Earth Science Advisory Committee Meeting Report
April 16-17, 2024

From: The NASA Earth Science Advisory Committee (ESAC) - Sara Tucker (Chair), Christine Chiu, Indrani Das, Belay Demoz, Venkataraman Lakshmi, Jennifer Logan, Rowena Lohman, Dylan Millet, Helen Pillar, Beth Plale, Melanie Preisser, Sara Rivero-Calle, Jennifer Watts, Robert Wright, Lisan Yu.

To: Karen St. Germain (Director, Earth Science Division, SMD)

Cc: Lucia Tsaoussi (Executive Secretary, Earth Science Advisory Committee), Julie Robinson (Deputy Director, ESD), Jack Kaye (ESD Associate Director for Research), Scott Schwinger (ESD Associate Director for Flight Programs), Tom Wagner (ESD Associate Director for Earth Action), Michael Seablom (ESD Associate Director for Earth Technology), Katie Baynes (ESD Earth Data Officer).

Date: 21 May 2024

Dear Dr. St. Germain,

The Earth Science Advisory Committee (ESAC) met on April 16 and April 17 in Washington DC and via WebEx. On April 16 the meeting was held jointly with the Applied Sciences Committee (ASAC) at the Residence Inn, Washington DC. The ESAC only meeting continued at NASA HQ on April 17, 2024. Findings and recommendations in this letter reflect discussions and perspectives of the full membership.

Earth Science to Action

Findings: At a time of great climate uncertainty, NASA ESD is a critical resource and national strategic asset for enabling our country, and our planet, to understand and adapt to climate change. NASA develops and supports many of the space-based observations used to provide actionable information that can support the work of NASA's sister agencies including NOAA, USGS, and EPA.

Recommendation: NASA should ensure that ES2A efforts will enhance or complement, and not replicate or conflict with, related work performed at the sister agencies.

Recommendation: As NASA ESD rolls out the ES2A strategy, it should continue to do so deliberately and with empathy for the larger community – seeking input from the broader science and technology community outside of NASA centers. In addition, NASA ESD would benefit from providing the community with additional examples of requests for earth information, and descriptions of how NASA determines its unique role in addressing requests, and how it coordinates and collaborates with other agencies (e.g., USGS, DOE, and NOAA) to address these national and global needs.

Recommendation: In implementing the ES2A strategy, ESD should further review and minimize the impacts of ES2A (intentional or not) on the foundation of NASA Earth Science (e.g., technology, flight mission, and R&A). ESD should avoid compromising Discovery science, the core NASA identity, and ensure messaging is clear regarding both the risks of operational applications on scientific discovery, as well as the opportunities provided by the actionable information. ESD should also carefully evaluate its current capability, barriers to optimum usage, and the need for additional computing requirements needed to meet the ES2A objectives and provide mechanisms for tracking the ES2A objectives with clear and actionable steps.

ESO

Finding: The decouple, partner, and (potential) compete approach to the Designated Observable missions AOS and SBG may result in significant cost savings, but it puts at risk the ability to deliver new and improved science (e.g., aerosol-cloud interactions) over what was learned from the A-train missions. There may be additional risk in working with external partners (e.g., leaning on international missions) that may not provide NASA's level of mission assurance.

Recommendation: NASA should work toward transparency in this new Earth System Observatory strategy, ensuring that the entire community is informed and aware of the opportunities it brings as well as the risks of this new approach to established and consequential legacy observations including global precipitation.

Finding: The lack of an Earth Science Decadal Survey mid-term review/report raises concerns about whether decadal surveys (and mid-term evaluations) are too infrequent or inflexible for the field of Earth Science in a rapidly changing world.

R&A

Finding: The ESD R&A program has continued the strong record of scientific discovery, actively working toward DEIA goals and inspiring a new generation of NASA scientists. Along this vein, the shift in the Earth Venture suborbital proposal process, identifying the team in a subsequent step, enhances the breadth of the teams and likely decreases the burden to PI entry and thus representation in the proposal pool.

Recommendation: The expansion of dual anonymous peer review and encouragement of breadth and diversity in science team formation are leading to improvements. NASA ESD R&A should continue with these important efforts and programs to engage students and faculty at minority serving institutions.

Finding: The Committee recognizes the importance of a modeling strategy that recognizes the fundamental importance of observations as a guide to both traditional and machine-learning modeling activities, to ensure that ESD modeling efforts extract the maximum value from Earth observations in the form of new scientific discoveries and societal benefits.

Computing and Data

Finding: Recognizing that all computing needs are not equal, computing will be a constraint on ESD's ability to provide products to meet ES2A goals. As NASA evolves the DAACs toward providing more open-source data, increasing amounts of commercial data and newly-generated NASA data products will continue to require more resources. In addition, ESD's High End Computing (HEC) capabilities are at their maximum capacity and aging, thus putting at risk the needed resources to support developments in AI/ML, digital twins, etc.

Recommendations: Future work in ESD is heavily driven by computational capacity. ESD needs to develop a robust way to assess and capture the HEC computing needs as it moves to execute on the ES2A strategy.

In addition to addressing the HEC hardware needs, resources must be provided to hire individuals that can support these objectives, ensuring computer scientists and earth scientists can work together to update/write code for modern day GPU systems, etc. In doing so, ESD should consider lessons learned from JCSDA.

In working toward Open Source Science, NASA should ensure that data and computing are co-located – where users can log in (e.g., into a cloud environment) and work with the data locally rather than download it. ESD should also work toward greater collaboration with other centers/agencies implementing commercial satellite centers.

Looking Ahead: Digital Twins and ESO Data Integration

Finding: The committee recognizes the importance of Digital Twins (DTs) and supports the activities being developed at NASA, recognizing that NASA and its partners generate most of the data needed to ensure digital twin efforts in Earth Science are successful.

Recommendation: In developing the Digital Twin framework, ESD should clearly define and prioritize application scenarios to ensure focused resource allocation and alignment with strategic objectives, engage with the broader community to ensure the framework is innovative and stays at the forefront of digital twin advancements, and ensure 1) co-location of DTs and the data systems they access (critical to integrating observations, data assimilation, and modeling, into DTs), and 2) that DT outputs (e.g., observations and forward modeling capabilities) include uncertainty quantification and are provided with rigorous education and communication about those uncertainties.

Finding: The committee recognizes the value of thinking holistically about the ESO missions and in planning, where possible, for known future data integration opportunities.

Recommendations: Addressing NASA ESD's ES2A objectives in the coming years will require leveraging the entire global observing system. NASA R&A activities should therefore accommodate the use of data from across the international portfolio of Earth observations, along with those from NASA assets. In so doing, NASA should be careful about overextending resources or being over-prescriptive about data integration and should leave adequate room for organic evolution.

Though the committee did not have sufficient time to discuss specific multi-sensor products or procurement approaches, we recommend that ESD focus on the Open Science computing approach and work to bring ESO data together (e.g., in the cloud), organized by observation category, with accessible interfaces to query data, test data fusion approaches, and thus push the data to their limits organically.

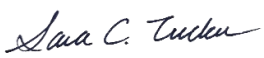
The committee also recommends that NASA include a competed aspect to data integration to ensure diversity of ideas and a broad scope of intellect.

Finding: Multiple communication layers exist at different centers, leading to potential information silos. ESD communications is being created to streamline the storytelling process.

Finally, the ESAC recommends ESD present at a future ESAC meeting on the needs and status of computing at ESD, including but not limited to high performance computing, open-source science, cloud computing, data centers, and communications, and plans to address any shortfalls in these areas.

The next committee meeting is planned for the first quarter of 2025.

Sincerely,



Earth Science Advisory Committee
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