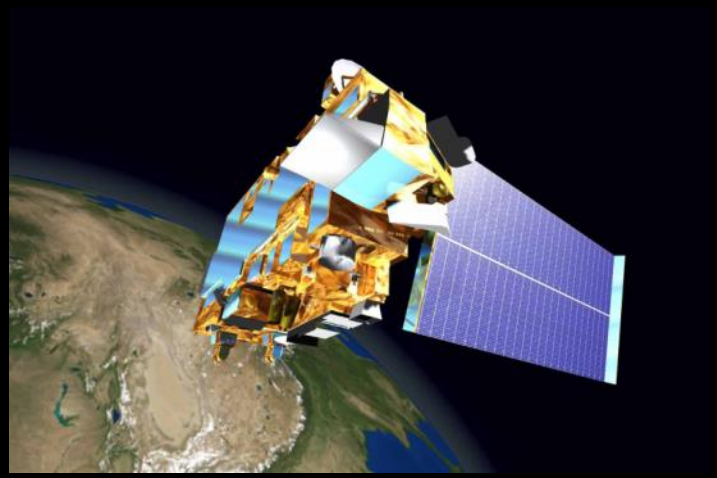
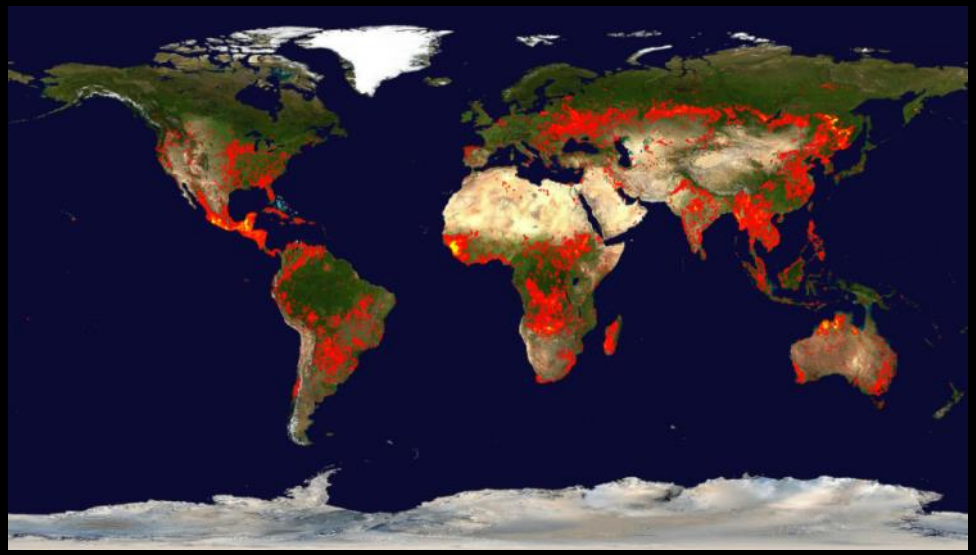
Earth Science Serving Society: NASA Earth Science, Water Quality, and Decadal Survey II

Lawrence A. Friedl
Earth Science Division
NASA Headquarters

March 12, 2014

Discovering the Earth,
Delivering it Home





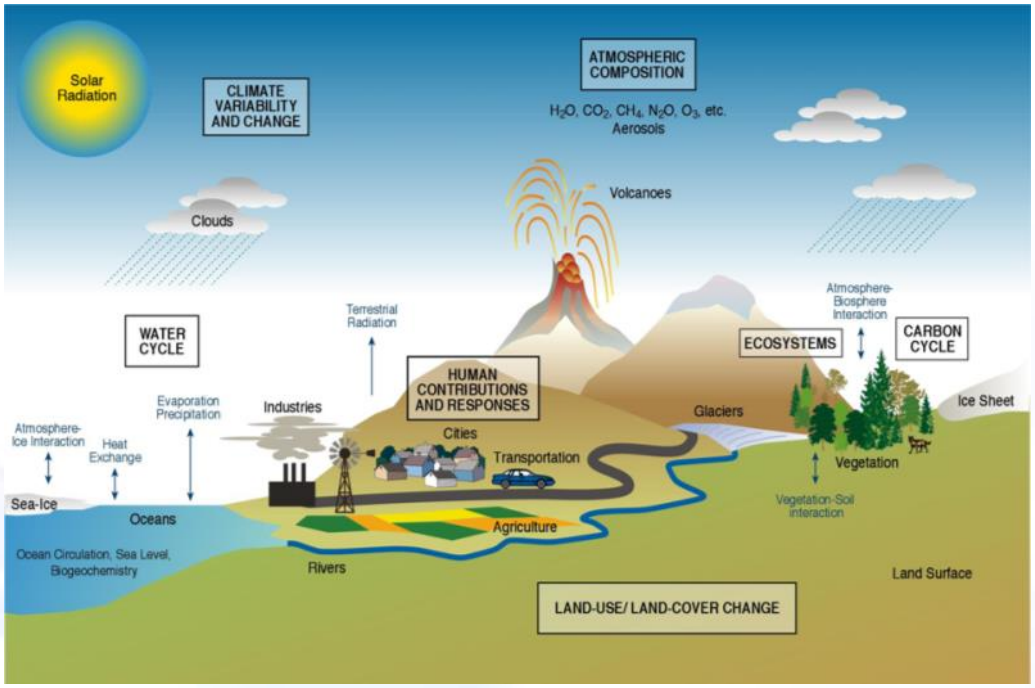
NASA Earth Science

Earth Science Missions

Earth Science & Applications

Human Dimensions in Earth System Science

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

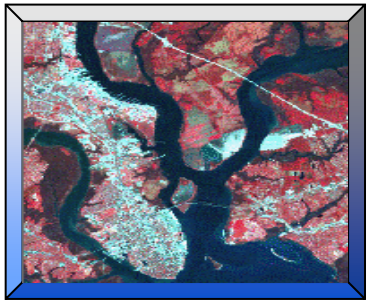
Research

Data Systems

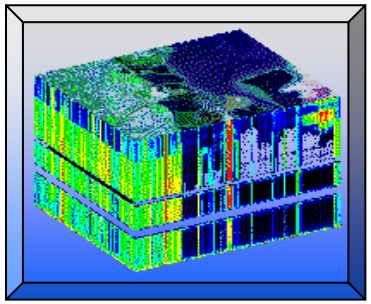
Education

Applications

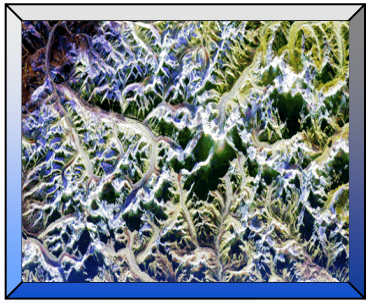
Remote Sensing Techniques



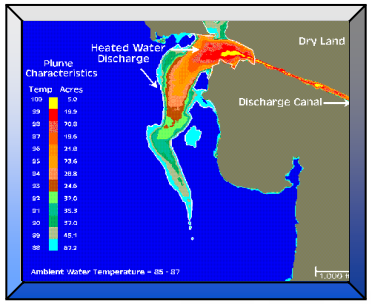
Multispectral



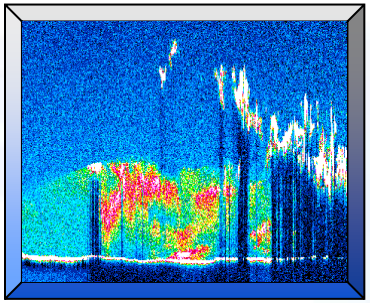
Hyperspectral



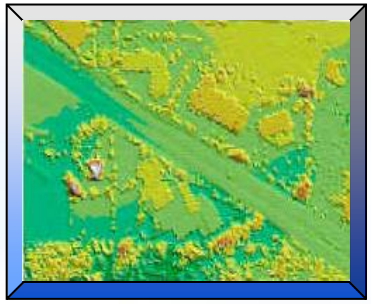
RADAR / SAR



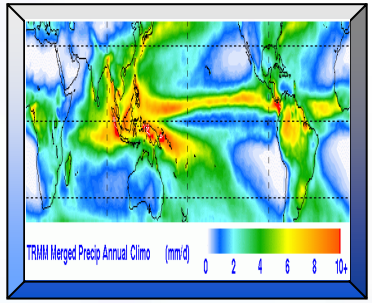
Thermal



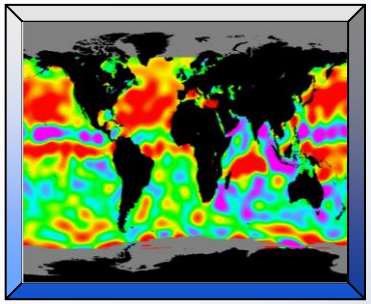
Atmospheric LIDAR



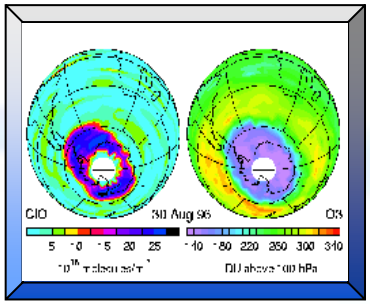
Surface LIDAR



Passive Microwave

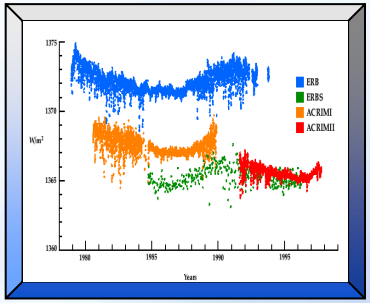


RADAR Altimetry

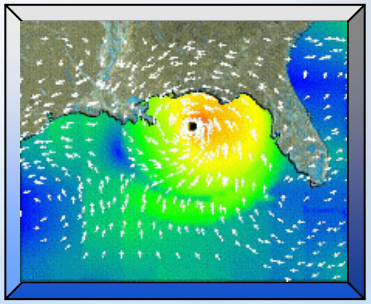


Limb Sounding

Microwave Ranging

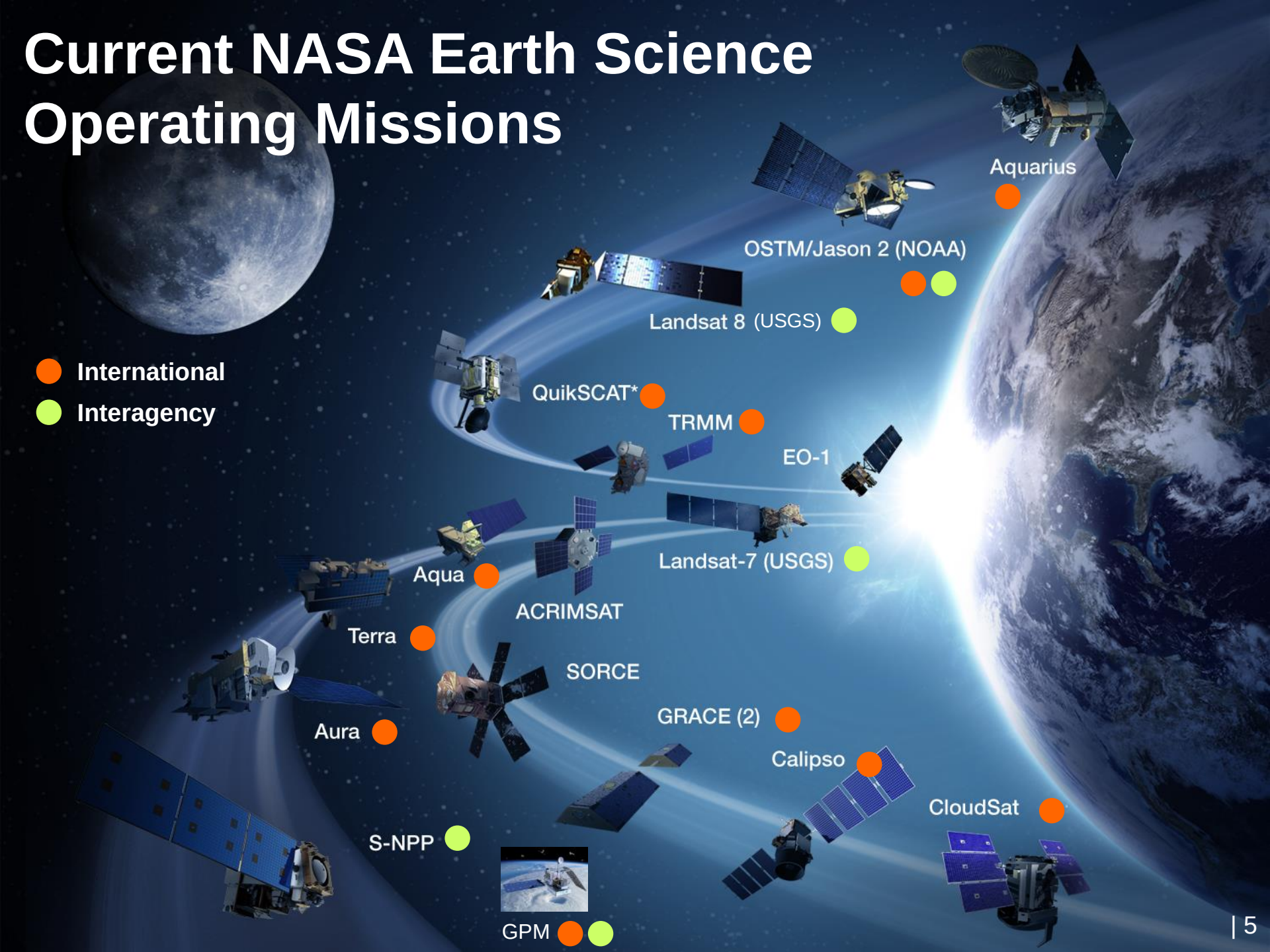


Irradiance/Photometry



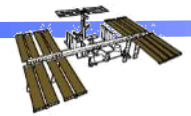
Scatterometry

Current NASA Earth Science Operating Missions



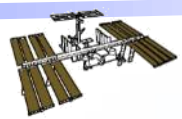
Near Term Mission Plans

GPM
Feb 2014
w/ JAXA; Precip



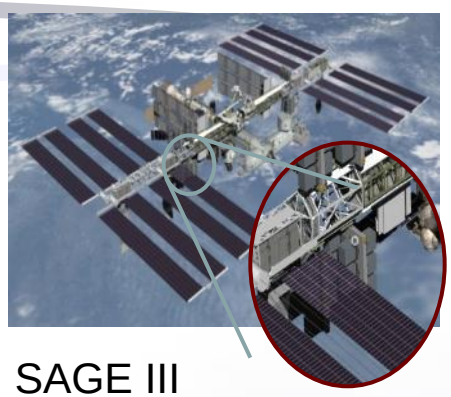
RapidScat
Ocean winds
June 2014

OCO-2
July 2014
Global CO_2



CATS
Aerosols
Sept.2014

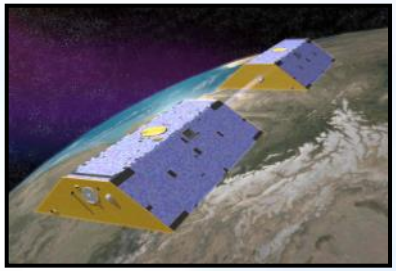
SMAP (w/ CSA)
Nov. 2014
Soil Moist.,Frz/Thaw



SAGE III
Mar 2015; on ISS
Ozone & Trace Gases

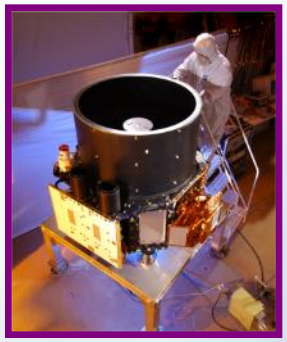
SWOT
Oct 2020
w/CNES; Sea surface &
Fresh water height, slope

TEMPO
2019
Hosted Payload:
Tropospheric
pollution

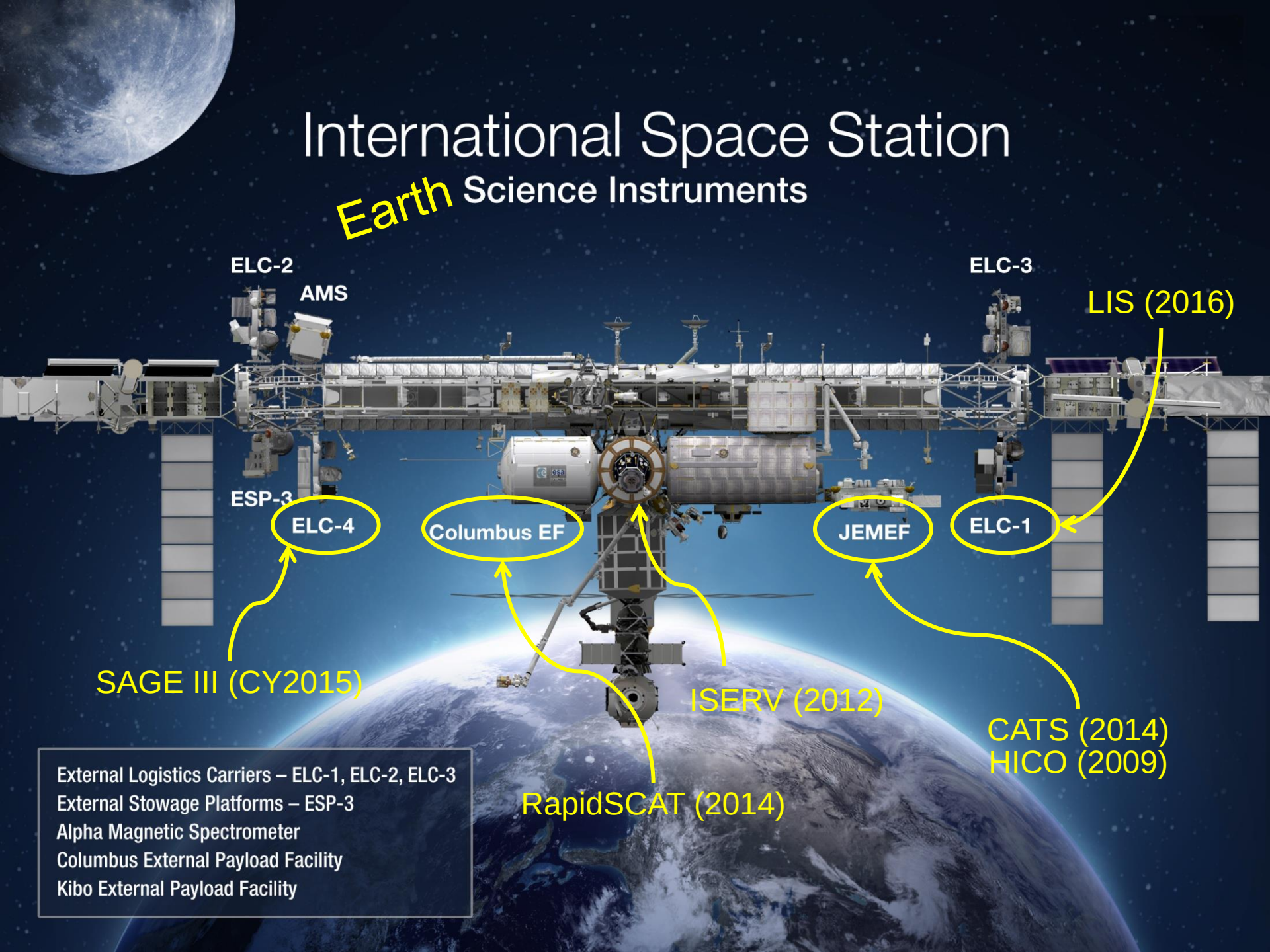


GRACE FO
Aug 2017
w/Germany; Global Mass
& Water Variation

CYGNSS
2016
Cyclone
Generation



ICESat-2
2016
Ice Dynamics


International Space Station
Earth Science Instruments
ELC-2
AMS
ELC-3
LIS (2016)
ESP-3
ELC-4
Columbus EF
JEMEF
ELC-1
SAGE III (CY2015)
ISERV (2012)
CATS (2014)
HICO (2009)
RapidSCAT (2014)
External Logistics Carriers – ELC-1, ELC-2, ELC-3
External Stowage Platforms – ESP-3
Alpha Magnetic Spectrometer
Columbus External Payload Facility
Kibo External Payload Facility

NASA Earth Science Missions
Current & Planned

NASA Earth Science Missions
Current & Planned

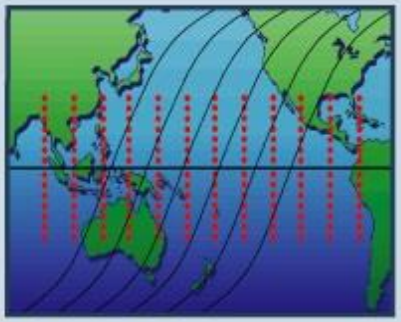
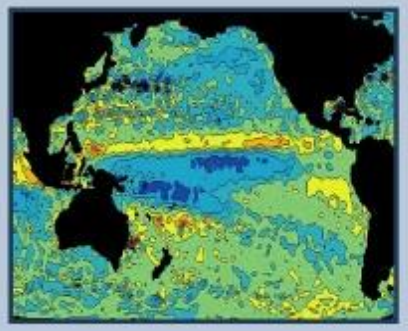
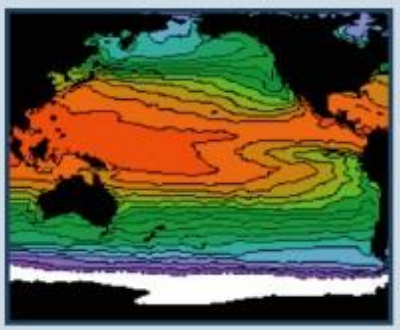
Observations to Knowledge Products

"from photons to electrons to neurons"

Petabytes 10^{15}	Terabytes 10^{12}	Gigabytes 10^{9}	Megabytes 10^{6}
Multi-platform, multiparameter, high spatial and temporal resolution, remote & in-situ sensing	Calibration, Transformation To Characterized Geo-physical Parameters	Interaction Between Modeling/Forecasting and Observation Systems	Interactive Dissemination and Predictions
Advanced Sensors	**Data Processing & Analysis**	**Information Synthesis**	**Access to Knowledge**






Research & Analysis

Terrestrial Hydrology

Physical Oceanography

Ocean Surface Topography Science Team

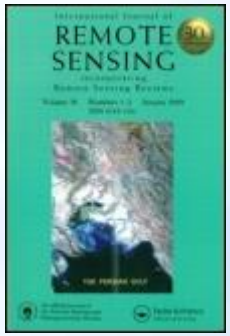
Remote Sensing of Water Quality

a) techniques to improve remote sensing of water quality and
b) improving links between optical and biogeochemical properties.

Barriers to adopting satellite remote sensing for water quality management

Blake A. Schaeffera, Kelly G. Schaefferb, Darryl Keithc, Ross S. Lunettad, Robyn Conmye, and Richard W. Gouldf*

Comprehensive water quality climate data records have potential to provide rapid water quality assessments, providing decision analysis methodologies and improved temporal/spatial diagnostics. … Results from an internal USEPA qualitative survey were used to determine perceptions regarding the use of satellite remote sensing for monitoring water quality.



International Journal of Remote Sensing, Vol. 34, No. 21, 7534–7544, 2013

http://dx.doi.org/10.1080/01431161.2013.823524

NASA Water Resources Applications

NASA Water Resources

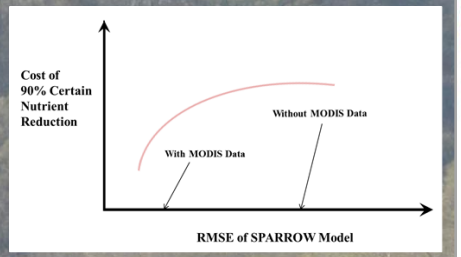
Addresses concerns and decision processes that are related to water availability, water forecast, and water quality.

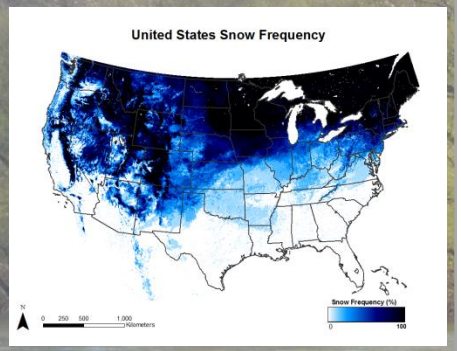
Goal: Promote and enable organizations to apply NASA satellite data to inform and improve the analyses, decisions, and actions of user organizations that manage water resources. Implementation requires close and enduring partnerships with academia, private firms, government agencies, and international organizations.

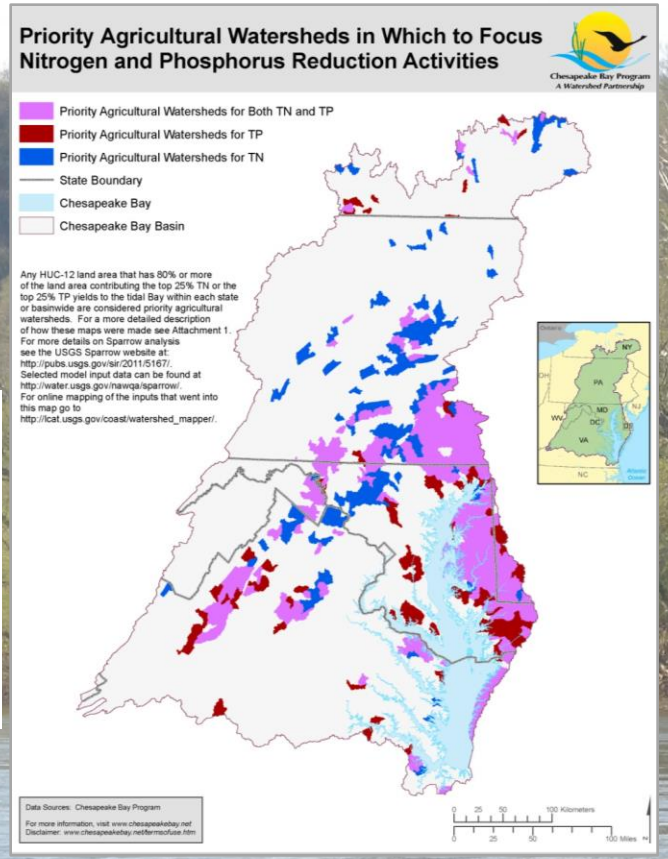
Water Resources Project Portfolio:
Projects are tactical implementations of Earth obs. applications, driven by water management challenges, and ultimately sustained by water resource information stakeholders. Portfolio: Feasibility studies, Applications Projects, Applied Science Teams, Impact Analyses.

Programmatic Activities:
National and international studies, workshops, market research, data access, user characterization, trainings, and other activities to improve skills, share data and applications, and broaden the range of users who apply satellite data and Earth science in water resources decisions.

Improving Water Quality Management: Use of Earth Observations in SPARROW







OBJECTIVE

Capture seasonal dynamics by enhancing SPARROW model utility in National and Regional (New England, Southeast, Great Lakes, Chesapeake Bay) with MODIS products

OPERATIONAL PARTNERS

USGS, New England Interstate Water Pollution Control Commission, Chesapeake Bay Program, Univ of Michigan Sea Grant, TN Dept of Env and Conservation

APP SCI INVESTIGATORS

M. Macauley, J Shih, A, Nolin, R. Moore, A, Hoos, D., Roberston, J Brakebill, D. Smith

Products 2001-2011 for cont US: Seasonal snow cover frequency data set; seasonal green biomass – using Enhanced Vegetation Index (EVI); seasonal median Land Surface Water Index (LSWI); seasonal mean Gross Primary Production (GPP); improved SPARROW output/RMSE

RESOURCES FOR THE FUTURE · NASA · USGS science for a changing world · OSU Oregon State University

Current Applications Solicitations

ROSES 2013 A.45
Earth Science Applications: Water Resources

The specific goal of this solicitation is to advance the long-term (30-180 day) outlooks of water supply anomalies and their effective use by water managers, their organizations, and/or decision-makers.

Proposals are due April 30, 2014.

ROSES 2013 A.44
Earth Science Applications: Health & Air Quality

Support the use of Earth obs. in air quality management and public health, particularly regarding infectious disease, environmental health issues, exposure, health-related hazards, risk characterization, air quality standards implementation, and climate effects on health & AQ.

Proposals are due April 24, 2014.

http://nspires.nasaprs.com/external/

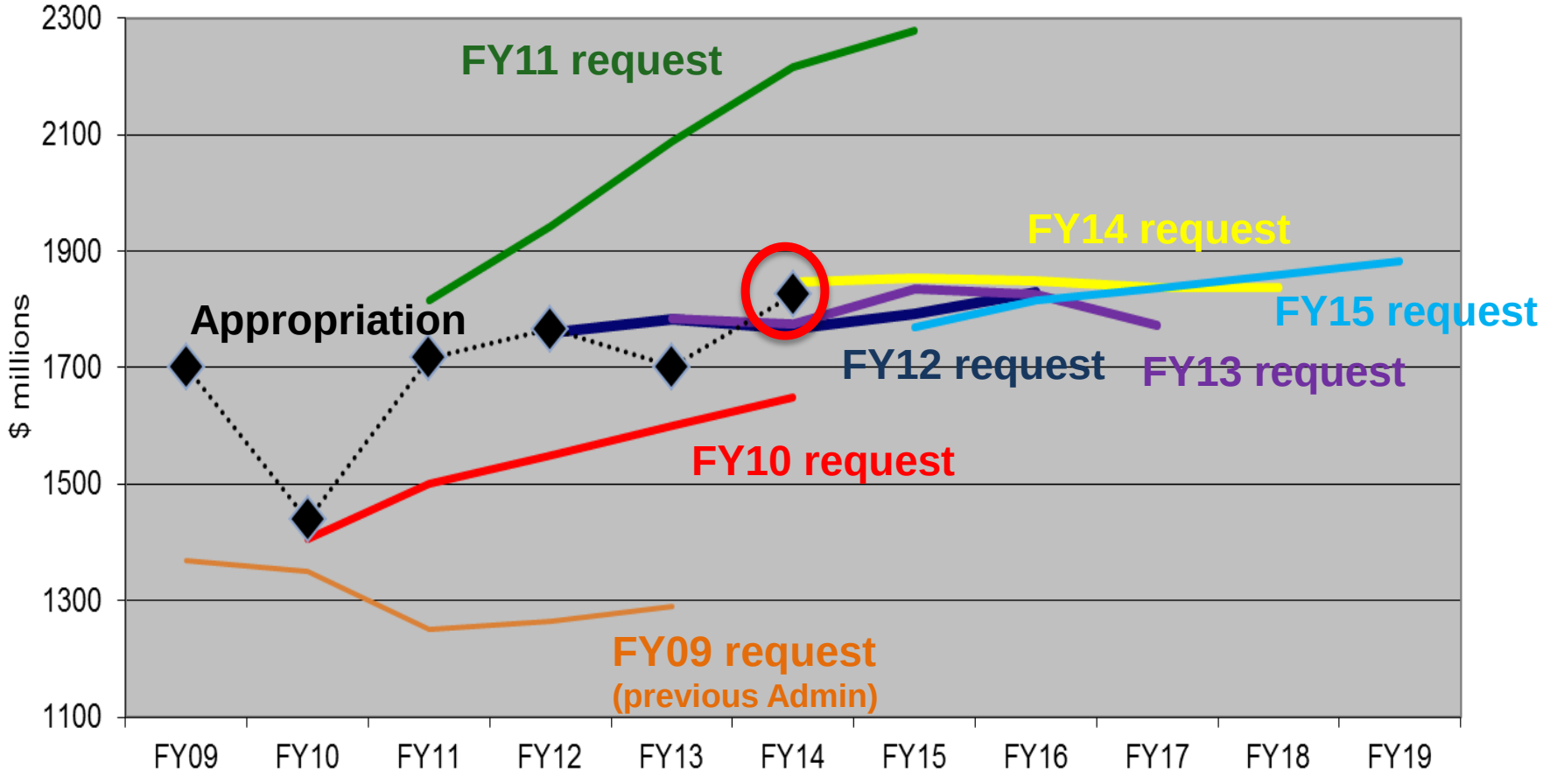
Earth Science

Outyears are notional

($M)	2015	2016	2017	2018	2019
Earth Science	$1,770	$1,815	$1,838	$1,862	$1,886

- Launches the Soil Moisture Active and Passive mission (SMAP), and the Stratospheric Aerosol and Gas Experiment III (SAGE III) to be mounted on the ISS.
- Formulates and develops ICESat-2, GRACE-Follow On, SWOT, CYGNSS, TEMPO, and a sustained Land Imaging capability.
- Develops and implements plans for measurements of solar irradiance, ozone profiles, and Earth radiation budget.
- Maintains weather and climate change modeling capabilities to enhance forecast accuracy.
- Operates over 21 Earth-observing spacecraft.
- Maintains robust R&A, airborne science (including IceBridge), technology development, and funds the Global Learning and Observations to Benefit the Environment (GLOBE) program.

Earth Science Budget: FY15 Request/Appropriation



Opportunity, Growth, and Security Initiative

- While the President's Budget adheres to the BBA's discretionary funding levels for 2015, it is not sufficient to expand opportunity to all Americans or to drive the growth our economy needs.
- The BBA replaced half the sequestration cut for 2014 but just one-fifth of the scheduled cut in the discretionary funding level for 2015. As a result, taking into account unavoidable growth in other Federal programs and other factors, the BBA non-defense discretionary funding levels for 2015 are below the levels Congress provided in the bipartisan Consolidated Appropriations Act of 2014.
- For that reason, the Federal Budget also includes a separate, fully paid for $56 billion Opportunity, Growth, and Security Initiative.
- NASA's share of that Initiative is $885M and is designed to show how additional discretionary investments in 2015 can further enable the NASA mission while spurring economic progress, promoting opportunity, and strengthening national security.

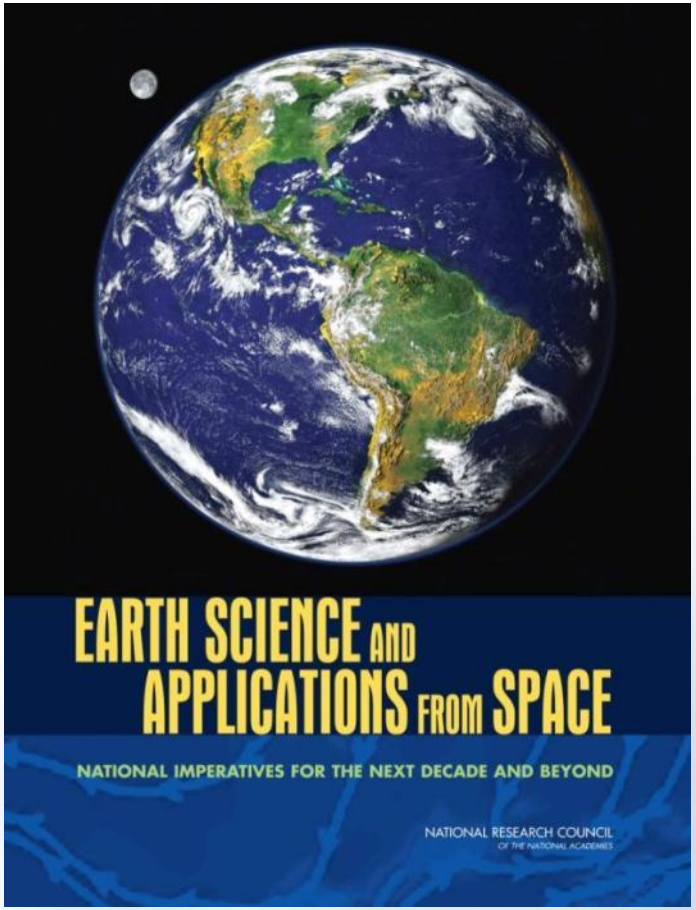
Budget Authority (in $ millions)	FY2015
Science	$187.3
Aeronautics	$43.9
Space Technology	$100.0
Exploration	$350.0
Space Operations	$100.6
Education	$10.0
Construction of Facilities and Environmental Compliance Restoration	$93.7
Grand Total	$885.5

Note: Detailed description of the content can be found in NASA's FY 2015 Budget Justification

Earth Science & Applications from Space

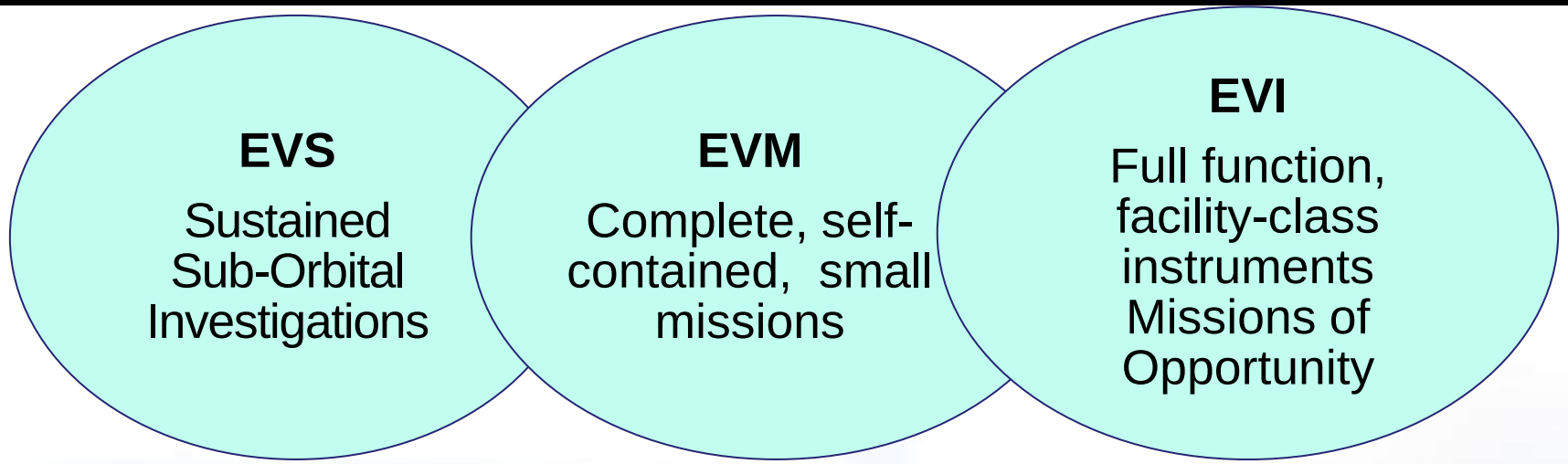
The national strategy outlined here has as its overarching objective a program of scientific discovery and development of applications that will enhance economic competitiveness, protect life and property, and assist in the stewardship of the planet for this and future generations.

Earth Science Decadal Survey
2007



NASA Earth Science Missions
Current & Planned

ESD Venture Opportunities



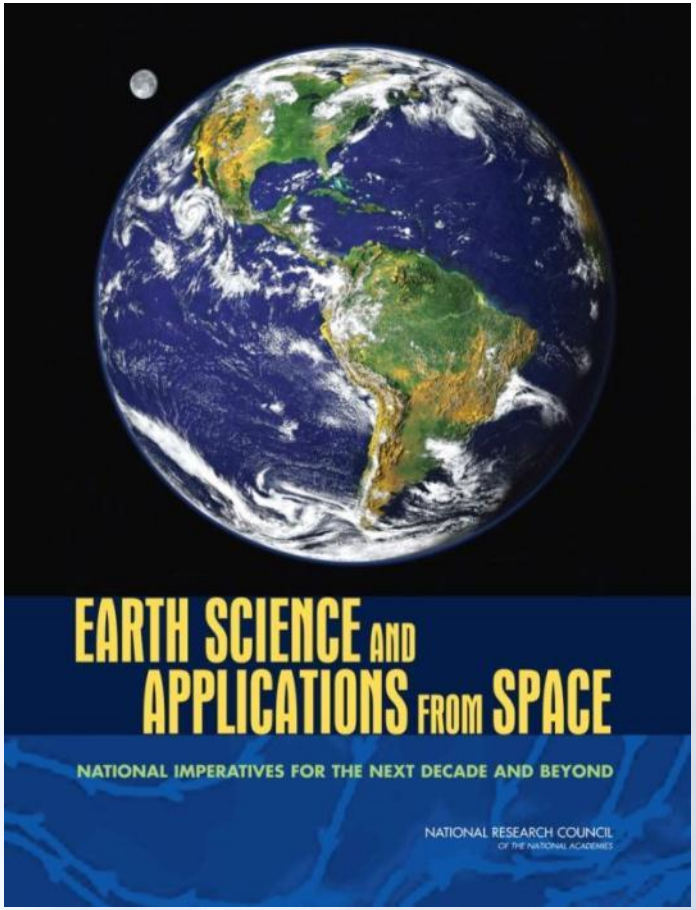
Mission	Mission Type	Release Date	Selection Date	Major Milestone
EV-1, aka EVS-1	Suborbital Airborne Campaigns	2009	2010	N/A
EVM-1, CYGNSS	Smallsat constellation	2011	2012	LRD October 2016
EVI-1, TEMPO	Geosynchronous hosted payload	2011	2012	Delivery NLT 2017
EVI-2	**Class C & Class D Instruments**	**2013**	**2014**	**Delivery NLT 2019**
EVS-2	**Suborbital**	**2013**	**2014**	**N/A**
EVI-3	Instrument Only	2014	2015	Delivery NLT 2020
EVI-4	Instrument Only	2015	2016	Delivery NLT 2021
EVM-2	Full Orbital	2015	2016	Launch ~2021
EVI-5	Instrument Only	2016	2018	Delivery NLT 2023
EVI-6	Instrument Only	2017	2019	Delivery NLT 2024

Open solicitation
Completed solicitation

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 Workshops
» Applications Traceability Matrices
» Early Adopters
» Webinars and Tutorials



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 & 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

***** ICESat-2 started Early Adopters in 2013 *****

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

Preparations for Next Decadal Survey

Earth Science Decadal Survey

10-year anniversary is 2017, preceded by years of preparation and data gathering

Terms of reference developed in 2014 timeframe

Several activities Earth Science has started will provide input:

- Land imaging program analysis
- NRC Continuity study
- Constellation and convoy studies
- Alternative acquisition and implementation approaches
- Missions & apps value study

Notional Schedule

Event	End Date	Duration (months)
ESD preparation	Oct-13	15
Call for inputs	Jan-15	3
Community meetings	Apr-15	9
Report writing period	Jan-16	8
Final report editing	Sep-16	4
Release of NRC's 2nd Earth Science Decadal Survey	Jan-17	

In 2013, the water community had a meeting to examine water priorities and mission concepts.

NRC CESAS – Continuity Study

Continuity Study

An ad-hoc committee will develop a framework and methodologies/metrics to assist NASA Earth Science in their determination of when a measurement(s) or dataset(s) should be collected for extended periods.

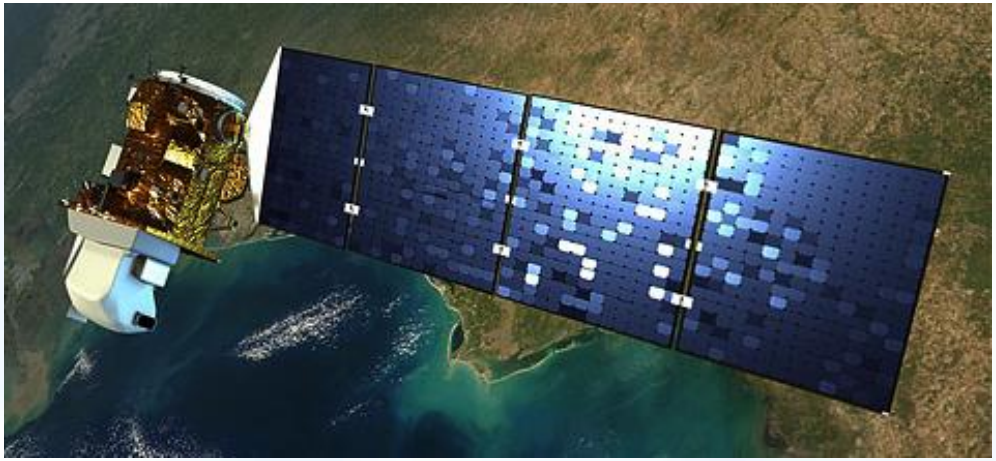
Guidance that will be applicable under a variety of scenarios over decadal timeframes.

Committee

- Byron Tapley, *NAE*, UT Austin, *Chair*
- Michael King, *NAE*, U. Colorado, *Vice Chair*
- Bob Dickinson, *NAS*, UT Austin
- Judith Lean, *NAS*, Naval Research Laboratory
- Randy Friedl, NASA-JPL
- Michael Prather, UC Irvine
- Joyce Penner, Univ. of Michigan
- John Bates, NOAA NCDC
- Chelle Gentemann, Remote Sensing Systems
- Bill Smith, Hampton University
- Steve Ackerman, Univ. of Wisconsin-Madison
- Bruce Wielicki, NASA Langley
- Mark Abbott, Oregon State University
- Lee-Lueng Fu, *NAE*, NASA-JPL
- Kathie Kelly, Univ. of Washington
- Eric Rignot, UC Irvine
- Jim Tucker, NASA-Goddard
- Rafael Bras, *NAE*, Georgia Tech.

Land Imaging (Landsat and Beyond)

FY14 President's NASA budget featured a new land imaging project for development of a national sustained Land Imaging Satellite System (with USGS).



NASA Architecture Study Team exploring trade space via several design cycles. Identify candidate architectures to satisfy desired performance, develop satellite technical parameters, orbit constraints, communications parameters, launch replenishment philosophy, and business models for each candidate architecture.

Land Imaging

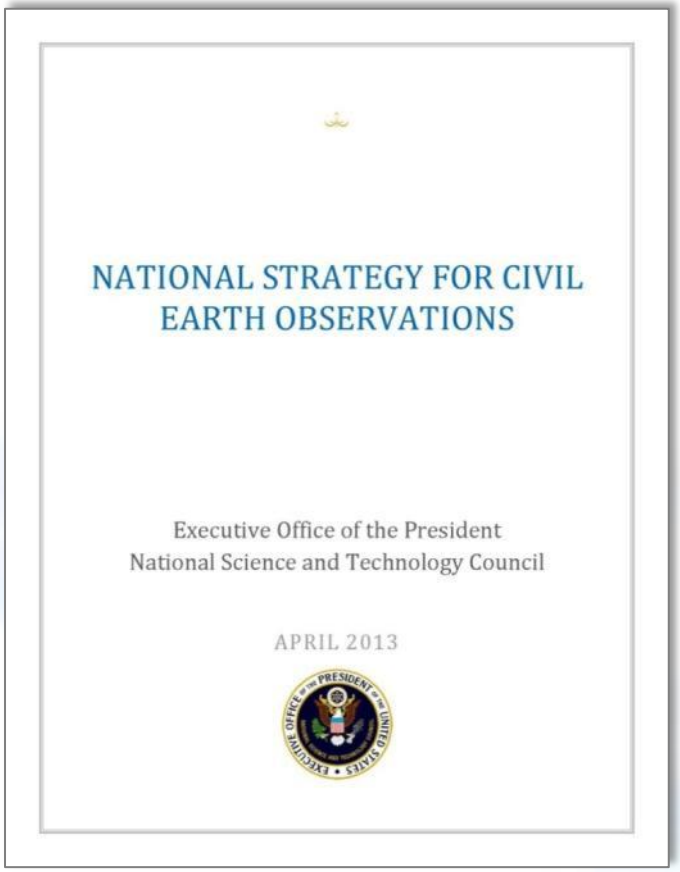
Basic study tenets for the program

- *Sustainability:* Provide data products for the long haul within the budget guidance provided.
- *Continuity:* Continue the long-term Landsat data record; focus is on usable products that define the utility of the data record.
- *Reliability:* Exhibit a form of functional redundancy. Data sets should be able to draw on equivalent or "near equivalent" deliverables from different sources; loss of a single satellite or instrument on orbit should not cripple the program or significantly impact users.

The study activity will result in recommendations and an implementation plan for a Sustainable Land Imaging System (combined space & ground system). NASA Sustainable Land Imaging report due April/Aug. 2014.

Interagency

http://www.whitehouse.gov/blog/2013/04/19/taking-pulse-our-planet-new-strategy-earth-observations



National Civil Earth Observations Strategy

Released 4/19/2013

- Supports efforts to organize existing Earth-observation systems and to coordinate plans for future projects.
- Provides an evidence-based framework for routine assessment, prioritization, and planning across all Federal agencies engaged in Earth observations.

In development:
National Plan for Civil Earth Observations, 2014-2024

Addresses sustained and experimental observations, priority observations, balanced portfolio approach, and guidance on implementation.

Plan is organized by the interagency U.S. Group on Earth Observations (USGEO), a Subcommittee within NSTC CENRS

USGEO: Rechartered, Reorganized

US Group on Earth Observations

USGEO is a Federal interagency committee to coordinate US input and positions for international Group on Earth Observations, address data management issues, and oversee triennial Earth observation assessments.

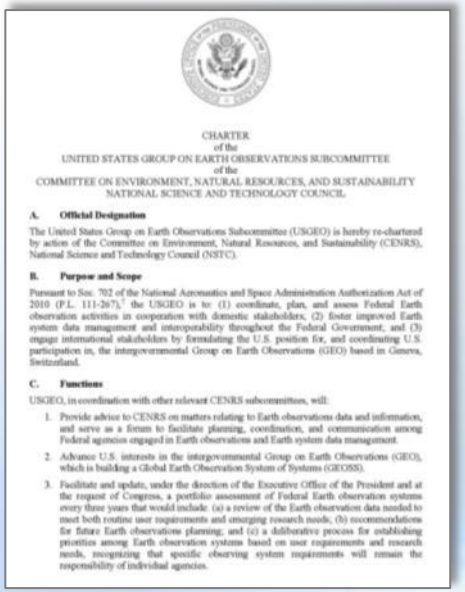
USGEO has focused primarily on international GEO.
New charter emphasizes national/domestic aspects.

Organization:
USGEO Subcommittee
Chair: OSTP; V.Chairs: NASA, NOAA, USGS

USGEO Program/Director at OSTP

Three Working Groups:

- International Working Group
- Data Management Working Group
- Assessment Working Group



CHARTER
of the
UNITED STATES GROUP ON EARTH OBSERVATIONS SUBCOMMITTEE
of the
COMMITTEE ON ENVIRONMENT, NATURAL RESOURCES, AND SUSTAINABILITY
NATIONAL SCIENCE AND TECHNOLOGY COUNCIL

A. Official Designation

The United States Group on Earth Observations Subcommittee (USGEO) is hereby re-chartered by action of the Committee on Environment, Natural Resources, and Sustainability (CENRS), National Science and Technology Council (NSTC).

B. Purpose and Scope

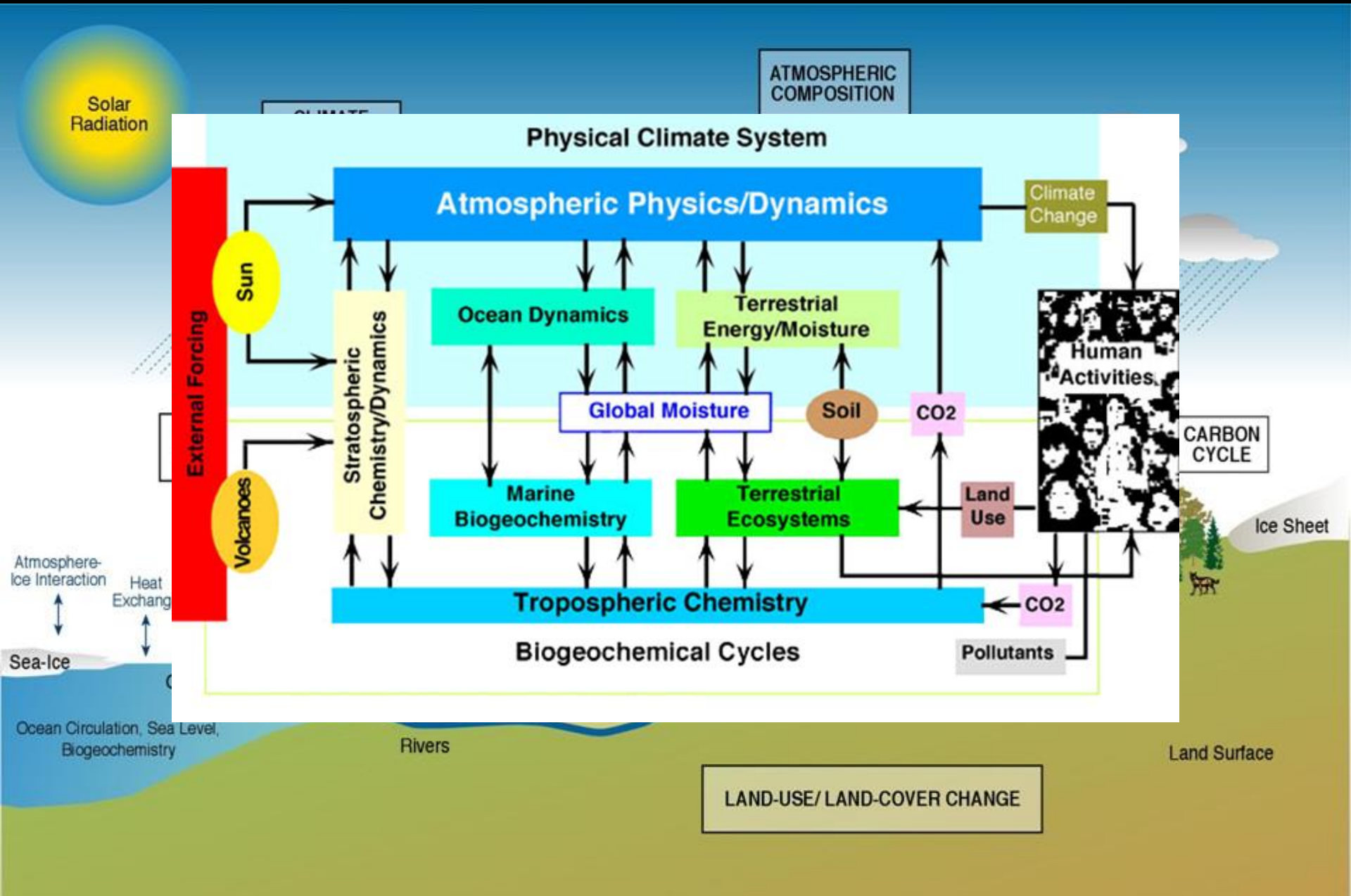
Pursuant to Sec. 702 of the National Aeronautics and Space Administration Authorization Act of 2010 (P.L. 111-267),[1] the USGEO is to: (1) coordinate, plan, and assess Federal Earth observation activities in cooperation with domestic stakeholders; (2) foster improved Earth system data management and interoperability throughout the Federal Government; and (3) engage international stakeholders by formulating the U.S. position for, and coordinating U.S. participation in, the intergovernmental Group on Earth Observations (GEO) based in Geneva, Switzerland.

C. Functions

USGEO, in coordination with other relevant CENRS subcommittees, will:

1. Provide advice to CENRS on matters relating to Earth observations data and information, and serve as a forum to facilitate planning, coordination, and communication among Federal agencies engaged in Earth observations and Earth system data management.
2. Advance U.S. interests in the intergovernmental Group on Earth Observations (GEO), which is building a Global Earth Observation System of Systems (GEOSS).
3. Facilitate and update, under the direction of the Executive Office of the President and at the request of Congress, a portfolio assessment of Federal Earth observation systems every three years that would include: (a) a review of the Earth observation data needed to meet both routine user requirements and emerging research needs; (b) recommendations for future Earth observations planning; and (c) a deliberative process for establishing priorities among Earth observation systems based on user requirements and research needs, recognizing that specific observing system requirements will remain the responsibility of individual agencies.

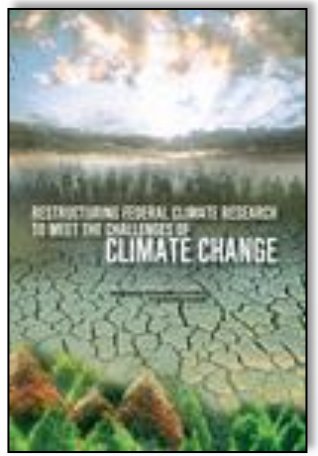
Earth as a Complex Inter-related System

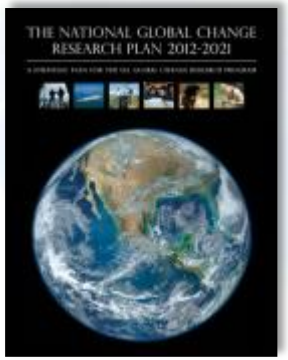


Human Dimensions in Earth System Science: Integration of Natural and Social Sciences

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.

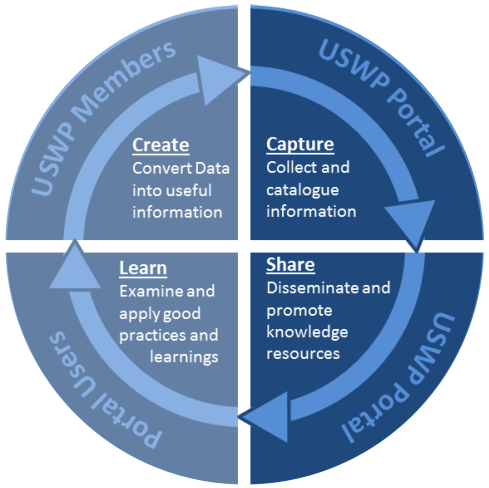
Planet Under Pressure: *State of the Planet Declaration* (2012)
"The international global-change research community proposes a new contract between science and society in recognition that science must inform policy to make more wise and timely decisions …"

Proposed a major research initiative, *Future Earth: research for global sustainability*

US Water Partnership

Unite and mobilize the best of U.S. expertise, resources, and ingenuity

Water information resources that contribute to solutions for global water challenges, especially for users in the developing world.



Partnership's Goals

www.uswaterpartnership.org

Collaboration

Management, policy, and applied research challenges

Connections to partners & stakeholders

Opportunities

Innovations
- Technical
- Organizational

Impacts & Testimonials

Is it feasible?

Is it valuable?

Is there commitment?

A successful project needs to be technically achievable, useful, and wanted.

A project needs to describe the context for the content.

In 2014, five NASA missions will launch to provide scientists critical data about Earth, continuing the agency's commitment to better understand our home planet.

EARTH *RIGHT* NOW

www.nasa.gov/earthrightnow

National Aeronautics and Space Administration

Questions

http://AppliedSciences.NASA.gov

NASA Earth Science
Applied Sciences Program

NASA Headquarters
Washington, DC
1.202.358.7200

National Aeronautics and Space Administration

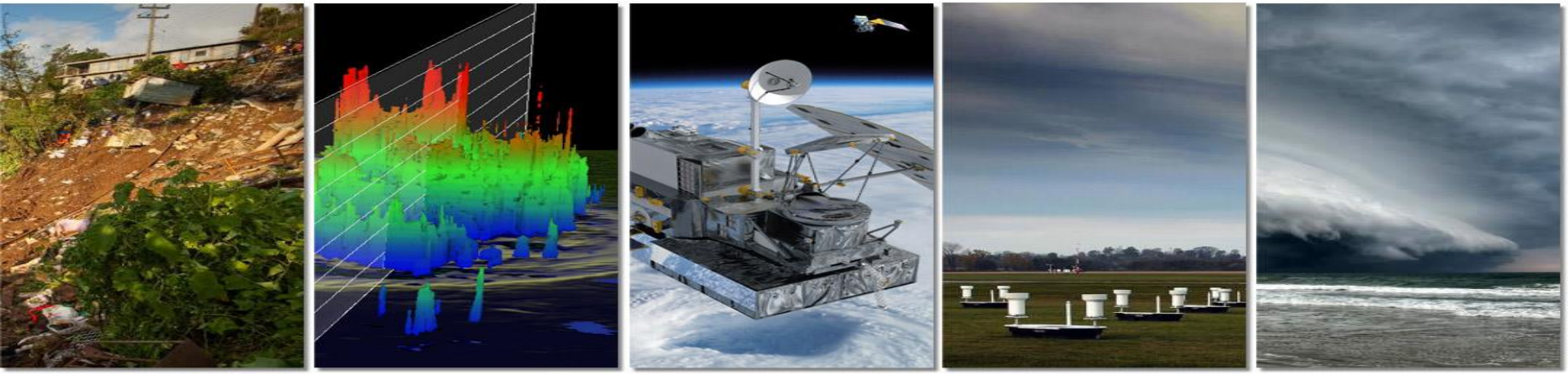
Back-up Materials

Missions & Applications

Upcoming Missions

- √ GPM
- » SMAP
- » OCO-2
- » ICESat-2
- » GRACE-FO
- » SWOT
- » PACE/ACE
- » HyspIRI

2013 GPM Applications Workshop



November 12th – 13th
NOAA Center for Weather and Climate Prediction

- Over 170 participants and ~30 posters
- JAXA's Riko Oki attended and gave plenary presentation
- Workshop addressed the range of current and future applications of satellite precipitation data to science and societal applications and provide feedback to the TRMM and GPM teams with respect to data access, usage, and availability.
- Results: Workshop identified need for greater communication of uncertainty in measurements, flagging of data sets that should not be utilized in applications, broader engagement of boundary organizations and other partners, and increased data accessibility and ease of usage (including simulated data).
- Presentations posted: http://pmm.nasa.gov/meetings/2013-gpm-applications-workshop
- Follow-on workshop tentatively planned for Spring 2015.

SMAP: Soil Moisture Active Passive

SMAP Applications

http://smap.jpl.nasa.gov/applications/

Early Adopters

» Total is now at 25 with 5 in review.

Community Events & Publications

» SMAP Town Hall at AGU2013

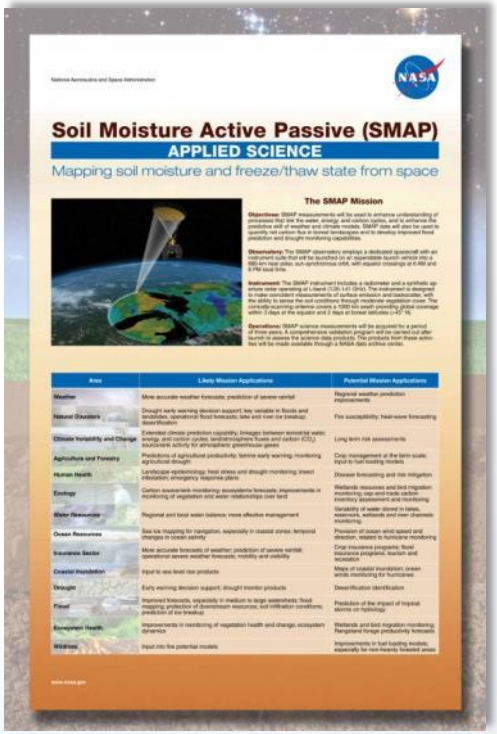
» BAMS paper (August 2013) on SMAP and applications

Workshops & Tutorials

» SMAP and Health Workshop. Hosted by CDC in Atlanta; Jan 7-8, 2014.

» AMS 2014: Short course on data continuity; Feb. 2, 2014.

» 3rd Applications Workshop. Hosted by NCAR, Exelis, NSIDC; Apr 8-10, 2014.



SMAP Applications Poster ^

See SMAP website for the mission Applications Plan

See Applied Sciences' 2012 Annual Report for longer description of past activities.

OCO-2/OCO-3 Applications

http://oco.jpl.nasa.gov/science/Applications/

Applications Workshop

» April 3-4 in Washington DC area.

Sessions are structured to explore relevance to key applications themes. Workshop will explore range of applications ideas. Examples:

Urban Fossil Fuel Carbon Dioxide monitoring

Agricultural Monitoring and Yield Estimation

Outreach & Media Presence

» Riley Duren/JPL (Deputy Program Applications Lead) on NPR's On Point

ICESat-2 Applications

Early Adopters

» Initiated in 2013; 6 EA proposals reviewed with 2 pending.

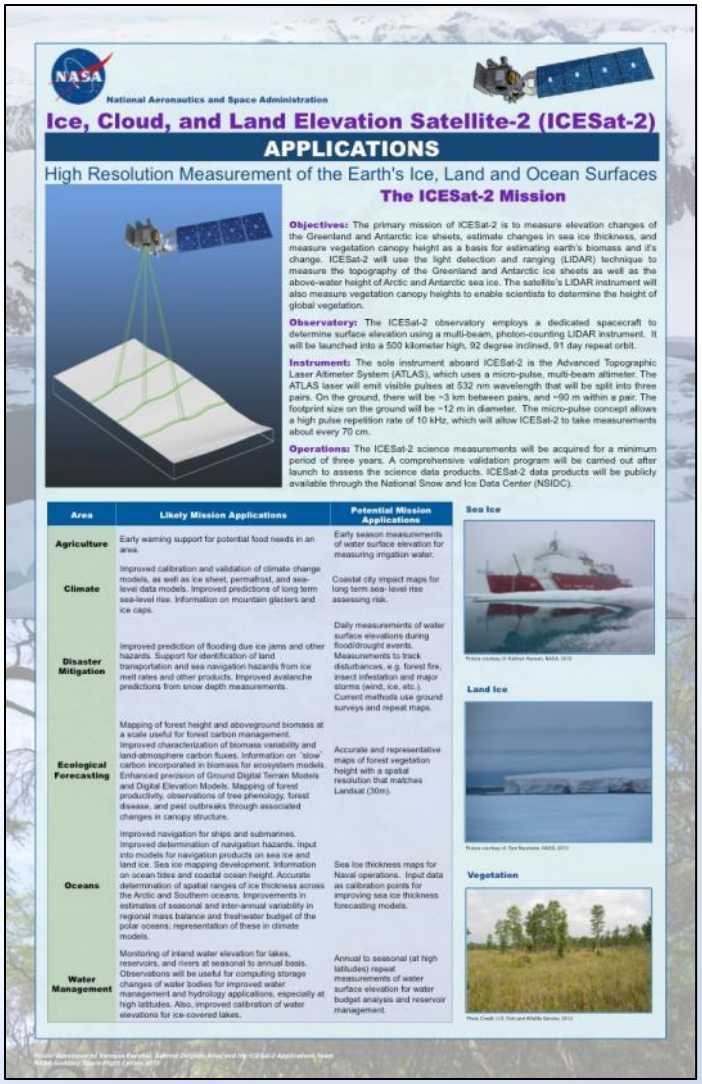
Community Events & Tutorials

» ICESat-2 Town Hall at AGU 2012 & 2013

» Joint Vegetation Tutorial (applications related) with Landsat 8. May 7-8, 2014; hosted by Dan Brown, U.Michigan

» Sea Ice Focus Session (applications related). Late summer 2014; hosted by NRL-Stennis

See Applied Sciences' 2012 Annual Report for description of past activities


National Aeronautics and Space Administration

Ice, Cloud, and Land Elevation Satellite-2 (ICESat-2)

APPLICATIONS

High Resolution Measurement of the Earth's Ice, Land and Ocean Surfaces

The ICESat-2 Mission

Objectives: The primary mission of ICESat-2 is to measure elevation changes of the Greenland and Antarctic ice sheets, estimate changes in sea ice thickness, and measure vegetation canopy height as a basis for estimating earth's biomass and it's change. ICESat-2 will use the light detection and ranging (LIDAR) technique to measure the topography of the Greenland and Antarctic ice sheets as well as the above-water height of Arctic and Antarctic sea ice. The satellite's LIDAR instrument will also measure vegetation canopy heights to enable scientists to determine the height of global vegetation.

Observatory: The ICESat-2 observatory employs a dedicated spacecraft to determine surface elevation using a multi-beam, photon-counting LIDAR instrument. It will be launched into a 500 kilometer high, 92 degree inclined, 91 day repeat orbit.

Instrument: The sole instrument aboard ICESat-2 is the Advanced Topographic Laser Altimeter System (ATLAS), which uses a micro-pulse, multi-beam altimeter. The ATLAS laser will emit visible pulses at 532 nm wavelength that will be split into three pairs. On the ground, there will be ~3 km between pairs, and ~90 m within a pair. The footprint size on the ground will be ~12 m in diameter. The micro-pulse concept allows a high pulse repetition rate of 10 kHz, which will allow ICESat-2 to take measurements about every 70 cm.

Operations: The ICESat-2 science measurements will be acquired for a minimum period of three years. A comprehensive validation program will be carried out after launch to assess the science data products. ICESat-2 data products will be publicly available through the National Snow and Ice Data Center (NSIDC).

Area	Likely Mission Applications	Potential Mission Applications
Agriculture	Early warning support for potential food needs in an area.	Early season measurements of water surface elevation for measuring irrigation water.
Climate	Improved calibration and validation of climate change models, as well as ice sheet, permafrost, and sea-level data models. Improved predictions of long term sea-level rise. Information on mountain glaciers and ice caps.	Coastal city impact maps for long term sea- level rise assessing risk.
Disaster Mitigation	Improved prediction of flooding due ice jams and other hazards. Support for identification of land transportation and sea navigation hazards from ice melt rates and other products. Improved avalanche predictions from snow depth measurements.	Daily measurements of water surface elevations during flood/drought events. Measurements to track disturbances, e.g. forest fire, insect infestation and major storms (wind, ice, etc.). Current methods use ground surveys and repeat maps.
Ecological Forecasting	Mapping of forest height and aboveground biomass at a scale useful for forest carbon management. Improved characterization of biomass variability and land-atmosphere carbon fluxes. Information on "slow" carbon incorporated in biomass for ecosystem models. Enhanced precision of Ground Digital Terrain Models and Digital Elevation Models. Mapping of forest productivity, observations of tree phenology, forest disease, and pest outbreaks through associated changes in canopy structure.	Accurate and representative maps of forest vegetation height with a spatial resolution that matches Landsat (30m).
Oceans	Improved navigation for ships and submarines. Improved determination of navigation hazards. Input into models for navigation products on sea ice and land ice. Sea ice mapping development. Information on ocean tides and coastal ocean height. Accurate determination of spatial ranges of ice thickness across the Arctic and Southern oceans. Improvements in estimates of seasonal and inter-annual variability in regional mass balance and freshwater budget of the polar oceans; representation of these in climate models.	Sea ice thickness maps for Naval operations. Input data as calibration points for improving sea ice thickness forecasting models.
Water Management	Monitoring of inland water elevation for lakes, reservoirs, and rivers at seasonal to annual basis. Observations will be useful for computing storage changes of water bodies for improved water management and hydrology applications, especially at high latitudes. Also, improved calibration of water elevations for ice-covered lakes.	Annual to seasonal (at high latitudes) repeat measurements of water surface elevation for water budget analysis and reservoir management.

Sea Ice

Land Ice

Vegetation

ICESat-2 Applications Poster ^

GRACE-FO Applications

http://grace.jpl.nasa.gov/applications

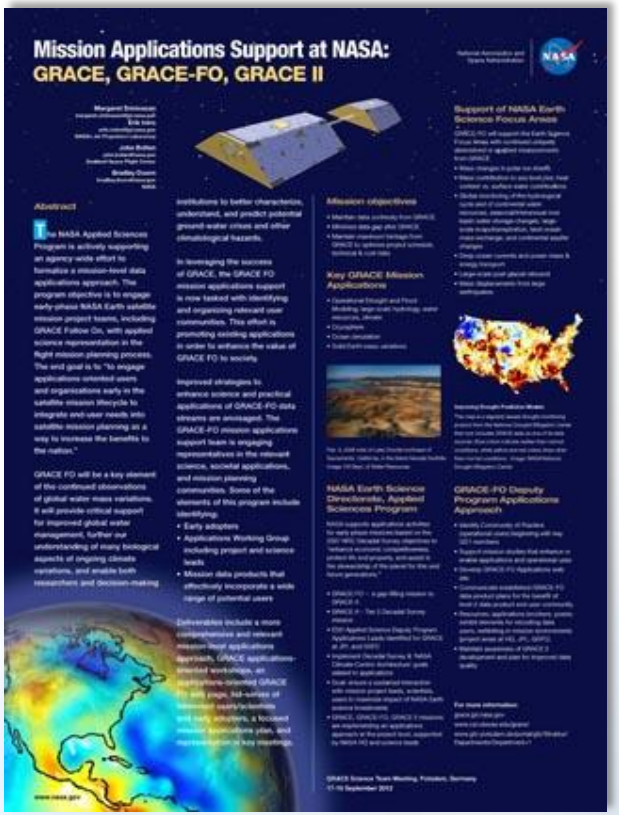
Community Events

» Two GRACE webinars in Nov. 2013 with more to follow
» GRACE Town Hall at AGU
» GRACE applications website in 2013

Workshops & Fora

» GRACE & SWOT participated in the 3rd “Texas Water Forum: Drought and Extreme Events”; 14-15.Oct.2013.

M. Srinivasan presented “Hydrology from Space: NASA's Satellites Supporting Water Resources Applications” and participated in a panel discussion.



∧ GRACE Applications Poster

Applications Plan is in development

SWOT Applications

http://swot.jpl.nasa.gov/applications

Early Adopters

» Pursuing plans for EA program.

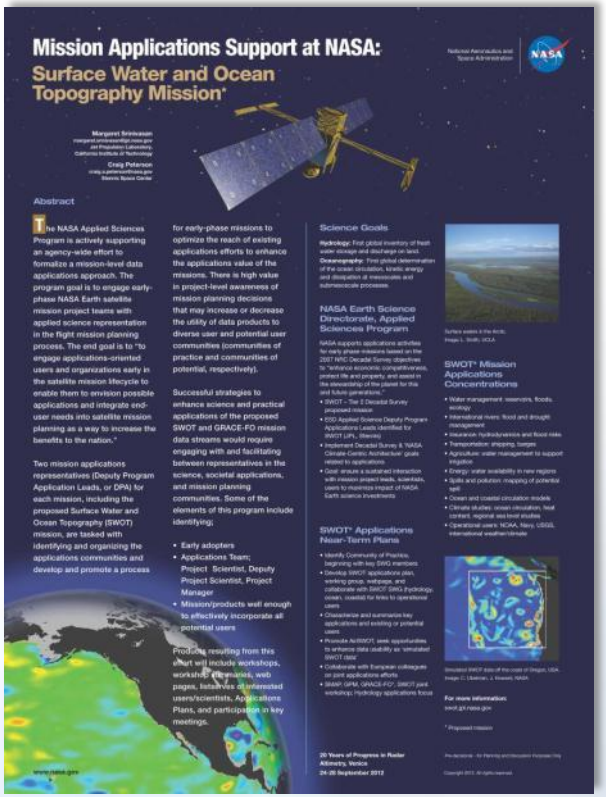
Science Definition Team Meeting

» 3rd SWOT SDT meeting;
Jan. 14-16, 2014 in Arlington, VA.

Applications presentation in plenary

Splinter session for the Applications Working Group

CNES is a partner and they have strong applications focus


Mission Applications Support at NASA:
Surface Water and Ocean Topography Mission*

Abstract

Science Goals

NASA Earth Science Directorate, Applied Sciences Program

SWOT* Mission Applications Concentrations

SWOT* Applications Near-Term Plans

For more information:

* Proposed mission

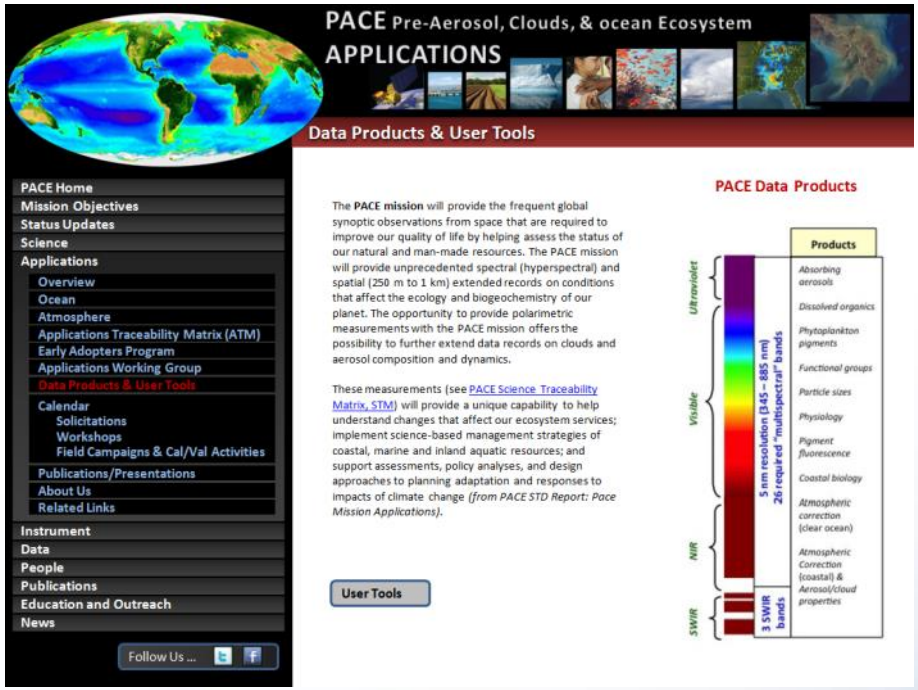
∧ SWOT Applications Poster

Applications Plan is in development

PACE / ACE Applications

Activities

- Applications Traceability Matrix developed
- Prototype Applications website developed
- Pursuing plans for an Early Adopters program



Development of Mission Applications Website

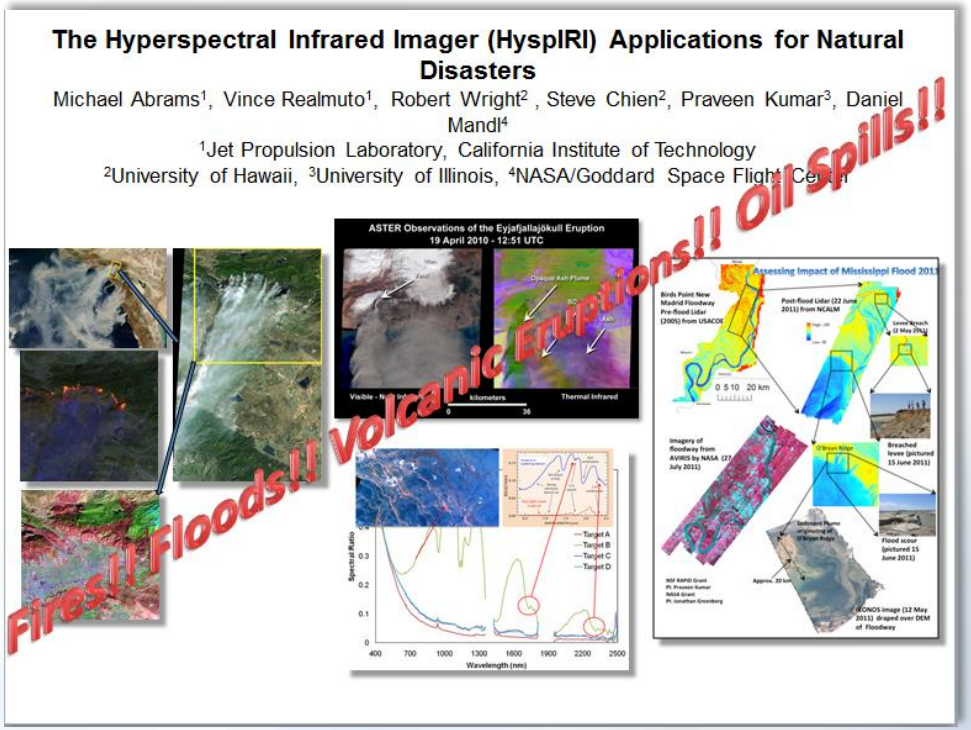
Community Events

- Town Hall at AGU
- Ocean Colour Science Conference, May 2013
- Impacts on Urban Coastal Communities Workshop, June 2013
- Session at 2014 Ocean Science Meeting "*Policy Impacts of Ocean Research: Communicating Science to Decision-makers", Feb. 2014*

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

See Applied Sciences' 2012 & 2011 Annual Reports for description of past activities.

HyspIRI: 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

Intl. Space Apps Challenge

http://spaceappschallenge.org/

April 12-13: NASA is conducting its next International Space Apps Challenge!

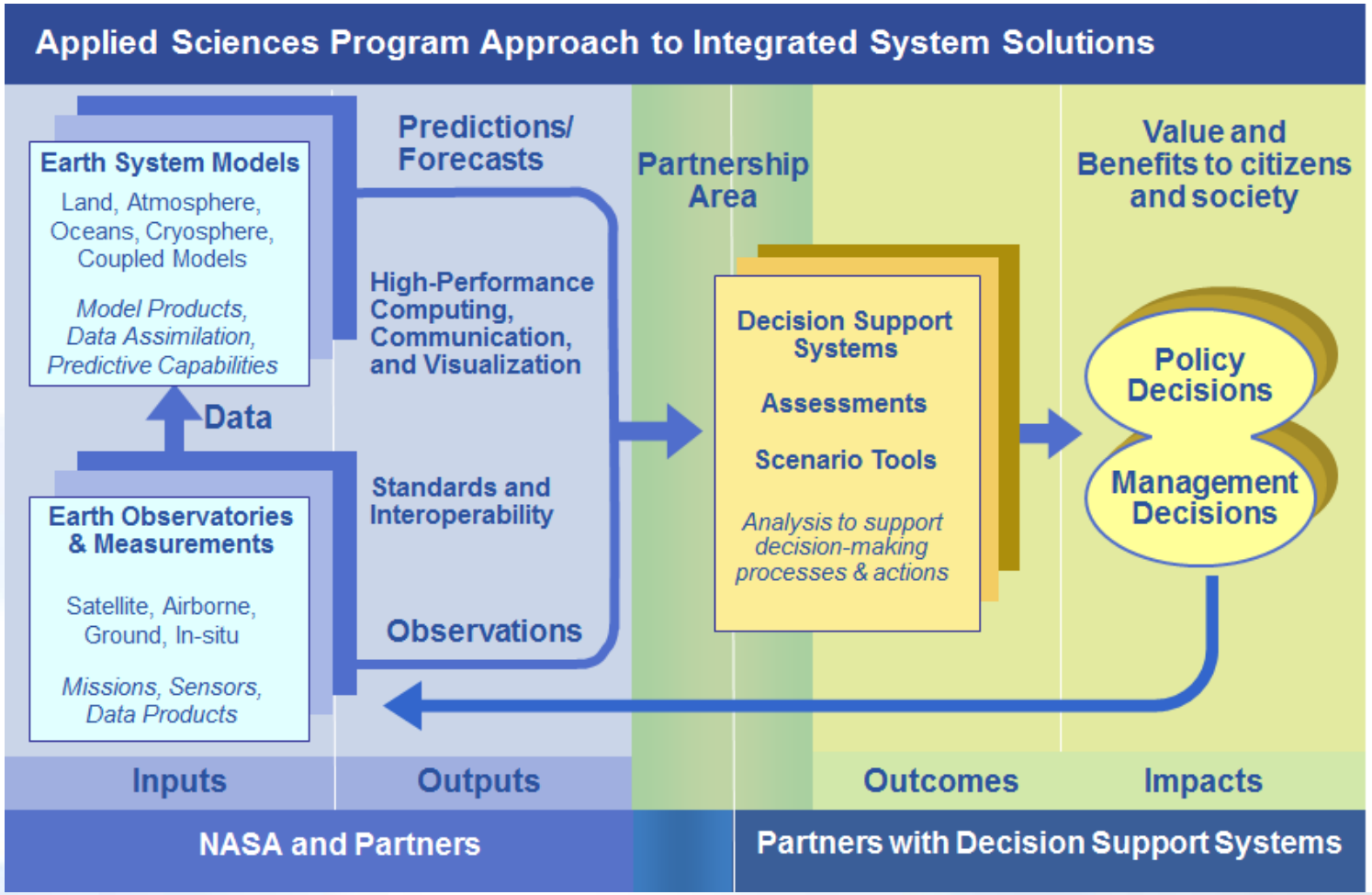
Challenge poses problems to groups of coders for 48-hour Hack-a-thons to develop preliminary-level Apps.

NASA and others then winnow down and pursue more promising ones

We have several that are focused on Earth science and environment.

Official announcement of challenges soon

Inform Decisions & Actions



Advance knowledge on how to effectively apply Earth science to serve society. Improve decisions and actions. Support innovation (technical and organizational). Transition applied knowledge. Induce demand.