



NASA Applied Science Wildland Fire Program

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NASA Earth Science Division - Applied Sciences Program

NASA Earth Science Data for Wildland Fire Decision Making

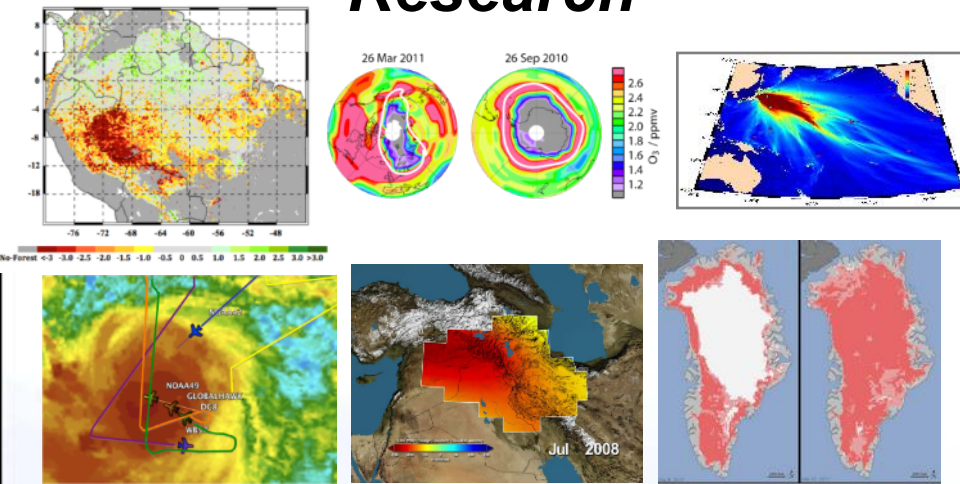
Opportunities to Apply Remote Sensing in Boreal / Arctic Wildfire Management and Science

Fairbanks, AK. 3 April 2017

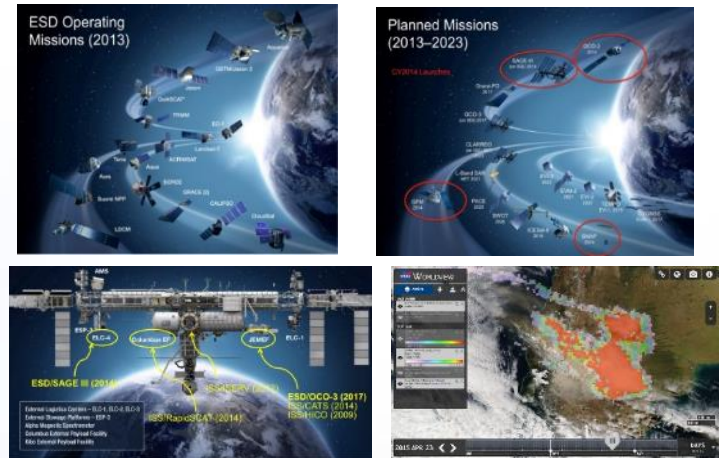
NASA Earth Science Division



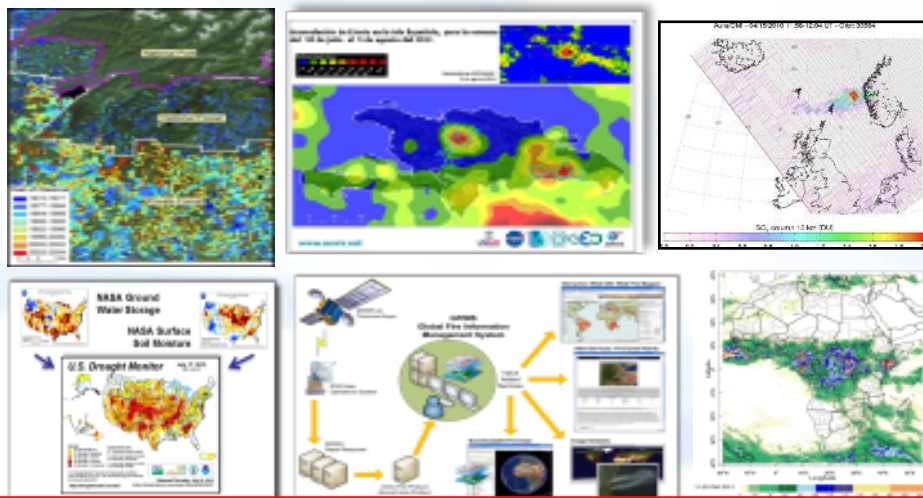
Research



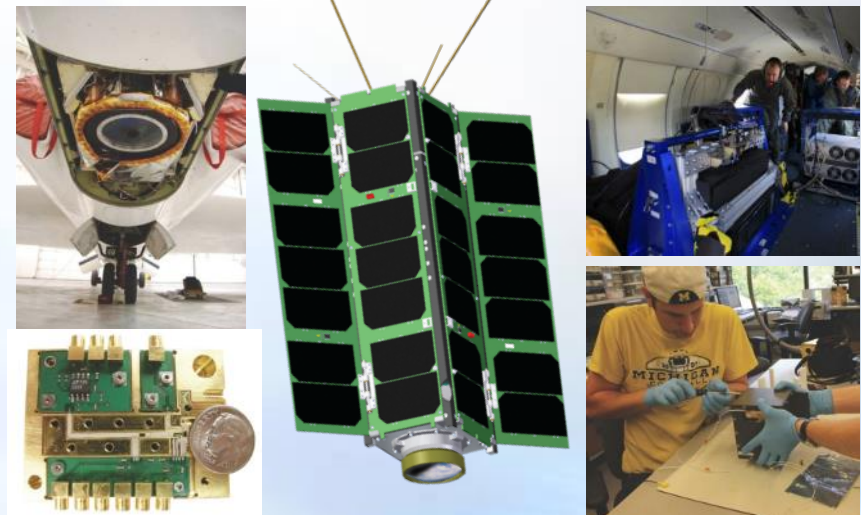
Flight (incl. Data Systems)



Applied Sciences



Technology



Applications Themes & Societal Benefit Areas

Emphasis in 4 Applications Areas



Health & Air Quality



Water Resources



Disasters

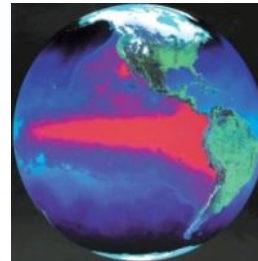


Ecological Forecasting

Support opportunities in 5 additional areas



Agriculture



Climate



Weather



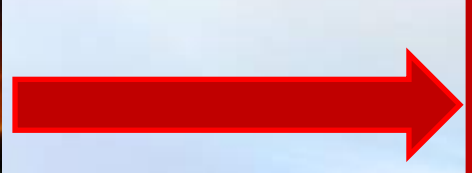
Energy



Oceans



Crosscutting theme:
Wildland Fires





Vision

Public and private organizations routinely and seamlessly integrating Earth observations in their decisions and actions, so much so they desire additional observation types and Earth science knowledge.

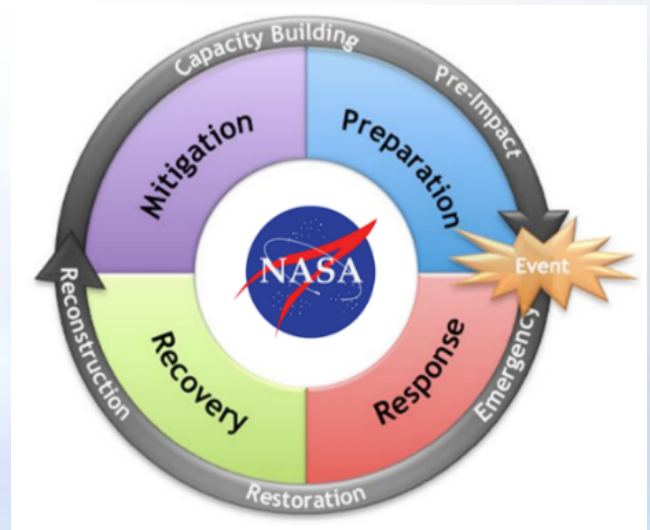
Wildland Fire Program Vision

Mature derived science results to high applications readiness levels to allow partners to operationalize the capabilities into wildland fire management practices.

Advancing NASA's Wildland Fire Applications Capabilities



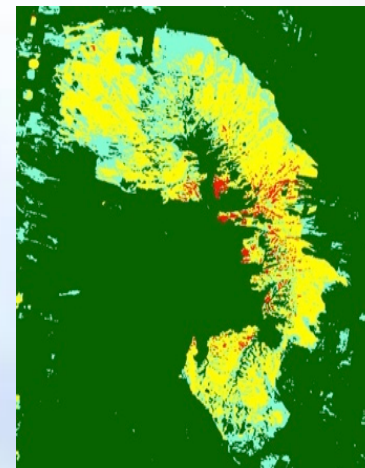
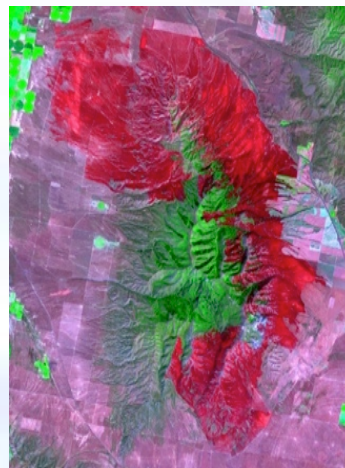
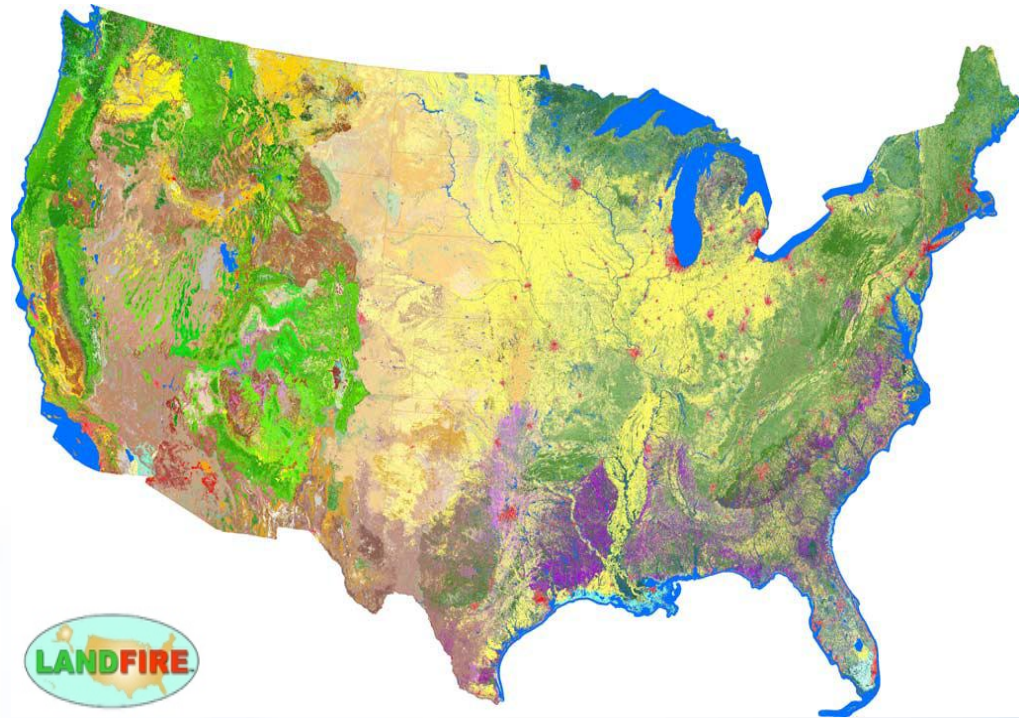
- **Wildland Fire application science answering questions and supporting decisions** transforming EO data and research results into environmental intelligence.
- **Coordination and collaboration** informing brokers, managers, and responders with critical products and services .
- **Creation and leverage of partnerships** strengthening and enabling effective response throughout the wildfire lifecycle.



Wildland Fire Focus Areas



- Pre-Fire Mapping
 - Vegetation density and extent
 - Soil moisture/drought severity
 - Topography
- Active Fire Mapping
 - Total area currently burning
 - Fire Radiative Power (FRP) using thermal bands
- Post-Fire Mapping
 - Total area burned
 - Burn severity
 - Post-fire vegetation regrowth (NDVI)



Above: A USGS Landfire map.
Left: 2007 Black Pine 2 Fire, Idaho, U.S. On the left: imagery, right: burn severity. USDA RSAC.

NASA Wildland Fire Program



Zachary Holden / USDA Forest Service:

A Prototype System for Predicting Insect and Climate-Induced Impacts on Fire Hazard in Complex Terrain;

Sher Schranz / NOAA:

Wildland Fire Behavior and Risk Prediction;

James Vogelmann / USGS EROS Center

Improving National Shrub and Grass Fuel Maps Using Remotely Sensed Data and Biogeochemical Modeling to Support Fire Risk Assessments;

Birgit Peterson / USGS EROS Center:

Enhanced Wildland Fire Management Decision Support Using Lidar-Infused LANDFIRE Data;

Karyn Tabor / Conservation International Foundation

An Integrated Forest and Fire Monitoring and Forecasting System for Improved Forest Management in the Tropics;

Wilfrid Schroeder / University of Maryland

Development and Application of Spatially Refined Remote Sensing Active Fire Data Sets in Support of Fire Monitoring, Management and Planning;

Stephen Howard / USGS EROS Center:

Utilization of Multi-Sensor Active Fire Detections to Map Fires in the US;

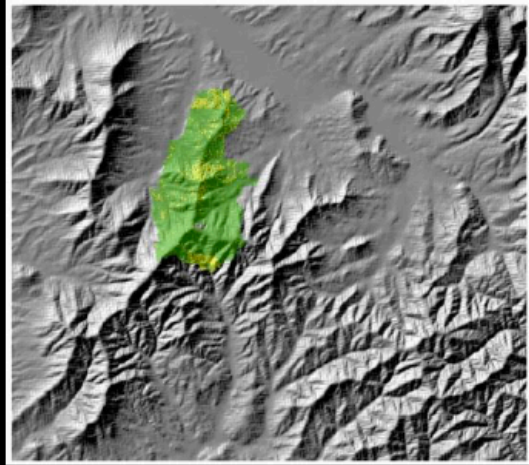
Mary Ellen Miller / Michigan Tech Research Institute (MTRI):

Linking Remote Sensing and Process-Based Hydrological Models to Increase Understanding of Wildfire Effects on Watersheds and Improve Post-Fire Remediation Efforts;

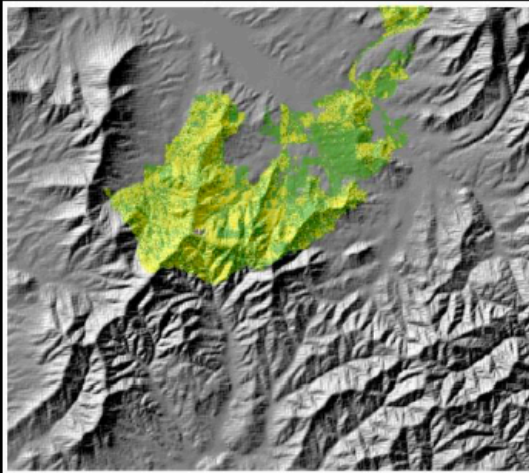
Keith Weber / Idaho State University;

RECOVER: Rehabilitation Capability Convergence for Ecosystem Recovery;

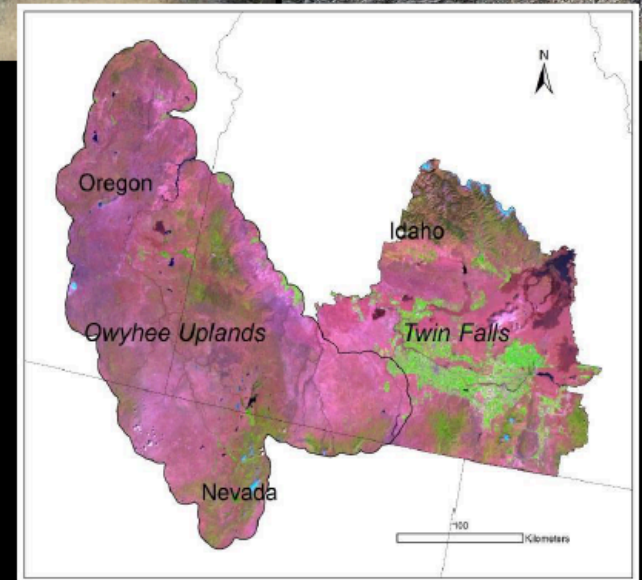
NASA Applied Sciences Wildland Fire Program



**Enhanced Wildland
Fire Management
Decision Support
Using Lidar-Infused
LANDFIRE Data**



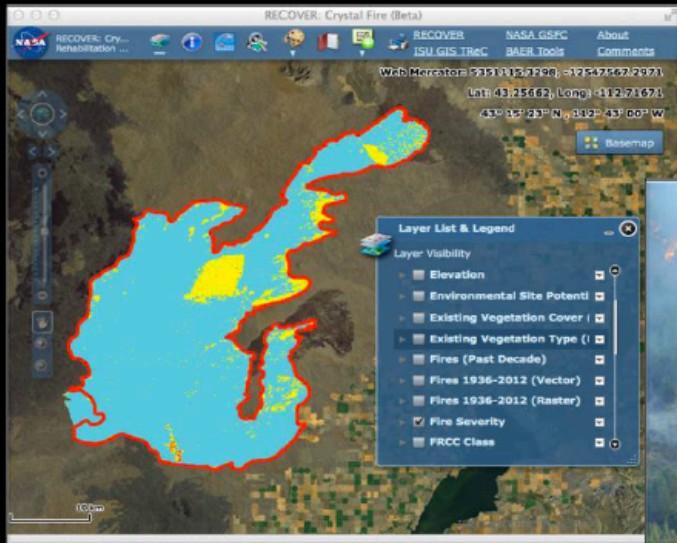
**Improving Shrub
and Grass Fuel
Maps Using
Remotely Sensed
Data to Support Fire
Risk Assessments**



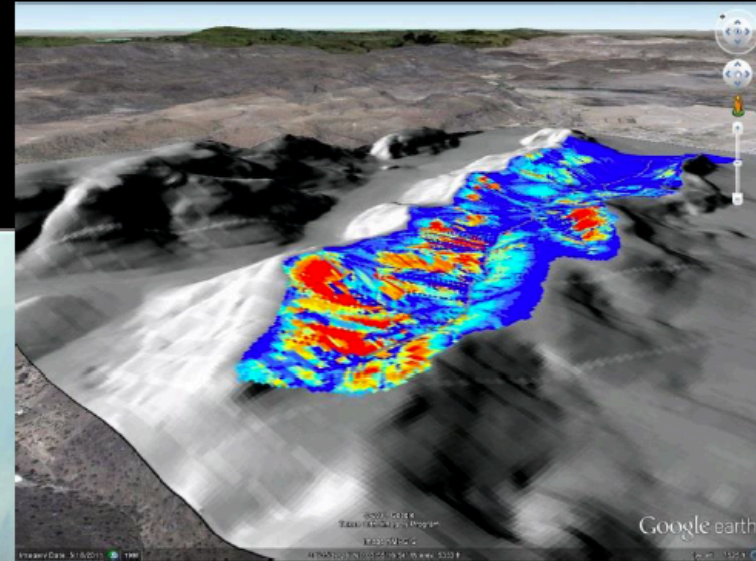
Peterson and team

Vogelmann and team

Another NASA Aim is to Support improved management strategies for mitigation of wildfire effects on ecosystems, infrastructure and human lives.



RECOVER Support Wildfire Rehabilitation of Grassland Ecosystems
Weber et al.



Erosion predictions for the Rock House Fire converted to KML; Fire Date: April 9, 2011; Location: Fort Davis, TX Size: 314,444 acres; Hospital Canyon: 536 acres; BAER Team: U.S. National Park Service.

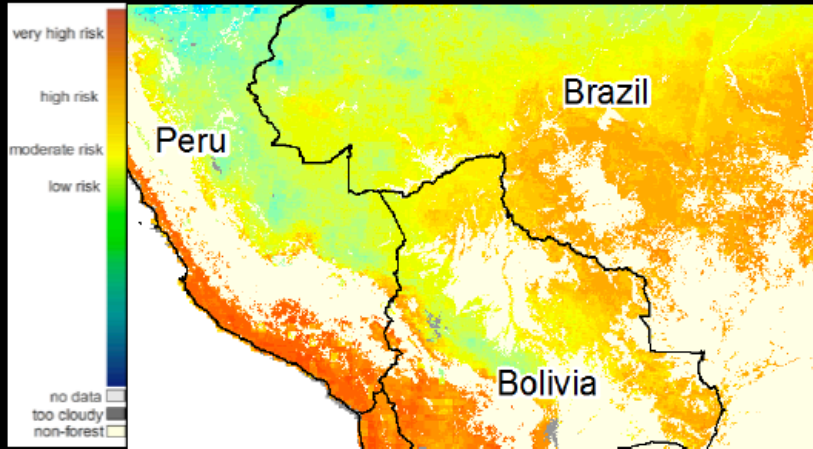
BAER Project: Improving Post-Fire Remediation Through Hydrological Modeling

Miller et al.

Burned Area Emergency Response (BAER)

FIRECAST: A Near-Real-Time Monitoring System Improving Forest Management in the Tropics

Karyn Tabor and team



FIRECAST uses satellite data to deliver daily email alerts of fire activity and daily forest flammability alerts that are used to warn communities and authorities of dangerous fire conditions.



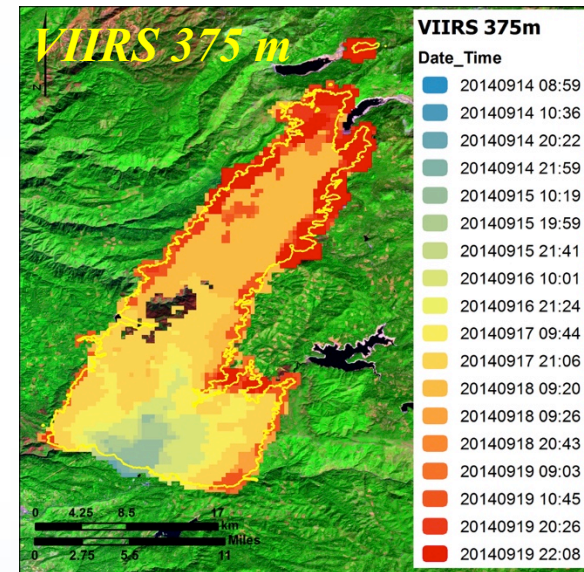
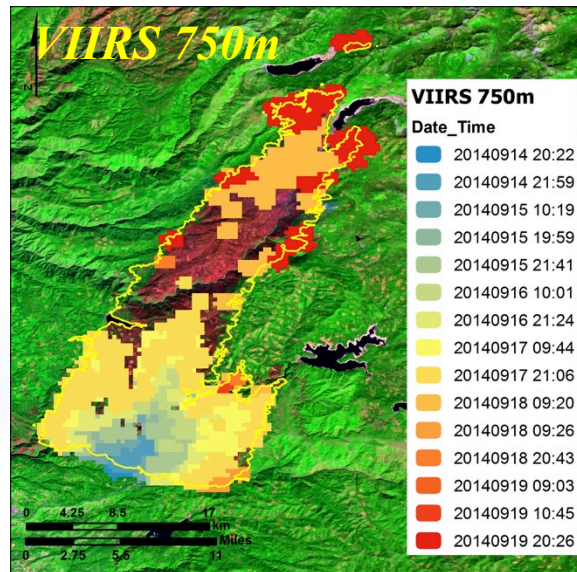
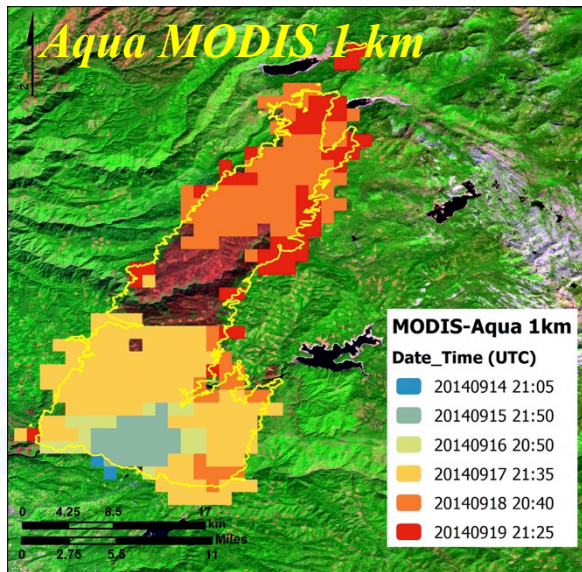
Targets areas of high biodiversity and specific communities.



Currently the system operates in Brazil, Peru, Madagascar and Bolivia

NPP VIIRS: The Next Generation of Fire Support

The new VIIRS 375 m active fire detection product enables early detection of small fires and improved mapping of large wildfires.



King Fire: Comparing MODIS 1 km, VIIRS 750 m, and VIIRS 375 m products

“These refined data further improve the situational awareness of fire managers and are also ingested into operational modeling, analysis and visualization applications that support fire management decision-making at a landscape scale.” –Brad Quayle, U.S. Forest Service

The new VIIRS fire data and algorithm are currently being used operationally to complement limited aircraft and satellite data in time and space, with the ultimate purpose of protecting resources, property and lives.

NASA Earth Observations Support Rapid Assessment & Recovery Operations on Ft. McMurray Wildfire



Situation: Ft. McMurray (Horse River) Fire in Alberta burned 1 May to 5 July 2016, and consumed 1.5 M acres. It was the costliest disaster in Canadian history (\$3.58B)!

Approach: Use MODIS and Landsat measurements, coupled with soils and terrain information to model burn severity and create inputs to hydrological forecast models in near-real-time.

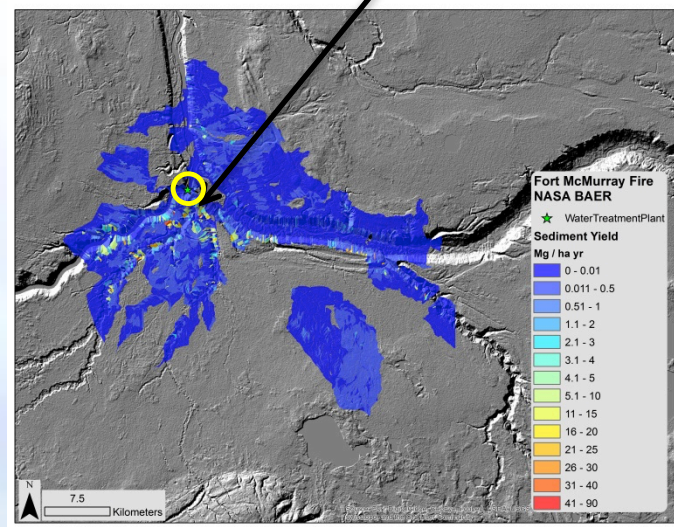
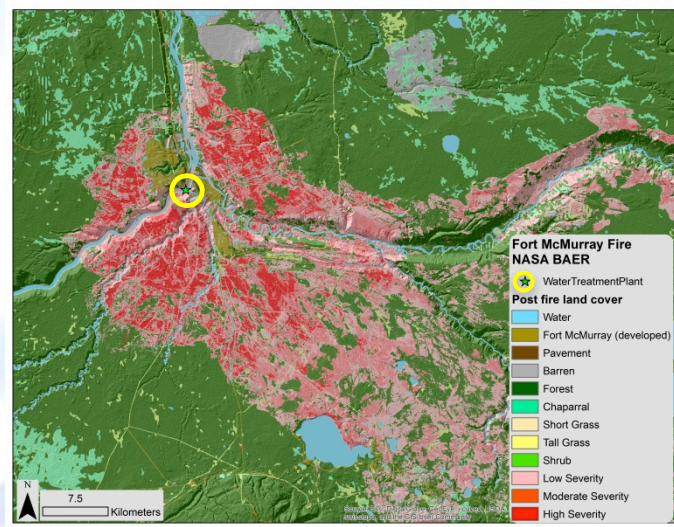
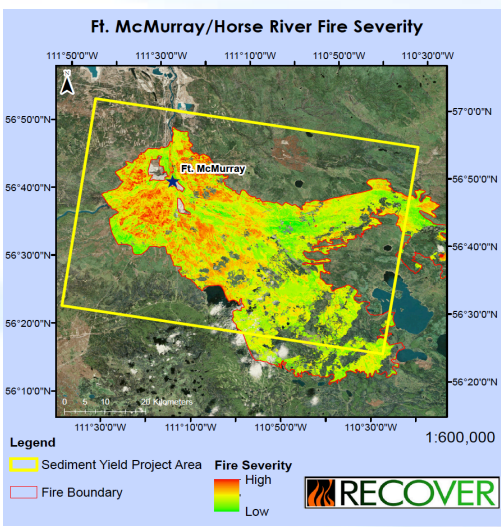
Results / Implications:

- Supported managers with real-time tools to pinpoint active fire, develop post-fire burn severity and model hydrologic processes for rapid remediation actions;
- Helped prioritize watersheds to concentrate post-fire treatment areas and save resources and significant mitigation costs.

Landsat-derived Differenced Normalized Burn Ratio

Post-fire land cover / burn severity modeled classification

High sediment / runoff predictions

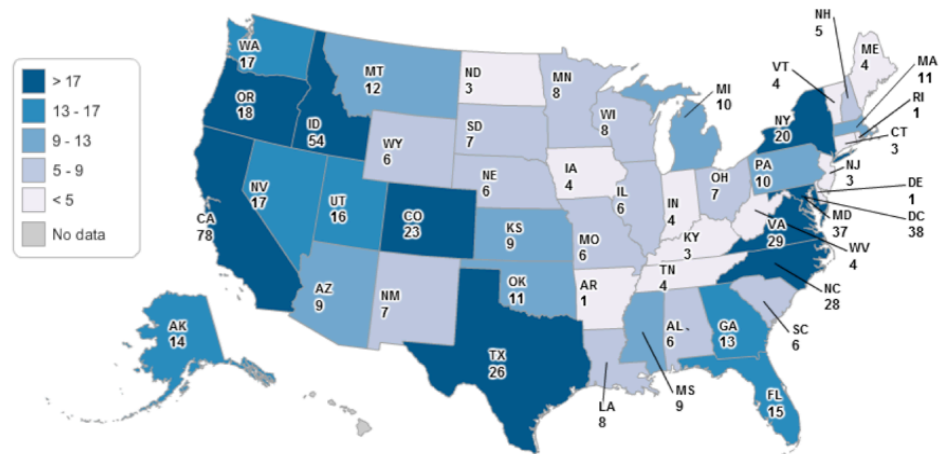
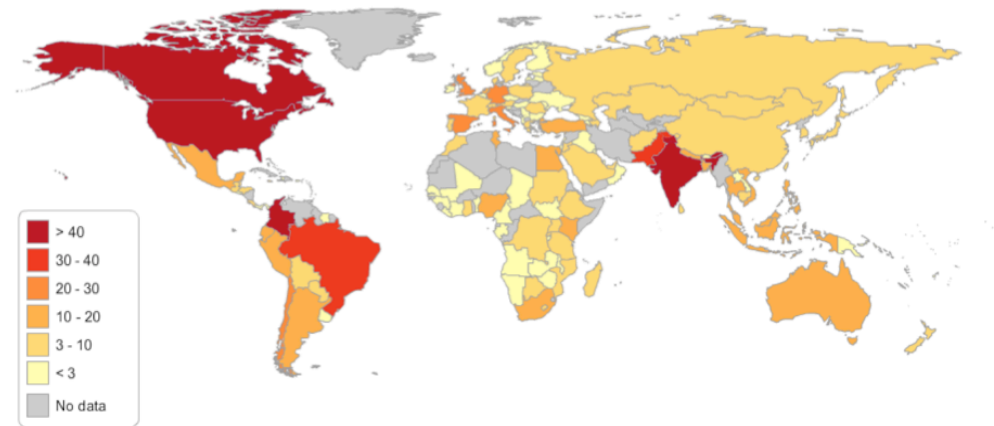


ARSET Trainings



- 66 Trainings Completed
- 4,000+ participants worldwide from:
 - 1,400+ organizations
 - 130+ countries
- More participants trained in 2015 than all previous years combined

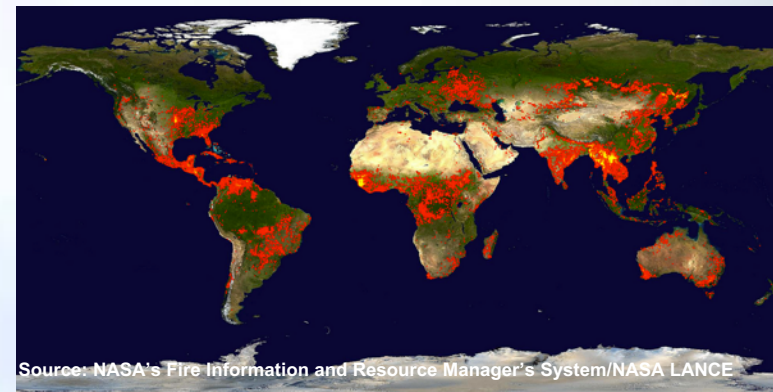
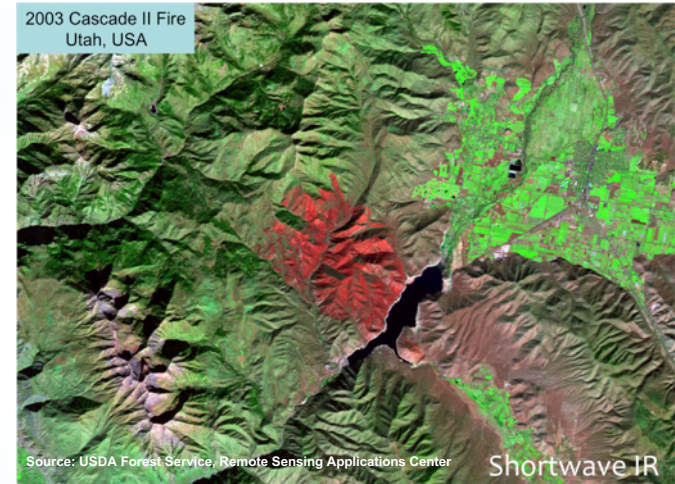
Number of Participating Organizations by Country & U.S. States (2008-2015)



Webinar: March 31 - April 28, 2015

- **Objectives:** Provide an overview of relevant NASA Earth science data products, tools, and access portals for wildfire applications for enhanced decision-making and assessment methods.
- **Overview Statistics:** 278 participants, 178 organizations, 42 countries, 33 states
- **Attendees:** USDA Forest Service, National Park Service, National Weather Service, Bureau of Land Management, US Geological Survey, US EPA, CAL FIRE, Idaho Army National Guard, Alaska Fire Science Consortium, Ministry of Environment and Natural Resources, El Salvador (MARN), Risk Management Solutions Inc., Western States Air Resources (WESTAR) Council, United Nations, Nature's Foster, ESRI, African Wildlife Foundation, Conservation International, etc.
- **End-of-Training Survey:** Majority of attendees (73%) indicated that the webinar met their expectations while 23% indicated that it exceeded expectations. 93% showed some level of improvement for understanding specific remote sensing data products appropriate for work needs.
- **<https://arset.gsfc.nasa.gov/wildfires/webinars/intro-wildfire-applications>**

First ARSET webinar focused on wildfire applications



NASA Firefighting Toolkit Brochure



Invisible Flame Imaging
A hand-held imager to detect invisible hydrogen and alcohol flames was developed at NASA's Space Center, which uses liquid hydrogen in its rocket testing program.

Breathing System
A breathing system that originated with Apollo missions uses aluminum composite materials to make the equipment lighter and easier to put on and take off. The system saves time and weight and has reduced the number of smoke-inhalation injuries.



Firefighters' Radio
NASA helped develop the first firefighters' radio, essential to coordinating hose lines and victim rescue. The rugged, short-range, two-way radio operates with an electronic circuit originally developed for NASA weather balloon communications.

Protective Jacketing
A ceramic cloth, like that used on the tiles that make up the Space Shuttle's outer skin, protects ethylene oil platforms from fires that can cause the platforms to buckle. The jacketing system can withstand temperatures of 2,000° F.

Fire Attire
Lightweight, fire-resistant, heat-protective materials were originally developed for spacesuits that protected Apollo astronauts during their missions to the Moon.

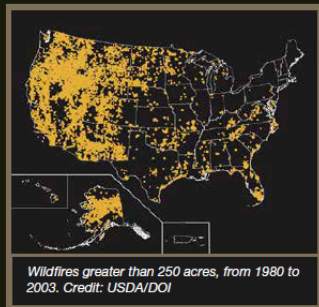
Why It Matters

- In 2015,**
- Over 10 million acres burned, the most in United States history.
 - The Federal Government spent \$1.71 billion to fight fire. This is the first time the U.S. Forest Service has spent more than half its budget on fire suppression.
 - 90 firefighters died in the line of duty, including 12 wildland firefighters.

Resources are scarce. According to the U.S. Fire Administration (USFA), the United States has 30,000 fire departments staffed by more than 300,000 career firefighters and nearly 800,000 volunteers.

USFA reported that in 2013, there were 1.24 million fires causing 3,240 deaths across the country, amounting to approximately \$11.5 billion in economic loss.

NASA helps firefighters and saves money in every state and district.



National Aeronautics and Space Administration
Office of Legislative and Intergovernmental Affairs
202-358-1055

<http://www.nasa.gov/offices/olia>

National Aeronautics and Space Administration



NASA's Firefighting Toolkit

From high-tech space materials to real-time remote sensing, NASA helps protect lives and save money.



Space Technology

Fire Shelters

NASA is testing prototype fire shelters made from the space agency's next-generation thermal protection systems. Materials initially intended to protect future spacecraft upon reentry are now being transformed to shield firefighters from a wildfire's blazing heat.

Infrared Imaging

A sensitive infrared camera developed to observe planetary atmospheres and the blazing plumes from rocket launches is also capable of scanning for fires and hotspots.



Aeronautics

Aircraft

NASA pilots fly various types of aircraft, ranging from Twin Otters to jets, to help scientists measure variables that affect fire season severity and air quality.

The Airborne Snow Observatory

uses an imaging spectrometer and scanning lidar to measure snow-water equivalent and predict spring runoff.

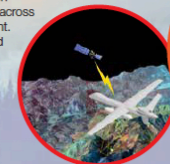


The Alpha Jet Atmospheric eXperiment (AJAX) project measures smoke from wildfires to understand its effect on air quality at the local and regional scales.



Unmanned Aerial Systems (UAS)

NASA's Ikhana aircraft, managed through a joint effort between NASA and the U.S. Department of Agriculture (USDA), can be remotely piloted to gather information on hundreds of wildfires across the West in a single flight. NASA has also partnered with the U.S. Fish and Wildlife Service to test small, lightweight UAS for forest fire detection.



Science

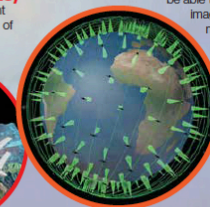
Earth Observing

NASA satellites have a role to play in detecting and monitoring wildfires. There are satellite systems currently in orbit that provide information on different fire characteristics, including location and timing of active fires, burned areas, and dry areas that are susceptible to wildfire outbreaks.



CubeSats

NASA is working on a concept for a constellation of cube satellites designed to quickly locate wildfires around the globe. This system would be able to send a low-resolution image of a fire once per minute, along with the latitude and longitude of exactly what is burning, enabling nearly continuous communication with the ground.



Brochure developed by NASA
Office of Legislative and
Intergovernmental Affairs

Interagency Partnerships



NASA collaborates with numerous U.S. land management agencies and other partners to improve wildfire characterization



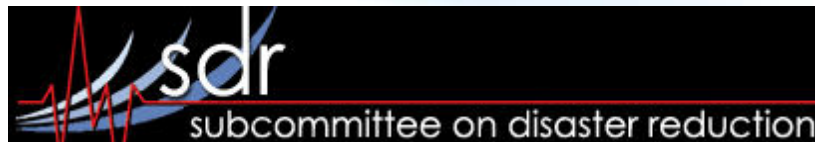
NASA Participates in National / International Fire Committees



NATIONAL ACADEMY
OF SCIENCES



- **Group on Earth Observations (GEO), Global Wildfire Information System (GWIS);**
- **National Science & Technology Council (NSTC) Subcommittee on Disaster Reduction (SDR) Wildland Fire Science and Technology Task Force (WFST TF);**
- **Interagency Arctic Research Policy Committee (IARPC); Wildfire Implementation Team (WIT);**
- **NRC, Div. of Earth & Life Sciences, Wildfire Study Team;**
- **JFS Program, Fire and Smoke Model Evaluation Experiment (FASMEE) Team**



NASA Applied Science – Wildland Fire Website



NASA Applied Sciences Program
NASA Earth Science

HOME PORTFOLIO NEWS/EVENTS FEEDBACK FORM



Going High Tech for Fire Detection – Conservation International Works with Foreign Agencies to Improve Fire Management Practices

Wildland Fires Program Wildland Fire Annual Report is available here!

Our Wildland Fire 2015 Annual Summary



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

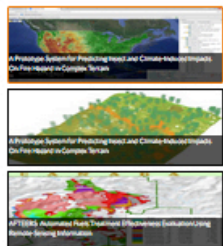


How We've Done

Wildland Fires Program July 2016 Update



PORTFOLIO



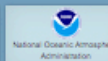
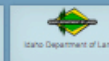
"We had some serious wildfires in September 2014, and the VIIRS 375-meter data performed excellently."

Phil Frost
Merika Institute

NASA Applied Sciences Program
NASA Earth Science

HOME PORTFOLIO NEWS/EVENTS FEEDBACK FORM

The innovative solutions delivered via the applied sciences program are made in collaboration and partnership with



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Program News

- October 31, 2016
Going High Tech for Fire Detection – Conservation International Works with Foreign Agencies to Improve Fire Management Practices
- September 15, 2015
This Technology Could Help Predict Where Wildfires Strike Next
- September 15, 2015
NASA Helps Tune Earth-Based/Fire-Using Space-Based Technology
- September 15, 2015
Starting Wildfires from Space: NASA Adds to Fireflyer's Toolkit
- June 4, 2015
Fire's Release – Conservation International's Use of NASA Satellite Information to Improve Wildfire Forecasting in Indonesia

See All News

Upcoming Events

- 10
2017
EPA/USDA 2016 – 7th AFE International Fire Ecology and Management Congress
- 8
2017
37th International Symposium on Remote Sensing of Environment (ISRS)

Past Events

- 3
2016
Tactical Fire Remote Sensing Advisory Committee (TFRSAC) Fall 2016 Meeting
- 26
2015
8th International Fire Ecology & Management Congress: Advancing Ecology in Fire Management

See All Events

Wildfires Program Team

LAWRENCE FRIEDL
Program Manager
NASA Headquarters

VINCE AMBROSIA
Associate
NASA Ames Research Center

AMBER SOJA
Associate
NASA Langley Research Center



VIDEOS

- Wildland Fire Program Video July 2016 Update
- Wildland Fire Program Video October 2015 Update
- Taking Wild Out Of Wildfires
- Helping Iñaho Recover Wildfires



PROGRAM LIBRARY

- Tactical Fire Remote Sensing Advisory Committee (TFRSAC) Fall 2016 Meeting Draft Agenda
- International Smoke Symposium – NASA/ARSET Wildfire Workshop Agenda
- 2nd International Smoke Symposium Structure
- Alaska Fire Science Consortium Workshop: Opportunities to Apply Remote Sensing in Boreal/Arctic Wildfire Management and Science
- Rapid Response to the 2014 King Fire: Final Report
- 2014 King Fire: Rapid Response: Deconstructing Megafire Behavior
- Weber JLS2 Recover Structure Glossary

LIBRARY

Tactical Fire Remote Sensing Advisory Committee (TFRSAC) Fall 2016 Meeting Draft Agenda

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Contact NASA
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WHAT'S TRENDING

Coming Soon...

<http://appliedsciences.nasa.gov/programs/wildfires-program>



WILDFIRE PROGRAM

<http://appliedsciences.nasa.gov/programs/wildfires-program>

Wildfire Management Team:
Lawrence Friedl (PM)
Vince Ambrosia (Assoc.),
Amber Soja (Assoc.)

Further Information

[*http://AppliedSciences.NASA.gov*](http://AppliedSciences.NASA.gov)

NASA Earth Science Applied Sciences Program

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