NASA Langley Research Center

Science, Technology, and Research Support Services (STARSS III) – Statement of Work

Exhibit A

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1.0 Purpose

This Statement of Work (SOW) defines the science, technology and research support requirements of the NASA Langley Research Center (LaRC) Science Directorate (SD). These requirements include, but are not limited to, support in Earth and planetary atmospheric science, research and technology, and Atmospheric Science Data Center (ASDC). The Contract Management section below (Section 3.0) addresses overall contract level requirements. Technical requirements are organized into nine SOW areas that define the services to be provided under both Core and Indefinite Delivery/Indefinite Quantity (IDIQ) requirements. The Core provides discipline-oriented work that includes technical engineering services as determined by programs, projects, and implementing organizations. In addition, the Contracting Officer (CO) will issue IDIQ Task Orders (TOs) to accommodate programmatic uncertainty, and work within the scope of this contract. The CO will issue TOs in cases that include, but are not limited to, short term technical efforts and new work where enduring nature is uncertain. IDIQ work that becomes enduring will be transitioned to the Core.

Core requirements as well as IDIQ requirements will utilize Technical Direction Notices (TDNs) as defined in Section G.7 of the contract. Contract documentation and deliverables are identified in Exhibit B, Contract Documentation Reporting Requirements. Individual TDNs and TOs will reference other unique applicable documents.

2.0 General Scope

The Contractor shall furnish all personnel, facilities, equipment, supplies, and materials, not provided by the Government, necessary to support the NASA LaRC science programs and related engineering activities. Work requirements encompass the broad scope of the missions and responsibilities of the LaRC's science, technology, research and related applications programs. Contractor support shall include, but is not limited to fundamental, theoretical, analytical, experimental, including flight and field mission concept, development, and deployment, and applied research. Work will be performed in compliance with Federal, Agency, and LaRC specific policies, procedures, and regulations, including but not limited to NASA Procedural Requirements (NPRs) as specified in the contract documents. The nine SOW areas to be performed are outlined below, in Section 4.0.

3.0 Contract Management Requirements

The Contractor shall provide management and administrative functions to ensure the proper resources are available and allocated, reports and documentation are provided and all SOW requirements are met. The Contractor shall provide an organizational structure with clear lines of authority and clearly identified Government interfaces. The Contractor shall ensure that all contractor and subcontractor personnel engaged in performance of this SOW have appropriate qualifications, knowledge, clearances, certifications, and are free from conflicts of interest, to perform work in accordance with the SOW requirements.

3.1 Annual Work Plan

The Contractor shall provide an Annual Work Plan (AWP), which defines and integrates contract work activities and requirements across the contract, including subcontractor efforts. The

Contractor shall develop the AWP and changes thereto in coordination with appropriate NASA personnel associated with the contract including, but not limited to, the Contracting Officer (CO), Contracting Officer's Representative (COR), SOW leads, representatives, Technical Point of Contacts (TPOCs) referenced in TDNs and TOs to ensure focus is placed on defining the requirements and matching those requirements to projected funding levels.

The AWP is intended to be a flexible working document, incorporating changes throughout the year (with COR concurrence, and CO approval) to accommodate emerging mission and customer requirements in addition to existing requirements. Government personnel and Contractor will continuously communicate and coordinate on changes to the AWP to ensure a clear understanding of the requirements, the division of roles and responsibilities, and the content that will be included in the AWP.

3.1.1 Objectives and Content of the AWP

The AWP shall reflect the most efficient operational approach within and across the SOW areas. The AWP shall detail the Contractor's overall approach to meet the SOW requirements associated with the successful accomplishment of program/project goals, objectives, and milestones, in accordance with Government provided information described in Paragraph 3.1.2. The AWP shall describe how the Contractor will meet performance requirements for work to be performed for a 12 month period of performance aligned to each Government fiscal year, excluding the first AWP. The first AWP shall be 17 months. The plan shall include the following:

a. Top-Level summary covering each SOW area and correlated with the applicable TDNs and CLINs
b. Approach to develop workforce plan and resource allocations
c. Annual staffing plan associated with projected workloads, including information regarding skill mixes, staffing levels, and distribution of Contractor workforce for each SOW area
d. Management approach (including but not limited to the criteria, methods, and procedures) for identifying, analyzing, planning, tracking, mitigating, controlling, communicating, and documenting contract related risks associated with contract administration; and performance of Core Requirements and TOs
e. Approach to implementing new skills within the workforce to align with requirements
f. Approach to maintaining core capabilities and knowledge to meet future requirements
g. Milestones and deliverables
h. Impact of requirements changes
i. Projected metrics and objectives to demonstrate continuous process improvement/innovation

3.1.2 Government Provided Information

The Government will provide the operational and budgetary parameters for use in development of the AWP for the upcoming Government fiscal year. The Government may also include

parameters for multiple years. The parameters may fluctuate and will include, but are not limited to:

a. Annual projections of requirements by SOW area and/or TDNs (programs/projects to be supported, mission objectives, major deliverables and milestones, sustained technical support requirements)
b. Performance criteria for functions to be performed by the Contractor

NOTE: The work that the Contractor shall perform is subject to change based on changes in Government requirements.

3.1.3 AWP Submission Requirements

The Contractor shall submit AWPs on an annual basis with semiannual updates or as otherwise directed by the CO. The Contractor shall submit the first AWP 30 calendar days after award of contract. The CO will provide comments within 15 calendar days after AWP submission. The Contractor shall submit the final plan within 15 calendar days after receipt of CO comments. In the subsequent years, the COR will provide the operational and budgetary parameters for inclusion in the AWP no later than July 1st. The Contractor shall submit the draft plan no later than August 15th. The CO will provide comments within 15 calendar days after plan submission. The Contractor shall submit the final plan within 15 calendar days after receipt of CO comments. Semi-annual updates will follow the same review/comment process. Since the contract years and fiscal years are different, the AWP shall clearly delineate the upcoming fiscal year and correlate to the contract years to ensure traceability to the contract values and funding limitations.

3.2 Electronic Contract Management System

The Government will provide a commercial-off-the-shelf Electronic Contract Management System (ECMS) implemented as a web based ordering system.

The Contractor shall use the Government provided ECMS to facilitate the contract management process, for both Core and IDIQ work, that will: (1) create, schedule, approve, document, track and monitor contract activities; and (2) plan and manage resources. For all SOW areas, TDNs and TOs, the Contractor shall input all applicable fields in ECMS (e.g., period of performance, WYEs, labor categories, total cost, total fee (if applicable), subcontractor data (e.g., labor categories, hours, and costs), government furnished equipment and/or information, customer contact information, travel, and a completed task quality standard metric (if applicable) with customer-feedback and comment input field).

Financial data shall be maintained in ECMS. The Contractor shall notify the CO immediately upon detection of significant errors in its financial data that impact work and/or costs reported. Financial reports shall be generated at multiple levels of detail that include, but are not limited to SOW area, TDNs and TOs. The Contractor shall provide monthly accumulated expenditures and projections of costs and workforce utilization in accordance with Contractor Financial Management Report, NASA Form 533M. All NF 533 data shall be available in the ECMS database. End of month TDN data must reconcile with the NF 533M.

The ECMS shall capture financial data for tracking work, funding and costs on the Contract by each TDN and TO. The data includes, but is not limited to, funding levels, actual incurred costs, funded through date, and estimated cost to complete.

3.3 Management Meetings

The Contractor shall participate in periodic scheduled as well as unscheduled meetings with the CO to discuss contract performance issues, process improvements, risks and related issues, corrective actions, recovery plans, and other details of contract operations. These informal meetings will be attended by the CO and COR and other NASA affected personnel.

The Contractor shall participate in reviews with the CO to discuss cost planning, phasing and performance of the overall progress of the Contractor, subcontractors and vendors as required by the CO. These reviews may include both formal and informal discussions with multiple customers requiring multiple products/reports, sometimes due concurrently.

Contractor personnel shall participate in meetings with CO, COR, and SOW representatives to discuss Annual Work Plan requirements. Contractor personnel shall maintain frequent communications with NASA regarding technical challenges, accomplishments, findings, problems, risks, corrective actions, progress and other details of contract operations.

3.4 Software Management

The Contractor shall develop and maintain a Software Management Plan (SMP), including supporting documents, in accordance with NPR 7150.2, NASA Software Engineering Requirements depending on the software class, identified as follows:

Class B: Non-Human Space Rated Software Systems or Large Scale Aeronautics Vehicles
Class C: Mission Support Software or Aeronautic Vehicles, or Major Engineering/Research Facility Software
Class D: Basic Science/Engineering Design and Research and Technology Software
Class E: Small Light Weight Design Concept and Research Technology Software

Based on software class (identified in NPR 7150.2) additional requirements, software products, and documentation contents will be specified by NASA in TDN's or TO's.

3.4.1 Use of Off-the-shelf, Reused or Open-source Software

The Contractor shall notify the COR, whether off-the-shelf, reused, or open-source software will be included in code developed for the project and to obtain all necessary licenses to permit use of such software. The Contractor shall satisfy the following conditions when a Commercial, Government, Modified Off the Shelf (COTS, GOTS, MOTS), open source, or reused software component is acquired or used:

a. The requirements to be met by the software component are identified
b. The software component includes documentation to fulfill its intended purpose (e.g., usage instructions)
c. Proprietary rights, usage rights, ownership, warranty, licensing rights, and transfer rights have been addressed to permit use of the software

d. Future support for the software product is planned and adequate for project needs
e. The software component is verified and validated to the level required for its intended use
f. Perform periodic assessments of reported defects to ensure the defects do not impact the selected software components

3.4.2 Automatic Generation of Software Source Code

The Contractor shall define the approach to the automatic generation of software source code including but not limited to:

a. Validation and verification of auto-generation tools
b. Configuration management of the auto-generation tools and associated data
c. Identification of the allowable scope for the use of auto-generated software
d. Verification and validation of auto-generated source code
e. Monitoring the actual use of auto-generated source code compared to the planned use
f. Policies and procedures for making manual changes to auto-generated source code
g. Configuration management of the input to the auto-generation tool, the output of the auto-generation tool, and modifications made to the output of the auto-generation tools

4.0 Technical Requirements

The Contractor shall provide technical services to accomplish work in the following SOW areas:

4.1 Atmospheric Composition Science

The Atmospheric Composition Science Technical Area provides both in-depth scientific understanding and broad technical capabilities for investigating atmospheric composition (for example: aerosols, clouds, ocean related constituents, Carbon Dioxide (CO_2) and others) to enable prediction of global changes that affect environmental quality. LaRC instruments are deployed on the ground, onboard aircraft, and on space platforms. The Contractor shall support research and development of experimental measurements, and algorithm development techniques for a wide array of customers and programs. Research shall also be conducted in mobile laboratories including but not limited to the ground-based ozone measurement laboratory and on-board airborne platforms for the advancement of technologies and the acquisition of important atmospheric measurements. Lidar system development, operations, algorithm development and data processing are all required to enable atmospheric composition science. This support requires proficiency in lidar systems, algorithm development, processing and operations. The Contractor shall perform the following work in atmospheric composition science activities including, but not limited to:

4.1.1 Lidar Field and Laboratory Research

The Contractor shall perform the following work in Lidar Field and Laboratory Research activities including, but not limited to:

4.1.1.1 Conduct measurements to determine the quantity of dissolved oxygen in seawater as an indication of the biological health of ocean and bay seawater for marine organisms.

4.1.1.2 Develop and document operational procedures for Atmospheric and Ocean Lidar Systems.

4.1.1.3 Conduct lidar system operations for calibrating, gathering, and analyzing Atmospheric and Ocean Lidar Systems at specified research sites.

4.1.1.4 Execute ozonesonde validation activities for both local and field measurements.

4.1.1.5 Perform lidar data retrieval, data analysis, and validation, data archival, and data comparisons.

4.1.1.6 Develop software for conducting simulations of experiments, analytical studies, and data reduction associated with atmospheric and ocean lidar remote sensing programs.

4.1.1.7 Develop hardware and software for data acquisition and real-time analysis systems for airborne, and ground-based lidar systems.

4.1.1.8 Develop, operate, and maintain lasers, detectors, and control systems in integrated airborne, ground-based and ocean lidar systems.

4.1.1.9 Provide on-site and off-site (field campaigns) operations, systems, networks, and configuration support to lidar programs.

4.1.1.10 Provide hardware support for lasers, detectors, and control systems for lidar systems.

4.1.1.12 Document the analysis and interpretations of science data

4.1.1.13 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Lidar standard data products
- Lidar experiment simulation results
- Lidar, in situ, and satellite data analysis products
- Scientific reports, papers, presentations, and journal articles.

4.1.2 Lidar Science Algorithm and Data Analysis

The Contractor shall perform the following work in Lidar Science Algorithm and Data Analysis activities and public release of science data products including, but not limited to:

4.1.2.1 Provide hardware support, including but not limited to lasers, detectors, and control systems development.

4.1.2.2 Develop, implement and test advanced algorithms for retrieval of atmospheric and ocean composition profiles from airborne, ground-based, ocean and space-based lidars, including but not limited to the development of appropriate models and studying the statistical variation of composition properties to determine capabilities and limitations of composition retrieval techniques.

4.1.2.3 Perform analyses to evaluate the information content of observations and improve the characterization of microphysical properties.

4.1.2.4 Provide travel support for technical interface meetings for non-NASA participants, including but not limited to visiting scientists, students, and post-doctoral fellows

4.1.2.5 Attend and present research results at science team meetings and technical conferences as required.

4.1.2.6 Explore retrieval techniques and the uncertainties in the retrieved products using combinations of extinction, backscatter, and depolarization profiles.

4.1.2.7 Provide assessment of each implementation of autonomous lidar algorithms for satellite-based lidars providing backscatter, as well as include retrievals using a combination of lidar data and data from passive radiometric instruments.

4.1.2.8 Develop and test a turn-key, high-speed hardware-software computing system to enable rapid operational retrievals from lidar data including but not limited to aerosol microphysical types, and the processing of airborne, ground-based and ocean and simulated data cases.

4.1.2.9 Conduct studies to improve the existing coupled ocean/atmosphere full polarization radiation transfer model.

4.1.2.10 Conduct studies of polarimetric measurements sensitivities to changes in physical properties of aerosols and ocean biogeochemistry and studies of the Remote Scanning Polarimeter (RSP) High Spectral Resolution Lidar (HSRL) data analysis relevant to the development of next generation combined lidar/polarimeter retrieval algorithm.

4.1.2.11 Perform assessment of calibration stability and theoretical assessment of calibration uncertainty associated with multiple scattering including time series of clouds, aerosols, ocean surface and subsurface backscatter and their seasonal/inter-annual variation.

4.1.2.12 Perform comparisons of data observations with climate modeling results by developing algorithms to apply observations of ocean surface properties using moderate resolution imaging and data analysis and radiative transfer calculations to assess uncertainties in atmospheric radiative fluxes.

4.1.2.13 Perform risk reduction analysis into the damage effects associated with Ultra Violet (UV) laser operation.

4.1.2.14 Identify potential mitigation strategies to improve laser lifetime.

4.1.2.15 Perform upgrades to the ocean color remote sensing data analysis system software program, and improve theoretical understanding of ocean surface mean square slope and its applications in lidar remote sensing.

4.1.2.16 Provide support to organize the applications communities to use NASA's remote sensing data sets for societal benefit.

4.1.2.17 Deploy ship-based in situ measurements of ocean sub-surface optical properties; conduct data analysis studies for assessment of ocean sub-surface beam attenuation and backscatter profiles using the ship-based measurements.

4.1.2.18 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- All field data collected

- Software Source code
- Data, graphics and other inputs for documenting technical analyses and scientific studies
- Lidar standard data products, experiment simulation results and analyses

4.1.3 Lidar Laser and Detector System Development and Maintenance

The Contractor shall perform the following work in Lidar Laser and Detector System Development and Maintenance activities including, but not limited to:

4.1.3.1 Provide support to lidar teams in characterizing the receiver interferometers for backscatter (e.g. aerosol and molecular), and analyze performance tests conducted in the laboratory and on the lidar systems.

4.1.3.2 Perform repairs or modifications to the interferometers as necessitated by the testing.

4.1.3.3 Develop new optimized interferometers.

4.1.3.4 Develop and maintain optical, mechanical, and electrical designs and components for the lidar instruments, including but not limited to upgrade of the lidar instruments, fixtures and instrument components required to mount the lidar instruments on aircraft, and ground support equipment for the deployment, operation, alignment, and maintenance of the lidar instruments.

4.1.3.5 Conduct and document structural and thermal analyses required by the lidar programs.

4.1.3.6 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Components and subsystem solid models and interferometers
- Components to enable the integration of lidar lasers
- Opto-mechanical assemblies and mounting systems
- Housing system and related assemblies required to enable use of items

4.1.4 Lidar Project Development and Validation

The Contractor shall perform the following work in Lidar Project Development and Validation activities including, but not limited to:

4.1.4.1 Develop input to the requirements, including science objectives with traceability to measurement requirements and instrument performance requirements as an input to the space flight instrument conceptual design.

4.1.4.3 Assess and evaluate scientific requirements.

4.1.4.4 Develop inputs to publications for peer reviewed journals and presentations and of research results at scientific conferences.

4.1.4.5 Define and assess algorithms, data products, and data validation plans.

4.1.4.6 Develop and evaluate science requirements and specifications for modeling measurement requirements.

4.1.4.7 Conduct flight planning and coordination to meet science objectives during the flight campaigns.

4.1.4.8 Conduct studies, including but not limited to: the impact of micron airglow on the determination of ground pressure by laser absorption spectroscopy of molecular oxygen; the analysis of the impact of airglow on satellite-based laser remote sensing of surface pressure; complete calculations and analysis to produce time dependent estimates of stimulated emissions; evaluate results of calculations.

4.1.4.9 Design and provide environmental enclosures necessary for flight campaigns including but not limited to fabrication, assembly, integration, alignment.

4.1.4.10 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- All documentation of preliminary and final design reviews
- Requirements, data analysis, and flight planning reports

4.2 Space Lidar Missions

Space Lidar missions are space-based instrument systems designed to provide global measurements of aerosols, clouds, winds, atmospheric composition, and ocean characteristics that are needed to better understand the climate and atmospheric processes. These missions improve the scientific community's ability to model long-term climate trends, as well as operational weather and air quality forecasts. These missions produce publicly available data products that meet the mission requirements for accuracy, availability, and latency. Contractor support shall include, but not be limited to review of data product algorithms, documentation of code, configuration management of software, interface control, data distribution, data archival, mission operations, public outreach, and data validation. The Contractor shall perform the following work in Space Lidar Missions activities including, but not limited to:

4.2.1 Project Management

The Contractor shall perform the following work in Project Management activities including, but not limited to:

4.2.1.1 Provide logistical, administrative and planning support for project, science team or technical interface meetings, workshops and Educational and Outreach activities.

4.2.1.2 Provide travel and reimbursement for non-NASA participants for project, science team or technical interface meetings.

4.2.1.3 Deliverables will be specified in each TDN or Task Order.

4.2.2 Science, Algorithm Development and Quality Assurance

The Contractor shall perform the following work in Science, Algorithm Development and Quality Assurance activities including, but not limited to:

4.2.2.1 Perform scientific and measurement validation studies with data from other atmospheric measurement and modeling systems provided by NASA.

4.2.2.2 Perform science and engineering analysis for algorithm development, implementation, and maintenance as well as provide operational, data reduction, and database archive support for mission-related correlative measurement activities.

4.2.2.3 Perform software development, code verification and review, analysis of preliminary data, and configuration management.

4.2.2.4 Perform error analysis of retrievals and development of advanced aerosol absorption retrievals.

4.2.2.5 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Data, graphics, visualizations, and other inputs for documenting technical, scientific or validation studies
- Detailed reports describing the analyses conducted and conclusions

4.2.3 Mission Operations and Engineering

The Contractor shall perform the following work in Mission Operations and Engineering activities, including, but not limited to:

4.2.3.1 Perform payload instrument operations, mission planning, development, validation, and execution of on-orbit payload instrument commands.

4.2.3.2 Maintain and enhance flight and ground payload processing software, characterization of lidar performance, trend analyses of significant payload and ground-system parameters, and payload and ground system trouble-shooting activities.

4.2.3.3 Perform engineering system and component characterization and testing; data acquisition; algorithm development and maintenance of flight software.

4.2.3.4 Extract engineering and scientific data from the science data downlink stream and perform analysis on engineering parameters, instrument performance, and science data.

4.2.3.5 Prepare, organize, collect, reproduce, all mission documentation for archival in the ASDC.

4.2.3.6 Monitor the maintenance of the ground system network to meet daily communication and processing requirements.

4.2.3.7 Provide a backup data collection and processing facility for mission operations.

4.2.3.8 Provide rapid response (2 weeks or less) for environmental monitoring for societal benefit.

4.2.3.9 Provide immediate response to on-orbit instrument and environmental anomalies, ground system malfunctions and unanticipated technical problems.

4.2.3.10 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Mission operations status reports, which summarize payload performance, operational activities, and payload commanding
- Anomaly reports, as required, that describe the causes and response to unanticipated or adverse payload performance
- Mission operations review presentation packages in support of CNES Annual EXploitation REViews (REVEX) and Joint Steering Group reviews
- Payload telemetry archive
- Payload flight software archive

4.2.4 Data Production and Management

The Contractor shall perform the following work in Data Production and Management activities including, but not limited to:

4.2.4.1 Develop, implement, test and maintain algorithms necessary to combine mission instrument data with spacecraft ephemeris and ancillary meteorological data to produce standard, expedited, research, and final data products.

4.2.4.2 Develop and maintain production software and conduct data production operations to produce and archive data products.

4.2.4.3 Modify existing software scripts and mission-level program elements as required to create a processing subsystem that will ingest data and create a specified data record.

4.2.4.4 Analyze, assess, and evaluate the geo-location and calibration accuracies of various data and support the validation of data products.

4.2.4.5 Provide expedited data in response to environmental monitoring for societal benefit, and on-orbit instrument and environmental anomalies, ground system malfunctions and unanticipated technical problems.

4.2.4.6 Perform updates to the mission data processing system operations guide.

4.2.4.7 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Monthly summary reports of the status of processing and archival activities and the status of the processing, archival, and local data storage system at ASDC as well as a report on the transfer of mission data products to the other data centers
- Software code and supporting documentation
- Software tools and supporting documentation for the analysis and display of data

4.2.5 NASA Cloud-Aerosol Transport System (CATS)

The NASA Cloud-Aerosol Transport System (CATS) lidar will provide range-resolved profile measurements of atmospheric aerosols and cloud distributions and properties. The primary objective of the CATS Lidar Support task is to use the CATS measurements to augment and extend the long-term data record established by CALIPSO. The Contractor shall perform the following work in support of the NASA CATS lidar including, but not limited to:

4.2.5.1 Identify, document, and track requirements for CATS lidar generation of CALIPSO-like Level 2 products (data processing levels as defined in http://science.nasa.gov/earth-science/earth-science-data/data-processing-levels-for-eosdis-data-products/).

4.2.5.2 Provide analysis to evaluate the geo-location and calibration of CATS Level 1 data and support the validation of the CATS CALIPSO-like data products (data processing levels as defined in http://science.nasa.gov/earth-science/earth-science-data/data-processing-levels-for-eosdis-data-products/).

4.2.5.4 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Monthly summary reports of the status of processing and archival. activities and the status of the processing, archival, and local data storage system at ASDC
- Provide updates, as determined by the NASA Technical Point Of Contact (TPOC), to the CATS-CALIPSO data processing system Operations Guide
- Provide CATS-CALIPSO code and supporting documentation
- Provide CATS-CALIPSO software tools and supporting documentation for the analysis and display of CATS-CALIPSO data
- Monthly progress reports including completed and projected, accomplishments, significant issues, and metrics reflecting the successes in meeting CALIPSO performance standards, and a schedule of planned activities

4.3 Climate Science Missions

The Climate Science Missions technical area provides both in-depth scientific understanding and broad technical capabilities for investigating radiative transfer within the atmosphere and at the surface of the Earth, and the effects of climate forcings, climate feedbacks, and climate sensitivity including the effects of clouds, aerosols, the general circulation, and surface properties on the global, regional, and local climates of the planet. LaRC instruments are deployed on the ground, on the ocean (e.g., buoys, boats), on airborne platforms (e.g., aircraft, helicopter, balloons), and in space. The Contractor shall support formulation of new mission concepts, technology and instrument development, calibration and characterization, data analysis (e.g., retrieval algorithms, spectral fingerprinting), data validation, data processing/distribution/archiving, generation of climate data records (CDRs) and applying the results for societal benefit. This support requires proficiency in remote sensing instrument design, development, and deployment, algorithm development, scientific data processing, and operations. NASA's new mission concept development, and short-term research and analysis (R&A) projects, require Contactor support in state-of-the-art technologies for the science and data handling, including large data fusion and instrument inter-calibration tools, design of multitier distributed frameworks for data handling, and software. The Contractor shall perform the following work in Climate Science Mission activities including, but not limited to:

4.3.1 Mission Technical Management

The Contractor shall perform the following work in Mission Technical Management activities including, but not limited to:

4.3.1.1 Perform analyses to accurately calibrate mission instruments.

4.3.1.2 Monitor mission on-orbit instrument operations and provide support for identifying and implementing any required actions, including actions associated with spacecraft maneuvers.

4.3.1.3 Develop tools for performing inter-calibration of climate science instruments.

4.3.1.4 Perform programmatic (including but not limited to cost, schedule, technical) and engineering trade analyses to facilitate design, development, acquisition and deployment of climate science instruments and missions.

4.3.1.5 Perform mission-required feasibility studies.

4.3.1.6 Study the performance of radiometric instruments in low-temperature and low-pressure environments for potential applications in polarregions and on high altitude platforms.

4.3.1.7 Perform studies supporting potential future Earth System Science Pathfinder Program (ESSP), Venture Class mission (e.g., Earth Venture Sub-Orbital (EV-S), Earth Venture Instrument (EV-I), and Earth Venture Mission (EV-M)) proposal opportunities.

4.3.1.8 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Monthly instrument/mission status reports
- Monthly calibration status reports
- Reports in support of programmatic and engineering trade analyses

4.3.2 Mission Science

The Contractor shall perform the following work in support of Mission Science activities including, but not limited to:

4.3.2.1 Participate in scientific studies and contribute to the development, presentation, and publication of study and mission results in scientific literature.

4.3.2.2 Develop and apply radiative transfer models to study cloud radiative effects at the top of the Earth's atmosphere and surface.

4.3.2.3 Perform tasks associated with algorithm development, analysis, validation, and improvement for existing climate science missions.

4.3.2.4 Perform tasks associated with development and implementation of cloud retrieval algorithms and software.

4.3.2.5 Develop and maintain ancillary datasets for aerosols, total solar irradiance and other physical parameters used to support production of radiation budget data products.

4.3.2.6 Assess the quality of mission data products and ascertain their long-term trends.

4.3.2.7 Develop and analyze simulated mission data sets to refine science and measurement requirements for climate science missions, including but not limited to, instrument field-of-view, swath width, spectral resolution and range, measurement accuracy and noise, and spacecraft pointing capability.

4.3.2.8 Perform orbital and sampling analyses in support of mission scenario analyses to refine requirements for sampling frequency, spacecraft altitude, mission life, and systematic sampling error.

4.3.2.9 Develop and validate multi-year data sets to be used for orbital sampling studies.

4.3.2.10 Support the development and demonstration of an information content framework (ICF), designed to quantify the information content of datasets that simulate a variety of atmospheric measurements. The contractor shall conduct framework development, data processing and analysis, data validation, and radiative transfer modeling, in support of the framework.

4.3.2.11 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Monthly instrument/mission status reports
- Monthly calibration status reports
- Standard mission data products
- Updated ancillary datasets
- Publications, as required

4.3.3 Mission Logistics

The Contractor shall perform the following work in support of Mission Logistics activities including, but not limited to:

4.3.3.1 Provide mission support required for science management, website content development, and education and public outreach activities.

4.3.3.2 Provide logistical support (e.g., travel, coordination, and planning) for science team meetings for NASA and non-NASA participants.

4.3.3.3 Assist mission team in planning and readiness for all major reviews of the mission progress.

4.3.3.4 Deliverables will be specified in each TDN or Task Order.

4.3.4 Mission Data Management

The Contractor shall perform the following work in Mission Data Management activities including, but not limited to:

4.3.4.1 Provide software and data processing support to Scientific Computing Facility (SCF) within the ASDC to validate data products.

4.3.4.2 Develop software to deploy science algorithms and code.

4.3.4.3 Develop and maintain documentation for all mission software.

4.3.4.4 Participate in working group and science team meetings.

4.3.4.5 Refine and implement configuration management processes for all mission software.

4.3.4.6 Provide inputs into NASA requirements definition and monitor the status of mission data stored at the NASA ASDC.

4.3.4.7 Provide software library maintenance and development support.

4.3.4.8 Provide data production requests, scheduling and monitoring, as required, for data processing at the ASDC.

4.3.4.9 Identify and provide support to implement methods to streamline and improve efficiency in mission production processing systems.

4.3.4.10 Develop and deploy tools for data dissemination.

4.3.4.11 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Provide science data processing codes for implementing algorithms into data management subsystem software
- Data products catalogs, interface requirements, data management plans, ancillary input data, quality assessment plans, coding guidelines, software design documents, validation documents, test plans, operator's manuals, data set collection guides, algorithm theoretical basis documents, and other documentation as needed to satisfy project/program requirements

4.3.5 Mission Validation

The Contractor shall perform the following work in Mission Validation activities including, but not limited to:

4.3.5.1 Perform instrument installation on Government-specified assets (e.g., boats, balloons, aircraft), including but not limited to maintenance, data collection, instrument calibration, and systems upgrades.

4.3.5.2 Maintain and operate ground support equipment for instrument characterization.

4.3.5.3 Provide transportation to validation sites to conduct on-site operations and maintenance using various modes of transportation including, but not limited to, helicopter and boat, as required to complete the work.

4.3.5.3 Resolve data quality issues, reprocess archived data and release to the public.

4.3.5.5 Install validation instruments at COR-specified observatories for calibration purposes, and assure high quality observations at those installations.

4.3.5.6 Incorporate algorithms and store results in COR-specified databases to allow detailed scientific analyses based on scenarios and different temporal samplings.

4.3.5.7 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Data sets derived from and specific to validation instruments

4.4 Climate Science Research and Analysis

The Climate Science Research and Analysis technical area provides both in depth scientific understanding and broad technical capabilities for investigating radiative transfer within the

atmosphere and on the surface of the Earth, and the effects of climate forcings, climate feedbacks, and climate sensitivity including the effects of clouds, aerosols, general circulation, and surface properties on the global, regional, and local climates of the planet. LaRC instruments are deployed on the ground and ocean, on aircraft, and in space. The Contractor shall support research and development of methods for experimental measurement; development and implementation of data fusion and analysis techniques; scientific modeling and simulation; and research, development, and implementation of computer architectures and systems for analyzing atmospheric data for a wide array of customers and programs. This support requires proficiency in remote sensing instrument development, algorithm development, scientific data processing, and operations. The Contractor shall perform the following work in Climate Science Research and Analysis activities including, but not limited to:

4.4.1 Data Fusion and Analysis

The Contractor shall perform the following work in Data Fusion and Analysis activities including, but not limited to:

4.4.1.1 Perform research and analysis using data from multiple satellites, aircraft instrumentation, ground instrumentation, and models to quantify the effects of clouds and aerosols on the Earth's radiation energy budget, and use multi-year satellite data records to quantify interannual variability at local, regional, zonal, and global spatial scales.

4.4.1.2 Calibrate instruments and operational and research satellite imagers dedicated to weather and climate problems. Update the calibration of existing infrared spectral sensors, analyze data, and reprocess existing data from instruments recorded in field campaigns.

4.4.1.3 Analyze cloud object types and Surface Radiation Budget (SRB) and derive cloud properties from radiometers.

4.4.1.4 Facilitate development and application of algorithms to estimate contrail properties and radiative forcing from satellite data. Conduct analysis, validation, and internet-based data display and data dissemination for scientific studies, image processing, and database development and management related to clouds, radiation, contrails, aerosol, and aircraft icing research.

4.4.1.5 Perform code development required for subsetting data, irradiance variability analysis, comparison with latent heat flux, and analyzing cloud properties by cloud types.

4.4.1.6 Facilitate development of light-scattering models and simulate heterogeneous single-scattering properties of heterogeneous ice crystals to enhance radiative transfer calculations.

4.4.1.7 Validate, improve, analyze and disseminate algorithms and data products using surface, aircraft, and independent satellite based estimates.

4.4.1.8 Provide monthly-averaged regional, zonal, and global estimates of radiation budget parameters identical to historical mission data products within acceptable tolerances.

4.4.1.9 Provide updated algorithms that are capable of production level data processing at the ASDC.

4.4.1.10 Study aerosol direct radiative effects and provide a quantitative assessment of the properties of thin clouds and their influence on the Earth's radiation budget using data from aircraft and satellite measurements.

4.4.1.11 Establish accuracy of derived Top-of-Atmosphere (TOA) irradiances and compare contributions of surface, cloud and atmospheric property variability to the TOA irradiance variability.

4.4.1.12 Compare surface radiation budget data sets to other surface radiation data sets and analyze long-term time series of surface radiation budget data in conjunction with surface measurement records.

4.4.1.13 Conduct research into the use of infrared spectral data for the assessment of climate change, analyze existing data sets from infrared instruments and test new concepts for using infrared data to assess climate variability and change, and investigate specific elements of climate processes through comparison of infrared measurements and models.

4.4.1.14 Perform analyses and studies in support of atmospheric sciences research projects and field experiments. Perform real-time satellite analyses for support of aircraft icing condition diagnoses, field program support, and data assimilation studies. Develop and document cloud analysis codes; develop and test cloud property retrieval algorithms.

4.4.1.15 Provide data management by producing merged data products for distribution to the public; revise the merged data by closely following the revision of data on the respective mission's websites; develop and maintain systems to archive and disseminate cloud and radiation products from satellite analyses; work closely with LaRC's ASDC for data archival and distribution. Provide data and documentation to users of the research data products.

4.4.1.16 Develop, validate, and disseminate data sets for decision support system needs in government and industry in societal benefit areas including but not limited to energy and agriculture.

4.4.1.17 Attend scientific conferences to present research results from these activities.

4.4.1.18 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Data products in standard digital and image formats for archival, dissemination, and internet access
- Web page code and documentation

4.4.2 Modeling and Simulation

The Contractor shall perform the following work in Modeling and Simulation activities including, but not limited to:

4.4.2.1 Develop and improve large eddy simulations, cloud-resolving models, single column models, convective cloud parameterizations, Multi-scale Modeling Frameworks (MMF) using various data sets, including but not limited to cloud object data.

4.4.2.2 Develop and improve climate model versions of higher-order turbulence closure schemes.

4.4.2.3 Test simplified versions of higher-order turbulence closure schemes and other schemes in single column and cloud-resolving models, and MMF.

4.4.2.4 Perform and analyze CO_2 doubling in MMF and other model simulations as needed.

4.4.2.5 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Data products in standard digital and image formats for archival, dissemination, and internet access
- Web page code and documentation
- Document methods and results of analyses by providing annotated computer code and written descriptions of methods and equations

4.4.3 Computer Architectures, Systems, and Distributed Processing Frameworks

The Contractor shall perform the following work in Computer Architectures, Systems, and Distributed Processing Frameworks activities including, but not limited to:

4.4.3.1 Facilitate the development of architectural designs and implementation of computer systems to provide distributed processing frameworks that perform inter-calibration of multiple instruments, and integrate science algorithms into the framework to demonstrate inter-calibration and data processing.

4.4.3.2 Demonstrate extendable distributed processing frameworks that allow instrument teams to perform more processing at remote data centers versus transmitting large volumes of data to local science data systems for processing.

4.4.3.3 Integrate networking software into the science data production environment to provide better use of computer resources and expedite production of collaborative merged data products.

4.4.3.4 Analyze code and map algorithms into framework of clients and server modules.

4.4.3.5 Develop all histogram server-side functions and perform document testing on ASDC data servers.

4.4.3.6 Develop and maintain all software in the ASDC and perform unit testing of development software.

4.4.3.7 Support deployment testing and document framework architecture, performance, and lessons learned

4.4.3.8 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Data products in standard digital and image formats for archival, dissemination, and internet access
- Web page code and documentation
- Framework architecture, performance, and lessons learned documentation
- Software source code and documentation

4.5 Chemistry and Dynamics Science

The Chemistry and Dynamics Science Technical Area provides both in-depth scientific understanding and broad technical capabilities for investigating atmospheric composition on

Earth (e.g., photochemically and radiatively active trace gases, aerosol chemistry and microphysics, aerosol-cloud interactions, upper atmosphere ozone and aerosols, biologically harmful radiation at aviation altitudes) and on other planetary bodies (e.g., Mars, the outer planets, Sun-Earth heliophysics connection) to enable prediction of global changes on Earth that affect environmental quality, and advance solar system science. The Contractor shall support LaRC instruments deployed on the ground, on balloon sondes, on aircraft and in space, with science enabled through cross- and inter-disciplinary investigations through modeling and analysis. The Contractor shall support formulation, research and development of experimental measurement instruments, algorithm development techniques, and modeling simulations for a wide array of customers and programs. The Contractor shall utilize LaRC provided laboratories, portable balloon sonde launch systems, and airborne and space-based instruments. The Contractor shall support NASA Earth Venture missions using a variety of aircraft-based instruments to study air quality and enable a space-based capability for global air quality measurements; the Stratospheric Aerosol and Gas Experiment (SAGE) III continuity mission which will provide long-term measurements of ozone, aerosols, water vapor and other key parameters; the Nowcast of Atmospheric Ionizing Radiation System (NAIRAS) which supports a physics-based prototype operational model for predicting aircraft radiation exposure from galactic and solar cosmic rays; and the Tropospheric Emissions: Monitoring of Pollution (TEMPO) project. The Contractor shall support various scales of scientific investigations ranging from small research and analysis tasks through complex sub-orbital campaigns to large flight missions, throughout the full project life cycle. The Contractor shall perform the following work in Chemistry and Dynamics Science including, but not limited to:

4.5.1 Upper Atmosphere Ozone and Aerosol Observations, Mission Operations, Data Processing, Analysis, and Science Activities

The Contractor shall perform the following work in Upper Atmosphere Ozone and Aerosol Observations, Mission Operations, Data Processing, Analysis, and Science Activities, including, but not limited to:

4.5.1.1 Provide data processing for instruments, missions, projects and experiments.

4.5.1.2 Develop, implement and test algorithms necessary to combine sensor data with spacecraft ephemeris data to produce scientific data products defined NASA.

4.5.1.3 Develop production software to run on the SCF in the ASDC with data product archival at the ASDC and other websites and provide detailed instructions for accessing this data.

4.5.1.4 Support science goals including but are not limited to, product definitions; software design, planning and development; configuration management; documentation; algorithm porting and development; software engineering and systems programming; ground and equipment work; data processing operation; software integration; testing and maintenance; debugging; and quality assurance.

4.5.1.5 Provide payload support to include, but not be limited to, instrument testing, evaluation of flight software architecture, implementation trade studies, development of limb scattering requirements, and development of concept of operations.

4.5.1.7 Perform and execute maintenance/upgrade testing, post refurbishment testing, and system level testing of instruments.

4.5.1.8 Provide programming for embedded systems in-flight hardware, ground test equipment, and instrument mockups as well as programming for ground data processing equipment.

4.5.1.11 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Data products, science and production code developed to produce data products

4.5.2 Travel and Deployment for Mission and Project Activities

The Contractor shall perform the following work for Travel and Deployment for Mission and Project activities, including, but not limited to:

4.5.2.1 Participate in field mission deployments; provide ground based and sub-orbital platform aerosol observations including, but not limited to, aerosol chemistry, size distributions, gaseous and particulate species, and volatility distributions using instrument systems.

4.5.2.2 Provide balloon observations of meteorological, trace gas and aerosol structure, near-surface gradients in trace gases and aerosols, and ground-truth aerosol measurements at various air monitoring sites.

4.5.2.3 Perform quality control/assurance and process data collected during field experiments.

4.5.2.5 Provide travel and logistics support for non-NASA participants for science team meetings, integration, deployments, and de-integration, to include, but not be limited to, travel arrangements, flight reservations, lodging, rental cars, reimbursements, and emergency medical evacuation.

4.5.2.7 Provide for shipping of instruments or other deployment-related items.

4.5.2.8 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Archival of data products

4.5.3 Passive Hyperspectral Engineering and Science

The Contractor shall perform the following work in Passive Hyperspectral Engineering and Science activities, including, but not limited to:

4.5.3.1 Provide engineering and technical support to maintain, optimize, and improve instrument hardware performance, while including advancements to instrument command and control, and data acquisition and visualization software.

4.5.3.2 Analyze and interpret near-real-time instrument flight science and engineering data including, but not limited to, checkout and experiment flights.

4.5.3.3 Perform ground testing, calibration, performance verification testing, and flight readiness improvement activities.

4.5.3.4 Support development of science algorithms and data processing concepts for the analysis of field program data, calibration/validation planning, and activities associated with instrument performance optimization, and study improvements for next-generation airborne and space-based sounding systems.

4.5.3.5 Conduct field deployments to identify science requirements, plan aircraft flight profiles, and analyze/interpret near real-time instrument flight science and engineering data.

4.5.3.6 Conduct software and analysis research on radiative transfer inversion codes.

4.5.3.7 Perform retrieval algorithm development for hyperspectral remote sensing.

4.5.3.8 Develop radiative transfer models and methods for hyperspectral sensors and generate proxy data.

4.5.3.9 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, those specified in Exhibit B, Contract Documentation Reporting Requirements.

- Software for radiative transfer model development and retrieval inversion codes

4.5.4 Atmospheric Composition, Air Quality Mission, Project Formulation and Research

The Contractor shall perform the following work in the area of Atmospheric Composition, Air Quality Mission, Project Formulation and Research activities, including, but not limited to:

4.5.4.1 Identify and analyze commercially hosted government payload data packages to support the goals and objectives of NASA's Decadal Survey missions.

4.5.4.2 Expand the database of documents from recent successful commercially hosted government payloads in geostationary orbit and assess these documents in accordance NASA policies and procedures.

4.5.4.3 Develop and improve documents for accommodating payloads on commercial spacecraft in geostationary orbit, including, but not limited to, developing and reviewing documents for compliance with applicable policies, technical, management plans and estimate baseline costs.

4.5.4.4 Provide scientific computing and analysis capabilities, including but not limited to, numeric simulations to evaluate models, and evaluate sensitivities and responses to various input parameters measured at experimental sites.

4.5.4.5 Perform data processing to include the development, implementation, and testing of algorithms required to combine space-based observations of pollutants and their precursors with relevant ground network data.

4.5.4.6 Provide support for presentation(s) of applied science results at inter-agency meetings and scientific forums.

4.5.4.7 Operate, calibrate, maintain, and repair the collection of current and future instruments for research activities and provide on-site work on additional monitoring instruments at research sites as needed.

4.5.4.8 Provide site preparation and instrument set-up, calibration, daily operation, and data retrieval for high temporal resolution instruments and integrated samplers.

4.5.4.9 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Data products, analysis reports, documentation for the operations of instruments
- Applied science data product demonstrations

4.5.5 Closed-path Laser Instrument, Data Acquisition, and Analysis

The Contractor shall perform the following work in Closed-path Laser Instrument, Data Acquisition, and Analysis activities including, but not limited to:

4.5.5.1 Perform measurement activities in the laboratory and onboard atmospheric research aircraft for sub-orbital flight experiments, instrument testing and preparation for laboratory and field deployments.

4.5.5.2 Develop all software tools and applications required to meet data acquisition, analyses, and archival processes and utilize the latest developments in software and hardware to upgrade and enhance present capabilities.

4.5.5.3 Perform data collection analysis, measurements, and field work for missions, projects, and campaigns.

4.5.5.4 Conduct laboratory testing of data acquisition hardware prior to integration on aircraft for campaigns, projects, missions, as well as laboratory testing and calibration at various stages throughout field campaigns.

4.5.5.5 Perform software development and data archiving for measurement activities on board atmospheric research platforms in on NASA sponsored sub-orbital flight experiments.

4.5.5.6 Deliverables will be specified in each TDN or Task Order.

4.5.6 In Situ Aerosol Measurements

The Contractor shall perform the following work in the area of In Situ Aerosol Measurements activities including, but not limited to:

4.5.6.1 Provide mission planning; instrument development, testing and checkout, and improvement; and execution of experiments to collect and analyze gaseous and particulate emissions from combustors and aircraft engines.

4.5.6.2 Provide instrument set up and calibration, field operations, data acquisition, analysis and archiving for tropospheric chemistry field missions.

4.5.6.3 Perform in situ measurements from aircraft as part of tropospheric chemistry field studies.

4.5.6.4 Participate in assimilating data from a variety of sources to create merged data sets and publicly-accessible databases for engine and combustor emission experiments.

4.5.6.5 Collect and analyze aerosol samples using laboratory equipment including but not limited to ion chromatography, thermal optical analysis, and gas chromatograph and mass spectrometer.

4.5.6.6 Deliverables will be specified in each TDN or Task Order.

4.5.7 Development Activities for Airborne and Ground-based Sensors

The Contractor shall perform the following work in Development Activities for Airborne and Ground-based Sensors activities including, but not limited to:

4.5.7.1 Provide support for airborne and ground-based sensors currently operating and under development. These sensors include, but are not limited to, the Differential Absorption Carbon Monoxide Measurements (DACOM) airborne instrument, the Diode Laser Hygrometer (DLH) airborne series of instruments, and the Carbon Cycle Column Radiometer (C3R) ground prototype instrument.

4.5.7.2 Manage laboratory instrumentation; conduct component specification and characterization; and coordinate instrument logistics.

4.5.7.3 Monitor instrument performance and data integrity to inform project scientists while on deployment.

4.5.7.4 Deliverables will be specified in each TDN or Task Order.

4.5.8 Earth and Planetary Space Weather

The Contractor shall perform the following work in Earth and Planetary Space Weather activities including, but not limited to:

4.5.8.1 Maintain the functionality and operation of the real-time version of models and the interface and dissemination of the respective data products to the public.

4.5.8.2 Develop scripts for interfacing radiation model codes and algorithms to analyze calibration data and flight data.

4.5.8.3 Improve and develop coding for implementation of space environment, particle transport, and dosimetric response models into a new integrated software system.

4.5.8.4 Perform verification and validation of models by setting up scripts to run test cases and providing analysis.

4.5.8.5 Provide on-site data collection and obtain instruments for use in calibration, integration, testing and flight.

4.5.8.6 Perform particle transport calculations for the Earth’s atmosphere, Mars atmosphere and other surface environments, and compare results.

4.5.8.7 Investigate, quantify, and compare the effects of different ionizing radiation dosimetry physics packages available.

4.5.8.8 Perform benchmark studies to make comparisons, including but not limited to, particle flux, total dose, dose by particle, total dose equivalent, and dose equivalent by particle.

4.5.8.9 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Scripts and routines to implement improved environment transport and response models and to run verification and validation test cases
- Transport simulation output files, source codes, installation/build/make files, and corresponding plots

- Comparisons for the benchmark cases
- Reports on instrument data analyses and data quality checks
- Flight operational procedures for the instruments

4.5.9 Field Campaign Database Management

The Contractor shall perform the following work in Field Campaign Database Management activities including, but not limited to:

4.5.9.1 Provide data management activities during field campaigns, including but not limited to, setting up archives with file scanning software to assure that the submitted airborne data files comply with the required file format; maintaining the archive to ensure seamless data exchange among science team members as well as mission partners and generating standard and custom requested data merge products.

4.5.9.2 Archive all airborne data generated from campaigns to include satellite, sonde, ground-based, model and correlative data sets required to facilitate research to meet field campaign science objectives, and transfer final NASA approved data to the ASDC.

4.5.9.3 Maintain and improve the data file scanning software to comply with the International Consortium for Atmospheric Research on Transport and Transformation (ICARTT) format.

4.5.9.4 Maintain a central webpage for public access and all merge data products and instrument data uploading; maintain a controlled access archive for intercomparison exercises and conduct analyses to assess measurement consistency.

4.5.9.5 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Archive of file scanning and flight planning software at the ASDC repository in accordance with project configuration management and version control

4.6 Cross-Cutting Science

The Cross-Cutting Science technical area includes, but is not limited to, technical services and management that span science disciplines to meet program, project, research and technology goals. The Contractor shall support planning requirements and participate on multidisciplinary teams. This support requires proficiency in professional skills including, but not limited to, program and project management; technical writing and editing; web design, video and graphics production and design; meeting and retreat facilitation; program analysis and control; proposal management and development; education and outreach; logistics management; and advanced technology and science methodology development, including software development. The Contractor shall perform the following work in cross-cutting science programs, projects, and activities including, but not limited to:

4.6.1 Science Communication and Outreach

The Contractor shall perform the following work in Science Communication and Outreach activities including, but not limited to:

4.6.1.1 Research and write news releases, fact sheets, video scripts, photo captions, and articles for COR approval and subsequent release for media consumption that are related to activities and research in the SD.

4.6.1.2 Post COR-approved items on the SD NASA web portal page and work with the NASA portal team to post these items.

4.6.1.3 Research content, write text and oversee production of video news releases, video b-roll, photography, animation, graphic illustrations, and provide on-site consultation on technical content to support television remote live shots and participate in local events.

4.6.1.4 Collaborate with LaRC Public Affairs Office in response to news media inquiries concerning the SD, help arrange interviews with LaRC personnel and provide requested media products, including but not limited to fact sheets, news releases, and other media products.

4.6.1.5 Provide feedback via email to LaRC personnel including but not limited to program/project personnel and senior staff on daily record of SD related news media outcomes as tracked by LaRC Public Affairs.

4.6.1.6 Monitor news media options and target SD content as appropriate for new media outlets including, but not limited to Vine, SoundCloud, FourSquare - SlideShare, Ustream, Flickr, Google +, and YouTube.

4.6.1.7 Provide technical writing support for internal SD communications including but not limited to the annual report, metrics report, and weekly key activities, as well as technical writing assistance to SD personnel to maintain, update and upgrade web pages containing research and public outreach content, and ensure that the pages meet NASA compliance.

4.6.1.8 Provide technical writing expertise for small and large-scale proposals using NASA templates. Create proposal content, review and edit existing content, facilitate proposal development efforts through coordination with subject matter experts, and ensure consistency of messaging and content across proposals. Review proposal requirements for compliance with solicitation requirements (e.g., Broad Agency Announcements).

4.6.1.9 Provide facilitation for science-related retreats.

4.6.1.10 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- News releases, fact sheets, technical articles, tip sheets for conferences with major LaRC participation, key activities, videos, graphics, outreach materials, web pages, and the SD annual metrics report and yearbook
- Agendas, meeting notes, and final reports from retreat meetings.

4.6.2 Proposals

The Contractor shall perform the following work in Proposal activities including, but not limited to:

4.6.2.1 Manage the development of proposal efforts to ensure compliance with LaRC proposal processes and coordinate proposal team activities with NASA proposal team partners (e.g., industry, academia and other NASA and Government agencies).

4.6.2.2 Facilitate development of the concept and mission requirements prior to solicitation release, to include capture plans, threshold and baseline mission concept, instrument concept, milestones, and provide progress updates.

4.6.2.3 Develop tools, techniques and templates to facilitate the LaRC proposal development process (e.g., proposal outline and compliance matrix, storyboard development) incorporating lessons learned from previous proposal efforts, and facilitate formal review teams with senior and executive-level managers.

4.6.2.4 Perform proposal management support functions, training, and team mentoring.

4.6.2.5 Support the proposal team through the LaRC proposal development process. Facilitate the development of proposals in compliance with solicitation requirements (e.g., Broad Agency Announcements).

4.6.2.6 Assist the proposal teams in risk identification and mitigation.

4.6.2.7 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Proposal development plans, schedules, and cost estimates

4.6.3 Earth Science Education and Communication

The Contractor shall perform the following work in Earth Science Education and Communication activities including, but not limited to:

4.6.3.1 Perform tasks associated with development and operation of education, communication projects, and activities related to NASA missions and Earth System Science.

4.6.3.2 Provide support to include, but not be limited to, responding to electronic and voice requests and questions, preparing and sending mailings, conducting virtual presentations and Question and Answer sessions, and recording information in databases for educators participating in the education and communication projects.

4.6.3.3 Maintain and update public websites containing information about education and communication projects as well as internal websites for use by teams, projects, and missions.

4.6.3.4 Develop and update unit and lesson plans and educational activities; populate and maintain a science glossary for an upper elementary level audience; and develop new media products for science education projects exploiting multimedia, social networking, mobile applications, telepresence, and other new media tools.

4.6.3.5 Provide planning and logistics support to conduct educator professional development related to education and communication projects and provide follow-up support to workshop participants including, but not limited to, responding to questions, providing materials, and supporting educational research projects.

4.6.3.6 Attend local and regional and national meetings to present the education and communication projects, as determined necessary by the project team lead.

4.6.3.7 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Metrics of activities (presentations and web metrics) to be summarized for periodic NASA Headquarters (HQ) and SD reports
- Materials for educator professional development workshops, content and tools for project websites and printed project materials

4.6.4 DEVELOP National Program

The Contractor shall perform the following work in the DEVELOP National Program activities including, but not limited to:

4.6.4.1 Provide administrative and financial services for the DEVELOP National Program, including distributing stipends to approximately 200-300 DEVELOP program participants annually, arranging travel, obtaining supplies and equipment, coordinating with the ASDC on management of DEVELOP's online application system, and other related program activities.

4.6.4.2 Provide program analysis and control services to the DEVELOP program including, but is not limited to, resources planning, budgeting, program control, analyses, documentation and resource reports.

4.6.4.3 Implement NASA DEVELOP Program activities in support of NASA's Applied Sciences Program.

4.6.4.4 Coordinate DEVELOP projects for all DEVELOP locations (approximately 12 world-wide).

4.6.4.5 Mentor and guide program participants throughout project proposal and execution process.

4.6.4.6 Plan and organize national activities, including participation in relevant conferences, lead weekly National Program meetings, and deliver research results at diverse forums.

4.6.4.7 Provide administrative support to the SD and Applied Sciences Program at NASA HQ including, but not limited to meeting and conference support and logistical support at panel reviews.

4.6.4.8 Edit and proofread technical papers and abstracts for publication at scientific and public policy forums.

4.6.4.9 Formulate DEVELOP communications (e.g., articles, virtual poster session, social media).

4.6.4.10 Collaborate to integrate NASA space-based Earth observation sources into research projects; collect and analyze NASA and partner satellite and in situ data to conduct rapid feasibility projects that address an environmental community concern and align with application areas as directed by the NASA Applied Sciences Program.

4.6.4.11 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, those specified in Exhibit B, Contract Documentation Reporting Requirements.

4.7 Atmospheric Science Data Center

The ASDC is a multifunction organization serving both as a Distributed Active Archive Center (DAAC) under the Earth Science Distributed Information System (ESDIS) Project and as an Information Technology (IT) service provider for the SD. The Contractor shall support the ASDC as a DAAC including ingesting, archiving, processing, distribution, and user support for a wide

range of science data. Primary missions supported include, but are not limited to, Clouds and the Earth's Radiant Energy System (CERES), Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) and Multi-angle Imaging Spectro Radiometer (MISR). The Contractor shall support the ASDC as a SD service provider to include installation, hosting, administration, IT Security for SD, and user support for the many shared SD IT resources. IT Security activities shall comply with NPR 2810.1, "Security of Information Technology" and appropriate Federal Information Processing Standards (FIPS) located on the NASA Online Directives Information System (NODIS) Library at http://nodis3.gsfc.nasa.gov/main_lib.html. The Contractor shall support software engineering and advanced development for the ASDC as a DAAC and SD as a service provider. The Contractor shall support ASDC collaborations with a wide variety of organizations inside and outside of NASA. The Contractor shall perform the following work in Data Center activities including, but not limited to:

4.7.1 ASDC Operations and User Services

The Contractor shall perform the following work in ASDC Operations activities including, but not limited to:

4.7.1.1 Provide ingest, archive, distribution, and data management services for satellite and data missions.

4.7.1.1.1 Develop and maintain data product catalogs, interface requirements, data management plans, quality assessment plans, coding guidelines.

4.7.1.1.2 Create and maintain software design documents, validation documents, test plans, data set collection guides, and other documentation as needed to satisfy project/program requirements.

4.7.1.2 Provide data production support including, but not limited to, processing requests; work with data providers to generate metadata to provide supporting information required for the ASDC's data access systems; provide documentation of processes and procedures and capture all changes in accordance with a COR approved change management process; as well as perform quality assurance on such data.

4.7.1.3 Maintain existing data holdings and acquire new data holdings in the atmospheric science discipline, including but not limited to Clouds, Aerosols, Radiation Budget, and Tropospheric Chemistry.

4.7.1.3.1 Implement Data Acceptance Plans; create documentation for full-life cycle of stewardship from acquisition to close-out processing and long-term preservation of data holdings.

4.7.1.4 Provide support to science teams to add new data and metadata to existing project and mission holdings and/or to replace with reprocessed data products.

4.7.1.5 Provide data management support for ASDC users and customers.

4.7.1.6 Collaborate with instrument teams, ASDC Management, and others as required to ensure system upgrades and enhancements meet planned archival and distribution levels; develop detailed schedules for such activities

4.7.1.7 Develop cost effective plans for migration of data holdings from current technology to new technology; and develop tools and innovative techniques to verify quality of data products.

4.7.1.8 Perform physical property management including but not limited to performing property custodian functions, space management of assets supporting property audits, and maintaining a current inventory of assigned property assets, record all maintenance actions taken on each piece of tagged equipment in accordance with ASDC configuration management procedures.

4.7.1.9 Maintain up-to-date manuals regarding technical architectures, system configurations, and interfaces to the Center and Agency databases.

4.7.1.10 Provide outreach and market research to maximize visibility of data holdings and services.

4.7.1.11 Promote access to and use of atmospheric science data by commercial customers and state and local governments as well as other Federal agencies; participate in working groups.

4.7.1.12 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Report on data production levels, additional reports as requested by ASDC Management, and internal schedules for ASDC managed processing and reprocessing activities
- Report on data holdings by project: including, but not limited to each project's total data volume, number of granules, number of orders for each project, and total volume distributed
- Posters and/or presentations made while on official travel representing the ASDC at specific training and/or conferences related to ASDC aligned topics or areas of interest
- Report on data statistics including, but not limited to archive volume, total distribution, and non-science team distribution, as well as additional data operations status and statistics reports in response to ad hoc inquiries
- Schedules and regular updates to ASDC Management

4.7.2 ASDC Advanced Architectures and Engineering

The Contractor shall perform the following work in ASDC Advanced Architecture and Engineering Development activities, which include but are not limited to:

4.7.2.1 Make recommendations to evolve the ASDC architecture systems, consistent with applicable Federal, NASA, LaRC and SD policies, standards, guidance, and procedures.

4.7.2.2 Develop comprehensive project management plans for all technology pilots and experiments within the NASA ASDC.

4.7.2.3 Maintain a repository of emerging technologies that can be mapped to ASDC capability needs and requirements; conduct comprehensive technology assessments and analysis of alternatives to make recommendations to the ASDC management for informed IT decision making.

4.7.2.4 Continually assess current technology (e.g., cloud computing systems, data center management software, software based storage) and its potential application to ASDC

requirements, through proposed pilots and experiments by updating a repository of emerging technologies.

4.7.2.5 Employ systems engineering practices to the development and maintenance of ASDC software systems.

4.7.2.6 Collaborate with other NASA contractors, Office of the Chief Information Officer (OCIO), ESDIS, and other government personnel to address and resolve issues relating to interoperability, compliance with policies and guidelines, system defects, and customer requirements.

4.7.2.7 Provide subject matter expertise in the areas of geospatial, semantic, and big data analytics; provide innovative solutions to science customers for discovery and access, analysis, visualization, and science application.

4.7.2.8 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, those specified in Exhibit B, Contract Documentation Reporting Requirements.

- Schedules and regular updates to ASDC Management
- Technology and pilot experiment project management plans

4.7.3 System Engineering and Administration – Enterprise Systems

The Contractor shall perform the following work in System Engineering and Administration activities, including but not limited to:

4.7.3.1 Apply industry standards and best practices tailored to the requirements of the specific system development project; document all requirements and changes throughout the lifecycle of the system.

4.7.3.2 Provide input to and recommendations for the Change Management Board to approve, as required for system engineering changes or system upgrades that affect any ASDC service; integrate all system administrator capabilities into the configuration management process to ensure all documentation, process diagrams, and technical architectures are baselined and accurate.

4.7.3.3 Provide engineering assessments for the ASDC including but not limited to providing trade-off analyses and assessments for improvements of overall capability and technical enhancements.

4.7.3.4 Plan and schedule all engineering efforts following NASA and LaRC IT procedures, and provide regular updates to ASDC Management

4.7.3.5 Provide Information Technology Security support; maintain the IT Security Plans for SD; conduct continuous monitoring and provide detailed reports on incidents and vulnerabilities; ensure compliance with NASA and Center IT Security procedures and support annual audits.

4.7.3.5.1 Maintain and implement a schedule for regular system patches and upgrades; communicate such schedules with all affected customers.

4.7.3.6 Develop systems and related components to support ongoing stewardship of assigned data products, and assets of ASDC and the SCF; develop and adhere to communications plans with science customers for all systems being administered by ASDC.

4.7.3.7 Design and develop systems and components in response to government requirements and integrate them into the enterprise; test, evaluate, and deploy systems and components.

4.7.3.8 Perform engineering and system administration support to operational systems; perform preventive maintenance and make recommendations for life-cycle improvements.

4.7.3.9 Provide system administration to ASDC systems and peripherals and to users, both onsite, offsite, on field campaigns, and travel, consistent with Federal, NASA, LaRC and SD policies and practices

4.7.3.10 Assist in software development techniques and processes; coordinate with the software engineering team for all schedules requiring developer or programmer support

4.7.3.11 Assist in evaluating scientific analysis tools, other clients, and applied math techniques to help estimate ASDC load and performance to be utilized as input to requirements for future improvements in data discovery, access, and understanding capabilities.

4.7.3.12 Provide valuation, experimentation, and implementation of Esri and open-source geospatial capabilities in support of advanced engineering

4.7.3.13 Collaborate with other contractors and customers in addressing SD IT related user issues including but not limited to specialized software support and connectivity support to SD managed assets.

4.7.3.14 Provide support in installation, management, and provisioning of cloud computing systems and services to ensure the ASDC cloud environment is efficient and evolving with industry best practices.

4.7.3.15 Apply industry best practices to system administration functions for all assigned systems.

4.7.3.16 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Software and documentation for all software and hardware systems in a digital library and ensure CM database remains current
- Report of life-cycle improvements for hardware and associated software quarterly to ASDC
- Records of all users and network services running on applicable IT assets
- Records of which applications are installed on each workstation and what license and registration information is used
- Report of day-to-day activities related to IT Security
- Schedules and regular updates to ASDC Management

4.7.4 Software Engineering

The Contractor shall perform the following work in Software Engineering activities including, but not limited to:

4.7.4.1 Perform development and programming activities for website design, software tools, and address science team requirements

4.7.4.2 Provide advanced level support for requirements generation, analysis, and documentation for software engineering projects in the ASDC

4.7.4.3 Maintain all ASDC and SD websites, applications, and software tools; provide updates to and complete enhancements to tools and applications as required

4.7.4.4 Provide advanced level support to enhance content management capabilities, scripting, coding, and testing of new capabilities that ASDC transitions to operations.

4.7.4.5 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, those specified in Exhibit B, Contract Documentation Reporting Requirements.

- Software and documentation associated with ASDC and SD websites, software tools
- Schedules and regular updates to ASDC Management

4.8 Engineering for Science Technology and Missions

The Engineering for Science Technology and Missions Technical Area includes but is not limited to, application of science, mathematics and engineering disciplines for the design, development, integration, and operation of small to very large complex equipment and processes to meet program and project goals within and outside of NASA. The nature of the work requires effective participation in highly integrated multidisciplinary development teams in compliance with established policies and work instructions. This work requires proficiency in technical skills including, but not limited to, mechanical and mechanism design, simulation, analysis, and drafting; structural mechanics analysis (static, dynamic, linear, non-linear); structural dynamics analysis; manufacturing engineering and methodologies; thermal and fluid systems design and analysis (e.g., steady state, transient, passive thermal, active thermal); optical, opto-mechanical and electromagnetic design and analysis; electrical and electronics design and analysis; measurement system development (passive and active, including but not limited to radiance and lidar systems); software design, verification, and control; development and implementation of production, assembly, test, integration, and operation plans. The Contractor shall perform the following work in Engineering for Science Technology and Missions activities including, but not limited to:

4.8.1 Software and Algorithm and Simulator Systems Development

The Contractor shall perform the following representative work in Software and Algorithm Development including, but not limited to:

4.8.1.1 Develop concept of operations and/or functional requirements of the software. Design the software architecture. Develop fully-documented code based on design.

4.8.1.2 Provide configuration management of the code during all phases of the project. Keep software documentation up-to-date during all phases of the project.

4.8.1.3 Test the software to verify it meets its intended need.

4.8.1.4 Develop software version description document for formal releases (releases to formal test or operations) of the software.

4.8.1.5 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Deliver software (source and executable) and documentation.

4.8.2 Robotic Testbed Sensor Validation and Algorithm Development

The Contractor shall perform the following work in Robotic Testbed Sensor Validation and Algorithm Development activities including, but not limited to:

4.8.2.1 Provide mechanical, electrical, and software design for the development of robots and other intelligent electromechanical systems.

4.8.2.2 Perform architecture definition, electrical and mechanical design, software development, integration, fabrication, and testing.

4.8.2.3 Develop real-time algorithms for embedded systems using real-time operating systems.

4.8.2.4 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Algorithms and documentation for embedded systems
- Reports describing the suitability of new technology or simulations results

4.8.3 Instrument Scientist Activities

The Contractor shall perform the following work in Instrument Scientist activities including, but not limited to:

4.8.3.1 Provide technical assistance during the Instrument environmental testing and Calibration/Validation activities including but not limited to the Cross-Track Infrared Sounder (CrIS).

4.8.3.2 Evaluate the on-orbit radiometric and spectral performance of instruments including but not limited to the CrIS F1 spectra; evaluate the accuracy of the algorithms used in flight and ground software; and evaluate the radiometric and spectral performance of instruments.

4.8.3.3 Characterize electro-optical instruments, materials, and subsystems in support of airborne and in-space atmospheric study and climate science missions.

4.8.3.4 Develop a theoretical model to simulate the ringing seen in calibrated instruments including but not limited to the F1 spectra.

4.8.3.5 Serve as on-site science observer at the NASA LaRC facility during testing.

4.8.3.6 Deliverables will be specified in each TDN or Task Order.

4.8.4 Engineering Technical Management

The Contractor shall perform the following work in Engineering Technical Management activities including, but not limited to:

4.8.4.1 Provide systems engineering technical management, develop systems engineering tools and databases, and conduct systems analyses in support of NASA's Earth Science programs, including but not limited to, the Committee on Earth Observation Satellites (CEOS) and the United States Group on Earth Observations (USGEO). These efforts may include, but are not limited to the following:

4.8.4.1.1 Maintaining and enhancing administrative databases and tools.

4.8.4.1.2 Developing outreach materials.

4.8.4.1.3 Performing gap assessments.

4.8.4.1.4 Performing testing and conducting training of systems engineering tools.

4.8.4.1.5 Providing data acquisition assessments.

4.8.4.1.6 Providing data management solutions for large datasets.

4.8.4.1.7 Managing technical communications.

4.8.4.2 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Provide recommendations and assessment of the program plans

4.8.5 Electronic Parts and Component Engineering

The Contractor shall perform the following work in Electronic Parts and Component Engineering activities including, but not limited to:

4.8.5.1 Provide technical expertise in Electrical, Electronic, and Electromechanical (EEE) activities including selection of quality parts for space and high reliability products.

4.8.5.2 Research EEE parts and provide recommendations on their use for the intended environment and provide designs to mitigate any risk associated with the use of EEE parts.

4.8.5.3 Provide purchase and costing analysis and performance trade-offs. Analysis tasks shall include but not be limited to Government-Industry Data Exchange Program (GIDEP) search alerts and recommendations as well as other environmental and quality component issues.

4.8.5.4 Provide technical analysis and recommendations for existing parts in payloads, as well as possible new EEE activities including selection of new high-reliability parts for any additional instrument modifications or new designs.

4.8.5.5 Provide input for improving operations in the area of receiving, inspection and bonded stores for projects past, present and forecasting needs for new project requirements in early life cycle phases.

4.8.5.6 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Reports, Parts Plans, WBS analysis, Parts Lists, Component and Circuit Analysis

4.8.6 Engineering Training

The Contractor shall perform the following work in Engineering Training activities including, but not limited to:

4.8.6.1 Develop training materials to introduce new employees to the engineering for science technology and missions development process, specifically as applied to Science Mission activities.

4.8.6.2 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Training materials

4.8.7 Mission Operations Management

The Contractor shall perform the following work in Mission Operations Management activities including, but not limited to:

4.8.7.1 Develop and implement the Mission Operations Plan at facilities, to include support of integration and test activities for flight projects and tests.

4.8.7.2 Participate in and support technical and operations interchange meetings with NASA, Jet Propulsion Lab (JPL), and other Contractors and government agencies.

4.8.7.3 Participate in project pre-mission simulations in preparation for upcoming missions.

4.8.7.4 Review mission operations procedures and data and provide analyses to assess the impact of mission operations on mission success.

4.8.7.5 Develop plans for data archival.

4.8.7.6 Deliverables will be specified in each TDN or Task Order.

4.8.8 Active Measurement Systems Development

The Contractor shall perform the following work in Active Measurement Systems Development activities including, but not limited to:

4.8.8.1 Develop concepts for advanced laser and lidar systems, and advanced signal processing algorithms for Earth, Planetary and Exploration science applications.

4.8.8.2 Analyze and interpret the strengths and limitations of lidar systems through experimental data analysis and develop new signal processing algorithms; report on any systematic errors or observations discovered about the sensor.

4.8.8.3 Design, fabricate, integrate, implement, and test active measurement systems including but not limited to:

4.8.8.3.1 Doppler lidar for future landing missions.

4.8.8.3.2 Develop models and lidar data analysis software for analyzing different lidar systems and predicting their performance in achieving specified requirements for landing missions.

4.8.8.3.3 Develop lidar models and perform design and performance analyses for candidate system concepts.

4.8.8.3.4 Develop new lidar systems with improved performance while achieving decreased size, increased efficiency, and decreased operating costs.

4.8.8.3.5 Participate in space flight qualification activities for lidar systems used in precision navigation and safe landing.

4.8.8.4 Develop pre/post processing and system interface components including, but not limited to, front-end data collection from the system analog to digital converters, application of a window function, Fourier transformation of the windowed function, magnitude detection, ratio application, and peak detection.

4.8.8.5 Develop hardware and software for data acquisition and real-time analysis systems for atmospheric science investigations; develop, operate, and maintain lasers, detectors, control systems, and other elements of integrated remote sensing systems.

4.8.8.6 Develop technologies leading to space-qualifiable lasers by investigating the areas of material out gassing and contamination, radiation damage, vibration resistance, and vacuum operation.

4.8.8.7 Develop instrument performance models, instrument design and development, aircraft-specific payload design and assembly, aircraft integration, data collection and analysis, and hardware development and risk reduction activities. Provide on-site operations, systems, networks, and configuration support for field campaigns and testing.

4.8.8.8 Document the analysis and interpretations of science data in informal reports, papers, and journal articles.

4.8.8.9 Integrate systems into ground-based facilities and test at LaRC and other mission sites.

4.8.8.10 Perform mechanical design, analyses of engineering designs, models of transmitters, receiver assemblies, telescopes, and prototyping of aircraft-related hardware required by missions, projects and experiments; perform mechanical design, thermal design, and robust packaging design for continuous-wave and pulsed, diode-pumped, lasers, telescopes, wavelength control hardware, and integrated lidar structure.

4.8.8.11 Perform frequency up-conversion device research and development to include but not be limited to, theoretical calculations, computer modeling and simulation, and perform laboratory experiments in the areas of solid state lasers, non-linear devices, optics alignment and optimization, and performance characterization for the research.

4.8.8.12 Perform research and development in the areas of spectroscopic measurements, modeling and data analysis, multi-disciplinary system design, analysis, simulation and prototyping, and laser design for ground-based, airborne and space-borne laser/lidar remote sensing, mid-infrared solid state laser research and other related technologies.

4.8.8.13 Perform optical design, electrical design, and laser operation optimization for continuous-wave and pulsed solid-state lasers and nonlinear optics devices.

4.8.8.14 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Analysis, material certifications, and design drawings
- Provide developed models and performance analyses
- Materials, fabrications, and prototypes for aircraft-related components
- Source code
- Design data for contractor-led design tasks; including but not limited to drawings and supporting analyses
- Design drawings, analysis and hardware of lasers and components
- Documentation and evaluation data on laser performance and resonator design
- Overviews of the design and proposed installation approach
- Resolution of all systems and configuration problems
- Updates of system and standard products

4.8.9 Passive Measurement Systems Development

The Contractor shall perform the following work in Passive Measurement Systems Development activities including, but not limited to:

4.8.9.1 Develop and integrate measurement facilities as necessary for development, selection and screening of measurement systems for exploratory investigations and determination of measurement uncertainties.

4.8.9.2 Perform required tests and document test results.

4.8.9.3 Develop required instrument models for the passive instruments.

4.8.9.4 Develop the mission level requirements document, recording the technology readiness levels of any new technologies and general support of the system engineering functions.

4.8.9.5 Develop and refine staffing profiles, long range schedules, internal review requirements, levels of mission, measurement requirements, technical allocations document, support preparation and concept reviews.

4.8.9.6 Conduct passive measurement sensitivity analysis, including but not limited to blackbody emissivity analysis, variable temperature blackbody, ambient temperature blackbody, and cold temperature blackbody.

4.8.9.7 Fabricate and test passive measurement system components including but not limited to single patches and metamaterial arrays.

4.8.9.8 Deliverables will be specified in each TDN or Task Order and may include the following but not be limited to those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Staffing profiles and schedules
- Review and measurement requirements
- Passive measurement system components
- Instrument models and test reports

4.9 Science Flight Project Management

The Science Flight Project Management Technical Area provides support for LaRC Flight Projects in the areas of Project Management; Systems Engineering; and hardware and software design, analysis, development, integration, test, and verification. Project Management includes but is not limited to, developing or reviewing documents specified in NPR 7120.5; risk assessment and analysis; schedule assessment and analysis; and technical editing services. Systems engineering includes, but is not limited to, requirements development, management, and documentation; system architecture development and analysis; and verification and validation. Hardware and software includes but is not limited to support for a variety of instrumentation as well as aircraft, spacecraft, or other platforms where instrumentation is installed. The Contractor shall perform the following work in Science Flight Project Management activities including, but not limited to:

4.9.1 Instrument Development

The Contractor shall perform the following work in Instrument Development activities including, but not limited to:

4.9.1.1 Design, analyze, fabricate, assemble, test, and calibrate equipment for mission instruments and Ground Support Equipment (GSE) planned for satellites (or other platforms).

4.9.1.2 Examine and assess the instrument's electrical and software design, subsystem, components, schematics, tests, and verification procedures to objectively confirm and ensure that the implemented design meets the operational and performance requirements.

4.9.1.3 Perform assessment of instrument functional and performance data including, but not limited to data obtained during instrument environmental testing, during instrument calibration, instrument vacuum testing, performance regression testing, and any performance issues identified from such activities.

4.9.1.4 Establish, plan and develop documentation for the spacecraft (or other platform) integration and test campaign.

4.9.1.5 Perform cost, programmatic and engineering trades analyses utilizing historical project data to facilitate development, acquisition, and deployment of instruments/missions.

4.9.1.6 Provide systems engineering technical input as needed to rapidly address questions or issues that arise concerning the design, implementation, and/or performance.

4.9.1.7 Plan and perform quarterly maintenance testing of flight instruments according to established processes and procedures; maintain and certify GSE; update legacy test plans and procedures to comply with current NASA and NASA LaRC Center processes and procedures and identify areas where processes and procedures can be improved.

4.9.1.8 Provide flight software programming for project flight software and GSE, including, but not limited to, programming for embedded systems in the flight hardware, ground test equipment, instrument mockups, update all documentation, and executable software.

4.9.1.9 Review and identify any applicable International Space Station (ISS) requirements; maintain the requirements documents and database.

4.9.1.10 Review all documentation for content flow and appropriate grammatical application and perform technical editing of all project documents for all reviews, including but not limited to subsystem and lifecycle reviews.

4.9.1.11 Initiate meetings for planning the retreats, interviews, documented agendas, on-site facilitation, and a final report of outcomes.

4.9.1.12 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Documented Agendas, meeting notes, and final report of outcomes
- Software and software documentation
- Modified test plans and procedures
- Cost, programmatic and engineering trades analyses

4.9.2 Instrument Requirements Development

The Contractor shall perform the following work in Instrument Requirements Development activities including, but not limited to:

4.9.2.1 Support technical and science requirements development of instruments for use on future satellites (or other platforms): review and evaluate pre-defined instrument and operations requirements, and contribute technical insight to the development of new requirements specific to the instrument and its operation.

4.9.2.2 Support design, analysis, and calibration tasks for the instrument and GSE planned for designated satellites (or other platforms).

4.9.2.3 Examine and assess the instruments' electrical and software design, subsystem, components, schematics, tests, and verification procedures to objectively confirm and assure that the implemented design meets the operational and performance requirements.

4.9.2.4 Formulate, manage and track instrument and GSE verification and validation activities and evaluate the submitted verification products, verification data, and spacecraft (or other platform) interface control documentation.

4.9.2.5 Perform the systems engineering services required for successive updating of the Interface Requirements Document (IRD), Environmental Requirements Document (ERD), and Mission Requirements Document (MRD), as well as populating and maintaining the Mission requirements database with the developed and matured mission requirements.

4.9.2.6 Perform the project management tasks required to develop input documents for the project plan and review provided documents.

4.9.2.7 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- All updates to required reviews and documentation

4.9.3 Instrument Documentation Development and Analysis

The Contractor shall perform the following work in Instrument Documentation Development and Analysis activities including, but not limited to:

4.9.3.1 Provide project management and system engineering expertise to projects to accommodate all reviews and develop documentation, plans, and schedules for the implementation and integration of assigned projects.

4.9.3.2 Provide analysis of and recommendations to address risk areas, mitigation steps, risk posture, schedule, and mitigation strategies.

4.9.3.3 Analyze, update and maintain the Project Implementation Plan, all documentation, including but not limited to, Education and Public Outreach content; provide all changes and improvements to reflect current project investments.

4.9.3.4 Support project outreach activities by developing posters and displays for use in Center tours; providing logistical support for tours.

4.9.3.6 Develop list of instrument development calibration and integration test work flow documents, as well as final report.

4.9.3.7 Deliverables will be specified in each TDN or Task Order and may include, but not be limited to, the following as well as those specified in Exhibit B, Contract Documentation Reporting Requirements:

- Software documentation
- All completed project management documents
- Project closeout report
- Instrument development calibration and integration documentation

5.0 Indefinite Delivery/Indefinite Quantity (IDIQ)

NASA anticipates that during the life of the contract additional requirements, which are within the general scope of this contract but not specifically identified under Section 4.0 above, will arise. To accomplish the additional requirements, the CO may issue TOs in accordance with NASA Far Supplement (NFS) 1852.216-80 “Task Ordering Procedure” identified in Section H.17 of the contract.

6.0 Acronym List

Acronym	Definition
ASDC	Atmospheric Science Data Center
AWP	Annual Work Plan
C3R	Carbon Cycle Column Radiometer
CALIPSO	Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations
CATS	Cloud-Aerosol Transport System
CDR	Climate Data Record
CEOS	Committee on Earth Observation Satellites
CERES	Clouds and the Earth's Radiant Energy System
CM	Configuration Management
CNES	Centre National d'Études Spatiales
CO	Contracting Officer
COR	Contracting Officer's Representative
COTS	Commercial Off the Shelf
CrIS	Cross-Track Infrared Sounder
DAAC	Distributed Active Archive Center
DACOM	Differential Absorption Carbon Monoxide Measurements
DLH	Diode Laser Hygrometer
EEE	Electrical, Electronic and Electromechanical
ERD	Environmental Requirements Document
ESDIS	Earth Science Distributed Information System
ESSP	Earth System Science Pathfinder
EV	Earth Venture
EV-I	Earth Venture Instrument
EV-M	Earth Venture Mission

Acronym	Definition
EV-S	Earth Venture Suborbital
CLIN	Contract Line Item Number
FIPS	Federal Information Processing Standards
GOTS	Government Off the Shelf
GSE	Ground Support Equipment
HQ	Headquarters
HSRL	High Spectral Resolution Lidar
ICARTT	International Consortium for Atmospheric Research on Transport and Transformation
ICF	Information Content Framework
IDIQ	Indefinite Delivery/Indefinite Quantity
IRD	Interface Requirements Document
ISS	International Space Station
IT	Information Technology
ITS	Information Technology Security
JPL	Jet Propulsion Laboratory
LaRC	Langley Research Center
MISR	Multi-angle Imaging Spectro Radiometer
MMF	Multi-Modeling Frameworks
MOTS	Modified Off the Shelf
MRD	Mission Requirements Document
NAIRAS	Nowcast of Atmospheric Ionizing Radiation System
NFS	NASA Far Supplement
NODIS	NASA Online Directives Information System
NPR	NASA Procedural Requirements
OCIO	Office of Chief Information Officer
R&A	Research and Analysis

Acronym	Definition
REVEX	EXploitation REViews
RSP	Remote Sensing Polarimeter
SAGE	Stratospheric Aerosol and Gas Experiment
SCF	Scientific Computing Facility
SD	Science Directorate
SOW	Statement of Work
SRB	Surface Radiation Budget
TDN	Technical Direction Notification
TEMPO	Tropospheric Emissions: Monitoring of Pollution
TO	Task Order
TOA	Top-of-the-Atmosphere
TOMS	Task Ordering Management System
TPOC	Technical Point of Contact
USGEO	United States Group on Earth Observations
UV	Ultra Violet
WBS	Work Breakdown Structure
WYE	Work Year Equivalent