Representative Task Order #1

Calibration and Validation Support

The Contractor shall support the calibration, characterization, and validation of satellite, airborne, and ground based remote sensing instruments. This includes the following:

A. The operation, improvement, and management of the Calibration Facility (CF) in the Code 618 Biospheric Sciences Laboratory at NASA's Goddard Space Flight Center (GSFC). These facilities include the Radiometric Calibration Laboratory (RCL) and the Diffuser Calibration Laboratory (DCL).

   Specific activities under this task include the following:

   1. Maintain and improve the current measurement capabilities of the RCL in the ultraviolet through shortwave infrared (i.e. 350nm to 2500nm). This includes (1) performing radiance and irradiance calibrations on RCL and customer sources with lowest possible measurement uncertainties traceable to the National Institute of Standards and Technology (NIST), (2) monitoring the stability of the RCL and customer sources in real-time, (3) characterizing the output uniformity of RCL and customer sources, and (4) delivering reports to the Code 618 Calibration Facility Principal Investigator (PI) containing descriptions of the measurements performed and the measured data with their associated uncertainties.
   2. Provide the above radiance and irradiance calibration capabilities to flight and ground remote sensing projects inside the RCL, at customer facilities, and in the field.
   3. Maintain and improve the RCL intensity-stabilized, continuous wave (cw) fixed wavelength and pulsed quasi-continuum tunable wavelength laser-based radiance responsivity and wavelength calibration capabilities. This includes (1) performing relative and absolute radiance responsivity calibrations using fiber-fed integrating sphere and collimator-based sources with lowest possible detector-based measurement uncertainties traceable to NIST and (2) providing radiance responsivity and wavelength calibration capabilities to flight and ground remote sensing customer projects inside the RCL.
   4. Identify and design promising new calibration and characterization capabilities with the goal(s) of implementation within the RCL, deployment in the field, and/or deployment at customer facilities. Examples of these capabilities include, but are not limited to, the characterization of detector and instrument non-linearity, sub-system and system-level polarization responsivity characterization, and the identification and development of calibration and characterization opportunities in support of current and future Light Detection and Ranging (LIDAR) projects.
   5. Schedule the receipt and measurement of laboratory standard and customer reflective and transmissive, diffuse and specular samples in the DCL from 230nm to 2500nm. This includes (1) interfacing with customers to understand their measurement requirements,

(2) performing measurements of Bi-directional Reflectance Distribution Function (BRDF), Bi-directional Transmission Distribution Function (BTDF), and 8 degree Total Hemispherical Reflectance (THR) on the laboratory scatterometer, and (3) performing measurements of reflectance and transmittance on the laboratory Perkin Elmer Lambda 1050 UV/Vis/NIR Spectrophotometer. All reflectance and transmittance measurements will be performed with lowest possible uncertainties traceable to the primary reflectance/transmittance facility located at NIST using DCL laboratory transfer standards.

6. Monitor, record, maintain, and improve the operation of the laboratory DCL scatterometer and Perkin Elmer spectrophotometer.
7. Formulate detailed electro-optical, radiometric, and mechanical requirements, design, and bread-board test a next-generation, state-of-the art scatterometer capable of making out-of-plane BRDF and BTDF measurements over the continuous 230nm to 2500nm wavelength range. Perform feasibility and design studies on scatterometer potential measurement capabilities of interest to the remote sensing community. Examples of potential measurement capabilities include, but are not limited to, full polarization scatter analysis and resolution of the wavelength of scattered light.
8. Attend a total of three conferences per year in the areas of radiometry and spectrophotometry and present papers at each.
9. Submit three papers per year for publication, two in peer reviewed journals and one in the Proceedings of the Society of Optical Engineering (SPIE).
10. Update the Code 618 Calibration Facility website at the beginning of each month.

B. Satellite instrument calibration, characterization, technical monitoring, and validation support, including (1) reviewing, maintaining, developing, and enhancing software required to produce calibrated, geo-located (Level 1B) radiance products from the Terra and Aqua Moderate Resolution Imaging Spectroradiometer (MODIS), the Suomi National Polar-orbiting Partnership (SNPP) Visible Infrared Imaging Radiometer Suite (VIIRS), and the Joint Polar Satellite System (JPSS) J-1 and J-2 VIIRS instruments, (2) monitoring the on-orbit performance of the Terra and Aqua MODIS and SNPP VIIRS instruments, (3) monitoring the build and test of the JPSS J-1 VIIRS, Cross-track Infrared Sounder (CrIS) and the Advanced Technology Microwave Sounder (ATMS) instrument hardware and software, and (4) monitoring the design and build of the J-2 VIIRS, CrIS, and ATMS instrument hardware and software.

Specific activities under this task include the following:

1. Provide calibration, characterization, and validation support for the EOS Terra and Aqua MODIS instruments including the maintenance, enhancement, and operation of Level 1B radiance product generation software. This includes (1) monitoring the overall radiometric, spectral and spatial performance of the MODIS instruments based on information provided by the MODIS on-board calibrators, Level 1B validation programs,

and satellite instrument comparisons, (2) supporting the planning and execution of on-orbit calibration maneuvers, and (3) making necessary corrections and/or improvements to the MODIS Level 1B algorithm and associated Look-Up-Tables (LUTS).

2. Support MODIS instrument performance, calibration, and characterization technical meetings and investigations, including diagnosing the causes and investigating the impacts of on-orbit changes in the instruments.
3. Provide monthly reports on the operational status of the MODIS instruments and all work performed in support of MODIS calibration and characterization to the MODIS Calibration Support Team (MCST) government lead.
4. Provide and present MODIS calibration and characterization information at the half-day session on MODIS instrument calibration and characterization held bi-yearly in conjunction with the MODIS Science Team meeting.
5. Submit 2 papers for publication on MODIS instrument performance and calibration in the refereed literature and 2 papers in the Proceedings of the Society of Optical Engineering (SPIE). Present the findings and results of these papers at conferences on satellite instruments, radiometry, or spectrophotometry.
6. Provide calibration, characterization, and validation support and monitor the on-orbit performance of the Suomi NPP VIIRS instrument for the SNPP Project Science Office. This includes (1) monitoring the overall radiometric performance of the instrument based upon information provided by its on-board calibrator, Sensor Data Record (SDR) validation programs, and satellite instrument comparisons, (2) supporting the planning and execution of on-orbit calibration maneuvers of the S-NPP spacecraft in support of VIIRS on-orbit calibration and characterization, and (3) making necessary corrections and/or improvements to the VIIRS SDR algorithm software tools and associated Look-Up-Tables (LUTS).
7. Support S-NPP VIIRS instrument performance, science, calibration, characterization, and SDR telecons, technical interface meetings, and investigations, including interacting with the Science Data Segment (SDS) and atmospheric and land Product Evaluation and Test Elements (PEATEs) to evaluate SNPP VIIRS SDR algorithms, and diagnosing the causes and investigating the impacts of on-orbit changes in the instrument.
8. Provide weekly reports on the operational status of the S-NPP VIIRS instrument and a description of calibration and characterization work performed to the VIIRS Characterization Support Team (VCST) government lead and to the SNPP Deputy Project Scientist.
9. Monitor the build and test of the JPSS J-1 VIIRS, CrIS and ATMS instrument hardware and software for the JPSS Program Science Office. This includes (1) reviewing instrument performance requirements, pre-launch instrument test plans and instrument SDR algorithm description documents, and monitoring and reviewing results of instrument and observatory level testing of the J-1 VIIRS, ATMS, and CrIS instruments, (2) coordinating and performing independent analyses of the radiometric, spectral and

spatial test data from those instruments, and (3) supporting the planning, instrument impact assessment, and execution of J-1 on-orbit calibration maneuvers.

10. Support analyses and provide assessments of J-1 VIIRS, ATMS, and CrIS instrument trade, waiver, or requirements change requests originating from the Science Office.
11. Support J-1 VIIRS, ATMS, and CrIS instrument performance, science, testing, calibration, and characterization, and SDR technical interface meetings, telecons, and investigations.
12. Submit 2 papers on SNPP VIIRS and 2 papers on J-1 VIIRS instrument testing, calibration and characterization for publication in the refereed literature and present findings and results at conferences on satellite instruments, radiometry, or spectrophotometry.
13. Monitor the design, build, and test of the JPSS J-2 VIIRS, CrIS and ATMS instrument hardware and software for the JPSS Program Science Office. This includes (1) reviewing pre-launch instrument statements of work, performance requirements, test plans, and SDR algorithm description documents, and monitoring and reviewing the results of sub-system and system level instrument testing of the J-2 VIIRS, ATMS, and CrIS instruments, (2) coordinating and performing independent analyses of radiometric, spectral and spatial test data from those instruments, and (3) supporting the planning, instrument impact assessment, and execution of J-2 on-orbit calibration maneuvers.
14. Develop the SDR tools to evaluate the on-orbit calibration and characterization performance of the J-2 VIIRS instrument.
15. Support analyses and assessment of any J-2 VIIRS, ATMS, and CrIS instrument trade, waiver, or requirements change requests originating from the Science Office.
16. Support J-2 VIIRS, ATMS, and CrIS instrument performance, science, calibration, characterization, and SDR technical interface meetings, telecons, and investigations, including diagnosing the causes and investigating the science impacts of any pre-launch performance issues.
17. Provide weekly reports on work performed in support of J-1 and J-2 VIIRS, ATMS, and CrIS review, test, and data analysis to the JPSS Deputy Senior Project Scientist.
18. Provide and present SNPP, J-1, and J-2 VIIRS calibration information at the half-day session on VIIRS instrument calibration and characterization held yearly in conjunction with the SNPP Science Team meeting.

Task Assumptions

The following assumptions shall be made in your approach to this representative task:

-All customer measurements, hardware and software development and calibration/characterization activities are planned in collaboration with GSFC civil servants and members of instrument science teams.

-Launch of the JPSS J-1 spacecraft is the last quarter of CY2016.

-The VIIRS Land PEATE is responsible for running calibration and geo-location software in response to requests by members of the team supporting this task.

-The Code 618 CF portions of this task will be performed on-site at GSFC while the EOS MODIS, SNPP VIIRS, J-1, and J-2 instrument activities will be performed at the Contractor's facilities.

-All fabrication, hardware, software, and instrumentation to perform the operation and improvement activities of the Code 618 CF listed will be furnished by the government.

Task Deliverables

Code 618 CF support in the RCL

1. Monthly radiance calibration and stability monitoring from 350nm to 2500nm of two Spectralon-lined integrating spheres. Radiance calibration and stability monitoring of the third Spectralon integrating sphere will be dictated by user request.
2. Radiance uniformity scanning of the three RCL integrating spheres will be dictated by user request.
3. Radiance calibrations on customer supplied sources will be performed as requested.
4. Radiance calibration reports with uncertainties on all RCL or customer sources due to the CF PI two days after completion of calibration with final radiance calibration results posted to CF website 4 days after completion of calibration.
5. Laser-based radiance responsivity and wavelength calibration reports with uncertainties on RCL or customer instruments due to the CF PI 4 days after completion of calibration with responsivity and wavelength calibration results posted to CF website 10 days after completion of calibration.
6. BRDF/BTDF/THR/Perkin Elmer Reflectance calibration reports with uncertainties on customer samples due to the CF PI 4 days after completion of calibration with results posted to CF website 10 days after completion of calibration.
7. Coordination of the NIST calibration of two DCL laboratory reflectance check standards yearly.
8. Detailed electro-optical and mechanical design and full radiometric model for the next-generation, state-of-the art optical scatterometer.
9. Updates to Code 618 CF website will be performed monthly.
10. Three papers per year on Code 618 CF work, two to be published in peer reviewed journals and one to be published in the Proceedings of the Society of Optical Engineering (SPIE). Present the findings and results of these publications at conferences on satellite instruments, radiometry, or spectrophotometry.

Satellite instrument calibration, characterization, technical monitoring, and validation support

1. Monthly reports on the status of MODIS performance and work performed by MCST in support of MODIS on-orbit calibration, characterization, and validation.
2. Powerpoint presentations on MODIS on-orbit performance, calibration,characterization, and validation for presentation by MCST personnel in conjunction with the bi-yearly MODIS Science Team meeting.
3. Weekly reports on the status of SNPP VIIRS performance and work performed by VCST in support of SNPP VIIRS on-orbit calibration, characterization, and validation.

4. Weekly reports on the status of J-1 and J-2 VIIRS, CrIS, and ATMS instrument design and development, instrument design reviews, subsystem and system testing, and data analyses.
5. Technical memos presenting the results of VCST independent analysis of J-1 VIIRS instrument and observatory-level test data as J-1 VIIRS tests are completed and data are received.
6. Two papers per year on SNPP VIIRS and two papers per year on J-1 VIIRS instrument testing, calibration and characterization for publication in the refereed literature and present findings and results at conferences on satellite instruments, radiometry, or spectrophotometry.
7. Powerpoint presentation on SNPP VIIRS on-orbit performance, calibration, characterization, and validation, J-1 VIIRS instrument and observatory-level testing, and J-2 VIIRS instrument design and testing for presentation by VCST personnel in conjunction with the yearly JPSS Science Team meeting.

Travel

1. One person for two weeks to NASA Ames Research Center, Mountain View, CA, to perform field integrating sphere calibrations.
2. One person for 1.5 weeks to NASA Dryden, CA, to perform field radiance source calibrations.
3. Six people for 4 days each to San Diego, CA, to present papers at the Annual SPIE meeting.
4. Three people for 4 days each to Logan, UT, to present papers at the Utah State University Calcon Conference.
5. Two people for 5 days each to present papers at the IGARSS Conference (assume the 2013 venue for this meeting of Melbourne, Australia).
6. Two people for 5 days each to present papers at the SPIE European Remote Sensing Conference (assume the 2013 venue for this meeting of Dresden, Germany).
7. Two people on two trips of 4 days each to attend J-1 VIIRS instrument subsystem and system reviews at Raytheon, El Segundo, CA.
8. One person on two trips of 4 days each to attend J-1 ATMS subsystem and system reviews at Northrop Grumman Electronic Systems, Azusa, CA.
9. One person on two trips of 3 days each to attend J-1 CrIS subsystem and system reviews at Excelis, Fort Wayne, IN.
10. Two people on two trips of 4 weeks each to attend J-1 VIIRS ambient and thermal vacuum testing at Raytheon, El Segundo, CA.
11. Two people for 4 weeks each to attend J-1 VIIRS observatory testing at Ball Aerospace, Boulder, CO.