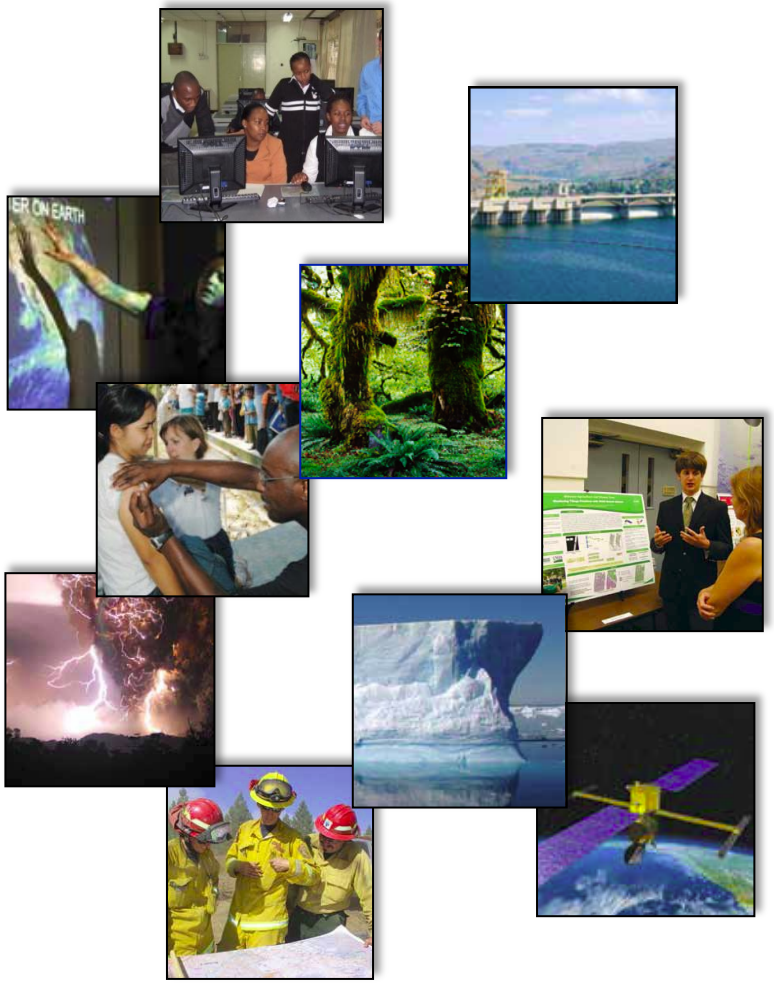


NASA Earth Science Applied Sciences Program

Earth Science Applications

Lawrence Friedl, Program Director

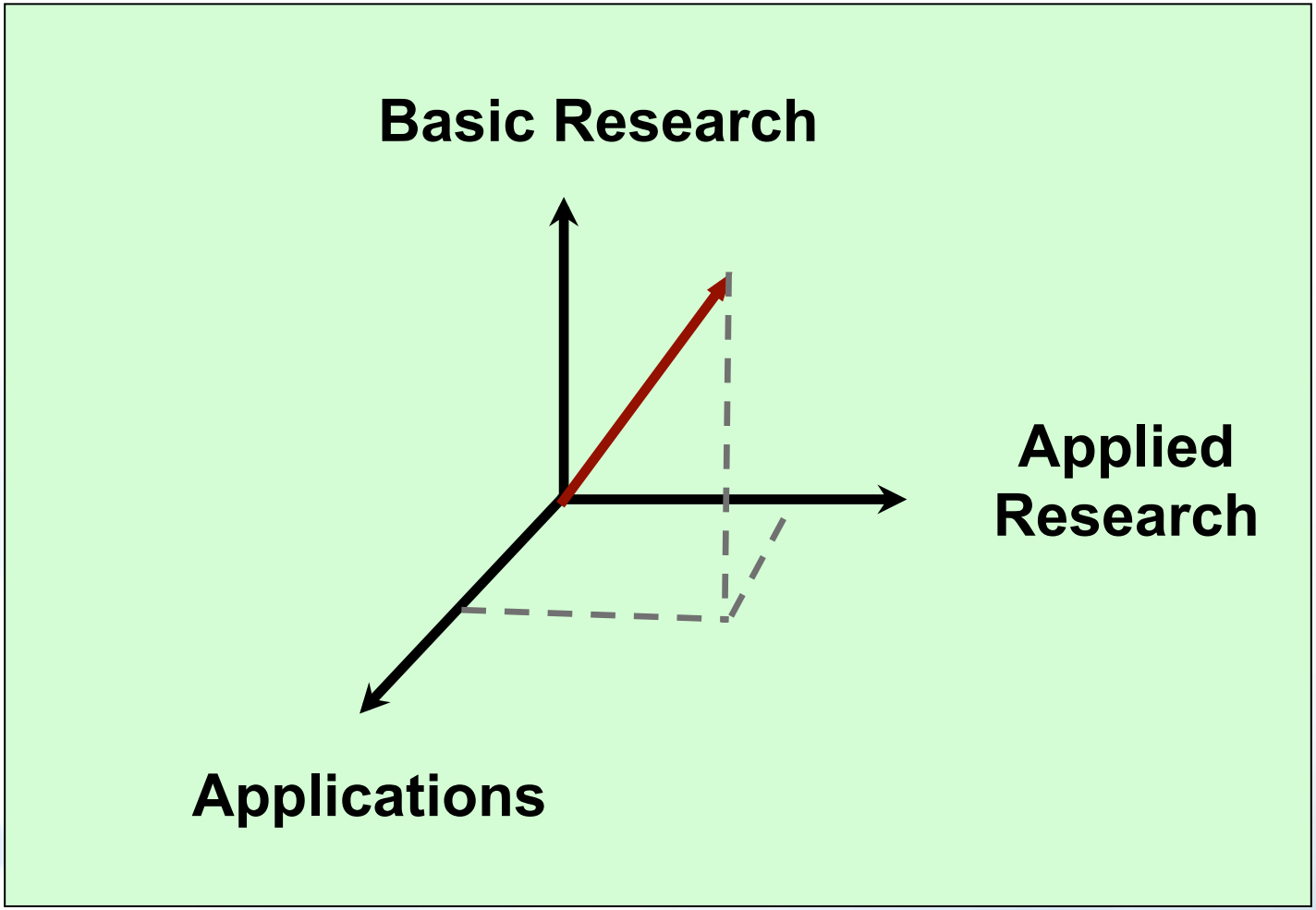
HyspIRI Science & Applications Meeting • October 2014

The mind may, as it appears to me, divide science into three parts. The first comprises the most theoretical principles, and those more abstract notions whose application is either unknown or very remote. The second is composed of those general truths which still belong to pure theory, but lead nevertheless by a straight and short road to practical results. Methods of application and means of execution make up the third.

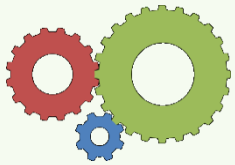
Each of these different portions of science may be separately cultivated, although reason and experience show that none of them can prosper long, if it be absolutely cut off from the other two.

Alexis DeTocqueville
***Democracy in America*, 1835**

Earth Science and Applications



Applied Sciences: Lines of Business



Societal & Economic Applications

Generate, test, develop, enable adoption, and extol applications ideas for sustained uses of Earth obs. in decisions and actions.

Capacity Building

Build skills, workforce, and capabilities in US and developing countries to apply Earth obs. to benefit society and build economies.

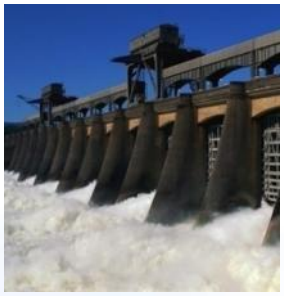
Applications in Mission Planning

Identify applications early and throughout mission lifecycle, integrate end-user needs in design and development, enable user feedback, and broaden advocacy.

Applications Themes & Societal Benefit Areas

Emphasis in 4 Applications Areas

Health & Air Quality



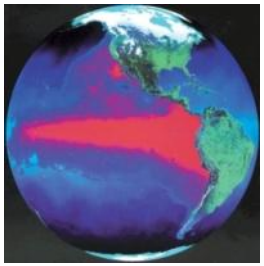
Water Resources

Disasters

Ecological Forecasting

Support opportunities in 5 additional areas

Agriculture



Climate

Weather

Energy

Oceans

Also: Cross-cutting Element of Wildfires

Strategic Goal 2
Advance understanding of Earth and develop technologies to improve the quality of life on our home planet.

The missions we pursue under this goal address national priorities and directly benefit both our Nation and the global community. For example:

- We are tracking and characterizing the mechanisms of environmental change.
- We are building the next generation air transport system.
- We are strengthening the economy.
- We are cultivating a strong future workforce.

Objective 2.2

Advance knowledge of Earth as a system to meet the challenges of environmental change, and to improve life on our planet.

Program Strategic Plan: 2015-2020

Program Strategic Plan

Elements:

Introduction

Vision

Mission

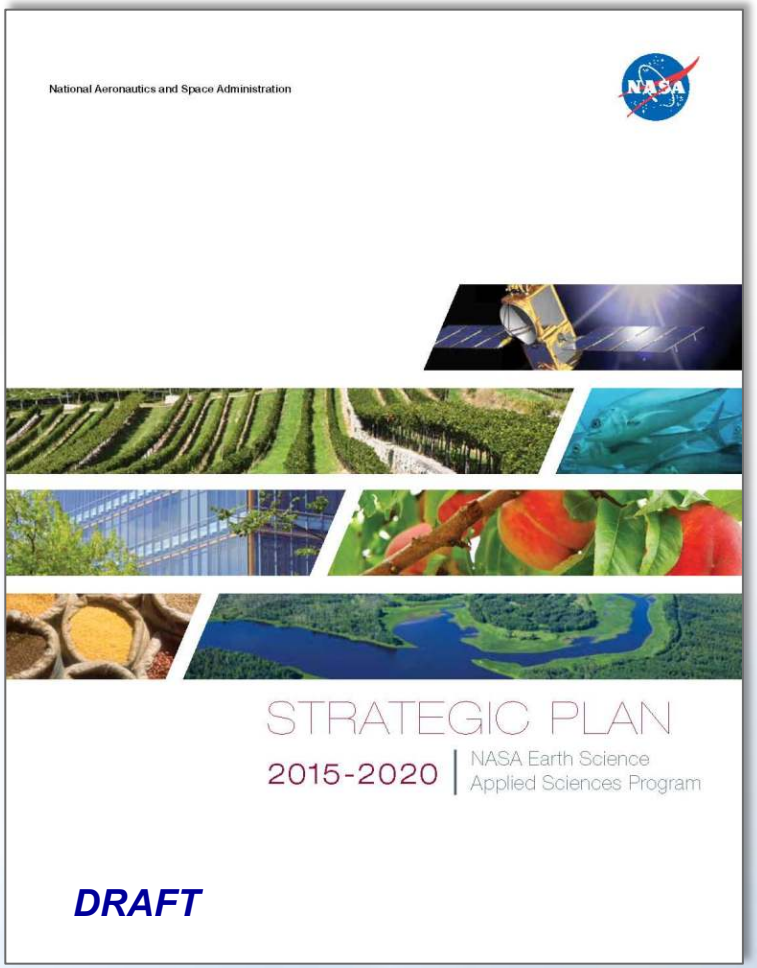
Goals & Objectives

Lines of Business

Program Initiatives

Implementation

Principles



Applied Sciences: Strategic Goals (draft)

Goals

I. *Advance beneficial applications of Earth observations and knowledge of methods to enable applications.*

II. *Increase capabilities and workforce expertise supporting organizations' innovation, pursuit of applications, and assessment of benefits.*

III. *Enhance the value and benefits of NASA Earth Science flight missions from concept through operations.*

IV. *Advance Program effectiveness through sound business and public management practices.*

draft

Earth Science: Global Challenges

Food Security

Growing populations, climate change, and increased demands for food, water, and energy have contributed to growing concerns on food supply, production, resiliency, price volatility, and vulnerability. NASA initiative to support organizations addressing the global challenge of food security. The initiative will be scoped in FY15 & FY16.

Water Availability

Freshwater is widely viewed as a critical resource, and recent U.S. droughts have increased attention on improved estimates of water availability, especially from snowpack. The initiative will provide a focus for NASA-wide activities regarding snow water, climate change, and decision support to managers/policy-makers on ecological and human uses. Stakeholder engagement is key element. Scope in FY15.

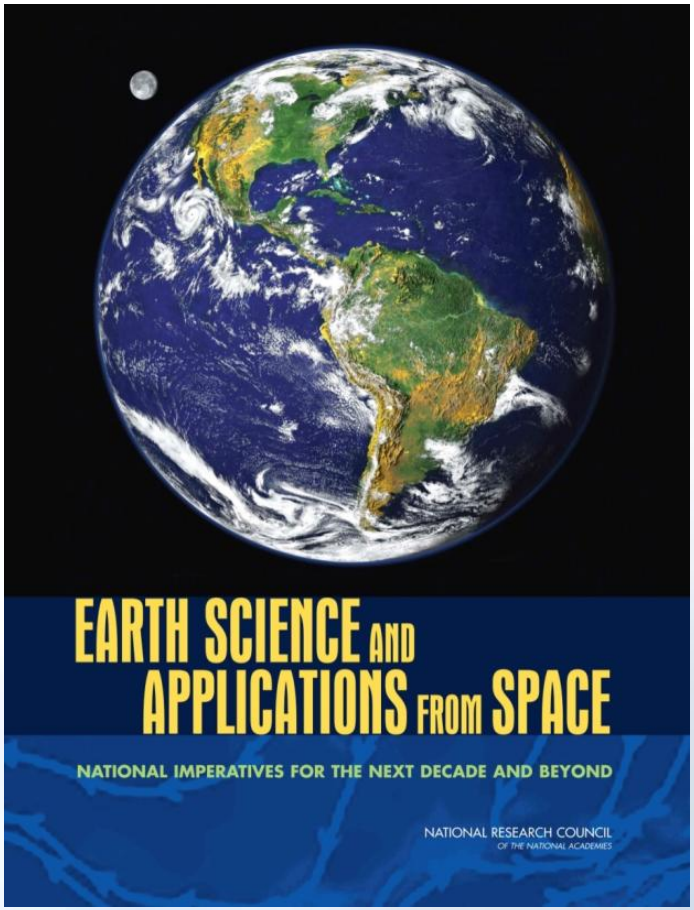
Disaster Response

Earth Science will initiate a Disaster Response support plan to move from a reactive, ad hoc approach during disasters to an approach based on anticipation, planning, and preparation to aid disaster responders. Plan includes an inter-Center working group, an event action team, and an annual work plan for key needs (if funds not used for disasters that year). Initiate in FY15.

Earth Science & Applications from Space

The national strategy outlined here has as its overarching objective a program of scientific discovery and development of applications that will enhance economic competitiveness, protect life and property, and assist in the stewardship of the planet for this and future generations.

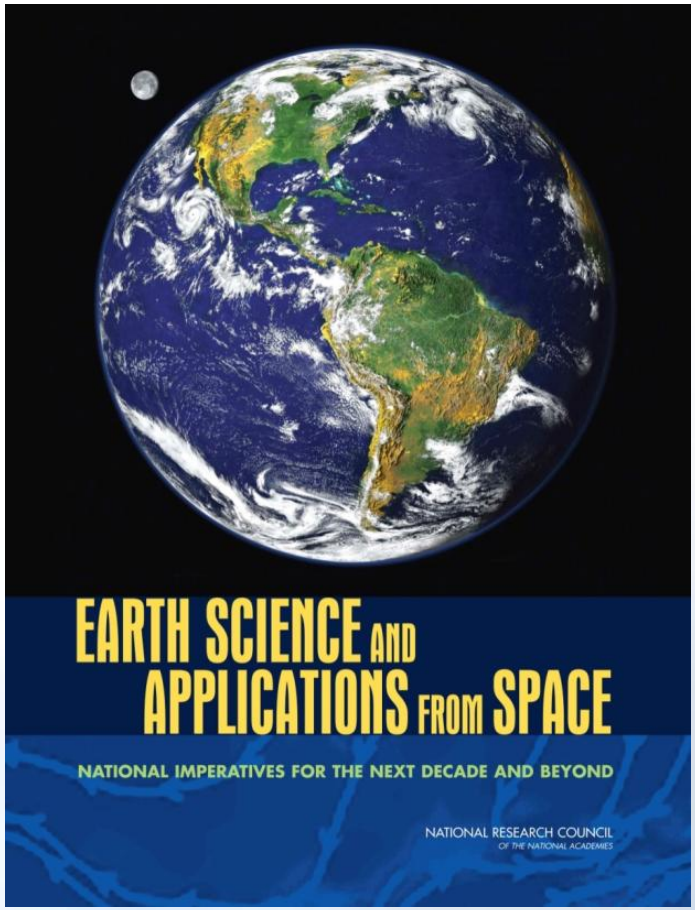
Earth Science Decadal Survey
2007



Applications in Mission Life-cycle

Significant efforts for applications-oriented users to engage throughout the satellite mission lifecycle, especially planning, formulation, and development phases. Examples include:

- » Community Meetings
- » Science & Applications Workshops
- » Applications Traceability Matrices
- » Early Adopters
- » Mission Applications Plans
- » Webinars
- » Tutorials



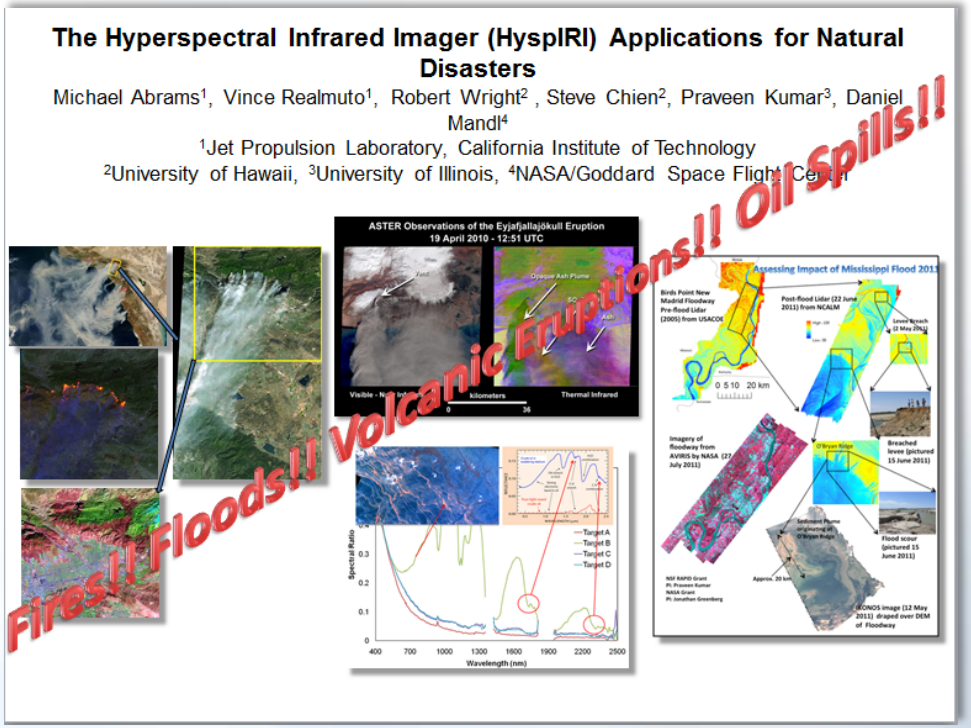
HysPIRI Applications

Activities & Community Events

» Annual Science Symposium; includes dedicated Applications session

» Annual Science & Applications Research Workshop; includes dedicated Applications session(s)

» Applications Traceability Matrix developed (example next slide)



Mission Poster focused on Applications

HysplRI: Applications Traceability Matrix

The following is an example row from the HypspIRI Applications Traceability Matrix

Application Question	Application Concept	Application Measurement Requirements	Applied Sciences Category
How do we schedule water releases & determine availability for irrigation use?	The major pathway of water transport in the hydrologic cycle is evapotranspiration(ET). ET is difficult to measure directly for large areas and determination of ET relies on a combination of models and surface parameterizations. Accurate determination of surface temperatures is critical in model parameterizations.	Spatial variability of landscape elements necessaite fine spacial resolution measurements ~60m. Repeat measurements of approximately 5 days are required to constrain ET models.	Water Management Agriculture

Potential Host Agency	Mission Data Product	Projected Mission Performance	Application Readiness Level	Ancillary Measurements
Western Governors Association 1600 Broadway Suite 1700 Denver, CO 80202 303 623-9378 Sebal North America 1772 Picasso Avenue Suite E	Surface temperature	Measure surface temperature within 0.5 K, 60 m resolution and 5 day repeat cycle.	9	SEBAL, other ET models, agricultural crop indentification/management info, stream flow, ppt, soils

Earth Science Missions – Early Adopters

Early Adopters: *New with SMAP*

Purpose is to conduct pre-launch applications research to accelerate use of data after launch.

Organizations with clearly-defined needs for *SMAP*-like data products evaluate and demonstrate the utility of *SMAP* data for their application and decision making.

Early Adopters:

- » Use data products prior to launch (simulated data and cal/val data from field campaigns)
- » Provide feedback on products and formats to increase applications value of mission
- » Streamline and accelerate use of data soon after launch and check-out
- » Supply own resources to do these activities

35+ organizations are currently EAs from public & private-sector, domestic & foreign

EA Video: http://www.youtube.com/watch?v=e6WGTRmsPVg

National Civil Earth Observations Plan

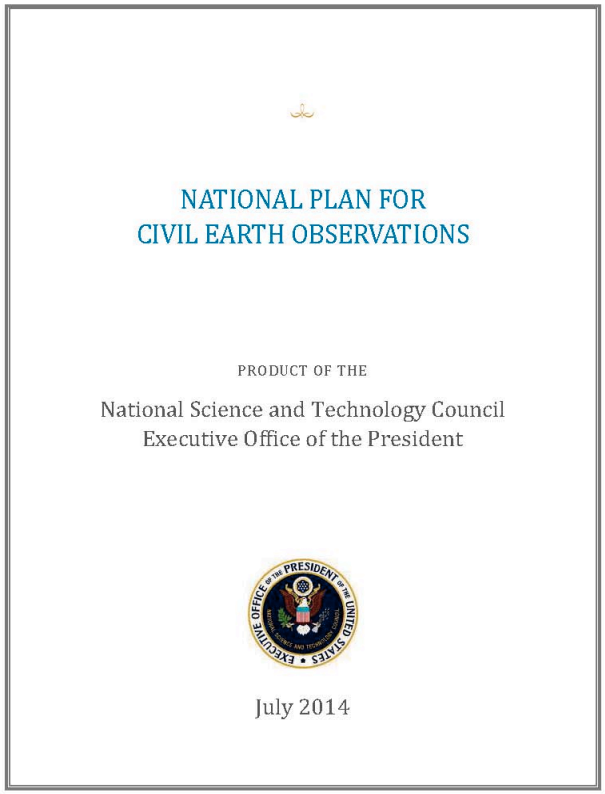
Defines a new framework for constructing a balanced portfolio of Earth observations and observing systems

Employs a measurement-driven approach by setting aside the immediate questions of hardware, sensors, and systems in order to prioritize measurement needs

Classifies Earth-observation activities according to two broad categories:

- **Sustained Observations**: Measurements generally taken for seven years or more

- **Experimental Observations**: Measurements taken for a limited observing period generally for research or development purposes


NATIONAL PLAN FOR
CIVIL EARTH OBSERVATIONS

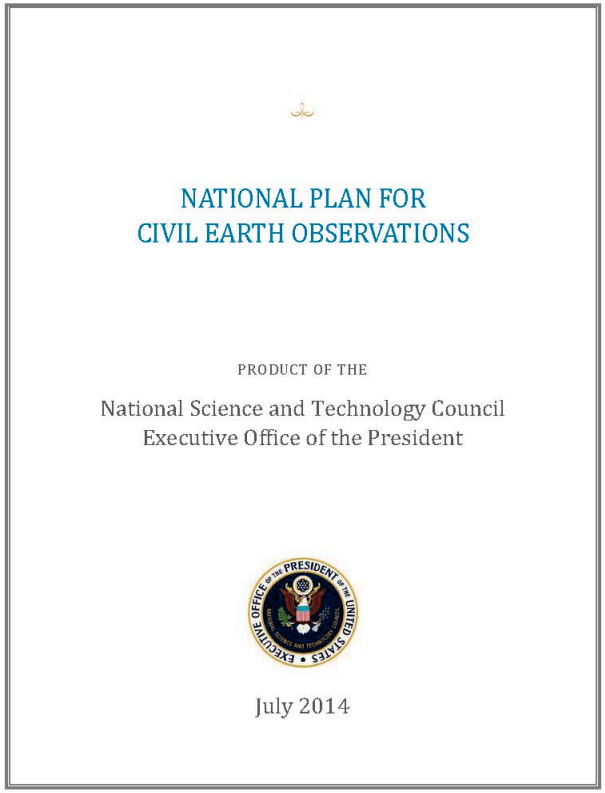
PRODUCT OF THE

National Science and Technology Council
Executive Office of the President

July 2014

National Civil Earth Observations Plan

1. Continuity of sustained observations for public services
2. Continuity of sustained observations for Earth system research
3. Continued investment in experimental observations
4. Planned improvements to sustained observation networks and surveys for all observation categories
5. Continuity of, and improvements to, a rigorous assessment and prioritization process


NATIONAL PLAN FOR
CIVIL EARTH OBSERVATIONS

PRODUCT OF THE

National Science and Technology Council
Executive Office of the President

July 2014

2nd Earth Science Decadal Survey

National Academy

Statement of Task in development

NAS/NRC Space Studies Board and it's *Committee on Earth Science and Applications from Space* leading it

SSB planning to include other NRC Boards in the Decadal Survey

NRC plans for a broadly distributed "Request for Information"

Main steering committee with likely panels

Pre-publication circa Spring 2017

NASA Earth Science

Revisit items and named mission backlog set forth in 1st Decadal Survey (are they still relevant?)

Opportunities and challenges for research and applications

Issues of balance

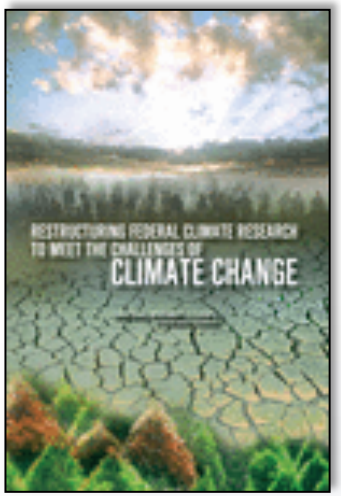
Budget realities – how to develop a plan that is realistic yet perhaps somewhat aspirational

Decadal Survey recommendations will not be the definitive word on the ESD program scope

Earth Science and Applications: Human Dimensions, Decision Support

Restructuring Federal Climate Research (NRC/BASC, 2009)
"Reorganize … to facilitate crosscutting research focused on understanding the interaction among the climate, human, and environmental systems …"

"Such a re-structuring around scientific-social issues is required to help the program become more cross disciplinary, more fully embrace the human dimensions component, and encourage an end-to-end approach (from basic science to decision support)."



USGCRP Strategic Plan, 2012-2021
Numerous references to the integration of physical, chemical, biological, and social sciences; to collaborations among researchers in natural and social sciences; to a workforce capable of bridging the natural and social sciences.

Goal 2: Inform Decisions. Improve the deployment and accessibility of science to inform [decisions].

What key questions and advancements does the Earth science and applications community need to address in the next 10-15 years?

What key questions – if addressed well or answered – would make major advances in our knowledge *and* it use in decisions and actions?

What are key questions and challenges that address both scientific needs and societal decisions?

What can the HypsIRI communities organize over next 15 months to address these, provide input, and support the next Earth Science Decadal Survey?

VQ5: How do changes in ecosystem composition and function affect human health?

TQ1: How can we help predict and mitigate earthquake and volcanic hazards … ?

CQ2: How are fires and vegetation composition coupled?

TQ3: How is consumptive use of global freshwater supplies responding to changes in climate & demand …?

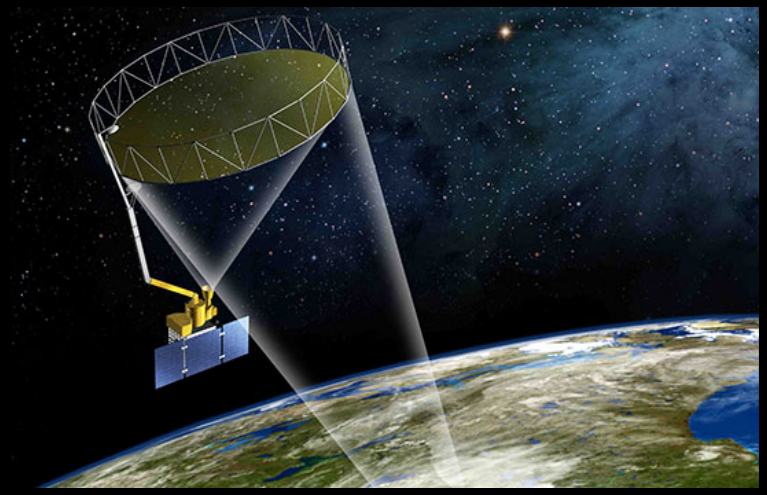
Researchers ***Managers***

HysplRI: A Challenge

Develop a sense of what managers would do if they had their issues address and advanced?

What would they do better, more effectively, more productively, etc. with the info and the Earth science question solved or advanced?

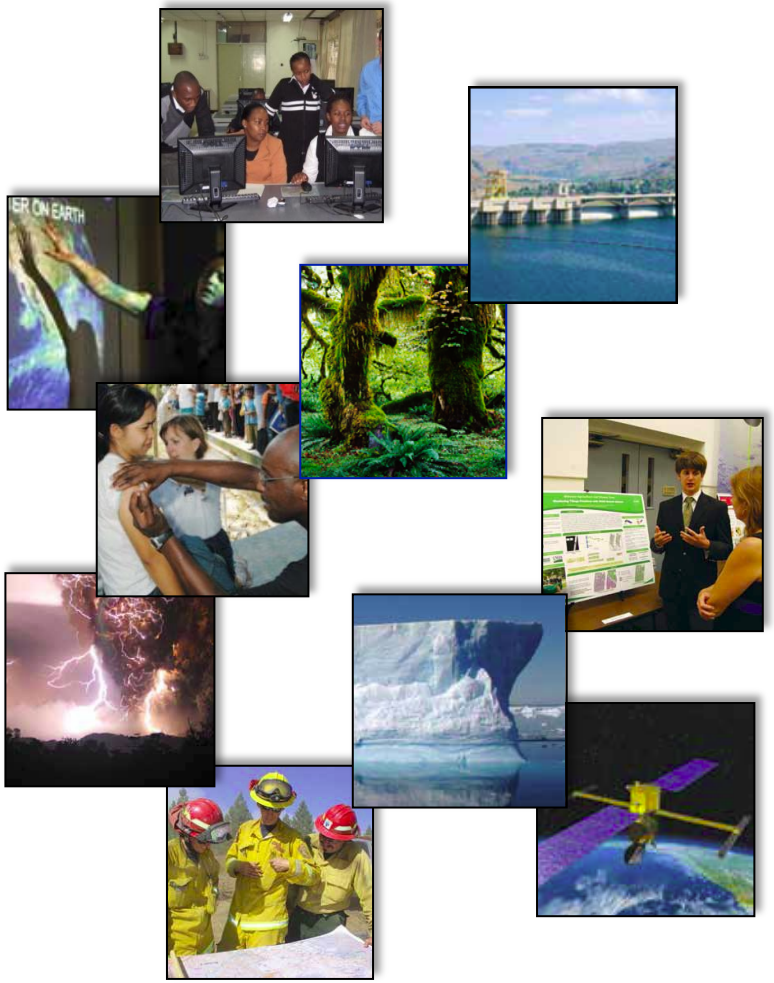
In addition to research reasons for measurements, input also on these aspects can provide language to the Decadal Survey panels to help within panel discussions and to write more cogent rationales.



NASA Earth Science Applied Sciences Program

NASA Headquarters
Washington, DC
1.202.358.7200

http://AppliedSciences.NASA.gov

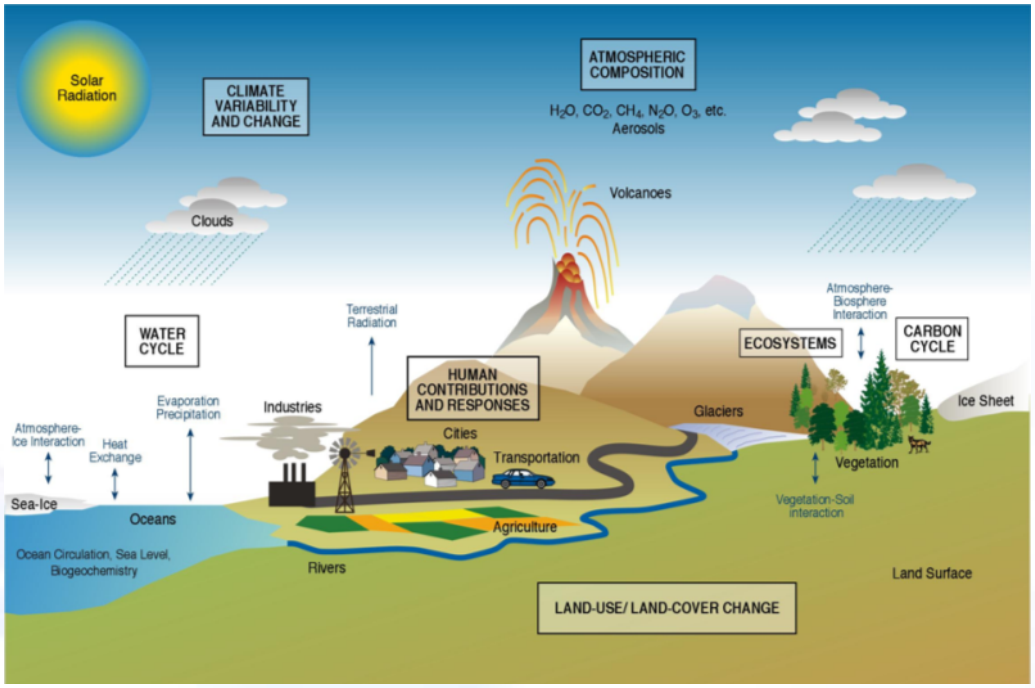


Back-up Materials

The underlying problem – that of linking knowledge and power in an open society – does not present itself in a convenient form of a procedural flow to be corrected, a structural defect to be repaired, or a disease to be prescribed for and cured.

– James Allen Smith

NASA Earth Science



NASA Earth Science supports basic and applied research on the Earth system and its processes.

Characterize, understand, and improve predictions of the Earth system to advance knowledge and benefit society.

Technology

Flight Missions

Research

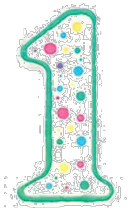
Data Systems

Education

Applications

Applied Sciences: Strategic Goal I (draft)

Goal I. Advance beneficial applications of Earth observations and knowledge of methods to enable applications.



- Supporting innovations and transitions of Earth science applications, the goal focuses on fostering the realization of societal and economic benefits from Earth observations.
- The goal encompasses the creation of new knowledge and fundamental understanding about methods for enabling applications of Earth obs and addressing technical, organizational, behavioral, and other barriers.

draft

Applied Sciences: Strategic Goal II (draft)

Goal II. Increase capabilities and workforce expertise supporting organizations' innovation, pursuit of applications, and assessment of benefits.

- The goal focuses on improving overall capabilities to support and expand applications of Earth observations.
- The goal entails efforts to build familiarity within current and future workforce of the capabilities, uses, and value of Earth observations.
- The goal includes activities to support user-generated applications ideas and evaluation of the ideas.
- It includes efforts for increased linkages between Earth science and social and economic sciences.

draft

Applied Sciences: Strategic Goal III (draft)

Goal III. Enhance the value and benefits of NASA Earth Science flight missions from concept through operations.

- The goal focuses on increasing the overall benefits from NASA Earth science missions through involvement by applications users in all phases of the mission life-cycle.
- The goal includes pursuit of studies to inform design trade-offs and enhance the missions' overall value.
- Activities to organize applications communities to understand mission life-cycle, identify priorities, and support mission advocacy.
- This goal includes focusing attention on data latency, formats, and access as part of the mission concept and requirements.
- The goal entails efforts to inform partners and customers on the health of the satellites and support transitions to follow-on missions.

draft

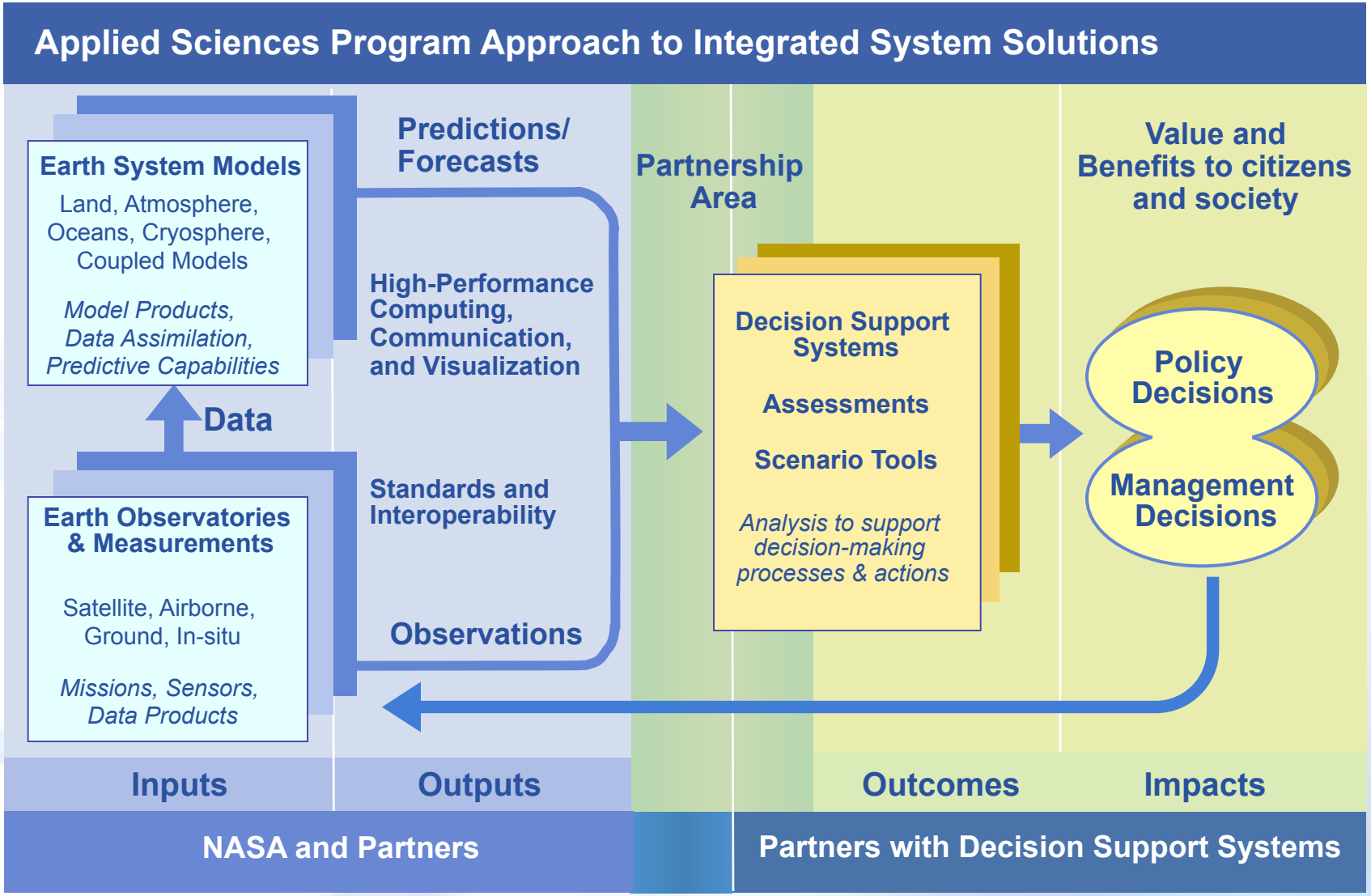
Applied Sciences: Strategic Goal IV (draft)

Goal IV. Advance Program effectiveness through sound business and public management practices.

- This goal focuses on improving the internal activities and operations of the Program, particularly to enhance priority setting, allocation of resources, and articulation of accomplishments.
- The goal includes use of market studies to characterize user needs, design interventions, identify strategic partnerships, and prioritize investments.
- The goal entails a strong focus on sound financial management during this timeframe.
- The goal includes a significant effort to improve how the Program communicates the value of applications, Program achievements, decisions affected, and broader societal benefits from uses of Earth observations.

draft

Inform Decisions & Actions



Applied Sciences Program Vision

DRAFT

Public and private organizations routinely integrate Earth observations in their decisions and actions, demanding additional observation types and Earth science knowledge.

Applied Sciences: Mission Statement (draft)

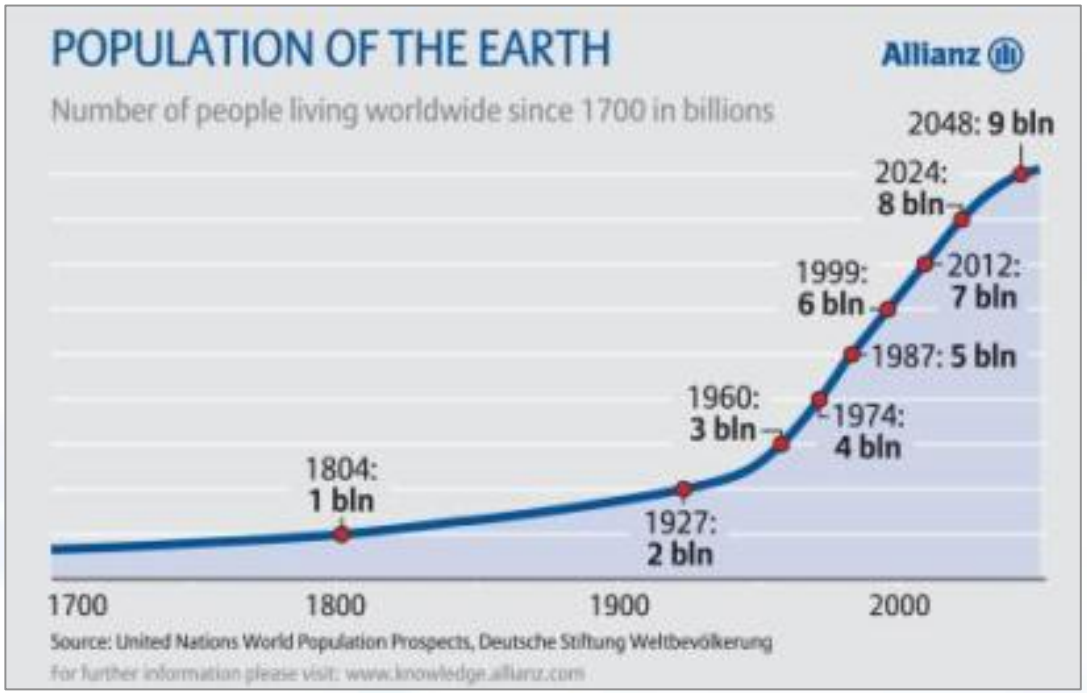
Mission

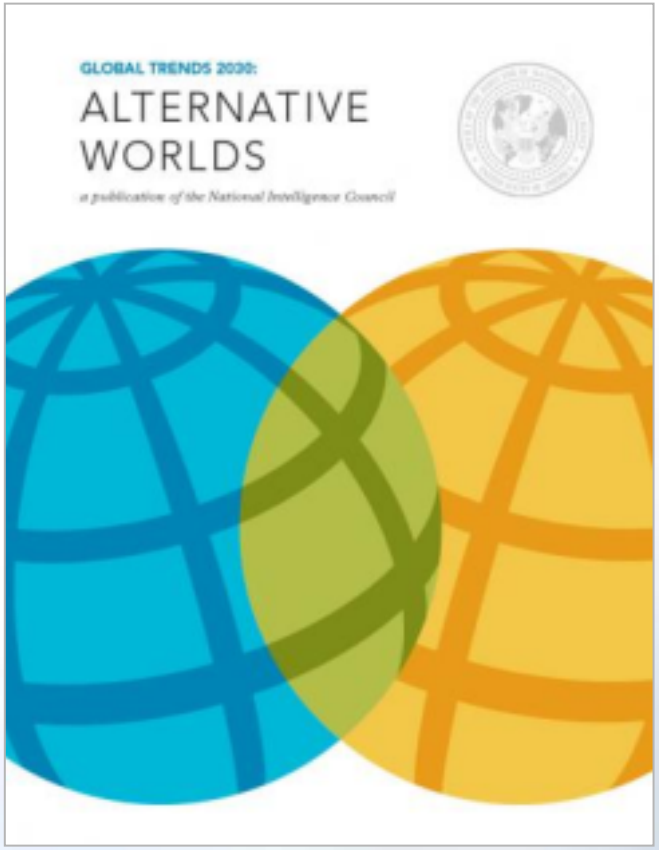
Enable and expand beneficial uses of Earth observations – ensuring sustained uses if we can, showing only potential value if we must – but always advancing beneficial uses of Earth observations.

Enable :
Reflects a purpose to build capabilities to use Earth obs., prove-out feasible applications, broker connections, and transition applications for sustained use and benefits.

Expand :
Reflects a purpose to attract new organizations to use Earth obs. workforce development, amplify data access and usability, engage users to anticipate applications in future missions, and help experienced users do more.

Earth in 2030





"… half of the world's population will probably be living in areas that suffer from severe shortages of fresh water, meaning that management of natural resources will be a crucial component of global national security efforts."

Global Trends 2030,
National Intelligence Council

Missions Supporting Agriculture & Food Security <<

Missions Supporting Water Resources >>