

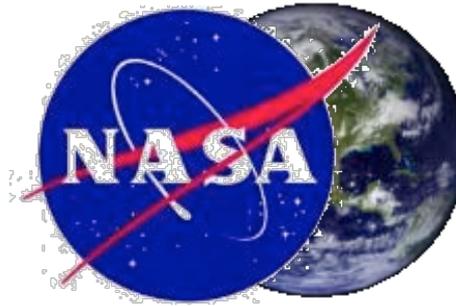
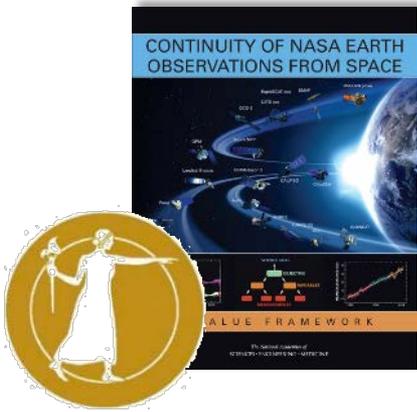
**Lawrence Friedl**  
*NASA Earth Science*

**Applied Sciences Program**

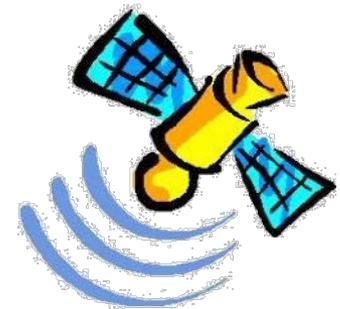
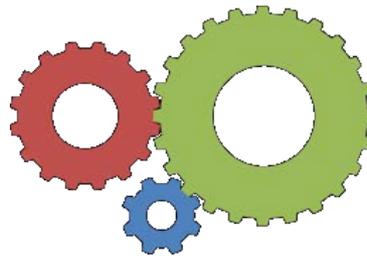
□ □ □ □ □

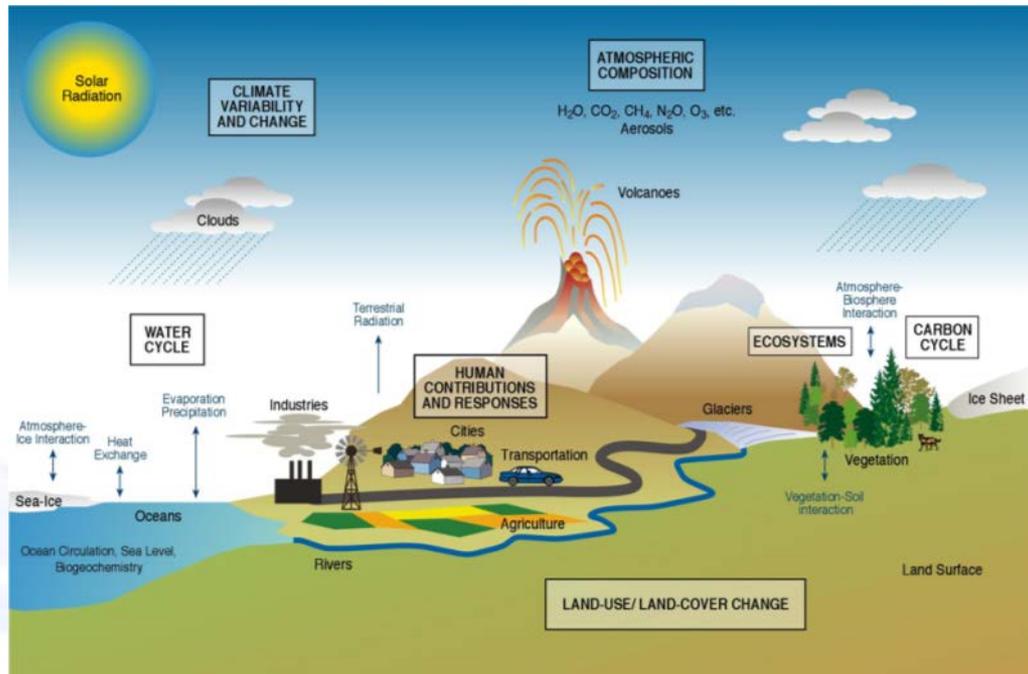
**Wildland Fires Team Meeting**  
**March 1-3, 2016**

# GEO GROUP ON EARTH OBSERVATIONS



**THE GLOBAL GOALS**  
For Sustainable Development





Supports basic and applied research on the Earth system and its processes to advance knowledge and benefit society.

In parallel with research, NASA pursues innovative and practical uses of Earth science data and results to inform decisions and actions.

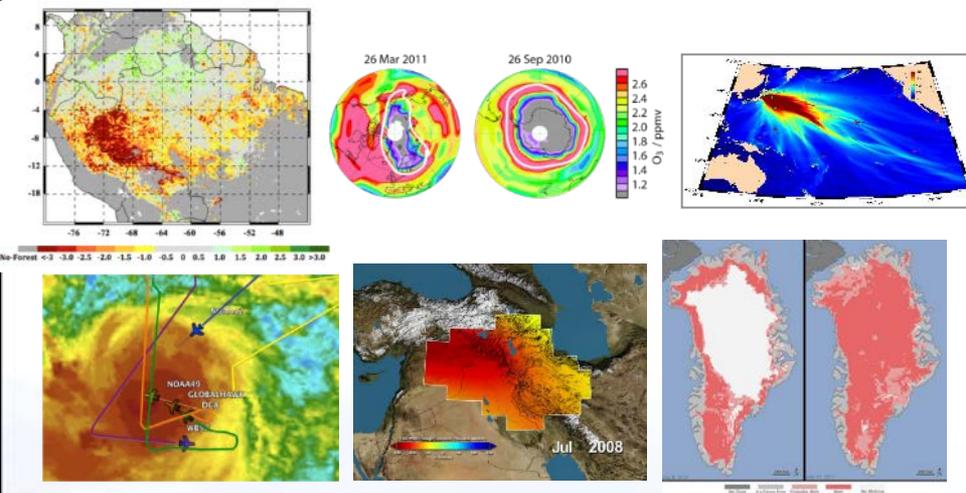
**Technology**  
**Flight Missions**  
**Research**  
**Data Systems**  
**Education**  
**Applications**



# NASA Earth Science: Four Programs



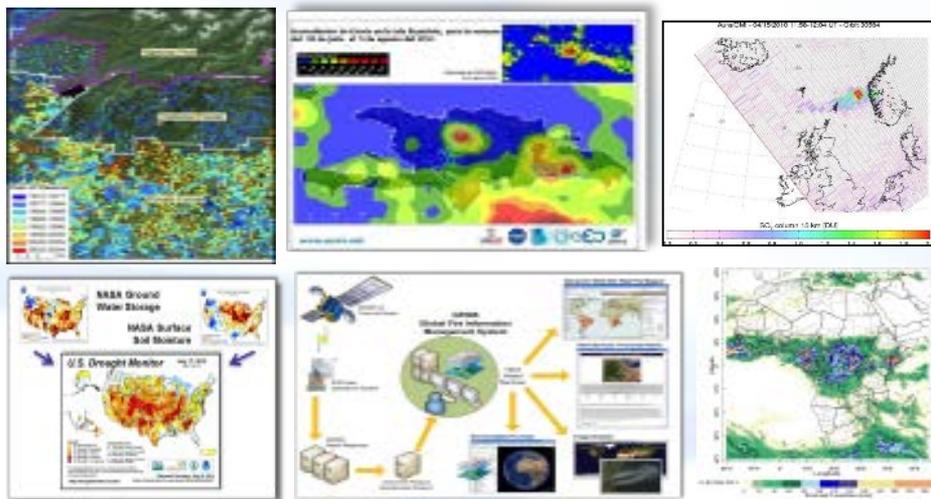
## Research



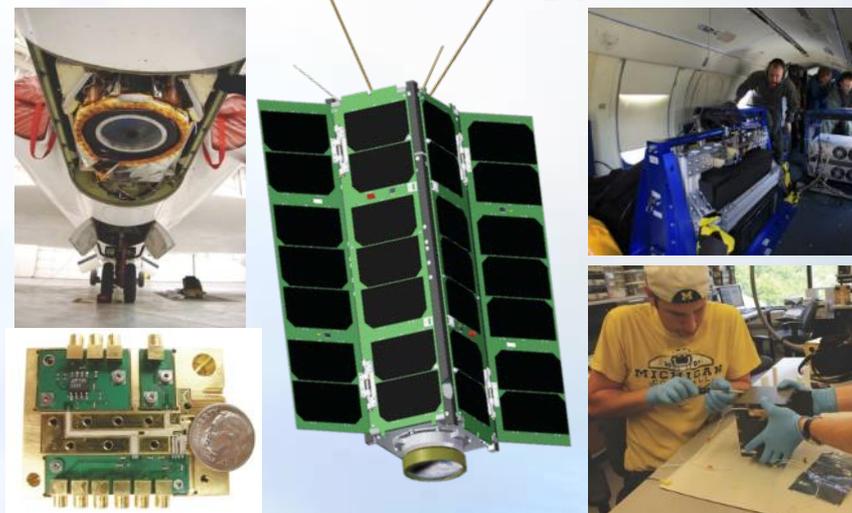
## Flight (incl. Data Systems)



## Applied Sciences



## Technology



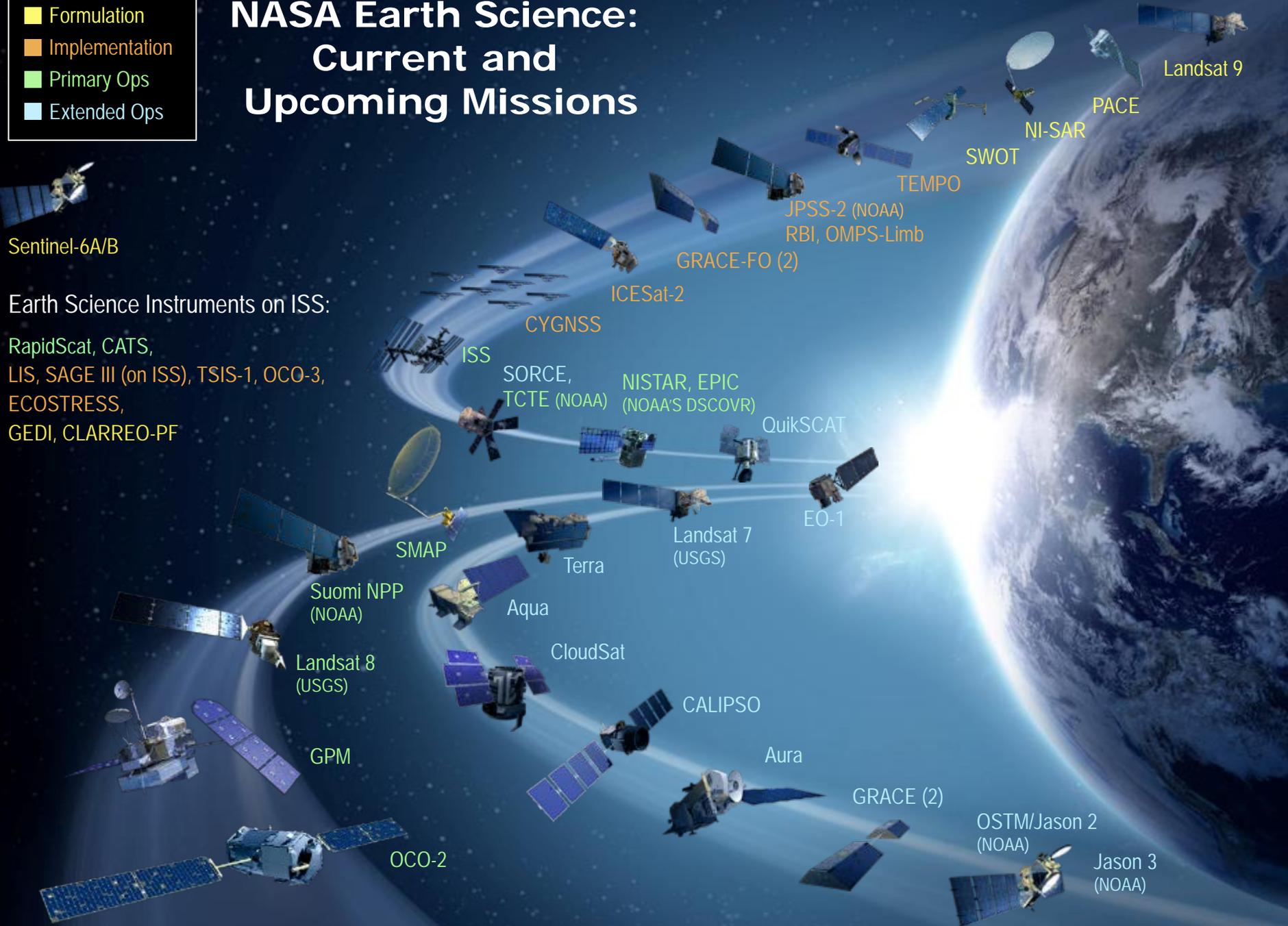
# NASA Earth Science: Current and Upcoming Missions

- Formulation
- Implementation
- Primary Ops
- Extended Ops

Sentinel-6A/B

## Earth Science Instruments on ISS:

RapidScat, CATS,  
LIS, SAGE III (on ISS), TSIS-1, OCO-3,  
ECOSTRESS,  
GEDI, CLARREO-PF



# **Applied Sciences Program: Lines of Business**

*Discover and demonstrate innovative and practical uses of Earth observations to inform decisions and actions.*



## ***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.



## ***Societal & Economic Applications***

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



## ***Capacity Development***

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

***Key Principle: On-going experimentation to figure out how to better inspire applications, ideas, ways to broker, etc.***

# Applied Sciences Program: Applications Themes



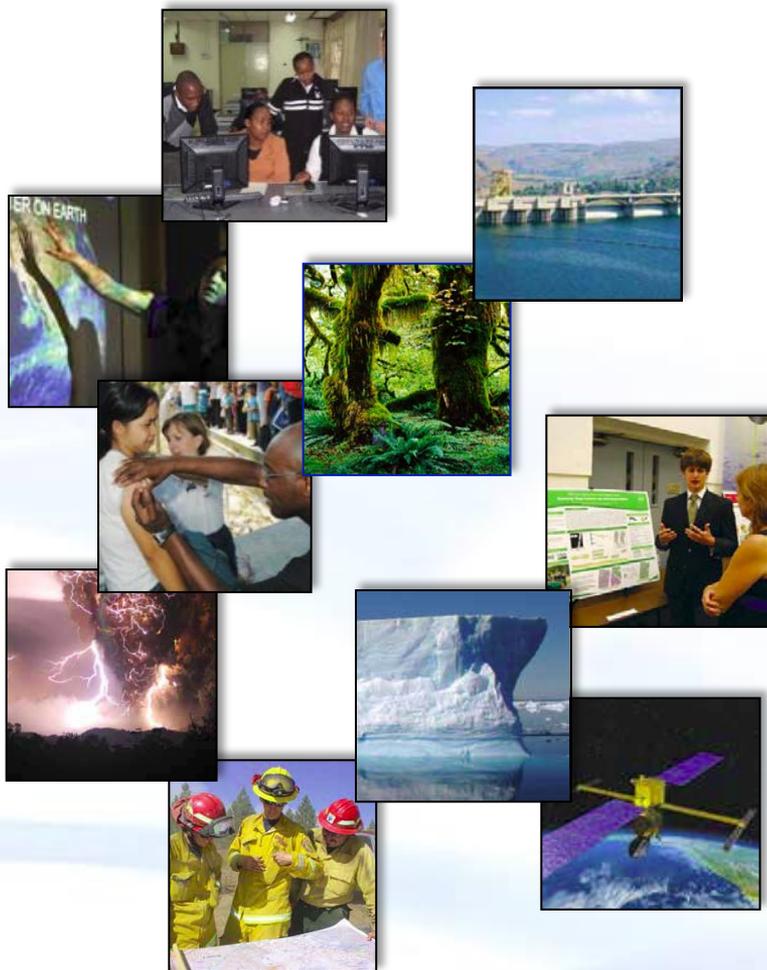
## Programmatic Focus on:

- Disasters
- Ecological Forecasting
- Health & Air Quality
- Water Resources
- Wildfires

## Support ad hoc opportunities in additional areas:

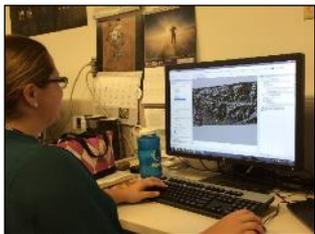
- Agriculture & Food Security
- Aviation Safety
- Energy
- Socioeconomic Impacts

*Climate & weather play into all themes* || 7



# Capacity Building: DEVELOP

**DEVELOP** is a national training and development program for individuals to gain experience applying Earth observations through 10-week interdisciplinary projects, including with state and local governments.



Participants

+

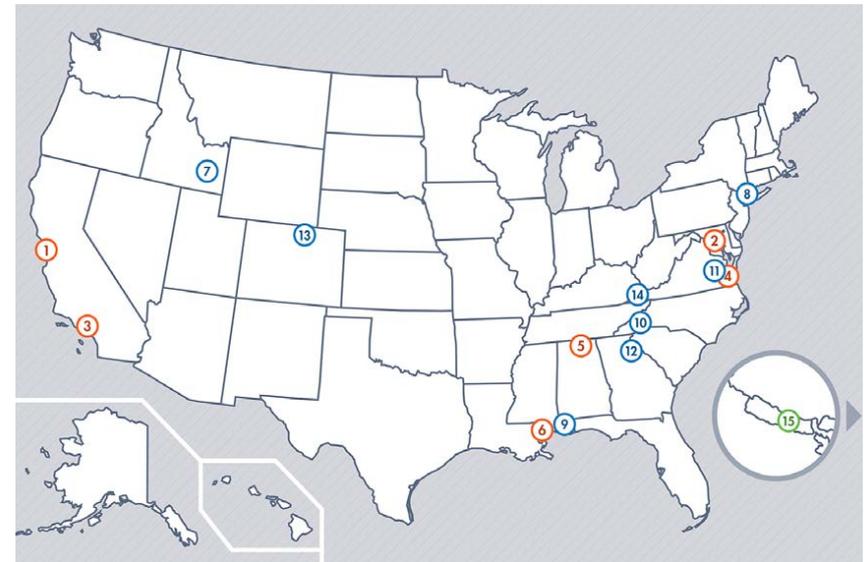


Earth Observations

+



Decision Makers



## NASA Center Locations

1. NASA Ames Research Center – Moffett Field, CA
2. NASA Goddard Space Flight Center – Greenbelt, MD
3. NASA Jet Propulsion Laboratory – Pasadena, CA
4. NASA Langley Research Center – Hampton, VA\*
5. NASA Marshall Space Flight Center at NSSTC – Huntsville, AL
6. NASA Stennis Space Center – Stennis, MS

\* The DEVELOP National Program Office is located at Langley.

## Regional Locations

7. BLM at Idaho State University GIS TReC – Pocatello, ID
8. International Research Institute for Climate and Society – Palisades, NY
9. Mobile County Health Department – Mobile, AL
10. NOAA National Centers for Environmental Information – Asheville, NC
11. Patrick Henry Building – Richmond, VA
12. University of Georgia – Athens, GA
13. USGS at Colorado State University – Fort Collins, CO
14. Wise County and City of Norton Clerk of Court's Office – Wise, VA

## International Location

15. International Centre for Integrated Mountain Development – Kathmandu, Nepal

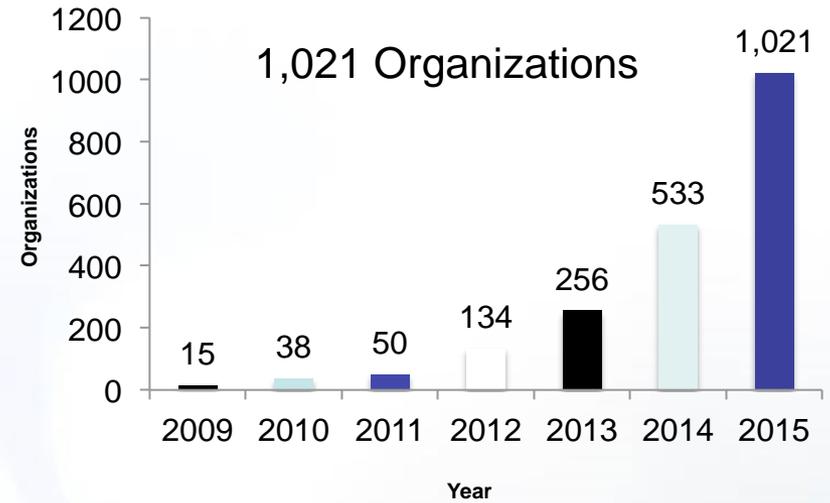
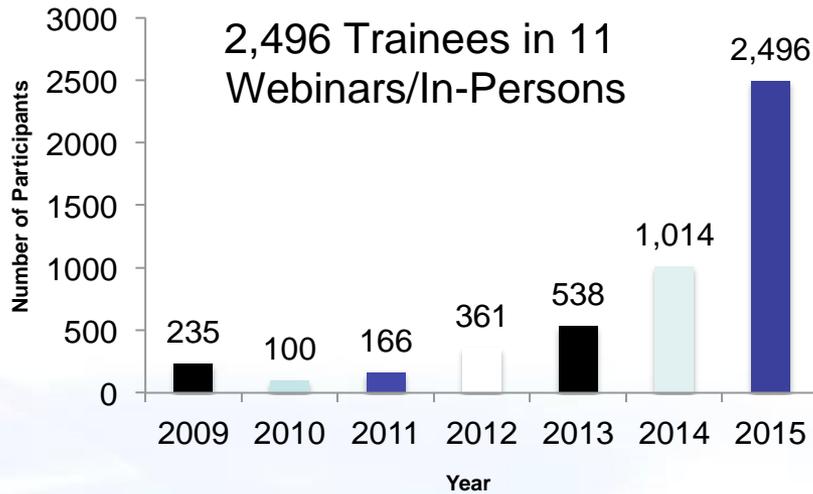
15 DEVELOP Locations

2015: 393 Participants, 93 Projects, 156 Partners

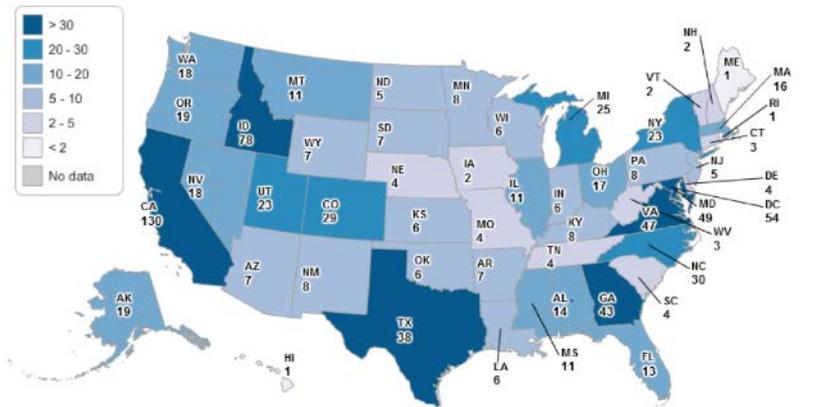
# ARSET, Applied Remote Sensing Training: 2015 Record Year



## Record Number of Participants in 2015 Exceeds all Previous Years Combined



Reached All 50 U.S. States, D.C., P.Rico,  
and 123 Countries (34 new in 2015)



Training Themes include:

- » Air Quality
- » Water Resources
- » Disasters (e.g., flooding)
- » Ecological Forecasting
- » Wildfires
- » NASA Data Products, Portals, Tools
- » Health (new in 2016)
- » Specials: Land Management, Drought, Conservation, Snow Products, GPM, ...

# New Website



**NASA Applied Sciences Program**  
NASA Earth Science

HOME PORTFOLIO NEWS & EVENTS FEEDBACK FORM

Applied Sciences Sponsored a Project with NOAA Applying Satellite Data for its Weekly Lake Erie Harmful Algal Bloom Bulletin, which Provides a Forecast for Microcystis blooms in Western Lake Erie

[Click here to view the Applied Sciences program 2014 digital annual report](#)

- OUR HIGHLIGHTS
- OUR COLLABORATIONS
- LINES OF BUSINESS
- HOW IT WORKS
- HOW WE'VE DONE

About Applied Sciences

Discovering innovative and practical uses of Earth observations

**NASA Applied Sciences Program**  
NASA Earth Science

HOME PORTFOLIO NEWS & EVENTS FEEDBACK FORM

Battling Wildfires from Space: NASA Adds to Firefighters' Toolkit

**King Fire VIIRS 750m**

Date_Time (UTC)
20140914 20:23
20140914 21:09
20140915 10:19
20140915 10:50
20140915 11:29
20140915 21:41
20140916 10:01
20140916 11:29
20140917 23:00
20140918 09:20
20140918 09:20
20140918 20:43
20140918 09:03
20140919 10:45
20140919 20:30

[The 2014 NASA Earth Science Applied Sciences Program Wildland Fires Annual Report is available here!](#)

**WILDLAND FIRES**

The Wildland Fires Application area promotes the use of Earth observations and models focused on addressing issues related to wildland fire in support of management strategies, business practices, and policy analysis and decisions. The Wildland Fire applications includes support of all aspects of pre, active and post-fire analysis tools that use Earth observations and models to enhance fuel load estimates, fuel treatment planning, risk assessment, air quality, insect infestations, burned area remediation and rehabilitation, and other topics that lead to improved land-management decisions.

- OUR HIGHLIGHTS
- OUR PARTNERS
- PROGRAM ACTIVITIES
- HOW WE'VE DONE

**Earth  
Observations  
Science Serving  
Decisions  
Making Space for  
Earth**

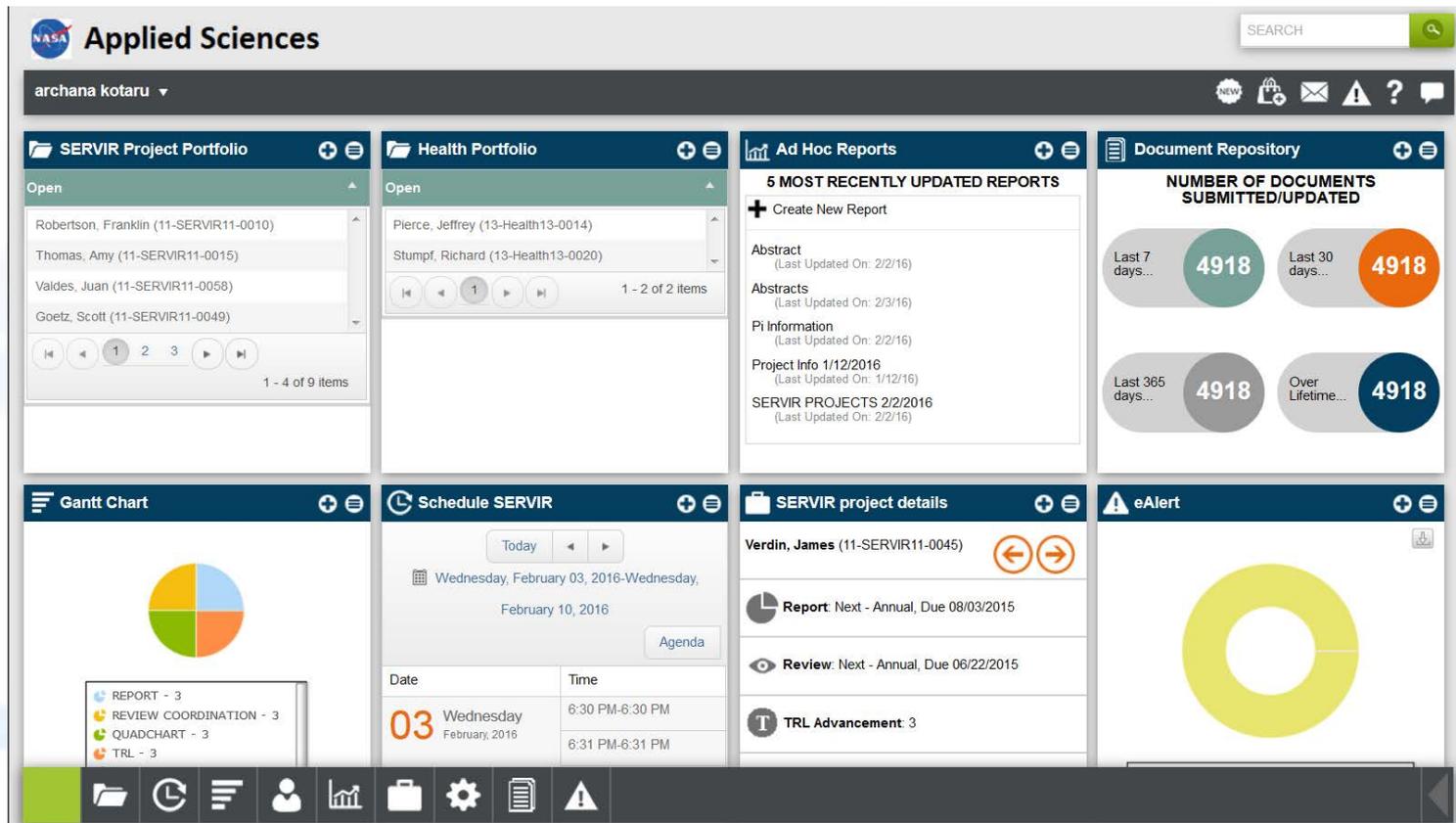


# eBooks Reporting System



Migrating to new system over upcoming months  
Significant new capabilities, features, and functions

“Dashboard”



# eBooks Reporting System



Migrating to new system over upcoming months  
Significant new capabilities, features, and functions

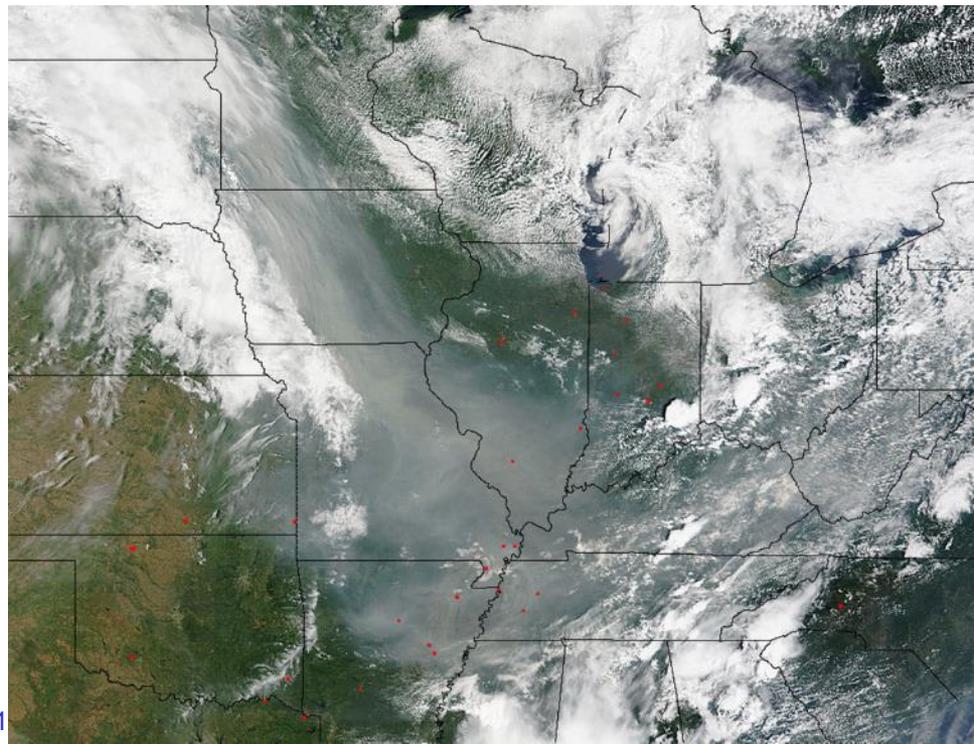
“Project Details”

The screenshot displays the 'Applied Sciences' section of the eBooks Reporting System. The user 'archana kotaru' is logged in. The main content area shows the 'SERVIR project details' for '11-SERVIR11-0045: A Long Time-Series Indicator of Agricultural Drought for the Greater Horn of Africa' by Verdin, James. The project status is 'Open' with a start date of 08/01/2012 and an end date of 07/31/2016. A navigation bar includes options like Project Summary, Procurement Information, Quad Chart, TRL Advancement, Reports, Reviews, Phasing Plan, Other Documents, Publications, Student Involvement, Project Assignment, and Project Continuation. The interface is divided into three main panels: 'Reports' (listing '11-SERVIR11-0045-REP-AUG-2015'), 'Reviews' (listing '11-SERVIR11-0045-REV-AUG-2015'), and 'Quad Chart'. The 'Quad Chart' panel shows a detailed view of the project, including an 'Objectives' section, an 'Approach' section, and a 'Key Milestones' table. The 'TRL Advancement' panel features a circular diagram with 'Agricultural Project' at the center, surrounded by 'Occurrence indicator', 'Drought Analysis', and 'Regional impact analysis'. A bottom toolbar contains icons for Update, Review, View, and Download.

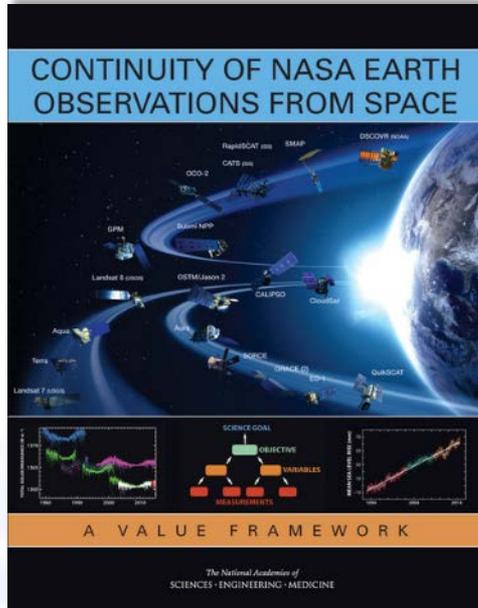


# FIREChem: A cooperative wildfire and air quality field study

- A NASA sponsored field study (July and August 2018) will focus on the links between satellite and ground-based measurements of both fresh and aged biomass burning emissions in the continental U.S..
- Efforts underway to coordinate with the NOAA FIREX and Joint Fire Science Program FASMEE field campaigns when possible. Also working with EPA and NSF.
- NASA project will include the Applied Sciences' Health & Air Quality applications area (and possibly Wildfires area)
- Current plan includes NASA DC-8 & B200 aircraft as well as ground-base mobile laboratories using *in situ* sampling and remote sensing to measure upwind and downwind of natural and agricultural fires.
- Goals: (1) improve our understanding of the transport of and chemical transformations in biomass burning plumes and their impact on air quality, and (2) improve the ability to incorporate wildfires into air quality forecast models.







<http://www.nap.edu/catalog/21789/continuity-of-nasa-earth-observations-from-space-a-value-framework>

*Of note:*

Study identified set of characteristics that enable a tractable evaluation of the benefit of measurement/quantified objective pair. They are:

1. The scientific *importance* (*I*) of the quantified objective;
2. The *utility* (*U*) of a geophysical variable record for achieving a quantified objective;
3. The *quality* (*Q*) of a measurement for providing the desired geophysical variable record; and
4. The *success probability* (*S*) of achieving the measurement and its associated geophysical variable record.
5. The *affordability* (*A*) of providing the measurement and its geophysical variable record.

$$V = (I \times U \times Q \times S) \times A$$

*One of the recommendations:*

NASA should initiate studies to identify and assess quantified objectives in Earth applications related to high-priority, societal-benefit areas.



## Steering Committee Roster

### CO-CHAIRS

**Dr. Waleed Abdalati**  
University of Colorado, Boulder

**Dr. Antonio Busalacchi**  
University of Maryland

### MEMBERS

**Mr. Steven J. Battel**  
Battel Engineering

**Dr. Dennis L. Hartmann**  
University of Washington

**Dr. Stacey W. Boland**  
Jet Propulsion Laboratory

**Dr. Anthony C. Janetos**  
Boston University

**Dr. Robert D. Braun**  
Georgia Institute of Technology

**Dr. Everette Joseph**  
University at Albany, SUNY

**Dr. Shuyi S. Chen**  
University of Miami

**Dr. Molly K. Macauley**  
Resources for the Future

**Dr. William E. Dietrich**  
University of California, Berkeley

**Dr. Joyce E. Penner**  
University of Michigan

**Dr. Scott C. Doney**  
Woods Hole Oceanographic Institution

**Dr. Soroosh Sorooshian**  
University of California, Irvine

**Dr. Christopher B. Field**  
Carnegie Institution for Science

**Dr. Graeme L. Stephens**  
Jet Propulsion Laboratory

**Dr. Helen A. Fricker**  
Scripps Institution of Oceanography

**Dr. Byron D. Tapley**  
The University of Texas at Austin

**Dr. William B. Gail**  
Global Weather Corporation

**Dr. W. Stanley Wilson**  
NOAA/NESDIS, Retired

**Dr. Sarah T. Gille**  
Scripps Institution of Oceanography

## STATEMENT OF TASK

Assess progress in addressing the major scientific and application challenges outlined in 2007 Earth Sci. Decadal Survey.

Develop prioritized list of top-level science and application objectives to guide space-based Earth obs. over a 10-year period

Identify gaps and opportunities in the programs of record at NASA, NOAA, and USGS in pursuit of the top-level science and application challenges—including space-based opportunities that provide both sustained and experimental obs.

Recommend approaches to facilitate the development of a robust, resilient, and appropriately balanced U.S. program of Earth observations from space.



## STATEMENT OF TASK, CONTINUED

For NASA, the committee will pay particular attention to prioritizing and recommending balances among the full suite of Earth system science research, technology development, flight mission development and operation, and applications/capacity building development conducted in the NASA Earth Science Division (ESD).

In particular, the committee will make recommendations on:

### ***ESD Portfolio***

The target budgetary balance between Flight and Non-Flight aspects

### ***Flight Portion***

Balancing new measurements against time series extensions of existing data sets (i.e., relative importance of continuing an existing mission with a follow-on and the initiation of a new mission/measurement)

### ***Non-Flight Portion***

Target balance between R&A, Applied Science, and Technology elements;

Any changes in scope(s) of the non-flight R&A, Applied Sciences, and Technology Development elements.

GEO is an intergovernmental organization working to improve the availability, access, and use of Earth observations to benefit society.

GEO is organizing efforts to coordinate observations from thousands of ground, airborne, in situ, and space-based instruments.

GEO focuses on Earth obs. for eight societal benefit areas, such as water, health, disasters, and agriculture.

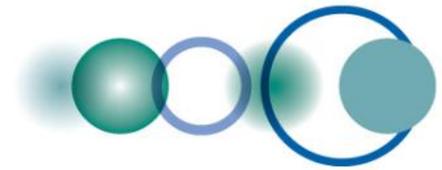


***Currently: 102 Members Countries and  
92 Participating Organizations.***



Recent Activities:

- » Ministers approved a new strategic plan for 2016-2025
- » World Bank became a new Participating Organization
- » New Work Programme structure
- » AmeriGEOSS initiated



## Societal Benefit Areas



**Disaster Resilience**



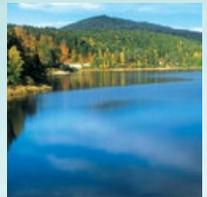
**Energy and  
Mineral Resources  
Management**



**Food Security and  
Sustainable  
Agriculture**



**Public Health  
Surveillance**



**Water Resources  
Management**



**Biodiversity and  
Ecosystem  
Sustainability**

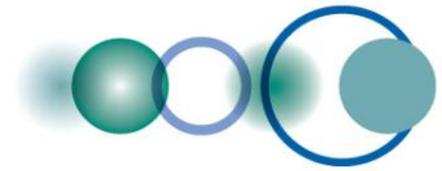


**Sustainable Urban  
Development**



**Infrastructure and  
Transportation  
Management**

*Note: Climate and weather cut across all SBAs*



# Global Wildfire Information System (GWIS)

Provide a platform for harmonized information and to enable the exchange and coordination of information among major national and regional fire information providers (e.g., existing systems in U.S., Canada, South Africa, Russia, Australia, and China).

GWIS seeks to link various national, global, and regional systems to make complementary Earth obs data on wildfires more readily available.

U.S. POC: Vince Ambrosia





## **News**

- » Jason-3 launch: 18 January 2016
- » Sentinel 3A launch: 16 February 2016
- » ASTER: Free and open data beginning April 1
- » China informed NASA that its TanSat satellite will not join the A-Train constellation. China did express interest to enhance data exchange and scientific cooperation.

## **Also**

June 6-10: MODIS VIIRS Science Team meeting

# Sustainable Development Goals



Sept. 2015: The UN General Assembly endorsed *The 2030 Agenda for Sustainable Development*, a global development agenda for all countries and stakeholders to use as a blueprint for progress on economic, social and environmental sustainability. 17 Goals and associated Targets and Indicators anchor the *Agenda*.

- » Opportunities in multiple SDGs to link Earth obs. and geospatial information to the indicators that will be used to assess the goals
- » Connections with statistics community on the Indicators
- » Near-term need for examples of how Earth obs can contribute to the goals
- » People needed to develop examples



## 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.

## 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.

## 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).

## Strategic Partnerships and Community Engagement

Freshwater availability, disasters, and food security are widely viewed as key global, societal challenges.

NASA Earth Science pursuing partnerships with leading organizations to address these issues and enhance societal benefits broadly.

Strong communications dimension to the partnerships



## Applications Handbook

Applied Sciences serves a fundamental role to advance global knowledge about effective ways to extend and apply science and inform decisions.

A maintained handbook would capture that knowledge and aid current and prospective project teams to better pursue applications and transitions.

### Possible Topics:

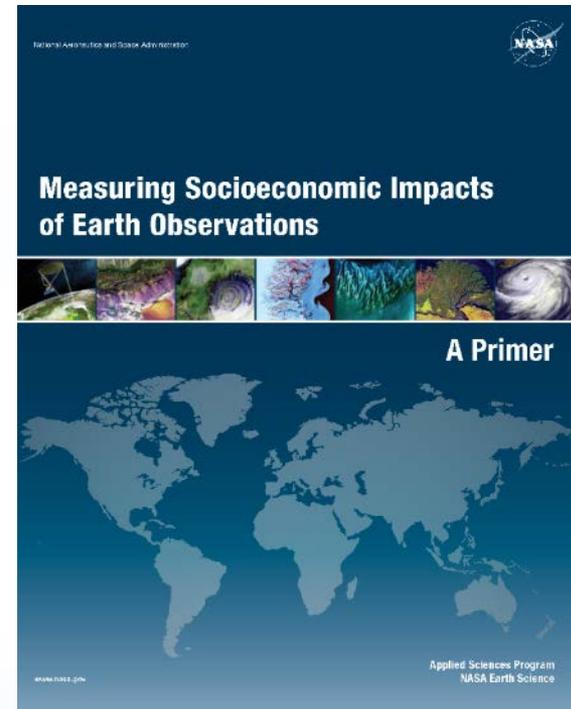
- » Key elements of applications
- » What an applications project is
- » Types of decisions & decision tools
- » Ways to address technical, behavioral, organizational barriers.
- » Performance measures/metrics
- » Approaches to manage projects
- » Decision process characterization
- » Common pitfalls
- » Impact assessment
- » Data access and integration
- » Good partnership practices
- » Communication practices (e.g., what makes a good testimonial)

## ROSES-15 A.45: Socioeconomic Benefits

Proposals to develop, implement, and manage a program of activities for the articulation of socioeconomic benefits of Earth science applications. Award is for a consortium of organizations to manage this program of activities. Two parts:

- » Impact Assessments
- » Earth Science Community Outreach (i.e., capacity building for E.Sci. community)

Goal: Advance analytic techniques and methodologies to determine the value and benefits (in social and economic terms) from the use of Earth obs. to inform decisions and associated actions. Generate examples across themes, types of decisions, sectors, etc.





## Expansive Approaches and Multipliers

Idea Factory

Matchmaking

Applications “Shark Tank”

Prizes & Contests

Foundation Funding

Kickstarter

Social Contracts

Partnershiping

Political & Technical Marriages

Indicators & Economic Indices

...



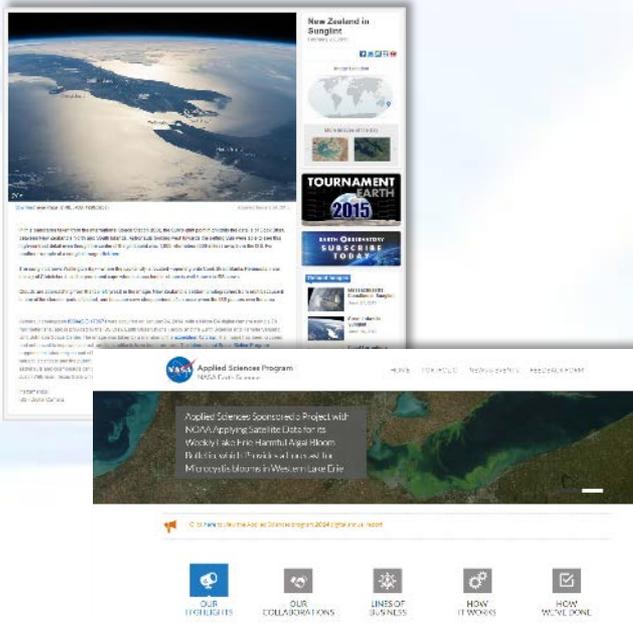
# Communications



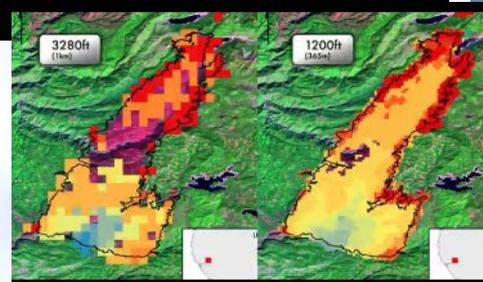
A significant emphasis on communications and outreach activities, especially to convey results to broad audiences.



## Website, Earth Observatory



## Videos



# In Search Of ... Project Highlights



Monthly, NASA Science Mission Directorate (SMD) senior management conducts a review of noteworthy advancements. Earth Science & Applied Sciences are always in need of project highlights for these SMD “monthly status reviews.”



## Substance Suggestions:

- » Accomplishments and major milestones.
- » The “ists”: First, longest, etc.
- » Things that directly affect daily lives
- » Addresses “Why now?” Needs a reason to be shown *now*
- » How NASA data improved something

Freilich Factors: He studies up a lot (reads the papers, Notes, background info); approaches it for the “teaching moment”

## Logistical Guidelines & Other:

- » One PPT slide
- » Arial font only, 14-pt or larger
- » Axes must have labels and units
- » Graphs, etc. must have a legend
- » Figures large enough to be legible
  
- » Put minimal text or bullets on a slide; increase size of images
- » Relegate most of text to “Notes”
- » A supplementary 1-page Word doc to explain issue & images is liked

# In Search Of ... Project Highlights



Monthly, NASA Science Mission Directorate (SMD) senior management conducts a review of noteworthy advancements. Earth Science & Applied Sciences are always in need of project highlights for these SMD “monthly status reviews.”



Nots:

- » Project description or summary by itself (without accomplishment)
- » Progress reports
- » Held a meeting or workshop (without impacts, significant findings, insights, importance)
- » Publications in journals known only to that field
- » No apparent application or management decision
- » Future activities (unless paired with actual accomplishment or major milestone)

Does each project want to “take a month” for the rest of 2016?

## Results

Factors to consider in articulation and communication of results

### **Earth Science Overall:**

- » What was the problem?
- » What did we do?
- » What did we learn? What came from our action?
- » What was the result?
- » What is the benefit and significance?
- » What is the new question(s) based on what we learned?

### **Applications:**

- » User group that clearly benefits and that can clearly state its benefits (and use of Earth observations)
- » Clear connection to NASA Earth science or Earth obs. of key partners
- » Context & anecdote that is clear
- » Substantive and specific testimonial (e.g., what decision was informed or changed; why is that significant)

# And ... But ... Therefore

ABT: And-But-Therefore

- » A framework and science communication tool.
- » A simple one-sentence, fill-in-the-blanks template

To find out more:

Book: *Houston, We Have a Narrative*

Video: *From Aristotle to South Park*

<https://www.youtube.com/watch?v=BfnxfNJRk7g>



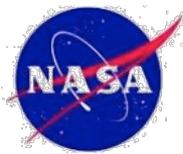
# And ... But ... Therefore

ABT: And-But-Therefore

- » A framework and science communication tool

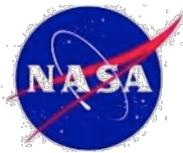


I can tell you the story of a little girl living on a farm in Kansas **AND** her life is boring, **BUT** one day a tornado sweeps her away to the land of Oz, **THEREFORE** she must undertake a journey to find her way home.



**Back-up Materials**

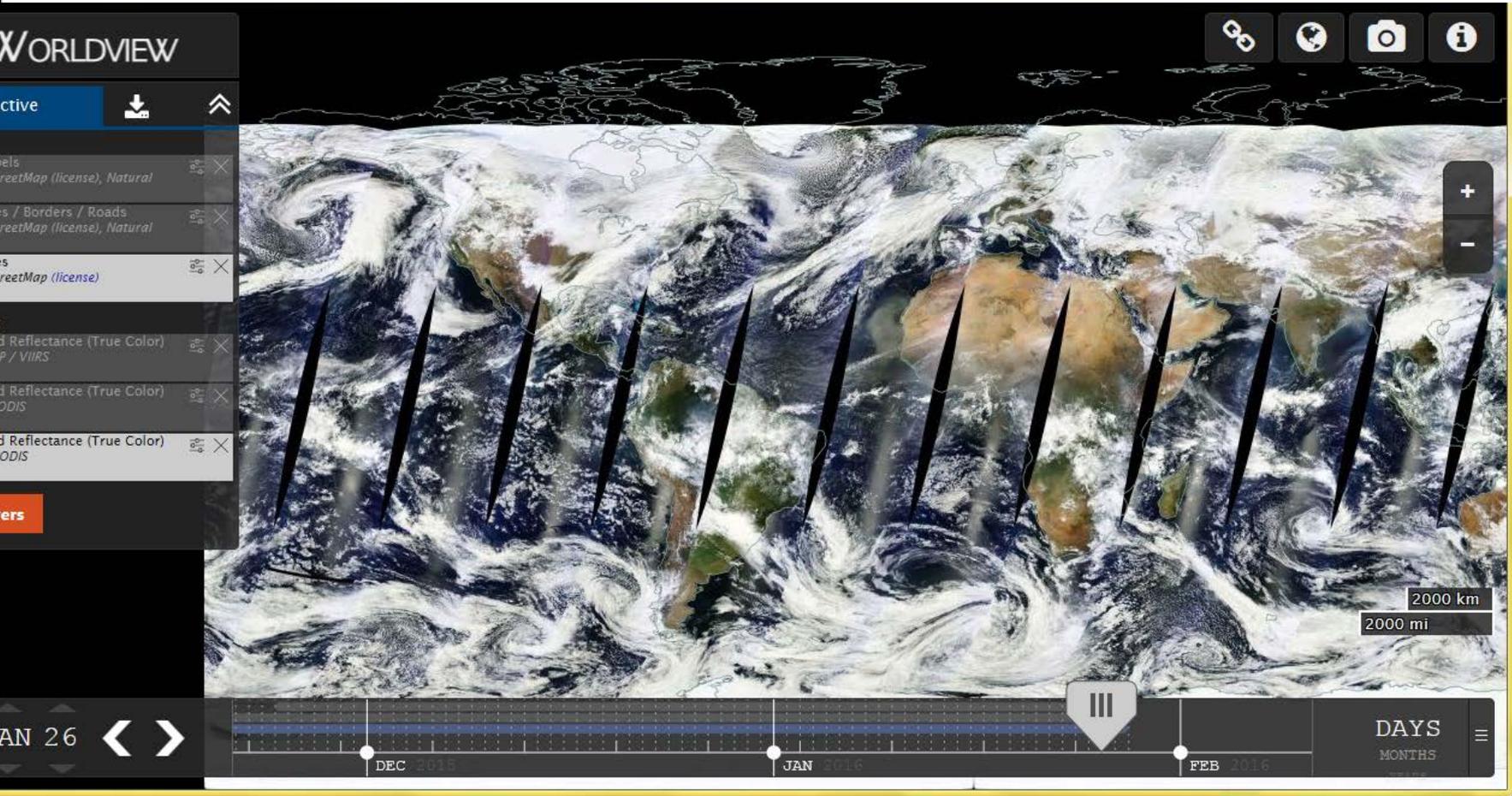
**Wildland Fires Team Meeting  
March 1-3, 2016**



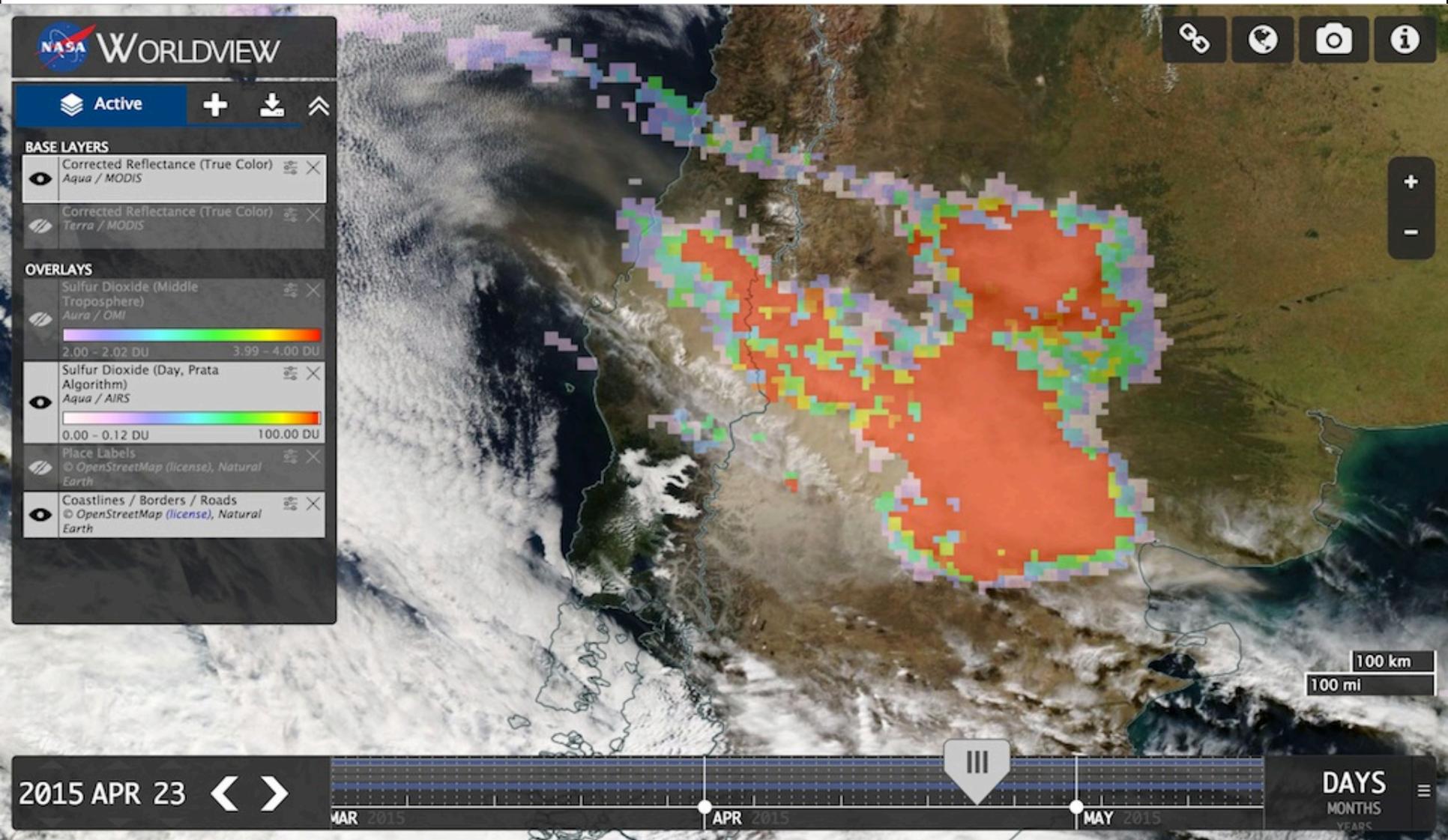
**Questions &  
Discussion**

**Wildland Fires Team Meeting  
March 1-3, 2016**

# Earth Science Data and Information



# Earth Science Data and Information



# Earth Science Data and Information



Discover Earth Science Data [Take a Tour](#)

Search NASA Earth Science data by keyword and filter by **time** or **space**.

Type any topic or collection name **Temporal** **Spatial**

[Browse All Data](#) [See featured collections or use categories to narrow your results.](#)

v 1.3.0 • NASA Official: Andrew Mitchell • FOIA • NASA Privacy Policy • USA.gov Earthdata Access: A Section 508 accessible alternative

# Earth Science Data and Information



The screenshot displays the Earthdata Search web application. At the top, the browser address bar shows the URL <https://search.earthdata.nasa.gov/>. The page header includes navigation links for "Data Discovery", "DAACs", "Community", and "Science Disciplines". A search bar is prominently featured with the text "Type any topic or collection name" and filters for "Temporal" and "Spatial".

The main content area is divided into three sections:

- Browse Collections:** A sidebar on the left lists various categories with their respective counts: AGRICULTURE (1835), ATMOSPHERE (7132), ATMOSPHERE-BIOSPHERE IN... (1), BIOLOGICAL CLASSIFICATION (4138), BIOMASS (1), BIOSPHERE (2), BIOSPHERE (8769), CLIMATE INDICATORS (540), CRYOSPHERE (3005), and HUMAN DIMENSIONS (3850).
- 31139 Matching Collections:** The central panel displays the search results. It includes a "Recent and Featured" section with four highlighted items:
  - 1 Kilometer Land Cover Product from the University of Maryland:** GLOF\_GLC\_1km v1.0, 1981-01-01 to 1994-01-01 | Collection only.
  - MODIS/Terra Aerosol 5-Min L2 Swath 10km V005 NRT:** MOD04\_L2 V5 - LAADS, 2014-12-25 ongoing | 1337 Granules.
  - MODIS/Terra Snow Cover 5-Min L2 500m V005 NRT:** MOD10\_L2 V5 - LAADS, 2014-12-25 ongoing | 1578 Granules.
  - Satellite Landsat TM Extr. Data (FIFE):** doi:10.3334/ORNLDAAAC/78 v1 - ORNL\_DAAC, 1987-04-09 to 1988-09-28 | 13 Granules.
- More Collections:** A section below the featured items shows "Background Air Pollution Monitoring Network - Measurements of Greenhouse Gases (Canada)" with details: CANEMRCCRSBAPMN vNot provided, 1975-01-01 ongoing | Collection only.

On the right side of the interface, a satellite map of North and South America is visible, with a scale bar indicating 1000 km and 500 mi. The footer contains the version number "v 1.9.0" and links to "NASA Official: Andrew Mitchell", "FOIA", "NASA Privacy Policy", and "USA.gov".



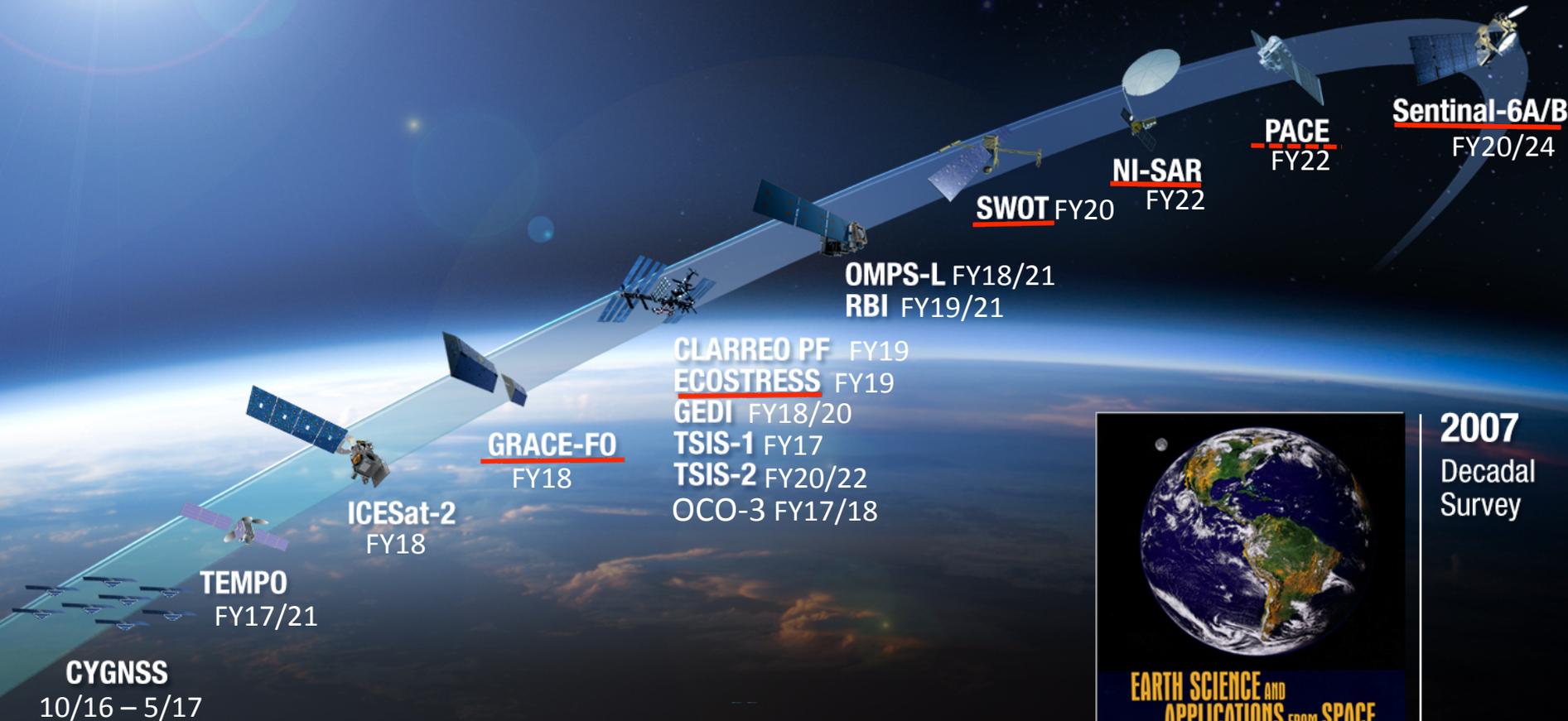
# NASA Earth Science

*March 1-3, 2016*

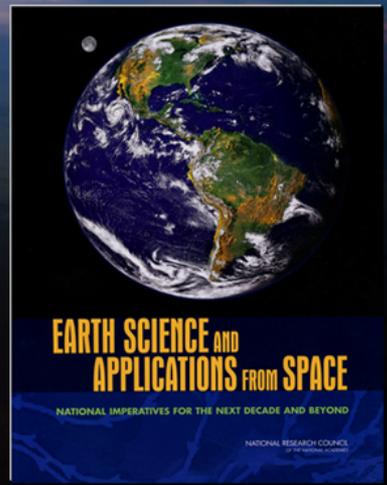
*Boise, ID*

# Wildland Fires Team Meeting

# Earth Science



**2007**  
Decadal  
Survey



# NASA Earth Science: Current Operating Missions

Jason-3  
(NOAA)

OSTM/Jason 2  
(NOAA)

QuikSCAT

Terra

ISS: RapidScat,  
CATS

Landsat 7  
(USGS)

EO-1

SMAP

Aqua

NISTAR, EPIC  
(NOAA's DSCOVR)

Suomi NPP  
(NOAA)

SORCE,  
TCTE (NOAA)

Landsat 8  
(USGS)

Aura

GRACE (2)

GPM

CALIPSO

OCO-2

CloudSat

- Formulation
- Implementation
- Primary Ops
- Extended Ops

# NASA Earth Science: Current and Upcoming Missions

