

NASA SCIENCE MISSION EARTH SCIENCE

Applied Sciences Program Crosscutting Solutions Element Geoscience Standards & Interoperability Geosciences Interoperability Office Program

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(July 11, 2007)*



*Science for Society
Accelerating the realization of economic
and societal benefits from Earth science,
information, and technology ...*



**Crosscutting Solutions Element
Geoscience Interoperability Office
FY07 – FY11 Program Plan Signature Page**

The Geosciences Interoperability Office (GIO) Program Manager and the Crosscutting Solutions Program Manager have reviewed the GIO Program Plan and agree the FY07-FY11 plan appropriately reflects the goals, objectives, and activities for the program to serve the Applied Sciences Program, Science Mission, and NASA.

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1.0 Introduction

Each day NASA collects and produces terabytes of data and information about the Earth from satellites, computational models, and other sources. These products are most useful when made easily accessible to NASA researchers and scientists, to NASA's partner Federal Agencies, and to society as a whole. A NASA objective is to apply its research results about Earth and other planetary systems for improved knowledge gain and enhanced decision support.

The Geosciences Interoperability Office (GIO), in the Applied Science Program of NASA's Earth Science Division, leads the community development, promotion, and implementation of geoscience interoperability for the purpose of facilitating interoperable discovery, access and use of NASA research results and model products in applications of national and international priority and other scientific, educational and commercial uses. This is achieved through:

- Designing, and implementing geospatial interoperability concepts, architectures, and standards to enable greater access and use of NASA's scientific data.
- Developing and demonstrating prototypes, pilots and testbeds implementing access to NASA data, products and models through Integrated Systems Solutions
- Participating in national initiatives working towards scientific research system of systems solutions in support of National Applications and partner federal agencies.
- Implementing interoperability directly in support of GEOSS, CCSP, and other national and international initiatives

The NASA Applied Sciences Program extends the results of NASA's Earth Science Division (ESD) research and knowledge beyond the scientific research communities to contribute to national priority applications with societal benefits. The program focuses on assimilation of NASA research results to improve decision support systems, and the transition of NASA's expanded technological capabilities to evolve advancements in partner operational systems. NASA's Research and Analysis Program (R&A) within the ESD has established seven research focus areas to study the complex processes associated with Earth-system science; Atmospheric Composition, Carbon Cycle and Ecosystems, Climate Variability and Change, Earth Surface and Interior, Water and Energy Cycle, Sun-Solar, and Weather. The GIO within Applied Sciences is focused on enabling access to NASA research results through the adoption of open interoperable interface and service technologies.

NASA's Applied Science Program (ASP) and its Geosciences Interoperability Office (GIO) are dedicated to the advancement and application of NASA's Earth Sciences research results. Over the past years these entities have worked towards the development of improved technology and processes towards enhanced discovery, access, and use of these research results. NASA as a whole has benefited from this work in the areas of new protocols, standards, services, and tools being developed and implemented. Within the agency the commitment to interoperability of systems, services, and tools has increased the use of NASA's data as well as increasing the agencies leadership and value within the national and international communities. NASA GSFC's MAP05, MAP06, and ECHO projects have all either implemented or are in the process of implementing interoperable web services that have been developed and promoted through the Applied Sciences Program's GIO.

It is the persistence of the development and implementation of architectures, standards and interfaces that will continue to bring about advances towards greater application of NASA data. Applied Sciences Program and the GIO continue to work towards these goals in support of NASA's leadership role within the Earth Observation and Earth Science Research disciplines. Advanced application of NASA's data will enhance societal knowledge, Earth science and research capabilities, and NASA's charter for Earth Observation missions

This Program Plan describes the GIO's management procedures, goals, projects, deliverables, and resource requirements. This document is intended as a management tool as well as to link the GIO directly to the Integrated Budget and Performance Document, the Science Mission Earth Science Applied Science Program Strategy, Crosscutting Solutions Element Plan, and the agency-wide implementation of geoscience standards, data management and interoperability to extend the societal benefits of NASA Earth Science research results.

2.0 Purpose and Scope

Sitting within the Applied Sciences Program of the Earth Science Division of the Science Mission Directorate, GIO is invested in working towards NASA's Vision "To improve life here..." and in supporting NASA's Mission "To understand and protect our home planet..." As a Program within the Applied Sciences GIO supports the Science Mission-wide objective "...to expand and accelerate the economic and societal benefits from Earth science, information, and technology..." through seamless access to NASA's Earth and planetary science data. This objective cannot be achieved by NASA alone, and requires the collaboration of many partners from the governmental, academic, and private sectors.

The GIO supports this collaboration through the development and adoption of technologies that encourage geoscience interoperability. Geosciences interoperability is the ability of disparate, independent information systems to work together in accessing, manipulating and utilizing geoscience data. Interoperability relies on standards based data services; recognized data formats; structured dataset descriptions (metadata); and shared terminology. The adoption of existing vendor-neutral standards from recognized standards-developing organizations allows seamless access to NASA's many science data products, and the unencumbered exchange of scientific data between members of a diverse collaborative environment. The GIO focuses its activities towards the three key areas of Geosciences Interoperability Development, Adoption, and Utilization.

3.0 FY07-FY11 Strategic Direction

The strategic approach for the activities undertaken in the GIO is outlined below. The three focus areas of Geoscience Interoperability Development, Adoption and Utilization are closely connected through a set of projects that support and enhance each focus area. The focus areas will continue to evolve over the next 5 years to facilitate the vision of NASA's seamless geoscience access and utilization of Earth science research results within partner agency decision support systems.

3.1 Geoscience Interoperability Development

Geoscience Interoperability Development is focused towards encouraging the development of geoscience interoperability technologies. GIO implements, promotes, and (when necessary) helps to shape the development of, open standards, services and tools for improved geoscience interoperability both within NASA and in its interagency partnerships.

The success of the enabling access to NASA's research results is critically dependent on the viability of geoscience interoperability technologies. GIO's objective in this regard is in proving this viability with the goal of demonstrating that geoscience interoperability is not only technically possible, but that the implementation of interoperability standards and interoperable computational capabilities furthers the utilization of Earth science research results. Through participation in standards bodies to test and pilot developing standards, with a focus on seamless access to data, applications of data, enabling technologies and data management, GIO furthers the interoperability of distributed geoscience data for the use of national applications. The continued advancement of technology within the "Research and Operations" architecture through development and implementation of interoperability standards through projects and prototypes is an essential part of the Applied Sciences Program. NASA's GIO Program aids the Applied Sciences Program in collaboration with the National and International interests by providing expertise and advancements in geoscience technology.

The implementation of geoscience interoperability standards and tools augment the ability to access, use and share NASA science results. GIO's Geoscience Interoperability Development focus area includes testbeds, pilot and prototyping, and development of consensus built geoscience interoperability standards that further NASA's capabilities in sharing its extensive Earth Science research results. There are two aspects of technology that GIO will focus on:

- Collaborative Portal
- Interoperability Testbed

3.1.1 Collaborative Portal

In order to demonstrate both the value of NASA data and the viability of Geoscience Interoperability GIO will field mature technology in a collaborative portal prototype environment for proving concepts and demonstrating benefits.

Prototypes are important because they lead the "usage" of technology and validate the implementation. GIO's work in implementing open standards based services into the Earth-Science Gateway (ESG) is an example of this. ESG is built around a "system-of-systems"

architecture and is being used as a GEOSS proof of concept and forms the basis of the Collaborative Portal prototype. By maintaining and promoting the use of a Collaborative Portal, we hope to encourage the standing-up and registering of many more data system services than is currently available. In this fashion the development of domain focused Communities of Practice (COPs) will be encouraged. The strategy roadmap for the Collaborative portal is:

- FY07 Standup a Collaborative Portal in a testing and validation environment
- FY07-09 Support the establishment of COPs through the proactive engagement of users and the population and maintenance of domain focuses within the Collaborative Portal
- FY07-09 Continue to add tools to the Collaborative Portal as technology matures and as the User Scenarios demand (e.g. geoRSS and 4D visualization)
- FY10-11 Move the Collaborative Portal (or next generation portal) to a fully operational environment

FY07 Focus

In FY07 GIO intends to provide the capability successfully prototyped in FY05-06 to a broader set of users to encourage use from both data providers and data users. In addition, it is GIO's role to anticipate and guide the development of the next generation of interoperability tools.

Collaborative Portal Project – The FY07 goals for this project are:

- Deploy ESG as a collaborative portal prototype for use by Applied Sciences
- Collaborating with National Applications Program Managers and our Partners on common functionalities required for advancing our Flagship Portal that connects to our science components such as GCMD and ECHO.

3.1.2 Interoperability Testbed

Unlike prototypes where the technology is proven, and operational value of the technology as a geoscience interoperability enabler is being validated, immature technologies are in the early stages of development, and provide both the users and developers a 'first-look' at where the technology is going.

Although the technologies being tested are immature, the Testbed environment (i.e. the support infrastructure, both hardware and software needed to run the technology experiments) is not. It is a robust operational environment that is connected to NASA's resources (models, simulations, data, compute and storage capacity), and flexible enough to support a variety of interface technologies. The strategic roadmap for the technology testbed is:

- FY07 Facilitate an Interoperability Testbed environment based on SOA - including connections to NASA data resources (e.g. MAP Project, Project Columbia, DAACs, ESG, and RPC)
- FY08-09 Establish SOA/High Performance Computing capability.
- FY07-11 Run appropriate prototype technology experiments leveraging the Geosciences Interoperability Roadmap

3.1.3 FY07 Focus

The key Information Technology trend is the transition from tightly coupled stove-piped traditional data systems to the more loosely coupled net-centric data systems implemented through Service Oriented Architecture (SOA). This trend offers the potential for great flexibility by data providers, and tremendous adaptability by end-users. However, this potential cannot be realized until some basic obstacles of legacy technology integration are overcome. In FY07 GIO will address some key NASA issues by deploying a testbed specifically to look at the integration of OGC web services and High Performance Computing (GRID) services within Service Oriented Architecture.

Interoperability Testbed Project – The FY07 goals of this project are:

- Provide interoperability with Project Columbia (GFSC), ESG and RPC (MSU)
- Working with our NASA DAACs to implement Web Services feeding our National Applications on specific user requirements that we can extend in a crosscutting manner.

3.2 Geoscience Interoperability Adoption

Geoscience Interoperability Adoption is focused towards enabling geoscience interoperability within NASA's earth science programs. The implementation of geoscience interoperability through open-standards, architectures and schemas allows any user of science data to access and apply the desired research results thus increasing efficiency and productivity and ultimately the demand for NASA geoscience results. As part of an agency-wide NASA Program, GIO coordinates and aids in the implementation of geoscience interoperability standards, system architectures, and related data management strategies for the agency.

One objective of the GIO is to encourage the adoption of open access technologies for NASA data. GIO's goal of implementing open geoscience interoperability standards that apply to NASA's requirements would result in advanced access and use of NASA's Earth-Science knowledge base, data, and model outputs. A key element of achieving this goal is to integrate geoscience interoperability technologies within NASA's IT systems architectures. Building on the Integrated System Solutions architecture developed within Applied Sciences and adopted within the international science community, NASA will be able to coordinate and share its data use efforts worldwide. Enabling geoscience interoperability within NASA's programs will improve the return from those investments by facilitating new customers and applications for NASA's research results.

Adoption of geoscience interoperability technology will be encouraged through engagement of NASA's engineering expertise.

3.2.1 Engineering Engagement

Developed in coordination with ***Geoscience Interoperability Development*** expertise, and using engineering experience from across NASA's data systems programs, common concepts that describe how technologies are brought together to provide Geoscience Interoperability will be developed. This will provide the linkage between the technology and data systems, and will develop the common understanding and language needed to ensure interoperability.

Although much work has been done over many years with regard to specific technology and data standards, the advent of Service Oriented Architect (SOA) concepts and technology, and the drive towards loosely-coupled net-centric systems, adds a potentially powerful architectural framework around which can develop a robust geoscience interoperability architecture, that will serve NASA for the next generation of science data systems. The strategic roadmap for this work is:

- FY07 Develop common understanding of geoscience interoperability technologies that support known end-user application. This will form the basis for a Geoscience Interoperability Roadmap that maps applicable technologies and standards to implementation timeframes.
- FY08-11 Promote and leverage the Roadmap both inside and outside of NASA (Federal Partners, Industry, and International)

3.2.2 FY07 Focus

Significant architectural experience both from within NASA and throughout the federal and international community already exists. In FY07 GIO will bring these efforts together and integrate the various ideas into a single documented product. This is an important step in the promotion of interoperable geoscience data and information systems. In addition, the promotion of a common architecture within NASA is an important step towards Applied Science's program objectives. Adoption of GI concepts by the data providers within NASA will provide the service flexibility necessary while protecting the core data systems from external technology dependencies.

Engineering Engagement Project – In FY07 GIO will execute a single coordinated project whose goals are:

- Under FEA and NASA's EA, working closer with NASA's CIO and Data Management to explore and assess a target architecture that could serve as a framework and architecture to advance Federal access to our Geoscience Research results.
- Continue participation in Standards bodies as appropriate
- Support the adoption of geoscience interoperability within NASA's Modeling and Observational Data Systems communities

3.3 Geoscience Interoperability Utilization

Geoscience Interoperability Utilization supports the integration of geoscience interoperability within science communities and Federal Partners. Federal Partner easy access of NASA data will strengthen the outcomes for NASA, our partners, and society, by enhancing their knowledge of Earth Science and enabling more informed decision-making, resulting in national and global economic and societal benefits. Through the Applied Sciences Program the Geosciences Interoperability Office facilitates the use of NASA's science information by decision-makers, scientists, and as part of the Crosscutting Solutions element of the Applied Sciences Program, GIO offers expertise on current and future information technologies that are directly applicable to the access of Earth science data and predictions among the Observations, Models and Decision Support System components of the Integrated Systems Solution architecture.

The key objective is the development of self-sustaining collaborative geoscience communities with the goal of increased discovery, access, use, and understanding of NASA's

science data and data models in support of the Science Mission Directorate's Earth Science Division's Applied Science Program and our Federal partner's Decision Support Systems and Tools for National Applications. The implementation of open interoperability standards advances data access and collaborations in Exploration, Global Earth Observation, Climate, Weather, Natural Hazards, Sustainability, and E-Government. Through teaming with the Applied Sciences Program Managers and partnering with government, private industry, academia and geoscience communities, GIO works towards the data application goals of the Science Mission Directorate, Applied Sciences Program, and our Federal partners. In addition, GIO ensures the success of Integrated System Solutions by supporting the Applied Sciences Program and Crosscutting Solutions Program Managers to enable interoperable information flow from missions to models to Decision Support Systems.

Utilization of NASA's research results through new technology will be promoted through user community engagement activities for National Applications, Crosscutting Solutions as well as other Outreach activities.

3.3.1 User Community Engagement

User community input is essential to defining the operational the use for NASA data and technology. Validated user scenarios provide the business justification for implementing new technology operationally.

Developed in conjunction with the user communities, user scenarios describe in engineering terms how geoscience interoperability supports end users. Applied Sciences is already engaged in a number of National and International Programs that have user engagement elements.

Progress in continuing our understanding of the usage characterization for geoscience interoperability progressed this year through the "Connections" activities between GIO and National Applications. Over the next 5 years and in close cooperation with Program Managers and federal partners, GIO will establish and maintain a characterization baseline for geoscience interoperability that can be used as a reference set for the planning of technology for data, research results and model output access and utilization by NASA's partners. The strategic roadmap for this work is:

- FY07-08 Engage user communities to develop understanding of Geoscience Interoperability with NASA data, focusing initially on the nine Societal Benefit areas, the twelve National Applications and GEOSS.
- FY08-09 Gain community-wide acceptance of the applicability geoscience interoperability through examples both nationally and internationally.
- FY08-11 Leverage user community input to validate technology development.

3.3.2 FY07 Focus

In FY07 GIO will support user engagement through two projects:

National Applications and Cross-Cutting Solutions Support Project – GIO activities will focus in engaging and supporting National Applications and Cross-Cutting Solution activities through:

- Working towards Global, National and Local interoperability through GEOSS demonstrations throughout the current year.

- Providing support and expertise to the RPC steering team
- ESG support to facilitate access to NASA data
- Support access to observations, modeling, simulation and research results through the Interoperability Testbed

Outreach Project – GIO will continue its outreach activities:

- Directed programs support for IAGT and Coppin State University,
- Continue to make use of DEVELOP Program resources
- Participate as needed in Applied Sciences National & International Initiatives
- Organize at least two workshops focused on aspects of geoscience interoperability technology (e.g. geoscience interoperability, and visualization)
- Participate in Conferences and Workshops as appropriate

4.0 Budget

Budget data for FY2008 forward is taken from the POP 06-1 and includes Full Cost associated with this Program. Manpower taken from the December 2005 WISP planning exercise (4.2 C.S.; 5.0 KTR)

FY2007 Resources Request

Geoscience Interoperability Development.....	\$841k
Geoscience Interoperability Adoption	\$490k
<u>Geoscience Interoperability Utilization</u>	<u>\$925k</u>
FY2007	\$2,256k

FY2008 Resources Request

Geoscience Interoperability Development.....	\$875k
Geoscience Interoperability Adoption	\$510k
<u>Geoscience Interoperability Utilization</u>	<u>\$962k</u>
FY2008	\$2,347k

FY2009 Resources Request

Geoscience Interoperability Development.....	\$910k
Geoscience Interoperability Adoption	\$530k
<u>Geoscience Interoperability Utilization</u>	<u>\$1,000k</u>
FY2009	\$2,440k

FY2010 Resources Request

Geoscience Interoperability Development.....	\$946k
Geoscience Interoperability Adoption	\$530k
<u>Geoscience Interoperability Utilization</u>	<u>\$1,040k</u>
FY2010	\$2,537k

FY2011 Resources Request

Geoscience Interoperability Development.....	\$984k
Geoscience Interoperability Adoption	\$573k
<u>Geoscience Interoperability Utilization</u>	<u>\$1,082k</u>
FY2011	\$2,639k

5.0 Implementation Approach

GIO's approach to implementing the program is based on evaluation, verification and validation and benchmarking in a process designed to ensure the progress of geoscience interoperability throughout NASA, ESE and the partner agencies. The strategy behind this approach follows.

- Evaluate the geoscience technology needs of NASA.
- Verify the standards being developed are appropriate within NASA's scope.
- Validate technology development through testbeds.
- Benchmark technology progress through implementation of developed standards.
- Assess the Agency position on individual standards and ensure that NASA speaks with one voice in the standards developing organizations (SDOs).
- Collate resource contributions from individual projects; direct NASA-specific needs during the standards development process; ensure solicitations for testbeds, pilot projects and final results clearly enunciate NASA needs.
- Seek out, evaluate and influence existing and emerging work from reputable software development organizations.
- Ensure that the standards are generically applicable to all types of georeferenced measurement data and model results, rather than only for a specialized subset.

6.0 Performance Measures

The GIO Program Manager regularly assesses the individual projects to ensure efficiency, effectiveness and progress and to establish milestones are met. The Program Manager also works with the Projects to accomplish Integrated Budget Performance Document (IBPD) measures.

The IBPD Fiscal Year 2007 requirements have been established and GIO works towards contributing to each of them for all GIO projects:

- APG 7ESS11: Issue twelve reports with partnering organizations that validate that using NASA research capabilities (e.g. observations and/or forecast products) could improve their operational decision support systems.
- APG 7ESS12: Complete five studies on plans to transition the results of NASA research and development, including scientific spacecraft and instruments, models, and research results, with potential to improve future operational systems of partner agencies.

The GIO Program reports periodically on the status of its activities and accomplishments of its objectives. The report highlights: 1) objectives, partners and decision support tools; 2) schedule; 3) budget and spending plan; 4) deliverables & accomplishments, 5) IBPD measures; and, 6) important issues.