dr. Battles said consortia has a positive feedback model that can expand beyond traditional grant roles, but leadership roles can be problematic for academics because of the amount of effort required to keep the consortium together as opposed to furthering their individual research. As a result, the leadership need to be at the mid-career level to take on these roles. For Dr. Battles, he is unable to conduct the research that he would like to conduct without a consortium. Dr. Becker-Reshef agreed with Dr. Battles that there’s a large management role that required of her, and added that the consortium work had been very much aligned with her interests, but that productivity varies. She felt that the consortium construct helped her organization have a bigger impact and that there’s so much untapped potential, and the ability to achieve impact has motivated her. Dr. Irwin said that for SERVIR, it’s “and” and not an “or;” he thought the combination of grants and consortia was beneficial. With a single institution, it’s hard to go into a region without a consortium model; part of it is the longer-term perspective. With SERVIR, he hoped to get five-year partnerships in order to get to a sustainable framework. Dr. Saah brought up a point that Mr. Woody Turner raised in the Webex chat which was that perhaps grants are better suited for short-term efforts and that consortia are better suited for longer-term efforts.

Dr. Saah commented that consortia are expensive to build, and asked: When does it make more sense to build new ones and let old ones die? Dr. Becker-Reshef felt that consortia were less expensive to run, and more responsive than, a program made up of many individual grants. Consortia can stop and start projects on a faster time frame than a standard three year grant. In addition, while they give out small amounts of money, they are able to leverage other funded projects. Dr. Saah asked: If you're trying to figure out how to push science forward, should you build a new consortium? How do you make the decision? Mr. Friedl added that the Applied Sciences Program has been having discussions with the program elements: Do we run individual solicitations with 12-15 grants, or do we run it as a couple of consortia, or some other mechanism? Looking at inclusivity, productivity, what balance do we strike? Mr. Woody Turner offered his perspective on conservation in the American West, an area he thought was well-suited to the consortium model. Much has been going on in California to decide if there is a niche for NASA, or if the Applied Sciences Program wants to fund existing activities to stitch them together. He is interested in scaling up conservation efforts using remote sensing as a key integrator, but this integration is very hard to do. He is interested in integrating conservation efforts across scales, starting at the state scale, moving to regional, and then national. There are ongoing efforts to create a harmonized Landsat and Sentinel dataset, but this is taking a lot of time. This suggests that integrating other datasets will be challenging. He is therefore looking for ways to be creative with funding to attempt to tackle these data integration issues across scales.

Dr. Saah asked the presenters: When is it time to kill a consortium and when is it good to keep it running until 2030? When is it good to have a consortium with a defined ending? Dr. Irwin thought it was important to reflect at regular intervals on what is working and not working in a consortium: to ensure that metrics and roles are understood, it is critical to pause, reflect, and rebuild as appropriate, and maybe plan for ramp-down phases, or for shrinking certain aspects of the consortium. Dr. Becker-Reshef recommended keeping an eye on the consortium vision, and continuously evaluating both the program and how it is run with respect to appropriate metrics. If the consortium is no longer serving the goal and vision, it should, of course, should be terminated. Dr. Battles felt that consortia should keep asking themselves if they're pushing the science. For example, in continually trying to link more regions and watersheds, it is useful to consider whether the record is valuable in itself, while trying to answer new questions as they come up. It's about the basic science, and how it serves the users. The monitoring has to have a purpose. The bigger question is whether you should take this money and do something else with it. Dr. Indrani Graczyk, offering perspectives from her role as the Director of the NASA Western Water Applications Office (WWAO), a consortium funded by the Applied Sciences Program, remarked that she felt that consortia require tangible goals that everyone agrees to, and that members have to respect the values of the individuals involved. She felt that the consortium structure has worked very well for WWAO.

Dr. Saah asked the discussants to give insights on when to think about a consortium, and when not to. Dr. Battles said it's about having the right question and being able to make a longer-term commitment. For something that can be answered in three years, it's not worth it to build up the infrastructure for a consortium.. Dr. Irwin commented similarly that the long-term perspective and the reach of a consortium were valuable, as well as the needs of the region, and that program managers should carefully consider how much time and commitment they are willing to give to the effort, as well as the risk and the time associated with investing in a consortium. Dr. Becker-Reshef added that one must also consider whether

longer-term commitments needed coordinated efforts across projects, and which projects would be suited to individual grants? For program managers, it's also about how much time they want to spend identifying individual projects as opposed to the overall vision of a consortium.

#### **Session 4: Public Comment Period I**

##### **Public Comments**

Anthony (no last name given), identifying himself as a private citizen, said that while the consortium is a great idea, the outreach program is not up to par; they need to get beyond a closed university community. [Note: it was unclear if "they" referred to the Applied Sciences Program specifically or NASA as a whole]. He said that people (outside the NASA/academic community) are going above and beyond to try to get this data. He pointed out that large datasets which previously could not be used by many due to their large size, can now be processed through private sector tools. Anthony expressed that didn't see NASA playing a significant role in the effort in getting the data out there to the people who want it. Ms. Price, in response to Anthony, commented that NASA has organically supported industry, and that this shows the value of what Applied Sciences has done and that the existing engagements show that there is even more potential for additional work with the private sector. Anthony said that even at the undergraduate level, the capability is there, but it seems to be throttled by regulation. Dr. Saah noted that NASA (including SERVIR) has relationships with Google Earth Engine for the express purpose of bringing these data products and cloud-based computing solutions into underserved classrooms; maybe it's a matter of awareness. Anthony said that as he understood it, the cloud computing environment is confusing to the government.

##### **Day 1 Synthesis**

Mr. Friedl reviewed the next day's agenda. Dr. Sylak-Glassman closed the meeting at 4:02pm.

#### **July 29, 2020**

##### **Opening of Day 2**

Dr. Sylak-Glassman opened the day's proceedings, made some logistical comments, and announced that Applied Sciences Week will commence on 3 August and run through 6 August, and will include thematic breakout sessions and user panels ([appliedsciences.nasa.gov/appsciweek](https://appliedsciences.nasa.gov/appsciweek)). During Dr. Saah's brief morning absence, Ms. Price acted as ASAC Chair to kick off the day. Mr. Friedl introduced the day's first session, noting that while much applications work occurs within the Applied Sciences Program, it also goes on in the R&A and Data Systems programs, in addition to other components of the Flight Program and the Earth Science Technology Office (ESTO). Mr. Friedl introduced Dr. Jack Kaye, who has a wealth of knowledge and access to a large network within the NASA community.

#### **Session 5: ESD Research & Analysis (R&A) Program**

##### **R&A and Applications**

Dr. Kaye provided his perspective on ESD R&A and its applications components, aiming to leave ample time for discussion. The R&A program is built around six interdisciplinary research focus areas (atmospheric composition, weather, climate variability and change, water and energy cycle, carbon cycle and ecosystems, Earth surface and interior). Some of these have a one-to-one match with areas of the Applied Sciences Program and some of which have many interconnections with the Applied Sciences Program. Application components come in when R&A products are used in some routine way for decision-making. This may occur when the products get used for assessments, resource management, policy and regulation development, and forecasting. Specific areas where there is significant overlap between R&A work and applications include ozone assessment, air-quality related work, water quality, assimilation and forecasting in support of field missions, methane observations, sea level rise and coastal impacts, severe storms, ecosystems, urban heat islands, space geodesy inputs into reference frames; large scale agriculture data assimilation efforts; and work towards organized assessments such as the National Climate Assessment.

For ozone assessment, the Advanced Global Atmospheric Gases Experiment (AGAGE) network provides chlorinated fluorocarbon (CFC) measurements to help track the success of the Montreal Protocol (or identify violations); ozone measurements from NASA satellites are helping to document the extent of the recovery of the ozone hole.

In the area of air quality, NASA field campaigns in tropospheric composition provide data that can be used by local and regional partners. The Earth Venture Suborbital Campaigns, for example, have conducted large R&A campaigns in Korea (2016). The Fire Influence on Regional to Global Environments and Air Quality (FIREX-AQ), a joint venture led by the National Oceanic and Atmospheric Administration (NOAA) and NASA, provides data on the impact on air quality and climate from wildfires and agricultural fires across the continental United States. There are other small campaigns including the Ozone Water-Land Environmental Transition Study (OWLETS), focused on ozone concentrations around the lower Chesapeake Bay area, and the Lake Michigan Ozone Study (LMOS) of 2017. The tropospheric composition program also works with the Health and Air Quality Applied Sciences Team (HAQAST), notably.

In monitoring methane, the second most abundant greenhouse gas, ESD's airborne campaigns and satellite measurement of methane have identified hotspots for emissions. Airborne campaigns have been particularly effective in documenting regions with high methane emissions linked to human activity.

In the area of water quality, NASA has invested for several years in evaluating Lake Erie via airborne campaigns, to better understand and respond to major health events; there is much regional interest in Ohio for this work. NASA has also done remote sensing of water quality with the aim of advancing the science (hyperspectral imaging, e.g.). This work is continuing, and was part of the most recent Remote Sensing of Water Quality ROSES call. The Cyanobacteria Assessment Network (CyAN), began as an R&A effort, and then with the Applied Sciences Program together with NOAA and EPA, has become a phone application to allow users access to water quality data.

R&A also carries out work in support of the National Climate Assessment, and funds four efforts at NASA Centers in this area. NASA released a competitive solicitation for on climate indicators and data products that could be used in the National Climate Assessment.

In support of operational forecasting, NASA participates in the interagency organization Joint Center for Satellite Data Assimilation (JCSDA), which includes NOAA and the US Navy. The NASA Short-term Prediction Research and Transition (SPoRT) Center extracts information from new types of data to improve short-term forecasts, and the Global Modeling and Assimilation Office (GMAO) at NASA Goddard Space Flight Center (GSFC) provides in-mission forecasting for NASA field campaigns.

For disaster-related efforts, NASA ESD flies an unmanned aerial vehicle synthetic aperture radar (UAVSAR) instrument to help assess damage on the ground, aiding in response. Fundamental research has led to a Real-time Global Navigation Satellite Systems (GNSS) Tsunami Early Warning system; R&A also supports Advanced Rapid Imaging and Analysis (ARIA), which enables routine processing of SAR data for response to and monitoring of natural hazards.

In support of the Terrestrial Reference Frame (TRF), NASA's Space Geodesy Project (SGP) was initiated to use positioning, navigation, and timing data in order to develop a stable, standardized TRF. NASA also contributes to the National Earth Orientation Service (NEOS). The TRF is widely used by government and commercial entities.

## **Discussion**

Dr. Saah came online and resumed Chair duties. Ms. Price asked Dr. Kaye: In terms of focus, how do you come up with the primary areas for analysis, and how do you determine partners to work with? Dr. Kaye described the effort as bottom-up, with program managers writing solicitations, to which principal investigators (PIs) respond. Occasionally R&A asks PIs where NASA should be going for a field campaign, and PIs select the region of interest. There are roughly a dozen standing R&A programs within the focus areas. NASA has been doing work to study ozone for decades, and has received Congressional direction to do so in at various points. In other cases, a new capability comes along that can support new areas of focus, such as methane in the last decade or so; in this latter case, technology enables the science, which then leads to partnerships that are generated by the people who are doing the work. R&A stays engaged at the individual investigator level, and the NASA Headquarters level, which naturally leads to widening of networks. Recognizing the value of many complementary observations also leads to collaborations. Dr. Saah commented that during the last Decadal Survey, there was some push to proactively include applied sciences into some of these work efforts; he asked: how do science teams work and how do they interact with the Applied Sciences Program? Dr. Kaye said the science teams for the satellite projects are an ESD-level entity. For competed projects, the PI decides on the composition of the team. The Multi-Angle Imager for Aerosols (MAIA) team in particular is very applied in nature. In other teams, it's up to the project scientist to populate the team. In the DO studies, there's a lot more integration of science and applications, and they use a traceability matrix to track the science and applications. In the R&A world, there is much discussion of how to amplify the cross-benefits of science and applications. Dr. Kaye said that he sees participants trying to have those conversations take place early in the work. The interaction between science and applied fields works well in Air Quality, and in

other areas. With Biodiversity and Ecological Forecasting, there are the same two people managing the programs (one in R&A and one in the Applied Sciences Program). There have been joint solicitations, as well. R&A just went through a selection for the NASA Sea Level Science Team, which considers impacts on coastal communities. The R&A program is making an effort to make the integration more seamless, and what the right of joint-ness is, and is still figuring out the right way to do it.

Dr. Saah asked what would Dr. Kaye find useful in making better connections between science and applications. Dr. Kaye said that people must make time for the discussions, make connections between existing efforts, look for the connections between related efforts, and do things in a way to engage the community and provide opportunities. Joint solicitations between R&A and the Applied Sciences Program may have their place but are not a panacea. There needs to be communication across the research/applications interface. The review process should be inclusive and supportive of both research and applications interests. Dr. Kaye observed that the new generation of students is increasingly interested in working at this interface, while the (established) academic community often feels pressured to make explicit dividing lines between research and applications, so it is important to prevent roadblocks to working in that interface. Future R&A solicitations can include more explicit reminders to try to make the connections with applications. Captain Yip asked if there exists any formal documentation of these collaborations to enable evaluations of some sort. Dr. Kaye reported no formal documentation, but said that he has continued to make regular presentations to ESD, and has been focusing more on getting things done rather than documentation of the collaborations. The Health and Air Quality Applied Sciences Team (HAQAST) is a good example of natural overlap between the two communities. Mr. Friedl added that the Applied Sciences Program has written many stories about data products and the organizations that are using them, but these stories generally do not go into the background of where within the research programs the data products come from (such as algorithm research). He said it would be interesting to look at the origin stories of applications and that he would follow up with Captain Yip on these issues; there may be ways for NASA to learn how to emulate formal documentation practices, and maximize the recognition of NASA's end-to-end involvement in turning to research into useful applications. Dr. Kaye added that the best stories that NASA has are the ones that turn scientific research into societal use. Dr. Jahn asked: If you were to look ahead approximately five years, of all the science you're funding, are there areas that you are particularly excited about in which you think there might be a high-impact, unique NASA contribution? Dr. Kaye said that he thinks about the new capabilities that will be available, and cited the Tropospheric Emissions: Monitoring of Pollution (TEMPO) mission, a geostationary satellite in development, which will be able to monitor air quality over the US, as one exemplary mission. The future satellite mission,)Surface Water and Ocean Topography (SWOT), will be able to monitor river stage and lake height, add to arsenal of information on hydrology, is another. PACE and the Geosynchronous Littoral Imaging and Monitoring Radiometer (GLIMR), as well as NISAR, are assets that will provide data on oceans and coasts. Many new capabilities are coming along, such as remote sensing of snow. There are fundamental remote sensing issues that also need to be worked through. There is upcoming work on the carbon cycle, through ECOSTRESS. NASA can collect data from around the globe, and Dr. Kaye cautioned against staying in the domestic mindset when we can provide equivalent data around the world. The impact of space based data for developing countries may be very important. The rest of the world is looking at carbon in a different way than the U.S.; there is a lot of interest in what we can say from space and from aircraft. Geostationary Carbon Observatory (GEOCARB) and a new generation of geostationary satellites from partners such as NOAA and JAXA will provide much new information. New

solicitations are going out, and there is a large degree of community interest. There is also enormous community interest in commercial satellite data buys, and high-resolution spatial data.

Dr. Saah asked if the Applied Sciences Program could use specific recommendations to help amplify cross-benefits. Dr. John Haynes of HAQAST noted that it just had a final showcase at the end of its last four-year period, which is being re-competed in the Fall. Dr. Haynes said there had been amazing cross-pollination between HAQAST and the Tropospheric Composition program. Data are being heavily used by forest and fire services; with time, things are just getting better. HAQAST is planning to hold another airborne campaign with the Department of Energy (DOE) in Houston. The MAIA science mission, which enables correlation of atmospheric data with health outcomes, is truly a joint collaborative mission.

Dr. Kaye commented that years before, he had been involved in initial discussions with the Environmental Protection Agency (EPA) in developing models using NASA's ozone data; it took years to get it done. The Applied Sciences Program has to plant the seeds and recognize that it takes a long time to germinate. The true value that NASA provides to the nation is in producing both fundamental and societally useful science, in a rigorous way. Captain Yip asked, given the wealth of R&A work, how the Applied Sciences Program decides what to amplify through the program. Mr. Friedl responded that starting with the user, the Applied Sciences Program looks across the missions and encourages understanding of issues through discussions between PIs and partners/users. This is typically done through the solicitation process, where PIs help to identify the research that is appropriate to apply. The Applied Sciences Program also tries to understand the latest and greatest research, and looks for ways to apply it. The Applied Sciences Program focuses on helping the user apply the most appropriate research.

#### **Session 6: ESD Earth Science Data Systems Program ESDS and Applications**

Mr. Friedl introduced Mr. Kevin Murphy, Program Executive for the Earth Science Data System (ESDS), who, as part of a response to recommendations from ASAC, would be discussing the role of data systems in applications. Mr. Friedl commended Dr. Murphy for his excellent and refreshing leadership in the ESDS program.

Mr. Murphy gave an overview of the program. ESDS receives its current guidance from the 2018 NASA Strategic Plan, and is responsible for active management of all NASA satellite/airborne data; develops unique data systems capability; processes and reprocesses instrument data; upholds NASA's open data policy; engages the Earth Science community; and provides user service. This is done primarily through the Earth Observing System Data and Information System (EOSDIS), and the Inter-Agency Implementation and Advanced Concepts Team (IMPACT). ESDS helps to maximize the return on NASA data sets, concentrating on the data life cycle and its association with the research lifecycle (the analytic aspects of data). ESDS is designed to support both those activities, engaging with the community of users, and understanding evolving requirements, and it does this for a broad audience. ESDS holds over 33 petabytes (projecting 250PB by 2025), encompassing 12,000 unique products, and also conducts an annual customer satisfaction survey. ESDS has consistently scored well on these surveys, according to the American Customer Satisfaction Index (ACSI). ESDS also supports the wide range of international, airborne, and field campaigns and research products, as well as the storage of archival data. The archive is growing rapidly, thus it is adopting new approaches to manage the system and make it accessible to users,

through new adaptations such as cloud services, machine learning (ML) techniques, user training services, and targeted partnerships. ESDS is trying to leverage expertise and knowledge outside of NASA as well.

The ESDS Earthdata Cloud is focused on improving NASA's data system operations, preparing for planned high-data-rate missions, increasing opportunities for users without the need for data management, and using an expandable open data framework. ESDS is using an approach in which the data is close to compute (scalable compute), thus external users do not need NASA credentials to access open data. Users no longer need access to supercomputers. A Data Lake approach enables centralized mission observation data sets. A recent external review has found significant sustained progress in the transformation of the system. Today, the Global Hydrology Resource Center Distributed Active Archive Center (DAAC), Earthdata Search and Common Metadata Repository, and the Alaska Satellite Facility (Sentinel 1 only), are operating in the Cloud (AWS). ESDS is in good shape for the large data streams from SWOT and NISAR.

ESDS has initiated a staggered cloud migration process to ensure that core systems have technical support during migration. High-value data is being moved first. Low-priority data sets, such as limited access frequency, data, may never be migrated to the cloud. Open-source, cloud native software is used for all of this, as transparency is a core tenet of the program. To avoid AWS lock-in, ESDS is considering various data transfer, application transfer, infrastructure transfer, and knowledge transfer risks. The program is also considering Microsoft and Google, and open source alternatives, to address each risk area.

To support GIS users, ESDS has initiated an Earth Science Data Systems Geographic Information Systems Team (EGIST) to create a GIS capabilities inventory, designed to demonstrate the proper use of GIS for Earth Science. The team is in the process of developing Data Pathfinder tutorials and tools, to try to make products available today, and to make sure they will be accessible in the future. It will be necessary to be sensitive to how NASA preserves and store data. ML activities are in progress to prepare for future high-data-rate missions; ESD hosted a ML workshop earlier this year and learned a lot. Prototype ML efforts include using an ML algorithm to discover and store interesting events, as well as a deep learning technique, using GOES, that runs a model to estimate hurricane intensity using visible imagery, with the aim of creating a scalable, real-time system triggered by event notification. NASA also has an ongoing collaboration with the European Space Agency (ESA) to develop a multi-missions algorithm and analysis platform (MAAP) for Biomass, which hopes to be operational in a year.

Open science in the cloud will enable scientific collaboration across communities, and will both support and benefit from strategic public/private partnerships. NASA currently has Space Act agreements with both Google and Amazon Cloud. The Commercial Smallsat Data Acquisition program has transitioned from a pilot program to a sustained use phase over the last few years, while ESD continues to coordinate evaluation and scientific uses of the data with ESA. The next Request for Information (RFI) will be released in September 2020. Spire, Planet, and Maxar Technologies are the latest selectees in the program. There are some license considerations to keep in mind, as minimum data rights apply to all phases of the Commercial Smallsat Data Acquisition Program. NASA is working across the government on evolving licensing frameworks.

## **Discussion**

Dr. Saah asked if ESDS was providing opportunities to train users in some of the solicitations. Mr. Murphy noted that things are shifting quickly, which is proving to be a challenge. One issue is that the people who know how to do these things typically get premium salaries, and are not easy to recruit to the civil service. In addition, it will be important to collaborate with some of the big tech firms, as well as smaller groups that have the expertise. It is always challenging to address the training and workforce in this area. Dr. Saah commented that, in his personal experience, he had found value in reaching out to Google Earth. Mr. Murphy felt that a similar effort was under way at ESDS in pushing out into other groups. ESDS does have a partnership with Google Earth, and has ongoing conversations with them, as well as with Microsoft and Amazon. NASA has interesting and unique problems that are inherently interesting to these companies. Dr. Wilkie expressed interested in some of the AI work ESDS has been doing, citing a project that had been enabled by the existence of millions of professionally identified species on camera images. AI enabled a program through which 614 species can be identified with accuracy: Where is NASA finding training sets? Mr. Murphy said that ESDS typically does not see rich environmental data in the commercial arena, and will need to make a more concerted effort to find those training sets for environmental models. It will also have to overcome the problems of some closed and proprietary data sets and techniques. Mr. Murphy said he would welcome an ASAC recommendation on the subject of training sets. Ms. Price asked: Is the community focusing on standards? Is this a barrier to collaboration? Mr. Murphy felt it was hard to get harmonization of standards when the technology is evolving so quickly; it's a process that will have to iterate over time, and continue indefinitely. ESDS will have to continue to engage with the communities.

Ms. Price asked Mr. Murphy what he felt the barriers were to open data, open algorithms, open training sets, and open licensing. Mr. Murphy said that for NASA or the US government, there are clear guidelines for the openness of data, distributed via Office of Management and Budget (OMB) circulars, executive memos, and the like. The ESDS community embraces that spirit. Releasing data quickly, even before it is validated, helps NASA understand those issues. NASA recognizes the need for balancing commercial viability and the openness of certain data. ESDS is always working through it. Dr. Jahn mentioned that she served on a NOAA group, the Data Access Archiving Requirements Working Group (DAARWG), that addresses archiving. It is a structure that allows issues to be handled, and reveals strategic implications. She asked if there were a similar group at NASA that could provide useful advice to ESDS. Mr. Murphy said that he was familiar with DAARWG, and that ESDS has access to some similar advisory bodies, and also participates in interagency groups. At the lowest level, the program has user working groups, about 180 people who are experts in their respective fields, who can provide insight. ESDS also does programmatic evaluations every few years, works with USGEO, and holds bilateral meetings with NOAA. These efforts all feed into annual work plans. Dr. Jahn said that the NOAA model is a two-way street, and acts as more of a technical support resource for decision-makers. Mr. Murphy said he would be happy to learn more about DAARWG.

Dr. Saah asked Mr. Murphy to comment on what he perceived to be the main challenges to increasing the capacity of GIS within Earth Science. Dr. Murphy said that many users want to use GIS, and many users want to work with other tools, we well. GIS is getting better at formatting data, which reduces some of the barriers. Some Level 1 and 2 products are not suitable for GIS, however, and these constitute a lot of ESDS data. Historically, the scope is more on the standard products that come out of what are considered raster products. It could be that ESDS will have to start producing more vector products. SWOT data will

be easier to import into GIS products. Dr. Saah asked: How do you create new information pathways? Someone needs to be thinking about it. Mr. Murphy felt that many ESDS strategies recognize the challenges, but the pace of change is even more challenging. Geospatial data has been receiving more attention of late, which means it will be necessary for NASA to balance the need for fundamental science data, with the need for products that are useful societally. Communities will build and coalesce around emerging data products, and it will take time to do this with more experimental data (e.g., ICESat data). Captain Yip asked if ESDS had the ability to monitor to the types of data used, to help inform how to meet the needs of the data user. Mr. Murphy said there was no monitoring process, *per se*, but that ESDS does have annual competitive announcements through ROSES, and is also part of the Satellite Needs Assessment Group, wherein other government agencies state their needs for non-weather satellite data. If NASA can meet the need, it gets funding to do it. At the last meeting of the Group, there were requests for surface water data on a weekly basis, and another for InSAR processing. This is one way to get important feedback. A lot of these products will likely be vector products that can be easily used for GIS.

Dr. Saah asked what sort of support ESDS had for producing knowledge products, training users, and getting the science right? Mr. Murphy said that the program relied on some cost models, and demand models. With the cloud, not everyone is paying the same rates, nor do they have the same expertise. However, a NASA grantee would likely to be able to use cloud services at reduced cost. Dr. Saah said that users would need basic generic guidance on matters such as when to use edge-computing, for example. Mr. Murphy noted that Amazon releases something like 140 products per week, and most of these need to be vetted for NASA use (security considerations, etc.).

## **Session 7: Earth Science – Diversity and Social Equity**

### **Introduction to Topic**

Mr. Friedl set the stage for a discussion on ways in which NASA can encourage diversity and social equity, noting that recent events have highlighted the need to focus attention on issues of race and racism. Within the ESD leadership, and within SMD, there are many ongoing discussions and the recognition that more learning is in order. NASA has made some progress in gender diversity, but has a way to go in other areas. The way the Agency combines civil servants and contractors has resulted in a good gender balance. NASA and the Applied Sciences Program, however, recognize that there is still a need to improve diversity of thought, and to provide more leadership opportunities for Black people. ESD has renewed efforts to ensure diversity and inclusion, and continues to look for ways in which it can help advance these broader societal issues. Internally, the Applied Sciences Program has initiated a dedicated staff meeting to the subject, set up a five-person steering group, and identified diverse candidates for ASAC membership. Each program element is being asked to address these issues, and is doing program-wide training. The new ESD Director and the SMD have created an Anti-Racism Committee. In efforts outside of NASA, the American Meteorological Society (AMS) has created a Standing Board on women and minorities; the American Geophysical Union (AGU) adopted a Diversity and Inclusion Strategic Plan in 2018, and now has a committee dedicated to the plan. *Physics Today* recently published an article calling for a doubling of the number of African Americans in physics and astronomy. Mr. Friedl presented four questions for the ASAC to consider on these issues.

## **Discussion**

Dr. Jahn spoke as a former dean at a fairly large institution, and charged with the topic, and as someone who found it personally important. What hasn't worked is tokenism: not only does it not work well, it has been personally costly to the token individuals who were brought into unchanged environments. Supporting diversity is not about adding people who look different, or ticking the boxes. It's about assuring that institutions will accrue the benefits that come from diverse places. Dr. Jahn described her efforts in focusing on the earlier parts of the educational pipeline (elementary and middle school), where the stereotypes first get hardened. She described successful outcomes with a Milwaukee high school that had been segregated, as well as a similar project in Chicago; this very successful and recognized effort has been under way for about 25 years. There are many practices that inadvertently reinforce racial inequalities, but they are not unique to the Applications community. Any technical community tends to be a guild system (similar to the modern college admissions process), and as such they tend to make assumptions about their own inherent importance. Students entering the 9<sup>th</sup> grade can be tremendous solvers of hard problems, even if they have low reading scores. The biggest barrier in this area has been this reading issue. There needs to be an effort to unlock that talent at an earlier age.

Captain Yip noted that the CDC has a program bringing in middle school and high school teachers to introduce concepts of public health at an early age. CDC also has had internships and fellowships with HBCUs, also targeting opportunities for Hispanic students. It's important to intervene early to foster interest in these subjects; this approach has been helpful in bringing in more diverse students.

Dr. Nancy Searby responded to a question regarding how she might incorporate these things via the DEVELOP program. Dr. Searby noted that DEVELOP was in its 20<sup>th</sup> year, and has been digging into diversity more broadly than gender, particularly within the Greenworks program on addressing urban heat. DEVELOP also actively works with the Minority University Research and Education Project (MUREP), which gets funded through the NASA STEM office. STEM Director Mike Kincaid is considering the creation of new partnerships between MUREP and DEVELOP. The DEVELOP program typically does a lot of measuring.

Ms. Price offered a private sector perspective; she thought the focus on education was important, as well as paying attention to the talent pipeline, and diversity in hiring, to ensure that the industry is appropriately supporting persons of color. The private sector is also having a similar "moment" of realization, which has been a breath of fresh air. Recognizing that there are already best practices in existence, the private sector is now assessing themselves with diversity and inclusion metrics. The industry tends to fall back on the "average," however, which Ms. Price felt to be inadequate. She felt that there is growing recognition that the "average" is a low bar. But there has been backlash, and much of that blowback is unfortunately being experienced by the very people the industry is trying to include. There needs to be strong institutional support for diversity in order for it to be successful. Ms. Price recommended engaging with groups that are actively trying to prioritize diversity, and with communities that already have the richness to offer. It is also important to consider that it's not just an academic exercise; people need to be thoughtful about understanding the intersectionality of the individual, such as the single mom who needs to deal with the pandemic. It's about people.

Dr. Wilkie commented that the Wildlife Conservation Society (WCS) opposes tokenism, and against the Peter Principle. The Human Resources department within the zoos has been looking hard at diversity and inclusion, and generally the zoo employees reflect the diversity of the community. Internationally, WCS recognized that it needed to start early, and to mentor people from differing scholastic programs; this effort has been quite successful. However, WCS is still struggling in the area of senior management because salaries are low, it is difficult to attract a talent pool from outside the NGO community. WCS is attempting to do this with the use of a talented HR department. But senior management is still largely old white guys.

Dr. Saah suggested having internal diversity groups vet job descriptions to ensure that they are accessible, and post the job in places where as many people as possible can find it. Dr. Wilkie said that WCS uses this technique, and while it attracts great talent, new hires get head-hunted like crazy for their talent and expertise, which means WCS has to re-fill the talent pool all the time. Dr. Saah asked Dr. Kartik Sheth for his thoughts, as Dr. Sheth has had a parallel career in diversity and inclusion, and has started a couple of programs, internationally and nationally. Dr. Sheth commented that at the NASA level, as part of the Anti-Racism Group (ARG), he has been part of the effort in addressing today's issues. ARG is trying to keep the laser focus on the problem. The ARG, which is small, consisting of one representative from each division, has come up with a number actions that will be re-evaluated in about six months. At the SMD level there is a Working Group looking at the same issues; the solutions may well overlap. Dr. Sheth was very pleased that SMD Associate Administrator, Dr. Thomas Zurbuchen, is fully behind the effort; as noted by several discussants, there needs to be a leadership push in order for real progress to take place. Dr. Sheth said he had been seeing amazing momentum in the ASAC and in other committees. In the current political atmosphere, 80% of protesters are white, which he felt was a real change, representing a long overdue focus on the problems faced by Black, Indigenous, and People of Color (BIPOC) individuals. In his own personal view, Dr. Sheth said that the focus on pipeline bothered him, because its limitations are already known, and things haven't really improved; the idea needs to be expanded. He said he also agreed about the disadvantages of tokenism, but that the definition of the "best-qualified person" remains far too subjective. One must also consider the potential for improvement when hiring. It is necessary to nurture people through their talent lifecycle. Today, 40% of PhDs in astrophysics are women, and while there was much backlash in trying to increase the representation women over the last 15 years, people shouldn't be hesitant to forge ahead— regardless of the potential backlash. The community must also strive to change the climate. Climate is important, but leadership is key. Dr. Sheth also felt that academics need to acknowledge that they tend to be terrible mentors; they must reflect on this fact, and challenge themselves to improve. Dr. Wilkie commented that he thought mentorship depends in part on the organization, and cited a central African remote-sensing organization that had used mentorship successfully. Dr. Sheth said that the agents of change must focus on these things before they turn on the spigot on the pipeline. Dr. Jahn said she resonated with Dr. Sheth's comment on mentorship, noting that many academic communities are brutal and unpleasant, and do not provide a welcoming atmosphere. Nurturing is very important. She reported that some of the most meaningful interactions she had witnessed have been interactions with tribes. It is important to note that historically, tribes have had particularly brutal experiences with well-intentioned science initiatives.

Mr. Friedl noted that the Applied Sciences Program has a 5 five-person steering group that is addressing diversity and inclusion. Ms. Mcrae Lenahan Lent commented that the steering group is just getting

started, and that she was trying to incorporate the UGroup's team efforts on diversity and inclusion, which is further along than NASA. Dr. Searby commented that she was on the steering group, and resonated with Drs. Sheth's and Jahn's remarks. Dr. Saah commented on his experience in a South African Masters program, where he was admitted right after the fall of apartheid; as a Palestinian, he said was able to hold a "third party" position between white and Black South Africans.

## **Day 2 Synthesis**

### **Review Day 2 Outcomes, Findings, and Recommendations**

Mr. Friedl closed out the day's discussion, addressed the next day's agenda, centering on the development of a Applied Sciences Roadmap). Dr. Sylak-Glassman thanked all participants and adjourned the meeting at 1:02pm.

## **July 30, 2020**

### **Opening of Day 3**

Dr. Sylak-Glassman opened the meeting. Mr. Friedl noted the successful launch of the Mars rover, Perseverance earlier in the morning, and reviewed the agenda.

### **Session 8: Applied Sciences Program Roadmap**

Mr. Friedl thanked Ms. Zdenka Willis, and Drs. Sheth and Sylak-Glassman for their efforts in standing up the Applied Sciences Roadmap. The Applied Sciences Program is planning another workshop in August to help finalize the draft. The materials being used as grist for the Roadmap include the 2017 Earth Science Decadal Survey, the 2019 National Plan for Civil Earth Observations, the 2018 NASA Strategic Plan, the NASA Science Plan, and OMB/OSTP memos to the agencies from the last three years, in addition to numerous ASAC discussions. The Roadmap's preliminary structure include: Vision and Mission, Value Proposition, Voice, Design, Guiding Principles, Goals, Implementation, Initiatives, and Success. The three goals are: Accelerate Impactful Uses of Earth Observation (through both funding and leadership opportunities); Build and Share Knowledge (guidebooks, user conferences, how to help the community, how to reach underrepresented groups); Expand Partnerships (reaching beyond the usual suspects). The Applied Sciences Program is still in the process of writing objectives within each goal.

Dr. Sylak-Glassman thought that the process had moved along well, and that discussions with Headquarters had been very helpful, as the Applied Sciences Program tries to strike a balance between sustainable goals and objectives. Ms. Willis commented that there had been much discussion about the Value Proposition, as to where in the continuum between NASA (inside and outside) does the Applied Sciences Program belong; she welcomed more conversation along those lines. She added that "Voice" refers to articulating the importance and impact of Earth Observations on science, policy, and communication efforts. "Design" brings the Applied Sciences Program forward in the thinking behind mission objectives, to early adopters. The Applied Sciences Program has made strides here and it should be noted. The team is still thinking about Plan vs. Roadmap as a title.

Asked how the team came up with the three goals, Mr. Friedl said that with respect to design, the Applied Sciences Program talked to the user communities, managers, officials, and businesses, because mission designers don't typically talk to the users. The Applied Sciences Program is trying to get users to see how is ESD designing future missions and research pursuits, and to enable users to identify items that can be built in to the mission designs, to provide more societal value. Ms. Willis noted that her background was in the Navy and NOAA, and that she used her ability to step back and facilitate discussions within the Applied Sciences Program team. There were two strategic sessions held in advance of drafting the Roadmap; the first round was a compilation of Program Manager contributions, focusing on what the program has done well, and what it wants to do in the future. There were also discussions of challenges and opportunities internal and external to NASA. Lastly, the team considered what does a Strategic Plan should look like. During the second session, the team concentrated on specific views of a vision: the "why" and the "what." Through discussion, the "whys" and "whats" were winnowed down, with general agreement on the goals. Ms. Willis and Dr. Sylak-Glassman wrote up a draft, got feedback, resulting in Roadmap Version 1. Version 1 will go back to the group, with an eye to further refinement. There is yet to be agreement on implementation and the definition of success. Asked how the team discussed building and responding to demand, Ms. Willis said the team was very much focused on how to create demand, beyond the normal channels of the federal government providing money. NASA certainly understands how to work on the supply-side part of the equation. The draft is intentionally about building demand. Mr. Friedl added that the Applied Sciences Program has been trying to avoid the "if you build it, they will come" scenario, and has been trying to listen to the user organizations. NASA needs to know what the user challenges are: do they need access to sea level data, for example? He hoped that increased awareness, and showing the value of Earth observation-based decisions, will help attract users. The Applied Sciences Program doesn't have the budget to do a "build it and they will come" approach.

## **Discussion**

Dr. Jahn wholeheartedly agreed with Mr. Friedl's approach, and asked how the Applied Sciences Program investments in the consortia inform this activity. Mr. Friedl said the program has been looking at the monetary and non-monetary value of Earth observations, and anticipated that some organizations will ask for proof of benefits; that's what the impact studies of VALUABLES has done. In the case of algal blooms, the Applied Sciences Program has been looking at how to improve conservation efforts in coastal California, and to determine how broad the applicability is. It might be possible to draw more on impact assessments, which hasn't been done for writing the Roadmap, as yet. Ms. Price asked: How are you thinking of tackling objectives on the execution side? Is there a way to hit all three goals at once? In terms of private sector engagement, Ms. Price thought it would be powerful to use the influence of existing users of NASA Earth Observation (EO) data to provide "market intelligence," to go beyond the hype. Mr. Friedl said that the RTI's DO studies are looking at private sector and nonprofits, and their current interest in EOs, so that the Applied Sciences Program can share this knowledge with DO mission designers. It is anticipated that the Applied Sciences Program might hear a need for application tip sheets, or for help in navigating the DAACs. The Applied Sciences Program is not limited to RTI DO studies, however; it is also considering a private sector plan, as to what data formats they might need, and what data they might need in GIS formats.

Dr. Dan Sarewitz asked if there were appreciable differences between the Roadmap's Goal 2 and Goal 3, as they both appear to be about co-production of useful products. Mr. Friedl viewed Goal 3 as enabling the Applied Sciences Program to engage with incubators and accelerators, beyond its usual, grant-based comfort zone, and to implement engagement in new ways. Goal 2 was intended to acknowledge the need for a different knowledge base that is needed in working with users, vs. working with researchers; the Applied Sciences Program sees a responsibility to share with the community the things that have worked and those that haven't. Dr. Sarewitz thought it was clear that Goal 3 is about expanded implementation of operational capabilities. Mr. Friedl agreed with that interpretation. Dr. Sylak-Glassman felt that the distinction between the two goals was about ensuring there is a focused effort on engaging with the private sector; Goal 2 incorporates workforce development, improving project teams, and obtaining recognition for academic partners. Ms. Willis added that there are different types of partnerships beyond traditional federal engagement that the Applied Sciences Program could pursue; there are Department of State opportunities that could be explored, for instance. Ms. Price said she liked the concept of Roadmap, and in particular the concepts of Voice and Design, and the opportunity for the Applied Sciences Program to set the tone in demand-building, by letting people know what the Applied Sciences Program already has to offer.

Dr. Saah noted that there's always a tension between wanting to do more, and wanting to focus efforts—how does this tension fit into the Roadmap? Mr. Friedl said the Applied Sciences Program is looking for a strategy to drive these decisions and identify priorities, and welcomed ASAC thoughts on the balance between breadth and depth. Dr. Saah asked ASAC conversations about diversity and inclusion fit into this Roadmap. Mr. Friedl said that inclusion is a core principle Roadmap. In addition, Goal 2 can include bringing in underrepresented groups. When the Applied Sciences Program gets to the next Roadmap workshop, it will want to be mapping inclusion and diversity to each goal, whether or not it is written explicitly into the document.

Dr. Saah asked Dr. Sheth for comments. Dr. Sheth felt that diversity and inclusion should be a central theme in all three goals; as currently written, he said he viewed Goal 2 as capacity-building and sharing knowledge, and Goal 3 as bringing in new participants. Dr. Saah said that there needs to be the cross-benefit conversation, and as the workforce changes, evolves, and diversifies, there will also need to be a lot more proactive mentoring efforts. Mr. Friedl said that the Applied Sciences Program is trying to avoid the view that one part of the program owns a goal and doesn't need to heed the others. Dr. Saah commented that, as has been seen in the past, the noble causes can be crossed over to every element of the program, after which the conversation stops. There's no effort to run it to the ground at a typical program review; diversity and inclusion measures need to be actionable. Mr. Friedl said that with respect to Goal 2, the Applied Sciences Program is learning how important it is to craft narratives to demonstrate impact. Dr. Sheth asked: How do you hold diversity and inclusion up in a program review? How do we know we are actually succeeding? What sort of metrics go beyond numbers and show impact? Ms. Price suggested using lighter touch points for assessing value propositions. Maxar is metrics-driven. Ms. Price said that she hadn't seen an organization that has done such an in-depth strategy and completely executed it. She didn't have a best practice to offer from the industry side, but felt that a living strategy, such as using blog posts and other social media could broaden the audience. Dr. Wilkie commented that NGOs such as WCS employ ambient monitoring as a metric, watching the trends and hoping they are going in the right direction. WCS also has a huge advantage because it is embedded in governments in 60 countries;

communicating is still a challenge, but NGOs have rapt audiences that rely on the information NGOs can provide. Dr. Wilkie thought SERVIR still has a tremendous role to play in expanding partnerships. Dr. Friedl said the traditional way is through print media; the Applied Sciences Program is wondering if it should roll out stories in a more contemporary way. Dr. Jahn suggested a fun and nimble platform called Mixonium, designed by a former Disney Imagineer, which uses a series of clips to bring documents to life.

The committee spent about 15 minutes looking at the collective notes compiled thus far.

### **Session 9: Public Comment Period II**

#### **Public Comments**

No comments were noted.

### **Session 10: Discussion with ESD Leadership**

#### **Preparation for ESD Leadership Discussion**

ASAC prepared for a debriefing with Dr. St. Germain. Dr. Saah solicited comments on the pros and cons of the consortium model. Dr. Jahn suggested recompeting some consortia that were not successful, to perhaps reach important contributors that tend to get shut out, to maintain the “ecosystem,” and sets of capabilities that can’t be easily estimated. Dr. Wilkie agreed, adding that ASAC might also consider a finding stating that consortia should be time-limited. Consortia should come together because they are purpose-driven, and disband when they have met their purpose; the effort could be decades-long, but it should still disband when it has done its job. Dr. Saah agreed, noting that Dr. Battles had made similar points during his presentation. Dr. Sarewitz said he completely endorsed Dr. Wilkie’s points; consortia are meant to be creative and responsive, and they lose their edge when they get too big, or too institutionalized.

Discussing findings on the R&A program, Dr. Saah noted that there is no “silver bullet” to make cross-benefits of research and applications happen. Dr. Wilkie said that cross-disciplinary research is complicated because we do not have or use the tools to enable that conversation. Dr. Saah said he was hearing that R&A’s ties to Applied Sciences resulted from a reactive process; it might be good for ASAC to make a finding suggesting more proactivity in order to amplify those cross-benefits. He also noted that seems like they’re treading water to keep everything going. Dr. Wilkie said he got a sense, rightly or wrongly, that the R&A program relies on the same set of people is always doing the same set of stuff. Dr. Jahn and Ms. Price agreed with this thought. Dr. Saah asked Dr. David Green how his program made individual connections. Dr. Green said there were opportunities for his program to bring people and organizations together, but as the Applied Sciences Program develops the Roadmap, it’s more of a Program Manager discussion. He said he has explored options involving interns and post-docs, but this hasn’t been captured in strategic discussions. It’s more of an untapped opportunity rather than a challenge. Dr. Saah floated a recommendation to have the Applied Sciences Program identify instances in which successful cross-communications have occurred. The ASAC concurred.

The ASAC unanimously concurred on a Data Systems Program recommendation, and developed findings on the open sharing of data/software, and support for innovative partnerships and migration of data to the cloud.

ASAC requested an updated status on ESD's commercial data buys, and discussed a finding on equity and diversity, praising NASA for leaning forward on the topics. Ms. Price suggested calling out that ASAC can also make progress on this front, and commend NASA for helping the Committee be more thoughtful on this front.

### **Discussion with ESD Leadership**

Ms. Sandra Cauffman, former Acting Director of ESD, and Dr. St. Germain, joined the discussion. Dr. St. Germain described her career experience with passive microwave remote-sensing of oceans, within NOAA. Her first project was flying through Hurricane Gilbert in 1988, a 600-mile-wide storm, which was an experience that drove home the importance of extracting societal value from science and engineering, and cemented her decision to join NOAA. Dr. St. Germain also briefly described her experience with national security and the Department of Defense, and expressed gratitude to Ms. Cauffman for smoothing her way at NASA. She felt that NASA's ESD is the engine room that makes societal impact possible, and that she viewed Earth Sciences holistically. She also view Applied Sciences as an integral part of everything ESD is trying to do, and wanted to ensure that ESD coordinate its efforts more tightly up front, from the research phase to the user (non-scientist) phase, and make an effort to bring the user community into the mission planning process.

Dr. St. Germain noted that the business environment that NASA works within is changing; there is an increasing commercial presence, there is demand, and the barrier to entry is lower. NASA doesn't want to compete against these interests; rather, it wants to maximize their impact. For example, ESA, which flies a satellite that maps gases around the globe at low resolution, has paired with a private sector satellite that can see methane at high resolution, but with much less coverage, to provide information to the petroleum industry so they can repair their facilities. It would be good for ESD to more fully exploit this model. Given that NASA enjoys a high level of trust, the Agency must avoid stepping on toes in the private sector.

Dr. St. Germain supported the idea of communicating up and out in plain English, and also receiving feedback, and of telling ESD stories to a broad community of people through a strategic communication process. She said she looked forward to working with the Applied Sciences Program and strengthening communication and feedback mechanisms across ESD, and to experimenting with and evaluating when and how the Division should use such instruments as consortia. Dr. St. Germain was also determined to ensure that ESD is as inclusive and diverse as it is able to be, to meet its own aspirations, and to understand a variety of perspectives.

Ms. Cauffman praised the Applied Sciences Program and Mr. Friedl for their tremendous work in reaching out of the box with many approaches: SERVIR, conservation work, and the consortia, all of which make for a very rich program. The Satellite Needs Working Group response is a good example of the Applied Sciences Program's ability to successfully provide data to other agencies. The Applied Sciences Program has also been instrumental in putting applications in the forefront for the next Decadal Survey.

Dr. Saah expressed his appreciation for Ms. Cauffman's response to ASAC, and was glad to see that everyone seems to be moving in the same direction. Citing a past ASAC recommendation on setting up a dedicated wildfires program within the Applied Sciences Program, he asked Dr. Wilkie to comment. Dr. Wilkie said he hadn't realized how much wildfire concerns were actually covered in Dr. Green's Disasters program, and was glad to hear that NASA was already on the job, and that there did not appear to be a need for a separate program, after all.

Dr. Saah described the presentations ASAC had heard on the various consortia that the Applied Sciences Program is involved with, and the concept of radical transparency and its role in promoting trust. Dr. Wilkie reiterated his comments about consortia lifetimes and the nature of consortia members. Dr. Saah noted that ASAC concurs generally on the value of consortia, and is considering a potential recommendation on forming a Lessons Learned (LL) document on consortia. Dr. Saah also reported on ASAC impressions resulting from Dr. Kaye's R&A presentation. Dr. St. Germain expressed interest in an LL paper on consortia, and a consideration of different metrics, because all successes are not the same. Dr. Saah agreed to get some potential frameworks to talk about.

Dr. Saah described a finding on ESDS and Dr. Murphy's leadership, as well as ASAC's enthusiasm for open data and open sharing, as well as a general finding on how NASA's growing relationships with Google, MercyCorps, and the Red Cross, etc. are starting to bear fruit.

Referencing the SmallSat Commercial Data Acquisition Program, Ms. Cauffman announced that NASA has rolled on two new companies, and has released a new RFI. For the second round of selections, there will be a ROSES call to allow researchers to assess the data. There will be a third RFI at the end of the calendar year; ESD is in the process of figuring out how to allocate funds, and determine more consistent licensing agreements. Right now the licenses are very limited. NASA is talking to agencies like the National Reconnaissance Organization (NRO), to see what they are doing, and is investigating a tiered approach to licensing.

Dr. Saah described a finding on GIS-acceptable data, detailing more hunger for data-training; and a need to develop open training sets that global users could use. This approach is very forward thinking, and ASAC is pleased to hear it.

Dr. Saah detailed the Committee's conversation on diversity and inclusion, about which ASAC has seen clear signs of leadership at NASA. Dr. Jahn noted that, in areas beyond demographics, the Agency has shown a willingness to embrace different ways of thinking and working; she commended Mr. Friedl and NASA for their efforts. Ms. Price asked if St Germain saw a silver lining in the current COVID situation. Dr. St Germain thought that not being at the office lends itself to de-centralized thinking about tackling

the problem of inclusion and diversity. She said that there are ongoing activities at the SMD level, discussing the post-COVID scenario. The nature of the work that people are doing impacts their reactions to telework; what it means to be inclusive is also different among microcommunities. Dr. St Germain said she is seeing a lot more ownership of the problem at every level, which will lead to more thoughtful solutions; the focus should be on inclusion first. Diversity and making opportunities available is more of a structural issue. Referring to Dr. Michael New's recent initiative in using a double-blind selection process in grant programs; it immediately leveled the playing field, and blew up the usual excuses. NASA and SMD will continue to look at ways to make adjustments, and make structural changes where possible. Ms. Cauffman felt that NASA was going out of its way to change; it is evident that bias is ubiquitous, and people need to examine their biases.

Dr. St. Germain said she was looking forward to a long relationship with the ASAC.

## **Session 11: Meeting Synthesis Meeting Outcomes, Findings, and Recommendations**

### **Committee Report Development**

Dr. Saah asked ASAC members to finalize comments, which he would edit into the Committee letter.

### **Future Meetings**

Mr. Friedl presented potential topics for the next meeting: the Applied Sciences Program Roadmap, progress on private sector efforts, follow up on recommendations, progress on diversity efforts, status of the guidebook and user conference and applications in missions. Dr. Wilkie noted that the Applied Sciences Program often provides new, ideas that people might think are “bonkers” with EOs (such as using drones to count albatross nests in the Maldives); crazy stories provide attraction. Dr. Wilkie suggested that the Applied Sciences Program website host a “crazy solution” page, while acknowledging that the website is already head-and-shoulders above what it was before. Ms. Price thought it would be valuable to take it further, and to develop a community of practice to validate some of the crazy ideas. Dr. Sarewitz suggested holding an applications hackathon. Dr. Saah suggested a “Bonkers Moonshot Meeting.” Dr. Sarewitz suggested Shali Mohleji as a potential ASAC member.

Dr. Saah asked: Is the guidebook still relevant? Mr. Friedl felt it was time to revisit its status. The user conference will follow the guidebook, and may be part of the new strategy. Dr. Saah referenced an upcoming report on the NGO Landscape, which could be tied into the foundations topic, to identify potential next steps and additional opportunities. Dr. Wilkie thought ASAC should learn more about what the foundations are doing, and see if there might be a way for foundations to be rewarded for bonkers ideas, perhaps through some kind of NASA competition for applications work. Ms. Price offered her help with identifying points of contact. Perhaps ASAC could have a special session inviting some of these stakeholders, and share information. Mr. Friedl suggested a joint meeting with the Earth Science Advisory Committee (ESAC) and ASAC, and maybe combining this with the foundation discussion.

With regard to rewards and incentives, Mr. Friedl asked how the Applied Sciences Program might reward and recognize academia for doing applied research, as academic performance reviews typically do not recognize the value of applications work as compared with the publication of research papers. Dr. Wilkie felt that foundations could play a role in incentivizing applications work, such as promising introductions to organizations like the Gates Foundation. Ms. Price suggested funding consortia to undertake a Shark Tank approach.

Mr. Friedl suggested carving out meeting time to allow ASAC members to talk about what they are doing. Conversely, he welcomed ASAC to suggest inviting specific community members that the Applied Sciences Program should be hearing from, thought leaders around these topics.

### **Meeting Wrap-up**

Dr. Saah expressed gratitude for both Mr. Friedl's and Dr. Sylak-Glassman and their exemplary work. Mr. Friedl expressed his deep appreciation for the ASAC. Dr. Sylak-Glassman thanked the support team for conducting a successful remote meeting.

### **Adjourn Meeting**

Dr. Sylak-Glassman adjourned the meeting at 4:06 pm.

## **Appendix A** **Attendees**

### Applied Science Advisory Committee members

David Saah, ASAC Chair, University of San Francisco  
Lisa Dilling, University of Colorado  
Molly Jahn, University of Wisconsin-Madison  
Rhiannan Price, Maxar Technologies  
Daniel Sarewitz, Arizona State University  
David Wilkie, Wildlife Conservation Society  
Captain Fuyuen Yip, Centers for Disease Control and Prevention  
Emily Sylak-Glassman, NASA Headquarters

### Webex Attendees

Lawrence Friedl, NASA HQ

John Haynes, NASA HQ  
Jack Kaye, NASA HQ  
Woody Turner, NASA HQ  
Amy Dickinson, Science Matters Consulting  
Indrani Graczyk, NASA JPL  
Argyro Kavvada, NASA HQ  
Aries Keck, NASA HQ  
Benjamin Hodgkins, NASA Langley  
Bradley Doorn NASA HQ  
Brady Helms, NASA HQ  
Brian Tisdale, NASA Langley  
Chauvana Gupta, NASA HQ  
David Green, NASA HQ  
Emily Kennebeck, HQ  
Kartik Sheth, NASA HQ  
Helena Chapman, NASA HQ  
Joan Zimmermann, Self  
Karen St. Germain, NASA HQ  
Kevin Reateh, NASA HQ  
Laura Riders  
Lauren Childs, NASA Langley  
McRae Lenahan, NASA HQ  
Nancy Searby, NASA HQ  
Patricia Thomas, NASA  
Sandra Cauffman, NASA HQ  
Sara Brennan, NASA HQ  
Shana McClain, NASA HQ  
Yasha Moz, NASA HQ  
Zdenka Willis, NASA HQ  
Alistair Funge  
Amy Robinson, NASA HQ  
Dara Lubkin, NASA HQ  
Darrell Brennan, NASA HQ  
David Borges, NASA Langley  
Katherine Zezima  
Kevin Murphy, NASA HQ  
Leah Swizer, NASA Langley  
Patricia Thomas, FANDRA  
Alysa Witcraft, NASA HARVEST  
Kathryn Carroll, NASA HQ  
Christine Mataya, NASA HQ  
Crystal Vang, NASA HQ  
Dan Irwin, NASA MSFC  
David Faust, USF

*NAC Earth Sciences Applied Sciences Advisory Council, July 28-30, 2020*

Greg Stober, LARC

Helena Chapman, NASA HQ

Ian Johnson

Inbal Becker-Reshef, NASA Harvest University of MD

Indrina Gracvyk, NASA JPL

John Battles, UC Berkley

Keith Gaddis, NASA HQ

Kevin Reath, NASA HQ

Michael Henry, NASA HQ

Molly Jones, Family Church Group

Lamont DiBiasi, DiBiasi Assoc

Maudood Khan, NASA HQ

Sara Lumkin, NASA HQ

Sarah Brennan, NASA HQ

**Appendix B**  
**ASAC Membership**

David Saah, ASAC Chair  
Department of Environmental Science  
University of San Francisco

Lisa Dilling  
University of Colorado

Molly Jahn  
Department of Agronomy  
University of Wisconsin – Madison

Rhiannan Price  
Maxar Technologies

Daniel Sarewitz  
Consortium for Science, Policy, and Outcomes  
Arizona State University

David Wilkie  
Wildlife Conversation Society

Capt. Fuyuen Yip  
Centers for Disease Control and Prevention

Emily Sylak-Glassman  
Designated Federal Official  
ASAC Executive Secretary, NASA

**Appendix C**  
**Presentations**

1. Earth Science, ESD, and the Applied Sciences Program Updates; *Lawrence Friedl*
2. NASA Harvest Consortium; *Inbal Becker-Reshef*
3. NASA SERVIR; *Dan Irwin, Ashuthoth Limaye*
4. NASA Terrestrial Ecology; *John Battles*
5. Research and Analysis, and Earth Science Applications; *Jack Kaye*
6. Earth Science Data Systems and Applications; *Kevin Murphy*
7. Earth Science; Diversity and Social Equity; *Lawrence Friedl*
8. Applied Sciences Roadmap; *Lawrence Friedl, Emily Sylak-Glassman*

## **Appendix D**

### **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
- Consortium as a Programmatic Model
- Applications and the Research & Analysis Program
- Applications and the Earth Science Data Systems Program
- Diversity and Equity with the Earth Science Community
- Applied Sciences Program Roadmap

The primary objective is to discuss Earth science applications done in parts of ESD beyond Applied Sciences Program and to formulate findings and recommendations. A product of the meeting is a draft summary or outline of the ASAC's findings and recommendations.

*Note: Information about audiovideo access to the meeting is at the end of this document; updates will appear in future versions of the document.*

**Day 1: July 28, 2020 • 11:30 am – 4:00 pm ET**

<i>Set-up</i>	<i>Times ET</i>
<b><u>Session 0: Federal Advisory Committee &amp; Ethics Training</u></b>	<b>11:30 – 12:30</b>
Ethics Training ( <i>NASA Office of the General Counsel</i> )	
<b><u>Session 1: Overview and Meeting Objectives</u></b>	<b>12:30 – 12:40</b>
Opening of Meeting ( <i>Sylak-Glassman</i> )	
Introductions ( <i>ASAC Members, Executive Secretary, Executive Recorder, Public</i> )	
Welcome and Meeting Overview ( <i>Friedl, Saah</i> )	
<b><u>Session 2: NASA Earth Science</u></b>	<b>12:40 – 13:35</b>
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>	<i>13:35 – 13:45</i>
<b><u>Session 3: Consortium Approaches</u></b>	<b>13:45 – 15:45</b>
Introduction to Topic ( <i>Friedl, Sylak-Glassman</i> )	
Guest Speakers	
- Inbal Becker-Reshef, NASA Harvest Consortium	
- Dan Irwin/Ashutosh Limaye, NASA/USAID SERVIR	
- John Battles, University of California-Berkeley	
Discussion ( <i>Led by Saah</i> )	
<b><u>Session 4: Public Comment Period I</u></b>	<b>15:45 – 15:50</b>
Public Comments ( <i>Led by Sylak-Glassman</i> ) – extend time as needed	
<b><u>Day 1 Synthesis</u></b>	<b>15:50 – 16:00</b>
Review Day 1 Outcomes, Findings, and Recommendations ( <i>led by Saah</i> )	
Preview Day 2 Activities ( <i>Saah, Friedl</i> )	

*Adjourn Day 1 of Meeting (Sylak-Glassman)*

**Day 2: July 29 • 9:00 am – 1:00 pm ET**

<i>Set-up</i>	<i>Times ET</i>
<b><u>Opening of Day 2</u></b>	<b>9:00 – 9:05</b>
Opening of Day 2 ( <i>Sylak-Glassman</i> )	
Day 2 Overview ( <i>Saah</i> )	
<b><u>Session 5: ESD Research &amp; Analysis Program</u></b>	<b>9:05 – 10:20</b>
R&A and Applications ( <i>Kaye</i> )	
Discussion ( <i>Led by Saah</i> )	
<i>Break</i>	<i>10:20 – 10:30</i>
<b><u>Session 6: ESD Earth Science Data Systems Program</u></b>	<b>10:30 – 11:45</b>
ESDS and Applications ( <i>Murphy</i> )	
Discussion ( <i>Led by Saah</i> )	
<b><u>Session 7: Earth Science – Diversity and Social Equity</u></b>	<b>11:45 – 12:50</b>
Introduction to Topic ( <i>Friedl</i> )	
Discussion ( <i>Led by Saah</i> )	
<b><u>Day 2 Synthesis</u></b>	<b>12:50 – 13:00</b>
Review Day 2 Outcomes, Findings, and Recommendations ( <i>led by Saah</i> )	
Preview Day 3 Activities ( <i>Saah, Friedl</i> )	
<i>Adjourn Day 2 of Meeting (Sylak-Glassman)</i>	

**Day 3: July 30 • 11:30 am – 4:00 pm ET**

<i>Set-up</i>	<i>Times ET</i>
<b><u>Opening of Day 3</u></b>	<b>11:30 – 11:35</b>
<b>Opening of Day 3</b> ( <i>Sylak-Glassman</i> )	
<b>Day 3 Overview</b> ( <i>Saah</i> )	
<b><u>Session 8: Applied Sciences Program Roadmap</u></b>	<b>11:35 – 1:15</b>
<b>Introduction to Topic</b> ( <i>Friedl/Sylak-Glassman</i> )	
<b>Discussion</b> ( <i>Led by Saah</i> )	
<b><u>Session 9: Public Comment Period II</u></b>	<b>13:15 – 13:20</b>
<b>Public Comments</b> ( <i>Led by Sylak-Glassman</i> ) – extend time as needed	
<i>Break</i>	<i>13:20 – 13:30</i>
<b><u>Session 10: Discussion with ESD Leadership</u></b>	<b>13:30 – 15:15</b>
<b>Preparation for ESD Leadership Discussion</b> ( <i>30 min; led by Saah</i> )	
<b>Discussion with ESD Leadership</b> ( <i>60 min; led by Saah</i> )	
<b>Follow-up Discussion</b> ( <i>15min; led by Saah</i> )	
<i>Break</i>	<i>15:15 – 15:25</i>
<b><u>Session 11: Meeting Synthesis</u></b>	<b>15:25 – 16:00</b>
<b>Meeting Outcomes, Findings, and Recommendations</b> ( <i>led by Saah</i> )	
<b>Committee Report Development</b> ( <i>Led by Saah</i> )	
<b>Future Meetings</b> ( <i>Led by Saah</i> )	
<b>Meeting Wrap-up</b> ( <i>Saah, Friedl, Sylak-Glassman</i> )	
<b><i>Adjourn Meeting</i></b> ( <i>Sylak-Glassman</i> )	<b>16:00</b>

