NASA SCIENCE MISSION DIRECTORATE
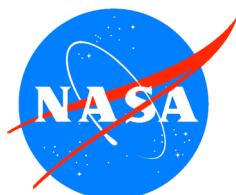
Earth-Sun System Applied Sciences Program
Invasive Species Program Element
FY 2005-2009 Plan

Version 1.1

March 16, 2005

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

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

Applied Sciences for the Invasive Species Program Element

This document contains the Invasive Species Program Element Plan for Fiscal Years 2005-2009. This plan derives from direction established in the NASA Strategic Plan, the Earth Science Enterprise Strategy, the Space Science Enterprise Strategy, the 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, the Earth-Sun System Division, NASA, the administration, and society.

(Signature on file)   February 11, 2005
Ed Sheffner   Date
Program Manager, Invasive Species
Applied Sciences Program
NASA Earth-Sun System Division

(Signature on file)   February 11, 2005
Lawrence Friedl   Date
Lead, National Applications
Applied Sciences Program
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NASA Earth-Sun System Division: Applied Sciences Program
Invasive Species

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Invasive Species Program Element Plan: FY 2005 - 2009

I. Purpose and Scope

This plan describes the Invasive Species Program Element for Fiscal Years 2005 (FY05) through 2009. The plan includes the purpose of the program and the strategy to meet the invasive species management objectives using the resources available. The plan describes the approach of the program element, including NASA's role in partnerships, the focus on decision support tools, and the extension of NASA Earth-Sun system science results to meet the decision support requirements of partner agencies and organizations. Within the Earth-Sun System Division, this plan functions as a program management tool, describing the program structure, functional mechanisms, performance measures, and general principles that the invasive species activity will follow.

Management and control of invasive species[1] is a major national concern. Estimates on the annual cost to management agencies in the United States, at all levels of government, to control invasive species are as much as $100 billion per year, and likely to grow[2]. Eradication is no longer a viable response for species that have become endemic in certain areas. The current focus is on predicting sites where invasive species are likely to venture and directing control efforts at eradication of emergent, small stands of invasive while the cost of eradication remains reasonable.

The purpose of the Invasive Species Program Element is to assist operational agencies meet mandates to manage invasive species. The purpose will be met through partnerships between NASA and the operational agencies. These partnerships will take advantage of NASA Earth-Sun system science observations, modeling and computational capabilities to develop tools that predict the spread of Invasive Species and help the operational agencies maximize the use of available resources for response to the Invasive Species threat. The collaboration among NASA, the Department of the Interior (DOI – especially United States Geological Survey (USGS)), the US Department of Agriculture (USDA) and the National Oceanic and Atmospheric Administration (NOAA) on invasive species is illustrative of the integrated systems solutions that the Applied Sciences Program seeks with its partners (see Appendix A).

The spread of invasive species is increasing as global travel and shipping expands the opportunity for movement of undesirable organisms. The issue has developed diverse stakeholder support, ranging from state and federal land management agencies, the agricultural and recreational industries, conservation organizations, and private landowner groups. The National Research Council's Committee on Grand Challenges in Environmental Sciences has identified increased

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[1] *For this program plan, "invasive species" are defined as non-native plants, animals, insects and other organisms that endanger the health of native species or have significant negative economic impact on society. The number of invasive species entering the US per year is estimated to be in the thousands.*

[2] *Pimentel, David, et al. "Environmental and Economic Costs Associated with Non-indigenous Species in the United States." Cornell University, 1999. Available on-line at: http://www.news.cornell.edu/Jan99/species_costs.html.*

understanding of biodiversity and ecosystem functioning as one of eight "Grand Challenges in Environmental Science" facing our nation and the world today. The committee emphasized the need for developing an ecological forecasting capability and improved management techniques for non-indigenous species. As such, the Invasive Species Program Element is closely related to the Ecological Forecasting program element.

Scope within NASA and Applied Sciences Program

The Invasive Species Program Element is managed in accordance with, and is guided by, the NASA Strategic Plan and Earth Science Enterprise Strategy. The program element benefits from Earth-Sun system science results and capabilities including Operation System Simulation Experiments (OSSEs), Project Columbia, the Joint Center for Satellite Data Assimilation (JCSDA), the Earth-Sun System Gateway (ESG), and the Transition from Research to Operations (R2O). The program element utilizes initiatives such as the Global Information Grid (GIG) and Federal Enterprise Architecture (FEA) and cooperates with national Earth-Sun laboratories and international programs.

The FY05 President's Budget for the NASA Applied Sciences Program* specifies $54M annually for FY05-FY09 for the National Applications ($24M) and Crosscutting Solutions ($30M) activities. While directly managing a subset of the $24M National Applications budget, the Invasive Species Program Element (and each of the national applications) benefits from the performance results of the $30M budget for Crosscutting Solutions (see Crosscutting Solutions Program Element Plan). The Invasive Species Program Element leverages and extends research results from the approximately $2.1B per year supporting Earth-Sun system science research 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.

* The National Applications and Crosscutting Solutions components of the Earth Science Applications Theme in the NASA FY05 Integrated Budget & Performance Document

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II. Goals and Objectives

Projects sponsored by the Applied Sciences Program invasive species element in FY05 address objectives 1.1, 1.2 and 3.3 of the NASA 2003 Strategic Plan, and the NASA Integrated Budget and Performance Document (IBPD) performance measures 5ESA4, 5ESA6, and 5ESA8 (see Table 1).

The long term goal of the Invasive Species Program Element is the integration of NASA Earth-Sun system observations, modeling and systems engineering capabilities into the operational procedures of federal agencies and other organizations with mandates to respond to the incursion and spread of invasive species in terrestrial and aquatic habitats. This goal is manifest in the integration of observations sponsored by the Earth–Sun System Division, modeling and systems

engineering in the National Invasive Species Forecasting System (NISFS). The USGS is the lead agency developing the NISFS on behalf of the National Invasive Species Council (NISC).

The NISFS will provide revolutionary capabilities of importance to understanding and managing the effects of invasive species on human health, economic issues, native biodiversity, and ecosystem processes. The techniques developed under this plan will have an immediate need for information derived from current and planned NASA research programs, including climate change, temporal and spatial ocean and land cover change, vegetation characterization, precipitation, soil moisture, topography, hydrologic cycles, and national and global carbon relationships. This process will be interlinked with Geographic Information System (GIS) capabilities in tracking, assessment, and prediction of probable introduction points, disease outbreaks, potential rate of organism spread, potential success in alternative management activities, and actual successful implementation of mitigation efforts. These activities will also create important new opportunities for commercial delivery of technologies for use by private industry and the consumer, meeting the NASA Strategic Plan objective to expand and accelerate the realization of societal and economic benefits from Earth-Sun science, information, and technology.

The primary outcome of this effort is a dynamic, flexible NISFS that allows scientists and resource managers to integrate climate, weather, hazard and land cover parameters to model and analyze regional-scale biological resources. The information products produced by the system are electronic and printed maps of potential hot spots of native plant diversity, including: (1) probable locations of rare habitats; (2) probable locations of relict/unique species assemblages; (3) potential areas of future invasion; (4) spatial auto-correlations with cross-correlation statistics for single exotic species; (5) accuracy assessments of native and exotic plant diversity; (6) evaluation levels of uncertainty in maps of natural resources; and, (7) classification and regression trees for map accuracy. These products are critical elements of an invasive species DSS.

The Invasive Species Program Element overlaps with research and technology activities in the Earth-Sun System Division. Research tasks in land cover/land use change, carbon cycle science and ecological forecasting, and technology tasks in advanced computation contribute to the development of capabilities that are implemented through the Invasive Species Program Element. For example, the Earth-Sun System Science Technology Office, through a competitive solicitation, sponsors development of new parallel processing techniques suitable for the computational requirements of the NISFS.

A. Objectives: FY05:
   1. Invasive Species Forecasting System and related activities
      a. Complete time series study analyses to determine their effectiveness in modeling particular species and landscapes.
      b. Derive the spectral-temporal signature of Tamarisk and associated vegetation from multiple ASTER and EO-1 acquisitions and MODIS time series over four Tamarisk study sites in the Western United States.
      c. Enhance NISFS data and analysis capabilities with MODIS NDVI time series summaries and hybrid regression trees/logistic regression to produce the new products

    d. Engineering Goals and Deliverables:

        i. ISDS prototype proving ECHO client feasibility and integration

        ii. A production release of *t*Map and associated databases at NIISS

        iii. An ISDS data upload tool on the production system at NIISS

        iv. Release the following Invasive Species Forecasting System products:

            a. V2.0 Requirements Documentation.

            b. V2.0 Design Documentation.

            c. V2.0 ISAMS and ISDS Applications.

    e. Benchmark ISFS: Draft Benchmarking Report for ISFS for review and revision, and Final V1.0 Benchmarking Report for ISFS

2. Aquatic invasive species decision support tools

    a. Evaluate Terra and Aqua based sensors, such as MODIS, for use in mapping widespread invasive weeds, the terrestrial weed kudzu and the aquatic weed hydrilla.

    b. Evaluate EO-1 Hyperion and ALI sensors for use in mapping widespread noxious weeds.

3. National Park Service (Yellowstone) decisions support tool for wildlife management and data visualization

    a. Predictions supporting NPS decisions e.g. timing of wildlife interventions

    b. Perform V & V on products toward benchmarking tools in FY06

    c. Visualization tools for ecosystem functioning for use by park managers and general public

    d. Prototype component capabilities for the NISFS on-line.

4. Benchmark Earth-Sun System science inputs to the NISFS.

5. Initiation of at least one new, invasive species-specific project (e.g., tamarisk, yellow starthistle) with the USDA and DOI.

6. Documentation of Invasive Species Program Element in appropriate journal and participation in at least one national /international conference, e.g., International Geoscience and Remote Sensing Symposium (9/04).

7. Initiate new projects under the "Decisions" solicitation

8. Represent NASA on the National Invasive Species Council

B. Objectives: FY06

    1. Examine the impact of observations from new NASA systems (e.g., OCO, Hydros and Aquarius) on climate and weather predictions and the impact of those predictions on invasive species decision support systems and tools.

    2. Benchmark performance of Earth-Sun science inputs in at least two additional decision support tools or systems for invasive species including at least one for aquatic invasives, and one for invasive animal species.

    3. Develop collaborative project(s) with USDA (and DOI) on invasive species DST and DSS under the terms of the Memorandum of Understanding (MOU) signed

between NASA and USDA in May 2003 for collaboration on Applied Sciences applications.

Table 1: Linkage among the objectives from the NASA 2003 Strategic Plan, the IBPD, and the Invasive Species Element Plan

NASA Strategic Plan 2003	Objective	FY05 Invasive Species Objective
1.1	Understand how the Earth is changing, better predict change, and understand the consequences for life on Earth.	1,4
1.2	Expand and accelerate the realization of economic and societal benefits from Earth-Sun system science, information and technology	1,2,3
3.3	Improve the Nation's economic strength and quality of life by facilitating the innovative use of NASA technology	1,2,3,4
IBPD FY05		
5ESA4	Benchmark at least five REASoN projects; observations from at least five sensors	1.e
5ESA6	Benchmark at least five decision support systems through Applied Science models.	1.e
5ESA8	V&V solutions for >five DSS associated REASoN projects.	1.c, 3.b

III. Program Management and Partners

A. Management assignments
  1) Program Manager, Invasive Species Program Element
    Mr. Ed Sheffner
    Earth-Sun System Division Applied Sciences Program
    NASA Headquarters
    Washington DC
    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 Invasive Species tasks
- Primary responsibility for metrics, performance goals and other performance evaluation criteria

  2) Deputy Program Manager, Invasive Species Program Element
    Mr. Rodney McKellip
    Project Research Scientist
    Applied Sciences Directorate
    Stennis Space Center, MS (SSC)
    Responsibilities:
- Management of invasive species tasks at Stennis Space Center

- COTR or Studies Manager (as appropriate) for grants and cooperative agreements that address Invasive Species management and are funded through procurement at SSC
- Coordination of activities among the program element team members including the NASA Centers

The Invasive Species Program addresses geospatial information needs and predictive capabilities of operational agencies and other organizations that make policy and management decisions related to Invasive Species Management. NASA's Earth-Sun System Division is pursuing partnerships with federal agencies that oversee land management policies. Invasive Species was one of five topic areas cited in the NASA/USDA MOU signed in May 2003. The Earth-Sun System Division is pursuing similar agreements with other departments and agencies such as the Department of the Interior (DOI). The program also includes NASA field centers, universities and local, state, or tribal non-government organizations that implement Invasive Species management policies that require decision support.

NASA's Earth-Sun System Division is a node in a network involved in invasive species response. This network is improving knowledge of Invasive Species in new environments and is developing and implementing information sources that provide managers and policy makers with the knowledge they need to allocate resources. Key nodes in the network and currently involved with the Program Element include:

B. Government agencies and programs:
  1. Department of Agriculture: Agricultural Research Service, Cooperative State Research Education and Economics Service, Natural Resources Conservation Service, Farm Services Agency (Dr. Ernest Delfosse)
  2. Department of the Interior: Memorandum of Understanding with NASA (Mr. Gordon Brown)
  3. Department of the Interior: US Geological Survey (especially the National Institute for Invasive Species Science); National Park Service (Dr. Tom Stohlgren)
  4. Department of the Interior: National Park Service
C. NASA Centers:
  1. Ames Research Center: Decision support tools for tamarisk and other invasive plants (Dr. David Bubenheim)
  2. Goddard Space Flight Center: Program element scientist, computational research for NISFS (Dr. John Schnase)
  3. Stennis Space Center: Program Element Management (Mr. Rodney McKellip)
D) Universities (current active contacts):
  1. Mississippi State University: DSS for aquatic invasive plants (Dr. Lori Bruce)
  2. University of Arizona: Tamarisk decision support tools (Dr. Edward Glenn)
  3. California State University Monterey Bay: Decision support tools for National Park Service (Dr. Fred Watson)
E) Other organizations:
  1. Bonneville County, ID: Implementation of decision support tools at the local level (Mr. Jeff Pettingill)

IV. Decision Support Tools

The NISFS is the primary decision support tool within the NIISS. Benchmarking the performance of the tool against USGS requirements is an objective for FY05. In FY06 and beyond, the tool will be benchmarked against the requirements of other USGS client organizations as part of the business plan for the NIISS.

V. Application Activities

A. Projects

Procurement funds in FY05 will be directed toward supporting collaborative activities between NASA and USDA in invasive species and NASA participation in working groups and councils such as the Invasive Species Focus Area Working Group of the NASA/USDA Interagency Working Group on Earth Science Applications, and the National Invasive Species Council (NASA accepted an invitation to join the council in December 2004.) The budget items listed in section VI address these tasks.

B. Solicitations

Two projects for Invasive Species were funded under the REASoN cooperative agreement notice – J. Schnase: "The Invasive Species Data Service: Towards Operational Use of Earth-Sun System Division Data in the USGS Invasive Species Decision Support System"; and F. Watson: "Systems Integration and Visualization of Yellowstone: an Earth Systems Research, Application, and Education Solution."

The former extends work underway with USGS/NIISS on the NISFS by improving access to NASA observation and data products (SeaWIFS, Landsat, Terra, Aqua, QuikSCAT, Jason) and data from commercial systems (Ikonos, Quickbird) for users to generate invasive species forecasting maps through the NISFS. The latter project extends the scope of NASA collaboration through the use of the "Tarsier" modeling framework (ASTER, MODIS, SRTM Landsat and AVHRR data) for decisions on mitigation of invasive species.

C. Congressionally Directed Activities

There are no congressionally directed activities related to Invasive Species for FY05.

D. Additional Activities and Linkages

Fellowships: NASA fellowships for the period 2002 through 2006 with potential impact on the Invasive Species Program Element:

Name	Title	Institution
Isabel Ashton	Biological invasions and alterations of the global carbon balance.	Stony Brook University
Laura Koteen	A Comparison of Carbon Cycling and Material Exchange in Landscapes Dominated by Native and Exotic Grasses in Northern Coastal California	University of California, Berkeley

The Crosscutting Solutions Program—The program consists of functional elements that contribute to all of the National Applications activities. The intention is to have the performance of these functions leverage accomplishments, and therefore the apparent resource investment, to the greatest extent possible into the National Applications partnerships. These functions are: Geoscience Standards and Interoperability, Human Capital Development, Integrated Benchmark Systems, and Solutions Networks. Examples of leveraged activities are:

- *The Earth-Sun System Gateway* is a "portal of portals" providing an access point through an Internet interface to all web-enabled NASA research results.
- *A Rapid Prototyping Center* is a proposed center at Stennis to support NASA and partners in testing and verification of Earth-Sun science results in decision support tools
- *Transition from Research to Operations Network (R2O)* is a network that focuses on systematically transitioning the results of research to operational uses.
- *DEVELOP* is a student-based program for rapidly prototyping solutions for state and local applications and helping students develop capabilities related to applied Earth-Sun science.

NASA and Science Mission Directorate Priorities

- *Federal Enterprise Architecture (FEA)* is a business and performance-based framework to support cross-agency collaboration, transformation, and government-wide improvement.
- *The Global Information Grid (GIG)* is the first stage of a U.S. military global, high-bandwidth, Internet protocol-based communications network (a.k.a., 'the Internet in space').
- *The Joint Center for Satellite Data Assimilation (JCSDA)* is a multi-agency collaboration to accelerate and improve the quantitative use of research and operational observational spacecraft data in weather and climate prediction models. NOAA (NESDIS, NWS, OAR), NASA, Navy, Air Force, and NSF (through UCAR) collaborate in JCSDA.
- *Metis* is a visual modeling software tool for planning, developing, and analyzing agencies' enterprise architectures. The Applied Sciences Program is using Metis to identify possible linkages between observations, models, and decision support tools to support the IWGEO and NASA/NOAA R2O activities.
- *Observing System Simulation Experiments (OSSEs)* use simulated observations to assess the impacts of future observational spacecraft instruments on weather and climate

prediction and provide opportunities to test new designs and methodologies for data gathering and assimilation.
- *Project Columbia* is a NASA-wide project to develop a new, fast supercomputer (using an integrated cluster of interconnected processor systems) to support the Agency's mission and science goals, including enhanced predictions of weather, climate, and natural hazards.

VI. Budget: Fiscal Year 2005

The following table lists the Invasive Species Program budget (procurement) for FY2005:

Invasive Species	
Project	**FY05 Procurement Allocation ($K)**
Initiate project with USDA/DOI (Tamarisk)	$120
NASA/USDA Invasive Species FAWG	$30
NISC and committee participation	$25
Prog. Mgnt.	$30
Total	$205

Appendix C lists program-wide budget allocations for FY2005.

VII. Schedule and Milestones

FY05:
October 2004
- Benchmark team meeting for ISFS.

December
- ECHO Prototype (ISDS 1), tMap/DB Release (ISDS 2)
- AGU ISFS Presentation
- Evaluate sensitivity and accuracy of algorithms against QA dataset (MSU)
- Journal Paper on Yellowstone DST

January 2005
- Benchmark team meeting for ISFS. Complete plan to benchmark by end of fiscal year
- Release ISFS V2.0

February
- Species Richness Map (MR1), Cheatgrass Map
- Adopt NIISS Business Plan, Operational Transfer Plan

March
- Release ISFS V2.0 Design
- Construct maps of kudzu and hydrilla distribution with confidence estimates.

April
- Release Data Upload Tool (ISFS)

May
- V2.0 ISAMS and ISDS Applications

June
- Combined Science Team and Client/Partners Meeting
- Demonstration of DST to Yellowstone Park staff

July
- Conduct second field campaign to validate NISFS V2.0 modeling algorithms.

August
- Leafy Spurge Map (MR3), Tamarisk Map
- Applied Sciences ISFS Workshop
- Benchmark report ISFS

September
- Temporal Analysis Research (TAR), Tamarisk Signature Research

FY06-09:
- Baseline decision support systems and tools used by NASA partners in invasive species including USGS and the National Park Service for potential Earth-Sun science inputs.
- Benchmark the improvement in predictive capability in the National Invasive Species Forecasting System from the integration of NASA observations, measurements and systems engineering.

VIII. Performance Measures

The Invasive Species Management Team uses performance measures to track progress, identify issues, evaluate projects, make adjustments, and establish results of the Program Element. The program's Goals and Objectives (Section II) state what the program intends to achieve. These measures help monitor progress within and across specific activities to ensure the Program meets its goals and objectives. The Management Team analyzes these measures retrospectively in order to made adjustments proscriptively to the Program approach and objectives.

The measures are in two categories. Program Management measures are internally focused to assess the activities within the Program. Performance measures are externally focused to assess if the Program activities are serving their intended purpose. In general, the Program Manager uses these measures to evaluate the performance of activities conducted and sponsored by the Program, especially the projects. In addition, the Applied Sciences Program uses this information in preparing IBPD directions and PART responses.

Project Management Measures (Internal):

Inputs	Potential issues and DSTs identified for Invasive Species – *number, type, range*
	Eligible partners to collaborate with – *number, type, range*
	Potential results/products identified to serve Invasive Species – *number, type, range*
Outputs	Assessments or evaluations of DSTs – *number, range*
	Assessments of Earth-Sun science results/products to serve DSTs – *number, range*
	Agreements with partners – *presence*
	Reports (evaluation, validation, benchmark) – *number, type*
Quality and Efficiency	Earth-Sun System science results/products – *number used per DST, ratio of utilized to potential*
	Agreements – *ratio of agreements to committed partners*
	Reports – *partner satisfaction, timeliness, time to develop*
	Reports – *ratio of validations to potential products, ratio of benchmarks to validations*

Performance and Results Measures (Externally-focused):

Outcomes	Earth-Sun System science products adopted in DSTs – *number, type, range; use in DST over time*
	Earth-Sun System science products in use – *ratio of products used by partners to reports produced*
	Partner and DST performance – *change in partner DST performance, number and type of public recognition of use and value of Earth-Sun System science data in DST*
Impacts	Partner value – *change in partner metrics (improvements in value of partner decisions)*

In addition to the stated measures, the Invasive Species Program Manager periodically requests an assessment of its plans, goals, priorities, and activities through external review. The Invasive Species Program Element Team uses these measures along with comparisons to programmatic benchmarks to support assessments of the Applied Sciences Program (e.g. internal NASA reviews and OMB PART).

IX. Appendices
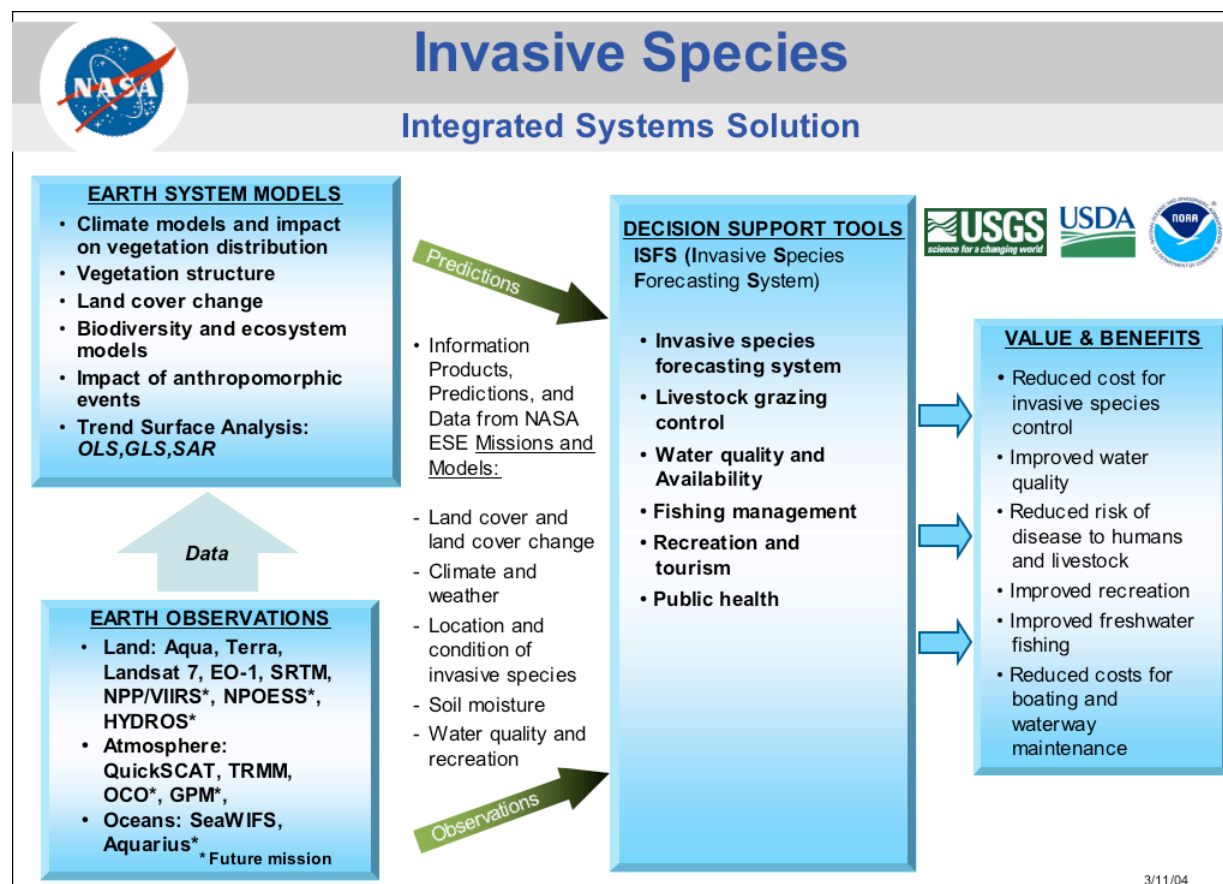
Appendix A. Integrated System Solution Diagram

Figure 1: Invasive Species Integrated System Solution

Appendix B. Roadmap

The Invasive Species Element roadmap illustrates how NASA capabilities in Earth observation, measurement, modeling and systems engineering are exploited systematically to improve the decision support systems and tools of USGS and other agencies and organizations making policy and resource decisions for invasive species. The roadmap focuses on NISFS, baselining current capabilities and benchmarking improvements as such improvements are integrated into the NISFS.

The roadmap starts in FY04 with the integration and evaluation of MODIS products and NASA systems engineering. Beginning in FY05 and continuing in the out years, data from new systems will be evaluated, initially through simulations, then through analysis of the data when available.

Several planned NASA Earth-Sun science missions have the potential to impact USGS decision support tools and systems. These missions include the Orbiting Carbon Observatory (OCO), Aquarius and Hydros. The OCO provides space-based observations of atmospheric carbon dioxide (CO_2), the principal anthropogenic driver of climate change. This mission uses mature technologies to address NASA's highest priority carbon cycle measurement requirement. The OCO generates the knowledge needed to improve projections of future atmospheric CO_2. The mission is relevant to invasive species because of the impact of climate change on invasive species habitat. Invasive species may also have to be considered in Carbon Management issues such as the sequestration of carbon in above ground biomass. Aquarius is a focused spacecraft mission to measure global sea surface salinity (SSS). Aquarius will resolve missing physical processes that link the water cycle, the climate, and the ocean. The Aquarius science goals are to observe and model the processes that relate salinity variations to climatic changes in the global cycling of water and to understand how these variations influence the general ocean circulation. The Hydrosphere State Mission (Hydros) will provide the first global views of Earth's changing soil moisture and land surface freeze/thaw conditions, leading to breakthroughs in weather and climate prediction and in the understanding of processes linking water, energy, and carbon cycles.

The Roadmap shows the major events in the chronology toward evaluation of these sources of observations and the progression of the data toward improved decision support systems and tools over the next ten years.
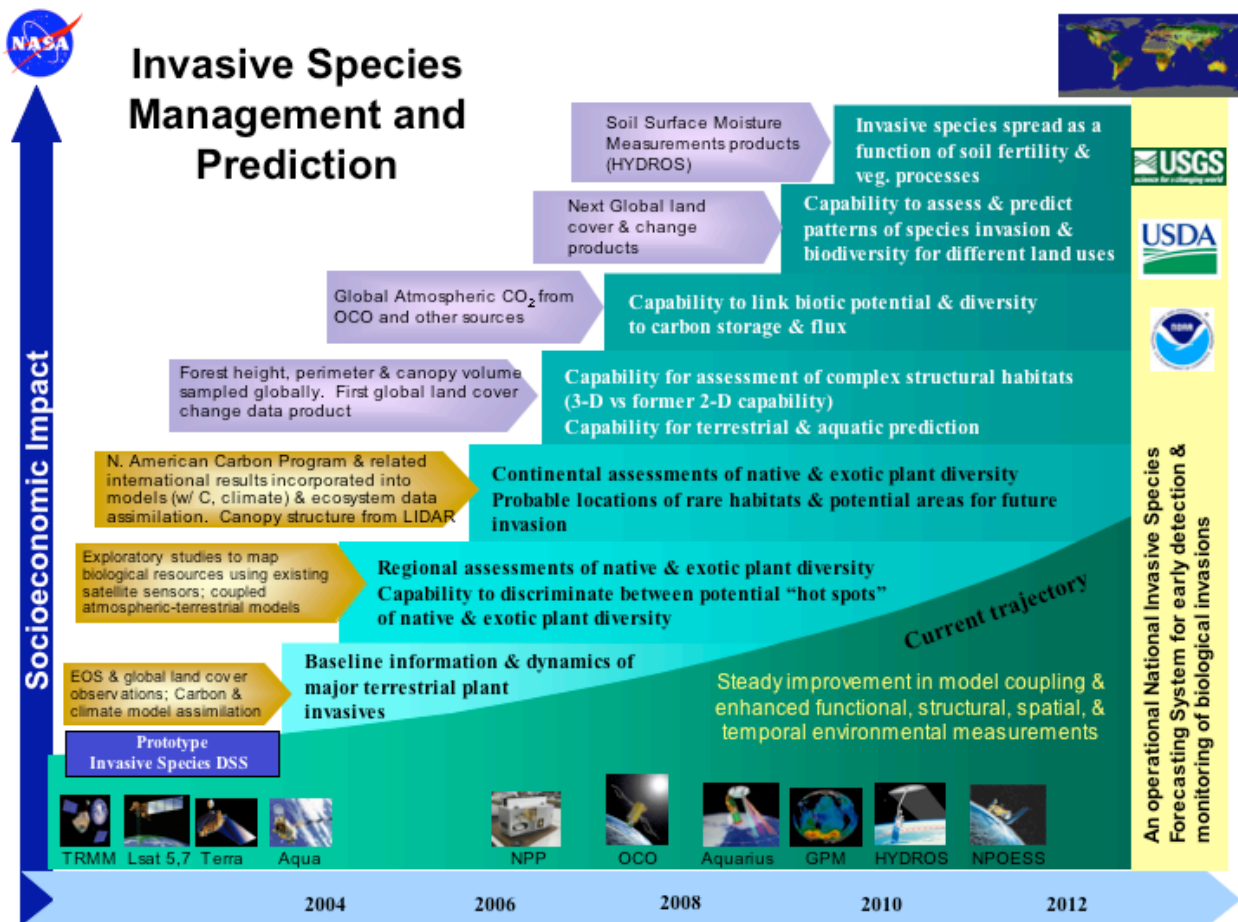
Figure 2: Invasive Species Element Roadmap

Appendix C. Applied Sciences Program Budgets FY2005-09

The overall program budget allocations are given below to provide the context in which this National Application is conducted. The allocations are based on Agency and program priorities and are subject to change according to the availability of funds and programmatic strategies. All values are in $ thousands.

*NOTE: Allocations include full utilization of the Applied Sciences FY04 carryover of approximately $2.7 million.

Table 1: Applied Sciences Procurement Allocation – FY05

Program Element	FY05 Procurement Allocation
National Applications	
Agricultural Efficiency	$ 467
Air Quality Management	$ 995
Aviation	$ 750
Carbon Management	$ 653
Coastal Management	$ 550
Disaster Management	$ 545
SENH	$ 1,429
Ecological Forecasting	$ 610
Energy Management	$ 775
Homeland Security	$ 205
Invasive Species	$ 205
Public Health	$ 725
Water Management	$ 870
Program Director Discretionary Fund	$ 588
Center Director Discretionary Fund Tax	$ 2,485
National Applications Total	$ 11,852
Crosscutting Solutions	
Integrated Benchmarked Systems	$ 3,529
Solutions Networks	$ 1,200
Competitive Solicitations	$ 7,600
Human Capital Development	$ 700
Geoscience Standards & Interoperability	$ 2,000
Crosscutting Solutions Total	$ 15,029
Applied Sciences Program Procurement Total	***$ 26,881***

Table 3: Applied Sciences Program NASA Institutional Allocations – FY05

NASA Center	FY05 Institutional Cost / National Applications	FY05 Institutional Cost / Crosscutting Solutions	Institutional Total
HQ	$3,773	$7,351	$11,124
ARC	$1,108		$1,108
GSFC	$1,009	$1,094	$2,103
JPL			
LaRC	$1,517	$444	$1,961
MSFC	$1,251	$183	$1,434
SSC	$3,194	$8,689	$11,883
Total	*$11,852*	*$17,761*	*$29,613*

Appendix D. Acronyms and Websites

ACRIM	Active Cavity Radiometer Irradiance Monitor Satellite
AGU	American Geophysical Union
AIWG	Applications Implementation Working Group
ALI	Advanced Land Imager
ARC	Ames Research Center
ASTER	Advanced Spaceborne Thermal Emission and Reflectance Radiometer
AVHRR	Advanced Very High Resolution Radiometer
CCSP	Climate Change Science Program
CCTP	Climate Change Technology Program
CO_2	Carbon Dioxide
COTR	Contracting Officer's Technical Representative
DOI	Department of the Interior
DSS	Decision Support Systems
DST	Decision Support Tool
ECHO	Earth observing system Clearing House
EO-1	Earth Observing-1
EOS	Earth Observing Systems
ESG	Earth-Sun Gateway
FEA	Federal Enterprise Architecture
FY	Fiscal Year
GIG	Global Information Grid
GIS	Geographic Information System
GSFC	Goddard Space Flight Center
IBPD	Integrated Budget and Performance Document
ISAMS	Improved Stratospheric and Mesospheric Sounder
ISFS	Invasive Species Forecasting System
IWGEO	Interagency Working Group on Earth Observations
JCSDA	Joint Center for Satellite Data Assimilation
MODIS	Moderate Resolution Imaging Spectroradiometer
MOU	Memorandum of Understanding
MR1	Portable Side Scan Seafloor Imaging System
MSU	Mississippi State University
NASA HQ	NASA Headquarters
NASA	National Aeronautics and Space Administration
NDVI	Normalized Difference Vegetation Index
NESDIS	National Environmental Satellite Data Information Service
NIISS	National Institute of Invasive Species Science
NISFS	National Invasive Species Forecasting System
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRA	NASA Research Announcement
NSF	National Science Foundation
NWS	National Weather Service
OCO	Orbiting Carbon Observatory
OMB	Office of Management and Budget
OSSE	Observing System Simulation Experiment
OSTP	Office of Science and Technology Policy
QA	Quality Assurance

QuikSCAT	Quick Scatterometer
R2O	Research to Operations Network
REASoN	Research, Education, and Applications Solutions Network
SEA	State Enterprise Architecture
SeaWiFS	Sea-viewing Wide-Field-of-View Sensor
SRTM	Shuttle Radar Topography Mission
SSC	Stennis Space Center
SSS	Sea surface salinity
TAR	Temporal Analysis Research
USDA	US Department of Agriculture
USGS	United States Geological Survey
V&V	Verification and Validation

WEBSITES:

AIWG: http://aiwg.gsfc.nasa.gov/

Applied Sciences Program: http://science.hq.nasa.gov/earth-sun/applications

DEVELOP: http://develop.larc.nasa.gov

Earth-Sun System Gateway (ESG): http://esg.gsfc.nasa.gov/

Earth-Sun Science System Components: http://www.asd.ssc.nasa.gov/m2m

NASA FY2005 Budget: http://www.ifmp.nasa.gov/codeb/budget2005

Research and Analysis Program: http://science.hq.nasa.gov/earth-sun/science/

Science Mission Directorate: http://science.hq.nasa.gov

Science Strategies: http://science.hq.nasa.gov/strategy/