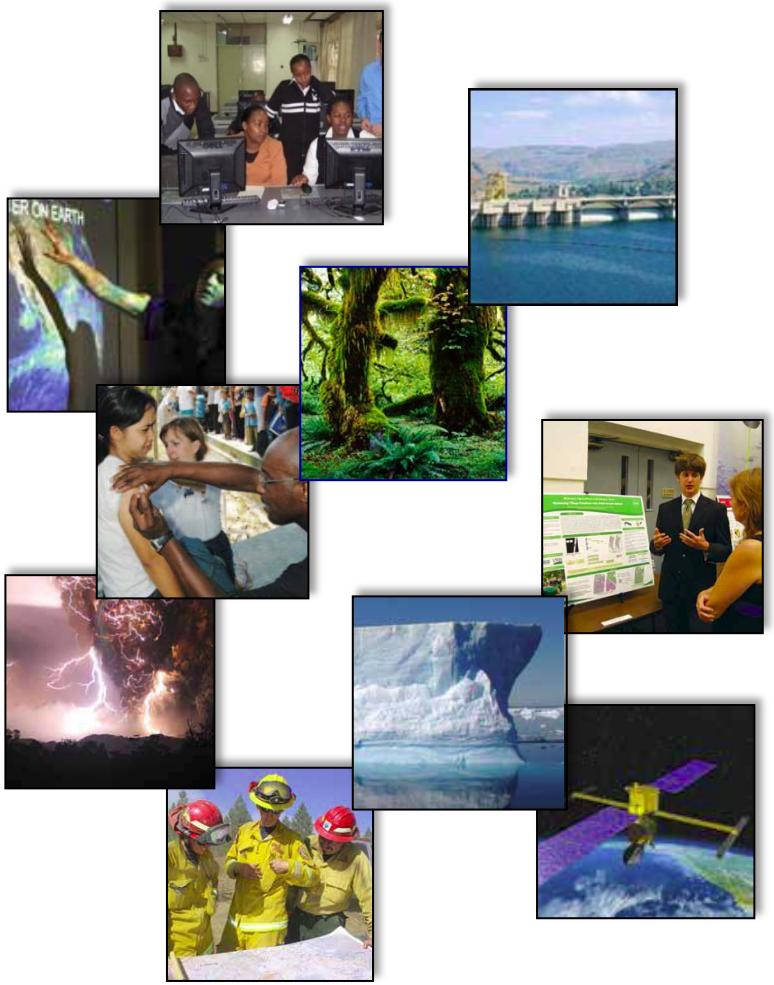
Science Mission Directorate
Earth Science Division

NASA Earth Science Applied Sciences Program

Making Space For Earth

CESAS Meeting

March 2016



Topics

I. Earth Science & Applications

II. Applied Sciences

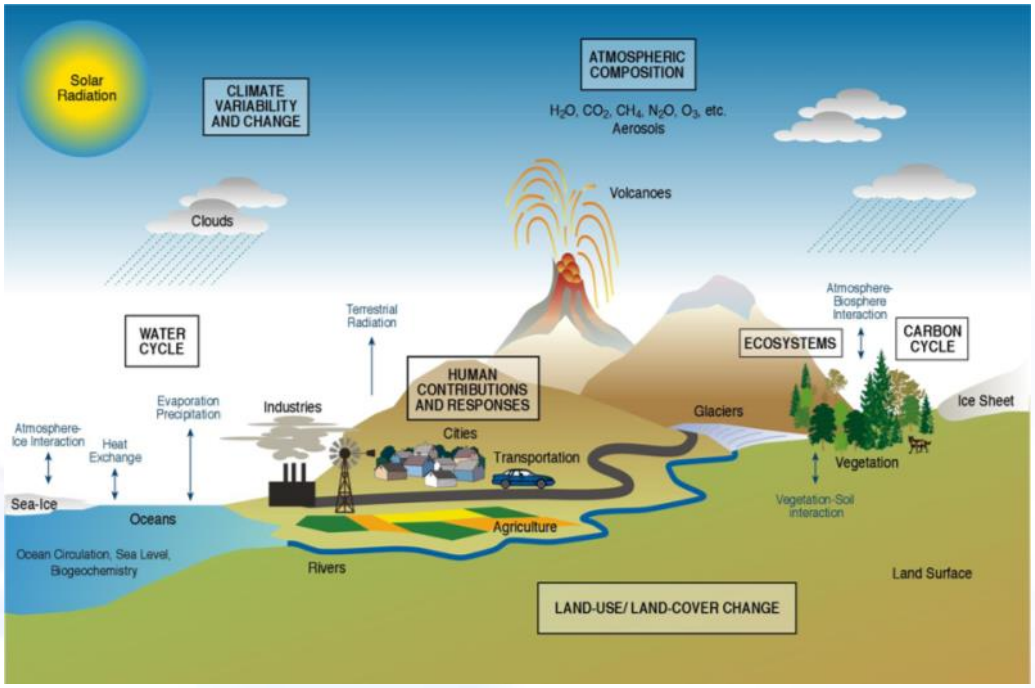
III. Disaster Response

IV. GEO & G20

V. USGEO Satellite Needs Process

VI. UN Sustainable Development Goals

NASA Earth Science



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

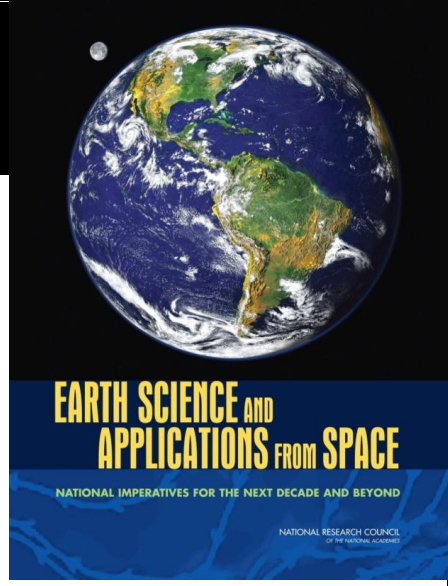
Research

Data Systems

Education

Applications

Earth Science & Applications from Space

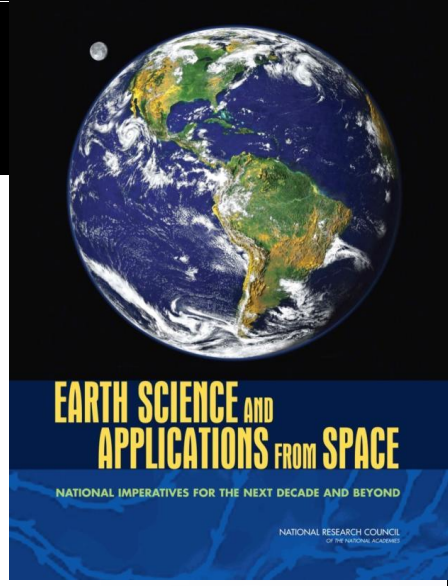


The national strategy outlined here has as its overarching objective a program of scientific discovery and development of applications that will enhance economic competitiveness, protect life and property, and assist in the stewardship of the planet for this and future generations.

… a decadal program of Earth science research and applications in support of society – a vision that includes advances in fundamental understanding of the Earth system and increased application of this understanding to serve the nation and the people of the world.

2007 Earth Science Decadal Survey

Earth Science & Applications from Space



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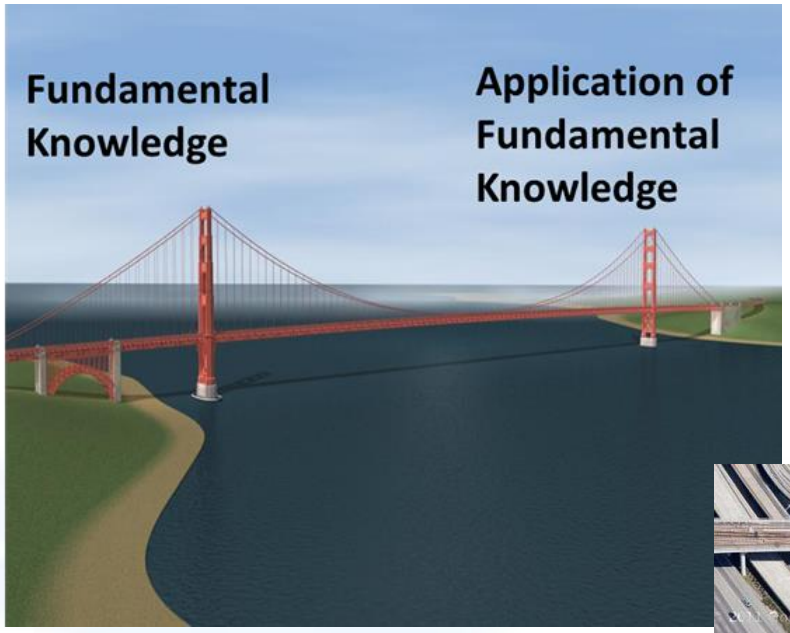
2007 Earth Science Decadal Survey

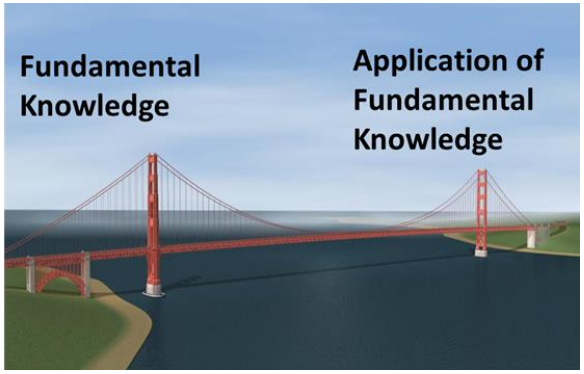
NASA defines science to include research, applied research, and applications.

The relative emphasis on each is unique to an individual investigation.

Research, Applied Research and Applications



Research, Applied Research and Applications



Supply: Is Relevant Information Produced?	Demand: Can User Benefit from Research?	
	YES	NO
NO	Research agendas may be inappropriate.	Research agendas and user needs poorly matched; users may be disenfranchised.
YES	Empowered users taking advantage of well-deployed research capabilities.	Unsophisticated or marginalized users, institutional constraints, or other obstacles prevent information use.

D.Sarewitz and R.Pielke Jr, 2007. The neglected heart of science policy: Reconciling supply of and demand for science.

Applied Sciences Program: Lines of Business

Societal & Economic Applications

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

Capacity Development

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

Innovative and practical uses of Earth observations

Applied						
$K	FY16 (op plan)	FY17	FY18	FY19	FY20	FY21
FY16 PBS	$ 48	$ 49	$ 48	$ 48	$ 49	
FY17 PBS		$ 48	$ 48	$ 49	$ 51	$ 52

Applications
Health & Air Quality
Ecological Forecasting
Water Resources
Disaster Applications & Response Team
Wildfires (through FY17)

Capacity Building
SERVIR (joint with USAID)
ARSET, Applied Remote Sensing Training
DEVELOP

Satellite Mission Planning
Early Adopters, Apps. Workshops

Program-wide
Socioeconomic Impact Analyses
Community Utilities (ESIP, NEX, etc.)
Communications; GEO and USGEO Support

President's FY17 Budget Request

- **Re-establishes funds for full SERVIR Applied Sciences Team FY16-18; expands Team in FY19-21 for increase to 6 SERVIR hubs by 2018**
- **Increases funding for Applications Areas (via internal re-allocation)**
- **Implements Snow & Water Availability focused activity for Western States**
- **Implements Food Security Consortium**
- **Implements Disaster Response Plan for increased preparation-based approach**
- **Continues activities to develop techniques to quantify social and economic benefits from Earth science applications**

Applications Areas

Emphasis in 5 Applications Areas

Health & Air Quality

Water Resources

Ecological Forecasting

Disasters

Wildland Fires (through 2017)

Support opportunities in additional areas

Agriculture / Food Security

Energy

Transportation

Climate & weather play into all themes

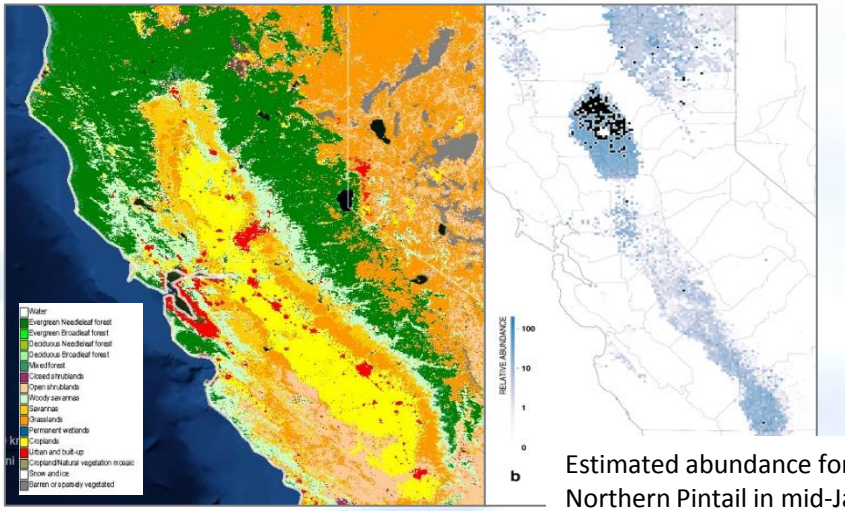
BirdReturns: Earth Obs Informs Reverse Auction to Increase Habitat for Migrating Waterbirds

TEMPORARY HABITAT COSTS **LESS THAN ONE PERCENT** OF THE PRICE FOR PURCHASING CONSERVATION LAND.

300+

bird species use the Pacific Flyway

BIRD OBSERVATIONS LOGGED WITH eBird



Estimated abundance for Northern Pintail in mid-Jan.

MODIS and ASTER data combined with citizen science reports from eBird drive bird habitat models and help TNC identify the best bird habitats

TNC uses a Reverse Auction:

» Farmers submit bids to flood their fields during spring and fall migration

» TNC reviews bids on price, migration projections, and other factors

» TNC selects the best fields to flood for habitat at the best price; pays farmers.

» And, farmland is only idle during migration

30,000 acres — *Cumulative total of temporary wetlands gained by end of 2015*

Programmatic Mechanisms: Two Examples

Applied Science Teams

Purpose: Flexibility and agility to extend research findings, data products, and techniques to managers and decision makers; increase throughput. Engage managers in identifying new research/applications topics.

Teams: Researchers and applied scientists. Explicitly charged with interacting routinely with managers in the field to listen, collaborate, and address key topics of emerging and urgent need. Can also identify data products and provide feedback to ESD research & missions.

Team Members – two roles:

» Work long-term apps or applied research
» Support short-term, quick-response efforts in ad hoc sub-groups (aka, Tiger Teams)

Two Teams Currently:

SERVIR Applied Sciences Team

Air Quality Applied Sciences Team (http://aqast.org)

Feasibility-to-Applications Projects

Purpose: Generate numerous applications ideas and focus investments on those with high-reward potential. Prioritize partners' "skin-in-the-game" to increase their involvement in project and support adoption.

Two-stage Approach:
Support studies of possible ideas with a year to work applications concept with partner. After a year, select a subset to pursue as in-depth applications projects

Year	Stage	Activity	NASA Share	Partner Share
Year 1	Feasibility	Prove out application potential	100%	Optional
Year 2	Decision Support	Develop application	~80%	~20%
Year 3	Decision Support	Continue development	~60-70%	~30-40%
Year 4	Decision Support	Complete application and transition	~30-40%	~60-70%

Partner Share in Years 2-4:

Wildfires: 49% of funding

Disasters: 31% of funding

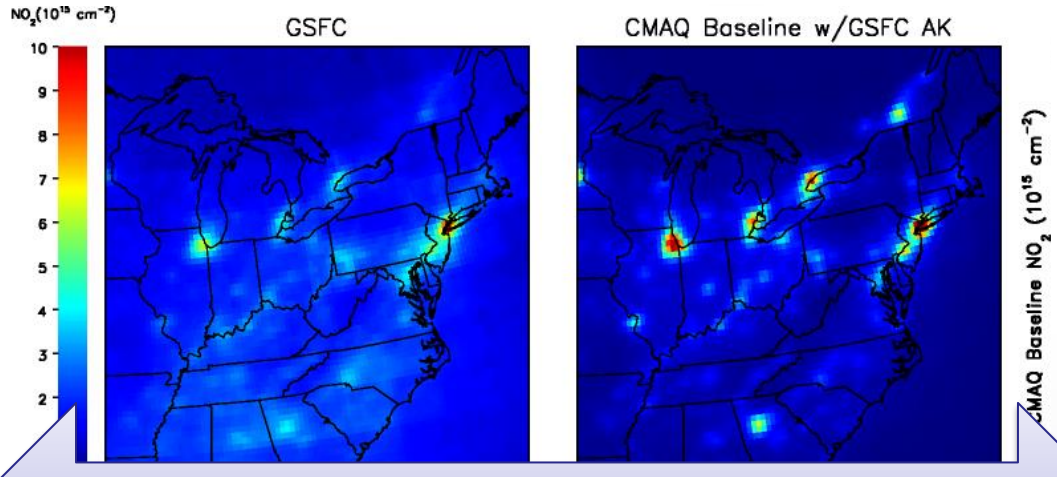
Water: 46% of funding

ESD Air Quality Applied Sciences Team:
Changing the way States use satellite data

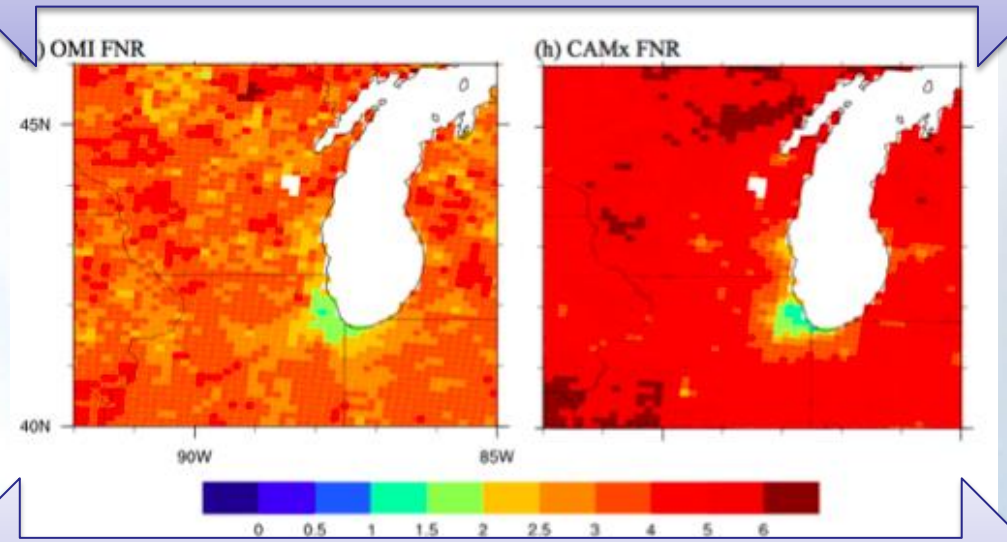
- Through support from AQAST, States now use OMI NO_2 data to evaluate regional air quality models. These models are used to support policy evaluation, so accuracy is important

- Work in Maryland found that that NO_2 lifetime is under-estimated in the models

- Work in the Upper Midwest found that the models over-estimate ozone sensitivity to NO_x

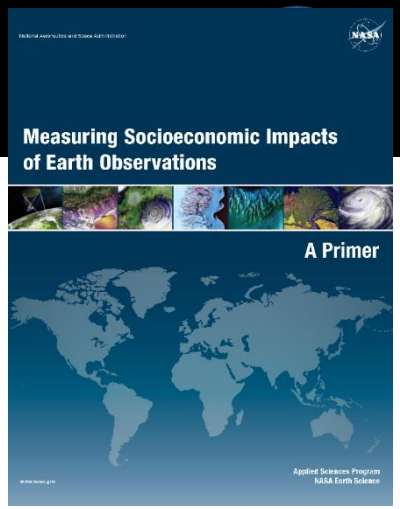


Satellite NO_2 (left) vs. Model NO_2 (right)
Powerful new way for evaluating policy models



Satellite (left) vs. Model (right), ratio of HCHO to NO_2
What controls smog production? Yellow/red = NOx sensitive

Socioeconomic Impacts



The Program conducts impact analyses of selected projects to assess the value and benefits (in social and economic terms) from uses of Earth obs. to inform decisions and associated actions.

- Strategically important for Earth science community to have skills & abilities (or know how to access them) to document impacts
- Part of effort is bridging the social sciences & economic fields with the Earth science and physical science fields.

Primer's Purpose:

Inform the Earth science community and project teams about the language, key principles, techniques, and applications of socioeconomic impact analyses.

ROSES-15 A.45:
Socioeconomic Benefits

Award(s) is for a consortium to manage a program of activities. Two parts:

- Impact assessments & techniques
- Outreach to Earth Science community on economic and policy terms and concepts

Terminology Transfer in Interdisciplinary Work

Economics & Policy Analysis

- Marginal Cost
- Shadow Price
- Discount Rate
- Contingent Valuation
- Cobb Douglas Function
- Revealed Preference
- Marginal Utility
- Price Elasticity
- Net Present Value

Earth Science, Remote Sensing, GIS

- Spectroradiometer
- Synthetic Aperture Radar
- Normalized Difference Vegetation Index
- Nearest Neighbor
- Supervised Classification
- Passive Microwave
- Backscatter
- Orthorectification
- Data Assimilation

Terms shared by both (though meanings may differ)

- Productivity
- Kriging

Capacity Building Program Element

The Capacity Building program improves the capabilities of individuals and institutions in the US and abroad, especially in developing countries, related to accessing and applying Earth observations. This context includes human, scientific, technological, organizational, institutional, and resource-based capacities.

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.

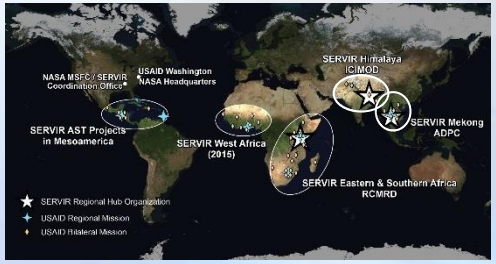
2015:
393 Participants,
93 Projects,
156 Partners

ARSET, Applied Remote Sensing Training, builds skills in accessing and using Earth observations data across applications topics through computer-based training for government and private sector individuals.

2015: 2,877 trainees; all 50 states

SERVIR is a NASA NASA/USAID-sponsored initiative that enables uses satellite observations to help developing nations monitor, forecast, and respond to environmental changes.

USAID FROM THE AMERICAN PEOPLE



ARSET: Applied Remote Sensing Training

http://arset.gsfc.nasa.gov

Increase utilization of Earth obs. and models for decision-support through training activities for professionals.

Topics:
Water, disasters, air quality, wildfires, land management, conservation, GPM, snow, drought, NASA data products and portals, and special topics. Health coming in 2016.

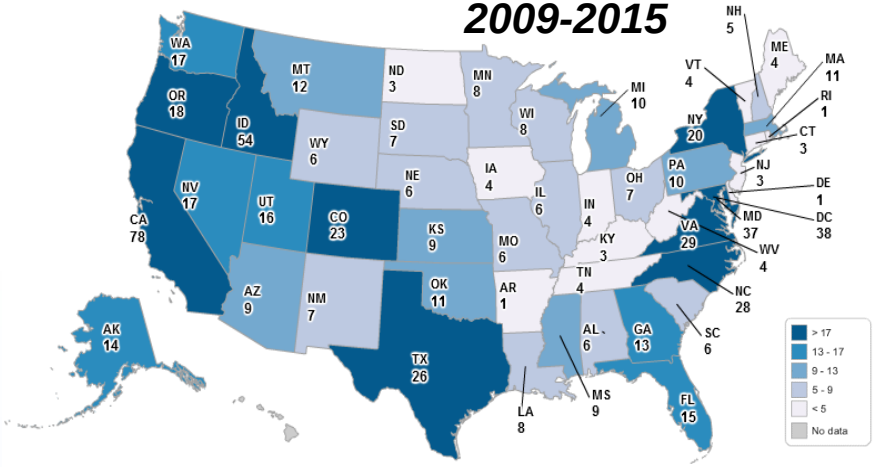
Online courses: Live and recorded, 4-6 weeks in length.

In-person training courses:
In a computer lab, 2- 4 days in length.

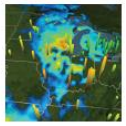
Train the Trainers: Courses and training manuals for organizations interested in conducting their own remote sensing training.

2015: 2,877 trainees.
More than 2009-2014 combined

2009-2015



Air Quality



- Monitoring atmospheric aerosols and trace gases
- Long range transport of pollutants
- Satellite and regional air quality model comparisons
- Long-term air quality trends

Disaster Management

- Earthquakes
- Floods
- Hurricanes
- Landslides
- Oil Slicks

Land Management

- Conservation
- Biodiversity
- Land cover mapping
- Habitat monitoring
- Animal movement

Water Resources

- Rainfall
- Snow cover
- Soil moisture
- Runoff and groundwater
- Evapotranspiration
- Atmospheric humidity

Wildfire Management

- Pre- and post-burn characteristics
- Vegetation indices
- Normalized burn severity
- Near real-time smoke and fire detection
- Burned area extent

Contact Us

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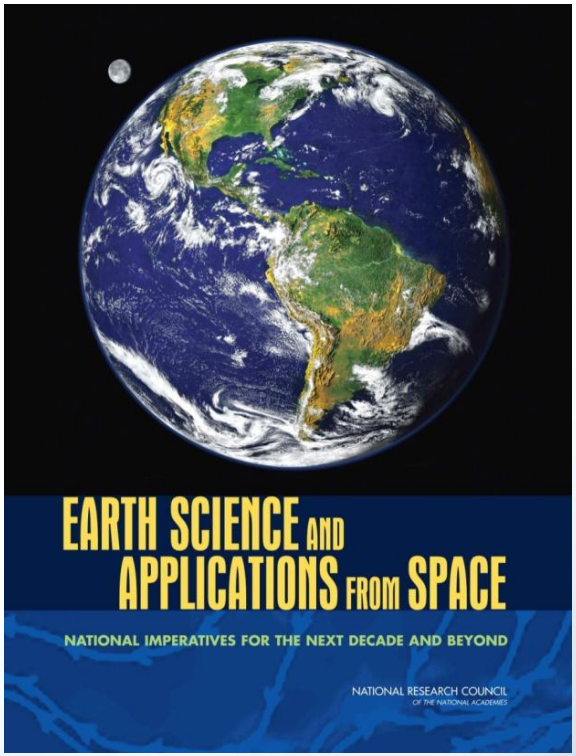
Brock Blevins: brockbl1@umbc.edu

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
» Early Adopters
» Mission Applications Plans
» Applications Traceability Matrices
» Webinars
» Tutorials



Earth Science Missions – Early Adopters

Early Adopters

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

Organizations with clearly-defined needs for mission data products evaluate and demonstrate the utility of the 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

EA Video: https://youtu.be/e6WGTRmsPVg

SMAP: 50+ orgs are EAs from public and private-sectors, domestic & foreign

Earth Science Missions – Early Adopters

"The Early Adopters program has gotten whole other organizations and industries enthusiastic about the mission. Their early engagement with the mission insures their benefits will be available much sooner than would otherwise be the case."

– Kent Kellogg, *SMAP*

Other Missions Pursuing Early Adopters Programs

- *ICESat-2: EA program has started. Now has bi-annual calls for EAs*
- *SWOT: EA program planned*
- *PACE: EA program planned*
- *NI-SAR: Similar program through SAR is not a new type of measurement*

Earth Venture: EVM-2 AO the first with an applications requirement

Text from EVM-2 AO:

For this EVM-2 solicitation, NASA places a strong emphasis on research and innovation for Earth system science issues, while expecting appropriate attention to applications-oriented aspects to further the overall value of the mission. (Section 2.3)

Part of Requirement:

For this EVM-2, NASA places the highest priority on research and innovation for Earth system science issues. However, proposals must also articulate, to the extent possible, a plan to address applications-oriented users for their measurements, investigation, and data products.

Applications in Criteria

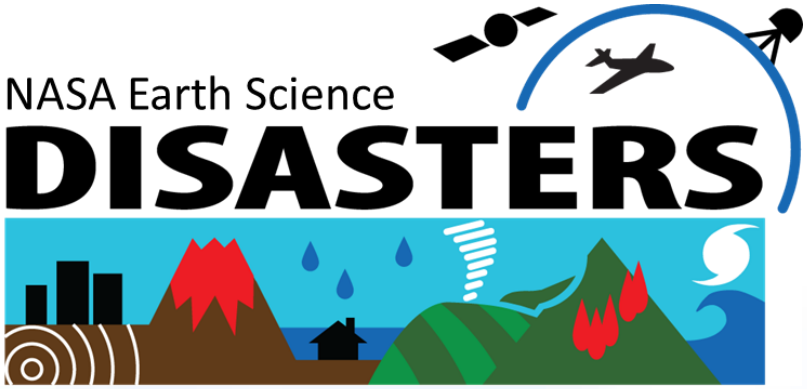
Factor A-1 on investigations goals & objectives
Factor A-2 on programmatic value
Factor B-1 on instruments and mission design
Factor B-3 on data analysis, availability, plan

Highlights

- Intention is to provide data and info products to key applications user groups
- Proposed investigation does not need to "conduct an applications project"
- Expectation is a plan to support and enable applications projects by others
- Encourage proposal team to engage, talk with, and listen to people from relevant applications communities
- If no applications are possible, burden of proof is on proposer to justify

Disaster Response Support

NASA Earth Science



Science for Disaster Risk Reduction and Resilience

Multi-hazard and Global

Preparatory-based Approach

Earth Science Support to Disaster Responders

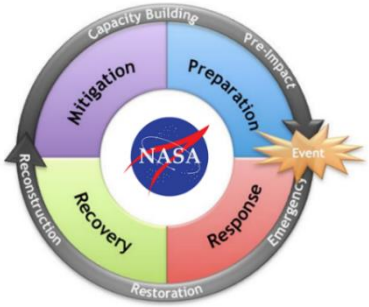
Disaster Response Support
NASA Earth Science Division

Program Manager: David Green
David.S.Green@nasa.gov

Disaster Response Program

NASA Earth Science

- Coordination and collaboration informing brokers, managers, and responders with critical products and services
- Monitoring hazard impacts; Mapping damage and impacts; Rapid dissemination of data and model products; Interfacing with response organizations
- Disaster application science answering questions and supporting decisions: EO data and research results as environmental intelligence
- Creation and leverage of partnerships strengthening and enabling effective response throughout the disaster lifecycle



Elements

NASA Center Disaster Response Coordinators

Cross-Center Facilitation Playbooks and Exercises

Solicitations, Directed projects, and Rapid Response projects

Interagency, International Operators, Researchers & Public Sector Agreements and Decision Support

External:
Communications, Education and Outreach, Workshops, Dissemination

Internal:
Administrative & Management Event and Action Tracking, Performance Evaluation, Communications

Rapid Assessment and Tiers of Disaster Response

Assessment: 30-50 events per year
Tier 1: 10-30 events per year
Tier 2: 3-10 events per year
Tier 3: 0-3 events per year

Assessment

Rapid Hazard Assessment Expected

- Centers and program experts to contribute within scope of daily activity
- Guidance to elevate to Tier response, direct to research or no action
- Days

E.g.: media report

Tier 1

Response and Recovery Short Term and Best Effort

- Centers and programs respond as available with only minor impact to existing/on-going activities
- Detailed assessment and products scaled to modest response
- Weeks to Month(s)

E.g..: Napa Earthquake (2014), Chile Earthquake (2015), Oklahoma tornadoes, yearly floods

Tier 2

Significant Contributions Over Extended Period

- Contributions are considerable given continual assessment of size and scale of impact
- Personnel relevant to disaster type (s) expected, tasked, and assigned to support
- Data and products adapted into recovery
- Weeks to Month(s)

E.g.: Nepal Earthquake (2015), Deep Horizon (2010), Eyjafjallajökull Eruption (2015)

Tier 3

Disaster is of major national importance

- All relevant personnel expected to review activities for level of support to the disaster and/or be on-call
- Assets and personnel may specifically assigned and tasked for lengthy time period (Months into recovery).

E.g.: Hurricane Katrina (2005), September 11, 2001 attacks

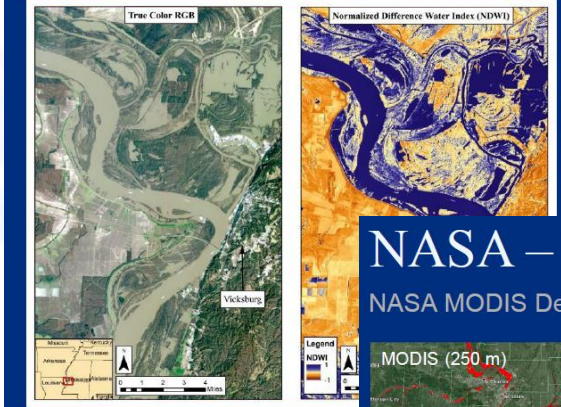
Tier 1:
Midwest Flood, January 2016

NASA Earth Science

Enabling End-to-end Response
Multiple Sensors, Models and Maps to Answer Critical Questions

NASA - Remote Sensing of Flood

Multispectral Views from NASA's Earth Observing-1 Mission



NASA staff at Goddard Space Flight Center and Marshall Space Flight Center targeted collections of imagery by NASA's Earth Observing-1 (EO-1) mission.

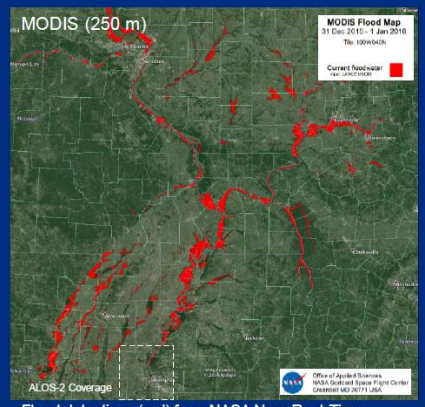
Multispectral imaging by EO-1 provides true color imagery (left) and capabilities for derived products (right), and can also be applied to Landsat-7 and Landsat-8 missions, Aqua and Terra MODIS, Suomi-NPP VIIRS, and other

True color (left) and Normalized Difference Wa
derived from NASA's Earth Observing-1 missic
Vicksburg, Mississippi on 17 January 2016.

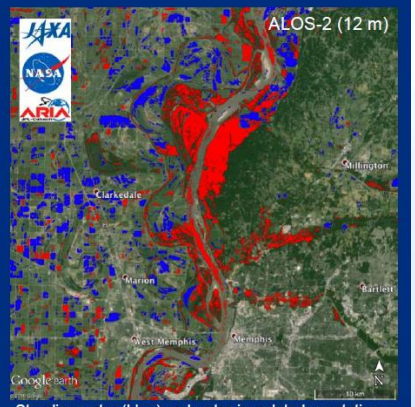
FEMA

NASA – Remote Sensing of Flood

NASA MODIS Detections and JAXA ALOS-2 Synthetic Aperture Radar



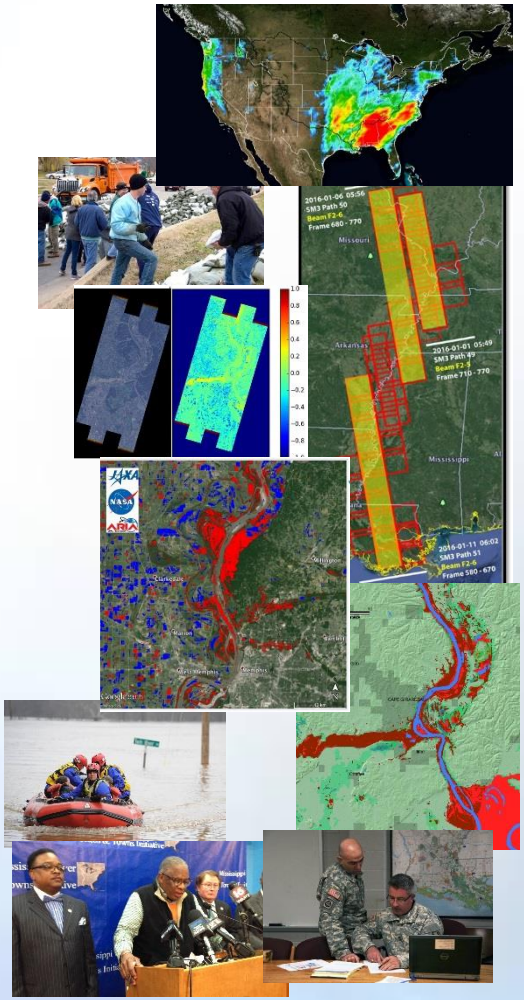
Flood detections (red) from NASA Near Real-Time Global Flood Mapping with flood extent on January 1, 2016, courtesy of Goddard Space Flight Center.



Standing water (blue) and water-inundated vegetation (red) detected by ALOS-2 and the Synthetic Aperture Radar (SAR) at the Jet Propulsion Laboratory, January 6. Coverage area shown as dashed inset of MODIS image.

FEMA

Christopher Vaughn February 4, 2016



HURREX Hurricane Exercise: Creates Pull for NASA Data

NASA Earth Science

Simulated response to a Category 3 hurricane hitting Houston shipping channel

Brought together U.S. Coast Guard, NOAA, EPA, Texas state & local authorities

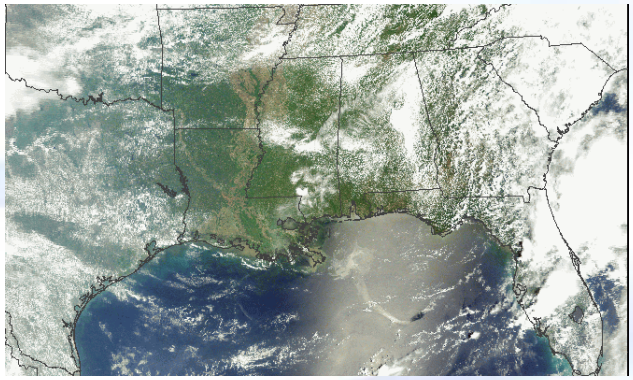
NASA on-the-spot demo of available data; USCG requests routine access to the data

NASA Delivers

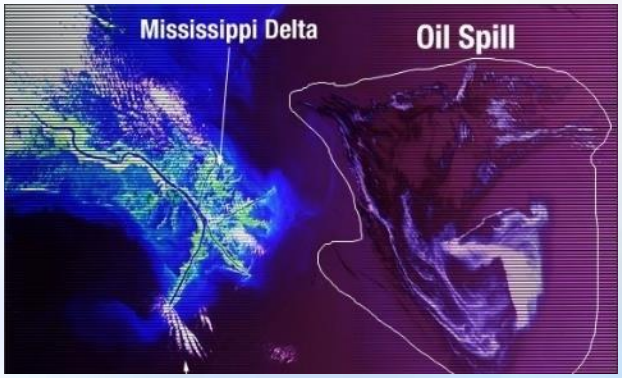
- MSFC developing web viewer to readily serve NASA images & data to USCG
- Next exercise in April will incorporate beta version of viewer

Requested Data

- ALOS-2, Sentinel-1 and airborne UAVSAR data
- MODIS, VIIRS, Landsat, ASTER, and other optical imagery

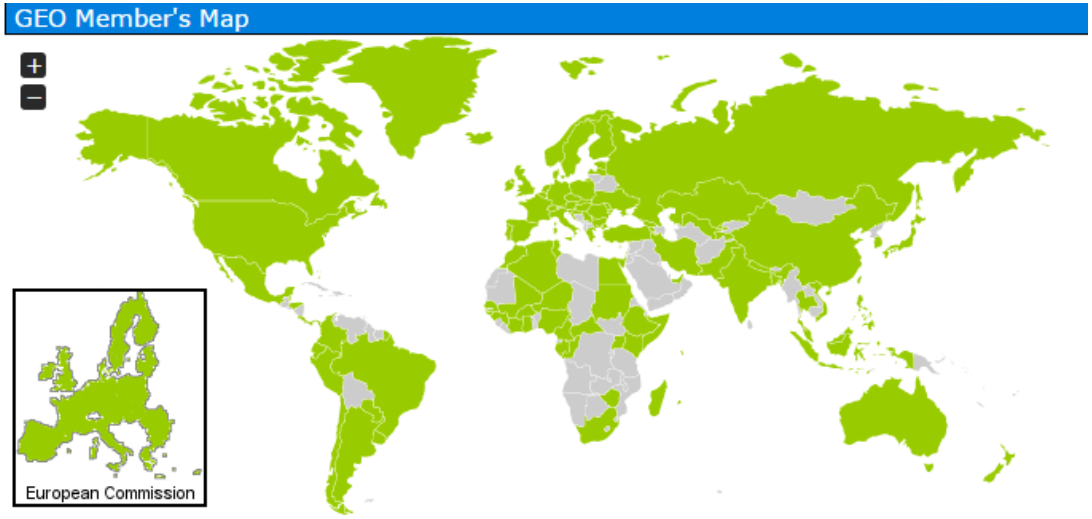


Terra MODIS True Color RGB
(NASA/MSFC)



Landsat-7 ETM+ False Color RGB
(USGS/NASA GSFC)

GROUP ON EARTH OBSERVATIONS



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

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

NEW Set of eight societal benefit areas:
Water, Health, Disasters, Agriculture, Energy, Biodiversity and Ecosystems, Urban Resilience, Transportation and Infrastructure.

Note: Weather and climate serving all areas.

Currently: 102 Members Countries and 92 Participating Organizations.

Recent Activities:

- Ministers approved a new strategic plan for 2016-2025
- World Bank and Future Earth became new Participating Organizations
- New Work Programme structure
- AmeriGEOSS initiated

GROUP ON EARTH OBSERVATIONS

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

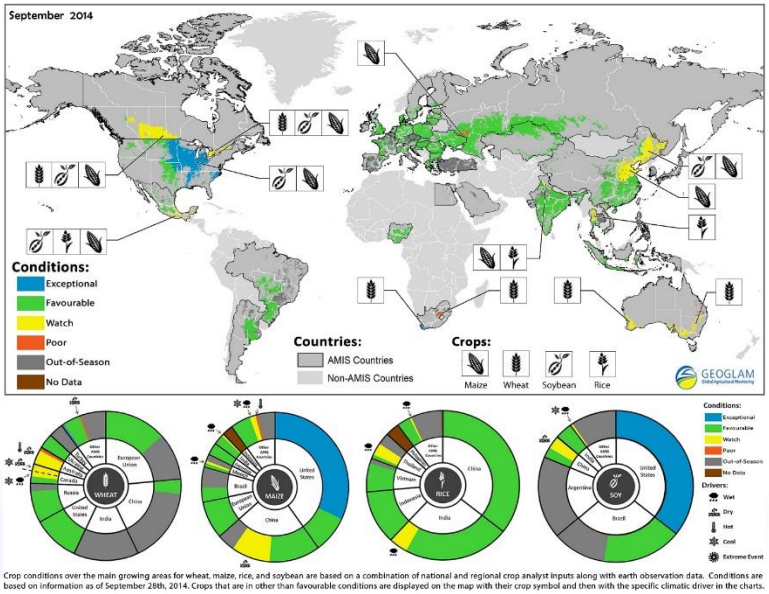
Sustainable Urban Development

Infrastructure and Transportation Management

Note: Climate and weather cut across all SBAs

GEOGLAM

Enhance the quality, reliability, accuracy, timeliness and comparability of food market outlook information.



Crop conditions over the main growing areas for wheat, maize, rice, and soybean are based on a combination of national and regional crop analyst inputs along with earth observation data. Conditions are based on information as of September 28th, 2014. Crops that are in other than favourable conditions are displayed on the map with their crop symbol and then with the specific climatic driver in the charts.

Mandate from G20 Ministers

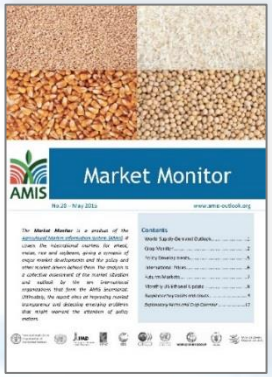
G20 FRANCE 2011

G20 Final Declaration

44. We commit to improve market information and transparency in order to make international markets for agricultural commodities more effective. To that end, we launched:

- The "Agricultural Market Information System" (AMIS) in Rome on September 15, 2011, to improve information on markets ...;
- The **"Global Agricultural Geo-monitoring Initiative" (GEO-GLAM)** in Geneva on September 22-23, 2011. This initiative will coordinate satellite monitoring observation systems in different regions of the world in order to enhance crop production projections and weather forecasting data.

http://www.amis-outlook.org/amis-monitoring



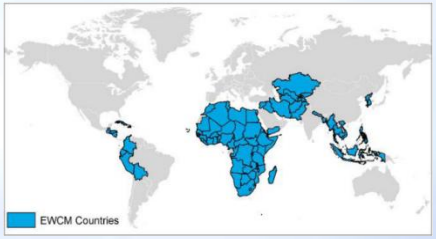
Market Monitor:
Monthly publication read by traders, policy analysts, ag economists, etc.

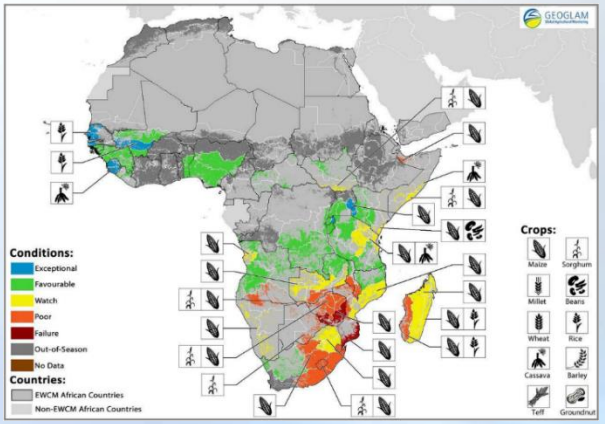
Rice, Wheat, Maize, Soybeans

Crop conditions for main growing areas based on a combination of national and regional crop analyst inputs along with Earth satellite observations data.

New in 2016: Early Warning Crop Monitor

Serves at-risk countries





United States
Group on
Earth Observations

USGEO:
Satellite Needs Process

SNProcess Summary I

In FY16 budget, OMB assigned NASA the responsibility for all civilian Earth-observing satellites (sans NOAA for weather and space weather).
OMB guidelines allow on this responsibility allow agencies to provide inputs to NASA for consideration of their needs for sustained measurements.

USGEO developed a Satellite Needs Process, conducted annually:

1. User agencies identify their needs
2. USGEO Sat. Needs Working Group (SNWG) compiles inputs; USGEO provides inputs to NASA
3. NASA reviews inputs; interacts with agencies as needed; makes decisions

Output: NASA informs agencies of decisions; provides explanation to OMB/OSTP on how it addressed inputs

NASA Role/Responsibilities

The agencies' needs serve as inputs into NASA decisions on which satellite measurements to fund. NASA develops its own process to assess the input.

NASA engages user agencies in trade-offs of end-to-end costs, capabilities, and risks to see to what extent it can serve the need. Where responsibilities are shared (e.g., ground systems) NASA and other agency work out budgets prior to OMB submits.

NASA has stated to USGEO that we'll look at creative ways to support inputs; it may take some iterations, and it may take seeing if an achievable 80% solution is better than an unachievable 100% one.

SNProcess Summary II

In FY16 budget, OMB assigned NASA the responsibility for all civilian Earth-observing satellites (sans NOAA for weather and space weather).
OMB guidelines allow on this responsibility allow agencies to provide inputs to NASA for consideration of their needs for sustained measurements.

USGEO developed a Satellite Needs Process, conducted annually:

1. User agencies identify their needs
2. USGEO Sat. Needs Working Group (SNWG) compiles inputs; USGEO provides inputs to NASA
3. NASA reviews inputs; interacts with agencies as needed; makes decisions

Output: NASA informs agencies of decisions; provides explanation to OMB/OSTP on how it addressed inputs

NASA Outputs

NASA provide to OMB and OSTP a supplement to its budget request that explains how it addressed user agency inputs, including a discussion of high-priority measurements identified by user agencies that NASA did not accommodate within its budget request, along with its rationale.

Responses to user agencies expected within 6 months. NASA may provide responses to an agency in stages based on the input and NASA's assessment of its ability to satisfy needs.

If the assessment and response on some inputs take more than 6 months, NASA notifies the agency and USGEO.

USGEO/SNWG Timelines

Prototype Cycle

March 1: Template to Agencies

March 15: Agencies give needs to SNWG to compile (no prioritization)

April 5: USGEO gives inputs to NASA

April 29: NASA provides responses regarding template and the clarity and adequacy of the content to OMB, OSTP, SNWG

May 6: SNWG analyzes NASA feedback

May 15: SNWG finalizes template and introduction/instruction doc.

Production Cycle

May 15: Final template and introduction/instruction doc.

June 1: Distribute template

August 1: Needs deadline

Nov. 1: SNWG passes needs to USGEO for concurrence

Dec. 1: NASA receives inputs and begins analysis and interactions

June 1: NASA provides responses to agency needs

~ Sept. 1: With budget submit, NASA submits info to OMB on how it adjudicated the inputs

Earth Observations Serving Sustainable Development

THE GLOBAL GOALS
For Sustainable Development

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
- » Development of methods for how Earth observations can contribute to the goals
- » Long-term capacity building to support countries and stakeholders use of Earth obs.

Earth Obs and Geospatial Information Support to SDG

Sustainable Development Goals represent normative goods in society

Opportunities for value with national:

– Planning – Tracking

– Reporting – Evaluating

GEO GROUP ON EARTH OBSERVATIONS

UN-GGIM UNITED NATIONS INITIATIVE ON GLOBAL GEOSPATIAL INFORMATION MANAGEMENT

15 LIFE ON LAND

Indicator 15.1.1

Forest area as a percentage of total land area

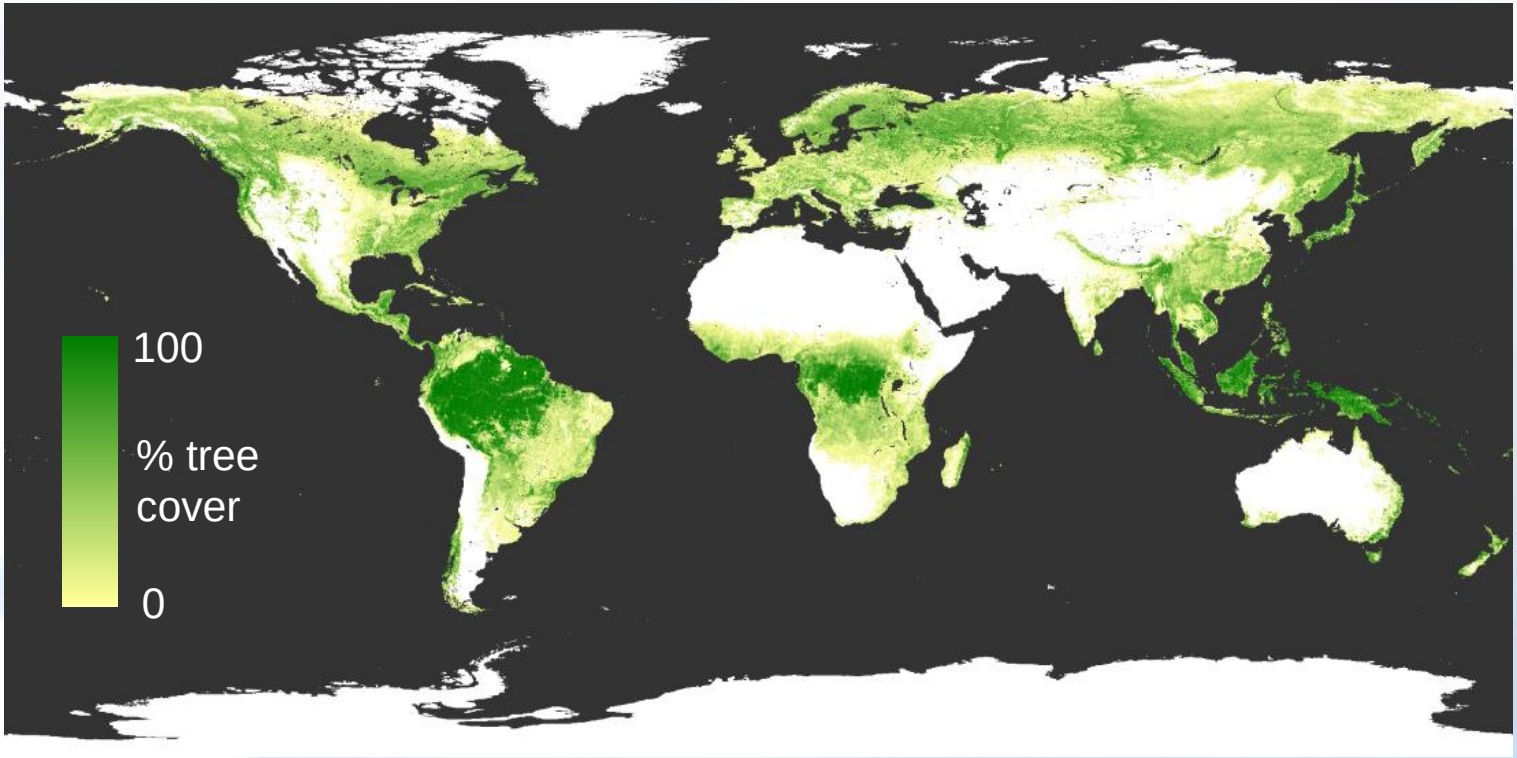
THE GLOBAL GOALS
For Sustainable Development

Target 15.1

By 2020 ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands...

Forest Area from Earth-observing Environmental Satellites

2013 Tree Cover



Credit: Matthew C. Hansen, Univ. Maryland, et al.

Indicator 15.1.1

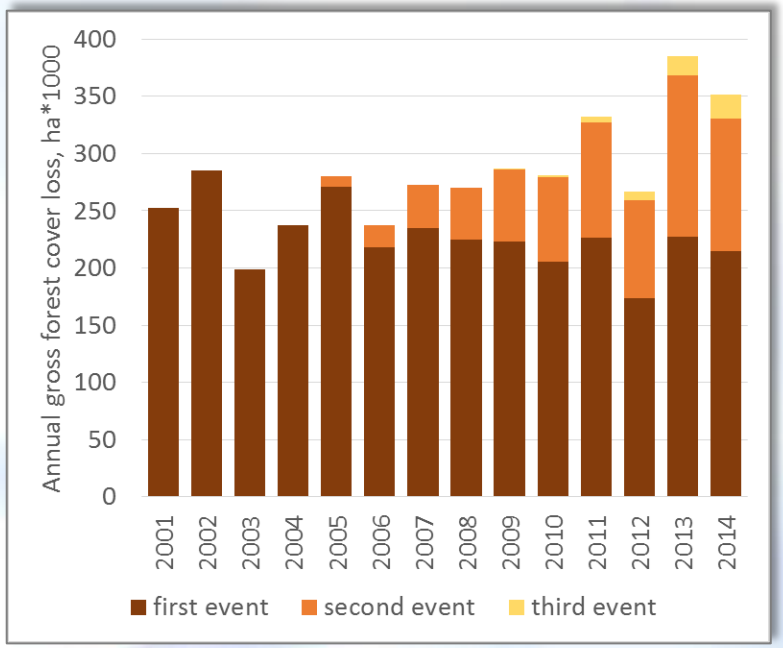
Forest area as a percentage of total land area

Target 15.1

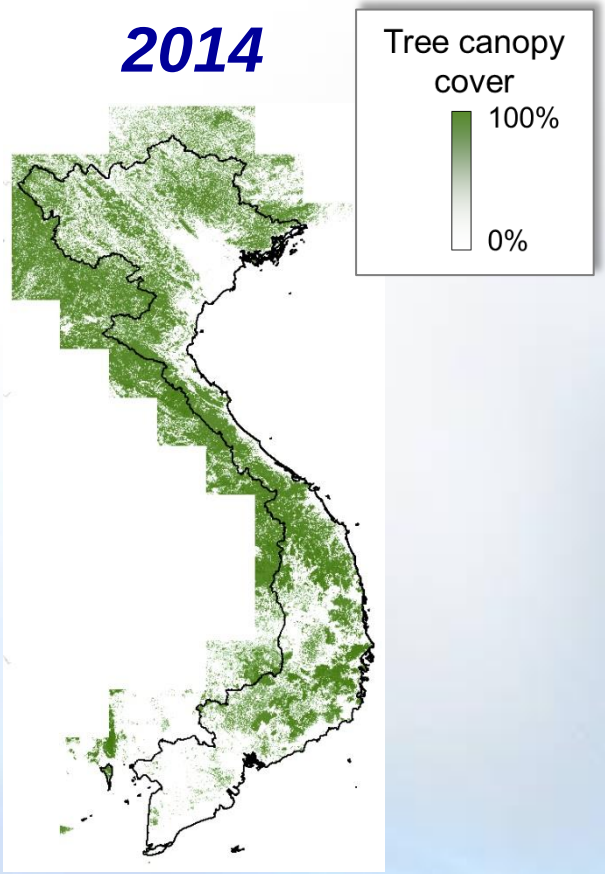
By 2020 ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands...

Vietnam: Forest Cover Mapping

Total annual gross forest cover loss 2001-2014:
3.2 million ha.



2014



Credit: Matthew C. Hansen, Univ. Maryland, et al.

Other Examples & Pilots in Development …

THE GLOBAL GOALS
For Sustainable Development

Indicator 3.9.1:

Population in urban areas exposed to outdoor air pollution levels above WHO guideline values

Approach/Data Sources:

US Census: Urban Areas in US (1:2000); Global gridded population dataset; Global population distribution at subnational level.

NASA: EPA AIRNow point-based air quality network; MERRA aerosol reanalysis.

Indicator 11.7.1:

Average share of the built-up area of cities that is open space in public use for all

Approach/Data Sources:

US Census: Vector data for infrastructure and public land ownership (1:2000); parcel data and municipal sources for open space definitions.

NASA: Landsat-based mapping of land cover for urban areas and open space.

Indicator 15.3.1:

Percentage of land that is degraded over total land area.

Approach/Data Sources:

US Census: Gridded population distribution (100m grid) Demobase for Sub-Saharan Africa, others.

NASA: Vegetation rigor from satellites (1981-present); 50cm satellite imagery; NASA GMAO reanalysis precipitation.

Taking it to scale . . .

THE GLOBAL GOALS
For Sustainable Development

Next Steps

Work with statistical agencies to ensure the methods are sound for use with Indicators and Targets

Ensure the methods and solutions are available for all to use

Support countries and stakeholders to use the methods and build capacity

GEO GROUP ON EARTH OBSERVATIONS

UN-GGIM
UNITED NATIONS INITIATIVE ON GLOBAL GEOSPATIAL INFORMATION MANAGEMENT

SUSTAINABLE DEVELOPMENT SOLUTIONS NETWORK
A GLOBAL INITIATIVE FOR THE UNITED NATIONS

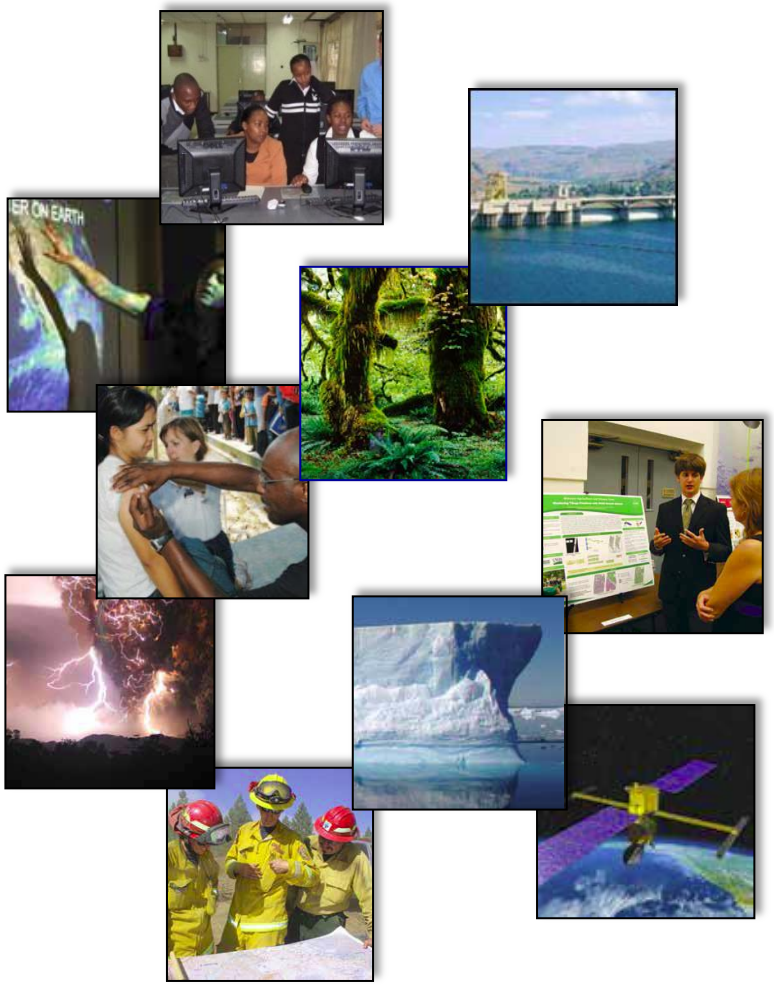
GLOBAL PARTNERSHIP FOR SUSTAINABLE DEVELOPMENT DATA

UNStats

CEOS

IISD
International Institute for Sustainable Development

others



Discussion and Questions

I. Earth Science & Applications
II. Applied Sciences
III. Disaster Response
IV. GEO & G20
V. USGEO Satellite Needs Process
VI. UN Sustainable Development Goals

Science Mission Directorate
Earth Science Division

ESD Applied Sciences Program

Backup Materials

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.

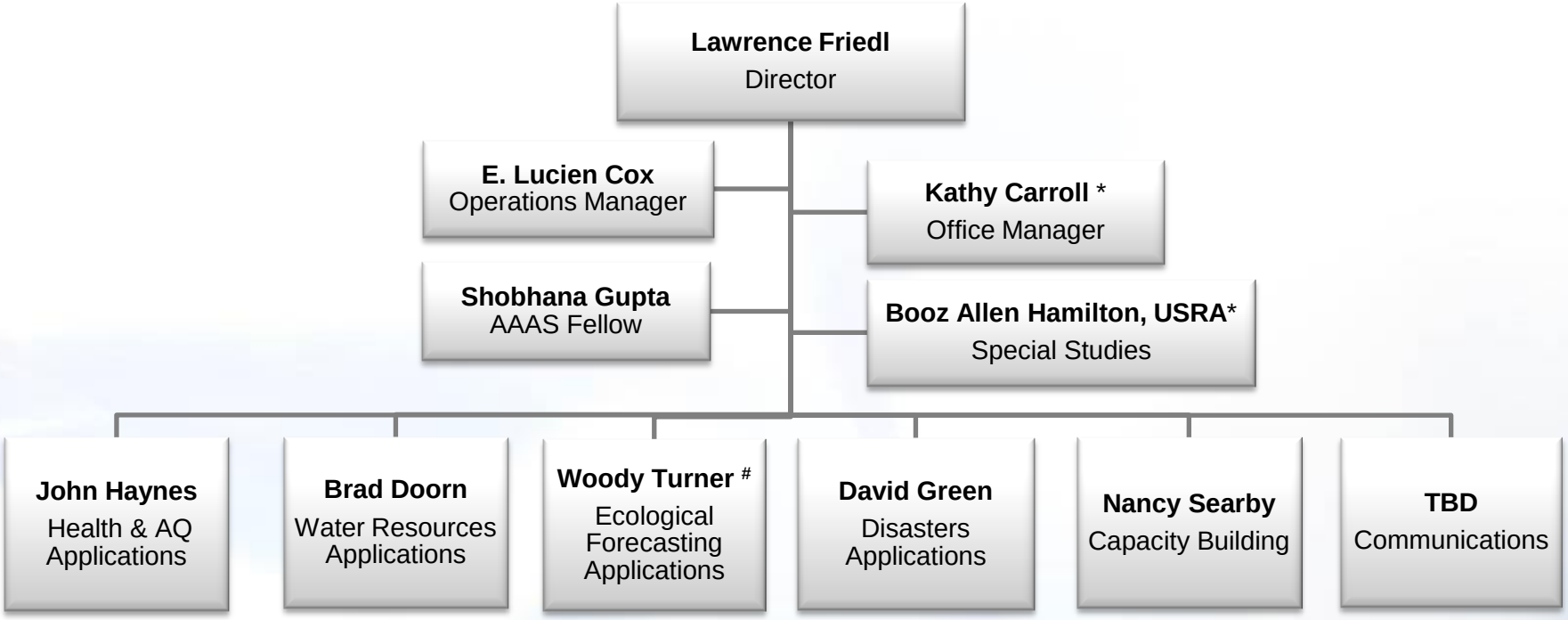
Alexis DeTocqueville
***Democracy in America*, 1835**

U.S. Space Policy (2010)

- Energize competitive domestic industries to participate in global markets and advance the development of … terrestrial applications …
- Facilitate new market opportunities for U.S. commercial space capabilities and services, including commercially viable terrestrial applications that rely on government-provided space systems;
- Promote the adoption of policies internationally that facilitate full, open, and timely access to government environmental data;
- Continue to develop civil applications and information tools based on data collected by Earth observation satellites. … the applications will be made available to the public.

SMD/ESD Applied Sciences Program

Organization Chart (March 2016)



Wildfires Applications is a cross-cutting area. Friedl serves as the program manager to encourage cross-program approaches.

** Contractor*

 # Turner is shared with ESD-Research

Applied Sciences: Logic Model

Resources and Inputs

Resources include funding, people, partnerships, connections to Earth science, and experience doing applications.

Inputs are Earth science data, info products, model outputs, visualizations, knowledge of the Earth system.

Activities and Outputs

The resources support needs analysis, feasibility studies and projects, trainings, internships, special data products, workshops, studies.

Outputs are ways to include data in analyses and users' decision tools, new training skills, special data products.

Outcomes

Outcomes are manifested in enhanced decisions and actions: more effective/efficient, productivity, confidence, reduced risk, etc.

Outcomes are also with increased capacity and capabilities in workforce.

Impacts

Resulting social and economic benefits from the enhanced decisions.

Specific impacts may include cost savings, increased profit, fewer cases of disease, reduced evacuation costs, etc.

Programmatic Tensions

Tensions

- » Partner/User Reach
  breadth v. depth
- » Program Role & Control
  direct involvement v. indirect
- » Earth Science Missions and Products
  ones less used v. popular, familiar ones;
  ones with continuity v. ones to encourage continuity
- » Project Portfolio: Scope, Size, Duration
  many small projects v. few larger/longer ones
- » Application Enablement
  data product development for decisions
  v. product integration into decisions
- » Innovation
  impacts on many, everyday decisions
  v. grand challenges and game changers

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.

Water Availability

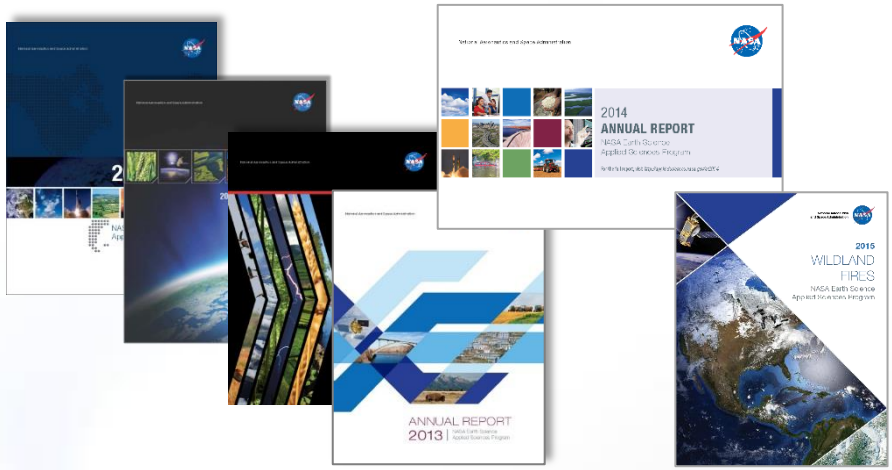
Freshwater is widely viewed as a critical resource, and recent U.S. droughts have increased attention on improved estimates of water availability, especially from snowpack. The initiative will provide a focus for NASA-wide activities regarding snow water, climate change, and decision support to managers/policy-makers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

Disaster Response

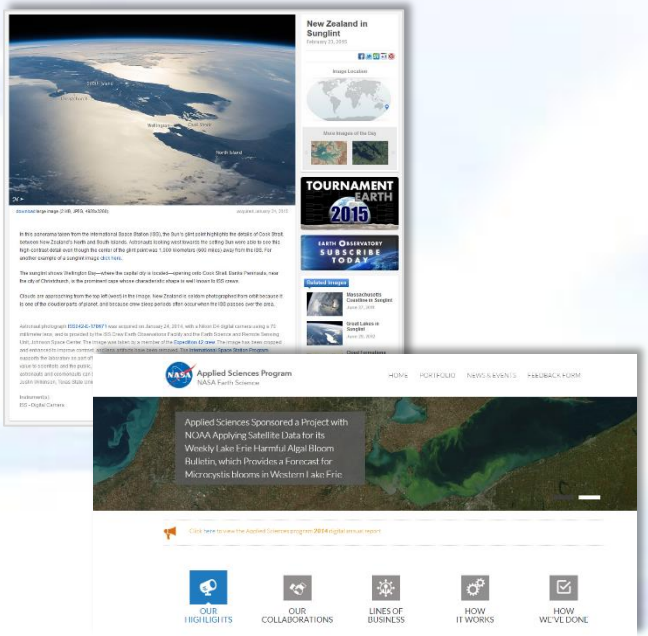
Earth Science will initiate a Disaster Response support plan to move from a reactive, ad hoc approach during disasters to an approach based on anticipation, planning, and preparation to aid disaster responders. Plan includes an inter-Center working group, an event action team, and an annual work plan for key needs

Communications

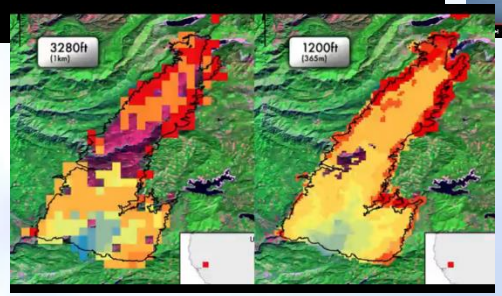
A significant emphasis on communications and outreach activities, especially to convey results to broad audiences.



Website, Earth Observatory



Videos



Earth Obs and Geospatial Information Support to SDGs

United Nations Sustainable Development Goals

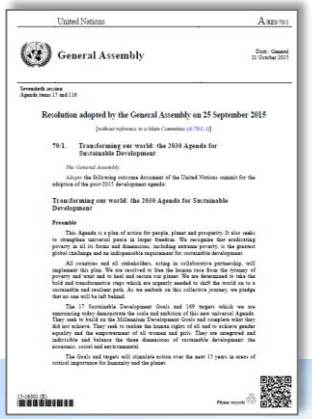
THE GLOBAL GOALS For Sustainable Development

Geospatial Information and Earth Observations: Supporting Official Statistics in Monitoring the SDGs

Agenda 2030

***Transforming our World: The 2030 Plan for Global Action* - Article 76:**

We will promote transparent and accountable scaling-up of appropriate public-private cooperation to exploit the contribution to be made by a wide range of data, **including Earth observation and geo-spatial information**, while ensuring national ownership in supporting and tracking progress.


United Nations A/RES/70/1

General Assembly

Resolution adopted by the General Assembly on 25 September 2015

70/1. Transforming our world: the 2030 Agenda for Sustainable Development

Transforming our world: the 2030 Agenda for Sustainable Development

Preamble

Indices and Declarations

Link to established or emerging indices

OCEAN HEALTH INDEX™

A quantifiable assessment of the capacity of our oceans to deliver benefits and resources sustainably.

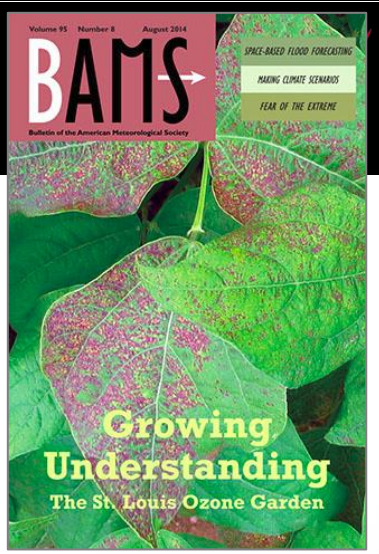
http://www.oceanhealthindex.org/

Link to International Declarations

Example:
Gaborone Declaration, an international agreement initially including 10 countries in Africa committed to integrating the value of nature into national and corporate planning and reporting practices, policies and programs.

Gaborone Commitments:

1. Incorporate the value of natural capital in public and private policies and decision making;
2. Pursue sustainable production in agriculture, fisheries and extractive industries while maintaining natural capital;
3. Generate data and build capacity to support policy networks.



Crossing the Valley of Death:

Lessons Learned from Implementing an Operational Satellite-Based Flood Forecasting System

Step 1: Do the research on theoretical feasibility on a popular and interdisciplinary research publication forum.

Step 2: Disseminate widely the theoretical feasibility to potential stakeholder agencies through a two-way public education process and generate interest.

Step 3: Respond to skepticism in an engaging way; do not lose stakeholder interest by talking more than listening.

Step 4: Get commitment from stakeholder agencies to prototype and test the satellite forecasting system; start with the simplest of ideas when you teach them how to fish.

Step 5: Begin hands-on training of stakeholder staff for implementing the prototype system; patiently hand hold the staff and teach them from the ground up the basics of the system.

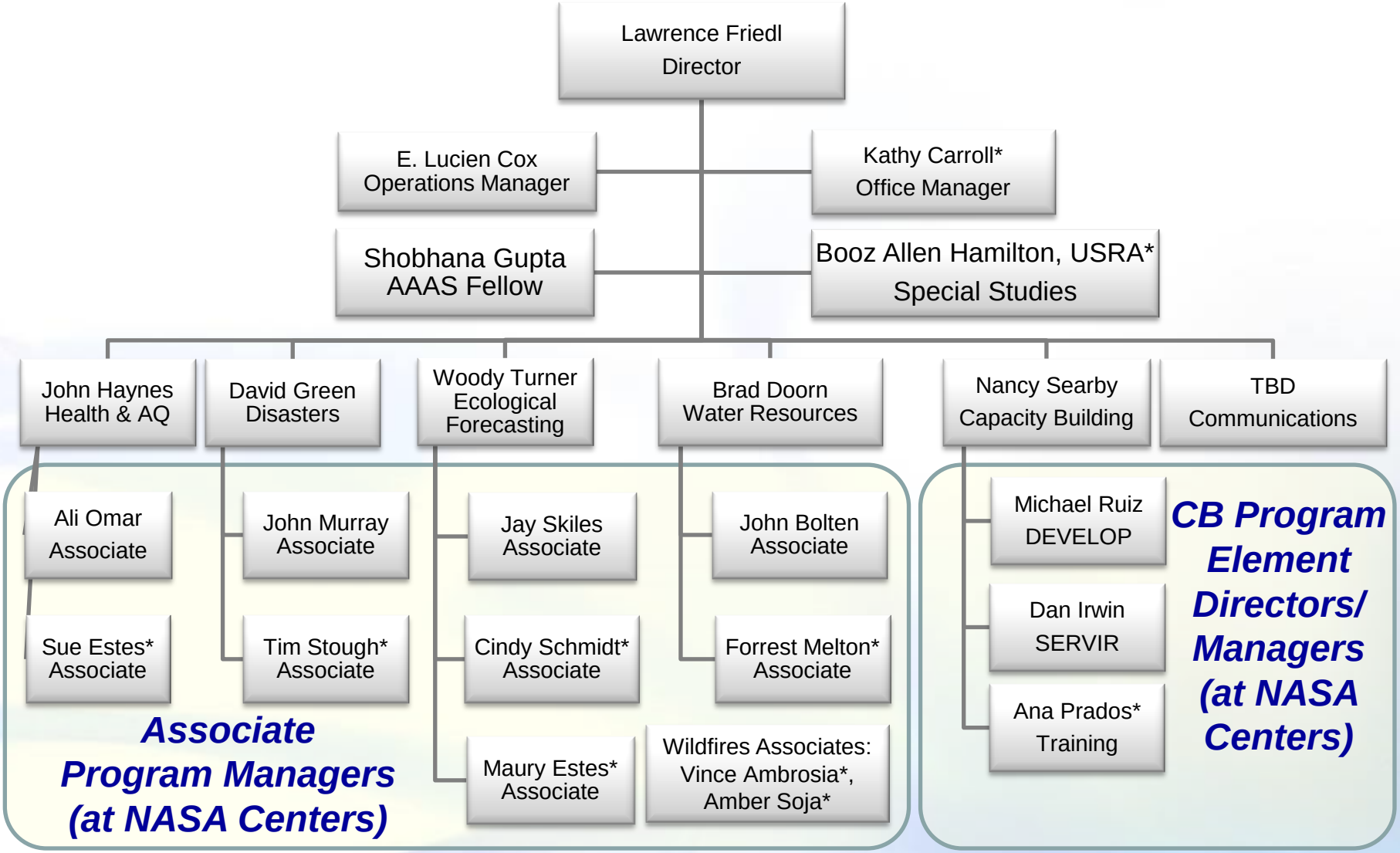
Step 6: Allocate supporting resources to address unexpected hurdles during launch of the prototype system.

Step 7: When launching the prototype, ensure complete ownership and independent operation; offer complimentary support as technical backstop.

From Faisal Hossain et al., BAMS, August 2014. DOI:10.1175/BAMS-D-13-00176.1

SMD/ESD Applied Sciences Program

Extended Organization Chart (March 2016)



** Contractor. Additional people serve as Deputy Program Applications leads for satellite missions*

Indicator 11.6.2

Annual mean levels of fine particulate matter (i.e. PM2.5 and PM10) in cities (population weighted)

Target 11.6

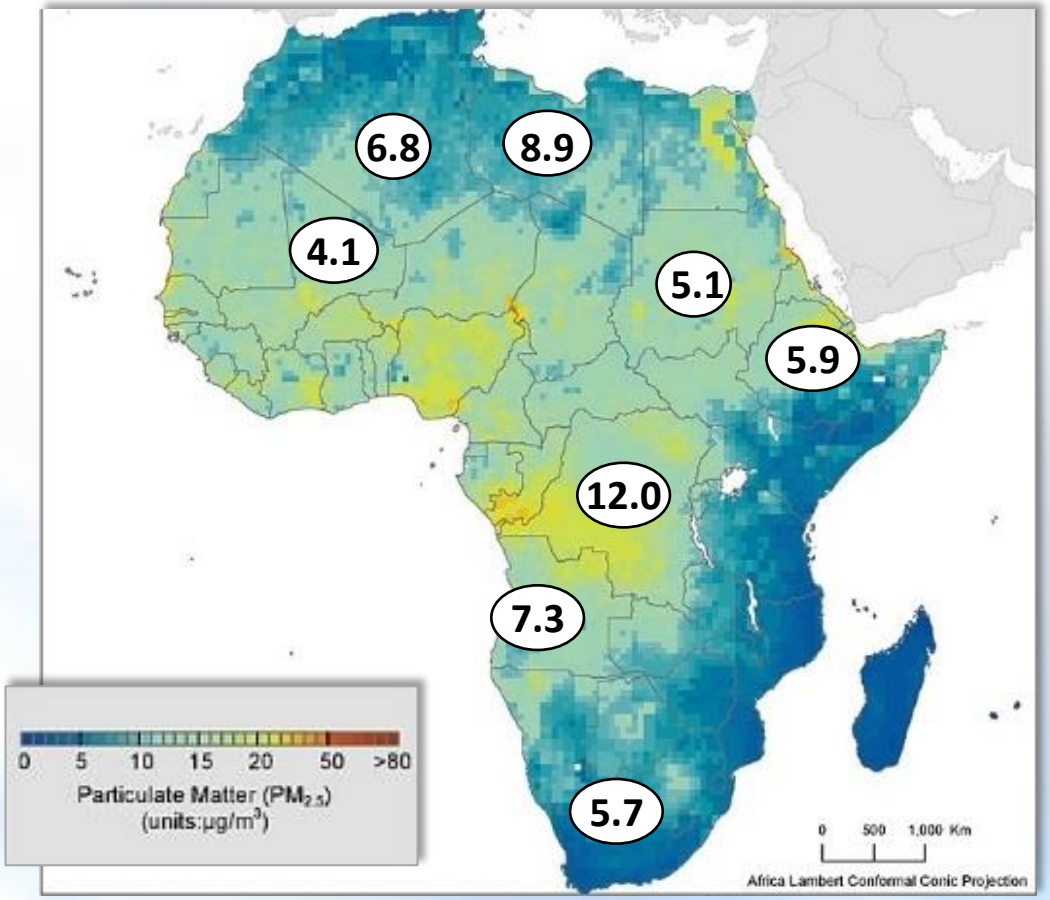
By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management

Air Quality: Annual Average PM2.5 Grids

Background image:
Data from 2010.

Circled values:
Two-year (2012-2014) country-specific values based on average population-weighted exposure.

Data Source:
Aerosol Optical Depth from MISR and MODIS sensors on Terra & Aqua satellites.

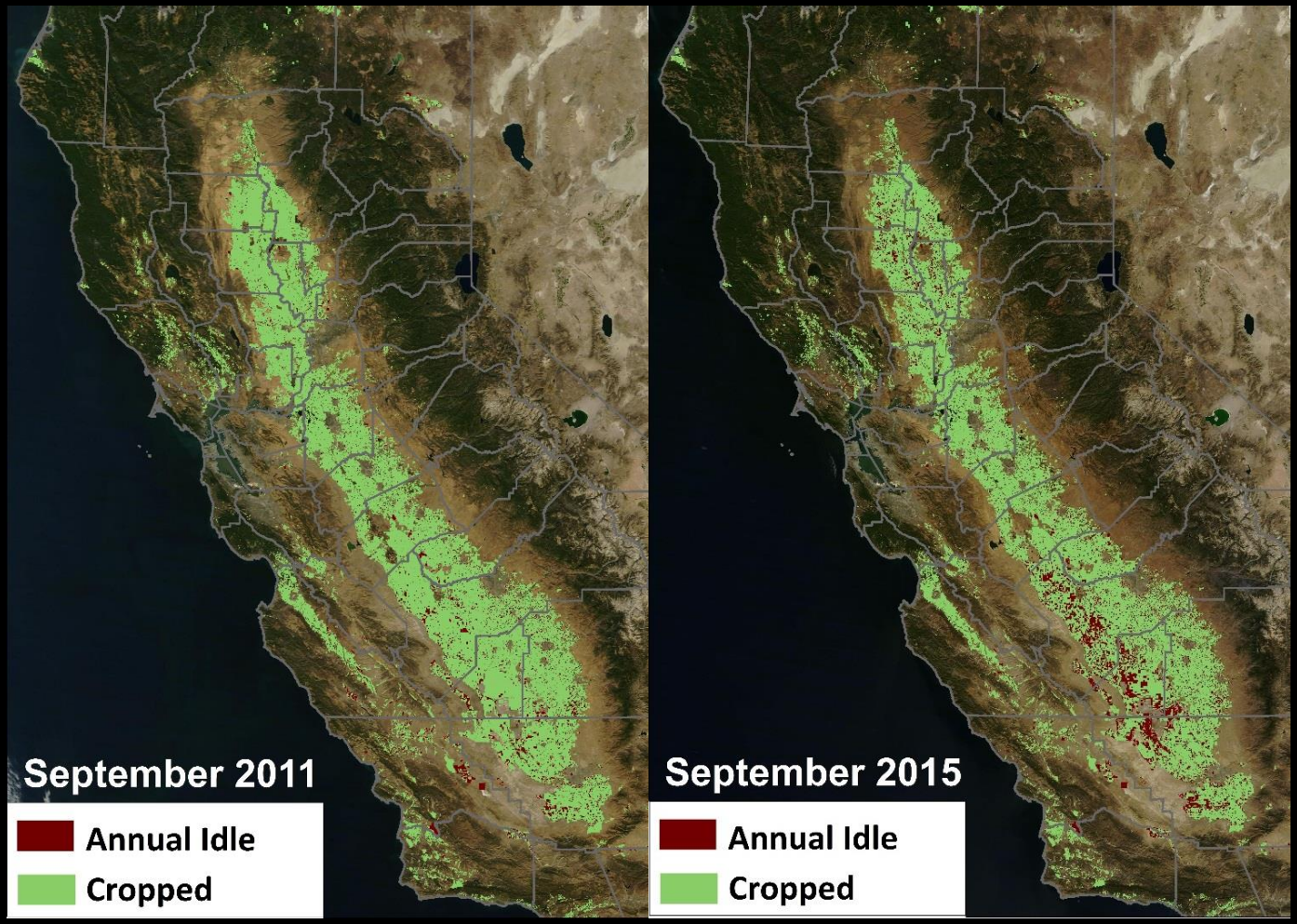


Source:
CIESIN
Columbia University.

Determining the Extent of Fallowed Land with Satellite Imagery

Fallowed Land are areas left idle for the growing season

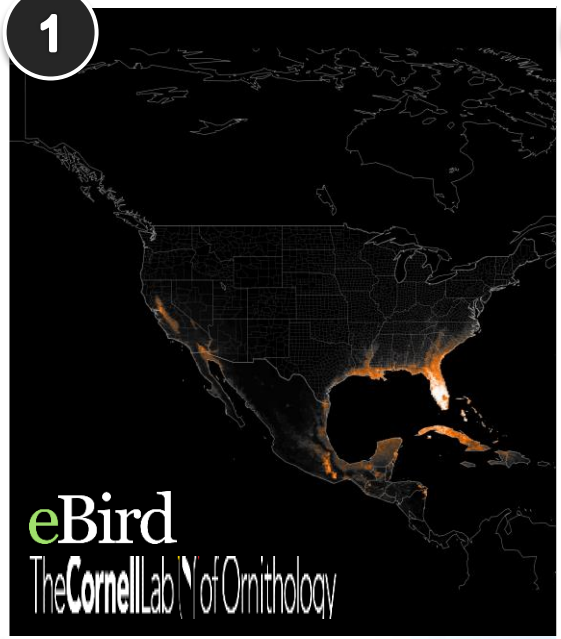
2015: 625,000 acres fallowed



NASA Data Inform Reverse Auction to Increase Habitat for Migrating Waterbirds

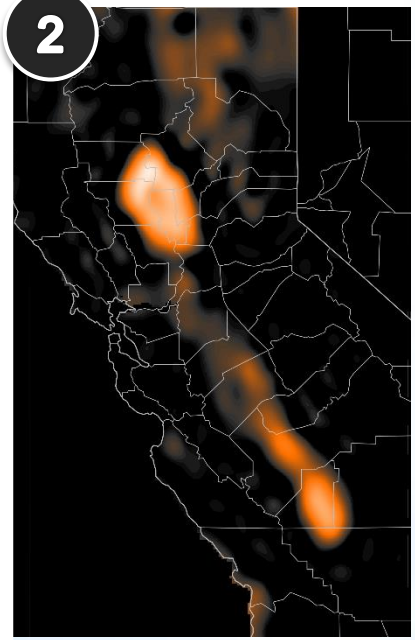
- **Results: 20,000 more acres of habitat** for migrating waterbirds in California at less than 1% of the annual cost of purchasing conservation easements.
- NASA MODIS and ASTER Earth imagery combined with citizen science reports from eBird help identify the best bird habitat
- The Nature Conservancy uses these data to select bids from farmers with best habitat in a reverse auction, and pays them to flood their fields during migration

1



Observations from satellites and eBird drive bird habitat models

2



Best bird habitat identified in the Pacific Flyway

3

The Nature Conservancy uses a reverse auction to select the best fields to flood for habitat at the best price

In a reverse auction, sellers submit bids that are selected by buyers on price and other factors

Reverse auction and bidding

4

Farmers submit bids: the price to flood their fields during migration

↓ ↓ ↓

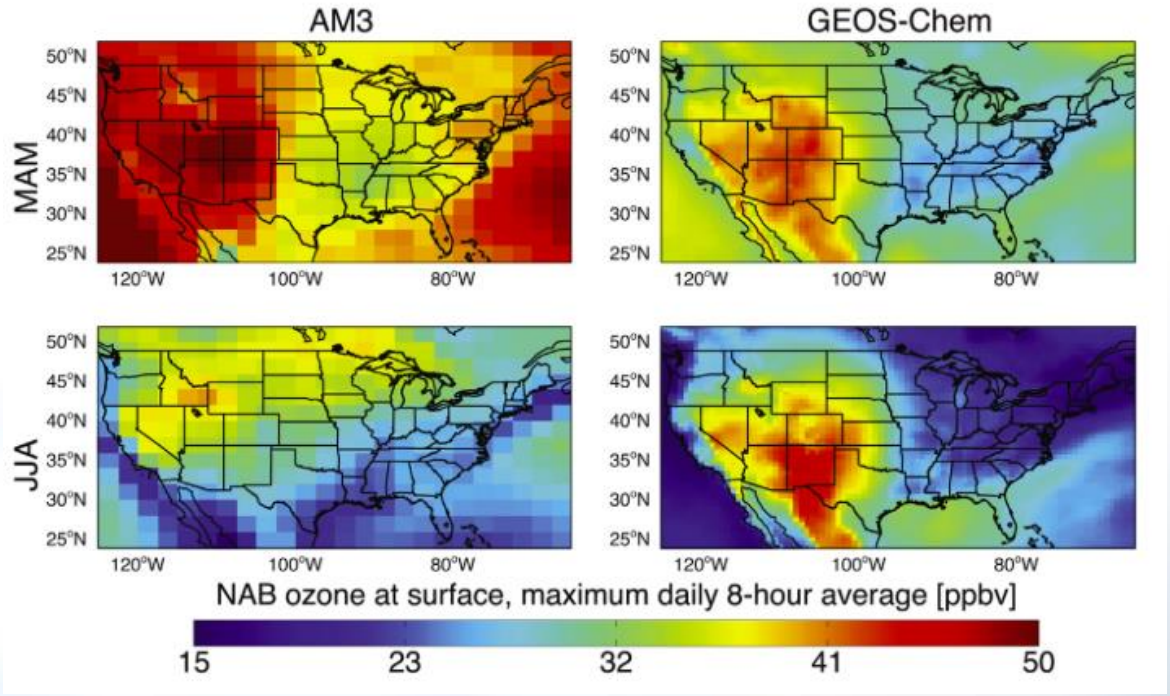
The Nature Conservancy
Protecting nature. Preserving life.™

Bids selected by price and migration projections

Selection of farms with best habitat at the best price

ESD Air Quality Applied Sciences Team:
Quantifying ozone entering from outside the U.S.

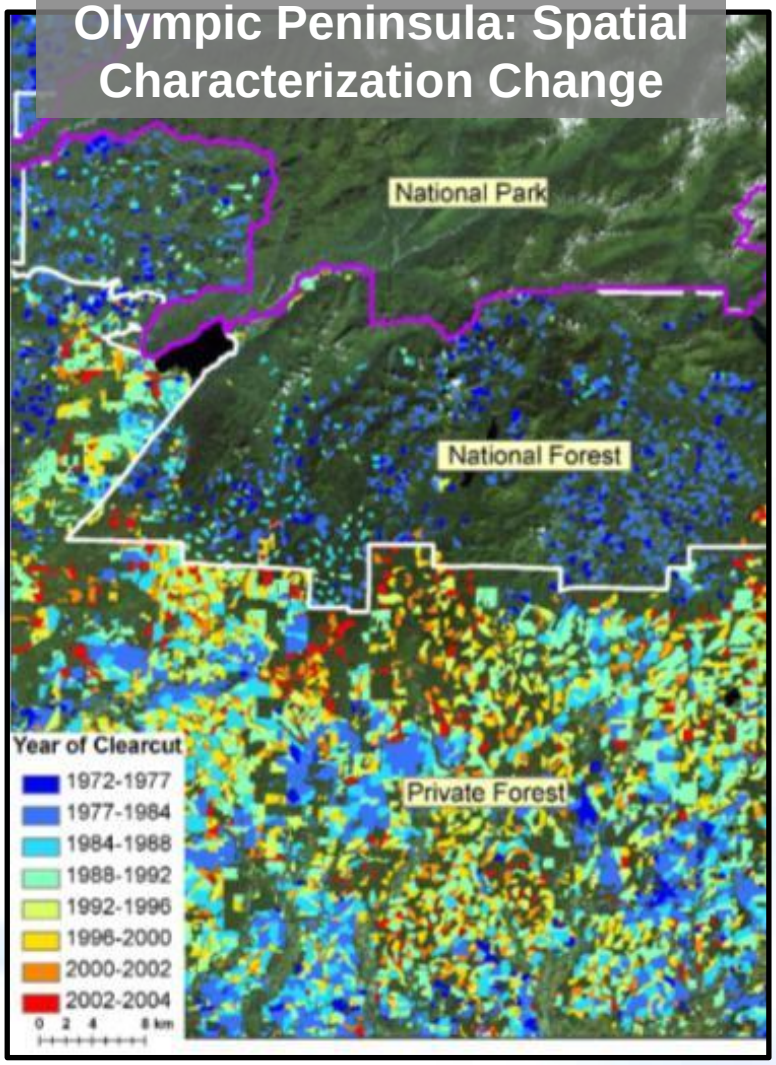
- In October 2015, EPA lowered the ozone "smog" standard from 75 ppb to 70 ppb.
- AQAST worked closely with EPA, Western States, and California districts to quantify how non-U.S. ozone affects air quality in Western U.S.
- AQAST work shows that model choice strongly affects background ozone estimate; work offers new insights and tools to policy community



Note: If EPA were to set the ozone standard too low and background ozone levels were high enough, then the standard might not be achievable by any means (regardless of technology or control strategies), because all the ozone would be coming from natural sources or sources outside the U.S.

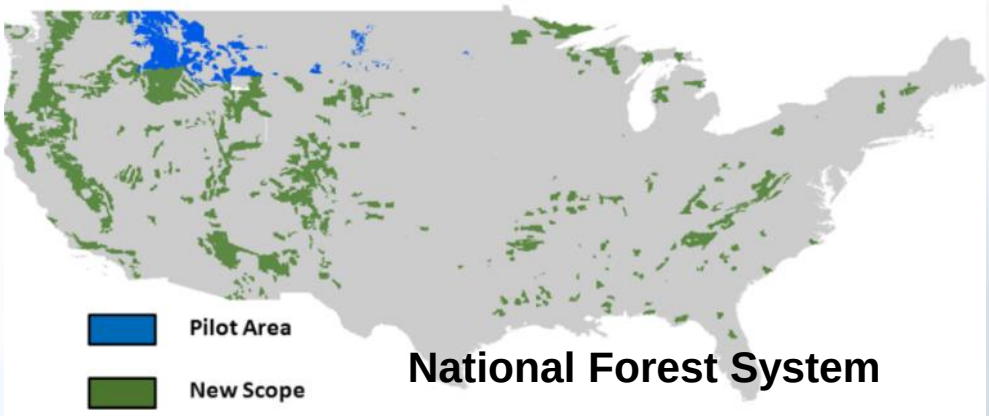
Forest Carbon Storage Assessments

Research ⇨ Applied Sciences ➔ USFS



Forest management and natural disturbances effect carbon storage

USFS adopted an ESD-developed forest carbon tool based on Landsat imagery in a comprehensive approach to carbon-storage assessments and forest management. Supports USFS implementation of Executive Order.



USFS funded the expansion of the application from the pilot areas to the entire National Forest System.