

National Aeronautics and
Space Administration



Mary W. Jackson NASA Headquarters
Washington, DC 20546-0001

Reply to Attn of: SMD/Earth Science Division

SUBJECT: NASA Earth Science Division Response to the 2022-2023 Out-of-Cycle Senior Reviews and 2023 Earth Science Senior Review

Background

The NASA Science Mission Directorate (SMD) Earth Science Division (ESD) conducts comparative reviews of the operating missions every three years to validate the ongoing scientific return from these projects. ESD uses findings from each Senior Review to define an implementation strategy and provide programmatic direction to the missions under review for the next three to six fiscal years.

For International Space Station (ISS)-hosted missions, extended accommodations must be requested near the end of prime mission life to support ISS processes. Out-of-Cycle Senior Reviews are conducted when needed to align the schedules of the extensions and Senior Reviews and ensure timely confirmation of extended ISS accommodations.

The specific findings of the 2022 and 2023 Out-of-Cycle Senior Reviews and the 2023 Earth Science Senior Review are used to:

- Prioritize continued funding of the operating mission projects.
- Define an implementation approach to achieve ESD strategic objectives.
- Provide programmatic and budgetary direction to the projects for fiscal year (FY) 2024 through FY 2026.
- Provide programmatic and budgetary direction to the projects for FY 2027 through FY 2029 for planning purposes or if a project is anticipated to end in or soon after the Senior Review extension period.

This established practice was codified in the National Aeronautics and Space Administration Transition Authorization Act of 2017 (PL 115-10; Sec 513 (a) 1):

“...The Administrator shall carry out triennial reviews within each of the Science divisions to assess the cost and benefits of extending the date of the termination of data collection for those missions that exceed their planned missions’ lifetime.”

Overview

From October to December 2022, ESD conducted three Out-of-Cycle Senior Reviews for the International Space Station (ISS) instrument missions ECOSTRESS, GEDI, and OCO-3, to support an expedited timeline required by the ISS Program for manifest planning. From February to August 2023, ESD conducted the nominal Earth Science Senior Review for ten missions that were already in extended operations (Aqua, Aura, CYGNSS, DSCOVR (Earth Science Instruments: EPIC and NISTAR), GPM, ICESat-2, OCO-2, SMAP, SAGE III, and Terra) and two missions that would reach the end of their prime mission during the 2023 Senior Review (GRACE-FO and TSIS-1). From September to December 2023, ESD conducted an Out-of-Cycle Senior Review for the ISS EMIT mission since its prime mission ended after the 2023 Senior Review was completed.

The Senior Review is composed of two panels: the Science Panel and the National Interests Panel. The Science Panel is the primary panel. It is an independent analysis group with sole responsibility to evaluate the scientific merit of each mission's datasets with respect to NASA's Earth science strategic plans and objectives. The Science Panel is drawn from recognized expert members of the Earth Science research community and supported by technical and cost experts from within and outside NASA to assess the health and viability of the operating satellites and the proposed mission budgets.

The National Interests Panel assesses the utility, applicability, and impact of the mission's data products to satisfy national objectives through non-research use for applied and operational purposes by non-NASA organizations. The National Interests Panel is drawn from federal, local government, non-profit and commercial users of NASA research data. The National Interests Panel briefs its findings to the Science Panel, who then use the utility findings in its assessments.

These reviews consisted of a series of comprehensive evaluations of current operating missions' science quality, societal applications and operational utility, and engineering/cost performance. A full description of the evaluation process, factors used by the review panels, and findings for the 2023 Senior Review missions, is available in the Final Report at: <https://smd-cms.nasa.gov/wp-content/uploads/2023/09/2023-nasa-essr-fullreport-final.pdf>.

ESD is very grateful to the Earth Science Senior Review panel members for their thoughtful reviews of the missions, engagement during the panel meetings, and their helpful suggestions to improve the process and our interactions with their communities, all of which required significant time and dedication.

Overview of Results

The Science Panel found that everything about the review process pointed to the unprecedented success of ESD missions and their data products. The data products have allowed discoveries and engendered understanding of earth system processes in myriad ways by the scientific community, both within the USA and internationally. The focus on validation of science products and making them freely available has been transformational for

the science community with many NASA data products being considered “the gold standard” around the world and used accordingly.

The Panel noted that the group of missions have been extremely successful, some for a remarkably long time (over 20 years). The data products from these missions have been transformative for studying the Earth system and have led to innumerable findings and discoveries. The use of these data products continues to increase for science as well as for applications and operational use. The Panel found the high rate of adoption of many of the science data products from these missions for applications and operational usage by a wide variety of agencies and partners to be a strong and impressive endorsement of the quality and societal impact of the data products from these missions.

The Panel also noted that many of the missions have now collected data products over previously unprecedented periods of time and as such, these long data records are beginning to support the ability to identify and attribute climate trends and to understand interannual variability. The Panel felt that these capabilities have greatly exceeded the original missions for the sensors and for some of the extremely successful long running missions, the cost of extending the data records was often less than one percent of the initial development cost. It was also the general feeling of the Panel that extending key data products would greatly increase their value for understanding trends in the earth system and provide a greater ability to evaluate interannual variability.

Finally, the Panel noted that the flagship multi-sensor missions Terra, Aqua and Aura, are rapidly running out of consumables and approaching passivation which poses some important challenges. The most obvious challenge is to continue to provide continuity for many extremely valuable and highly used data products. The Panel recognized the effort that has gone into supporting continuity of products, particularly the success of many new missions. However, there are two issues in this context that the Panel highlighted for NASA going forward. The first issue concerns support for the incredible technical expertise of the workers supporting the missions that are nearing passivation. The panel encouraged NASA to consider creative solutions to support the need for orderly ends to the current set of missions, while at the same time allowing the highly experienced personnel to find new positions that will continue past the end of the missions they currently support. The second issue concerned the transitioning of users of data products to the versions that will be supported going forward. There are understandable challenges for the user community to make these kinds of transitions. While the Panel recognized that there have been significant efforts in this domain, many users applying NASA data have not invested in transitioning to new data sources. It would behoove ESD to find new ways to promote and facilitate the transitions to the data products from newer sensors that will continue farther into the future.

NASA Decisions

Aqua

The Aqua mission will be extended through its predicted natural end of life in late FY 2026 as currently baselined in the Senior Review budget target. The project should initiate Phase F

closeout activities in FY 2027. No 2026 Senior Review proposal is anticipated from the Aqua mission.

Aura

The Aura mission will be extended through its predicted natural end of life in late FY 2025 as currently baselined in the Senior Review budget target. The Project should initiate Phase F closeout activities in FY 2026. No 2026 Senior Review proposal is anticipated from the Aura mission.

CYGNSS (Cyclone Global Navigation Satellite System)

The CYGNSS mission will be extended through FY 2025 with a reduction to the current baselined Senior Review budget target. Continued operations beyond FY25 are contingent upon the team addressing the findings of the 2023 Senior Review and the successful completion of an interim review in FY25 to assess progress towards addressing those findings. Phase F closeout activities are expected to begin no later than in FY28. No 2026 Senior Review proposal is anticipated from the CYGNSS mission.

DSCOVR (Deep Space Climate Observatory)

Earth Science Instruments: EPIC Earth Polychromatic Imaging Camera) and NISTAR (National Institute of Standards & Technology Advanced Radiometer)

The DSCOVR (Earth Science Instruments: EPIC and NISTAR) mission will be extended through FY 2026 with additional funding above the baselined Senior Review budget target to ensure uninterrupted processing and the long-term provision of the science data. A 2026 Senior Review proposal is anticipated from the DSCOVR (Earth Science Instruments: EPIC and NISTAR) mission.

ECOSTRESS (ECOsysteM Spaceborne Thermal Radiometer Experiment on Space Station)

The ECOSTRESS instrument on the ISS will be extended through FY 2026 as currently baselined in the Out-of-Cycle Senior Review budget target. ISS has confirmed that accommodations are available for ECOSTRESS through at least September 2028. A 2026 Senior Review proposal is anticipated from the ECOSTRESS mission.

EMIT (Earth Surface Mineral Dust Source Investigation)

The EMIT instrument on the ISS will be extended through FY 2026 with additional funding above the baselined Out-of-Cycle Senior Review budget target to support enhanced onboard cloud screening, and the development and delivery to the DAAC of a fractional cover product. The EMIT mission will expand its scientific objectives beyond surface mineral and dust source observations to include greenhouse gas measurements and additional geology, ecosystem, cryosphere, and aquatic targets to serve as a precursor for the Surface Biology and Geology mission. ISS has confirmed that accommodations are available for EMIT through end of life. A 2026 Senior Review proposal is anticipated from the EMIT mission.

GEDI (Global Ecosystem Dynamics Investigation)

The GEDI instrument on the ISS will be extended through FY 2026 as currently baselined in the Out-of-Cycle Senior Review budget target. GEDI is currently in storage on the ISS and

expected to be reinstalled in spring 2024; ISS has confirmed that accommodations are available after reinstallation through end of life. A 2026 Senior Review proposal is anticipated from the GEDI mission.

GPM (Global Precipitation Measurement Mission)

The GPM mission will be extended through FY 2026 with additional funding above the baselined Senior Review budget target to support the near real-time processing system and two-reaction wheel science mode development. A 2026 Senior Review proposal is anticipated from the GPM mission.

GRACE-FO (Gravity Recovery and Climate Experiment Follow-On)

The GRACE-FO mission will be extended through FY 2026 as currently baselined in the Senior Review budget target. A 2026 Senior Review proposal is anticipated from the GRACE-FO mission.

ICESat-2 (Ice, Cloud and land Elevation Satellite-2)

The ICESat-2 mission will be extended through FY 2026 with additional funding above the baselined Senior Review budget target to support enhanced atmospheric data products. A 2026 Senior Review proposal is anticipated from the ICESat-2 mission.

OCO-2 (Orbiting Carbon Observatory-2)

The OCO-2 mission will be extended through FY 2026 with additional funding above the baselined Senior Review budget target to support Assessment and Authorization activities, weekend data downlinks to minimize science data losses, algorithm improvements and reprocessing, and Total Carbon Column Observing Network sustainment. A 2026 Senior Review proposal is anticipated from the OCO-2 mission.

OCO-3 (Orbiting Carbon Observatory-3)

The OCO-3 instrument on the ISS will be extended through FY 2026 as currently baselined in the Out-of-Cycle Senior Review budget target. OCO-3 is currently in storage on the ISS and expected to be reinstalled in spring 2024; ISS has confirmed that accommodations are available after reinstallation through end of life. A 2026 Senior Review proposal is anticipated from the OCO-3 mission.

SAGE III (Stratospheric Aerosol and Gas Experiment III)

The SAGE III instruments on the ISS will be extended through FY 2026 with additional funding above the baselined Senior Review budget target to support community validation and timely algorithm and product improvements. ISS has confirmed that accommodations are available for SAGE III through at least September 2027. A 2026 Senior Review proposal is anticipated from the SAGE III mission.

SMAP (Soil Moisture Active Passive)

The SMAP mission will be extended through FY 2026 with additional funding above the baselined Senior Review budget target to support Assessment and Authorization activities, algorithm improvements and reprocessing, and to fund the near real-time Air Force operator. If a radar re-start on-orbit test is approved by ESD and successful, a Reconfiguration Review

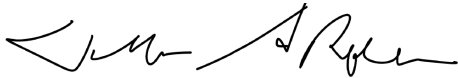
would be required before planning a permanent re-start of the Synthetic Aperture Radar. A 2026 Senior Review proposal is anticipated from the SMAP mission.

Terra

The Terra project will be extended through its predicted natural end of life in mid-FY 2027 as currently baselined in the Senior Review budget target. The project should initiate Phase F closeout activities following the end of operations in mid-to-late-FY 2027. No 2026 Senior Review proposal is anticipated from the Terra mission.

TSIS-1 (Total Solar Radiance Spectrometer-1)

The TSIS-1 instrument on ISS will be extended through FY 2026 with additional funding above the baselined Senior Review budget target to support the acquisition of new measurements in the 2400-2800 nm wavelength range. ISS has confirmed that accommodations are available for TSIS-1 through at least September 2027. A 2026 Senior Review proposal is anticipated from the TSIS-1 mission.



Julie A. Robinson, Ph.D
Deputy Director, Earth Science Division
NASA Science Mission Directorate