

Representative Task # 2**A. Science Support and Product Generation, Archiving and Distribution**

The Contractor shall support the development and sustaining engineering of data processing systems for product generation, archiving and distribution based upon the MODIS Adaptive Processing System (MODAPS) hardware architecture and common software base. Instances of MODAPS supported under this task order are the MODIS SIPS (Science Investigator Processing System) that produces, archives and distributes MODIS and VIIRS data products, and the Land and Atmosphere Near real-time Capability for EOS (LANCE) that produces and distributes MODIS and VIIRS near real-time products.

Specific activities under this task order include:

- i) Integrating software developed by the MODIS and VIIRS Science Teams and contractors supporting the NOAA IDPS into PGEs (product generation executives) that will run in the MODIS Adaptive Processing System (MODAPS) to generate global products.
- ii) Maintaining and enhancing MODAPS to improve system performance and reliability, add new functionality requested by users or operations staff, and meet IT security requirements. Changes include:
 - a. Modifying data ingest routines to accommodate new data sources;
 - b. Modifying production scripts to implement different rules for staging data to accommodate new science products or to improve current products;
 - c. Modifying routines that generate custom products to accommodate new output formats or data transformations;
 - d. Modifying job scheduling and archiving routines and the underlying database tables to improve system performance and reliability;
- iii) Developing product metadata fields that will capture the provenance of data products to the extent necessary to reproduce the product.
- iv) Developing tools to assess whether two instances of a product produced from the same raw data and the same software and lookup tables are equivalent to within the limits of precision.
- v) Developing the capability to rapidly restore MODIS daily Level 1 product generation and distribution in the event that access to Building 32 computing facilities that house MODIS processing systems is lost for more than 5 days.
- vi) Developing approaches to efficiently handle computationally intensive applications within MODAPS.

Task Assumptions

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

- MODAPS will process data acquired by the MODIS instruments on EOS Aqua and Terra and the VIIRS instrument on Suomi NPP from Level 0 (raw instrument data)

data files to produce higher level products, e.g. calibrated and geolocated radiances (Level 1), geophysical parameters in instrument swath format (Level 2) and gridded geophysical parameters (Level 3) produced from the Level 2 products.

- MODAPS will run around the clock with the exception of scheduled periods for maintenance of 1 to 4 hours per week as required.
- MODAPS operations will be fully staffed during normal business hours Monday through Friday and the data system has the capability to run largely unattended in the second and third shifts and on weekends.
- MODIS product generation executives (PGEs) are mature and current versions of the software have been thoroughly tested. An average of 3 changes per PGE for the 64 MODIS PGEs will be required to get these PGEs ready for a reprocessing campaign. Each PGE is tested by Science Team developers prior to delivery to the integration team. The integration processes includes both unit tests of PGEs as they are integrated into MODAPS and science tests that involve product generation from raw radiances through multi-day products. Examples of MODIS science processing software is available at: <http://modis-sdst.gsfc.nasa.gov/source.html> for your inspection.
- The MODIS Science Data Processing System description document is available at: <http://modis-sdst.gsfc.nasa.gov/documents.html> An updated version of this document describing how Collection 6 PGEs will execute is a deliverable under this RTO.
- Information about MODAPS computing systems is available in “MODIS products and MODAPS computing systems” available at: <http://modis-sdst.gsfc.nasa.gov/documents.html>
- Delivery of fully integrated PGEs to support the reprocessing of MODIS Level 1, Land and Atmosphere products can occur at separate times driven by availability of improved science software from the MODIS team and resources to integrate, test and evaluate the software.
- MODAPS software is written in C, Perl, Java and SQL and runs under the CentOS operating system.
- Configuration management of MODAPS software is handled in the open-source Subversion CM package and software bugs are tracked with Bugzilla.
- System administration and product quality assurance will be performed onsite (at GSFC) in the same location as the data processing facility that houses the MODAPS systems but are not included in this task. Operations staff that run the data system will be housed at the Contractor’s facilities offsite but operations is not included in this task.
- All activities on this task will be performed by staff located at the Contractor’s offsite facility.
- 25 VIIRS PGEs that generate Level 1 and Level 2 are immature relative to the MODIS PGEs on which they were originally based. For these PGEs, assume an average of 6 changes per PGE per year will need to be integrated each year.

- There are also 19 PGEs developed in-house based on MODIS Level 3 PGEs. Assume 2 changes per PGE per year will be required for this in-house developed software.
- MODIS Level 1 PGEs for a reprocessing campaign are PGE 00, 01, 02, 03, 60, 71, 92 and 93.
- Atmosphere PGEs for a reprocessing campaign are PGE 04, 06, 55, 56, 57, 69, 70, 81, 83, 85, 89 and 90.
- Land PGEs for a reprocessing campaign are PGE 7, 8, 11-16, 21-38, 40-46, 58, 59, 65-67, 72, 75,80, 82,84, 86,88 and 94.
- Interactions with MODIS and VIIRS science team members will generally be via email and by phone. A 3-day MODIS science team meeting and a 2-day VIIRS meeting will be held in the Baltimore-Washington area once a year. The task leader and software integrators who work directly with Science Team members will attend these meetings.

Task Deliverables

During the first 12 months of this task order, the contractor shall:

- i) Make Improvements to the distribution web page <http://ladsweb.nascom.nasa.gov/> to make it easier for users to find information about the MODIS and VIIRS products distributed by MODAPS and also to improve the experience of ordering standard products and creating custom versions of these products.
- ii) Deliver a PCR (PGE change request) report that details the improvements to each Atmosphere PGE with examples from the current Collection 5 product and the improved product that will be produced in Collection 6.
- iii) Deliver fully integrated Atmosphere PGEs for the Collection 6 reprocessing.
- iv) Deliver a PCR (PGE change request) report that details the improvements to each Land PGE with examples from the current Collection 5 product and the improved product that will be produced in Collection 6.
- v) Deliver a suite of fully integrated Land PGEs for the Collection 6 reprocessing.
- vi) Deliver a MODIS Science Data Processing System Description document updated with changes to PGEs for the Collection 6 reprocessing.
- vii) Develop the capability to rapidly restore MODIS daily Level 1 product generation and distribution in the event that access to Building 32 computing

During the 2nd year of this task order, the contractor shall:

- i) Deliver a fully integrated suite of VIIRS PGEs that will produce Level 1 global calibrated and earth located radiances and Level 2 and Level 3 land and atmosphere science products.
- ii) Produce a VIIRS Science Software Data Processing System Description document that describes the inputs, how each PGE is run in the MODAPS system and the output products it creates.

- iii) Deliver updates to MODIS and VIIRS product generation software into the MODAPS processing system. Documentation accompanying each update shall include the author of the change, a description of the change (bug fix or algorithm enhancement) including links to supporting documentation from science team member for algorithm improvements and description of tests run on the software and analysis of test results.
- iv) Design and prototype metadata that will be written in each data product that captures the provenance of the product. The metadata should contain all information necessary for the end-user to reorder and the data system to reproduce the product.
- v) Design tools to assess the differences between two versions of the same product and verify if the two versions are functionally identical from the standpoint of the original science investigator responsible for the algorithm which generated them. The tools should highlight locations in the product where differences occur and whether these differences fall within an acceptable range.
- vi) Develop approaches to efficiently handle computationally intensive applications within the MODAPS processing framework in an efficient manner. Note, this activity is not linked to the production of MODIS or VIIRS products because these are, in general, not computationally intensive.

Target Performance Standards

- (1) MODIS or VIIRS PGE (product generation executive) changes received from developers will be integrated and baselined under CM within an average of 5 business days.
- (2) A full scale test of a baselined PGE with all PGEs in its processing chain will be initiated within an average of 4 business days after a test plan has been approved by the relevant science discipline lead and all the required software for the test has been baselined.
- (3) All software bugs will be entered into the Bugzilla defect tracking system within 3 business days of discovery, the status of each bug in Bugzilla will be updated weekly.
- (4) The task leader will report progress on software integration and testing, system improvements and resolution of software bugs on a weekly basis at a status meeting with the task monitor and other civil servants and contractors who support the MODIS and VIIRS science teams.

Task Performance Period: Contract Years 1 and 2