GODDARD SPACE FLIGHT CENTER	**TASK ORDER** (Instructions and Distribution on Reverse)	PAGE 1 OF 1
1. CONTRACTOR: **SSAI**	2. CONTRACT NO.: **NNG12HP06C**	3. TASK/REVISION NO.: **CY4_0_02**
4. JOB ORDER NO./PROJECT:	5. FLIGHT HARDWARE/SOFTWARE; CRITICAL GSA (IF, YES, OBTAIN BLOCK 16 CONCURRENCE): YES X NO	6. DESIGNATED FLIGHT ASSURANCE MGR.:

7. DESCRIPTION OF WORK TO BE PERFORMED (OBJECTIVES OR RESULTS DESIRED):

GMAO Land Data Assimilation

8. TASK DOCUMENTATION REQUIREMENTS/DELIVERABLE ITEMS:

See Attached

9. PERFORMANCE/MILESTONE SCHEDULE:

February 1, 2015 – January 31, 2016

10. QUALITY ASSURANCE REQUIREMENTS:

11. TRAVEL, MATERIALS, ETC., KNOWN TO BE REQUIRED:

12. OTHER (FUNDING, NTE, HOURS, ETC.):

Estimated Cost
Fixed Fee
Estimated Total Cost-Plus-Fixed Fee $140,383

13. TASK ORIGINATOR/MONITOR/CODE/PHONE:

Rolf Reichle

14. BRANCH APPROVAL:

15. DIVISION CONCURRENCE:

16. CONTRACTING OFFICER'S TECHNICAL REPRESENTATIVE:

Stephen Cohn

17. CONTRACTOR SIGNATURE:

18. THIS TASK ORDER IS ISSUED PURSUANT TO THE TERMS OF THE CONTRACT.

CONTRACTING OFFICER'S SIGNATURE/ DATE

Ayana A. Briscoe
Contracting Officer
TYPED OR PRINTED NAME

Science Systems and Applications, Inc.
NNG12HP06C
Task Order Statement of Work

Task Order Number: CY4_02_Mod0
Task Order Title: GMAO Land Data Assimilation

1.0 Task Monitor (TM):

Name:	Rolf Reichle
Organization:	GMAO:GMAO
Email Address:	rolf.h.reichle@nasa.gov

2.0 Description of Work to be Performed

Changes from CY3 to CY4 are noted in red.

The task will support the GMAO land data assimilation activities, including the development of land data assimilation in the coupled land-atmosphere system, the initialization of the land model for global coupled forecasts using satellite and in situ data streams, the generation of off-line land surface data products such as MERRA-Land and the SMAP Level 4 products, development and generation of observation-corrected precipitation products, and support for the GEWEX/GLASS Project for the Intercomparison of Land Data Assimilation Systems (PILDAS). Support will include development of scripts and Fortran source code, optimization of code performance, assimilation tests conducted for model/module evaluation, validation and scientific analysis, as directed by the ATR, with a focus on the calibration and validation effort supporting the SMAP L4_SM data product. Support for developments by collaboration with scientists external to the GMAO will be provided as approved by the ATR. The contractor will be responsible for assembling data sets for validation. The contractor will also be responsible for interfacing with the GMAO modeling group, providing feedback to the model developers on model performance issues that arise through assimilation.

Performance metrics for evaluation of the systems and the assimilation products will include difference measures from and correlations with observations, impact on forecast accuracy (measured by forecast skill in near-surface air temperature and precipitation), as well as wall clock and CPU time requirements. The different data types to be assimilated include: soil moisture (radiances or retrievals from AMSR-E, ASCAT, SMOS and SMAP, and synthetic soil moisture data such as used in PILDAS), snow water equivalent (radiances or retrievals from SSM/I and AMSR-E), snow cover (retrievals from MODIS), land surface (skin) temperature (retrievals from MODIS, ISCCP, and NASA/Langley), and precipitation (such as the gauge-based CPC Unified product). The contractor will have the responsibility of retrieving these data sets, preparing them for ingest into the assimilation system, including quality control if necessary, and utilizing them for comparisons with the assimilation products and with the coupled forecasts.

Subtask a: Land data assimilation system development, testing, and application

i. Develop improvements to the GMAO land data assimilation system (LDAS), including the coupling of the LDAS to the GEOS-5 atmospheric modeling and data assimilation system (ADAS) so that the LDAS becomes part of the GMAO GEOS-5 reanalysis and forward processing infrastructure.
ii. Additional development goals include

   a. the use within LDAS of the ESMF-based common modeling infrastructure used in GEOS-5, and
   b. the use of MPI for parallel computing in LDAS.

iii. Maintenance of source control for the LDAS under CVS repositories.
iv. Evaluation of the performance of the LDAS with a limited series of tests defined in consultation with the ATR. Define a series of metrics for evaluation, including the impact of the assimilation on seasonal forecasts and, in coupled LDAS mode, on the atmospheric state.
v. Conduct retrospective land data assimilation integrations in off-line mode (not coupled to the ADAS) and in coupled mode, for the periods specified by the ATR.
vi. Evaluate the impact of assimilated data sets on the quality of the assimilation products. Develop a set of metrics to evaluate the quality of the assimilation products.
vii. Evaluate impact of land data assimilation on historical forecasts (typically 15-year period).
viii. Document the experiments and system performance on the GMAO web site.

Subtask b: Land Data Assembly and Processing

i. Retrieval, quality control processing and documentation of forcing, ingest, and validation data sets required for the LDAS.
ii. Maintenance and further development, as identified by the contractor and/or ATR, of the Matlab and python scripts that are used for post-processing LDAS output.

3.0 Special Requirements

None

4.0 Performance/Milestone Schedule

The GMAO Contract Year 4 POP is February 01, 2015 - January 31, 2016

5.0 Deliverables/Reporting Requirements

Monthly status reports will be provided to the ATR. All subtasks will provide software/algorithm documents and user guides in conformance with GMAO guidelines as appropriate.

Subtask a: Land data assimilation system development, testing, and application

i. Support the development of the GEOS-5 LDAS (including its SMAP L4_SM configuration) and the implementation of PILDAS.
ii. Documentation of the GEOS-5 LDAS and its performance in technical memoranda and in the peer-reviewed literature.
iii. The software must be modular, be efficient on parallel computing architectures, and utilize ESMF.
iv. Compare the land assimilation products with observations to demonstrate whether the land data assimilation products improve upon state estimates without assimilation. Assimilation integrations are to be conducted for a validation period identified in collaboration with the ATR.
v. Generation of assimilation products with different observation types, as identified in collaboration with the ATR.
vi. Results of experiments will be presented at regular LDAS meetings with the ATR and personnel from the GMAO land group.
vii. The retrospective assimilation data sets will be archived on GMAO local storage for analysis.
viii. Figures and movies will be provided as needed to staff members for presentations and publication.
ix. The analysis (focus on quantities determined in collaboration with GMAO personnel) will be presented at regular meetings of the GMAO land assimilation group and other GMAO internal meetings and it will be posted on GMAO web pages as directed by the ATR.

Subtask b: Land Data Assembly and Processing

i. Utilization of land surface and near-surface meteorological data streams for forcing, assimilation and validation on a routine basis, including AMSR-E soil moisture, MODIS snow cover and land skin temperature, NASA/Langley land surface (skin) temperature, in situ soil moisture measurements (SCAN, USCRN, Cosmos and SMAP core/candidate validation sites), SNOTEL snow data, and Fluxnet observations. These data are to be updated on a weekly or monthly basis from internet accessible archives, processed for quality control and for ingestion into the LDAS as directed by the ATR.
ii. Processing and analysis of data generated by PILDAS participants as directed by the ATR.

6.0 Other Information Needed for Performance of Task

TRAVEL AUTHORIZED:
Attendance of 1 contractor support staff at local meetings and up to one domestic conference or workshop during the performance period to present research results from this Task as approved by the TM. Local travel for training purposes, not to exceed 5 person-days, will be authorized at the request of the TM or the GMAO Chief.

7.0 Data Rights

N/A

8.0 Safety

Staff on this task will comply with federal, state, local, and center safety regulations. This will be accomplished through management emphasis, technical training, and personal responsibility. Staff will participate in safety orientation and training in accordance with the contract Safety and Health Plan, and work within the requirements of that plan.

9.0 Risk

SSAI will provide ongoing risk assessment and mitigation in performance of the Task Order. Priorities will be re-evaluated as appropriate with the TM. Cost and schedule performance will be assessed on a regular basis (no less frequently than monthly) and significant variations discussed and acted on in consultation with the TM and COTR.

10.0 Proposed Cost and Fixed Fee

In accordance with Paragraph B.5, of the contract, propose the Cost and Fixed Fee amount.