December 22, 2014

To:	GSFC/Anne Douglass	Project Scientist for Aura
	GSFC/Gene Feldman	Project Scientist for Aquarius
	GSFC/Claire Parkinson	Project Scientist for Aqua
	GSFC/Kurt Thome	Project Scientist for Terra
	GSFC/Dong Wu	Project Scientist for SORCE
	JPL/Lee-Lueng Fu	Project Scientist for OSTM
	JPL/Ernesto Rodriquez	Project Scientist for QuikSCAT
	JPL/Graeme Stephens	Mission PI for CloudSat
	JPL/Michael M Watkins	Project Scientist for GRACE
	JPL/Deborah Vane	Project Scientist for CloudSat
	LaRC/Charles Trepte	Project Scientist for CALIPSO
	LaRC/David Winker	Mission PI for CALIPSO
	Laboratory for Atmospheric & Space Physics/Tom Woods	Mission PI for SORCE
	University of Texas/ Byron Tapley	Mission PI for GRACE
	Earth and Space Research/Gary Lagerloef	Mission PI for Aquarius
CC:	GSFC/T. McCarthy	ESM Program Manager
	LaRC/G. Stover	ESSP Deputy Program Manager

From: NASA HQ/DK/ M. Freilich/ Director, Earth Science Division

Subject: Call for Proposals – Senior Review 2015 of the Mission Operations and Data Analysis Program for the Earth Science Operating Missions

The NASA Earth Science Division (ESD) of the Science Mission Directorate (SMD) is supporting several Earth observing missions that are operating beyond their prime mission lifetimes. Extended operations and associated data analysis activities require a significant fraction of the ESD annual budget. NASA and the ESD thus periodically evaluate the allocation of Mission Operation and Data Analysis (MO&DA) funds with the aim of maximizing within finite resources the missions' contributions to NASA's and the nation's goals. This periodic NASA comparative review for missions in extended operations is known as the "Senior Review."

ESD will host the next Senior Review during the weeks of April 6 and April 27, 2015. This letter describes the objectives and process for the review, contains instructions for the preparation and submission of proposals and for in-person presentations to the Science review panel.

The following ten missions (in alphabetical order) are invited to propose to the 2015 Senior Review: Aqua, Aquarius, Aura, CALIPSO, CloudSat, GRACE, Jason-2/OSTM, QuikSCAT, SORCE, and Terra.

The Senior Review:
The objective of the ESD Senior Review is to identify those missions beyond their prime mission lifetime whose continued operation contributes cost-effectively to both NASA's goals and the nation's operational needs. The primary evaluation criterion for extension of a mission is its contribution to NASA's research science objectives, but the ESD Senior Review also explicitly acknowledges (1) the importance of long term data sets and overall data continuity for Earth science research; and (2) the direct contributions of mission data to national objectives, such as the routine use of near-real-time products from NASA ***research*** missions for applied and operational purposes by U.S. public or private organizations.

Each mission that is invited to this Senior Review will submit a proposal outlining how their activities over the period for the review (FY16 to FY19) will benefit the Earth Science objectives described in the 2014 Science Plan for NASA's Science Mission Directorate (the *SMD Science Plan*). Each proposal will contain descriptions of the project's proposed science data analysis activities, recent accomplishments, technical status relating to the ability to deliver the proposed datasets, contributions to national objectives for Earth system monitoring and prediction, and a high level budget for the proposed activities.

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The Senior Review panels (described in more detail below) will be formed by ESD to evaluate these proposals in March-April 2015. Their evaluations will be documented in reports to ESD. ESD will use the panels' findings, rankings and conclusions as inputs to rebalancing mission allocations. Actions may include maintaining the status quo, restructuring the project including changes to the mission objectives, or deciding to terminate an ongoing science mission.

The Senior Review Panels:
The Senior Review is composed of two panels: the Science Panel and the National Interests Panel. The Science Panel is the primary panel. It will be 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 will be 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 MO&DA budgets.

The National Interests Panel will assess the utility and applicability of the mission's data products to satisfy national objectives by public (non-NASA) and private organizations. The National Interests Panel will be drawn from users of NASA research data for applied and operational purposes, including federal agencies, associations, non-governmental organizations and state/local/tribal agencies. The National Interests Panel will brief its findings to the Science Panel, who will use the utility findings in its overall assessment and conclusions.

The panel will be supplemented by engineering and cost experts who will conduct focused evaluations of the technical status of the flight and ground hardware systems, and the proposed costs.

Instructions to the Senior Review Panels/Review Criteria:
NASA HQ will provide the following instructions to the Senior Review Science Panel:

> In the context of the ESD science goals, objectives and research focus areas described in the 2014 SMD Science Plan, evaluate and rank the scientific merits of the proposed returns from each mission. Factors to consider are intrinsic value of the mission datasets, the trend over the mission life of the quality of the datasets, relevancy to the ESD research objectives, and promise for future scientific impact, especially considering the technical status changes and/or performance degradation as assessed by the technical experts.
>
> As secondary evaluation criteria, evaluate the non-research utility of the missions, using the findings from the National Interests panel, and the reasonableness of the cost of the extended mission.
>
> From the assessments above, provide findings on an implementation strategy for the ESD extended missions portfolio for FY2016-2019, which could include a mix of:
>
> - Continuation of projects "as currently baselined";
> - Continuation of projects with either augmentations or reductions to the current baseline;
> - Project termination;

NASA HQ will provide the following instructions to the technical & cost experts, subject to additional guidance from the Science Panel:

> Assess each mission's performance and reliability projections for the satellite and instrument(s), the mission operations implementation plan, and the likelihood of accomplishment within the proposed cost. The technical experts will consider factors including the status of consumables and predicted utilization; spacecraft and instrument status, performance degradation, and failure risk; the proposed mission operations approach for the effective and safe management of an aging satellite; and mission and data management. The cost experts will compare the requested budget against historical expenses and allocated funds. The technical review will result in narrative text as well as a risk rating for the feasibility of the extended mission implementation.

NASA HQ will provide the following instructions to the National Interests Panel:

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Evaluate the contributions of the standard data products to applied and operational uses by public and private organizations (i.e. non-research purposes). National interests will include activities at state, tribal, regional, national and international levels. The evaluation will assess to what degree the mission has and will provide applied and operational benefits and utility to the nation. The evaluation will result in narrative text as well as a utility rating (Very High, High, Some, Minimal) for a mission's products or group of products, considering such factors as intrinsic value, frequency of use and latency. The panel will consider the adequacy and robustness of the mission's approach to data product for application and operational uses, through both on-going examples and future plans for an extended mission.

Extended Mission Scope:
ESD's priority for extended missions is ***the continuation of quality standard data products*** which have been demonstrated to be relevant and valuable to the NASA Earth science objectives as stated in the 2014 SMD Science Plan.

The basic mission should include the minimum necessary science review and assessment of instrument performance to verify and validate the data products. The proposal should clearly justify the level of science support required to maintain the quality of the datasets, including calibration and validation activities. Compared to the prime mission phase, algorithm maintenance is assumed to have become routine and fewer services to external data product users needed during the extended mission.

Mission operations coverage should provide for the safe management of the aging satellite, but compared to the prime mission phase, proposers are encouraged to propose and justify an increased risk of data collection degradation in exchange for an associated reduction in mission cost. For example, greater allowance for hands-off operation and longer data outages for anomaly response should be considered. It is expected that a continuous improvement process will result in reductions in the cost of established activities during the extended mission.

New upper level product development and science investigations are not solicited through the Senior Review. Proposals of this nature are solicited through the ESD Research, Applied Sciences and EOSDIS Programs.

Funding Environment:
Missions proposing to the ESD Senior Review will compete for an allocation from a pool of funds comprised primarily of the budgets from all of the missions in extended phase. Each mission will be provided a target baseline budget, and must submit a proposal which meets that budget. Because the pool of funds available to the operating missions is extremely constrained, optimal proposals will be accepted only for missions which can justify that the baseline budget is non-sustainable even after descopes; no proposals for additional scope will be accepted.

Instructions for Proposal Format and Content:
Each mission that is subject to this Senior Review and that is seeking to continue operation shall submit a proposal outlining their mission implementation approach and proposed Project-supported data analysis for the FY2016 – FY2019 period covered by the review. Missions will be approved for continuation beginning with FY2016, with the most immediate impact on the budget allocations for the near-term (FY2016-2017); and will act as rough guidelines for the level of support in the out-years (i.e. FY18-19). The proposals must detail and justify how the project will continue to conduct basic mission operations and provide the data products that meet ESD, NASA, and national needs.

The proposal shall contain a science section, a technical/budget section, and five appendices containing a mission data product inventory, budget spreadsheets, references, a list of acronyms, and an engineering data supplement. Note that "STEM" (science, technical, engineering and mathematics) education is no longer included in mission scope; communications for the user community and for public engagement are still in scope and should be included as part of the mission content.

For all missions including the Terra, Aqua and Aura flagship missions, the scientific and technical/budget sections should be no more than 30 pages. All pages are to be on 8.5 inch by 11 inch paper, with character

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(font) size not less than 10 points. Not included in the page limits are the five Appendices. The proposal must be submitted in PDF format with the budget spreadsheets in XLS format (see below). (If your institution requires signatures, please place them on one separate submittal letter; copies of this submittal letter will not be used in the peer review but will be retained within the ESD. The project name and names of key authors at the top of the first page will suffice for review purposes.)

Instructions for the Science Section: The science section should comprise approximately two-thirds of the proposal and address four major topics: science merit, data products, applied and operational uses, and programmatic elements

Science Merit: Describe the science merits of your mission datasets and the specific contributions of the instruments within your mission. List the current science objectives for the mission and a summary clearly focused on what has been accomplished in the past two years. Explain how the continuation of the mission datasets and the proposed science program contribute to the ESD objectives as stated in the SMD Science Plan.

Data Products: Describe how the mission will maintain/manage the standard data products during the extension, including discussion of any current or predicted instrument or spacecraft performance degradations that affect the quality of those products. Discuss the history/trend of product quality over the life of the mission, with attention to the 2 years since the last Senior Review. Resources required for routine calibration, validation, and algorithm maintenance to maintain the quality of these data products should be included. The proposal narrative should focus on the work that is being performed by the core DA science team. A list of standard data products, highlighting changes since the last Senior Review, should be included in Appendix A. This list in Appendix A must include a table, or otherwise indicate which standard products are developed/maintained by the core DA science team, or by the ROSES-selected competed science team.

For standard data products that rely on data from missions or instruments outside of the proposing project's control, identify the required external resource. If all NASA parties in the shared data product are proposing in response to this letter, each mission should detail its own elements of the task along with the complementary support from the other mission(s).

Applied and Operational Uses: Describe the applied merits of the mission and specific contributions of the instrument and data products to applied and operational uses (i.e. non-research purposes). The proposal should convey the value of datasets for applications that serve national interests (operational uses, public services, military operations, etc). Clearly summarize what has been accomplished in the past two years for applied and operational uses, including technical specifics and well-described examples. Explain how the proposed mission extension contributes to the applications-oriented objectives as stated in the SMD Science Plan.

Programmatic Elements: Briefly summarize the programmatic elements required for mission implementation, including the geographic and organizational locations of key mission elements (science management, project management, ground station, science data acquisition and distribution center, etc.), and the identification and roles of any international or inter-Agency partners. Also identify any parallel funding sources, such as ROSES, that are ***required*** for supporting any of the activities in these mission extension proposals, both for efforts already funded and for anticipated future funding.

Projects should consider providing an on-line bibliography of recent publications. The proposal should contain the URL/web address to this bibliography. Bibliographies included in the text of the proposal will be counted against the page limit.

Instructions for the Technical/Budget Section: This section should be approximately one-third of the proposal and address two major topics: technical status and a budget narrative.

Technical Status: Discuss the overall technical status of the elements of the mission, and the team's approach to managing operations to optimize health and vitality of the elements. Include the spacecraft, instruments, and ground systems including spacecraft control center and science center(s). Summarize actions taken to improve the effectiveness of the mission operations tasks and describe what improvements have been accomplished. Summarize the health of the elements and point out limitations as a result of degradation, aging,

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use of consumables, obsolescence, failures, etc. Provide supporting data in the form of engineering data tables and figures in Appendix E. Include an estimate and rationale of mission life expectancy.

Budget Narrative: ***The budgets proposed in the Senior Review must be fully consistent with the budgets submitted in the parallel Program Planning & Budget Execution (PPBE) 2015 process.***

Each mission must submit only one budget scenario: either the in-guideline scenario or a "sustainable" scenario. All effort must be made to develop an in-guideline scenario; an over-guideline "Sustainable" scenario will be considered only if you can demonstrate that a viable mission cannot continue to be operated with the in-guide budget allocation.

- In-Guideline Scenario: Describe a scenario that does not exceed the baseline allocation provided in the Guideline Mission Spreadsheets provided by your responsible Program Office (Earth Systematic Missions or Earth System Science Pathfinder). The in-guide budget allocation matches the NASA Operating Plan ("N2" budget). If the Project believes that the guideline is sufficient to support a viable mission, but not the present set of products and activities, the project should identify the set of activities and products that will be supported, those that will not, and the impacts of any adjustments in work content on the science return for the mission.

- Optimal "Sustainable" Scenario: An optimal "Sustainable" scenario will be considered only if you can demonstrate that a viable mission cannot continue to be operated with the in-guide budget allocation. By submitting a Sustainable Scenario, the project understands that the mission will likely be terminated if the extra funding cannot be made available.

Labor, major equipment and other expenses must be explained in sufficient detail to determine the incremental cost of each proposed task. The budget must include all project-specific costs including mission services performed at GSFC by the ESMO Project, at JPL, by NASA's networks such as the Ground Network (GN), the Space Network (SN), or the NASA Integrated Network Services (NISN).

Summarize anticipated 'in kind' support from NASA-funded sources other than the project's MO&DA budget. These 'in kind' sources include but are not limited to: processing of mission data to generate core data products by the EOSDIS Program; satellite tracking support from NASA networks; and support from the multi-mission infrastructure projects at GSFC, JPL, and elsewhere. Supporting or in-kind sources that should NOT be included in the budget tables: algorithm development activities funded through ROSES; airborne science infrastructure; supporting activities from non-NASA sources such an international partners, other US Government agencies. However, the extent of the partners' participation should be identified in the narrative.

Note that an E/PO narrative section is no longer required as part of the Senior Review Proposal, nor is there a requirement to reserve approximately 1-2% of your total budget for E/PO activities. The budget format no longer includes a WBS 11.0.

Attachment A to this letter contains the Work Breakdown Structure and definitions for "MO" and "DA;" there is only one change, to advise that public engagement activities previously tracked under WBS 11.0 as "Education/Public Outreach" should be included under WBS 4.0 "Science." Attachment B contains instructions and the mandatory form for the budget portion of each proposal, also unchanged since the last Review. Attachment C contains one additional template to be used as a supplement to the budget narrative; there is a slight change in this template from last year: the data request is now for workforce numbers only (no labor dollars) supplemented by other direct cost elements (e.g. travel, subcontracts, material). There is no total dollar figure in this form. As before, this is requested for only one year.

Civil service labor is included in the budget allocations.

Required Appendices: Five appendices are required and do not count against the page limit:

Appendix A: Mission Data Product Inventory. Include a brief (no more than 100 words per product suggested) summary description of the data product; the approximate time duration of the data record; the

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instrument(s) required to produce the product; the maturity of the algorithm(s) required to produce the product; the primary NASA and/or applied and operational users (including contact information such as phone or e-mail addresses, if known); and the availability and location of the product for community use and access. The inventory must include a summary table that contains as a minimum the following columns: Data Product Name, Data Product Description, and Algorithm Source (ROSES or Mission DA). Sample data product tables will be provided at the Senior Review Library (see "Further Information" below).

Appendix B: Mission budget in specified format. Attachment B describes the mandatory formats for your budget request and supplies spreadsheet templates. The additional budget content format from Attachment C may be submitted here, although the preferred location is part of the budget narrative in the body of the proposal. Supplementary, detailed cost information to assist the cost evaluation is encouraged, and does not count against the page limit.

Appendix C: Acronym list

Appendix D: References actually cited in the text of the proposal.

Appendix E: Technical data (e.g. engineering data, consumables and predicted utilization, performance degradation) to support the spacecraft and/or instrument projected performance and life expectancy.

Proposal Submission:
Proposals must be uploaded electronically in PDF format to https://nspires.nasaprs.com/external/and must be received by COB on March 3, 2015. The budget spreadsheets should be incorporated into the PDF proposal document, and also submitted in Excel format (XLS or XLSX)via email to the Senior Review Program Officer.

Senior Review Panel meetings:
The Technical experts and National Interests Panel will meet before the Senior Review Science Panel to permit their findings to be available to the Science Panel. In addition to their evaluations, these panels will provide a set of questions for further clarification from each mission and submit the questions to the Science Panel for their consideration to ask the project teams.

The Senior Review Science panel will meet twice: First, to discuss the proposals and identify topics needing additional clarification; and second, to meet with the mission teams for questions, clarification and mission updates, then finalize their evaluations and develop findings.

1st Meeting (April 10):

Morning: Instructions, Operating Missions background, logistics (writing assignments, etc.), discussion of conflicts of interest and procedures to minimize their impacts. Afternoon: Discussion of Proposals & Develop Questions for the Projects.

2nd Meeting (April 28-30):

Day 1: Morning: Review Instructions, Operating Missions background, logistics (writing assignments, etc.) and briefings from the National Interests Panel and supporting technical & cost reviewers. Afternoon: Project Presentations.
Day 2: Complete Project presentations.
Day 3: The Senior Review panel finalizes their evaluations, develops findings, and prepares an initial draft report.

Presentations to the Senior Review panel:
Each proposing project will be allotted time for an oral presentation to the panel, with the time allocation varying depending on the mission size and complexity, with a minimum duration of 30 minutes allotted for any single mission. Two weeks before the presentation, each mission team will be provided a set of questions from the Science Panel and a time allocation. The project team should be represented by no more than three people, supplemented on the flagship missions by no more than one representative per major instrument, or as negotiated with the Senior Review Program Officer. During each project presentation, the project

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representatives should plan on using no more than one-half of the allocated time for their prepared presentation, reserving one-half for additional questions and answers. The prepared presentation should concisely and thoroughly answer the specific questions that the Science Panel provided to the mission team following their initial review.

- The primary purpose of the oral presentations is to provide a forum for questions from panelists and answers from the projects.
- Secondarily, this is an opportunity for projects to provide any significant updates, e.g. changes in technical status since proposal submission.
- Lastly, and with lowest priority, it is an opportunity to repeat highlights of the proposals, which will all have been read and discussed by the panelists.

After the meeting of the Senior Review panels:
The Senior Review Science Panel will produce a report of its findings. The National Interests Panel, and the technical and cost experts will produce reports of their findings and submit to the Science Panel for inclusion in the Science Panel report. The Senior Review Science Panel will provide a mature draft of key findings and conclusions, prior to completing its deliberations; the Science Panel chair will brief the ESD Director on the day following the panel. Within six weeks following the ESD review, the panel will submit its final written report, which incorporates information from the supplementary panels, to the ESD Director. All the panel reports will be posted later to a public NASA HQ web site.[1]

NASA HQ will contact each of the proposing missions/projects and relay the new SMD mission extension decisions resulting from the Senior Review. The decisions will include new budget guidance, if appropriate, programmatic guidance including possibly notices of intent to terminate, and other specific instructions resulting from the Senior Review process. Within four weeks of being informed of the Senior Review decisions, each project must submit back to HQ its plan for complying with the new guidance and instructions, including any documentation updates as required.

The Senior Review Program Officer will ensure that key officials in participating international space agencies or other U.S. government agencies that are partners in a proposing mission are kept informed of the Senior Review process, and will be responsible for apprising our partners of NASA's decisions resulting from the Senior Review.

Schedule for the 2015 Senior Review:
The following is a schedule for the 2015 Senior Review:

Mission Team Feedback at AGU:	December 16, 2014
Call for Proposals issued:	December 22, 2014
Proposals due:	March 3, 2015
Technical & Cost and National Interests Reviews	April 6-9, 2015
Senior Review panel meets:	April 10 & April 28-30, 2015
Publication of the panel's report	June 2015
New budget guidelines and instructions to projects:	August 2015
Projects revised implementation plans to ESD	September 2015

Further Information
A resource library website will be established http://soma.larc.nasa.gov/2015esd_seniorreview/. Proposers may have requests for clarification on any of the items contained in this letter or on the website. For further information, contact the Senior Review Program Officer, Cheryl Yuhas, at Cheryl.Yuhas@nasa.gov, or at the address below. The ESD will review all requests for information and if additional updates are sent out they will be shared with all proposers. It is the sole discretion of the ESD to determine which, if any, clarifications are required.

Cheryl Yuhas

[1] See for example: http://nasascience.nasa.gov/earth-science/mission_list. Reports from the prior (2005-2013) Senior Reviews are currently available on this site.

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Three attachments:

A. Definitions of the Work Breakdown Structure for NASA Science Operating Flight Missions
B. MS Excel spreadsheet: ESD Senior Review FY16-FY19_Spreadsheet.xls
C. Supplemental Budget Narrative Template

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Attachment A: Definitions of Work Breakdown Structure for NASA Science Operating Missions

The WBS elements shown below are intended for flight projects in all phases of implementation, from pre-Phase A through mission termination and disposal. The Projects should use the WBS dictionary for guidance on how to break out their proposed costs, but as general suggestion for missions in operation, and in particular in extended operations beyond the primary mission phase, only a subset of the standard WBS elements are expected to show any activity. Among the eleven level 2 WBS categories identified below, active elements for our missions would reasonably be:

1.0 Project Management
4.0 Science/Data Analysis
7.0 Mission operations
9.0 Ground systems
11.0 Education & Public Outreach *(NOT USED)*

Management of the mission elements could be accounted for in either Project Management (1.0) or Science (4.0), with the projects defining the appropriate distribution in their proposals. Any efforts related to Systems Engineering (2.0), Safety and Mission Assurance (3.0), Payload (5.0) and Spacecraft (6.0) could reasonably be folded into Mission Operations (7.0) for extended missions. Launch vehicles (8.0) and Systems Integration and Testing (10.0) clearly are no longer applicable.

(Taken from NASA WBS Handbook, January 2010)
Standard Level 2 WBS elements for space flight projects are shown in Figure G.4-1. The standard WBS template below assumes a typical spacecraft flight development project with relatively minor ground or mission operations elements. For major launch or mission operations ground development activities which are viewed as projects unto themselves, the WBS may be modified. For example, the spacecraft element may be changed to reflect the ground project major deliverable product (such as a facility). The elements such as payload, launch vehicle/services, ground systems, mission operations system that are not applicable may be deleted.

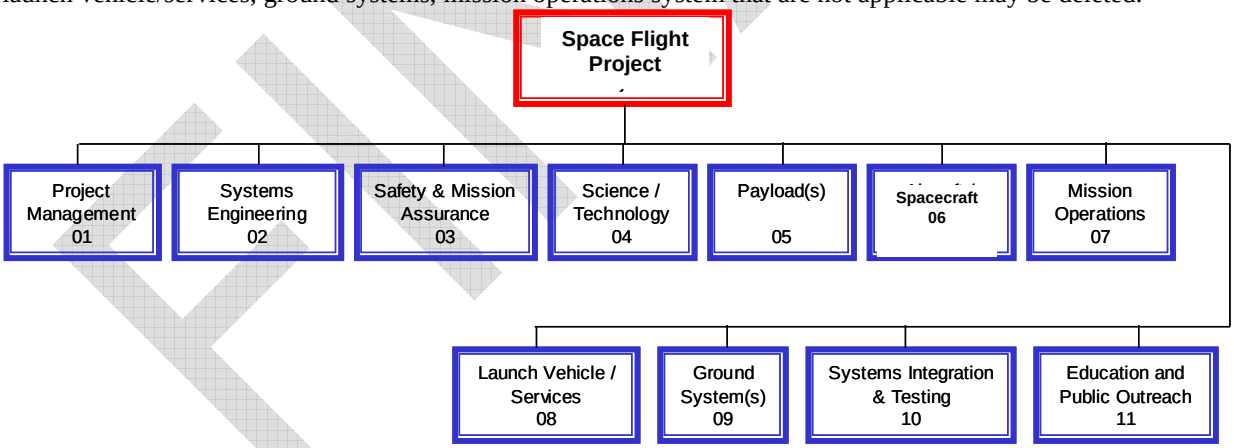

Figure G.4-1 Standard Level 2 WBS Elements for Space Flight Projects

Space Flight Project Standard WBS Dictionary

Element 1 – Project Management: The business and administrative planning, organizing, directing, coordinating, controlling, and approval processes used to accomplish overall Project objectives, which are not associated with specific hardware or software elements. This element includes project reviews and documentation, non-project owned facilities, and project reserves. It excludes costs associated with technical planning and management, and costs associated with delivering specific engineering, hardware and software products.

Element 2 – Systems Engineering: ***[Include in 7.0, Mission Operations.]*** The technical and management efforts of directing and controlling an integrated engineering effort for the project. This element includes the

efforts to define the project space flight vehicle(s) and ground system, conducting trade studies; the integrated planning and control of the technical program efforts of design engineering, software engineering, specialty engineering, system architecture development, and integrated test planning, system requirements writing, configuration control, technical oversight, control and monitoring of the technical program, and risk management activities. Documentation products include requirements documents, interface control documents (ICDs), Risk Management Plan, and master verification and validation (V&V) plan. Excludes any design engineering costs.

Element 3 – Safety and Mission Assurance: ***[Include in 7.0, Mission Operations.]*** The technical and management efforts of directing and controlling the safety and mission assurance elements of the project. This element includes design, development, review, and verification of practices and procedures and mission success criteria intended to assure that the delivered spacecraft, ground systems, mission operations, and payload(s) meet performance requirements and function for their intended lifetimes. This element excludes mission and product assurance efforts at partners/ subcontractors other than a review/oversight function, and the direct costs of environmental testing.

Element 4 – Science / Technology: This element includes the managing, directing, and controlling of the science investigation aspects, as well as leading, managing, and performing the technology demonstration elements of the Project. The costs incurred to cover the Principal Investigator, Project Scientist, science team members, and equivalent personnel for technology demonstrations are included. Specific responsibilities include defining the science or demonstration requirements; ensuring the integration of these requirements with the payloads, spacecraft, ground systems, mission operations; providing the algorithms for data processing and analyses; and performing data analysis and archiving. This element excludes hardware and software for on-board science investigative instruments / payloads.

Element 5 – Payload: ***[Include in 4.0, Science.]*** This element includes the equipment provided for special purposes in addition to the normal equipment (i.e., GSE) integral to the spacecraft. This includes leading, managing, and implementing the hardware and software payloads that perform the scientific experimental and data gathering functions placed on board the spacecraft, as well as the technology demonstration for the mission.

Element 6 – Spacecraft(s): ***[Include in 7.0, Mission Operations.]*** The spacecraft that serves as the platform for carrying payload(s), instrument(s), humans, and other mission-oriented equipment in space to the mission destination(s) to achieve the mission objectives. The spacecraft may be a single spacecraft or multiple spacecraft/modules (i.e., cruise stage, orbiter, lander, or rover modules). Each spacecraft/module of the system includes the following subsystems as appropriate: Crew, Power, Command & Data Handling, Telecommunications, Mechanical, Thermal, Propulsion, Guidance Navigation and Control, Wiring Harness, and Flight Software. This element also includes all design, development, production, assembly, test efforts and associated GSE to deliver the completed system for integration with the launch vehicle and payload. This element does not include integration and test with payloads and other project systems.

Element 7 - Mission Operations System: The management of the development and implementation of personnel, procedures, documentation and training required to conduct mission operations. This element includes tracking, commanding, receiving/processing telemetry, analyses of system status, trajectory analysis, orbit determination, maneuver analysis, target body orbit/ephemeris updates, and disposal of remaining mission resources at end-of-mission. The same WBS structure is used for Phase E Mission Operation Systems but with inactive elements defined as "not applicable." However, different accounts must be used for Phase E due to NASA cost reporting requirements. This element does not include integration and test with the other project systems.

Element 8 – Launch Vehicle / Services: ***[Not applicable for operating missions.]*** The management and implementation of activities required to place the spacecraft directly into its operational environment, or on a trajectory towards its intended target. This element includes launch vehicle; launch vehicle integration; launch operations; any other associated launch services (frequently includes an upper-stage propulsion system), and associated ground support equipment. This element does not include the integration and test with the other project systems.

Element 9 – Ground System(s): The complex of equipment, hardware, software, networks, and mission-unique facilities required to conduct mission operations of the spacecraft systems and payloads. This complex includes the computers, communications, operating systems, and networking equipment needed to interconnect and host the Mission Operations software. This element includes the design, development, implementation, integration, test and the associated support equipment of the ground system, including the hardware and software needed for processing, archiving and distributing telemetry and radiometric data and for commanding the spacecraft. Also includes the use and maintenance of the project testbeds and project-owned facilities. This element does not include integration and test with the other project systems and conducting mission operations.

Element 10 – Systems Integration and Testing: ***[Not applicable for operating missions, or include in 7.0 Mission Operations.]*** This element includes the hardware, software, procedures and project-owned facilities required to perform the integration and testing of the project's systems, payloads, spacecraft, launch vehicle / services, and mission operations.

Element 11 – Education and Public Outreach: ***[Include in 4.0, Science]*** Provide for the education and public outreach (EPO) responsibilities of NASA's missions, projects, and programs in alignment with the SMD Mission EPO Policy. Includes management and coordinated activities relevant to formal education, informal education, and/or public outreach. Periodic support for news media and an education-related web presence is allowable, but should not be the focus of the EPO task. Web site development for project management and coordination is also outside of the scope of EPO.

Additional work element definitions:
"Data Analysis" encompasses the work scope defined in Element 4 above, and specific project-funded data processing of Level 1 and above products. Activities typically included in "Data Analysis" are: customized data processing, analysis activities, documentation, presentation and publication of scientific results, science events planning, instrument and observation performance analysis, science data calibration, validation and certification of processed data, science operations centers, etc.

"Mission Operations" encompasses the work scope defined in Element 7 above, data acquisition and processing through Level 0 only. Activities typically included in "Mission Operations" are: command generation and telemetry monitoring; health and performance monitoring of the spacecraft, instruments, and ground system; mission analysis and planning/scheduling; spacecraft resource (power, etc) constraints analysis; trajectory, orbit, attitude planning and determination, etc.

"Competed Science" or "Competed Data Analysis" encompasses investigations solicited through ROSES.

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Attachment B:
MS Excel spreadsheet: Blank New FY15 Budget Template rev 4.xls

	Instructions for the Budget Spreadsheet
General Guidelines	
Show all costs in Real-Year dollars.	
For those missions with budgeted activities at more than one NASA center provide the full cost budget for each Center in both Table I (Budget by Cost Elements/labor, travel and procurements) and Table II (Budget by WBS).	
The approved budgets are for the entire year shown, so if the prime mission ends in the middle of a fiscal year, show the total budget for that year, covering both prime and extended operations.	
The budget totals (all Centers) for the Budget Tables I, II, and III should match, and should equal the top-level approved budget provided on the $K template.	
	Note: Budget totals and breakouts by MO /DA must be consistent with PPBE submission.
Table I	**FY16 - FY19 Approved Budget by Cost Element by Center**
	Separate entries should be made for each supporting Center.
Table II	**FY16- FY19 Approved Budget By WBS By Center**
	Describe how your project's budget breaks down by function
	The rows in Tables II correspond to the WBS definitions shown in Attachment A to the Call for Proposals.
	Separate entries should be made for each supporting Center.
	o Only Civil Servants should be entered under FTE line
	o WYEs include all NASA center on-site/near site contractor workforce.
	o Other WYEs include any NASA far offsite workforce and/or remote non NASA workforce (i.e. SORCE @ LASP , GRACE, etc.)
	Note: WBS 11/EPO is now deleted
Table III	**FY16 - FY19 Approved Budget by Instrument Team**
	Table III is required only for Terra, Aqua and Aura. Other missions should leave this table blank.
	Describe how your budget breaks down by the instrument teams.
	"Other Science teams" may apply to cross instrument science teams and efforts.
	"Other expenses" may apply to shared services such as mission operations, E/PO, Cal/Val, etc..
Table IV	**FTE Template**
	Fill in FTEs or WYEs as appropriate.
	o Only Civil Servants should be entered under FTE line
	o WYEs include all NASA center on-site/near site contractor workforce.
	o Other WYEs include any NASA far offsite workforce and/or remote non NASA workforce (i.e. SORCE @ LASP)
Table V	**Supplemental Budget Narrative**
	Workforce (the mission may itemize by center, but not required). No totals required.
	Note: this sheet has **4** workforce categories, NASA CS FTEs, JPL WYEs, WYEs and Other WYEs.
	The previous workforce definitions still apply, **in this sheet the JPL WYEs should be shown in their own line.**
	Other Direct Costs (the mission may itemize by center, but not required). No totals Required
	Travel: (consider itemizing by type, e.g. Conference, Science Team Meetings, Program meetings, etc)
	Contracts: (list each contract, company/institution, work scope, annual cost)
	Grants: (list each, university, work scope, annual cost)
	Materials and other purchases:(summary estimate, group as appropriate)

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Project :

Contact Point: Phone #:

	FY16	FY17	FY18	FY19
Approved Budget				
NASA "Sustaining" Guideline				
Total Project Budget Input:	$ -	$ -	$ -	$ -
DELTA Budget Input to Approved Budg	**$ -**	**$ -**	**$ -**	**$ -**

Table I Approved Budget by Cost Element and Center

	FY16	FY17	FY18	FY19
	$ K			
Center ***GSFC***				
1000 Labor				
2100 Travel				
3000 Procurements				
Total*	$ -	$ -	$ -	$ -
Center ***JPL***				
1000 Labor				
2100 Travel				
3000 Procurements				
Total*	$ -	$ -	$ -	$ -
Center ***LARC***				
1000 Labor				
2100 Travel				
3000 Procurements				
Total*	$ -	$ -	$ -	$ -
Center ***Other***				
1000 Labor				
2100 Travel				
3000 Procurements				
Total*	$ -	$ -	$ -	$ -
Center ***Other***				
1000 Labor				
2100 Travel				
3000 Procurements				
Total*	$ -	$ -	$ -	$ -
TOTAL - Includes all Applicable Centers/Organizations				
1000 Labor	$ -	$ -	$ -	$ -
2100 Travel	$ -	$ -	$ -	$ -
3000 Procurements	$ -	$ -	$ -	$ -
Total*	**$ -**	**$ -**	**$ -**	**$ -**

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Table II Approved Budget by WBS and Center

	FY16			FY17			FY18			FY19		
Center **GSFC**	**$K**	**FTE**	**WYE**	**$K**	**FTE**	**WYE**	**$K**	**FTE**	**WYE**	**$K**	**FTE**	**WYE**
4.0 Science												
Science (other than labor)												
FTE Labor												
WYE Labor												
7.0 Mission Operations												
Mission Ops (other than Labor)												
FTE Labor												
WYE Labor												
Total*	$0.00	0	0	$0.00	0	0	$0.00	0	0	$0.00	0	0
Center **JPL**	**$K**	**FTE**	**WYE**	**$K**	**FTE**	**WYE**	**$K**	**FTE**	**WYE**	**$K**	**FTE**	**WYE**
4.0 Science												
Science (other than labor)												
FTE Labor												
WYE Labor												
7.0 Mission Operations												
Mission Ops (other than Labor)												
FTE Labor												
WYE Labor												
Total*	$0.00	0	0	$0.00	0	0	$0.00	0	0	$0.00	0	0
Center **LARC**	**$K**	**FTE**	**WYE**	**$K**	**FTE**	**WYE**	**$K**	**FTE**	**WYE**	**$K**	**FTE**	**WYE**
4.0 Science												
Science (other than labor)												
FTE Labor												
WYE Labor												
7.0 Mission Operations												
Mission Ops (other than Labor)												
FTE Labor												
WYE Labor												
WYE Labor												
Total*	$0.00	0	0	$0.00	0	0	$0.00	0	0	$0.00	0	0
Center:	**$K**	**FTE**	**WYE**	**$K**	**FTE**	**WYE**	**$K**	**FTE**	**WYE**	**$K**	**FTE**	**WYE**
4.0 Science												
Science (other than labor)												
FTE Labor												
WYE Labor												
7.0 Mission Operations												
Mission Ops (other than Labor)												
FTE Labor												
WYE Labor												
Total*	$0.00	0	0	$0.00	0	0	$0.00	0	0	$0.00	0	0
Center:	**$K**	**FTE**	**WYE**	**$K**	**FTE**	**WYE**	**$K**	**FTE**	**WYE**	**$K**	**FTE**	**WYE**
4.0 Science												
Science (other than labor)												
FTE Labor												
WYE Labor												
7.0 Mission Operations												
Mission Ops(other than Labor)												
FTE Labor												
WYE Labor												
Total*	$0.00	0	0	$0.00	0	0	$0.00	0	0	$0.00	0	0
TOTAL - Includes all applicable Centers/Organizations	**$K**	**FTE**	**WYE**	**$K**	**FTE**	**WYE**	**$K**	**FTE**	**WYE**	**$K**	**FTE**	**WYE**
4.0 Science	$0.00	0	0	$0.00	0	0	$0.00	0	0	$0.00	0	0
Science (other than labor)	$0.00	0	0	$0.00	0	0	$0.00	0	0	$0.00	0	0
FTE Labor	$0.00	0	0	$0.00	0	0	$0.00	0	0	$0.00	0	0
WYE Labor	$0.00	0	0	$0.00	0	0	$0.00	0	0	$0.00	0	0
7.0 Mission Operations	$0.00	0	0	$0.00	0	0	$0.00	0	0	$0.00	0	0
Mission Ops(other than Labor)	$0.00	0	0	$0.00	0	0	$0.00	0	0	$0.00	0	0
FTE Labor	$0.00	0	0	$0.00	0	0	$0.00	0	0	$0.00	0	0
WYE Labor	$0.00	0	0	$0.00	0	0	$0.00	0	0	$0.00	0	0
Total*	**$0.00**	**0**	**0**	**$0.00**	**0**	**0**	**$0.00**	**0**	**0**	**$0.00**	**0**	**0**

* Totals for Table II should be equal to the year by year totals in Table I.

Table III Approved Budget by Instrument Team AQUA, AURA & TERRA Only

	FY16	FY17	FY18	FY19
1. Instrument A				
2. Instrument B				
3. Instrument C				
4. etc., (Repeat for all instrument teams)				
Other science teams				
Other mission expenses				
Total*	$ -	$ -	$ -	$ -

* Totals for Table III should be equal to the year by year totals in Table I.

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Project: **0** **0**

Point of Contact:

All entries in Full Time Equivalent (FTE) for Civil Servants, or Work Year Equivalents (WYE) for Contractors

Table IV Workforce by Center

		FY16	FY17	FY18	FY19
Center:	**GSFC**				
	4.0 Science	**0.0**	**0.0**	**0.0**	**0.0**
	Civil Service FTEs				
	WYEs On/Near Site				
	Other WYEs-- Offsite				
	7.0 Mission Operations	**0.0**	**0.0**	**0.0**	**0.0**
	Civil Service FTEs				
	WYEs On/Near Site				
	Other WYEs-- Offsite				
	Total*	**0.0**	**0.0**	**0.0**	**0.0**
Center:	**JPL**				
	4.0 Science	**0.0**	**0.0**	**0.0**	**0.0**
	Civil Service FTEs	0.0	0.0	0.0	0.0
	WYEs On/Near Site				
	Other WYEs-- Offsite	0.0	0.0	0.0	0.0
	7.0 Mission Operations	**0.0**	**0.0**	**0.0**	**0.0**
	Civil Service FTEs	0.0			
	WYEs On/Near Site				
	Other WYEs-- Offsite				
	Total*	**0.0**	**0.0**	**0.0**	**0.0**
Center:	**LARC**				
	4.0 Science	**0.0**	**0.0**	**0.0**	**0.0**
	Civil Service FTEs	0.0	0.0	0.0	0.0
	WYEs On/Near Site				
	Other WYEs-- Offsite	0.0	0.0	0.0	0.0
	7.0 Mission Operations	**0.0**	**0.0**	**0.0**	**0.0**
	Civil Service FTEs	0.0			
	WYEs On/Near Site				
	Other WYEs-- Offsite				
	Total*	**0.0**	**0.0**	**0.0**	**0.0**
Center:	**Other**				
	4.0 Science	**0.0**	**0.0**	**0.0**	**0.0**
	Civil Service FTEs	0.0	0.0	0.0	0.0
	WYEs On/Near Site				
	Other WYEs-- Offsite	0.0	0.0	0.0	0.0
	7.0 Mission Operations	**0.0**	**0.0**	**0.0**	**0.0**
	Civil Service FTEs	0.0			
	WYEs On/Near Site				
	Other WYEs-- Offsite				
	Total*	**0.0**	**0.0**	**0.0**	**0.0**
Center:	**Other**				
	4.0 Science	**0.0**	**0.0**	**0.0**	**0.0**
	Civil Service FTEs	0.0	0.0	0.0	0.0
	WYEs On/Near Site				
	Other WYEs-- Offsite	0.0	0.0	0.0	0.0
	7.0 Mission Operations	**0.0**	**0.0**	**0.0**	**0.0**
	Civil Service FTEs	0.0			
	WYEs On/Near Site				
	Other WYEs-- Offsite				
	Total*	**0.0**	**0.0**	**0.0**	**0.0**
	TOTAL - Includes all applicable Centers/Organizations				
	4.0 Science	**0.0**	**0.0**	**0.0**	**0.0**
	Civil Service FTEs	0.0	0.0	0.0	0.0
	WYEs On/Near Site	0.0	0.0	0.0	0.0
	Other WYEs-- Offsite	0.0	0.0	0.0	0.0
	7.0 Mission Operations	**0.0**	**0.0**	**0.0**	**0.0**
	Civil Service FTEs	0.0	0.0	0.0	0.0
	WYEs On/Near Site	0.0	0.0	0.0	0.0
	Other WYEs-- Offsite	0.0	0.0	0.0	0.0
	Total Workforce	**0.0**	**0.0**	**0.0**	**0.0**

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Attachment C. Supplemental Budget Narrative Table

The following table should be incorporated into the budget narrative, but may be submitted as part of Appendix B (Budget). This table covers ONLY FY2016, and it main purpose is to associate workforce & non-labor cost elements (e.g. travel, subcontracts, material) with the products/deliverables and activity/ task being performed.

- Describe and break out major activities and deliverables, by WBS and by performing organization
- For each task, provide workforce estimates, and associated travel, subcontracts and other direct costs.
- No labor dollars, or total budget dollars, should be included in this table, only proposed workforce and other direct costs.

Supplemental Budget Narrative Table FY16 Only

Workforce (the mission may itemize by center, but not required). No totals required.

Other Direct Costs (the mission may itemize by center, but not required). No totals Required
Travel (consider itemizing by type, e.g. Conference, Science Team Meetings, Program meetings, etc)
Contracts (list each contract, company/institution, work scope, annual cost)
Grants (list each, university, work scope, annual cost)
Materials and other purchases (summary estimate, group as appropriate)

Workforce

Science WBS element 4.0	Description	NASA Center Civil Srv FTE	NASA JPL WYE	WYE	Other WYE
Task 1					
Task 2					
Task 3 etc					

Mission Operations WBS element 7.0	Description	NASA Center Civil Srv FTE	NASA JPL WYE	WYE	Other WYE
Task 1					
Task 2					
Task 3 etc					

Other Direct Costs

WBS 4.0/Science	Description	Annual Cost $
Travel		
Science team meetings		
Conferences		
Program travel		
Contracts		
Company 1		
Company 2		
Grants		
University 1		
University 2		
Material & Other Purchases (group or itemize as appropriate)		

WBS 7.0/Mission Operations	Description	Annual Cost $
Travel		
Science team meetings		
Conferences		
Program travel		
Contracts		
Company 1	Flight Operations	
Company 2		
Grants (if appropriate)		
University 1		
University 2		
Material & Other Purchases (group or itemize as appropriate (e.g. software licenses)		

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