Exhibit I
Space and Earth Science Data Analysis (SESDA-IV) Statement of Work NNG16575844L

1. PURPOSE

The purpose of this contract is to provide a broad range of services to support primarily Sciences and Exploration Directorate (SED, Code 600) Earth and Space science research and development, data operations, as well as activities in information system technologies, engineering, and education and public outreach, that enable Code 600 to successfully carry out its science missions at the Goddard Space Flight Center (GSFC).

SED science research and development activities and funding are closely aligned to NASA's science projects and programs. Science data systems in the SED exist to enable the production of science results. SED science data operations are driven primarily by science discipline-specific needs and discipline-specific approaches to how data are most effectively and efficiently made available and useful to discipline research communities.

2. SCOPE

The services required under this contract support all the science disciplines within Code 600, including, but not limited to, solar and space plasma physics, astrophysics and astronomy, planetary systems studies, astrobiology, atmospheric science and climatology, oceanography, land processes, geodynamics, and solid earth geophysics. Research and information technology support services includes scientific data analysis and visualization, modeling and simulation of physical processes, development and testing of flight project instrument and data systems, field experiments, development and operations of large-scale data management, archival and delivery systems, systems analysis, and programming; and includes engineering, technology, research and development, network engineering, and education and outreach. The contractor shall support both ongoing and new projects as required in all these areas.

Work defined under this contract is primarily funded by the SED (Code 600) although other Directorates such as the Flight Projects Directorate (Code 400), the Applied Engineering and Technology Directorate (Code 500), and the Information Technology and Communications Directorate (code 700) can utilize this contract when appropriate. These Directorates have pivotal roles in NASA's mission to pioneer the future in space exploration, scientific discovery, and aeronautics research. GSFC also has other areas of strategic responsibility that support NASA's programs and new focus areas are occasionally defined by NASA Headquarters. Most of the services provided will be in direct support to the Science, Flight Programs, Information Technology and Engineering

organizational entities at GSFC. The technical performance requirements for this contract are defined below by category with expanded definitions.

3. TECHNICAL PERFORMANCE REQUIREMENTS

The Contractor shall provide support in the functional areas listed below. In so doing, the contractor shall coordinate activities across work elements to the extent possible in order to achieve consistent and best practices, reuse where possible, so as to maximize efficiency and benefits to the Government.

3.1 Science Support

Code 600 science research and development activities cover broadly four main areas: Astrophysics, Heliophysics, Planetary and Earth sciences. Technical support requirements in each science area, and in support of cross-disciplinary exploration missions, can vary due to differences in research methodologies and tools, instrumentation, discipline community culture and resource priorities. For *each of the science focus areas*, the following science support efforts are generally anticipated:

3.1.1 Analysis and modeling

Support is required to perform multi-mission science and instrument data analysis using theoretical, statistical and empirical techniques.

The modeling and data analysis function requires the Contractor to provide computational physics support encompassing such areas as mathematical modeling or simulation of physical theories and associated numerical and scientific analyses, pattern recognition, simulation of physical systems, image data analysis, dynamic interaction with graphical displays, and data correlation and error studies using statistical techniques. This requires problem analysis, algorithm restructuring and documentation as well as program implementation for integration both on high-end computer technology and advanced workstations via high-speed networks.

The information extraction function requires the Contractor to provide mathematical analysis and computer implementation of techniques to perform such functions as data reduction and processing, data product generation and documentation. Discipline science support may require the performance of a variety of theoretical and empirical analyses in space plasma physics, heliophysics, astrophysics, planetary and Earth sciences. Studies may include, but are not limited to, radiative transfer and microwave scattering analysis, image enhancement, noise removal, radiometric corrections, geometric correction, registration, filtering and other transformations, pattern recognition, multivariate classification, and change detection of Earth resources and meteorological image data. Included will be conducting surveys or literature searches, gathering or generating related data, setting up and conducting tests, analysis of test

results, producing reports of the investigation, recommending solutions and development, and implementing techniques to solve particular information extraction problems.

3.1.2 Tools development

Support is required to develop tools for scientific research, mission science planning and operations, as well as instrument data analysis and processing, and to support data systems development and operations.

The Contractor shall provide research, design, integration and enhancement of technical systems consisting of hardware and/or software tools, as well as the integration of the same in support of various scientific research and operations efforts.

The scientific data processing function requires the Contractor to support the design of efficient input/output and data packing/unpacking techniques; the application of total instrument calibration results to experiment data; the development and maintenance of standard data formats (e.g., FITS, CDF, SPASE); data reformatting, conversion, and validation operations; handling and correlating satellite and detector housekeeping information required for data analysis; elimination of data overlap and merging of orbit and attitude data with experiment data where necessary; applying the appropriate data reduction algorithms to process the raw initial data into final physical units; and implementing numerical algorithms.

3.1.3 Instrument development and engineering support

Support is required to design, develop and test instruments to be flown on balloon, rocket, aircraft, and satellite missions for science investigations, as well as in ground-based field campaigns.

The engineering support function requires the Contractor to support the Government in all facets of science instrument development, including design, development, fabrication and verification of space instrumentation and ground support equipment. The Contractor shall provide engineering designs and analyses of an instrument, drafting component sections, development of electronic components and interfaces, field-testing, and verification of operations and acceptable performance of systems, subsystems, and/or instrumentation in science measurement, telemetry and data acquisition.

3.1.4 Mission Ground System and Engineering Support

The mission ground support function requires the Contractor to support ground systems development and operations, and shall require support for telemetry acquisition, storage, processing and distribution, various data displays, experiment monitoring, and science instrument operations. In

addition, the Contractor shall be required to provide systems support such as systems configuration and local modification to the operational system. This function includes collaborating and providing support in worldwide scientific field campaigns.

3.1.5 Science data acquisition, archiving and distribution

Support is required to acquire, maintain, disseminate, and document science data archived and distributed by various science data centers within Code 600.

The multi-mission data archiving and distribution function requires the Contractor to provide Earth science and space science communities as well as general data users with access to archival data from Earth science, Astrophysics, Heliophysics and planetary missions (past, present and future). This will include acquiring, maintaining and disseminating data from previous and current missions as well as missions in multiple disciplines; providing software and data analysis support for these data sets; developing and maintaining tools for combining, displaying and visualizing the data from various missions and for multi-data set analysis; providing a uniform environment, such as interoperable virtual observatories, active and permanent archives, for searching and accessing data from centralized or distributed archives, and for analyzing and combining the data from various missions; developing and maintaining catalogs of observations and ancillary and archival information and documentations for data holdings; providing online access to catalogs of results from each mission; deriving data products from each mission; coordinating data, software, data format and media standards with external archives, including other multi-mission centers; writing and distributing a regular newsletter; distributing the Level 1 raw data, the derived Level 2 data products, catalogs of results, calibrations, analysis software, and documentation; and application of data center reference models (e.g. ISO Open Archival Information System (OAIS)) and collaborative models (e.g. virtual observatories, active and permanent archives).

The production data processing function requires the Contractor to provide support with the preparation of computer scripts for submitting and executing computer programs for the reduction, calibration, and validation of data and associated computational results. The Contractor shall maintain files and records of all data received and/or processed, checking and maintaining data inventory, integrity and gaps, set up and maintain science information libraries across a range of technologies, and online work files and production logs. The Contractor shall establish, execute and document data reprocessing and schedule. The Contractor shall provide for the creation and operation of visual displays for interactive processing of data on modern visualization equipment and hard copy devices, and for the operation of other computer-driven equipment

used to analyze or reduce data. Display of other scientific and engineering data, data entry, and other operations analysis work shall be required.

3.1.6 Science data users and utilization support

Support is required to provide science data user and utilization support for a wide range of systems for data acquisition, archiving, access, delivery, and distribution.

The Contractor shall provide training to science data users to use applications software packages for searching, accessing, retrieving, processing and analyzing science mission data. The science data user support function requires the Contractor to conduct meetings, classes, seminars and give presentations in order to provide user support. Also included is working with and setting up visiting scientist programs, field campaigns and mission support, outreach activities, science education support and technical support for science conferences.

The science utilization support function requires the Contractor to identify and implement specific technologies for tracking the utilization of science data and products that are important to the science discipline communities and will have a benefit for the society. The latter could include multiple areas such as national and international space weather services, homeland security, air and water quality, disasters, agriculture, energy, coastal zone management, public health, aviation, ecological forecasting, and education. The Contractor shall work with the Goddard science community in identifying, proposing, and developing specific products that will be valuable to user communities or governmental agencies at the local, regional, and/or national level in making critical decisions impacting our society. This will also include international entities when applicable.

3.1.7 Mission planning, operations and systems development

Support is required to design, plan and operate space missions for science investigations. Activities requiring support include planning of mission science operations, data acquisition and distribution, data processing and development of mission data systems, data format standards, products, tools and documentation.

The mission planning function requires the Contractor to provide technical inputs to support and develop mission planning activity, schedules, resource estimates, and management documentation such as mission plans. The Contractor shall also provide supporting technical analysis for GSFC mission integration with other organizations including other NASA field centers, science working groups, advisory groups,

investigators, and other entities. The Contractor shall identify conflicting needs and propose solutions.

The Contractor shall establish and maintain the design, development, and maintenance of mission databases including payload, hardware, experiments, requirements traceability, and operational and documentation databases. The Contractor shall organize and coordinate mission meetings and conferences as well as develop materials such as brochures, videotapes, web sites, displays, coordinate, and participate in events.

3.2 Information systems and technology support

3.2.1 Data systems development and maintenance

Support is required to develop, operate and maintain a wide range of databases, software and hardware systems for data acquisition, archiving, search, access, delivery, and distribution.

The systems development, maintenance and software systems engineering function requires the Contractor to provide support in all phases of systems development/software systems engineering and maintenance. This includes such areas as requirements definition and analysis; conceptual and detail design; configuration and integration; hardware sizing and validation; development of technical documents including information technology documents for targeted systems; software configuration and security control; and the development and control of external interfaces including digital communication networks. The Contractor must maintain all relevant systems to ensure maximum continuity of service. Such support may include aspects of mechanical, electrical, and digital engineering along with aspects of the information and computer sciences.

The database creation and data archiving function requires the Contractor to support data and metadata ingestion and archiving, database creation and management, data warehousing, data mining, retrieval and distribution, as well as data display functions, while operating effectively with the rapidly evolving data management technologies; and requires the Contractor to provide for computing systems to automatically generate data catalogs, file statistics, data quality summaries, and retrieval of data and extraction of information and knowledge from the science archives and databases created.

The application software development and use function requires the Contractor, in coordination with users community, to define specific design standards and requirements; identify and understand applicable hardware and system software capabilities and constraints; document the proposed design, develop code, test, document, and maintaining software

packages; implementing software configuration control; and demonstrate and/or train users in program or system functionality.

The applications software development will typically be in, but not limited to, the areas of data processing, calibration, de-trending and reduction, data formatting, data search and retrieval, data display and browsing, satellite orbit configuration, image processing, noise removal, CAD/CAM, radiometric correction, geometric correction, registration, filtering and other transformations, change detection, multi-spectral classification, statistical and mathematical analysis and modeling, and related image and non-image data analysis functions. Maintenance and modification to existing operations or application software shall also be required. This function includes the removal of software errors, changing the code for improved operations, and making additions to provide new capabilities. Applications software support includes development and maintenance of web applications, web portals and visualization of science data in multi-media form, which may be suitable for research purposes or the general public. Web developers shall be trained in writing secure web and database access codes, in using code libraries, in configuration management and configuration control, and in using the required web languages such as PHP, Cold Fusion, perl, python, ASP, etc, while maintaining compliance with current NASA IT procedures and regulations.

3.2.2 Telecommunications and network management

The telecommunications function requires the Contractor to plan, develop, implement, and test advanced telecommunications systems supporting all evolving high performance networks and web based science and data systems. The Contractor shall monitor performance, gather statistics, generate reports, evaluate performance, troubleshoot, analyze and resolve problems in the area of network systems.

3.2.3 Computer systems management

Support is required to administer, manage and maintain the software and hardware of designated (e.g., non-administrative) computer systems as well as their network connectivity, accessibility, and security integrity that meet or exceed GSFC IT standards and IT security requirements.

The computer systems management function requires the Contractor to provide system administration and management that includes items such as installing, updating, securing and testing new releases of manufacturer-supplied operating systems, commercial software, and other software necessary for evolving computer systems. The Contractor shall ensure common processes and best practices are applied as broadly and

consistently as possible towards the management and security of IT, and shall maintain systems in compliance with Agency IT and IT security requirements. The Contractor must maintain all relevant systems to ensure maximum continuity of service. Utilizing or integrating existing data sources where practical, including but not limited to NASA and GSFC IT tools, the Contractor shall provide the capability to track and readily produce inventory reports upon request of all IT systems, installed operating systems and third-party software including release and patch level across all managed computers either individually or collectively. These inventories and reports shall be in sufficient detail to demonstrate compliance with mandated Federal, Agency and Center IT security system configuration requirements.

The Contractor shall develop and maintain as directed FISMA/NIST and NASA compliant IT security plans, contingency plans and risk assessments documenting all managed computers.

The Contractor shall provide systems programming support for all phases of system software development. This includes such items as the installation, development, modification and enhancement of operating systems, systems software, data management systems, web servers, mail servers, image display and control functions, various system support routines, special device handlers, configuration management, and diagnostics for special peripherals.

The contractor areas of responsibility shall include but are not limited to setup of end-user authorization, accounting system, data backups (e.g., incremental and full of all critical system/user files and data for a rebuild to the nominal state at any point within a 6-12 month period, depending on facility requirements), routinely monitor for availability of critical updates and/or patches, maintain current/accurate information of configuration for all hardware/software, researching and specifying new systems to meet a new IT requirements, and computer security monitoring. Provide general maintenance functions required of system management performing error analysis, monitoring/tailoring system performance, monitor log files for unusual or suspicious activities and report to appropriate management, consulting, and other activities that are required of system management. Provide responsive and communicative technical support to the end-user. The contractor shall provide as needed support to NASA and/or GSFC-wide IT and IT security initiatives such as vulnerability scanning and remediation. The contractor shall provide support to the Government with the on-going development of IT systems configuration policies and enforcement. Contractor staff must comply with pertinent Agency and GSFC IT security training requirements.

The Contractor shall provide the full range of science services required for fully utilizing a spectrum of scientific services on a spectrum of computer systems from small standalone workstations to large-scale high-end computing facilities. This includes documentation, problem tracking and resolution, code optimization or conversion, algorithm restructuring, telephone or online support, software tailoring to meet user requirements, training, performance analysis of application packages, and other activities that are required to support system activities. When appropriate, coordination with NASA's agency-wide desktop IT support contractor or Center network service providers such as the CNE, SEN or IONet is required.

The Contractor shall provide High Performance Computing (HPC) system integration, configuration, performance tuning, system operations and support of computational platforms, data storage and backups, networking and system software. Enhance and implement HPC system architecture and system design, reduce system obsolescence, and increase interoperability, compatibility and reliability for the continued future evolution of high performance computing at GSFC.

3.3 Ancillary support

3.3.1 Proposals and scientific documentation support

Support is required to work with Code 600 scientists through the Science Proposal Support Office in developing science or mission proposals and publications. This support will include development and delivery of graphical illustrations, animations, and/or data visualization materials.

The Contractor shall support the preparation and presentation of technical papers, reports and newsletters. Technical support also includes the editing function for revising and updating documents, coordinating the physical production, and distribution of various technical and mission documents.

3.3.2 Education and Public Outreach (E/PO)

Support is required to work with Code 600 scientists in support of NASA's education and public outreach initiatives. The Contractor shall support local and national science education programs, developing and maintaining E/PO websites that highlight Code 600 sciences, missions and data, developing and conducting science exhibits, supporting educational aspects of science campaigns such as Sun-Earth Day, solar eclipses, etc., mentoring and conducting training workshops for teachers and students, and preparing classroom materials. This support will include development and distribution of educational, public outreach, and curricular materials with graphical and/or digital data illustrations and visualizations.

The educational outreach function requires the Contractor to prepare press releases of latest GSFC science discoveries, and educational materials via written, electronic, web, and audio-visual vehicles with formats that include publications, posters, instruments, apparatus, videos, software, hardware, CDROM's or DVDs, and other technology based mediums.

The science educational programs at the Center encompass outreach and partnering; development activities with schools, teachers, and students; support of generation of educational technology; sponsorship or creation of materials; and activities to improve Earth and Space science literacy involving the general public and specific audiences.

Examples of the ancillary support activities may also include writing, editing, desktop publishing, design, layout, imagery, animation, communications, publicity, documentation, presentations, visitations, field trips and expeditions, technical or scientific support of meetings and/or conferences, travel as needed, and collaborative projects with a wide range of scientists, educators and interest groups.

3.4 Work activity management

An electronic and online work activity management system is required for use by both the Government and the Contractor for insight into assessing cost and schedule performance and to facilitate and document the management of work activities performed under the contract. The system must comply with the requirements specified in the contract clause C.3 New and Modified Funding Procedures.

Electronic and Information Technology Accessibility Standards

- Section 508 requires that when Federal agencies develop, procure, maintain, or use electronic and information technology, they shall ensure that the electronic and information technology allows Federal employees with disabilities to have access to and use of information and data that is comparable to the access to and use of information and data by Federal employees who are not individuals with disabilities, unless an undue burden would be imposed on the agency. Section 508 also requires that individuals with disabilities, who are members of the public seeking information or services from a Federal agency, have access to and use of information and data that is comparable to that provided to the public who are not individuals with disabilities, unless an undue burden would be imposed on the agency. In order to comply with the Section 508 Electronic and Information Technology Accessibility Standards, the contractor shall perform all work required under this contract in compliance with the following technical standards delineated in Code of Federal Regulations (CFR) Title 36:

Subpart B -- Technical Standards
§1194.21 Software applications and operating systems.
§1194.22 Web-based intranet and internet information and applications.
§1194.23 Telecommunications products.
§1194.24 Video and multimedia products.
§1194.25 Self contained, closed products.
§1194.26 Desktop and portable computers.

Subpart C -- Functional Performance Criteria
§1194.31 Functional performance criteria.

Subpart D -- Information, Documentation, and Support
§1194.41 Information, documentation, and support.

Emergency Preparedness and Response

The Contractor's obligation may include resolution of unusual or emergency situations. The Contractor may be required to support NASA, within the general scope of work, but in currently unidentified ways, in preparation for, or in response to emergencies. Obligations under this requirement shall only arise when one or more of the criteria at FAR 18.001, enabling NASA to utilize "Emergency Acquisition Flexibilities", are met. If the emergency preparedness and response requirements result in changes to the contract, all contract adjustments will be processed in accordance with the Changes clause of this contract.