NASA SCIENCE MISSION DIRECTORATE

Earth-Sun System Applied Sciences Program
Agricultural Efficiency Program Element
FY2006-2010 Plan

Version 1.0

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Expanding and accelerating the realization of economic and societal benefits from Earth-Sun System science, information, and technology

NASA Science Mission Directorate
Earth-Sun System Division
Applied Sciences Program

Applied Sciences for the Agricultural Efficiency Program Element:

This document contains the Agricultural Efficiency Program Element Plan for FY 2006-2010. This plan derives from direction established in the NASA Strategic Plan, Earth Science Enterprise and Space Science Enterprise Strategies, Earth Science Applications Plan, and OMB/OSTP guidance on research and development. The plan aligns with and serves the commitments established in the NASA Integrated Budget and Performance Document.

The Program Manager and the Applied Sciences Program Leadership have reviewed the plan and agree that the plan appropriately reflects the goals, objectives, and activities for the Program Element to serve the Applied Sciences Program, Earth-Sun System Division, NASA, the Administration, and Society.

(Signature on file) _____ _____
Ed Sheffner Date
Program Manager, Agricultural Efficiency
Applied Sciences Program
NASA Earth-Sun System Division

(Signature on file) _____ _____
Lawrence Friedl Date
Lead, National Applications
Applied Sciences Program
NASA Earth-Sun System Division

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Ronald J. Birk Date
Director, Applied Sciences Program
NASA Earth-Sun System Division

NASA Earth-Sun System Division: Applied Sciences Program

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I. Purpose and Scope

This Applied Sciences National Applications Program Element Plan is applicable for Fiscal Years 2006 through 2010. The plan documents the purpose of the program and the implementation approach to meet the program objectives using the allocated resources. The plan describes the program element approach in extending NASA Earth-Sun system science research results to meet the decision support requirements of partner agencies and organizations. The Applied Sciences Program requires this plan to function as a program management tool, describing the program structure, functional mechanisms, performance measures, and general principles that will be followed in extending NASA research results for societal benefits.

Scope within NASA and Applied Sciences Program

Each National Applications Program Element is managed in accordance with, and is guided by, the NASA Strategic Plan and Earth Science Applications Plan. The program element benefits from NASA Earth-Sun system science research results and capabilities, including the fleet of NASA research satellites, the predictive capability of models in the Earth System Modeling Framework (ESMF), Project Columbia, the Joint Center for Satellite Data Assimilation (JCSDA), and the Earth-Sun System Gateway (ESG). The Applied Sciences Program seeks to develop with its partners scientifically credible integrated system solutions in which uncertainty characterization and risk mitigation has been performed using the capability of the national Earth-Sun laboratories and others in the community of practice.

The FY06 President's Budget for the NASA Applied Sciences Program specifies between $48 million and $55 million annually for FY06 – FY10. There are two elements to the Applied Sciences Program: National Applications and Crosscutting Solutions. Each National Applications Program Element benefits from the performance results of Crosscutting Solutions (see Crosscutting Solutions Program Element Plan). Each National Applications Program Element leverages and extends research results from the over $2 billion per year supporting Earth-Sun system science and development of innovative aerospace science and technology. Additional information about the NASA Applied Sciences Program can be found at http://science.hq.nasa.gov/earth-sun/applications.

Information on vegetation condition derived from remote sensing has long been used in decisions concerning agricultural production. Collaborations among the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Department of Agriculture (USDA) in the 1970's and 1980's (e.g., the Large Area Crop Inventory Experiment (LACIE), and Agriculture and Resources Inventory Surveys Through Aerospace Remote Sensing (AgRISTARS)) demonstrated that observations and measurements from Earth observing spacecraft provide valuable information on crop production, yield, and

condition. The technology and methodology that emerged from those programs contributes substantially to the global and domestic crop assessment work USDA conducts through the Foreign Agriculture Service (FAS) and the National Agricultural Statistics Service (NASS). FAS and NASS assessments are utilized by policy makers, agribusiness resource managers, and producers to make decisions on agricultural management affecting planting, harvesting, marketing, commodity export and pricing, drought monitoring, and food assistance. USDA administers a number of production, conservation, and environmental programs for American farmers regarding the sustainability of domestic agricultural production. Through USDA agencies such as the Farm Service Agency (FSA), the Natural Resource Conservation Service (NRCS), the Risk Management Agency (RMA), and others, programs are implemented and managed that enable the American agricultural producer to manage the perils associated with nature and markets while conserving, maintaining, and improving America's natural resources and environment. Management of many of these farmer-focused programs requires timely and accurate information on crop condition and weather--and longer-term climate predictions--that can be derived from existing and planned NASA Earth-Sun science missions and models. The Agricultural Efficiency Program Element focuses on enhancing the ability of NASA's partners to predict agricultural production and yield.

This program plan addresses such predictions primarily through integration of NASA capabilities, especially data and modeling capabilities in weather, climate, and natural hazards, into the global and domestic production and yield forecasting mandates of USDA. In the next decade, NASA contributions to decision support for agricultural efficiency will involve the transition of observations and measurements, from NASA experimental Earth observing platforms of proven utility in agriculture, to operational systems, and the evaluation of new observations and measurements for their value to enhance the performance of agricultural decision support tools. The current generation of NASA Earth-Sun System observations (e.g., Terra, Aqua, TRMM) and models have demonstrated their utility in decision support tools, and, where appropriate, enhancements to decision support tools based on NASA observations and model output are being incorporated into the operational procedures of users. NASA is assisting to ensure the continuity of observations and measurements with proven operational utility in operational follow-on instruments.

Observations and measurements from the new missions, (e.g., the Orbiting Carbon Observatory (OCO), and Aquarius) may also enhance the decision support systems and tools employed by USDA and other organizations with mandates to monitor agricultural efficiency. An example of NASA contributions to agriculture is the collaboration with the Foreign Agricultural Service (FAS) to improve the timeliness and accuracy of the information and predictions the FAS supplies to the World Agricultural Outlook Board (WAOB) in the board's monthly review of global agriculture. The inputs from FAS have an impact in the billions of dollars on agriculture decisions at all levels of agriculture – from individual operators to agribusiness and national agricultural policy and management. The collaboration between NASA and FAS is illustrative of the integrated system solutions that the Applied Sciences Program seeks with its partners (see Appendix A). USDA and NASA's Earth-Sun System Division are partners in a number of program elements that affect USDA mandates. The partnership is formally recognized in a Memorandum of Understanding (MOU) between NASA and USDA signed in May 2003. An interagency working group, authorized under the MOU, is meeting regularly to define collaborative projects in Agricultural Efficiency and other Earth-Sun System Division Applied Sciences Program Elements, including Carbon Management, Invasive Species, Air Quality, Water Management, Disaster Management, and Homeland Security. When identifying collaborative projects between USDA and NASA in Agricultural Efficiency, the requirements and contributions from the other program elements are considered by the interagency working group to ensure efficiency and prevent duplication of effort.

II. Goals and Objectives

Goals

NASA research on climate weather and natural hazards uses unique observations from space and predictive models to meet its research goals. Observations of land cover and land use, and change in both over time, the condition on vegetation, and direct measurements of parameters such as soil moisture, surface and atmospheric temperature and precipitation are potentially of great utility to agriculture. The spatial resolution of NASA observations and measurements make them particularly helpful in scaling up information on local conditions to make regional, continental and global assessments. In addition, NASA predictive modeling capabilities in weather and climate can be enhanced to provide regional input to models for agricultural productivity and yield. The long-term goal of the Agricultural Efficiency Program Element is to extend the use of NASA terrestrial and atmospheric observations, measurements, and predictive models to enhance the decision support tools of organizations with mandates for policy and management decisions affecting agriculture.

Objectives

All National Applications Program Elements are aligned to the NASA Strategic Plan and the agency's objectives as expressed in the NASA Integrated Budget and Performance Document (IBPD) and the Performance Assessment Rating Tool (PART).

FY06 Objectives:

1. FAS: Goddard Space Flight Center (GSFC) – Integration of MODIS and TRMM products into Global Agricultural Decision Support System

a. Complete validation and verification of MODIS and TRMM products in ARS crop model and for evaluation by FAS
b. Complete integration of MODIS and TRMM products in to Agricultural Information System (AIS) for delivery of products on demand to FAS and UN/WFP users.
c. Integrate crop model output into FAS and WFP operational procedures for evaluation and assessment
d. Benchmark use of MODIS TRMM products in FAS decision support tool.

2. FAS: University of Maryland – Application of NASA EOS MODIS Data buy FAS

a. With FAS, plan the transition to full FAS responsibility for operational implementation of the system to generate and supply the MODIS VI products to FAS analysts and make available to the public via CropExplorer.
b. Complete the operational implementation of rolling window MODIS VI composites.
c. Verify and validate a merged, synthetic MODIS/SPOT/AVHRR VI for use by FAS analysts
d. Complete the 500m MODIS crop mask and evaluate the product in the US.
e. Complete and verify a vegetation moisture stress index based on MODIS data products.

3. FAS GSFC – Lake and Reservoir Monitoring System

a. Increase the quality and quantity of existing Topex/Poseidon and Jason-1 lake and reservoir elevation products
b. Enhance the existing system by increasing the range of targets and products available via the inclusion of new satellite data from the Topex-Tandem Mission and the NOAA Geosat Follow-On (GFO) mission.
c. Compile and update systems engineering report comprising an evaluation study, verification and validation exercises and benchmark the enhanced system.

4. USAID: NASA-Goddard Institute for Space Studies (GISS) - Integrating NASA Models and Missions into Climate and Agriculture DSS

a. Complete an evaluation report for of current systems and procedures used by USAID for integration of weather and climate data into agricultural decision support
b. Conduct Scoping Mission to Uruguay and Central America to strengthen connections between NASA and DSS users, fine-tune data and database needs of user groups. This will improve team efficiency and communication, and allow greater feedback.

5. FAS: USDA/ARS - Integrate NASA's Global Soil Moisture Remote Sensing and Modeling Data into USDA's Global Crop Production Decision Support System (new project)

a. Develop one year model of soil moisture using AMSR-E and MODIS observations
b. Streamline process for delivery of NASA soil moisture product to USDA
c. Complete processing of AMSR-E soil moisture data
d. Complete Land Information System, Ensemble Kalman Filter code for AMSR-E data analysis.

6. NRCS: Institute for Technology Development – Improving the RUSLE Model Using Remotely Sensed Crop Residue Maps

a. Evaluate the uncertainty in the Revised Universal Soil Loss Equation (RUSLE) estimated soil loss and “soil conditioning index” using traditional model input parameters at various locations
b. Evaluate existing crop residue algorithms and image based products that can quantify crop residue consistently.
c. Evaluate uncertainty in RUSLE estimated soil loss and SCI using satellite based products
d. Verify and validate image products for use by NRCS in the RUSLE.

FY07 Objectives:

1) Verify and validate initial AMSR-E soil moisture products
2) Initiate project(s) to evaluate impact of OCO and Acquarius products on decision support tools
3) Initiate project to integrate NASA climate/weather models in agricultural decision support tools.
4) Complete transition of MODIS/TRMM products used by FAS to fully operational FAS system.
5) Complete evaluation report for FEWS DST

III. Program Management and Partners

A. Program Management

Program Manager
Agricultural Efficiency Program Element
Ed Sheffner
Applied Sciences Program
Science Mission Directorate
NASA Headquarters

Responsibilities:
- Development of and implementation of interagency agreements and partnerships with other organizations
- Program development including program plans and budgets
- Development and implementation of solicitations for Agricultural Efficiency tasks
- Primary responsibility for metrics, performance goals and other performance evaluation criteria
- Liaison to the Research Program in Earth–Sun System Division; North American Carbon Program (NACP); Climate Change Science Program (CCSP) and Climate Change Technology Program (CCTP).
- Liaison to the NASA/USDA Interagency Working Group for Earth Science Applications.
- Co-chair (with USGS) of the USGEO taskforce on Global Land Observsation System (GLOS)
- NASA representative on the Interagency Task Force on Science to Support Agriculture

Deputy Program Manager
Agricultural Efficiency Program Element
Rodney McKellip
Project Research Scientist
Applied Sciences Directorate
NASA Stennis Space Center (SSC)

Responsibilities:
- Management of Agricultural Efficiency tasks assigned to Stennis Space Center
- COTR or Studies Manager (as appropriate) for grants and cooperative agreements that address Agricultural Efficiency management and are funded through procurement at Stennis Space Center.
- Coordinator and liaison with Program element management for Agricultural Efficiency tasks at NASA centers.

B. Agricultural Efficiency Network & Partners

The Applied Sciences Program pursues partnerships with federal agencies and others that oversee land management decisions and policies that effect agricultural production and yield. The program includes, for technical support, NASA field centers; universities; non-government organizations and commercial entities; and local, state, and tribal organizations that implement agricultural efficiency policies through decision support systems and tools. The Program is a node in a network involved in agricultural efficiency. The network members enhance agricultural efficiency through information sources that provide managers and policy makers with the knowledge to allocate resources. Key nodes in the network and currently involved with the program element include:

NASA field centers:

John C. Stennis Space Center	Mr. Rodney McKellip et al
Goddard Space Flight Center	Dr. Steven Kempler, Dr Charon Birkett, et al
Goddard Institute of Space Studies	Dr. Cynthia Rosenzweig et al

Federal partners:

USDA/FAS	Dr. Glenn Bethel
USDA/FAS	Dr. Brad Doorn
USDA/Agricultural Research Service	Dr. Mark Weltz
USDA/World Agricultural Resources Board	Dr. Gerry Bange
USDA/National Agricultural Statistics Service	Dr. Roberta Pense
USDA/Cooperative State Research, Education and Extension Service	Dr. Ray Knighton
Department of State	Mr. Fernando Echavarria

Other organizations:

Institute for Technology Development	Dr. George May
Raytheon Corporation	Dr. Peter Gilruth
INIA (Ururguay)	Dr. Walter Baethgen
SERVIR	Dr. Dan Irwin
UN World Food Programme	Dr. Leonard Milich

Universities:

George Mason University	Dr. Paul Houser
Mississippi State University	Dr. David Shaw, Dr. Roger King
University of Arizona	Dr. Charles Hutchinson
University of Maryland	Dr. Chris Justice
	Dr. John Townshend
University of Florida	Dr. Jim Jones
University of Missouri	Dr. Verne Kaupp

Utah State University.....	Dr. Phil Rasmussen
Virginia Polytechnic Institute.....	Dr. Randall Wynne
Idaho State University.....	Dr. Keith Weber
State University of New York - Syracuse.....	Dr. Jim Hassett
University of North Dakota.....	Dr. George Seielstad

DAACS and Earth Science Modeling Centers: None.