NASA ADVISORY COUNCIL

EARTH SCIENCES ADVISORY COMMITTEE

NASA Headquarters
Washington, D.C.
October 24, 2022

TELECONFERENCE
MEETING REPORT

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Sara Tucker, Chair

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Lucia Tsaoussi, Executive Secretary

Prepared by Joan M. Zimmermann
T&J Inc.

October 24, 2022

Introduction

Dr. Lucia Tsaoussi, Executive Secretary of the Earth Science Advisory Committee (ESAC), opened the teleconference, which was devoted to the annual Government Performance Reporting Act Modernization Act (GPRAMA) exercise. The committee reviewed reports on the science focus areas that serve as indicators for GPRAMA progress, before voting on performance goal grades. Dr. Tsaoussi turned the proceedings over to Dr. Sara Tucker, Chair of the ESAC, who briefly described the review of the two metrics under discussion, with their respective subsections. Dr. Tucker referenced definitions for the grades associated with GPRAMA outcomes (Green, Yellow, and Red), which are associated with reporting requirements. She commended NASA Program Managers for their extensive work on the GPRAMA report, a sampling of Research & Analysis achievements in each of the Earth Science focus areas. Dr. Jack Kaye spoke briefly, thanking everyone for their hard work in telling the story of NASA Earth Science research and analysis. Committee members provided short summaries of each subsection, and h, followed by voting

Annual Performance Goal 1.1.8: NASA shall demonstrate progress in characterizing the behavior of the Earth system, including its various components and the naturally-occurring and human-induced forcings that act upon it.

Atmospheric Composition (1.1.8.1)

Dr. Daven Henze commented on the topics in the section, which included progress in the measurement of aerosol data and changes in data that were coincident with the effects of the COVID pandemic lockdown. Other highlights included the theme of biomass-burning wildfires, Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) data, and estimating the impacts of biofuel adoption. Progress was seen in greenhouse gas studies, in terms of remote sensing becoming an increasingly useful tool for setting baselines for CO2 and methane levels, enabling people to look at trends; this is exciting work. The research well supports the performance goals. Dr. Jennifer Logan said she was happy to see that the aircraft campaign was included in the report, and that in general, Earth Science research was not adversely affected by COVID. Dr. Beth Plale said she had no additional comments to offer.

Carbon Cycle and Ecosystems (1.1.8.2)

Dr. Lucy Hutyra said the report indicated progress in ocean biology and biogeochemistry, with a nice discussion of the Arctic Boreal Vulnerability Experiment (ABoVE) activity. She thought the section was comprehensive, but could have used better hyperlinking in highlighting references; in particular, on page 22, she felt it was important to highlight where the program is now. She commented that the way it is presented in the current draft reads like a "first of its kind," while not stating that this has been a key area of uncertainty for the last decade. In the landcover change section, she noted that the section on agricultural sustainability, etc., employed a very different tone of writing than the rest of the document; the document should focus on consolidating key points. She complimented the inclusion of the airborne components of the program, a nice job on carbon, the preparation for the Plankton, Aerosol, Cloud, ocean Ecosystem PACE launch in early 2024, what satellites bring to the long-term record, and the investment in hyperspectral and polarimetric observations that will be enabled by PACE. She also liked the idea of the Open Source/Open Science round, and was pleased to see breadth of the success of the program. Dr. Nancy Glenn said she appreciated the author's response to feedback, and that the report was in great shape, with good details of biodiversity and biogeographic topics; the Surface Biology and Geology (SBG) study section was nicely detailed. Dr. Anastasia Romanou commented that the report provided good detail on carbon cycle and ecosystems, and did a great job at showing how color algorithms are being incorporated into some measurements. She praised a paper that included a step-by-step guide on radiative transfer models; the report that indicated the connection of this paper to the Open Source/Open Science initiative; kudos to the group for showing this.

Climate Variability and Change (1.1.8.3)
Dr. Lisan Yu focused on ocean current data, saying the report provided a high-quality, detailed review of ocean dynamics, demonstrating the value of satellites for monitoring the global energy budget; also, the importance of salinity as a constraint for ocean stratification. Work in ocean winds and currents was highly reflective of the Decadal Survey's targeted observables, and emerging topics. Conclusions from data on cyclone formation were also valuable. She felt the report was well done, showing the breadth of programs; the report quality itself is much improved over previous years. Dr. Indrani Das spoke to the land ice section, which highlighted incredible advances in the remote sensing of the Arctic, Antarctic and Greenland ice sheets. Two studies, which looked at satellite data from ICESat-2, revealing interesting data on ice patterns and the influence of large-scale and mesoscale patterns on ice sheet evolution. As ICESat-2 gathers more data, more important results will follow in the future. The data show that it is important to study seasonal variation to understand Greenland ice, in particular. A study from 1997-2021, showing how much Antarctic ice loss has been accelerating, highlighted importance of large remote sensing data sets, and the study of seasonal variation. Dr. Das said he would like to see the latest land ice data integrated into global ice sheet models. Dr. Romanou discussed results on snow measurement and sea ice melting; ocean circulation; and advances in climate models, and also agreed that the next step forward is to put land ice data into the global ice sheet models.

Earth Surface and Interior (1.1.8.4)
Dr. Robert Wright discussed the report's results in hydrogeology grouping, methane data, and NASA-ISRO Synthetic Aperture Radar, (NISAR); he suggested placing a map measuring the water content of land (p. 48) in section 1.1.9. Other highlights included an algorithm on volcanic ash emissions; and measuring processes over wide areas using synthetic aperture radar (SAR) to fill in measurement gaps when using airborne resources. He felt that the report subsection certainly satisfied GPRAMA requirements. Dr. Rowena Lohman commented on planet imagery, the use of lidar, pushing understanding of seismic cycles, and the great deal of work that had been accomplished by the community in calibrating and setting up for NISAR.

Water and Energy Cycle (1.1.8.5)
Dr. Jasmeet Judge commented on this section, covering water budget/cycle dynamics; she said that topics such as surface water, throughout the writing, are very exciting, and reflect the preparation for the Surface Water and Ocean Topography (SWOT) mission. She cited sections on high mountain Asia, and the science team selection for the study of Himalayan glaciers. In areas regarding soil moisture, data from Soil Moisture Active Passive (SMAP), Gravity Recovery and Climate Experiment Follow-On (GRACE-FO), and Cyclone Global Navigation Satellite System (CYGNSS) showed huge gravity changes in Australia from the alternating impact of drought/flood conditions, as well as the impact of water availability on wildlife. Data also showed that COVID lockdowns resulted in transient improvements in water quality, and also where the water currently resides, and climate change impacts on water availability. Dr. Judge felt it was a thorough comprehensive report, and that it gets better every year. Dr. Plale referenced mentions of the Open Source/Open Science initiative as it relates to publishing, and its impact on water resource research. Another notable effort was the "Hack Week" for integrating data from multiple remote-sensing instruments. A broad participation effort was seen; these are good activities. Dr. Venkataraman Lakshmi added that the section represented a good era for water cycle research, with both SMAP and SWOT on-line.

Weather and Atmospheric Dynamics (1.1.8.6)
Dr. Belay Demoz said the section provided exciting data from the National Oceanic and Atmospheric Administration (NOAA), Global Precipitation Measurement (GPM); the foundation for all the Himalayan glacier data. There was much good science and application deriving from CYGNSS and SWOT data on hydrology, lightning and flash floods. Doppler radar validation work, and overall field operations, are

repeated in 1.1.9. Dr. Demoz liked the ties volcanic activity, commenting that it was heavy on legacy data sets, setting a foundation for future direction. Dr. Tucker added that one value of focus area was an emphasis on long-term data sets, and the contribution of GPM, TRIMM and international missions, which has enabled interesting findings. In IMERG, she thought it was interesting that radar showed better performance; and she liked the constellation study for continued global precipitation studies. Other highlights were efforts to retrieve wind-speed observations, and the use of microwave sounding to retrieve 3-D wind patterns.

***ESAC concluded the discussion of Goal 1.1.8. Dr. Tucker proposed a Green grade for this section. There was unanimous agreement.*

<u>Annual Performance Goal 1.1.9:</u> NASA shall demonstrate progress in enhancing understanding of the interacting processes that control the behavior of the Earth system, and in utilizing the enhanced knowledge to improve predictive capability.

Atmospheric Composition (1.1.9.1)
Dr. Henze commented briefly on work in radiative forcing, fires, and also the inclusion of the impact of COVID. The papers spanned data analysis and integration, with updates on aerosol data, and fusion with other data for modeling inputs; the science gets better as more remote sensing data becomes available. Dr. Logan referenced some data under 1.1.8.2, relating to ecosystems.

Carbon Cycle and Ecosystems (1.1.9.2)
Dr. Plale discussed the section's work on ocean biology, including the use models for anthropogenic forcing, to predict future scenarios for different regions of the world, as well as population dynamics and impacts on wildlife species. Dr. Glenn said she appreciated the discussion of Geostationary Littoral Imaging and Monitoring Radiometer (GLIMR), ABOVE and the carbon monitoring system. Dr. Romanou said it was a well-written section.

Climate Variability and Change (1.1.9.3)
Dr. Das cited the discussion of polar bears, microwave data, and bringing brightness temperatures into climate models; this is an important highlight, representing new advances in land ice modeling. He also referenced data on the sea ice melting that drives sea level rise, atmospheric rivers, and extreme soil moisture. He thought aspects of 1.1.9.4 were covered in this section as well. Dr. Yu commented that Estimating the Climate and Circulation of the Ocean (ECCO) has proved to be a major mission; last year alone ECCO covered over 200 applications. Open source/open science data is being used at 90 coastal sites. Sea level data on the US coast, and sea level change team projections, are important for climate change. Dr. Das commented that there are important new processes highlighted in the section that models should be accounting for.

Earth Surface and Interior (1.1.9.4)
Dr. Wright commented that ground saturation data, in future, could be moved into 1.1.8. Dr. Lohman highlighted data on hydrologic cycles, and surface deformation re: volcanic processes.

Water Cycle (1.1.9.5)
Dr. Lakshmi commented that the section was well-written; surface water is a big thing coming on-line with SWOT; droughts are the big deal now, and water availability. The section on the lower Mekong

basin data, with its discussion of social and environmental impacts, or "sociohydrology," was well articulated. Dr. Judge said that one study used 3-hour interval data taken over a 40-year period.

Weather and Atmospheric Dynamics (1.1.9.6)
Dr. Tucker cited important progress in gathering long-term data, with more coupled models and assimilation efforts; sensors are looking at radii from different IR sounders in the lower troposphere. There is a new Python interface that makes these data more accessible to community. Long-term AIRS (on the Aqua EOS satellite) data sets are being used to further understanding of climate models, and have helped to constrain predictions on Arctic warming. Dr. Logan had no further comments to add.

***ESAC concluded the discussion of Goal 1.1.9. Dr. Tucker proposed a Green grade for this section. There was unanimous agreement.*

Dr. Julie Robinson (ESD) thanked everyone for their effort and independent assessment of the report. Dr. Tucker complimented the report as very thorough and comprehensive, and remarked that the GPRAMA process is a time-consuming but valuable effort. Dr. Tucker concluded the meeting at approximately 2 pm.

APPENDIX A
ATTENDEES

Earth Science Advisory Committee Members
Sara Tucker, Chair, Ball Aerospace & Technologies Corp.
Indrani Das, Lamont-Doherty Earth Observatory (LDEO)
Belay Demoz, JCET, UMBC
Nancy Glenn, Boise State University
Daven Henze, University of Colorado
Lucy Hutyra, Boston University
Jasmeet Judge, University of Florida
Venkataraman Lakshmi, University of Virginia
Jennifer Logan, Northrop Grumman Aerospace Systems
Rowena Lohman, Cornell University
Colleen Mouw, University of Rhode Island
Beth Plale, Indiana University
Anastasia Romanou, NASA Goddard Institute for Space Studies
Robert Wright, University of Hawaii
Lisan Yu, Woods Hole Oceanographic Institution
Lucia Tsaoussi, Executive Secretary – NASA Headquarters

Non-NASA Attendees
Joan Zimmermann, T&J, Inc.

APPENDIX B
ESAC MEMBERSHIP

Sara Tucker, ESAC Chair
Ball Aerospace & Technologies Corp.

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Belay Demoz
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Venkataraman Lakshmi
University of Virginia

Jennifer Logan
Northrop Grumman Aerospace Systems

Rowena Lohman
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Beth Plale
Indiana University

Robert Wright
University of Hawaii

Lisan Yu
Woods Hole Oceanographic Institution

Anastasia Romanou
NASA Goddard Institute for Space Studies

Colleen Mouw
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Daven Henze
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Jasmeet Judge
University of Florida

Lucy Hutyra
Boston University

Nancy Glenn
Boise State University