Ms. Sandra Cauffman
Director, Earth Science Division
Science Mission Directorate
NASA Headquarters
300 E St SW
Washington, DC 20546

May 9, 2019

Dear Ms. Cauffman,

The Applied Sciences Advisory Committee (ASAC) met in-person in May 2019. We received excellent briefings and had productive discussions on a variety of subjects. The Earth Science Division (ESD) and the Applied Sciences Program are to be commended on how they coordinate ASAC meetings that are well organized, informative and transparent in both Applied Sciences strengths and challenges. The meetings strongly support us in providing advice and give us confidence in the sound management of ESD and the Applied Sciences Program. Our letter report provides summaries of key topics and findings and recommendations from these discussions.

During our May meeting, we received a high-level overview of Applied Sciences recent work in its primary program areas and initiatives: Health and Air quality, Water Resources, Ecological Forecasting, Disasters, Food Security and Agriculture, Capacity Building, Missions and Applications, Sustainable Development Goals, and Prizes and Competitions. We also learned of their ad hoc, supporting work in the areas of energy, urban development, and transportation-infrastructure. We received briefings and had rich discussions with the VALUABLES consortium for social and economic impacts of Earth observations, Applied Sciences technical content and communications strategy, ESD implementation of the 2018 Decadal Survey, and planned engagement with commercial and private sector entities. We are very grateful for the discussions with you and Paula Bontempi and your perspectives on NASA Earth Science priorities and director.

Applied Sciences Program

FINDING: ASAC continues to be impressed with the leadership and accomplishments of the Applied Sciences Program and its service to advance ESD and NASA goals. NASA ESD and Applied sciences should take satisfaction in their ongoing work with collaborators in government agencies, private sector, non-profits, and universities domestically and abroad to foster societal uptake of scientific advance.

Some of the ASAC members have observed the Applied Sciences Program for many years, and for others the May 2019 meeting was there first. All members noted the collaborative approaches the Program is using and supporting others to use.

FINDING: Applied Sciences commitment to building a culture of collaboration between knowledge producers and knowledge users is a significant strength. ASAC recognizes that the nature of applications to support knowledge transfer and adoption by the partner organizations is inherently collaborative. ASAC congratulates and is impressed by the degree to which a collaborative culture is increasingly becoming a part of all Applied Sciences Program activities. We learned that some program areas put a strong emphasis on attending forums where the users and managers from that applications theme gather, and ASAC recognizes and applauds this approach for understanding the user communities and their norms, value chains, and trusted sources.

- **RECOMMENDATION:** The Program should consider how to continue to build and formalize this collaborative culture across multiple sectors (Public, Academic, Private, and Non-Profit). ASAC encourages ESD to include this topic for discussion at an upcoming ASAC meeting.

- **RECOMMENDATION:** ESD should sustain an Applied Sciences presence at inclusive forums. Applications areas that have been doing this should maintain these activities, and other applications areas should begin or increase its presence. Attendance at major user-community conferences can regularly bring the Earth science applications community together with the user community to build a shared understanding of experiences, expectations, capabilities, and limitations in both communities. This recommendation extends to all program areas and the Applied Sciences consortiums, such as Harvest, VALUABLES, Western Water Applications Office, and SERVIR.

  In addition, ASAC encourages ESD to examine the annual conference of DOD's environmental science and technology program - the SERDP and ESTCP Symposium – as a model for effective practices to enable collaborations; Applied Sciences could apply their effective practices at user conferences it attends or in other activities it pursues.

- **RECOMMENDATION:** ASAC re-iterates prior recommendations for the Applied Sciences Program to develop a guidebook or manual for the community to document lessons learned over the past 10-15 years on effective ways to conduct applications, work with users, and manage projects.

FINDING: Applied Sciences pursuit of methods to institute programmatic agility and flexibility is productive and beneficial. At this meeting and prior ones, ASAC has learned about approaches Applied Sciences has initiated for creative engagement with user communities to identify opportunities and to create agility in the response and collaboration. Examples include the Health and Air Quality Applied Sciences Team, Harvest Consortium, WWAO, DEVELOP, ARSET, and SERVIR Applied Sciences Team. ASAC notes that the Earth Decadal Survey stated "Agility in programmatic structures, and in the authorities of staff who implement programs, is essential to respond to new discoveries and emerging needs, particularly in the context of resource constraints." ASAC supports continued ideation with programmatic innovation and administrative methods by Applied Sciences and ESD in pursuing its mission.

- **RECOMMENDATION:** Applied Sciences should systematically integrate agile learning into its program areas. ASAC recognizes that the traditional ESD approach includes solicitations and usually grants for approximately 3-year projects. While this approach may serve research and applied research activities, more agile approaches may be needed for applications work. There may be cases where elements of a project have different product cycles. Applied Sciences should strongly consider programmatic and administrative approaches so that sub-parts of a multi-year project that have different product cycles are rolled out throughout the life of the project and not just at the end.

  ASAC encourages the broad Applied Sciences team to pursue agile learning training and seek to apply agile methods, such as Scrum, into its activities. ASAC encourages Applied Sciences to extend such training to its project teams to gain experience with agile methods.

  ASAC recognizes that building trust and maintaining relationships with organizations are critical to achieving applications, successful adoption, and co-identification of future research and applied research topics – and that trust and relationships take time. Our recommendations above are not intended to shorten projects, make projects purely transactional, or support only mature applications. Instead, we emphasize and recommend a portfolio approach to projects and agile methods to allow and incentivize projects to mature organically (rather than a pre-determined, traditional 3-year cycle).

- **RECOMMENDATION**: Applied Sciences should articulate its approach to enabling opportunities across the ARL spectrum. ASAC, like Applied Sciences, recognizes that not every application project needs to have a goal of ARL 9, but the community may perceive this. There are needs for proof-of-concept application studies, high-risk/break-through applications activities, rapid prototyping, and applied research in addition to efforts for development and adoption of more mature applications. ASAC recommends that ESD and Applied Sciences better articulate its approach to the community in order to damp the perception stated above. Applied Sciences should put together a plan on its balance of project/study types, and ASAC could review and provide comments and advice.

FINDING: Traditional performance metrics in Earth Science limit NASA's potential societal benefits, return on investment, and impact. Publications are an established element for sharing knowledge in the scientific community and are used as a traditional metric in judging performance. The work of applications and securing lasting societal benefits from Earth science involves skills, engagement, and activities that take time that may reduce one's publication levels. ASAC is concerned that overly publication-centric metrics may dissuade and dis-incentivize qualified and interested people from pursuing applications and engagements with user communities that generate the societal benefits. ASAC appreciates that the Applied Sciences Program is considering this difficult, sensitive topic as part of NASA's strategic efforts to advance research and societal benefits from its significant public investments.

- **RECOMMENDATION:** NASA Earth should examine this topic in-depth and appropriately modify performance metrics to allow and to value time for applications-related work for scientists (and others) interested in pursuing such work. The relationships and trust built

with user communities through applications work represent an asset value to the organization. ASAC recommends that ESD recognize and value these relationships as strategic assets and incorporate in performance metrics, and ESD should provide guidance on this topic to its Centers.

The skills and activities to engage non-research users, achieve applications, and enable societal benefits from Earth Science observations are distinctive. NASA should support and reward the development of these competencies at NASA Centers and in the community. With the value Earth science can bring to society, NASA should work with the Earth science community to tackle this issue broadly and enable appropriate structures for reward and recognition.

Applied Sciences has successfully targeted applications of NASA science across a broad swath of the national agenda. In the high-level overview of Applied Sciences primary areas, ASAC learned that climate and weather are crosscutting themes that integrate into all of the areas, and this approach seems appropriate. ASAC was briefed on how Applied Sciences was contributing to a variety of the United Nations' Sustainable Development Goals (SDG). We also learned that there is no longer a dedicated program to Wildfires as has been the case in prior years. We learned that ESD has spread wildfire applications into the Ecological Forecasting, Disasters, and Health & AQ programs.

FINDING: The current approach to Wildfires applications is minimally adequate but far from ideal. ASAC recognizes that Earth observations can play roles from before any wildfire starts in assessing and reducing risk, to during fires in supporting strategic and tactical response, to after wildfires end in supporting remediation. While ASAC recognizes that Wildfires are cross-cutting in nature and that multiple applications areas may touch on Wildfires topics, ASAC is concerned that the lack of a dedicated program is suboptimal to addressing this national issue adequately.

- **RECOMMENDATION:** ESD should strive for a dedicated Wildfires area and a dedicated program manager. This topic represents a strong opportunity for cross-benefits within ESD and a clear way to address a topic of national importance.

Earth Decadal Survey

ASAC had a dedicated meeting to the Earth Decadal Survey in June 2018. At the May 2019 meeting, ASAC received an update on ESD's progress in implementing the Earth Decadal Survey, including a particular emphasis on the applications activities.

FINDING: ASAC commends NASA for acting on the Decadal Survey recommendation for integrating applications into mission planning. The inclusion of applications members to the Mission Science Teams in future solicitations and open calls is a forward-thinking and strategic integration of resources that makes accomplishing many of the directions in the DS achievable.

- **RECOMMENDATION:** ASAC recommends that each Applied Sciences program area examine the Societal/Science Goals and the Science/Applications Objectives from each of the Panels in the Earth Decadal Survey. These represent opportunities for Earth Science – both Applied Sciences and Research – to make progress on the Decadal Survey in parallel to the longer-term development of the observing systems and flight projects. Similarly, these represent specific topics to amplify the cross-benefit of science and applications identified in the Decadal Strategy. ASAC specifically requests a status on Program and ESD activities on these topics – Goals/Objectives and the Cross-Benefits – at its next meetings.

- **RECOMMENDATION:** ASAC is pleased that applications are part of the scope of the observing system studies that ESD is pursuing for the Designated Observables and that applications will support the concept for a mission/observing system.

  In the identification of potential users of new observing systems, ESD should include researchers associated with the respective applications area communities. Not everyone in an "applications community" is a decision maker. Some people in those communities are also researchers, but they don't identify as part of the Earth Science community. Thus, the data from a mission could support and enhance their research.

Private (Non-Public) Sector Engagement

A primary topic at the May 2019 meeting was Applied Sciences engagement with the private/non-public sector, such as commercial entities, NGOs, and foundations. Applied Sciences identified three key reasons for pursuing this engagement. The first is an increase in the overall user base that includes broadening the types of organizations working with Applied Sciences. The program's portfolio in recent history has been heavy on academic and federal government institutions, and Applied Sciences would like to include more non-public organizations in its portfolio. Second is broadening of applications for observations beyond the typical visible and NIR measures. And third is bringing them into Decadal Survey activities and building up applied use cases for emerging sensors that include those identified in the Decadal Survey and systems in applications.

FINDING: ASAC understands and supports the strategic purpose in the pursuit of private/non-public sector. This sector represents a direction for significant growth opportunities for Applied Sciences and ESD. ASAC finds that mechanisms to engage private companies will likely look different than NASA Science's traditional solicitations and grants mechanisms.

- **RECOMMENDATION:** Applied Sciences should conduct a landscape analysis of the private/non-public sector. An assessment of this type could identify potential partnerships and opportunities for Applied Sciences to accelerate its impact.

- **RECOMMENDATION:** Applied Sciences and ESD should inventory and take advantage of all the authorities NASA has, consistent with law and policies. Applied Sciences should

develop a plan for commercial sector engagement, including identifying special expertise in engaging with commercial entities or issues related to commercialization and intellectual property. Applied Sciences should consider having a private sector ambassador as a point of contact.

ASAC acknowledges that NASA's full, free, and open data policy is a treasure to the nation and should not be diluted. If things progress, ESD should carefully consider under what conditions a taxpayer delivered "free" public good would be transitioned.

- **RECOMMENDATION:** The Applied Sciences Program and ESD should pursue novel approaches to engage organizations that have been underrepresented or non-traditional to NASA Earth Science and novel mechanisms to allow flexibility and agility in serving the Program's objectives. Examples include: Bridge-science financing that would help the private sector get applications on the ground; Blue Forest Conservation, which has proven successful for the US Forest Service; Personnel exchanges; Capacity building efforts focused on the non-public sector on how to write strong ROSES proposals; Modifications proposal review process that includes significant viewpoints and representation from beyond the traditional academic and government perspectives. ASAC also recommends that Applied Sciences examine the style of RFPs that the commercial sector is familiar with and incorporate such elements into its calls.

- **RECOMMENDATION:** Applied Sciences should engage commercial entities to support capacity building efforts, leveraging their focus on corporate citizenship and volunteering. Many companies and others allow their employees to spend part of their time supporting social good efforts, including data scientists and others.

Small Satellite Data Buy Program

ASAC received a status update on ESD's Private Sector Small-Satellite Constellation Pilot at the May 2019 meeting.

FINDING: ASAC praises ESD for including applications in the Constellation Pilot. ASAC appreciates the responsiveness of ESD to its recommendation. The resulting evaluations will be of significant use to ESD and the research and applications communities, and ASAC recognizes an opportunity to link needs from the study to future NASA capabilities and prepare existing tools for the evolution of technologies.

- **RECOMMENDATION:** ASAC requests a status report on this topic an upcoming ASAC meeting.

Communications

Applied Sciences provided ASAC with an overview of its technical content and communications strategy, with the final strategy to be provided to ASAC in the near future. Applied Sciences also informed ASAC about the amazing *Space For U.S.* website and communications project (https://www.nasa.gov/SpaceforUS/).

FINDING: Communications is a core element of the Applied Sciences Program's strategy. Over the years, ASAC has many times encouraged and recommended that the Applied Sciences Program needed a strong, dedicated communications effort to share its results and to show the relevance of NASA's benefits to the nation and the world. It finally has a well-organized effort. NASA would be well served to nurture and support this effort and build on it. A change at this stage would be detrimental to NASA's aims.

- **RECOMMENDATION:** Applied Sciences should move quickly to implement its technical content strategy and use communications to further its mission.

- **RECOMMENDATION:** Applied Sciences should develop a communications capacity building effort focused not only on the use of Earth observations data but also how to communicate results and learning. ASAC emphasizes the importance of sharing stories where success is mixed or where failures occurred, as there are lessons learned that would be helpful for the broader community.

- **RECOMMENDATION:** A simple communications plan should be an essential element of all awards that Applied Sciences (and ESD) issues. The Applied Sciences team should provide guidance to proposers on key items in a communications plan as well as on-going guidance and interaction with successful project teams.

Collaborative Science

FINDING: Applied Sciences is to be commended on its novel use of a consortium model for the development of collaborative EO science. ASAC has been presented with domestic examples of such efforts including HAQAST, WWAO, and VALUABLES with the expectation that ASAC learns about the Harvest food security consortium (https://nasaharvest.org) in an upcoming meeting. ASAC recognizes that Applied Sciences has also invested in the SERVIR network, which leverages a collaborative co-development approach on the global stage with five unique hubs. Given these networks, Applied Sciences currently has multiple distinct examples of collaborative-based applied science that it should use for learning.

- **RECOMMENDATION:** Applied Sciences should conduct a meta-analysis of the multiple consortiums and collaborative science examples it supports with the objective of increasing the use of their models use to Applied Sciences agility, replicability, and flexibility.

- **RECOMMENDATION:** ASAC requests ASAC requests a discussion of Harvest and SERVIR at an upcoming meeting along with a general discussion on consortiums.

- **RECOMMENDATION:** Based on the presentation and discussion around an incubator example between the private sector and NOAA, ASAC recommends that Applied Sciences investigate this incubator model, as well as other accelerator and social entrepreneurship models, for increasing more private sector engagement and increasing collaborative science with the private sector.

- **RECOMMENDATION**: Applied Sciences should leverage and make use of existing networks to seek out utility for its applications and applied sciences activities. Stakeholders can become fatigued with too many independent requests for engagement, In particular, WWAO should collaborate and leverage existing stakeholder networks to the maximum extent possible. It is important that WWAO find out at what scale its information may become useful. WWAO should reach out to a variety of existing boundary organizations to complement its in-house efforts – both so as to not "reinvent the wheel" and to make rapid progress finding out where WWAO data and information products could be most usefully applied.

Applied Science Advisory Committee

This ASAC meeting included three new members and was the final meeting of two long-term committee members. With extreme gratitude, ASAC thanks Bill Hooke for his wisdom and years of service on the committee and thanks Kass Green for her leadership as ASAC Chair and years of service on the committee.

FINDING: ASAC is pleased with the expansion of the committee to include three new members that represent a diversity of experience and domain expertise coming from multiple geospatial sectors. It is clear to ASAC that Applied Sciences is clearly thinking of how to sustainably harvest and integrate feedback from a diverse advisory committee. This feedback is dependent on personal experience and learnings from existing NASA programs. With new members joining ASAC, exposure to more of ESD and Applied Sciences is critical for the committee to be of value. In addition, there were specific topics that arose at the May 2019 meeting that may be very beneficial to address at future meetings.

- **RECOMMENDATION:** ASAC recommends maintaining a full committee of ten members and requests that NASA pursue new members who are of equal caliber of Bill and Kass.

- **RECOMMENDATION:** ASAC requests a status on the implementation of the Flight Project Applications Program Directive at the next meeting.

- **RECOMMENDATION:** ASAC recommends that ASAC and Applied Sciences present at a future Earth Sciences Advisory Committee meeting.

- **RECOMMENDATION:** ASAC requests that a future meeting have a discussion with R&A to examine other parts of ESD that address applications.

- **RECOMMENDATION:** ASAC requests that a future meeting have a discussion about GIS and NASA Earth Science.

On behalf of the ASAC Committee, we are very grateful for the opportunity to provide our advice and recommendations to you and NASA Earth Science, and we are grateful for how NASA has considered prior findings and recommendations seriously. Please contact me if you have questions about this letter report, and I would be pleased to discuss the findings and recommendations with you.

Sincerely yours,

David Saah
Chair, Applied Science Advisory Committee
Director of the Geospatial Analysis Lab at the University of San Francisco
Managing Principal of Spatial Informatics Group

Cc. Lisa Dilling, University of Colorado Boulder
Molly Jahn, University of Wisconsin-Madison
Rhiannan Price, Maxar/DigitalGlobe
Daniel Sarewitz, Arizona State University
David Wilkie, Wildlife Conservation Society
Fuyuen Yip, Centers for Disease Control and Prevention
Kass Green, Kass Green and Associates
Bill Hooke, American Meteorological Society
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