NASA Applied Science Wildfire Program

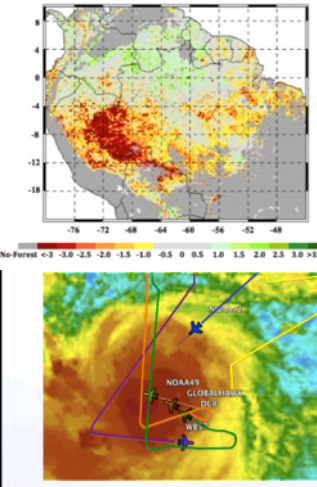
Vince Ambrosia, L. Friedl, A. Soja

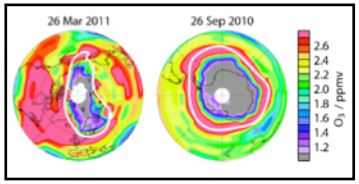
NASA Earth Science Division - Applied Sciences Program

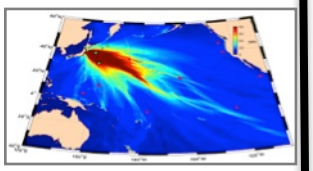
IAWF 2nd International Smoke Symposium, Long Beach, CA. 14 November 2016

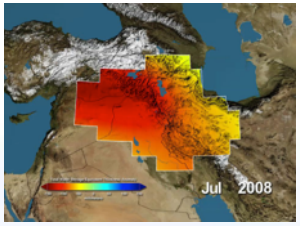
NASA's Earth Science Division

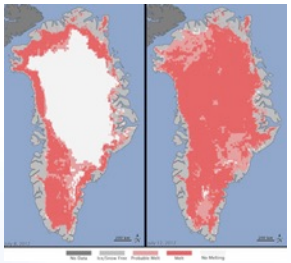
Research



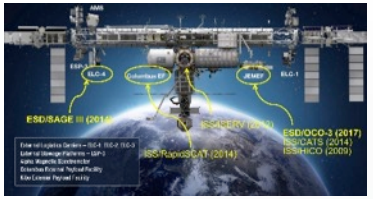




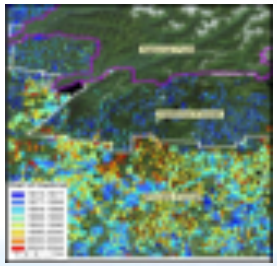


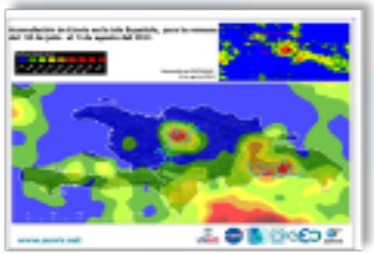


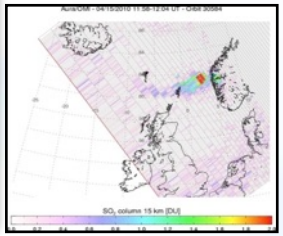
Flight

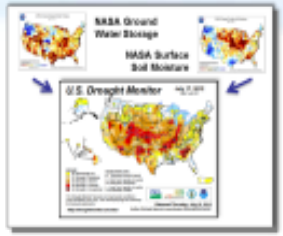


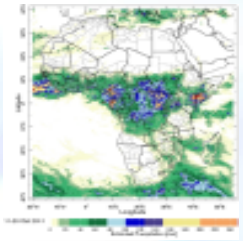
Applied Sciences



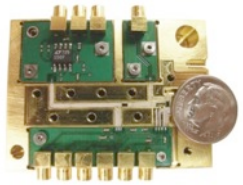


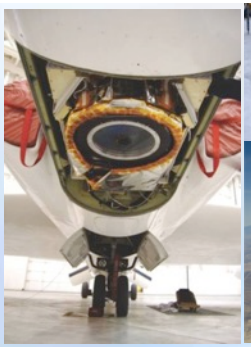






Technology





NASA Supports Fire Science

- Science Mission Directorate:
  - Earth Science Programs
    - Carbon Cycle and Ecosystems (e.g. Carbon Cycle, Land Cover Land Use Change, Terrestrial Ecology, Biodiversity, Climate and Biological Response, HysplRI, Terra and Aqua, Ocean Biology Biogeochem.)
    - Climate Variability and Change
    - Water and Energy Cycle
    - Atmospheric Composition
    - Interdisciplinary Science
    - Weather
  - Applied Science

Science Mission Directorate

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Earth Science Programs

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Applications Science

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Wildland Fire

Solicitations through NASA ROSES

Applications Themes & Societal Benefit Areas

Emphasis in 4 Applications Areas

Health & Air Quality

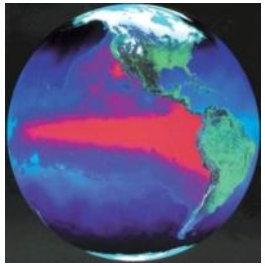
Water Resources

Disasters

Ecological Forecasting

Support opportunities in 5 additional areas

Agriculture



Climate

Weather

Energy

Oceans

Crosscutting theme: Wildland Fires

NASA Applied Sciences Program

Vision

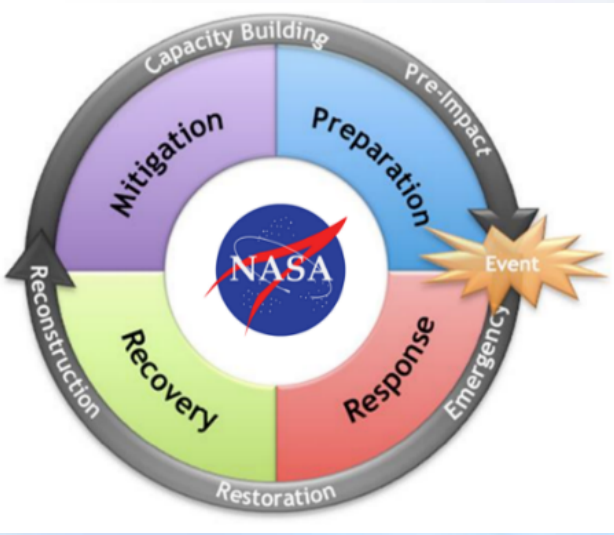
Public and private organizations routinely and seamlessly integrating Earth observations in their decisions and actions, so much so they desire additional observation types and Earth science knowledge.

Wildfire 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.



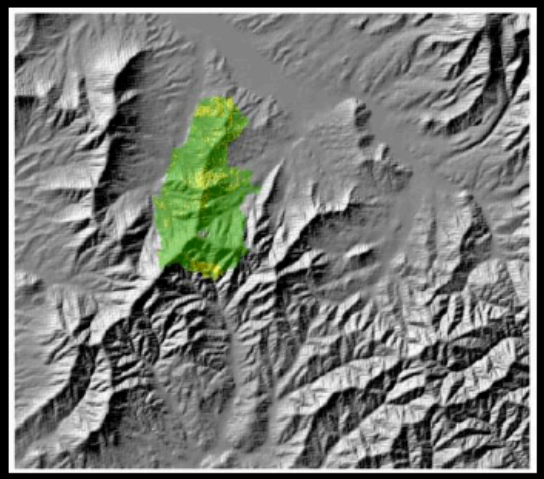
NASA Wildland Fire Program

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;

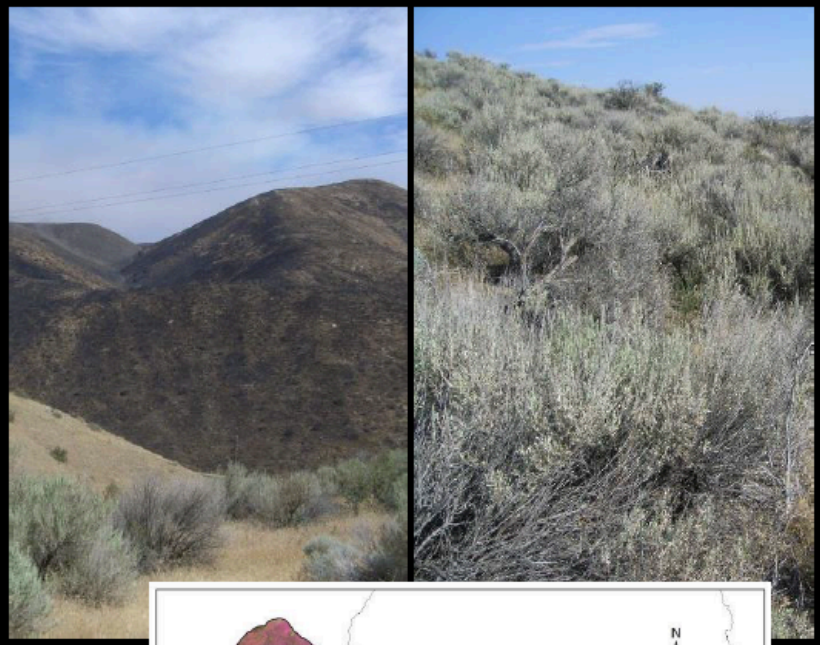
Wilfrid Schroeder / University of Maryland
Development and Application of Spatially Refined Remote Sensing Active Fire Data Sets in Support of Fire Monitoring, Management and Planning;
Stephen Howard / USGS EROS Center:
Utilization of Multi-Sensor Active Fire Detections to Map Fires in the US;

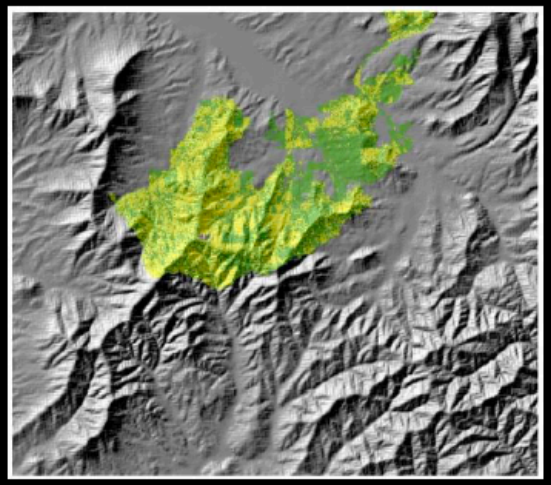
Mary Ellen Miller / Michigan Tech Research Institute (MTRI):
Linking Remote Sensing and Process-Based Hydrological Models to Increase Understanding of Wildfire Effects on Watersheds and Improve Post-Fire Remediation Efforts;
Keith Weber / Idaho State University;
RECOVER: Rehabilitation Capability Convergence for Ecosystem Recovery;

NASA Applied Sciences Wildland Fire Program

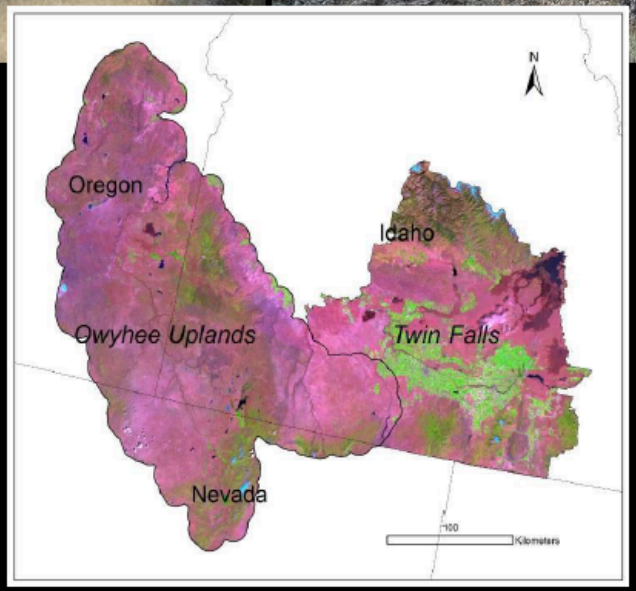


Enhanced Wildland Fire Management Decision Support Using Lidar-Infused LANDFIRE Data





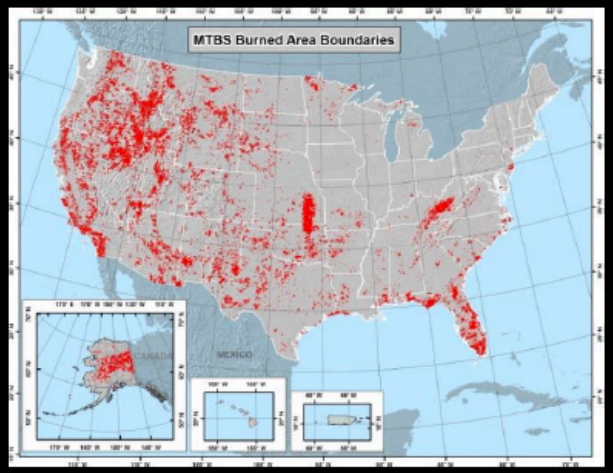
Improving Shrub and Grass Fuel Maps Using Remotely Sensed Data to Support Fire Risk Assessments



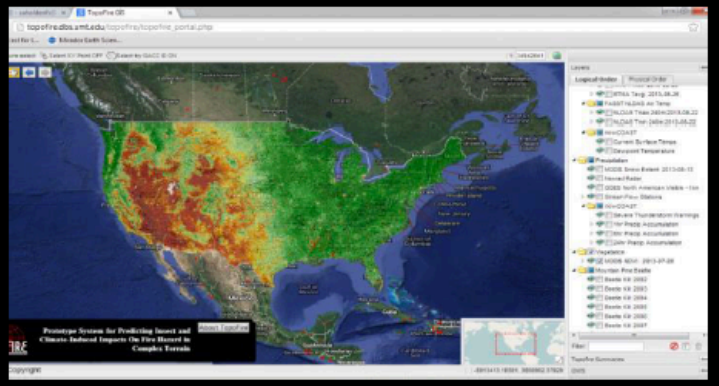
Peterson and team

Vogelmann and team

Utilization of Multi-Sensor Active Fire Detections to Map Fires in the United States

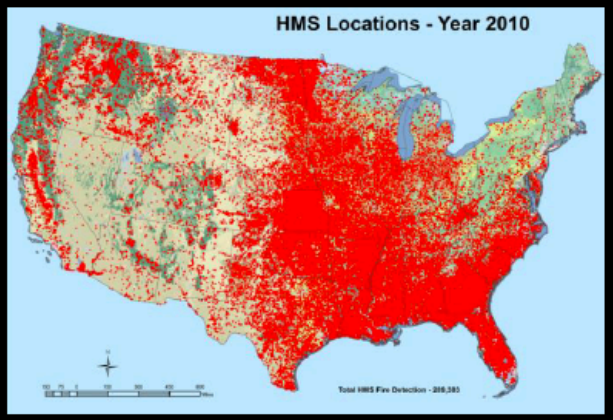


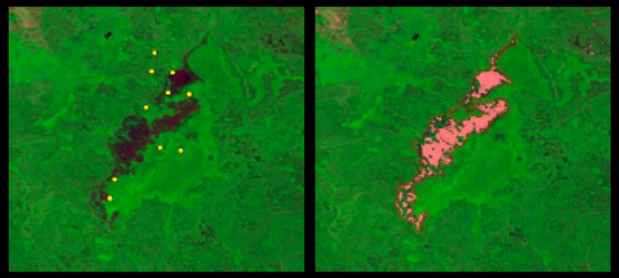
Howard and colleagues

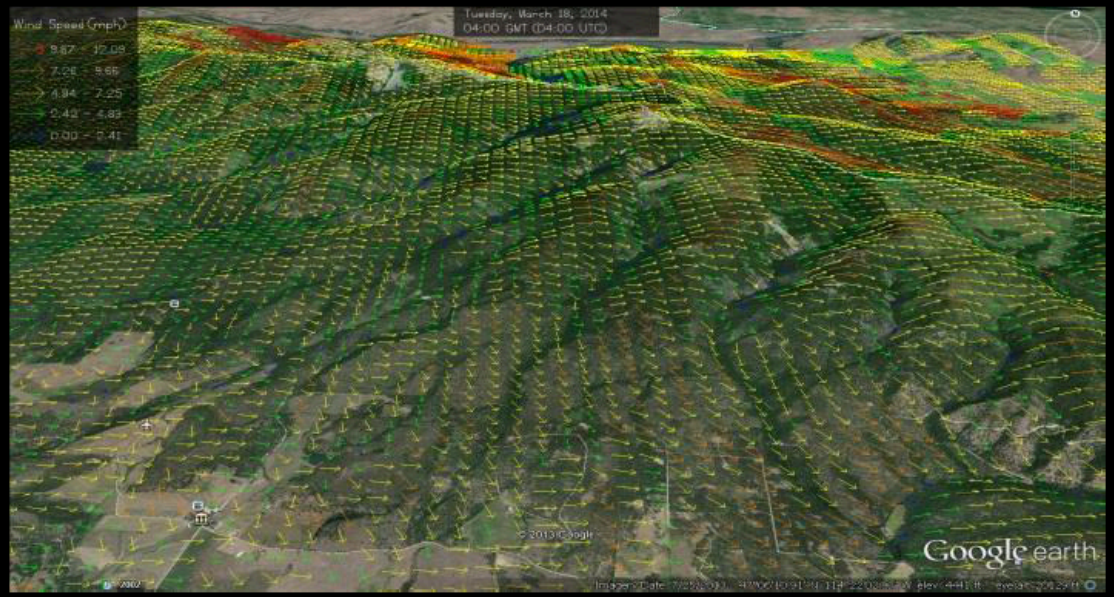


TOPOFIRE: A System for Monitoring Insect and Climate Induced Impacts on Fire Danger in Complex Terrain

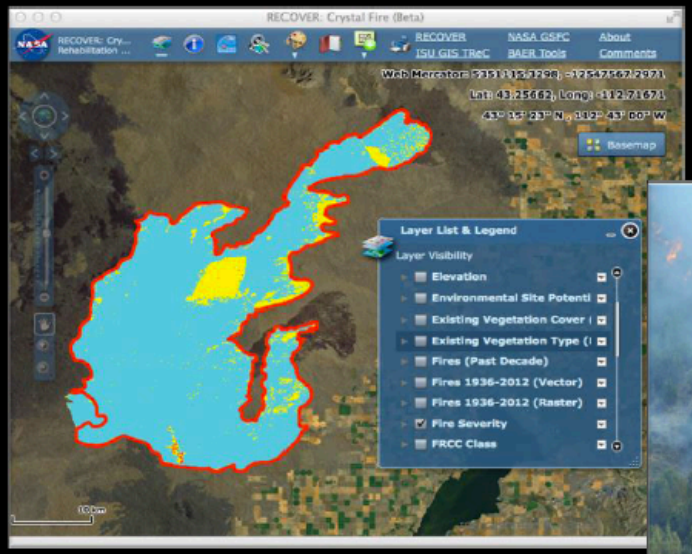
Holden and team

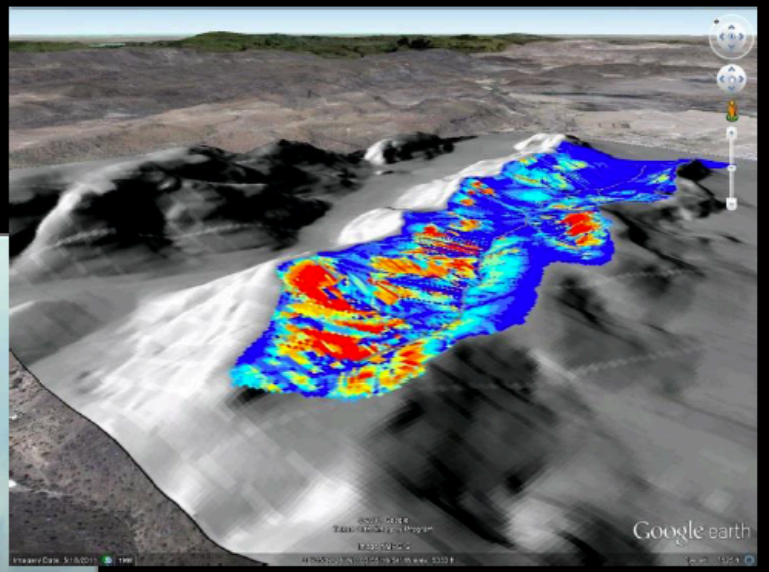






Another NASA Aim is to Support improved management strategies for mitigation of wildfire effects on ecosystems, infrastructure and human lives.





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.

RECOVER Support Wildfire Rehabilitation of Grassland Ecosystems

Weber et al.

BAER Project: Improving Post-Fire Remediation Through Hydrological Modeling

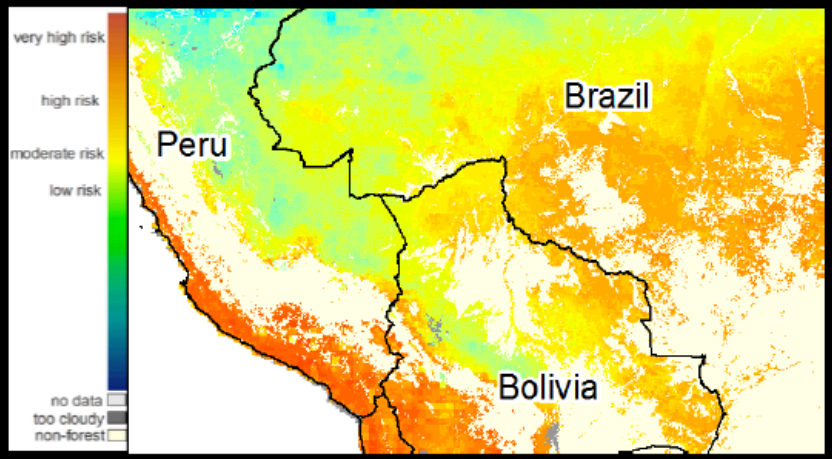
Miller et al.

Burned Area Emergency Response (BAER)

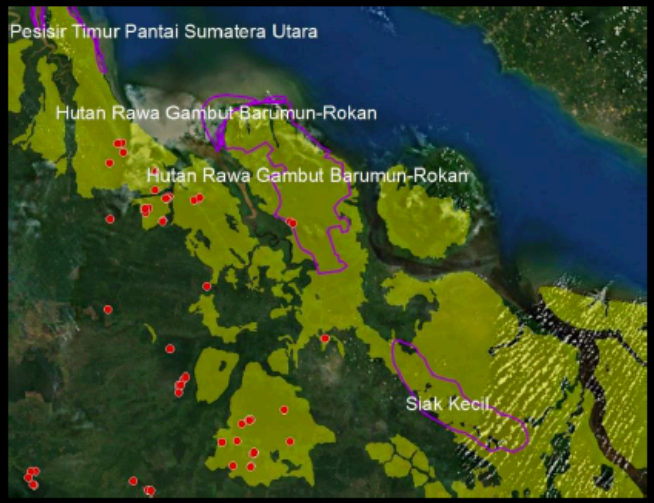
FIRECAST: A Near-Real-Time Monitoring System Improving Forest Management in the Tropics

CONSERVATION INTERNATIONAL

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.

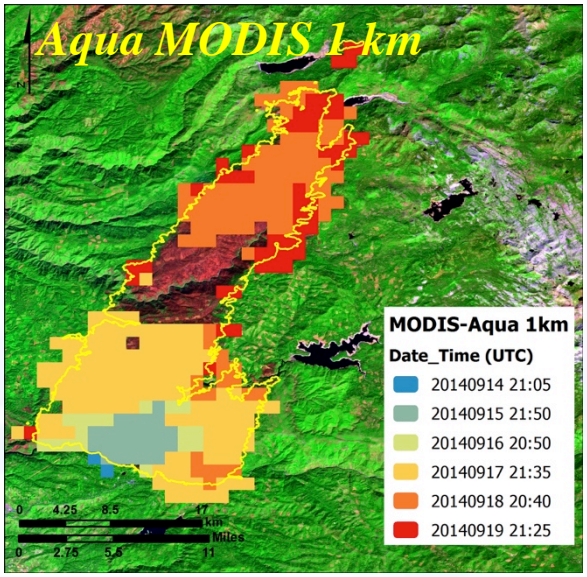


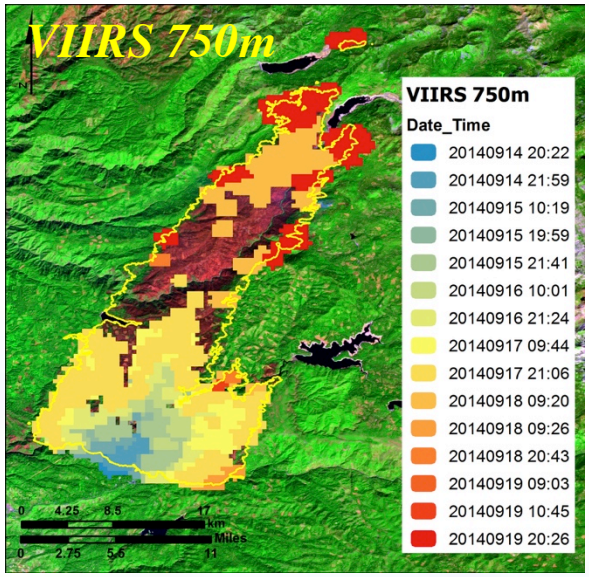
Targets areas of high biodiversity and specific communities.

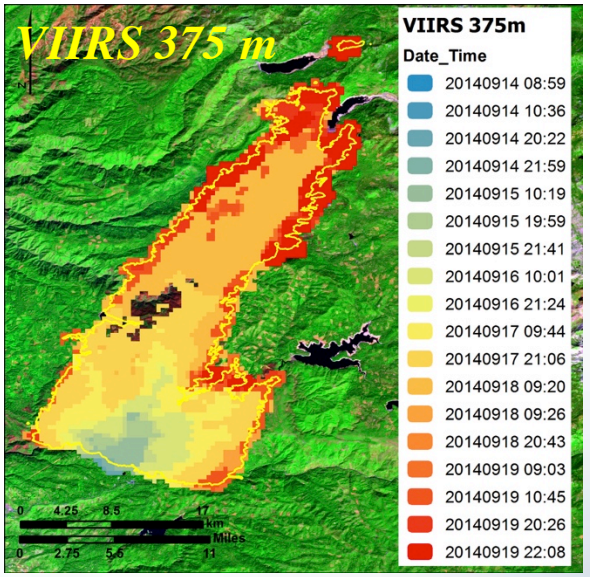
Currently the system operates in Brazil, Peru, Madagascar and Bolivia

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

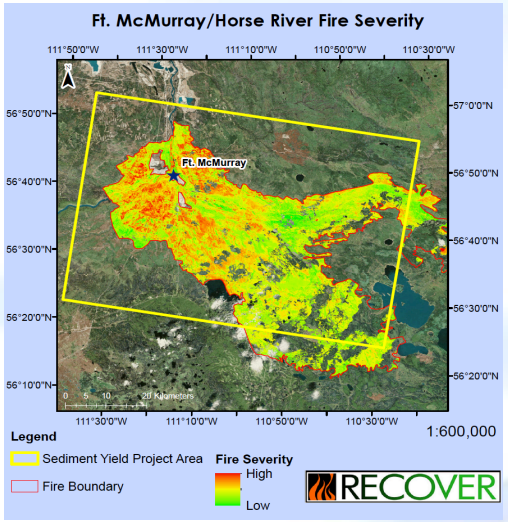
Situation: Ft. McMurray (Horse River) Fire in Alberta burned 1 May to 5 July 2016, and consumed 1.5 M acres. It was the costliest disaster in Canadian history ($3.58B)!

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.

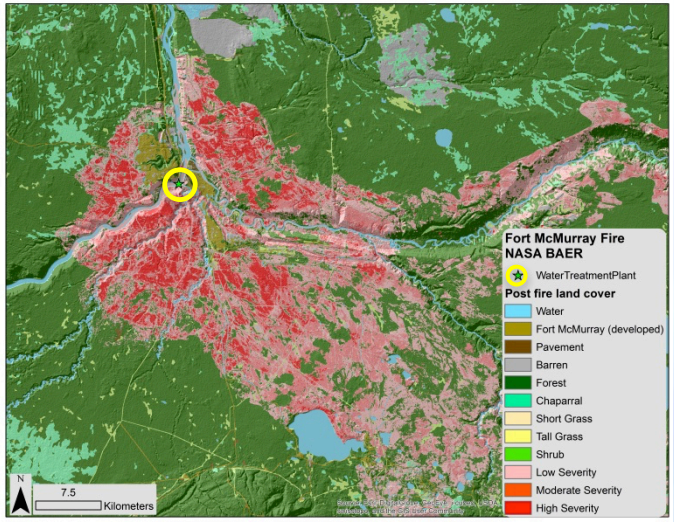
Results / Implications:

- 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.

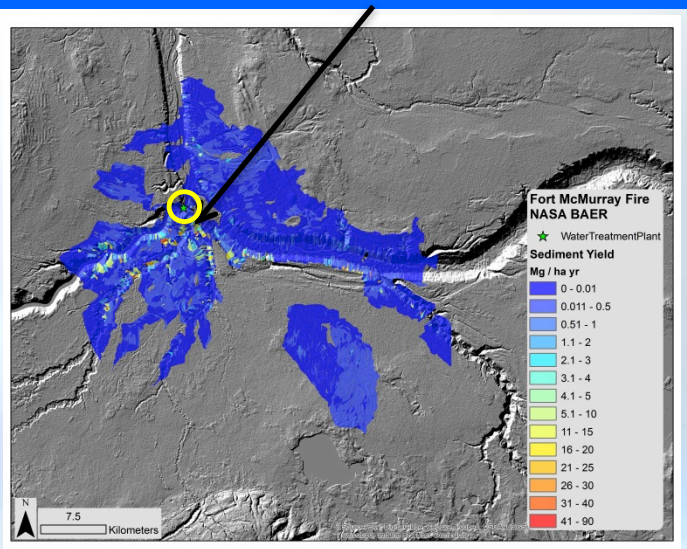
Landsat-derived Differenced Normalized Burn Ratio



Post-fire land cover / burn severity modeled classification



High sediment / runoff predictions

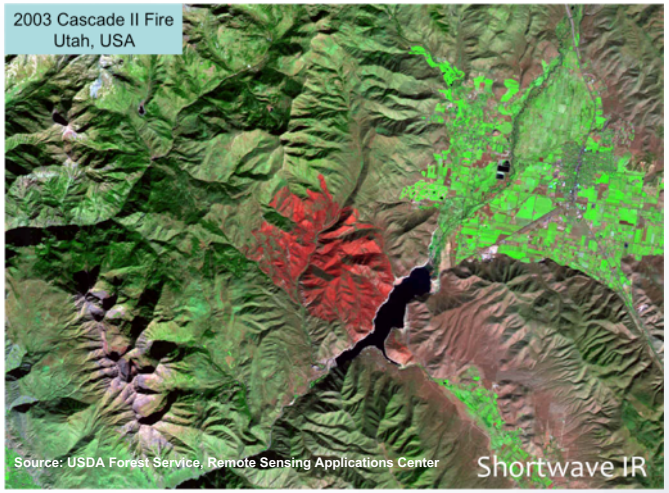


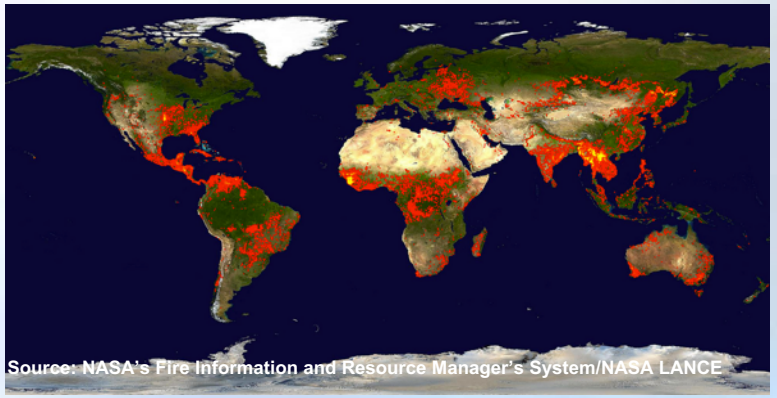
Webinars and Workshops…

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





Webinars and Workshops…

Workshop: Opportunities to Apply Remote Sensing in Boreal / Arctic Management & Science

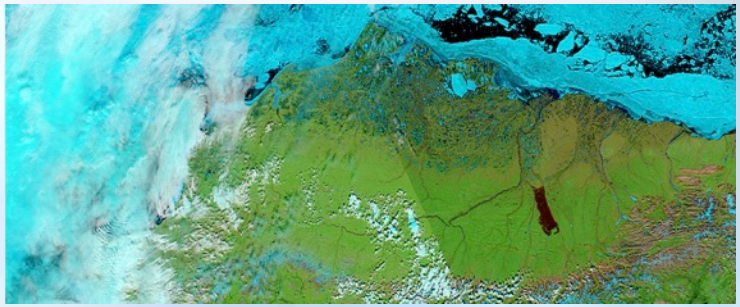
April 2017; Fairbanks, AK.

- **Objective:**

  Convene an international, interdisciplinary workshop of remote sensing scientists, ecologists, hydrologists, and agency fire managers and decision-makers to develop new opportunities for use of remotely sensed data in boreal / arctic wildfire management and science.

- Three-day workshop (April 4-6, 2017) University of Alaska - Fairbanks
- Workshop supported by NASA under a ROSES E2 solicitation. Workshop concept derived from IARPC white paper on satellite and airborne systems available for wildfire observations (Ambrosia, et al).
- Visit: **akfireconsortium.uaf.edu**

IARPC COLLABORATIONS



Remote Sensing in Boreal / Arctic Wildfire Management and Science Workshop

ALASKA FIRE SCIENCE CONSORTIUM

Call for Abstracts and Travel Support

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

April 4-6, 2017
University of Alaska Fairbanks

Abstracts and Travel Support Submissions due: November 15, 2016
Notification of abstract and travel support: December 1, 2016

Visit akfireconsortium.uaf.edu

Background and objectives: With support from NASA Applied Sciences Program, the Alaska Fire Science Consortium (AFSC) is organizing an international workshop to advance remote sensing tools and data for operational and scientific applications by high northern latitude fire ecology and management communities. Participants will include interagency fire managers as well as scientists with an interest in remote sensing and a variety of disciplines.

Topics of interest include:

- **Potential fire risk:** Can remotely sensed data (e.g., daily snow extent, others) estimate spring soil moisture and surface and subsurface fuel moisture and fuel conditions, and thus provide critical inputs for fuel moisture indices used to predict fire danger and risk?
- **Near real-time fire behavior:** Which remotely sensed data are best and most timely for fire detection, plume tracking of fire emissions, fire behavior modeling, mapping of flaming fronts, fire intensity, active fire perimeters, and response for ongoing fires?
- **Post-fire effects:** Can we improve analytical methods for remotely sensed data to assess fire severity, consumption/CO2 balance, active-layer changes, and successional trajectories of high latitude vegetation communities?

The **outcomes** of this workshop will advance co-developed investigations into new management and scientific uses of remote sensing data,

- increasing the scientific foundation and operational efficiency of northern fire management;
- improving understanding of climate-induced changes in northern fire regimes and ecosystem components and potential feedbacks to the global climate system; and
- leading to expanded application and use of remotely sensed data for fire management and fire science in high latitudes.

AFSC will publish workshop proceedings, including presentation abstracts, results, and consensus recommendations. This project is a contribution to the Interagency Arctic Research Policy Committee's Wildfire Collaboration Team.

Guide for authors: Abstracts of up to 500 words for both oral and poster presentations are welcome. The deadline to submit abstracts is November 15, 2016. To submit abstracts, visit akfireconsortium.uaf.edu.

Applications for travel support: Limited funding is available to offset selected presenters' travel expenses, with priority given to students and other young investigators. Applications for travel support are available at akfireconsortium.uaf.edu. and are due November 15, 2016.

Associated training opportunity: With sufficient interest, NASA's Applied Remote Sensing Training (ARSET) project and/or Short-term Prediction Research and Transistion Center (SPoRT) will offer an optional day of hands-on training for integrating NASA Earth Science data into wildland fire science, decisionmaking, and management. Please indicate your interest in this opportunity on the submission form.

Organizing committee:

Vince Ambrosia, NASA-Ames
Laura Bourgeau-Chavez, Michigan Tech Research Institute
Amy Breen, University of Alaska Fairbanks
Jessica Cherry, University of Alaska Fairbanks
Evan Ellicott, University of Maryland
Mike Flannigan, University of Alberta
Tom Heinrichs, University of Alaska Fairbanks
Everett Hinkley, US Forest Service
George Huffman, NASA-Goddard
Randi Jandt, Alaska Fire Science Consortium
Jennifer Jenkins, Alaska Fire Service
Tatiana Loboda, University of Maryland
Rachel Loehman, USGS Alaska Science Center
Tim Lynham, Canadian Forest Service
Christine Waigl, University of Alaska Fairbanks
Robert Ziel, Alaska Fire Science Consortium

IARC International Arctic Research Center University of Alaska Fairbanks

UAF UNIVERSITY OF ALASKA FAIRBANKS

Contact AFSC coordinator Alison York with any questions (907-474-6964 or ayork@alaska.edu).

UAF is an affirmative action/equal opportunity employer and educational institution

NASA Firefighting Toolkit Brochure

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.

Wildfires greater than 250 acres, from 1980 to 2003. Credit: USDA/DOI

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

NASA's Firefighting Toolkit

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

www.nasa.gov

Various NASA science, technologies and information processing capabilities support the nation's wildfire management communities

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.

Fire-Resistant Fabric

Firefighters wear suits made of fabric developed for NASA spacesuits created to protect astronauts from extreme temperatures.

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

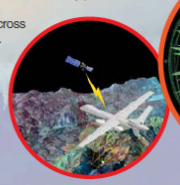
uses an imaging spectrometer and scanning lidar to measure snow-water equivalent and predict spring runoff.

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)

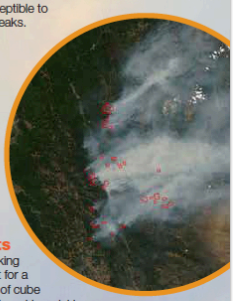
NASA's Ikhana aircraft, managed through a joint effort between NASA and the U.S. Department of Agriculture (USDA), can be remotely piloted to gather information on hundreds of wildfires across the West in a single flight. NASA has also partnered with the U.S. Fish and Wildlife Service to test small,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



Science

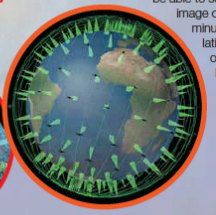
Earth Observing

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

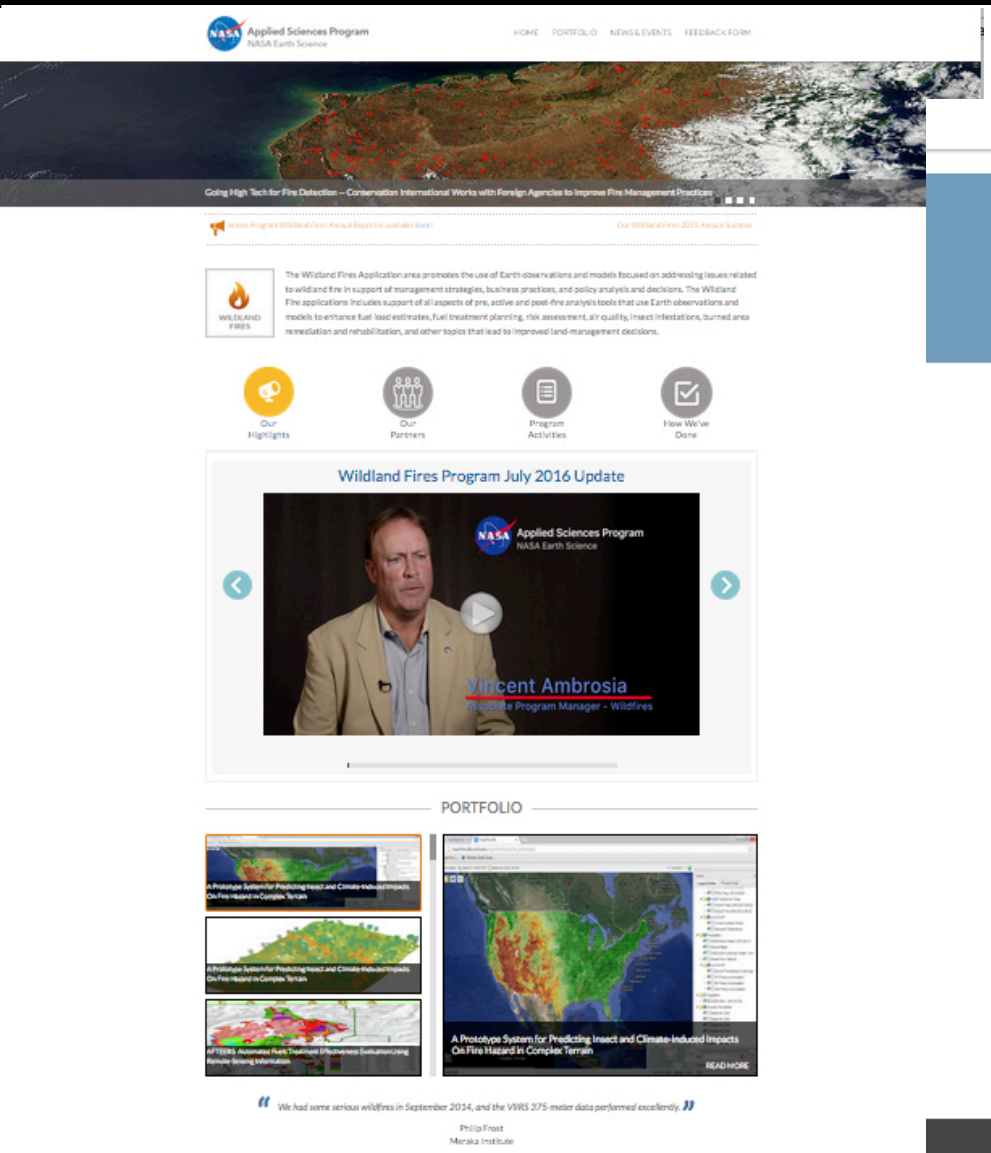
Interagency Partnerships

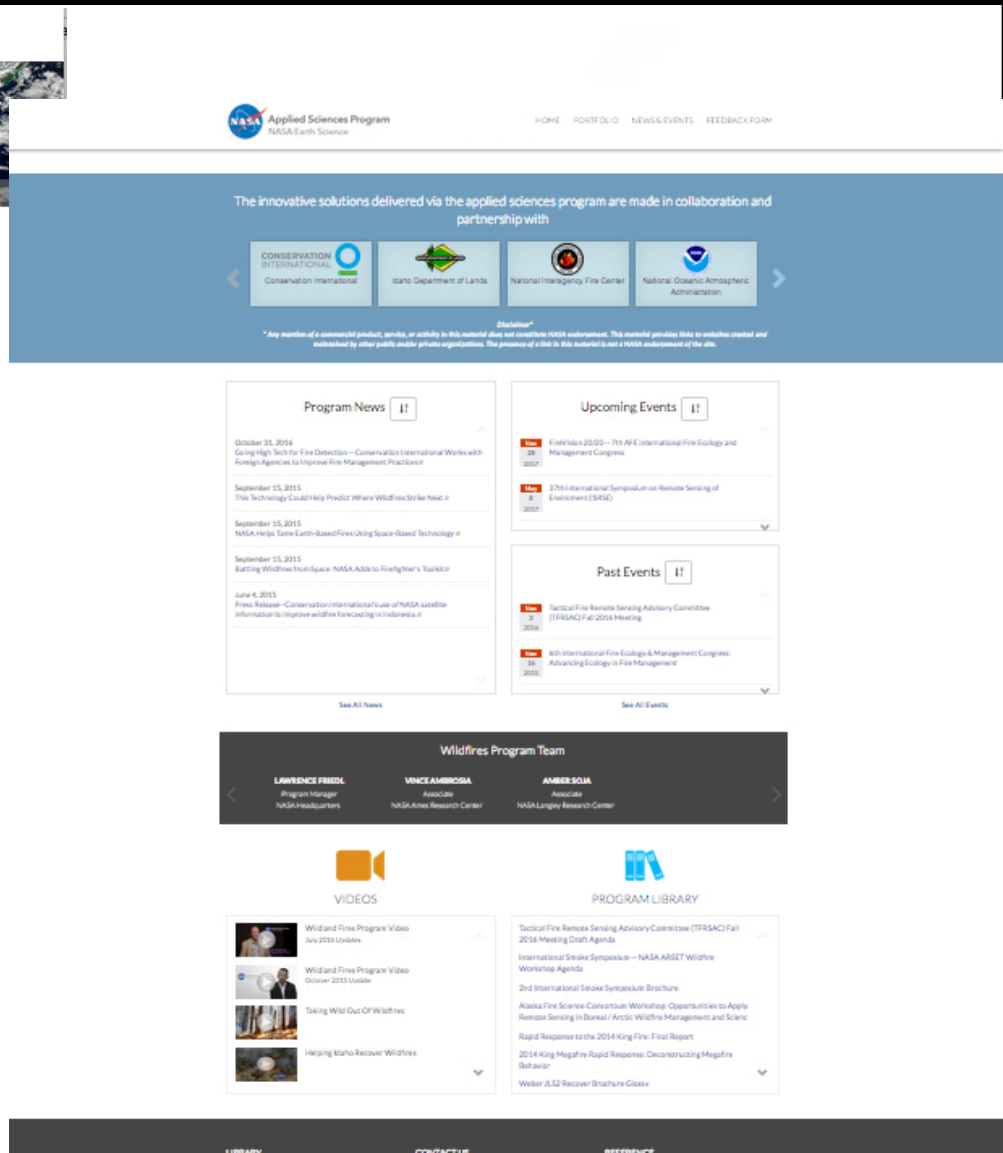
NASA collaborates with numerous U.S. land management agencies and other partners to improve wildfire characterization

NASA Participates in National / International Fire Committees

- 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





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

National Aeronautics and Space Administration

WILDFIRE PROGRAM

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

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Further Information

http://AppliedSciences.NASA.gov

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