

NASA ADVISORY COUNCIL

EARTH SCIENCES ADVISORY COMMITTEE

October 2, 2017

NASA Headquarters

Washington, D.C.

TELECONFERENCE MEETING REPORT

J. Marshall Shepherd, Chair

Lucia Tsaoussi, Executive Secretary

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October 2, 2017

Introduction and Announcements

Dr. Lucia Tsaoussi, Executive Secretary of the Earth Science Advisory Committee (ESAC), opened the meeting. Dr. J. Marshall Shepherd, ESAC Chair, welcomed members and introduced the meeting's sole topic, which was the 2017 Senior Review Report, recently completed by a dedicated ESAC subcommittee.

NASA Earth Science Senior Review 2017 for the Mission Extension of Earth Science Operating Missions Process Overview

Ms. Cheryl Yuhas presented a history of the Senior Review in the Earth Science Division (ESD), and an overview of the process. Until 10 years ago, ESD had no official review process for extending missions beyond their baseline operations. Recognizing the gap, a National Academies of Science National Research Council (NRC) report in 2005 recommended how NASA should approach extending its missions beyond their prime operations. The first ESD Senior Review was held in 2005 as part of the Sun-Earth Division of the Science Mission Directorate (SMD). A second review was held in 2007, and it implemented the recommendations of the 2005 NRC report. In 2007, the ESD Senior Review officially incorporated other US Government agencies that utilize Earth Science mission data and observations. In 2014, the NASA Office of the Inspector General endorsed the ESD process. The 2016 NRC report also endorsed it. In 2017, Federal Advisory Committee Act (FACA) rules were applied to the Earth Science Senior Review, which now is conducted by a subcommittee of the ESAC.

In the Senior Review process, a comparative review is made of all missions in extended operations. At present, ESD is supporting 13 extended missions. Each mission has made unique contributions during their prime mission lifetimes. About \$150M per year, or 8-10% of the ESD budget, is dedicated to Earth Science (ES) extended operations and data analysis. ESD explicitly acknowledges the importance of long-term data sets and overall data continuity for ES research, as well as direct contributions of ESD mission data to national objectives; e.g., routine use of near-real-time products from NASA research missions for applied and operational purposes by US public or private organizations. ESD looks to the Senior Review to identify "egregious underperformers" when determining which missions to continue and which to terminate.

The 2017 Senior Review encompassed 13 missions: Aqua, Aura, International Space Station-Cloud Aerosol Transport (ISS-CATS), Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO), CloudSat, Global Precipitation Measurement (GPM), Solar Radiation and Climate Experiment (SORCE), Total Solar Irradiance Calibration Transfer Experiment (TCTE), Terra, Quick Scatterometer (QuikSCAT), Soil Moisture Active-Passive (SMAP), and the Deep Space Climate Observatory (DSCVR) instruments, Earth Polychromatic Imaging Camera (EPIC) and NISTAR. Not included in the 2017 review were the Cyclone Global Navigation Satellite System (CYGNSS), Earth Observing Satellite (EO-1) (terminated in March 2017), GRACE (expected to reach end of lifetime soon), Suomi-NPP (a National Oceanic and Atmospheric Administration operation, which will operate to the 2022 timeframe), Ocean Surface Topography Mission (OSTM)/Jason-2, and Landsat 7 and 8 (operated by

the US Geological Survey). Reviewed for the first time were the DSCVR instruments EPIC and NISTAR, GPM, OCO-2, and TCTE. In addition, Terra and Aqua, which are now over 10-15 years old, and some of their standard products, previously competed, being well recognized, will now become part of mission funding and managed with the rest of the missions' products. Finally, ESD is now asking for three-year proposals, per a NRC recommendation. **Not included** in Senior Review decisions are research grants under ROSES, and routine product generation, distribution, and archiving.

The Senior Review Subcommittee (SRS) is the primary independent analysis group for the Senior Review. No one on the SRS is permitted to have a conflict of interest with any of the missions being reviewed. All members are appointed Special Government Employees (SGE) must assess and vote on all of the missions under review, in addition to considering the findings of the National Interests Panel and the technical/cost experts in final review ratings. Evaluation criteria for mission continuation is consideration of the mission's ability to produce quality standard data products that support scientific use and research; scientific merit of the mission datasets; and quality trends of the standard data products. Ms. Yuhas reviewed the flow of the process and closed with a brief overview of schedule milestones. Dr. Tsaoussi noted for the record that the three ESAC members with conflicts of interest tied to the Senior Review missions, Drs. Thomas Herring, Anne Nolin, and Christian Kummerow, identified themselves and recused themselves from the ensuing discussion.

Senior Review Subcommittee Findings

Dr. Douglas Vandemark, Chair of the Senior Review Subcommittee, presented the 2017 Senior Review findings, noting that a fair amount of new material had been introduced to the process, including the submission of comprehensive proposals over 100 pages long, and new emplacement under FACA rules. The review includes a National Interests Subpanel, Science Subpanel (i.e. Senior Review Subcommittee), Technical Risk Subpanel, and Cost Risk Subpanel. The panels base their reviews not only on mission proposal documents, but on mission merits and weaknesses that might be outside the proposal. The subpanels also pose questions to the missions based on what is found in the proposals, and make sure to allow sufficient time for each review. Reviewers must also understand the cost and technical risks associated with mission extensions. In-person exchanges take place between the review team and each mission lead or Principal Investigator during a final 3-day meeting toward the end of the process. The overall SRS membership seeks to achieve consensus, but each science team reviewer separately scores each mission.

Subpanels meet for 2-3 days and discuss the mission's relevance to NASA science, and score the missions on core mission data product quality and continuity, and technical and cost risks, by subcategory, using the designations Excellent, Good, Fair, and Poor. Dr. Vandemark walked through a sample evaluation related to the SORCE/National Interest Panel, which recommended continuation of the project with an augmentation to baseline. The National Interests Subpanel Summary rated SORCE overall as High Utility, while one agency rated it as High, and another rated it as Very High.

The technical subpanel for SORCE brought in expertise on lidar and radar. These experts were also trained on handling proprietary data, signed nondisclosure agreements, and were screened for conflicts of interest. The technical subpanel summary for SORCE rated the mission as medium risk, with much of the

risk associated with the idea of losing the satellite in terms of safety contacts re: failure associated with an eclipse.

The cost assessment panel looked for general spend-down on funds, management of funds, and follow-through on expectations with regard to mission operations and science budgets. These assessments are scored as Low, Medium, or High, but don't go into great detail; this is left to Headquarters to further elucidate.

The final SRS scoring document integrates scores across science merit, data quality, and relevance to NASA. In the case of SORCE, the National Interests Utility score was High; Technical Risk was Medium, and Cost Risk was Low. Overall, 8 of the 13 missions had consensus voting across the entire panel. In a new twist, the panel was asked to use a (3+3 approach), producing scores for FY18-20 and FY21-23 timeframes. Dr. Vandemark said the panel was confident about their FY18-20 scoring, but that it was a little tougher to take the new step out to 2023.

Senior Review Mission Extension Conclusions (3+3 dispositions for FY18-20; FY21-23)

Aqua- Continue; Continue

Aura- Continue/reduce; Continue/reduce

CATS- Continue; N/A

CALIPSO- Continue; Continue

CloudSat- Continue; Augment

DSCOVR- EPIC and NISTAR- Continue/Augment; Continue/Augment

GPM- Continue/Continue

OCO-2 Continue/Augment; Continue

QuikSCAT – Continue/Augment for 1 year, or 2 years if ScatSat shows significant instability

SMAP- Continue; Continue

SORCE- Continue/Augment; Continue/Augment

TCTE- Continue/Augment; N/A

Terra- Continue/Augment; Continue

For the Aura mission, the Tropospheric Emissions Spectrometer (TES/JPL) sensor was a point of concern; the team has been expending a lot of effort to keep TES alive. It has a problematic mirror, and has had a low-duty rate since 2011/12. The Senior Review panel feels it should be turned off eventually, after which Aura can turn attention to getting a high-quality, accurate final data set. Very few publications now associated with the mission.

The Senior Review also recommended an augmentation on OCO-2, if possible, for algorithm development. For CloudSat, the panel recommended augmenting in an outyear to coincide with a JAXA/ESA satellite launch, for cross-calibration purposes.

Dr. Dessler noted that CloudSat has had battery issues, and asked how long it would be likely to survive. Dr. Michael Freilich, Director of ESD, mentioned that it also has a gyro problem. To that end, the mission will soon leave the A train by adjusting the orbit slightly downward. CALIPSO is also considering

leaving the A Train constellation to maintain formation with its complementary satellite. CloudSat and CALIPSO still have several more years' potential for producing high-quality data, but it will require some effort.

Dr. Freilich added that because EPIC and NISTAR have been suggested for termination, the ESAC will need the extra input (material not discussed today, but contained in the complete body of the Senior Review report). In the meantime, Dr. Tsaoussi asked the ESAC to vote on the complete Senior Review output, including briefing materials, and recommended that the information be included for completion in the final SRS report.

The Senior Review regarded EPIC and NISTAR as new and fundamentally different measurements of Earth, which score high in terms of science merit and relevance to NASA. EPIC also has an element of popular interest. The two instruments did have lower data quality score, as DSCOVR data is generally young. One recommendation was to extend the mission to see how beneficial it could be, and use an augmentation to develop some Level 1 data products. The weakness (technical risk) is the quality of the data from the camera and spectrometer, in terms of science value. Dr. Freilich suggested that the ESAC base their vote on the language of the summary of EPIC/NISTAR provided in the Senior Review final report.

Dr. Vandemark reported that in sum, science merit was generally high across missions; there were no obvious underperformers; and while several newer missions scored lower on data-related metrics, Flagships continue to excel. The newest missions tended to have the lower scores. One uneven mission was SMAP, but it must be noted that it is not yet at the end of its prime phase, and will not be for one more year. SMAP also has a variable that is difficult to validate (soil moisture—more difficult than validating rainfall). Dr. Freilich added that due to an early loss of the radar instrument, the mission is confined to more modest spatial resolution. Dr. Vandemark noted that it also takes time to acquire customers, when considering National Interest scores; younger missions tend to have uneven scores for this reason.

QuikSCAT is still part of the portfolio because its radar is still super-stable, and it contributes to data continuity. SORCE/TCTE are also contributing similar benefits to solar irradiance measurements. Aqua and Terra are still the “stars of the show,” and still make high-quality measurements across most of their sensors. Dr. Vandemark directed ESAC's attention to page 32 in the final report, which contains a color graphic that clearly scores the platforms in terms of their respective contributions to other missions. SMAP is also valuable; there is very high interagency interest in soil moisture.

Additional findings

Dr. Vandemark indicated that the Senior Review membership wished to point out that it is hard to judge ISS-sensor missions in comparison to long-term dedicated ES missions, and with the same forms used for other missions. ISS reviews could use a little added nuance if they are to be included in future Senior Reviews. Secondly, the addition of Aqua and Terra large number of algorithms maintenance proposals; the Senior Review feels that these should be included in the mission proposals.

The Senior Review subcommittee applauded the concept and implementation of pre-launch outreach to acquaint data users with upcoming missions, and endorsed this “early adopter” approach such that they

might be considered as regular features of future mission proposals. The subcommittee was also pleased to see the forward-looking work by the A-train mission teams to adjust to upcoming orbit-adjustment needs, and the interplay among mission and science needs, that were contained in the Senior Review mission proposals.

Q and A Session

Dr. Shepherd asked members to weigh in with any commentary. ESAC members received the report favorably. Dr. Shepherd moved to accept the report as presented, with the augmentations as discussed. The ESAC voted unanimously to accept the Senior Review's findings, to be followed by a formal letter from Dr. Shepherd. Dr. Tsaoussi noted for the record that the Senior Review subcommittee would be adding material in the appendix to clarify and support mission scoring. Dr. Freilich pointed out that after the report is transmitted, any specific findings of note could be highlighted in future ESAC meetings. Dr. Tsaoussi added that these highlights could also be included in the Chair's formal letter that accepts the Senior Review recommendations. Dr. Shepherd said he was particularly impressed by the high number of excellent ratings, an item worthy of mention. He also noted comments about DSCVR's instruments, which are to be augmented by the appendix material. Dr. Freilich took the opportunity to thank everyone, especially Ms. Yuhas, for being the intellectual architect of the Earth Science Senior Review, Dr. Vandemark for his leadership and superb job, Dr. Tsaoussi for keeping the cats herded and getting the report delivered under FACA rules; he also thanked the Headquarters Program Executives, the ESAC and its Chair.

Appendix A **Attendees**

Earth Science Advisory Committee Members

J. Marshall Shepherd, ESAC Chair, University of Georgia

Andrew Dessler, Texas A&M

Kass Green, Kass Green and Associates

Tom Herring, MIT

Ian Joughin, University of Washington/APL

Christian Kummerow, Colorado State University

Anne Nolin, Oregon State University

Richard Rood, University of Michigan

Lucia Tsaoussi, Executive Secretary, NASA Headquarters

NASA Attendees

Gregory Dell, NASA HQ

Michael Freilich, NASA HQ

Charles Webb, NASA HQ

Jamie Wilson, NASA HQ

Cheryl Yuhas, Retired NASA HQ

Non-NASA Attendees

Joan Zimmermann, Ingenicomm

Appendix B
ESAC Membership

J. Marshall Shepherd, Chair
University of Georgia

Roland Burgmann
University of California, Berkeley

Gregory Carmichael
The University of Iowa

Andrew Dessler
Texas A&M University

Kass Green
Kass Green and Associates

Thomas Herring
Massachusetts Institute of Technology

Ian Joughin
Applied Physics Laboratory

Christian Kummerow
Colorado State University

Anne Nolin
Oregon State University

Richard Rood
University of Michigan

Ray Schmitt
Woods Hole Oceanographic Institution

Appendix C
Presentations

1. NASA Earth Science Senior Review 2017/Process Overview; *Cheryl Yuhas*
2. NASA Earth Science 2017 Senior Review Subcommittee Findings; *Douglas Vandemark*

Appendix D
Agenda

NAC Earth Science Advisory Committee

Agenda

Earth Science Advisory Committee (ESAC)

Telecon

Dial in number: 800-369-3189

Leader passcode: 51298

Participant passcode: 9725782

NASA Headquarters Only MIC 6A

2-October-17

- Introductions 1:30 – 1:45 pm
- Overview of the SR process 1:45 – 2:00 pm
- SRS report presentation – SRS chair 2:00 – 3:00 pm
- ESAC discussion and recommendation 3:00 – 3:20 pm
- Adjourn 3:30 pm

