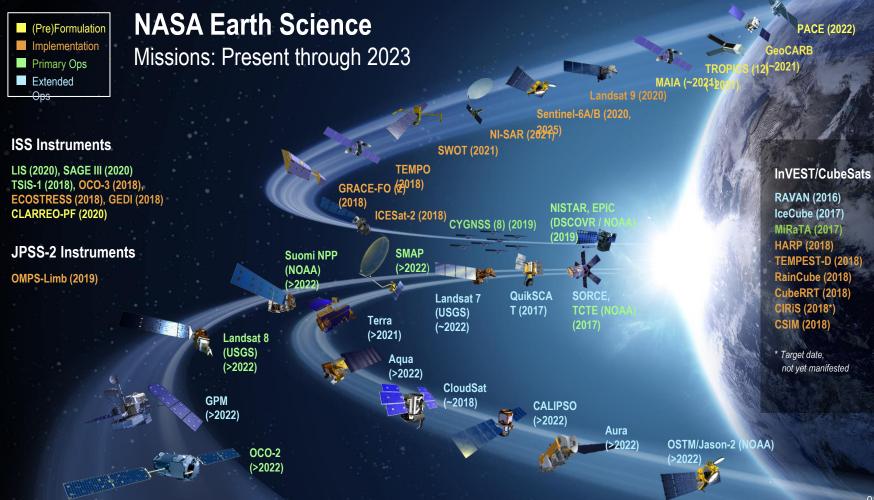
NASA Wildland Fire Program NASA GEO GWIS Contributions

Amber Soja, Vince Ambrosia and Lawrence Friedl NASA Applied Science Program

3rd GWIS and GOFC-GOLD Fire IT Meeting 1-2 October 2018 University of Maryland

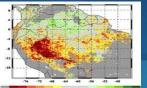


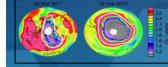


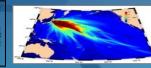
NASA's Earth Science Division

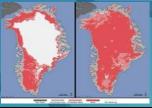


Research









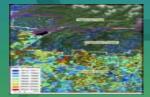
Flight



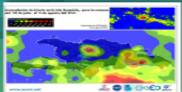


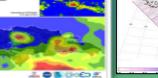


Applied Sciences

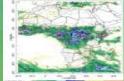












Technology









Applications Themes & Societal Benefit Areas Emphasis in Support opportunities

4 Applications Areas



Water

Resources

Health & Air Quality



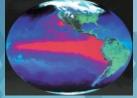
Disasters



Support opportunities in 5 additional areas



Agriculture



Climate



Weather

4



Energy



Oceans



Wildfire Program Focus Areas

NASA

Pre-Fire (Fire Risk Modeling)

- 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.

ROSES-2011 A.35 Phase II Projects



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;

Josh Picotte / 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 Earth Observations Support Rapid Assessment & Recovery Operations on Ft. McMurray Wildfire

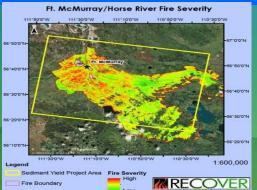
Situation: Ft. McMurray (Horse River) Fire in Alberta burned 1 May to 5 July 2016, and consumed 1.5 M acres. It was the costliest disaster in Canadian history (\$3.58B).

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:

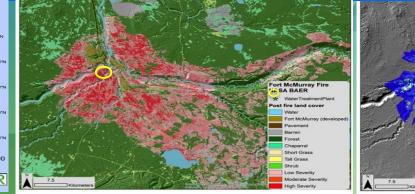
- Supported managers with tools to pinpoint active fire, develop post-fire burn severity and model hydrologic processes for rapid remediation actions;
- Helped prioritize watersheds to concentrate post-fire treatment areas and save resources and mitigation costs.

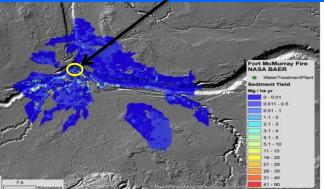
Landsat-derived Differenced Normalized Burn Ratio



Post-fire land cover / burn severity modeled classification

High sediment / runoff predictions





Advertising our Successes

support systems could lead to improvements in both strategic (i.e. pre-preparedness and planning) and tactical (i.e. fre behavior)



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4

2-page Fact Sheets (IAWF, USFS, CI, USGS, AFE, TFRSAC, ESRI, other Partners)

National Aeronautics and Space-Administration

ional Aeronautics and Space Admini WRF-SFIRE: Wildland Fire Behavior FIRECAST: A Near Real-Time Monitoring and Risk Forecasting; Coupling Weather and Fire Behavior Models System Improving Forest Management - veneritii Mort spendroch the spendrochanic housing both may be a set of the spendrochanic housing both may be a set of the spendrochanic housing both may be a set of the housing both may be a s () 0 in the Tropics \mathbf{a} Challenge regressent conditions at the actual fee location or use coarse resolution numerical executive prediction predicts (a couple of kitometers) that are not sufficient for enables the feerings of the attraciptive, as set to local-toals elicituations induced by thereforemen, also therease, or other meteorological phenomenon, also therease, or other meteorological phenomenon, also therease, or other meteorological phenomenon, and therease of the phenomenon of the phe The loss of the world's natural habitat through timber extraction, widland fires, and agricultural expansion is causing wide-ranging environmental and economic impacts. Projected increases in cerno.opensfm.org 4 S S frequency and intensity of drought conditions will increase the incidence of wildland fires. Drought and fire cause economic strain, displacement, and food insecurity while also impacting biodiversity \triangleleft Solution \triangleleft To provide fire managers with improved forecasting capabilities, a new forecasting modeling foramenth has been diversigned based on the excepted fire-attrengativer model WIRF-SFREE. This innovative system, called WR2XPT is the serviry first impacted fire and sensite prediction platform, offering magaled the, weather and smalle forecasts diven by an advanced lad monitor and the provision of ecosystem services such as water availability, water quality, and polirization. In addition, fire disasters cause health problems from cor air quality and the spread of diseas-Solution Consecution International's Directant tool is Conservation International's Finemat tool is designed to help prover the destructive effects of fires on natural habitat and human well-being privacet uses emerging technologies and cutting-edge insearch to encourse insultability and internation. The system packages and dedivers shortfarm fire-risk effects. FIRE-ATMOSPHERE MODEL WRF-SFIRE WRF-SFIRE couples a high resolution, reult-scale seather research and forecasting model (WRF) with a evabler research and forecasting model (WHT) with a seeni-empirical fire spread model and a prognetic deal field mointure model (21962). Through the integration with a hail mointure model that is driven by the atmospheric data, this model has the ability to reache the durnal and spatial variability of fuel mostore, and its brecasting and near real-time (NRT) detection of fires, droughts, and deforestation to subsorbers impart on the free helvavior, plane rises, and downwind smoke dispersion. As a misuit, the forecasted free behavior and plane dynamics are linked to the atrocophere and only due to the locally fine-affected winds but also through the fuel meisture. WRF-SFIRE is trough a suite of delivery mechanic to the needs of in-country decision makers Element along in deliver the latest MOT East National Aeronautics and Space Administration onal Aeronautics and Opace Administration National Aeronautics and Space Administration VASA Advanced Wildfire Mapping and Enhanced Wildland Fire TOPOFIRE: a topographically resolved Modeling Tools S Wildfire danger and drought monitoring Management Decision Support ť system for the continental United States using Lidar-Infused LANDFIRE Data 0 User Requirements widfres lasting several days. The demand for timely, consistent, and quality wildlife information is high and peaks each Fire Danger in Complex Terrain ß S The United States has experienced increases in severe wildfire behavior, property losses, and costs. Concurrently, recognition of the role of fire in restoring Active Fire Mapping Many weather factors such as temperature humidity, wind, radiation, and snow cover summer when interagency fire operations and resource requests are maximized in resoonse to Δf resource requests are maximized in response to multiple large wildfree. Wildfre response at all government levels requires current and predictive fre information for lactical friefighting. influence ignition probability and regulate the behavior of that fire upon ignition. These and maintaining resident ecosystems has recommen-tracture facture intertwine to oneate difficult decision reaking for land managers. As society begins to learn how to five with five, land managers are attempting to 4 conditions vary dramatically in complex terrain with lower radiation loads creating cools evacuation, and strategic planning to avert of begreatures and delayed snoweek1 on north-facing siques (Tigues 1). The outside effects of on operators with aspect position and delayed snoweek1 eval in large differences in fail molecular and fire danger that can persist throughout the fire assess (Figure 1). However, operational fire management todystem (MFAS) and the Waldment Fire System (MFAS) and the Waldment Fire ics to safely and S mitigate impacts. Remote sensing active fire datasets, fire modeling tools, and associated S effciently manage fire for benefit while protecting eople and cor nities from harm. New decisio chattal minimums are essential to interanen geospatial products are essential to meragency fire operations. They provide ontical support to fire managets and help inform the public in areas 813.70 1715.60 upport tools are continuously being developed b 4 4 threatened by widfres. 7 The Wildard Fire Decision Support System (WFDDS) is the de facto decision support tool for federal fire 10-25 m 25.50 m Recent advances in satellite-based fire detection managers. WFDGS integrates fire behavior prediction models and economic tools to assess widthe-itmatened values, such as houses or infrastructure. The mealing risk and vulnerability assessments provide a consistent and quantitative Decision Support System (WFDSS) use information from a single Remote Automated and mapping, airborne fire mapping and measurement, and coupled weather-wildland fire V 41 - V - V - V Neather Station, often located many miles rom a fire to inform weather-related decisions modeling present a new opportunity to routinely map fire extent and progression, examine active fire areas in greater detail, and predict fire and modeling across the entire fre ire behavior asses ation structure and faels products from the - north Gridded weather datasets currently available in he U.S. are produced at spatial resolutions The U.S. are produced at spatial resolutions that are simply to coarse (> Um) to resolve temperature variations associated with aspect position and code air distance in variance cological barries of widther to be contrast to suppress most first, maching these first-scale variation is variable waither and incomposing these inde weithing management decision response most each first incrementation. 50 m to the 3D arrangement of material within vegetation canopies is not well represented in the LANDFIRE Nov Jon Mor Max Jul Sco saps. This is, in part, driven by LANOFIRE's reliance Figure L An area in western Mantana shawing on Landsat imagery as the sole menote sensing data input for mapping, such imagery does not directly. modeled solar radiation (top) with cnow woter equivalent (middle) and







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NASA ROSES-16 GEO Solicitation



A.50 Group on Earth Observations Work Programme

- Solicitation offered by NASA Earth Science and Applied Science Program
- To demonstrate a strong ability to support and advance GEO, to further U.S. and NASA interests, and to demonstrate U.S. and NASA commitments to GEO;
 - To foster broader domestic involvement in a U.S. national approach to GEO and the Work Programme;
- Advance the use of Earth observations to inform decisions and actions and broaden the organizations routinely using them;
- Increase international collaboration and partnering across GEO and broaden the GEO community;

GWIS Timeline





2013 - Copernicus and GEO support development of GWIS as a extension of EFFIS







2001-20XX GOFC-GOLD Fire

Implementation Team Meetings to

promote joint developments of

global fire monitoring and EEFIS

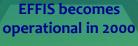


2016

2018

GWIS Operational

2020



Creation of Forest Fire

Experts Group in EC

2000

Information System



1998



2003--Rapid damage assessment was introduced to EFFIS; quasi-real time maps of burned areas in southern Europe.

2001-GOFC-Fire holds a joint workshop with the **CEOS LPV on Fire Product**

Validation in Lisbon

2004

2001

2004--EFFIS Fire **Database** was established

Global Observation of Forest

nd Land Cover Dynamics



NASA Supports 3 GWIS Teams Luigi Boschetti, Robert Field Schroeder / Giglio

NASA ROSES-16 GEO Solicitation



A.50 GEO Work Programme Solicitation

- Funding Opportunity Number: NNH16ZDA001N-GEO
- Number of New Awards: ~20-25 (increased to 32)
- Max Duration of Awards: 36 months
- Total Amount of NASA Funding (FY17-20): \$8M (increased to ~\$15M)
- Expected Level of Awards: \$30K \$200K per year
- Proposal Due Date: March 10, 2017
- Notify Pls: September 18, 2017 (about 2-3 weeks late)
- Expected Project Start Date: December 1, 2017

GEO solicitation POC: Lawrence Friedl

GEO GWIS POC: Vince Ambrosia

GEO GWIS Selected Proposals



A.50 GEO Work Programme 3.8 Global Wildfire Information System (GWIS)

Robert Field (Columbia University)

 "Enhancements to the Global Wildfire Fire Information System: Fire Danger Rating and Applications in Indonesia"

Louis Giglio / Wilfrid Schroeder (University of Maryland / NOAA)
 "Development of a Harmonized Multi-Sensor Global Active Fire Data Set"

Luigi Boschetti / David Roy (U. of Idaho & So. Dakota State Univ.)

• "Using the NASA polar orbiting fire product record to enhance and expand the Global Wildfire Information System (GWIS)"

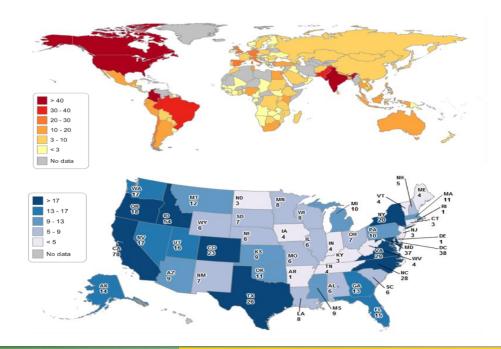
ARSET Trainings



• 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)



http://arset.gsfc.nasa.gov

ARSET 2018 Wildfire Applications Webinars: GEO-GWIS

- **Objectives:** Provide an overview of relevant uses of GWIS and navigation through the GEO-GWIS tools and map services
- **Date:** 19 July 2018



- Agenda / Schedule: Usually one, 1-hour session per week for 5-weeks. Materials can be accessed on own time following the completion of the webinar.
- **Audience:** National and international entities involved in wildfire management or responsible for providing fire statistics on regional or national wildfire events. Professionals interested in implementing satellite capabilities for wildfire management activities.

Burned Area (small Landfire)

- Objectives: Utilize an open source tool (QGIS) to download Landsat imagery to identify suitable imagers for fire mapping, and subsequently create an automatically-derived, MTBS-like threshold burn severity products. Provides a much needed tool to allow worldwide users to track and map fires. Josh reported success
- Date: 12 July 2018

400+ attendees

- Agenda / Schedule: Workshop with Josh Picotte (USGS-EROS)
- Audience: National and international entities involved • in burn severity assessment or providing fire statistics on regional or national wildfire events.



https://arset.gsfc.nasa.gov



Points of Contact

NASA Applied Science Program – Wildfire and GEO-GWIS

http://appliedsciences.nasa.gov/

Vince Ambrosia NASA Ames vincent.g.ambrosia@ nasa.gov Lawrence Friedl NASA Headquarters LFriedl@nasa.gov Amber Soja NASA Langley amber.j.soja@nasa.gov

International Space Station Earth Science Operating Missions

FC



ESP-3

ELC-2

AMS

FIC-4

Columbus

FF

External Logistics Carriers: ELC-1, ELC-2, ELC-3 External Stowage Platforms: ESP-3 Alpha Magnetic Spectrometer Columbus External Payload Facility Kibo External Payload Facility



TSIS-1 (2018)

ELC-3

ELC-1

LIS (2020)

JEMEF

NASA ARSET 2018 GWIS Webinar







- **Objectives:** Provide an overview of relevant uses of GWIS and navigation through the GEO-GWIS tools and map services;
- **Dates:** July 19, 2018
- Audience: National and international entities involved in wildfire management or responsible for providing fire statistics on regional or national wildfire events.
 Professionals interested in implementing satellite capabilities for wildfire management activities.

https://arset.gsfc.nasa.gov

ARSET Workshop: Wildfires in Boreal Systems



Workshop: Opportunities to Apply Remote Sensing

in Boreal / Arctic Management & Science April 4-6, 2017; Univ. of Alaska, 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).





https://akfireconsortium.uaf.edu

First ARSET Wildfire Applications Webinar:



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.





Source: NASA's Fire Information and Resource Manager's System/NASA LANCE

https://arset.gsfc.nasa.gov/wildfires/webinars/intro-wildfire-applications

ARSET Workshop: Wildfire Applications at ISS²



Workshop: November 14, 2016

- **Objectives:** Provide an overview of relevant NASA Earth science data products, tools, and access portals for wildfire applications for enhanced fire and smoke monitoring
- **Training Summary:** Attendees learned how to apply NASA Earth observations to air quality forecasting; smoke, fire, and PM2.5 monitoring; image interpretation; and image processing. The training provided practitioners in wildland fire, smoke management, public health, and air quality management with tools to incorporate satellite remote sensing into their decision-making process.
- **Overview Statistics:** 26 participants, 18 organizations, 5 countries,
- Audience: National and international entities involved in air

https://arset.gsfc.nasa.gov/wildfires/workshops/smoke-symposium-2016

Attendees included: USDA Forest Service, National Park Service



Long Beach, California



GWIS Goals in GEO WP 2017-2019



- **Provide harmonized fire information (e.g. fire danger)**
- Promote networking of fire information providers through annual workshops;
- Establish operational links with other wildfire communities;
- Integrate / harmonize regional wildfire information data sources;
- **Develop, implement and promote interoperability and communication**
 - **Coordinate / promote capacity building and training activities**

Advancing NASA's Wildland Fire Applications Capabilities

NASA

- 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.



