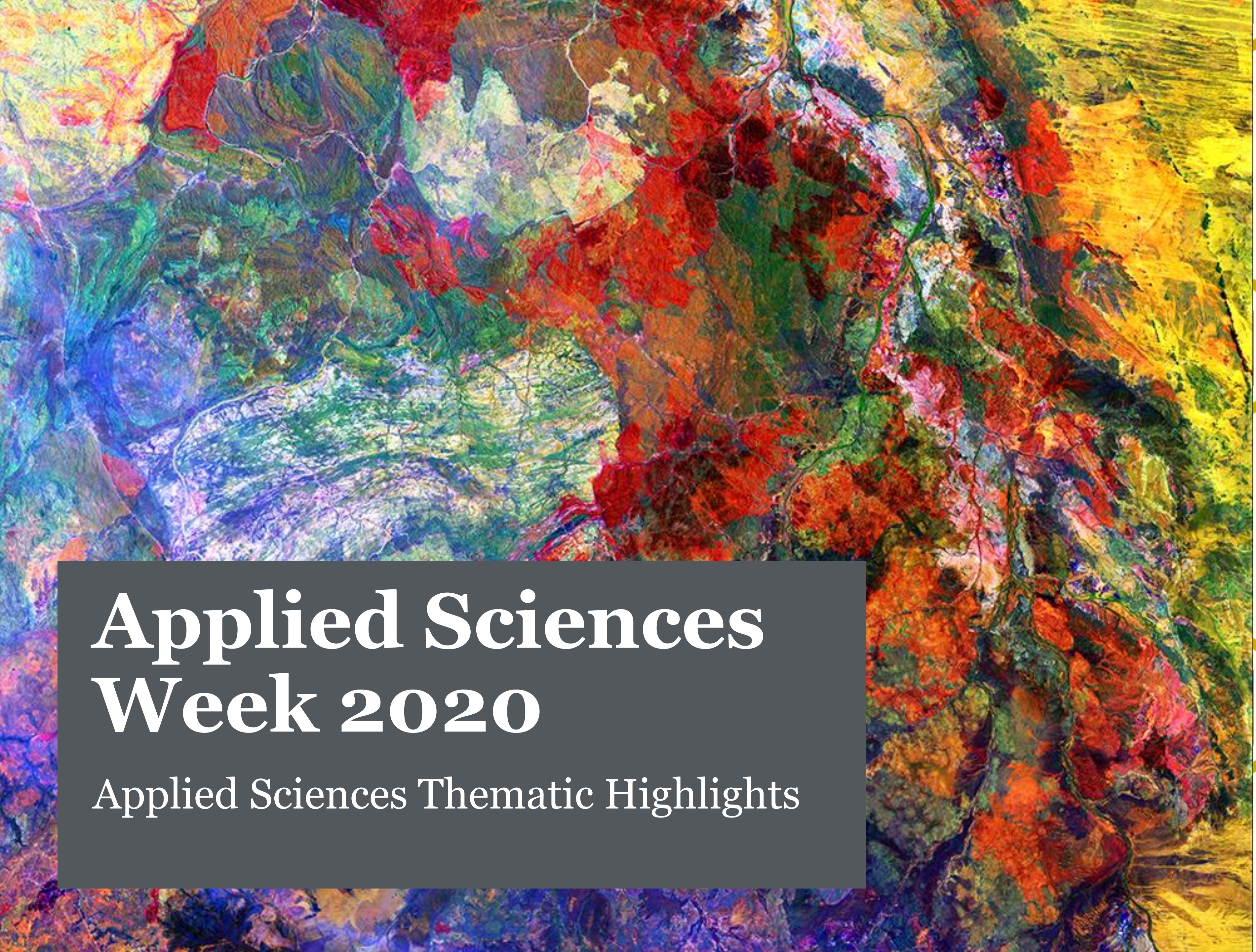
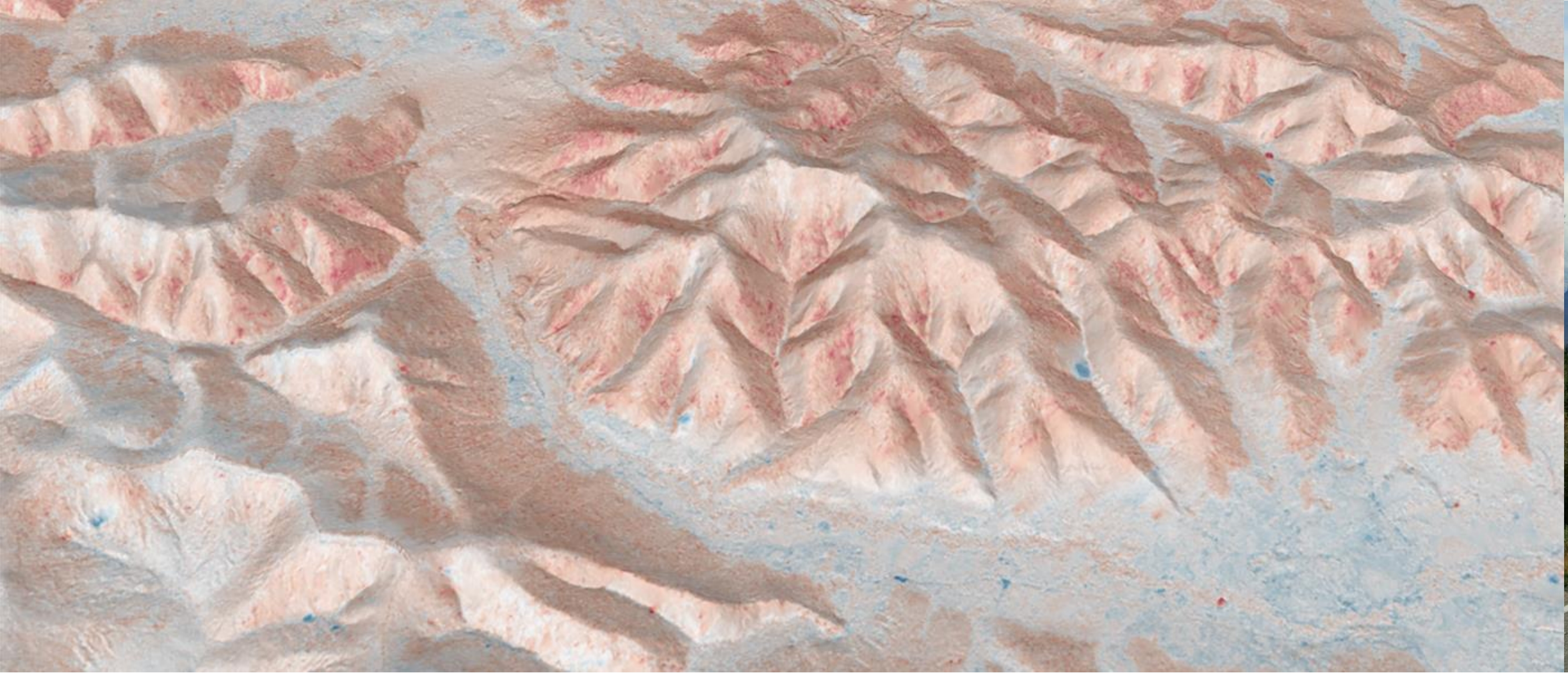


Applied Sciences Week 2020

Applied Sciences Thematic Highlights

EARTH SCIENCE
APPLIED SCIENCES



Alaska Transportation & Infrastructure:

Identifying Permafrost Subsidence Using NASA Earth Observations to Pinpoint Road & Infrastructure Vulnerability in Fairbanks, AK

Joshua Green*, Patrick Saylor, Marissa Dudek, Katie Lange

CAPACITY BUILDING

COMMUNITY CONCERNS

- Structural damage of critical public infrastructure including roads, bridges, highways, buildings, and utility lines
- Destabilization of infrastructure posing an environmental and health hazard (e.g. oil and gas pipelines, power facilities, etc.)
- Environmental harm from permafrost thaw including flooding and greenhouse gas emissions

PROJECT OBJECTIVES

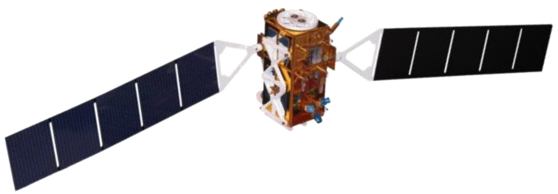
- Detect permafrost deformation and thermokarst formation
- Identify road and infrastructure vulnerability
- Create a Python module to automate Sentinel-1, UAVSAR, and LiDAR processing & analysis
- Evaluate the feasibility & accuracy of Earth observations to detect permafrost thaw

Bicycle path buckling due to permafrost thaw in Fairbanks, AK - Thomas A. Douglas, U.S. Army Cold Regions Research and Engineering Laboratory

PROJECT PARTNERS

- US Army Corps of Engineers, Cold Regions Research & Engineering Laboratory
- Alaska Department of Transportation & Public Facilities
- Alaska Department of Natural Resources
- Alaska Satellite Facility

EARTH OBSERVATIONS & METHODS



Sentinel-1 C-SAR

- **HyP3** – Create Interferograms
- ↓
- **OpenSARLab** – Pre-Process
- ↓
- **GIAnT** – Deformation Analysis

UAVSAR

- **JPL** – Data Acquisition
- ↓
- **Python** – Pre-Process
- ↓
- **GIS** – Deformation Analysis

LiDAR

- **Products** – Data Acquisition
- ↓
- **GIS** – Pre-Process
- ↓
- **GIS** – Analysis

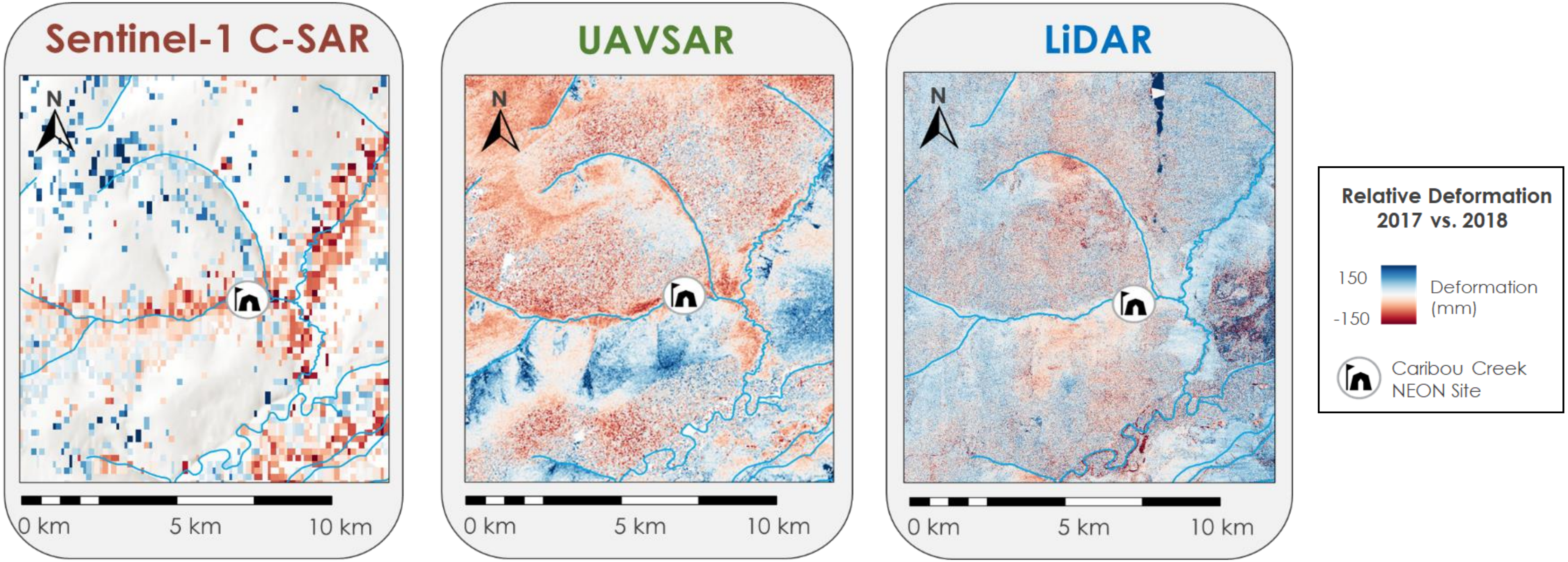
Credit: Rama, 2012

Credit: NASA Jet Propulsion Laboratory

Credit: John Davies, 2004

RESULTS

- Focusing on the Caribou-Poker Creek study area seen below, LiDAR demonstrates notable deformation along riverbanks and valleys while UAVSAR highlights deformation features along slope angle gradients and hillsides
- Sentinel-1 detects deformation at low spatial but high temporal resolution
- UAVSAR detects deformation at higher spatial resolution than Sentinel-1
- LiDAR detects deformation at high spatial but low temporal resolution



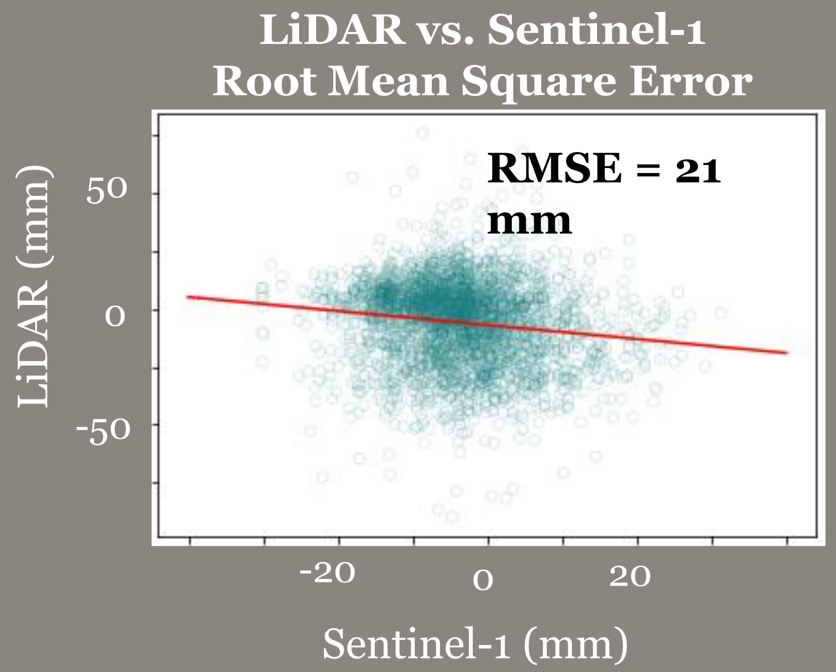
CONCLUSIONS

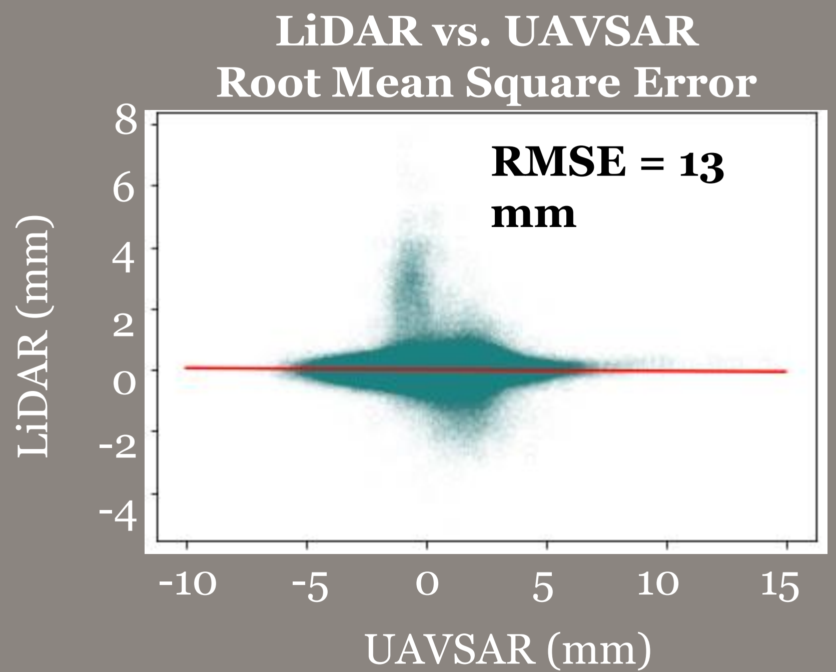
Earth Observations

- Sentinel-1 C-SAR can be used to identify road & infrastructure vulnerability on a large scale, offering greater spatial and temporal coverage.
- UAVSAR demonstrates a greater accuracy and higher spatial resolution imagery than Sentinel-1 C-SAR, enabling the improved identification of deformation features.

Project Applications

- Project partners can use Sentinel-1 C-SAR, UAVSAR, and LiDAR to identify and prioritize areas experiencing the highest intensity of permafrost deformation.
- The PerMA (Permaforst Measurement and Analysis) module developed during this project enables automated processing of Earth observation data for detection of deformation features.



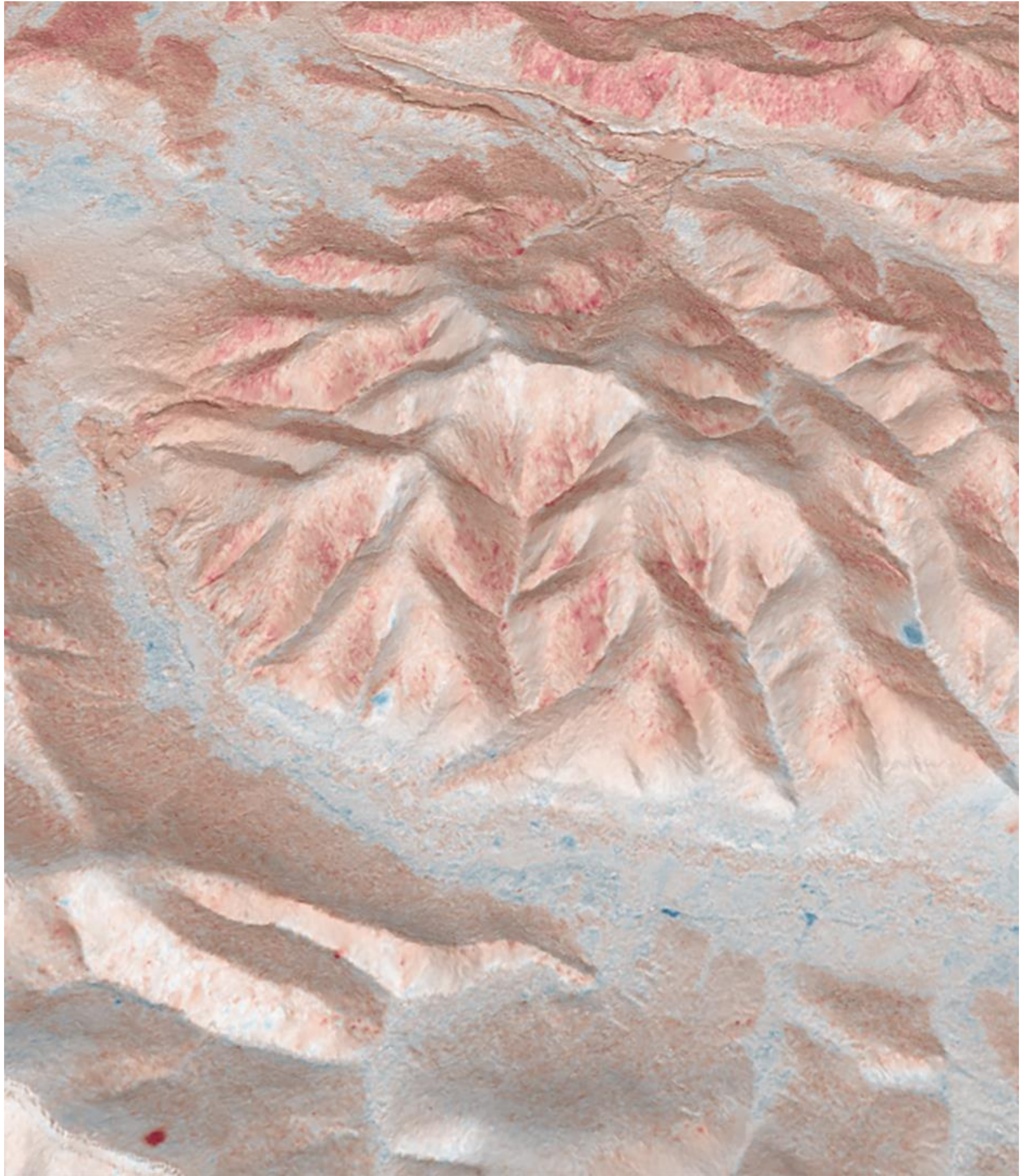


Thank You.

For further questions, please contact
us at NASA-DL-DEVELOP@mail.nasa.gov

https://develop.larc.nasa.gov

EARTH SCIENCE
APPLIED SCIENCES



(Photo: Christopher Scragg)

Rising Dust and Impacts on American Public

Daniel Tong

George Mason University, Email: qtong@gmu.edu

HEALTH & AIR QUALITY

"DUST BOWL"

Severe dust storms during the 1930s;
Extended droughts & poor land management

Will we see another "Dust Bowl"?

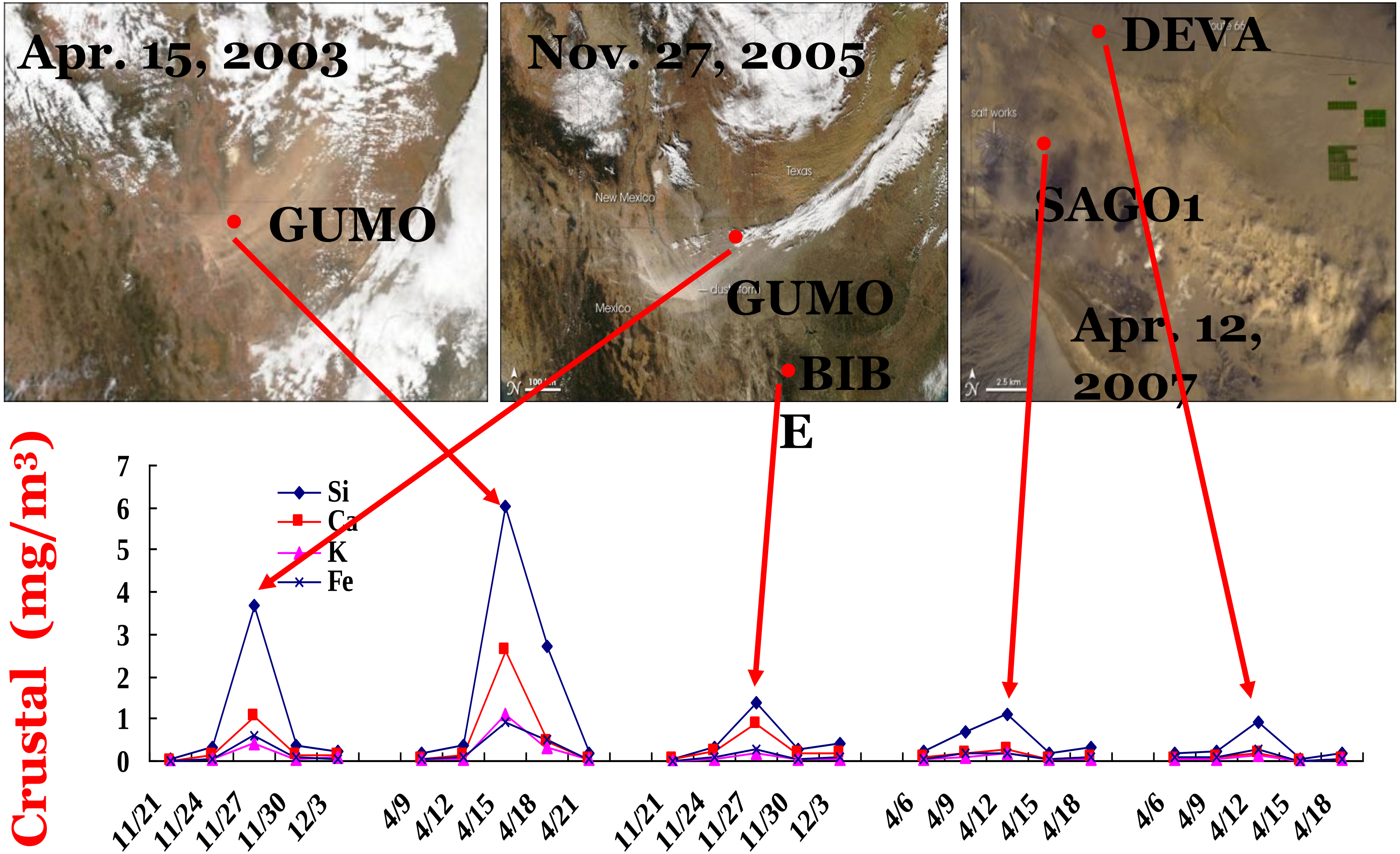
Yes!

- Severe droughts about once or twice a century
- Global warming → Precipitation shift, greater evaporation, less snow/ice, and earlier spring → amplify natural oscillation→ intensified droughts and "dust-bowlification" (Romm, 2011).

Probably Not?

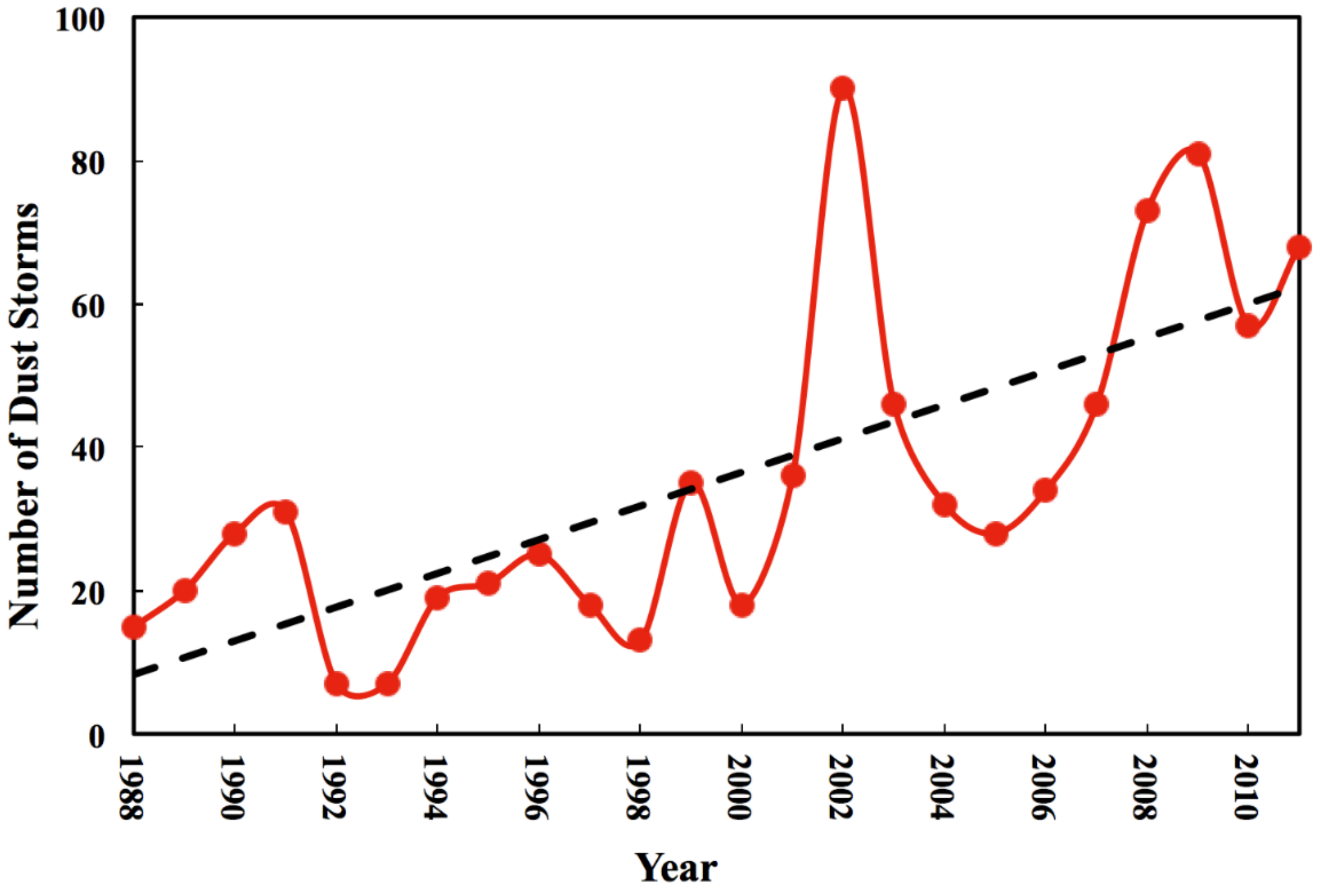
- Partially man-made
- Under economic stress in 1930s
- Soil conservation measures in places

SATELLITE-AIDED DUST DETECTION



Si – Silicon; Ca – Calcium; K – Potassium; Fe – Iron

LONG-TERM DUST TREND

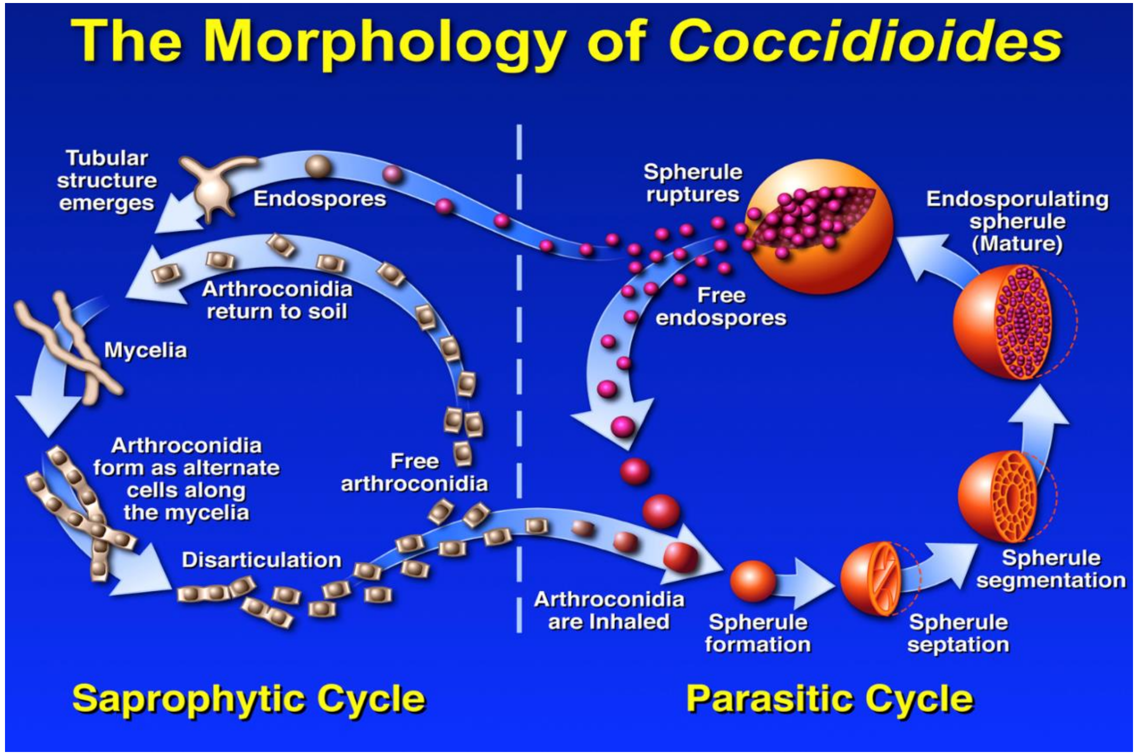


(Source: Tong et al., 2017)

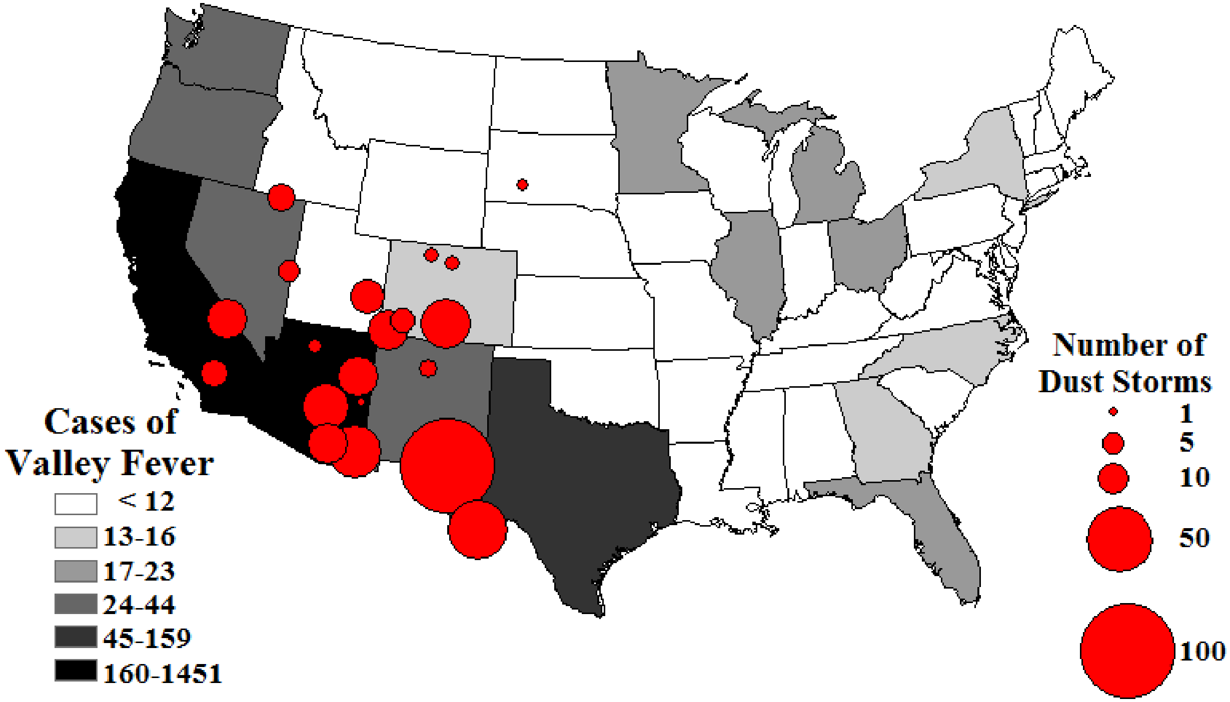
- Dust storms increased 240% from 1990s to 2000s.
- 10 times faster and in opposite direction to global dust trends

VALLEY FEVER (Coccidioidomycosis)

Infection caused by inhaling the soil-dwelling fungus Coccidioides



(Source: thinklink.com)



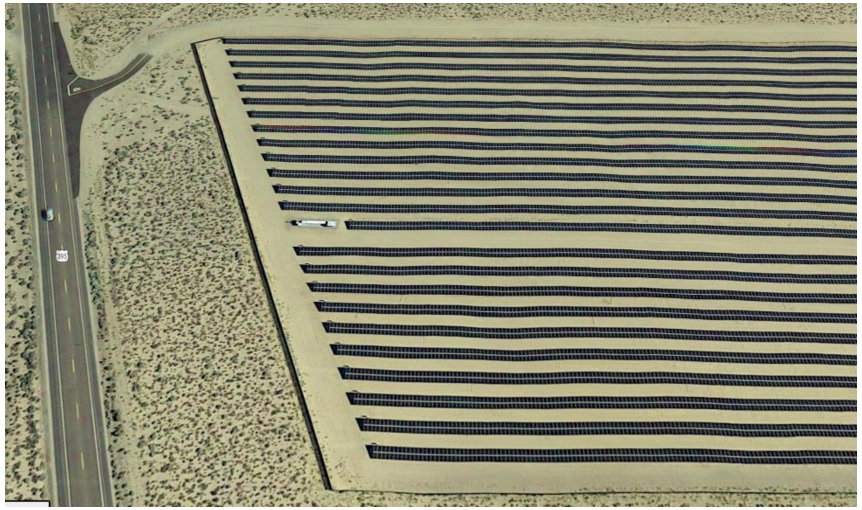
(Source: Tong et al., 2017)

- **Tens of thousands** infected each year;
- **3000 deaths** caused by Valley Fever;
- **High Valley fever cases in states frequented by dust storms.**

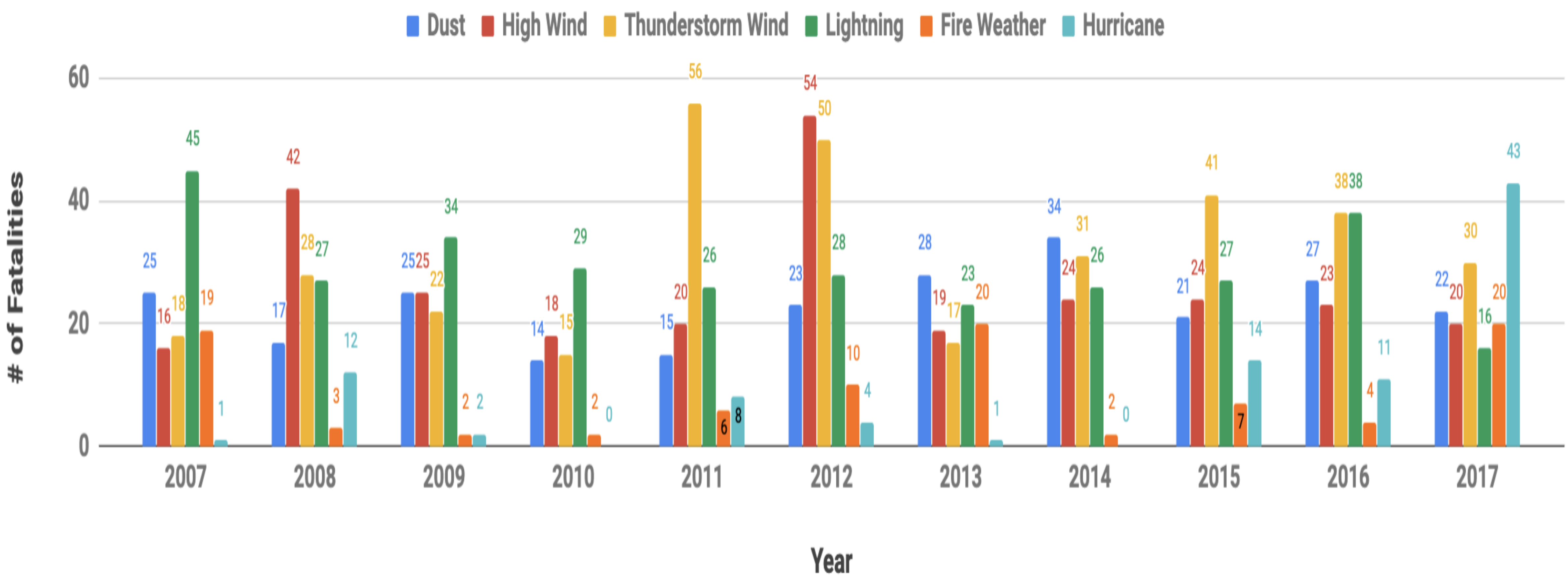
HIGHWAY SAFETY, SOLAR POWER, AGRICULTURE…

- Highway traffic accidents caused by visibility loss and high wind

- Dust deposition reduces power generation efficiency of solar farms

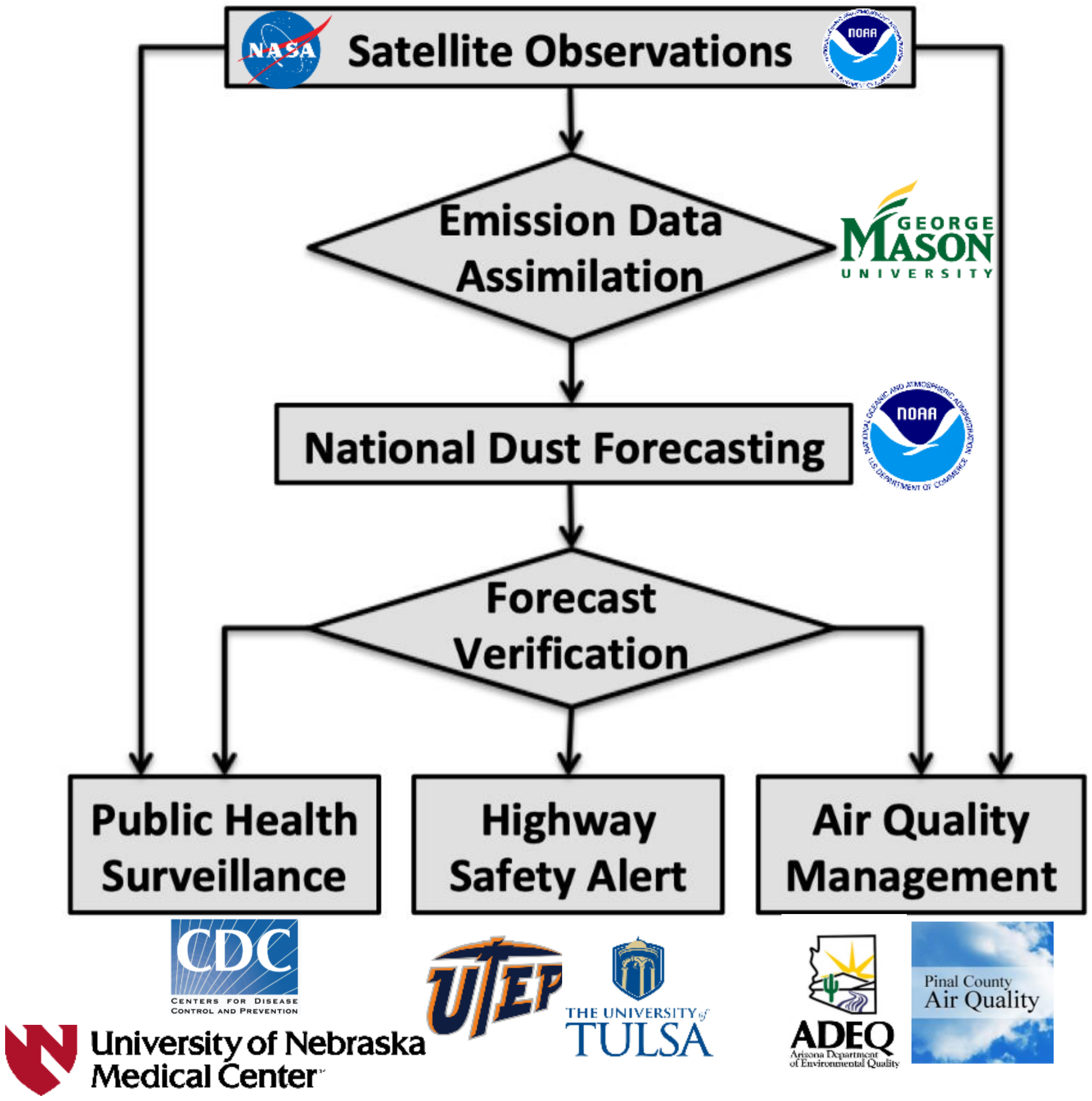


FATALITIES FROM DUST & OTHER EXTREMES



In Most Years, Dust Storms Kill More People than Hurricanes.

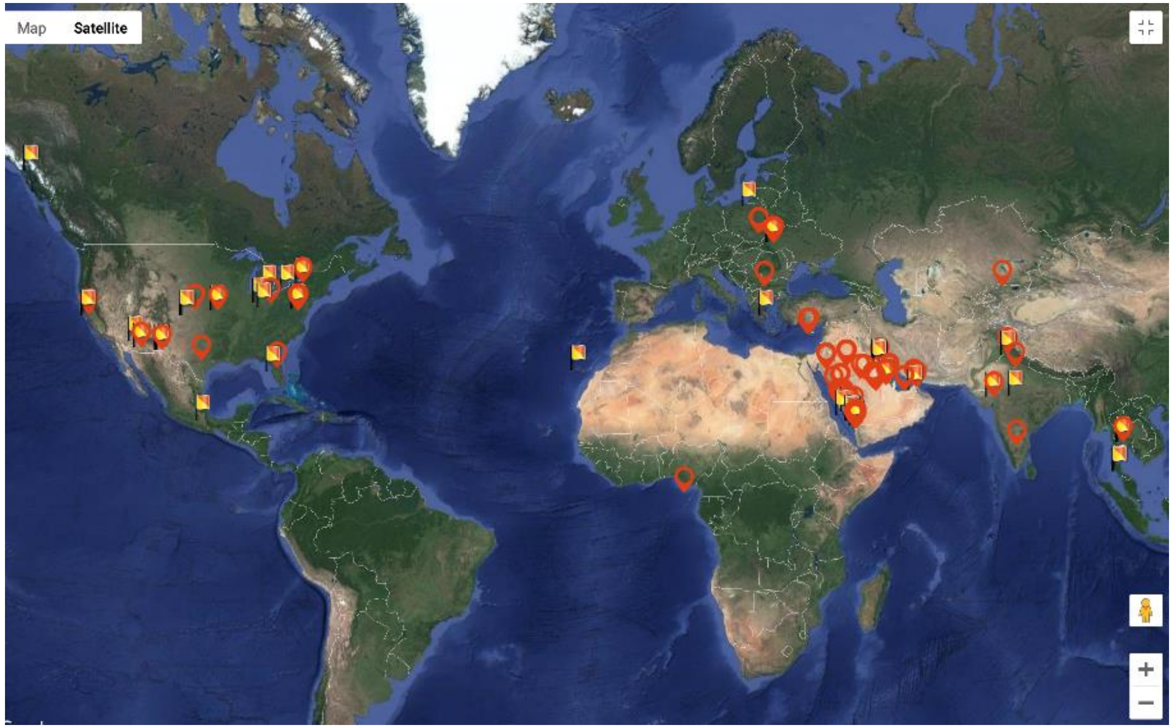
SATELLITE-AIDED DUST EARLY WARNING SYSTEM



NASA Health & Air Quality Project:

- Use satellite observations to improve dust forecasting;
- Support three dust services:
  - a) Valley fever surveillance;
  - b) Highway safety alert;
  - c) Air quality management;

Working with NASA GLOBE Observer to launch a new citizen science campaign to collect dust observations (reports and photos).



NASA GLOBE Observer Contacts:

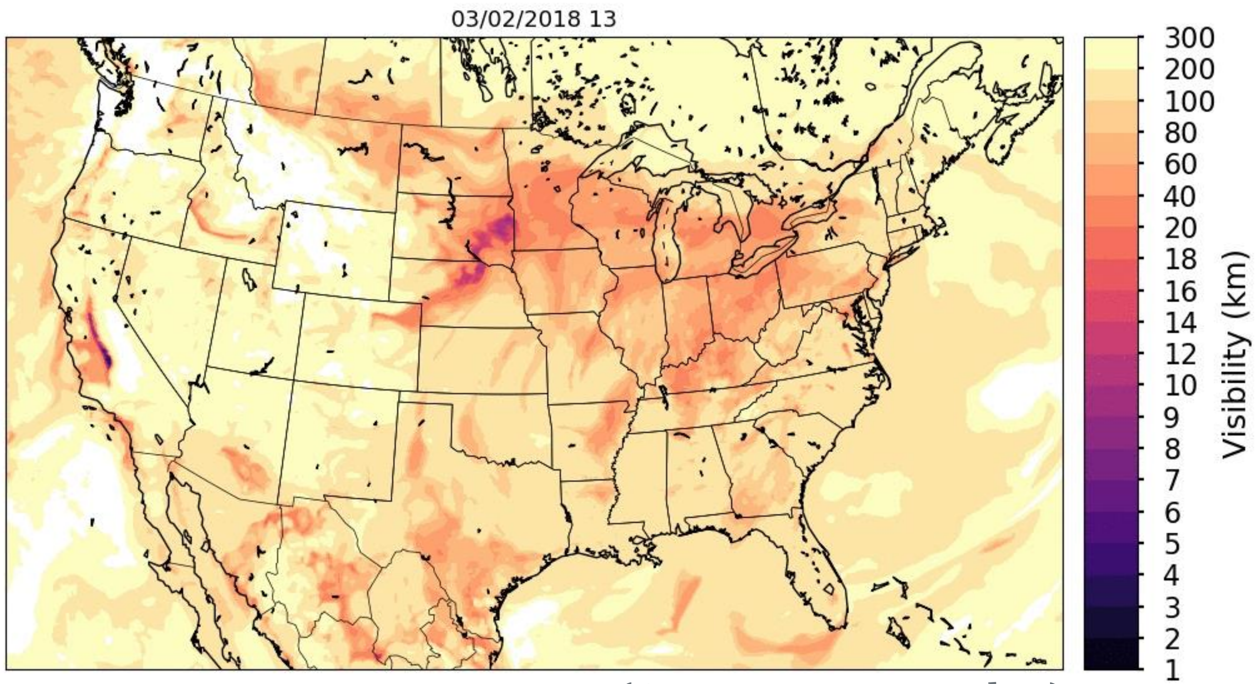
Marile Colon Robles: marile.colonrobles@nasa.gov
Helen Amos: helen.m.amos@nasa.gov

Stakeholders:

WMO Sand and Dust Regional Centers;
Transportation/Health/Air Quality Agencies

Highway dust forecasts:

- Visibility
- High Wind
- Dust Concentration
- Inhalable Particle Concentration



(Courtesy: Barry Baker)

DustWatch App:

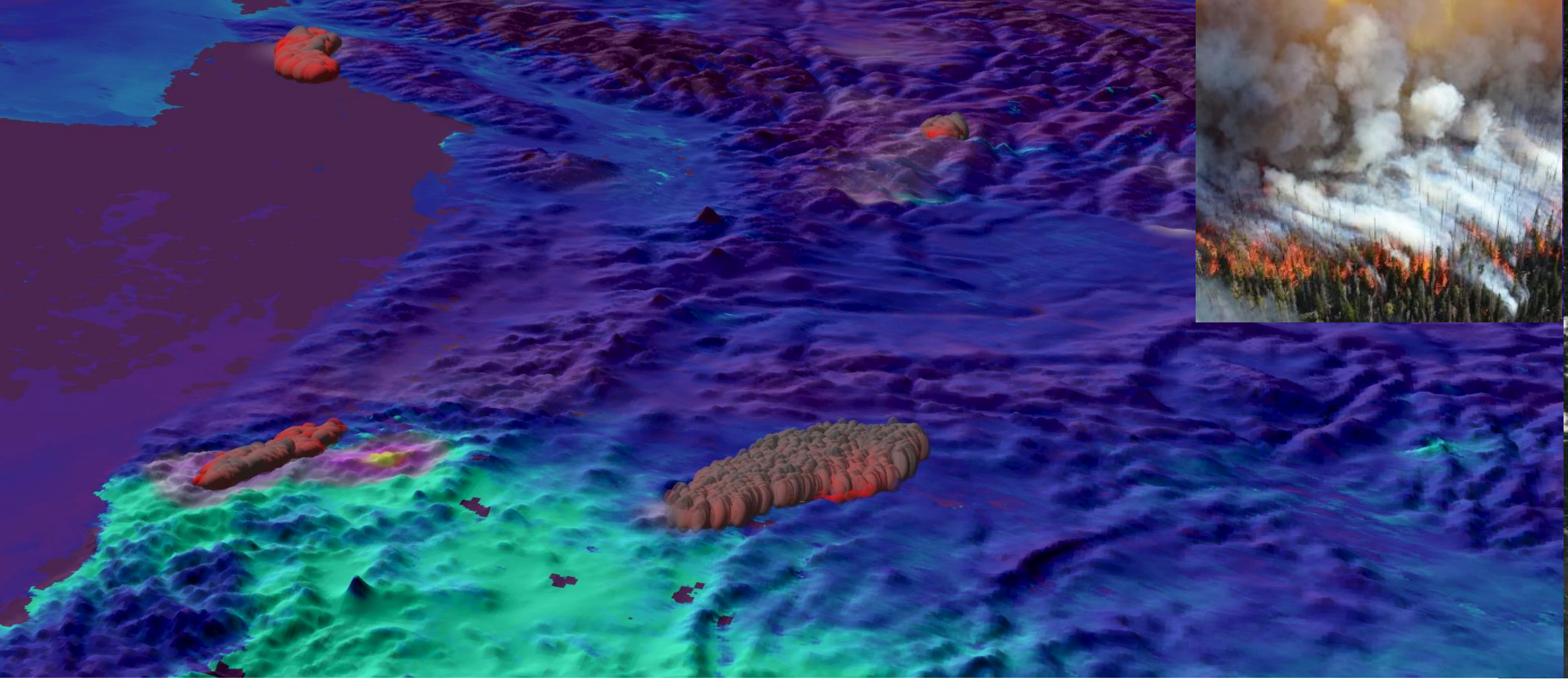
- Citizen Scientist Project
- Use dust forecasts
- Real-time dust alerts

(Contact Dust App. Team: dustapp2018@gmail.com)

Thank You.

For further questions, please contact Daniel Tong at qtong@gmu.edu

EARTH SCIENCE
APPLIED SCIENCES



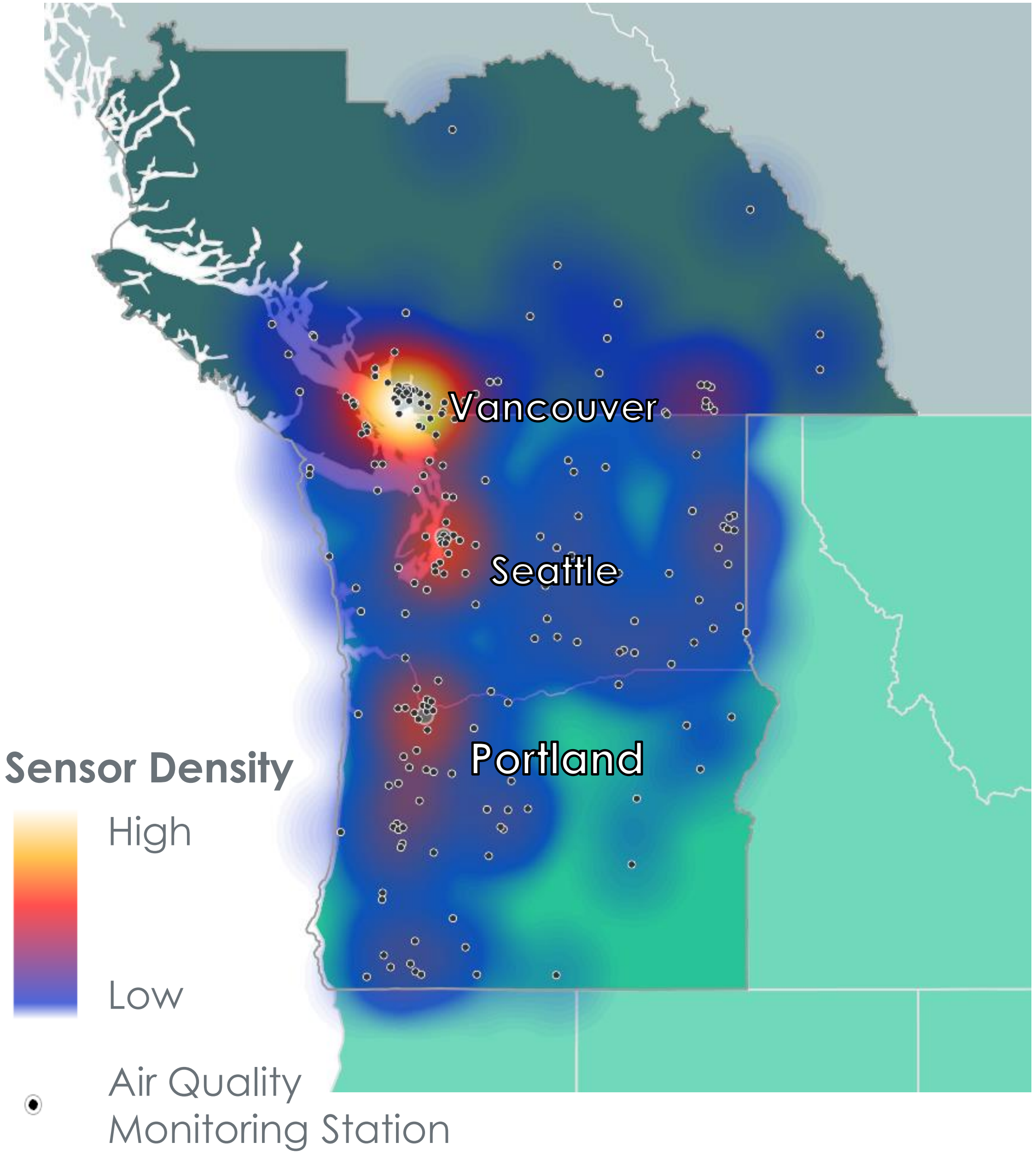
Pacific Northwest Health & Air Quality:
Utilizing NASA Earth Observations to Analyze Air Quality Impacts from Wildfires in the Pacific Northwest

Liana Solis*, Ani Matevosian, Taylor Orcutt, Danielle Ruffe

HEALTH & AIR QUALITY

CAPACITY BUILDING

COMMUNITY CONCERNS & PROJECT PARTNERS

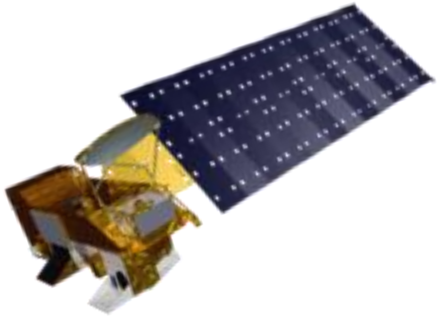


Impacts of wildfire smoke:

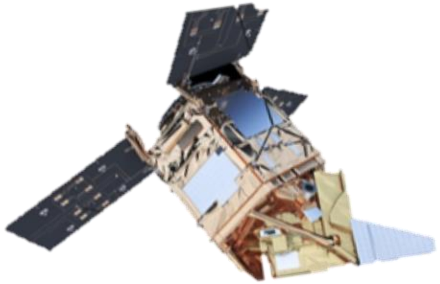
- Reduced air quality
- Adverse effects on health

End users:

- The Nature Conservancy, Washington Chapter
- Puget Sound Clean Air Agency



Aqua
MODIS



Sentinel-5P
TROPOMI

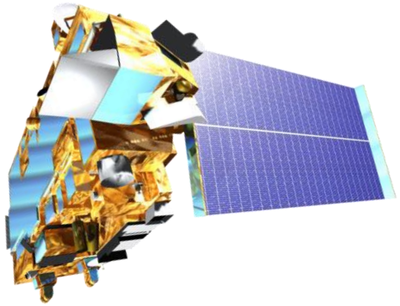
How can we visualize & analyze smoke?

Vertical Extent

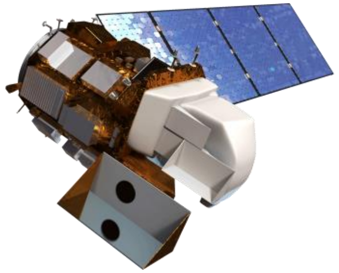
MINX Methodology
Plume Height

Geographic Extent

GEE Tool PHOENIX
Pollutants and Aerosols

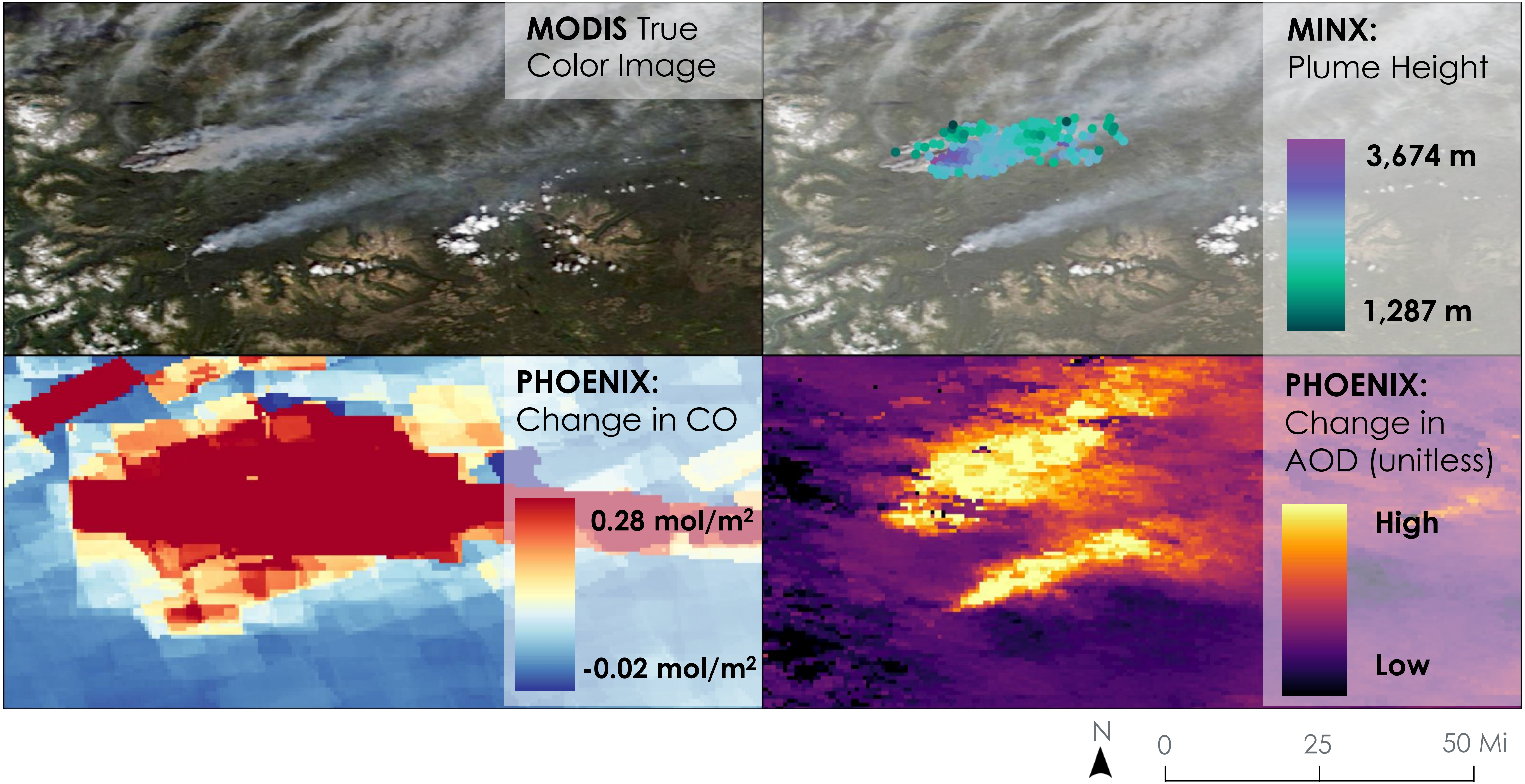


Terra
MODIS & MISR



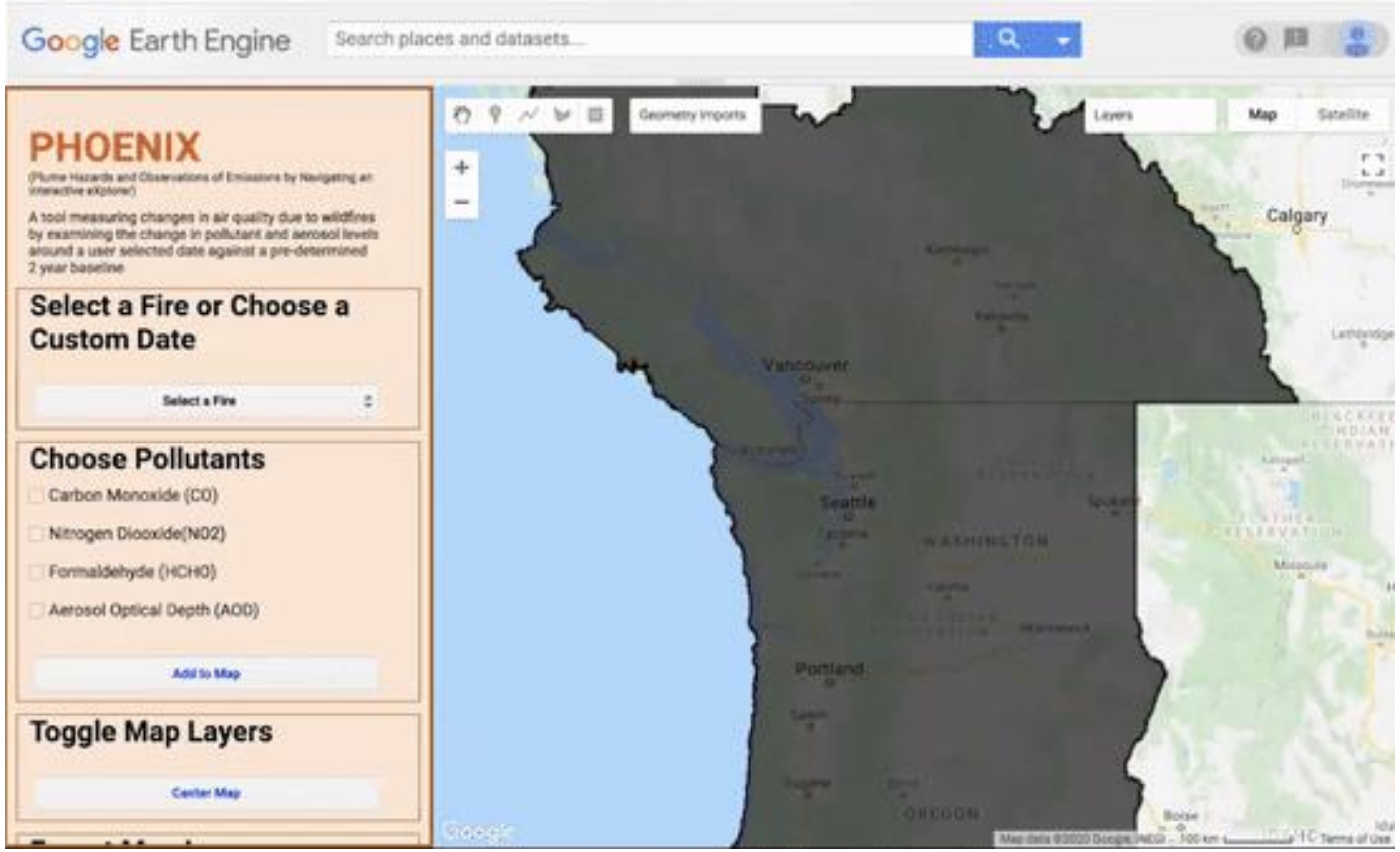
LANDSAT 8
OLI

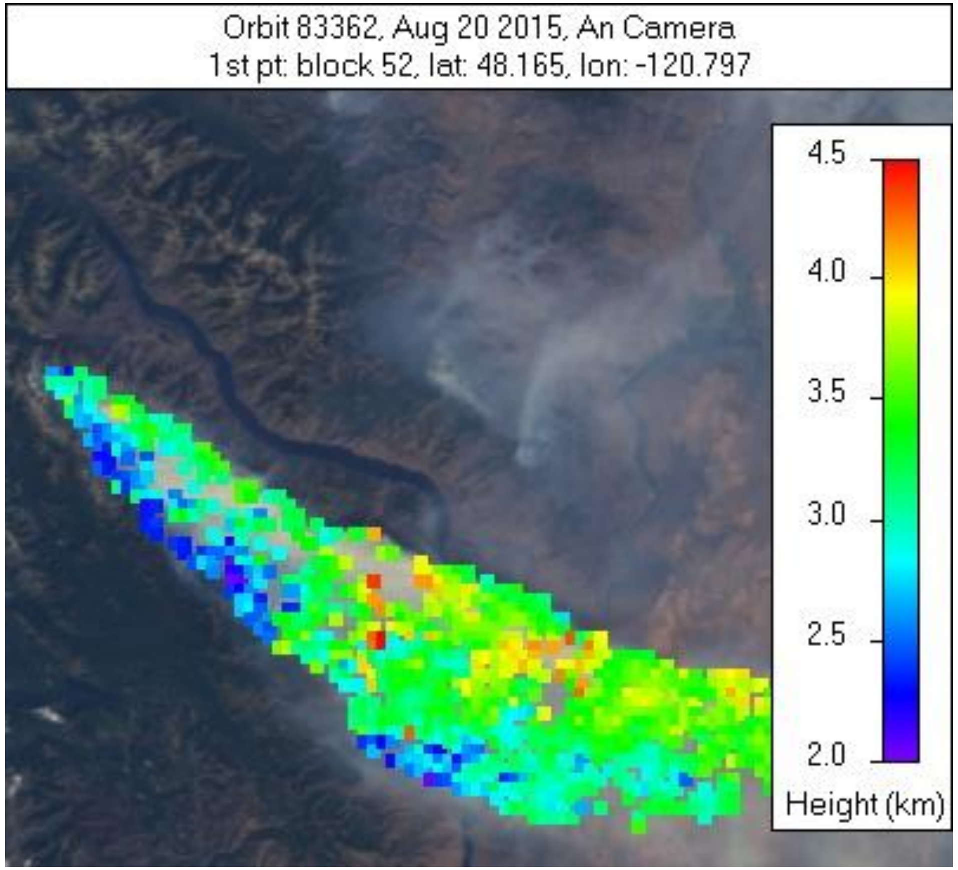
RESULTS: CASE STUDY FIRE IN BRITISH COLUMBIA AUGUST 6, 2018



CONCLUSIONS & END USER BENEFIT

- Satellite data fills in gaps over **remote regions** that lack ground monitoring stations.
- PHOENIX complements NASA JPL's MINX for a **comprehensive,** multi-dimensional understanding of wildfire smoke.
- PHOENIX and the MINX methodology build the partner organizations' **capacity** to analyze **future** fire events and their impacts on air quality.





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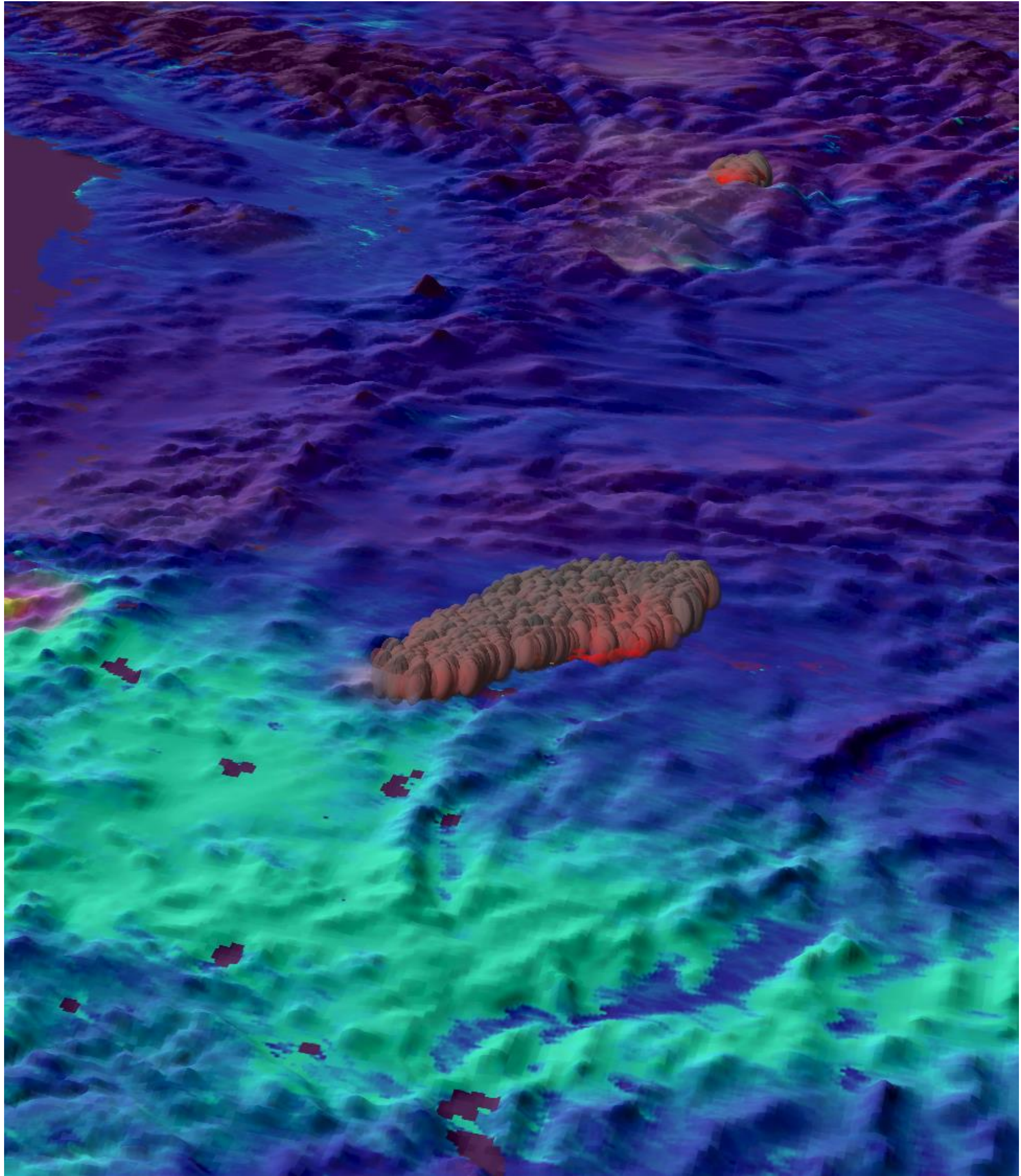
https://develop.larc.nasa.gov



EARTH SCIENCE
APPLIED SCIENCES

Operational Remote Sensing of Agricultural Water Use in Cooperation with Western State Water Resource Agencies for Improved Water Management

Justin Huntington, Research Professor, DRI

Lee Johnson, Charles Morton, Alberto Guzman, Matthew Bromley, Britta Daudert, Jody Hansen, & Forrest Melton

NASA DRI Desert Research Institute California State University MONTEREY BAY WATER RESOURCES

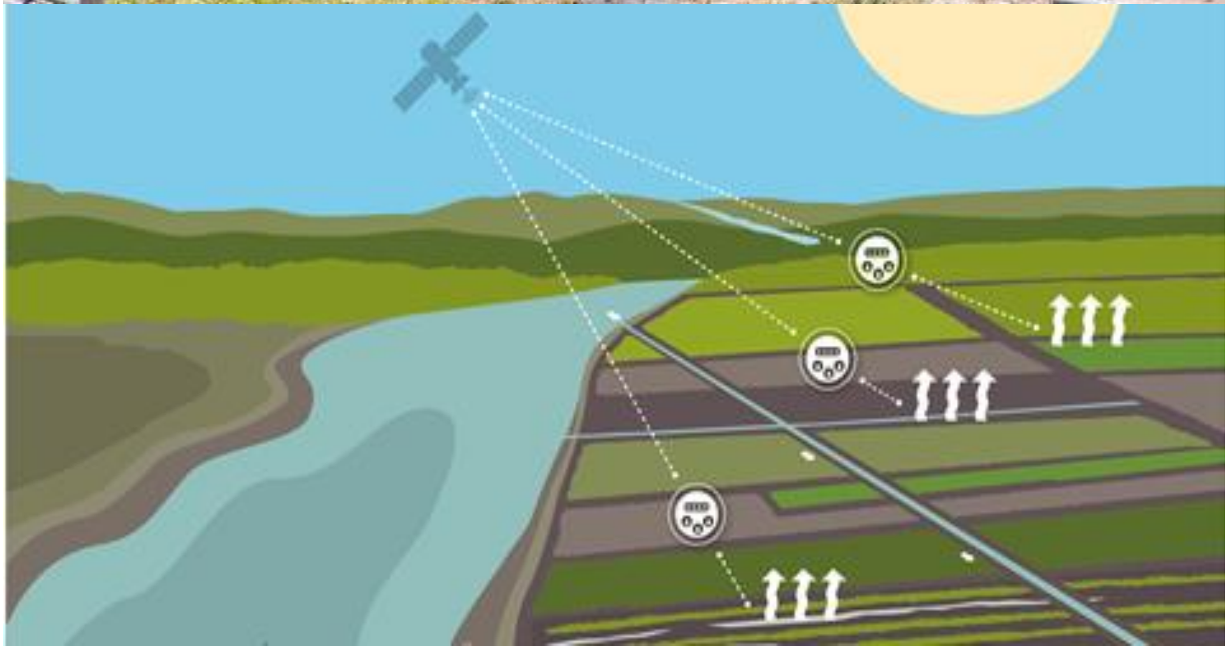
EVAPOTRANSPIRATION AND CONSUMPTIVE USE

Water applied to a field ultimately:

1. Evaporates
2. Transpires (after being used by plants to grow)
3. Recharges underlying groundwater
4. Runs off and returns to a local canal or river

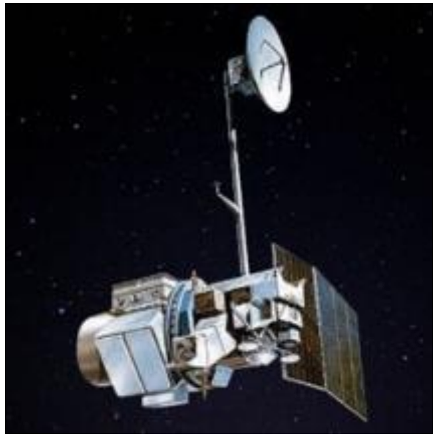
Measuring ET enables:

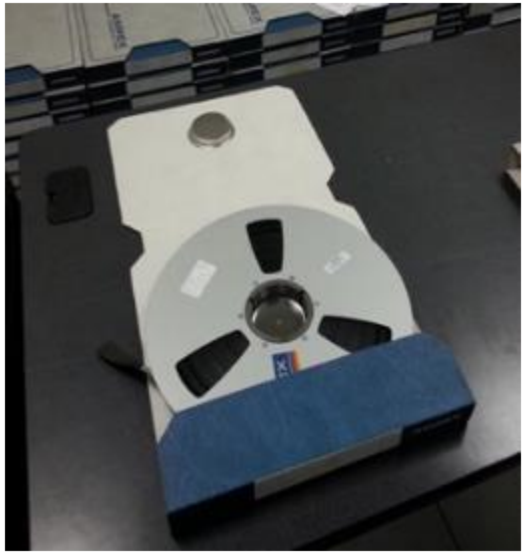
- Development of realistic water budgets
- Proof of beneficial use
- Proper credit for reduced use
- Data-driven water trading programs
- Increased on-farm efficiencies



THEN AND NOW…

1985

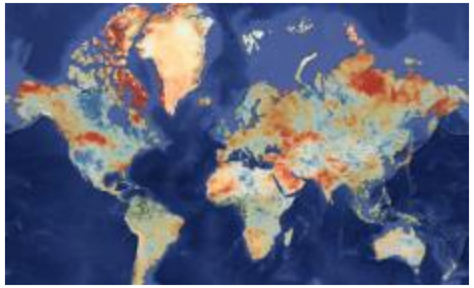
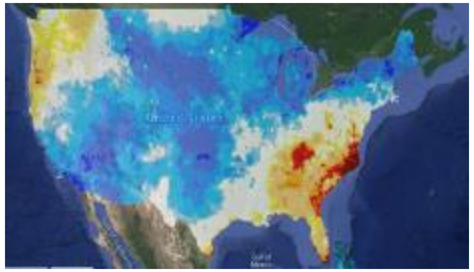


2020






Agency Co-Investigators include:

- –California State Water Resource Control Board
- –Nevada Division of Water Resources
- –Utah Division of Water Resources
- –Idaho Department of Water Resources
- –Oregon Water Resources Department
- –Wyoming State Engineer’s Office
- –Texas Water Development Board
- –Montana Department of Natural Resources and Conservation
- –California Department of Water Resources

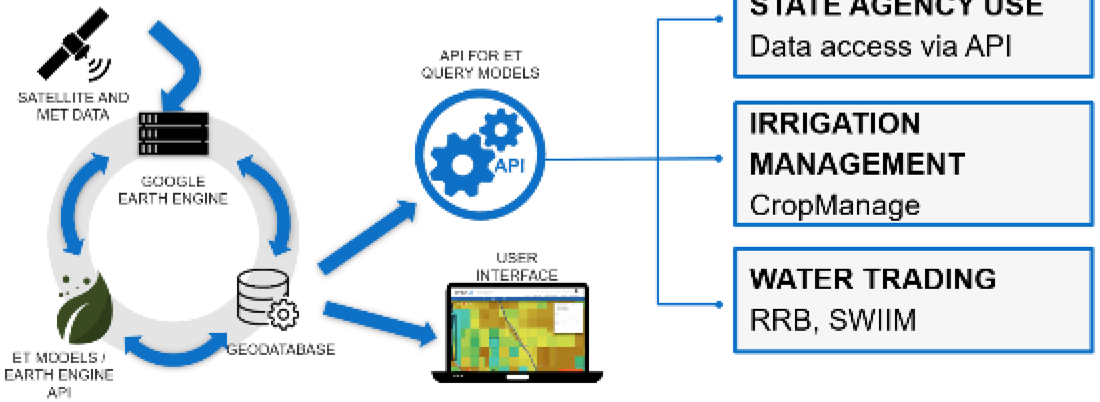
Other partners include federal (USGS & Reclamation), state, local, and private / NGOs

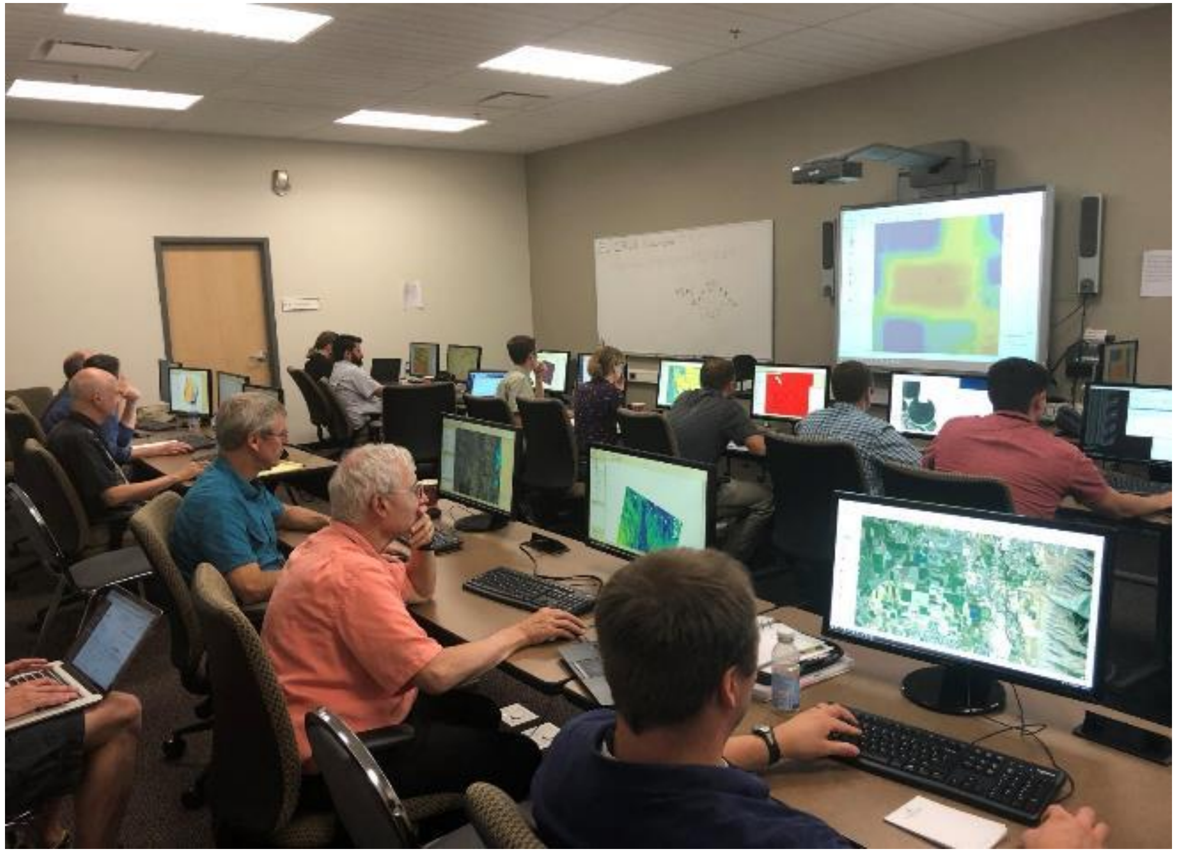
Goal

- Create the ability for water management to make field scale satellite-based ET maps and summaries using best available science

Approach

- Develop semi-automated open-source open-platform ET software (based in Python) to produce field scale ET estimates on local computers at state agencies
  - pySIMS and pyMETRIC
- Technology transfer via numerous hands on trainings with state agency staff
- Migrate the software to the cloud for operational compute, storage, data access, and visualization via UIs and APIs





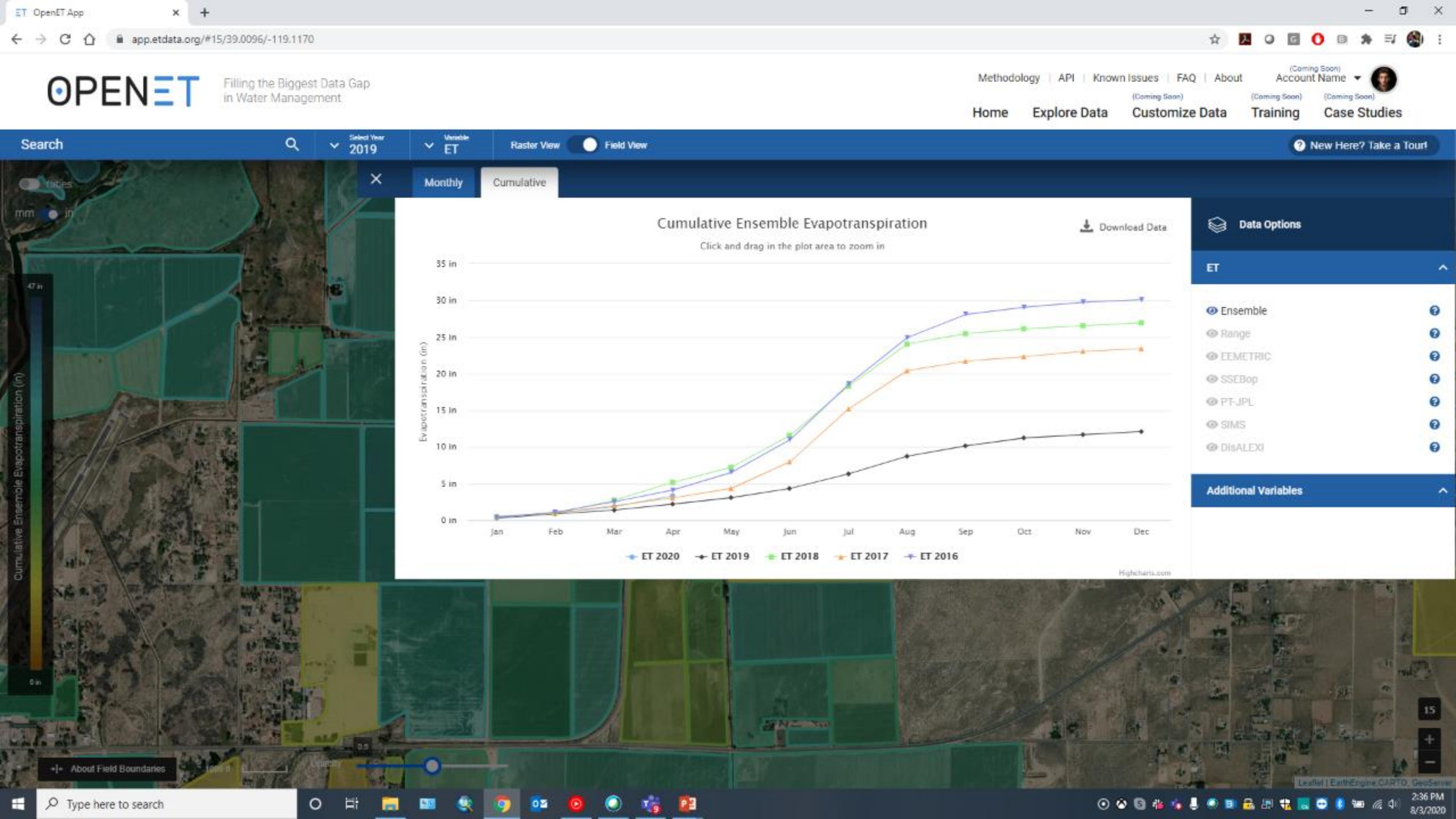
Some Comments from Agencies

- Open lines of communication with technical staff using GitHub and Slack
- Version Control, documentation, and issue reporting using GitHub very useful for transparency and reproducability
- Without the support from ASP to develop software and trainings, most agencies unable to apply this technology for water management
- Landsat data must stay free for agencies to use new technology

The OPENET Team

EDF ENVIRONMENTAL DEFENSE FUND Finding the ways that work
NASA
Google Earth Engine
DRI Desert Research Institute
USGS science for a changing world
USDA ARS
IHE DELFT
THE WORLD BANK
GWSP

University of Idaho
WISCONSIN UNIVERSITY OF WISCONSIN–MADISON
UNIVERSITY OF MARYLAND
University of Nebraska Lincoln
California State University MONTEREY BAY
HabitatSeven


OpenET App
app.etdata.org/#15/39.0096/-119.1170
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Filling the Biggest Data Gap in Water Management
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New Here? Take a Tour!
Monthly
Cumulative
Cumulative Ensemble Evapotranspiration
Download Data
Click and drag in the plot area to zoom in
Evapotranspiration (in)
35 in
30 in
25 in
20 in
15 in
10 in
5 in
0 in
Jan
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Mar
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ET
Ensemble
Range
EEMETRIC
SSEBop
PT-JPL
SIMS
DisALEXI
Additional Variables
Cumulative Ensemble Evapotranspiration (in)
47 in
0 in
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in
About Field Boundaries
Type here to search
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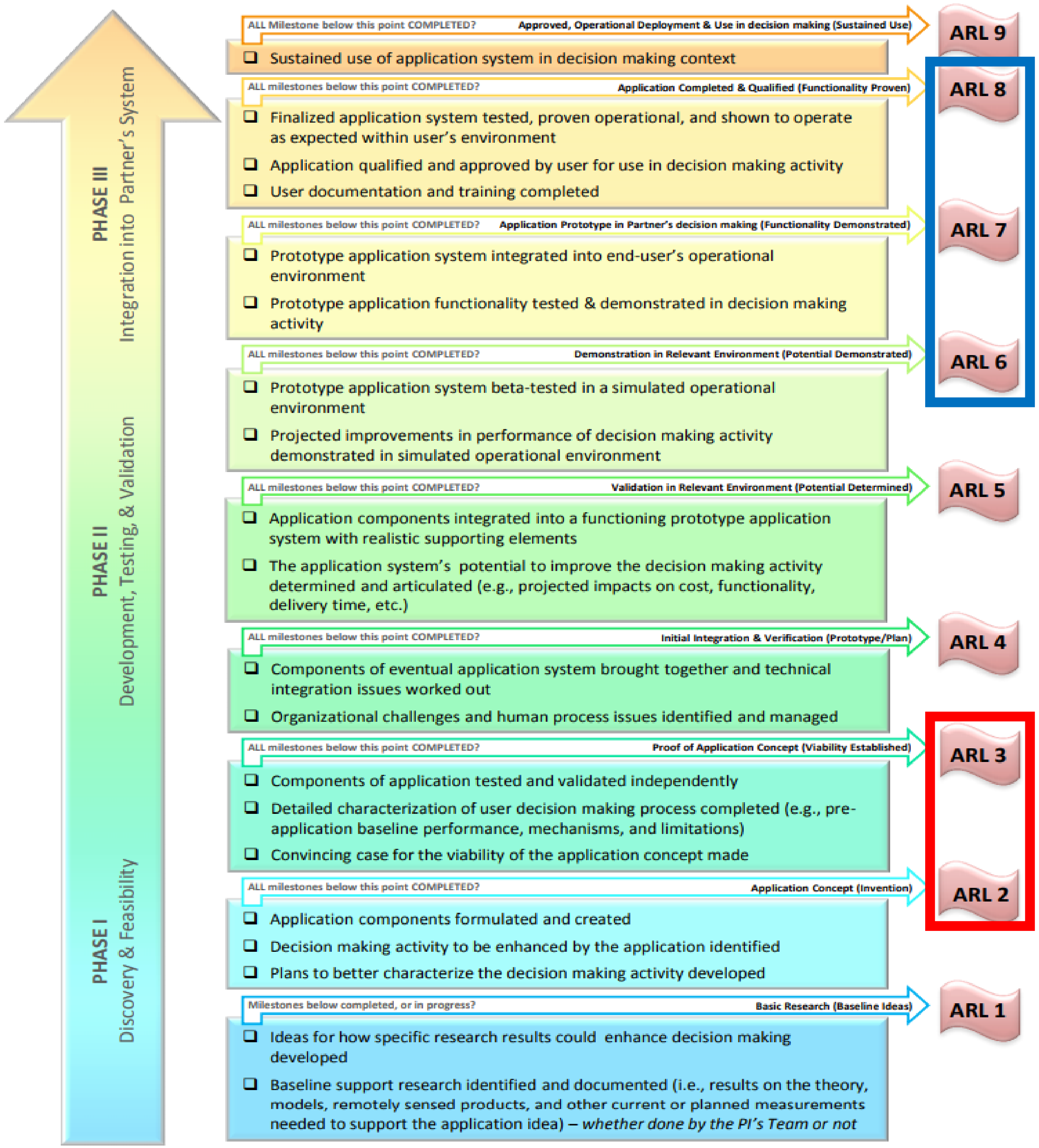
8/3/2020

SUMMARY AND NEXT STEPS

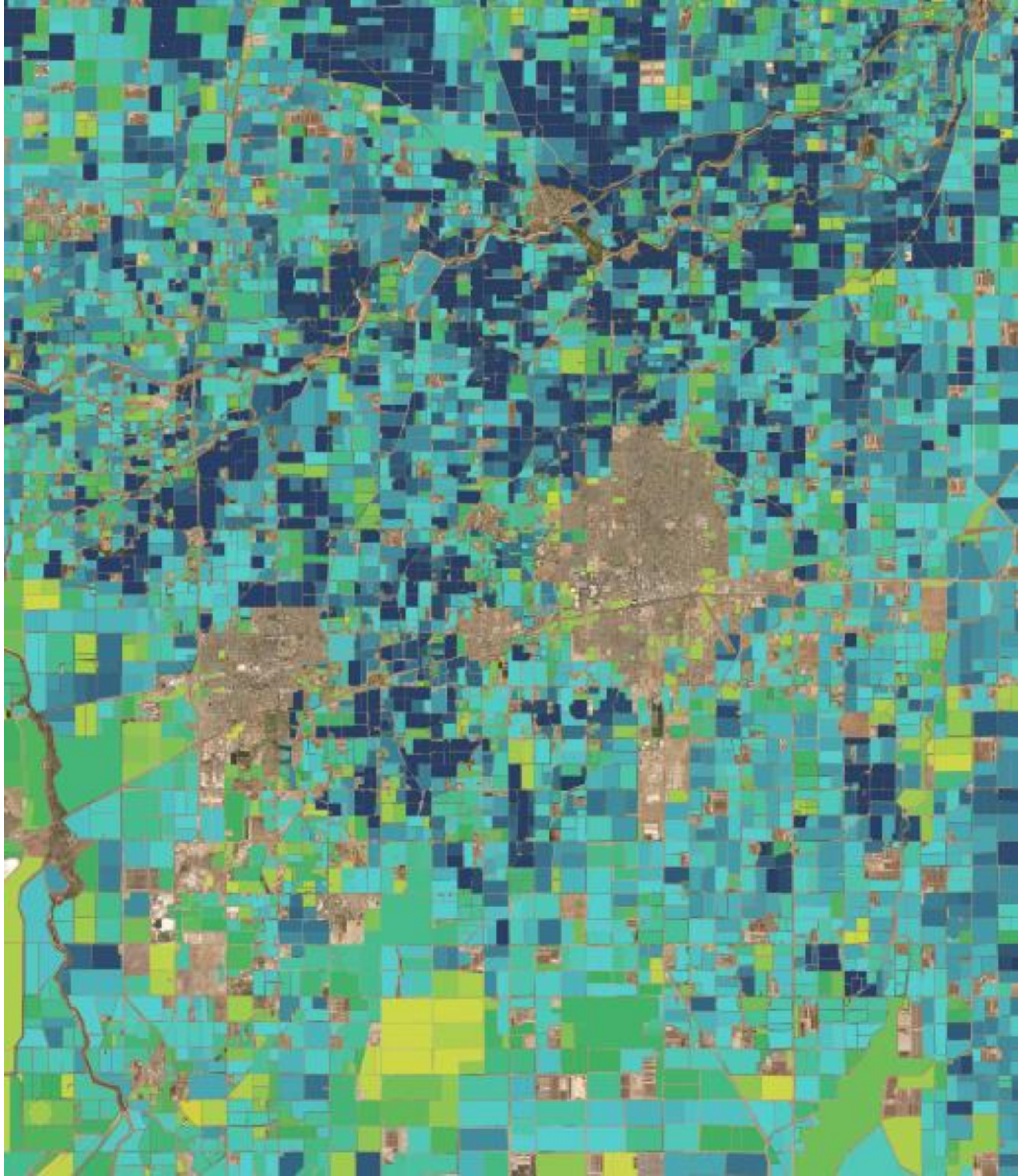
- Developed software and visualization tools so that State agencies can create and summarize satellite based ET products in-house
- Support agencies to use stand alone and cloud based software
- Provide 10 years of automated OpenET data for priority areas for agencies to evaluate
- Conduct agency trainings to beta test API and custom reporting tools
- Continue to support agencies to integrate into decision making
- Sustainability…
- Lessons learned
  - Research -> software engineering and support
  - Balance between end user driven wants, needs, and platform designs with feasibility and project scope
  - Engagement, outreach, trainings > 1 FTE
  - Community efforts build trust with partners

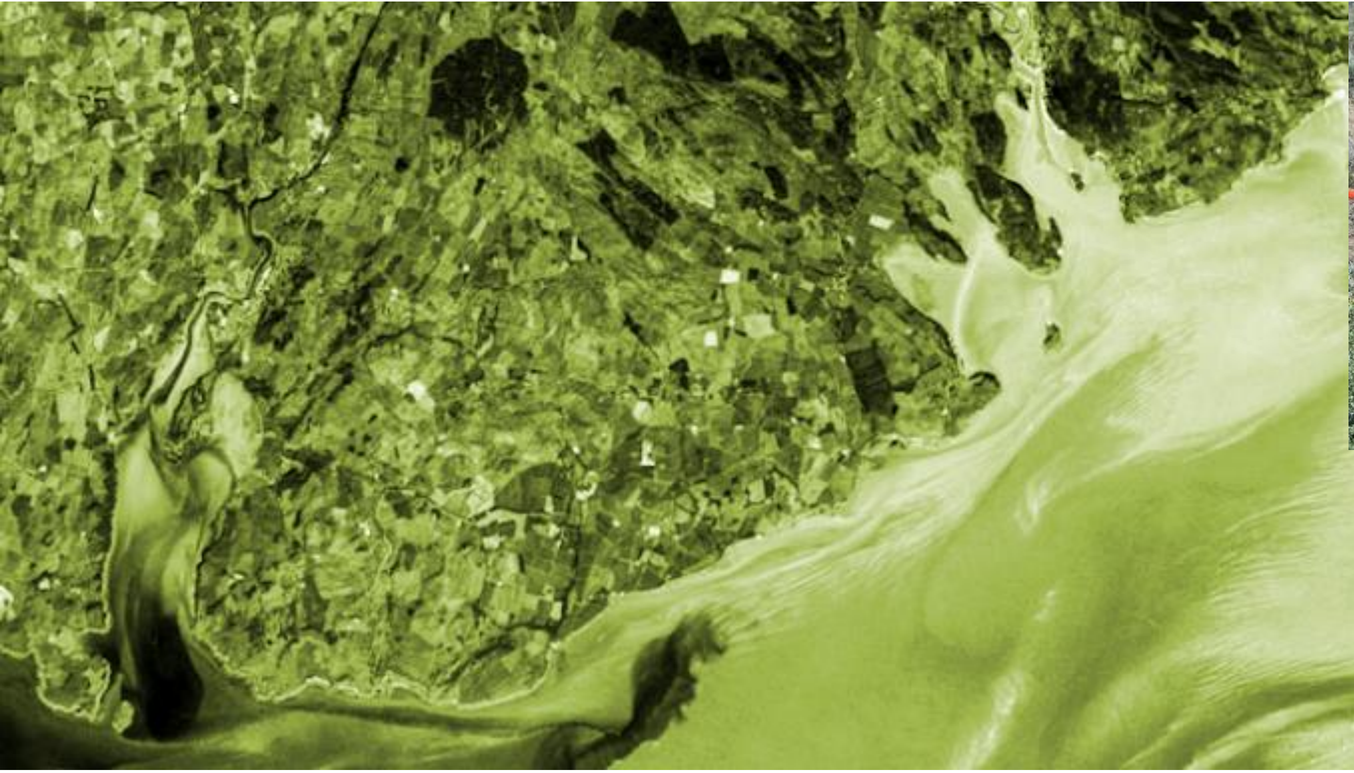


Thank You.

For further questions, please contact:
Justin.Huntington@dri.edu

WATER
RESOURCES





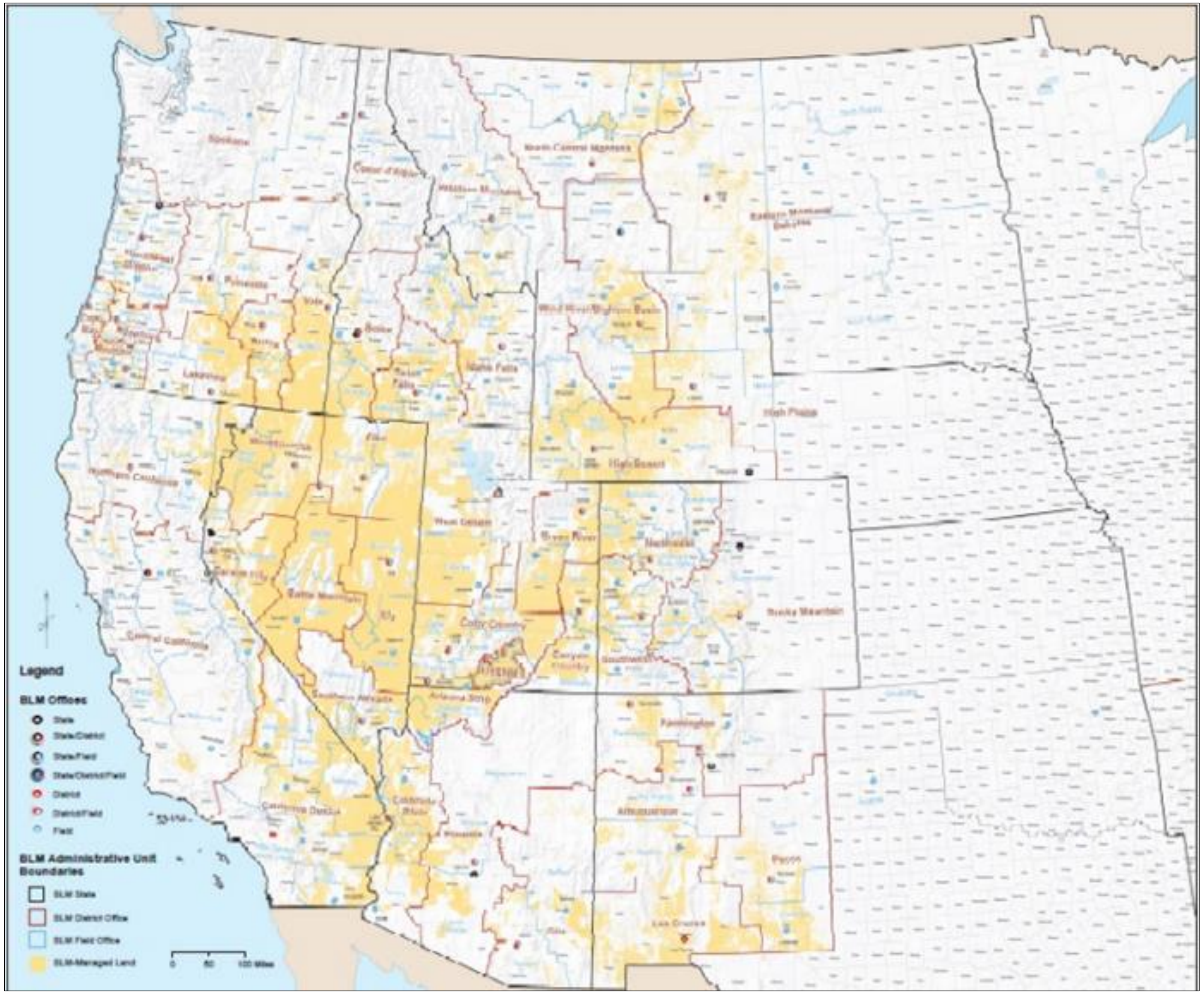
Leveraging Google Earth Engine for Rangelands Monitoring

Bo Zhou & Greg Okin

UCLA Geography

ECOLOGICAL FORECASTING

- Bureau of Land Management (BLM) Lands are both working lands and native habitat
- We are developing tools to help make management decisions

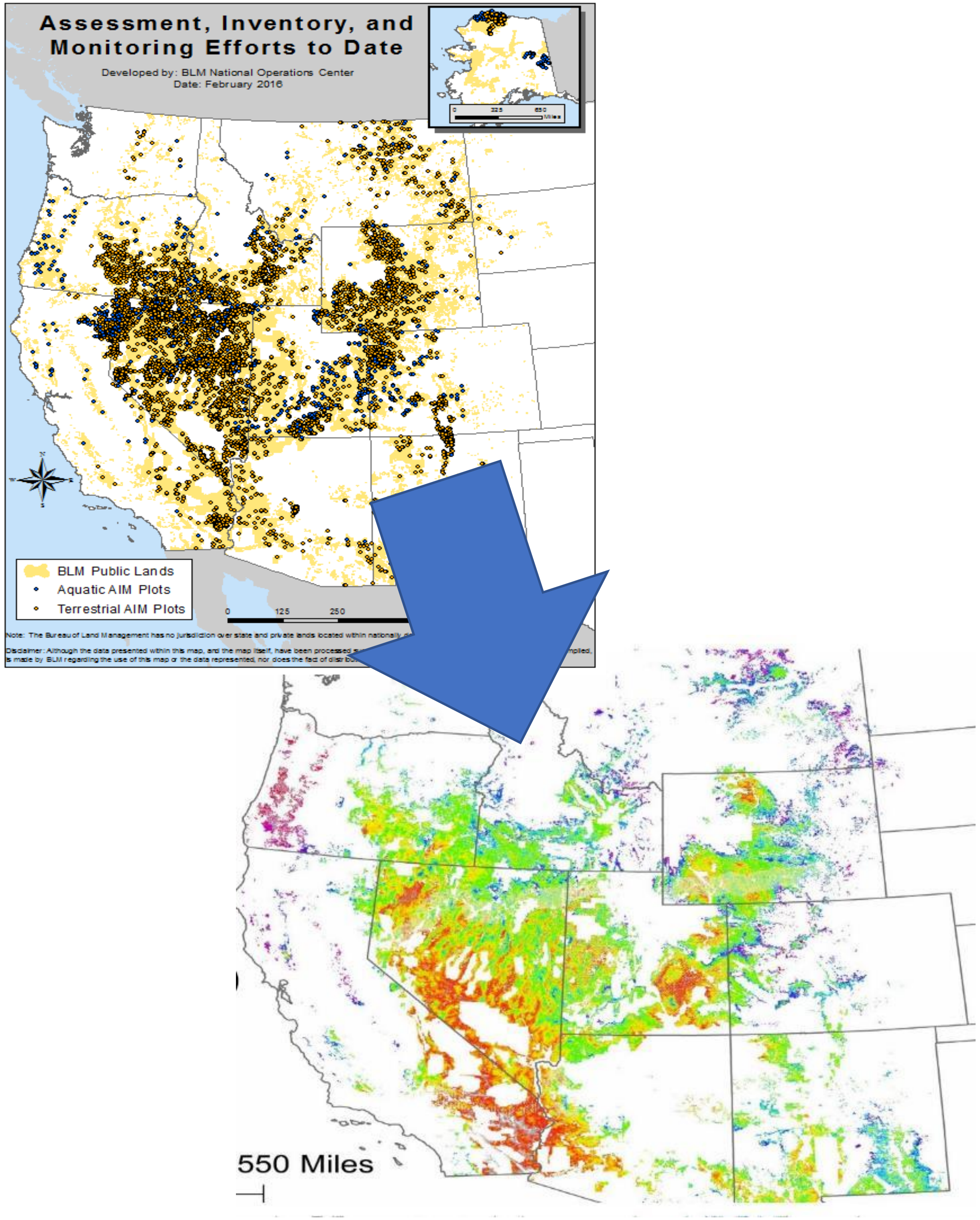


Tools are made to answer real questions asked by Field, District, State, and National Offices

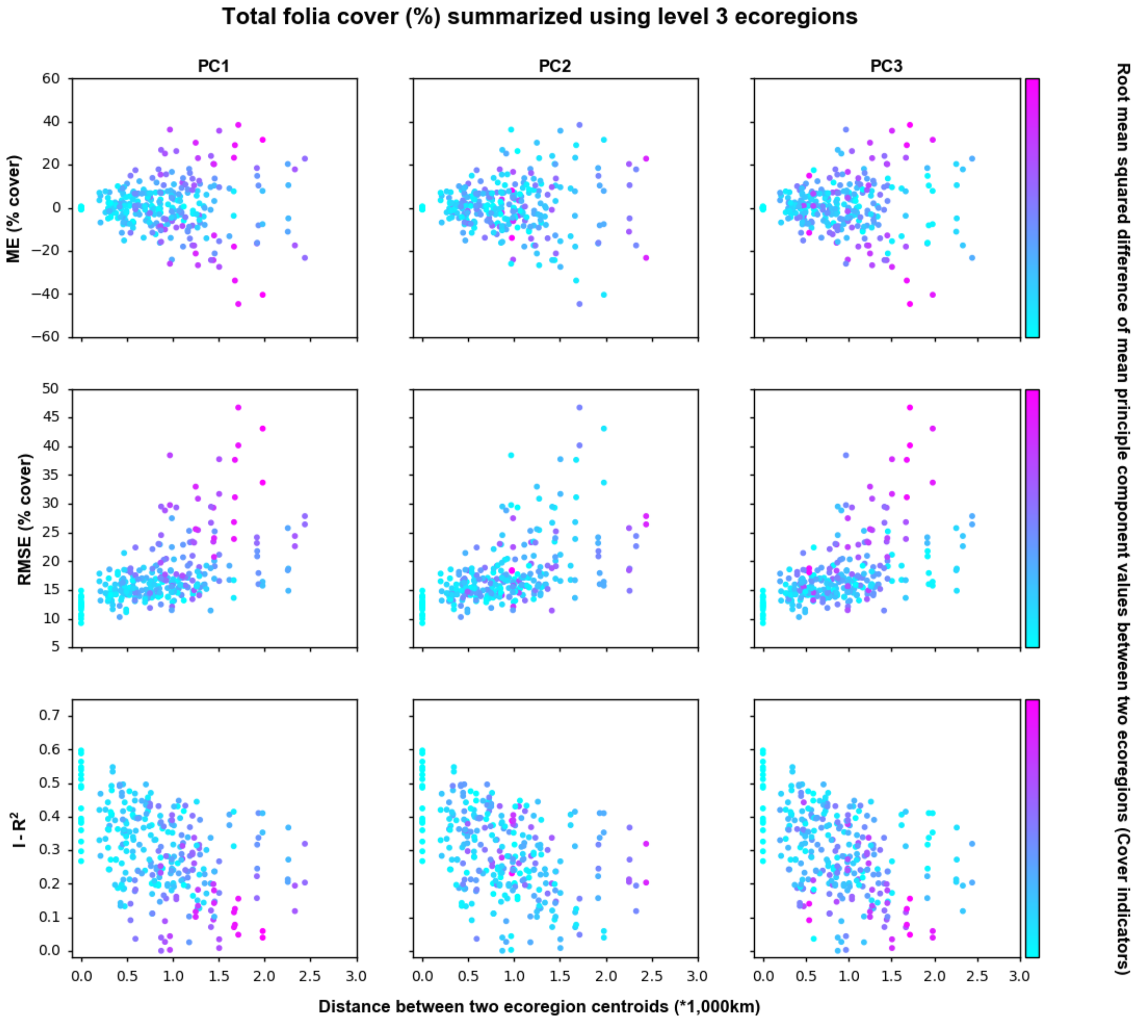
- What is the wind erosion risk in Colorado Plateau?
- How is vegetation recovery on abandoned oil pads in North Dakota?
- Is grazing allotment also suitable habitat for sage grouse in Wyoming?
- How has release from grazing affected vegetation on grazing allotments in Nevada?

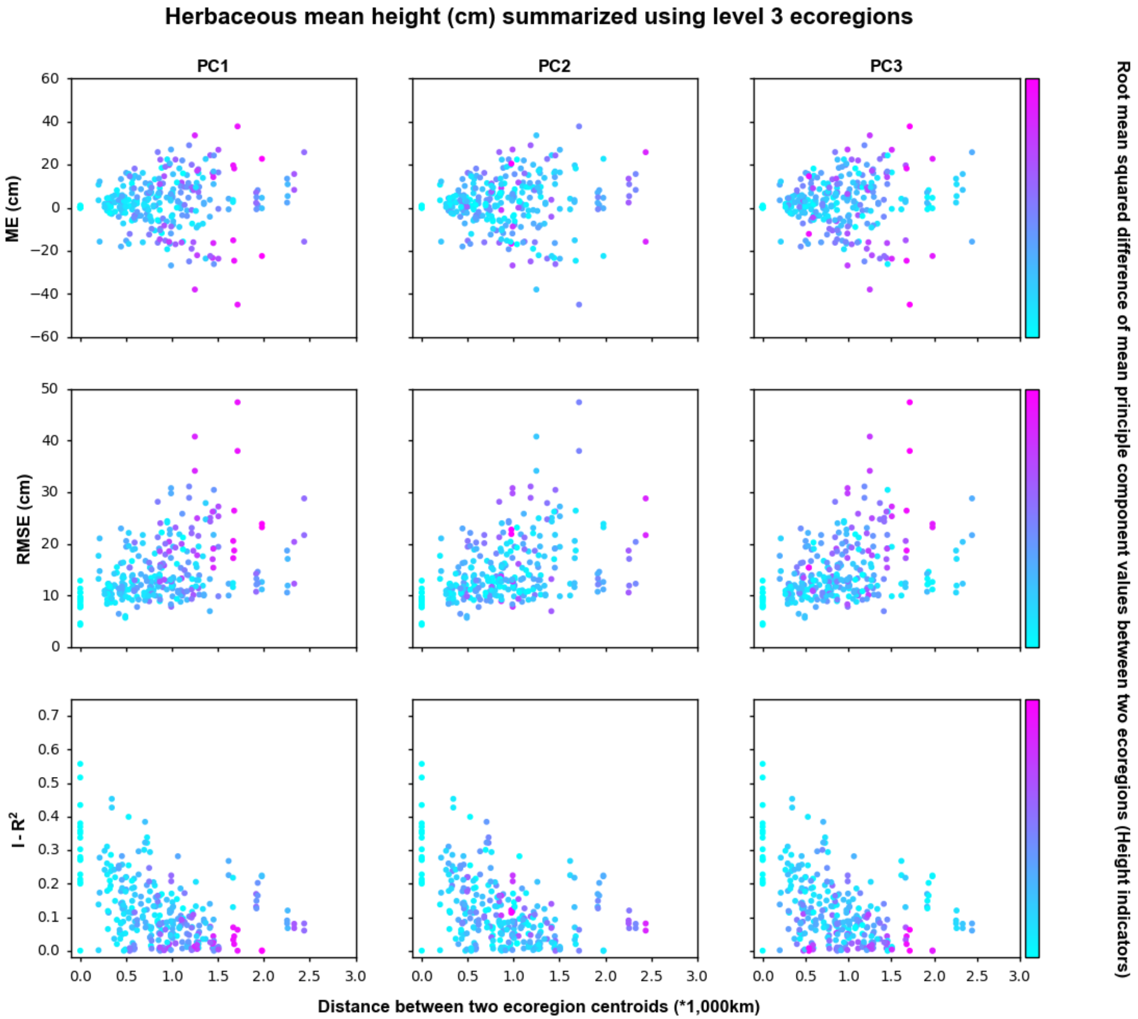
Model Parameters

- Different Types of Users:
  - Field Office
  - Power User
- Choose Your Own Adventure Approach using Multiple Apps, like:
  - Map making and getting statistics
  - Comparing the same area at different times, with statistics testing
  - Time series analysis, with statistics testing
- On-the-fly map making
- Scientifically sound in using spatially and temporally dispersed field data

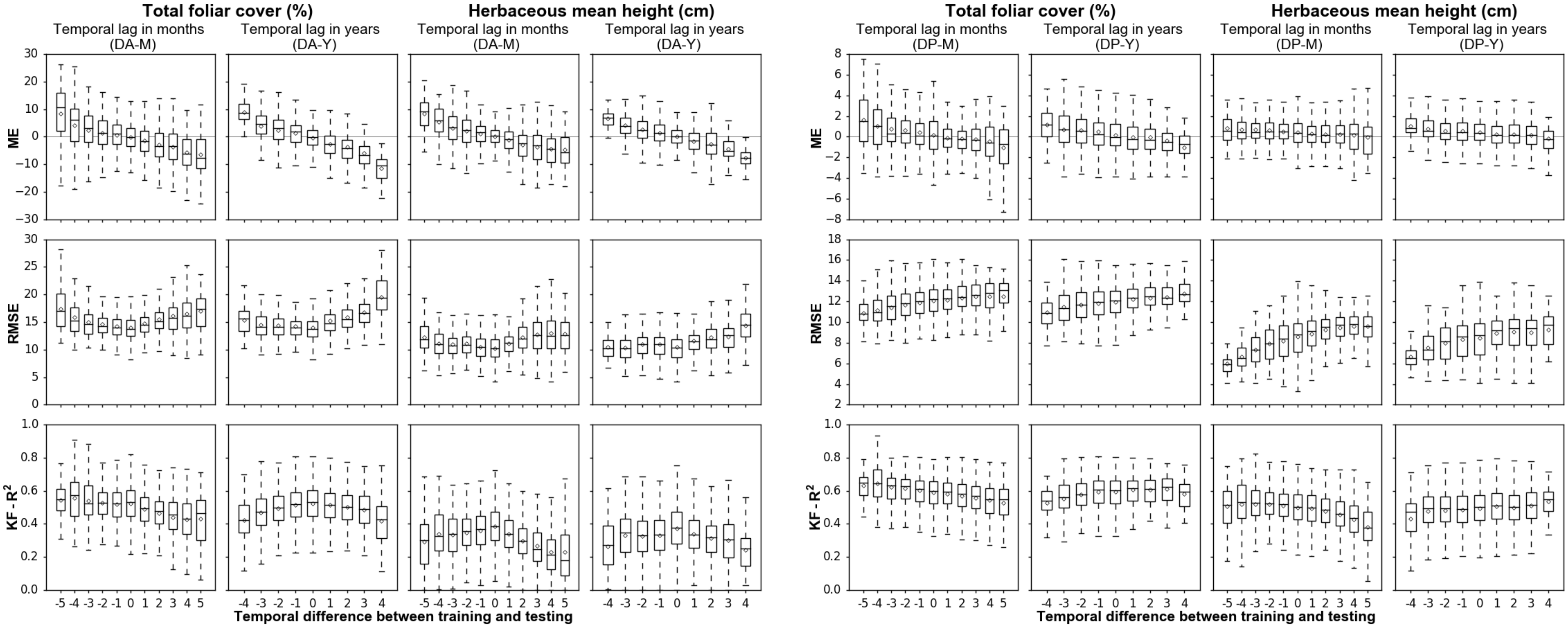


Spatial Biases





Temporal Biases

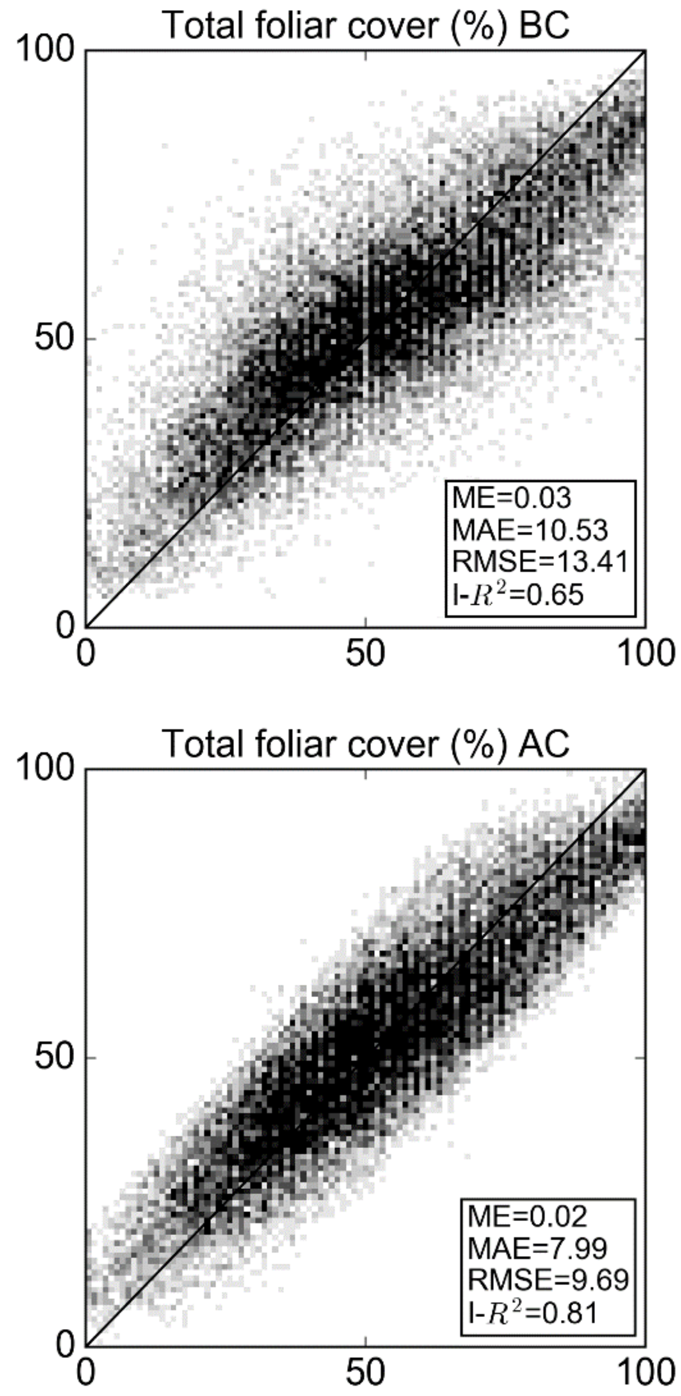


Previous solutions

- Time series approaches were used to help address the temporal inconsistencies in remote sensing data.
- Regional and various spatial ensemble modeling approaches were used to address the spatial biases.

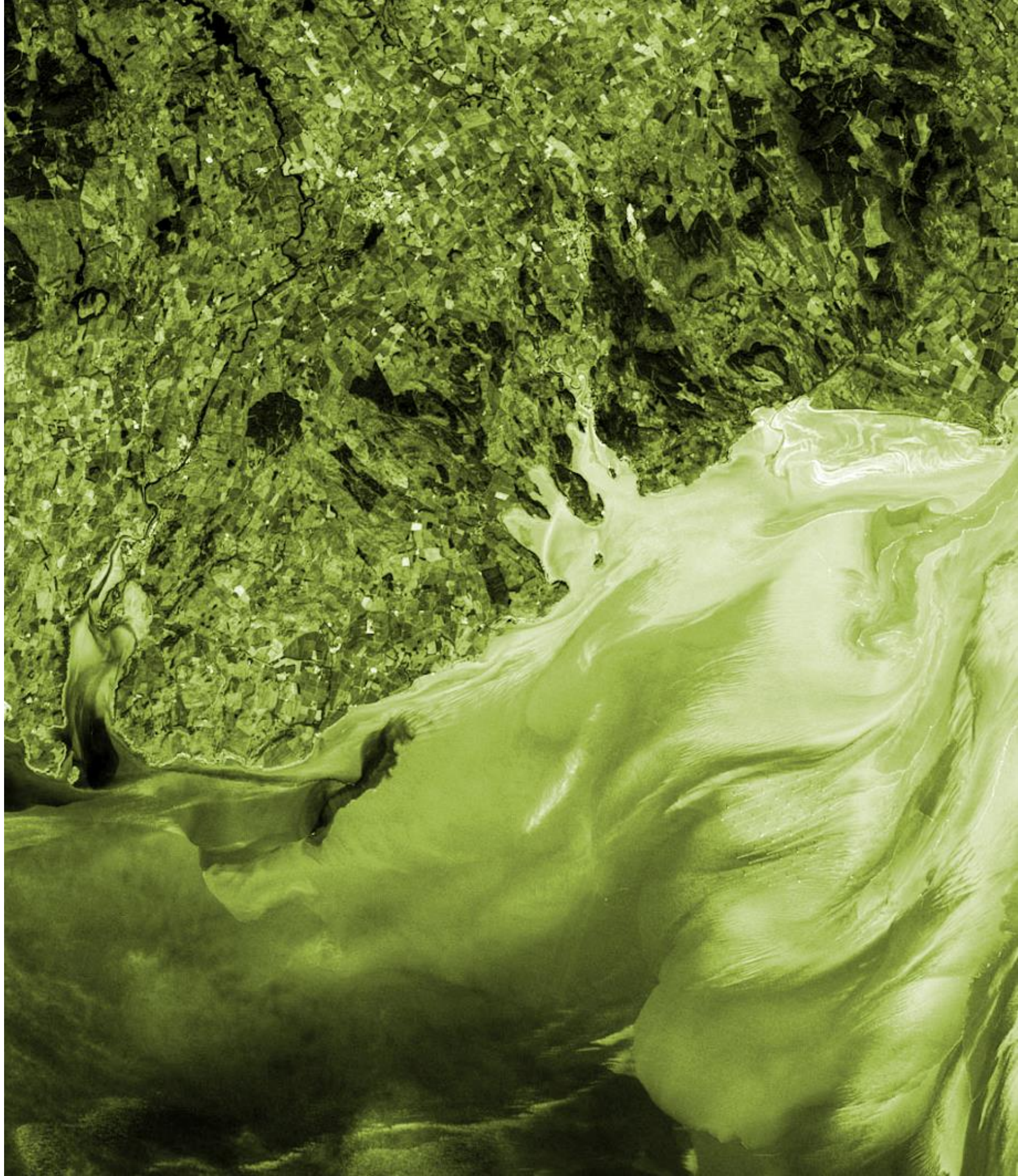
Our approach

- We experimented a new approach using one model trained with spatially and temporally dispersed data and applied spatial and temporal correction to address the respective biases.
- The result is promising and will enable our model to reliably predict in any location at any time within the spatial and temporal envelope of field data collection.
- Extrapolating beyond the spatial and temporal envelope can be done but may subject to lower confidence and accuracy.

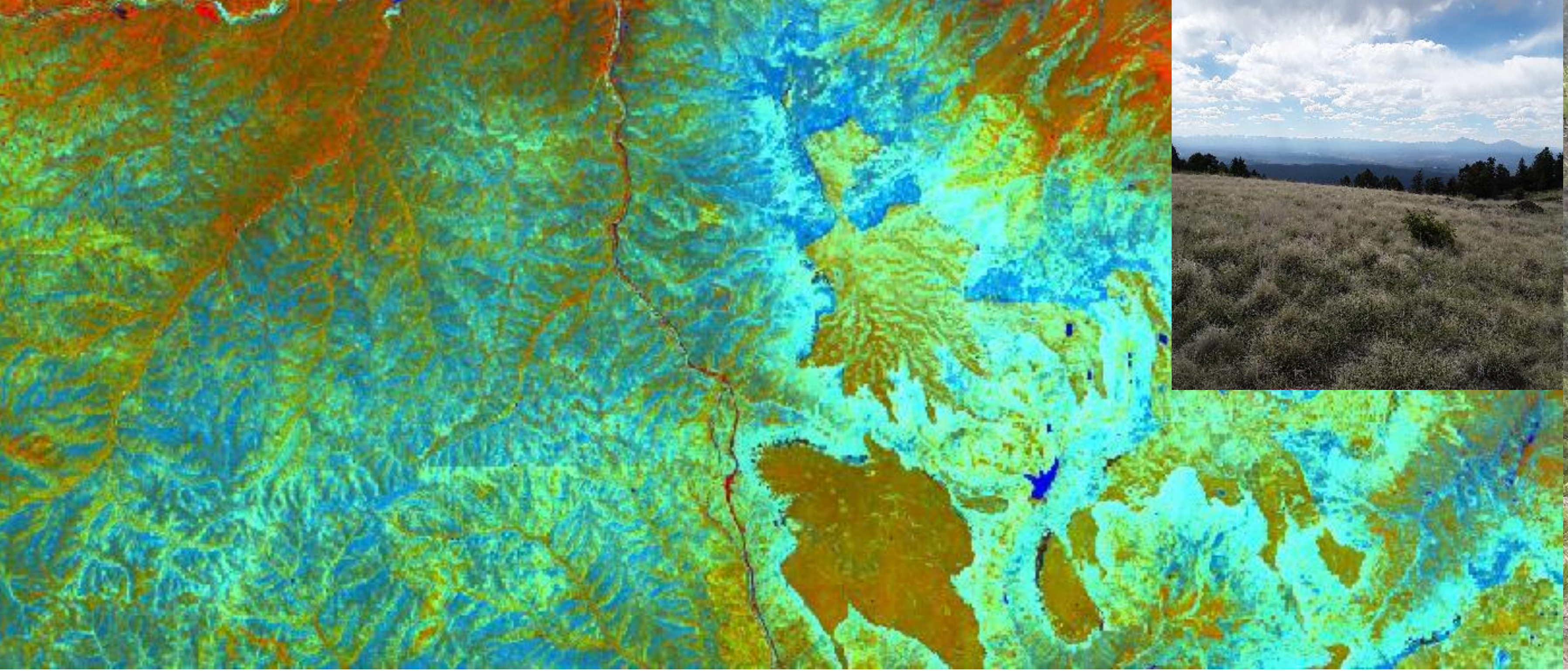


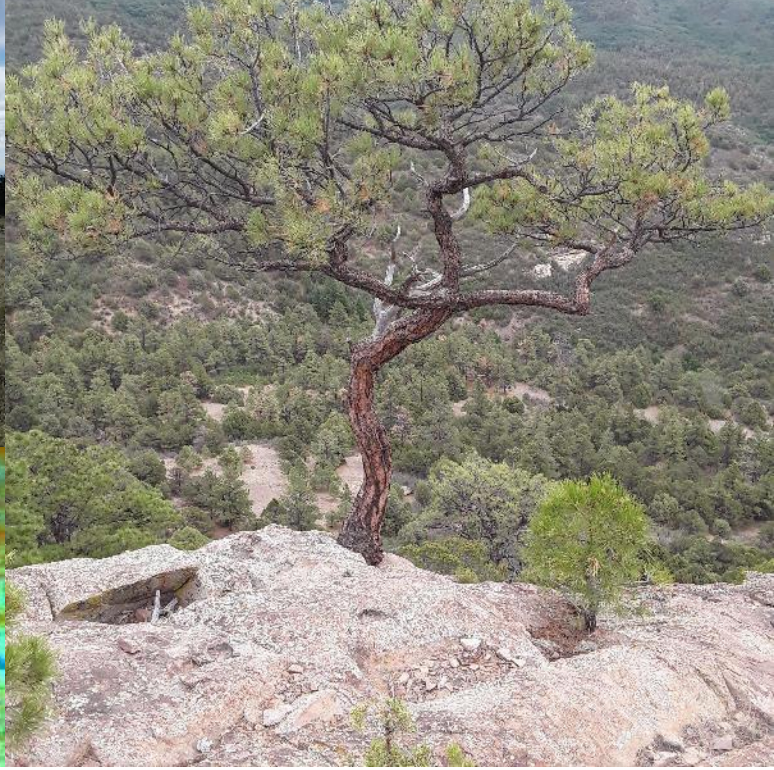
Thank You.

For further questions, please contact:
Bodacious@UCLA.edu



ECOLOGICAL
FORECASTING





Fisher's Peak Ecological Forecasting:
Mapping Biomass to Inform Conservation Planning of a Future State Park in Southern Colorado

Lauren Lad*, Scott Cunningham, Laura Krauser, Darby Levin

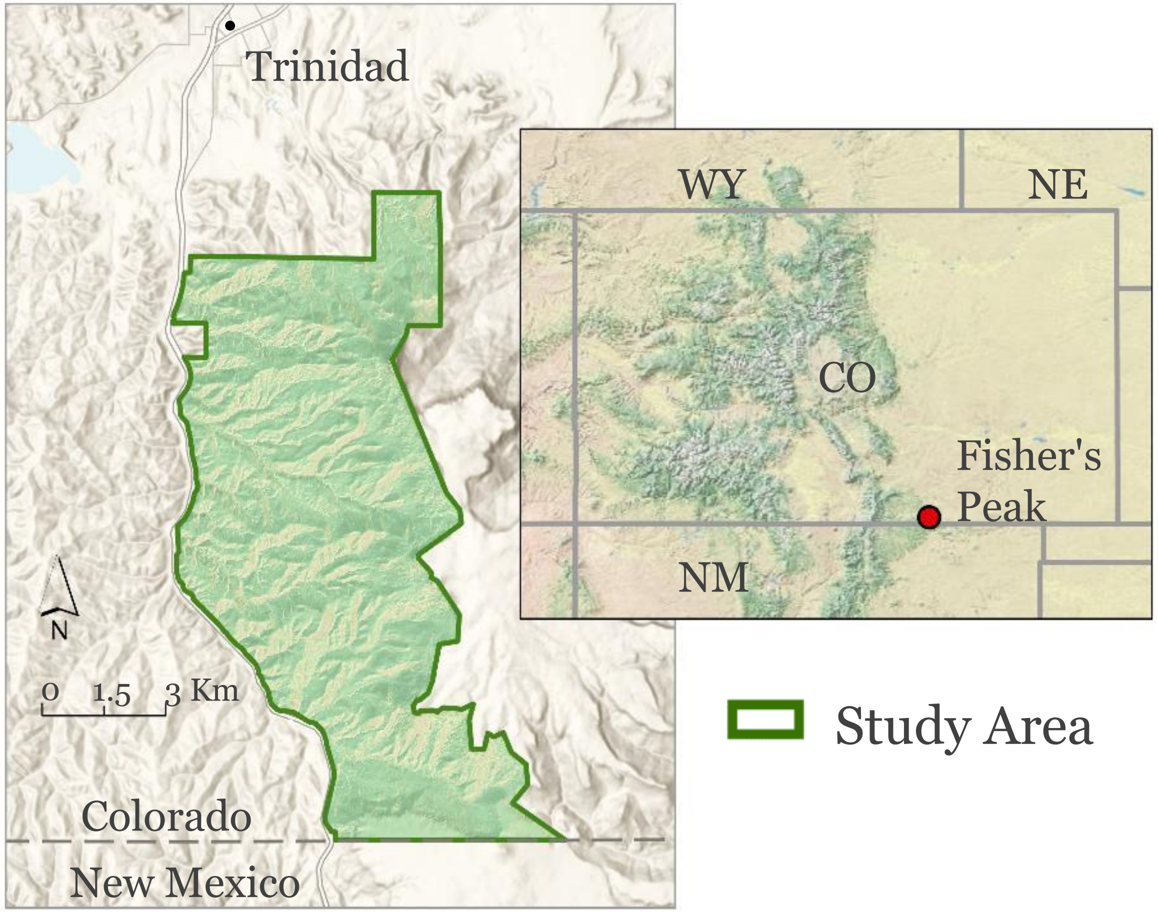
ECOLOGICAL FORECASTING

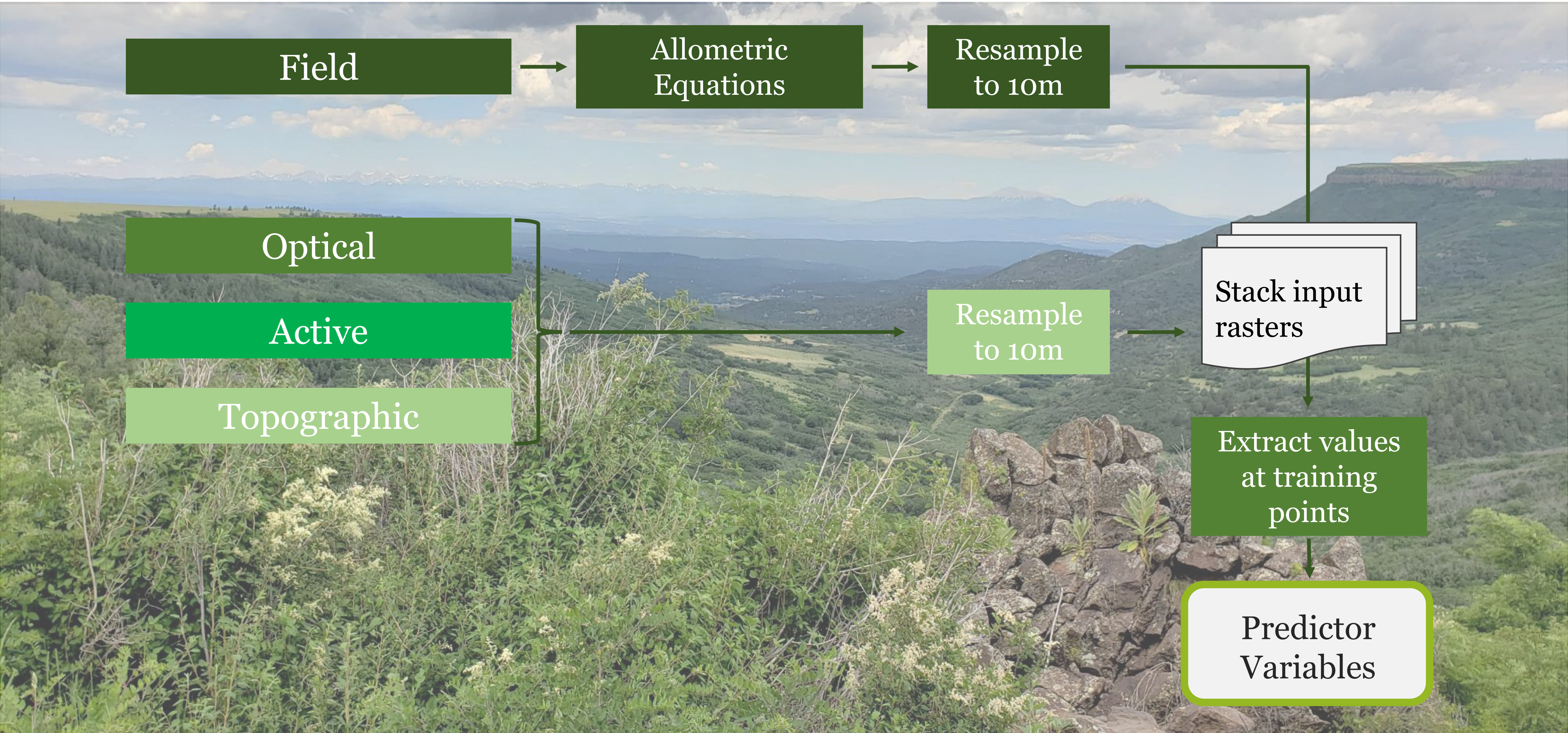
CAPACITY BUILDING

Fisher's Peak State Park is a venture undertaken by The Nature Conservancy and Colorado State Forest Service.

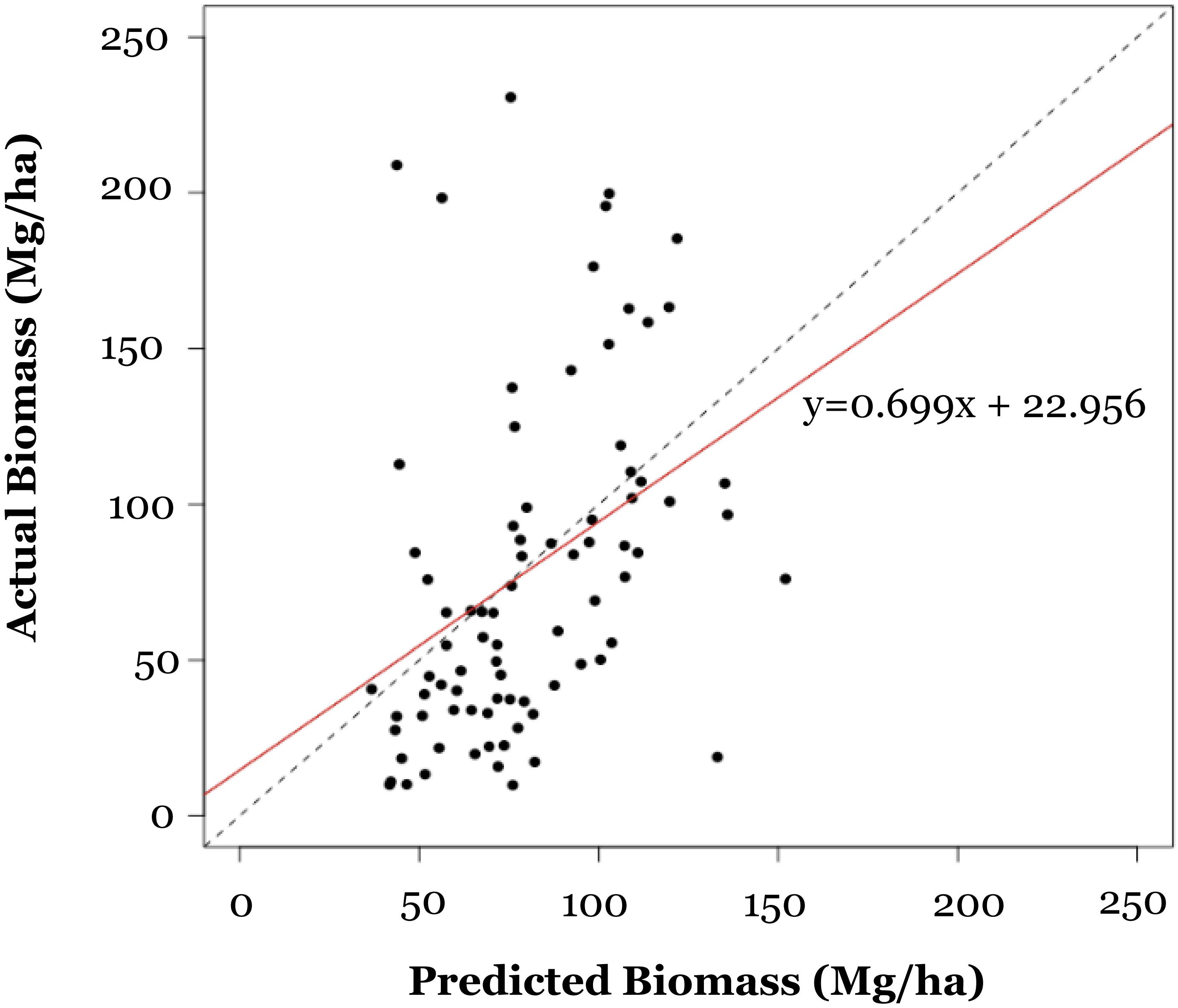
- Their joint effort for park development will strike the difficult balance of:
  - Growth of the recreation economy for the City of Trinidad
  - Ecological diversity of the existing area
  - Preservation of major carbon sinks
  - Effort to estimate the potential for carbon market entry
- The objectives of this project were to:
  - **Develop** a model for mapping biomass
  - **Create** a biomass map of the property
  - **Estimate** the property's carbon storage
  - **Forecast** high priority preservation areas

Biomass = total mass of living matter, which functions as an estimation for carbon storage




Field
Allometric Equations
Resample to 10m
Optical
Active
Topographic
Resample to 10m
Stack input rasters
Extract values at training points
Predictor Variables

RESULTS



Training Data Distribution (Mg/ha)

Average: 79.17

Max: 265.31

Min: 9.86

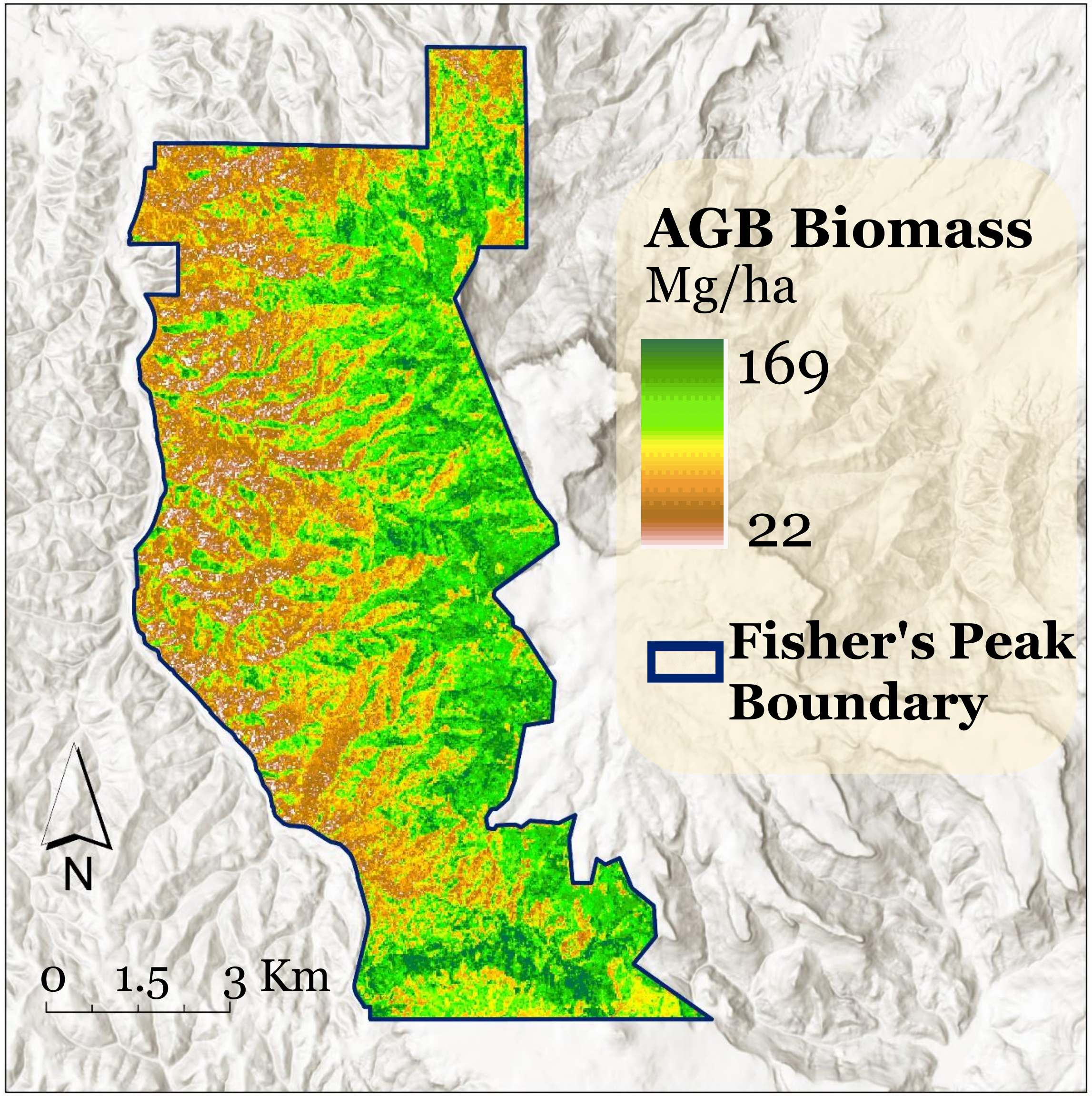
Standard Deviation: 57.67

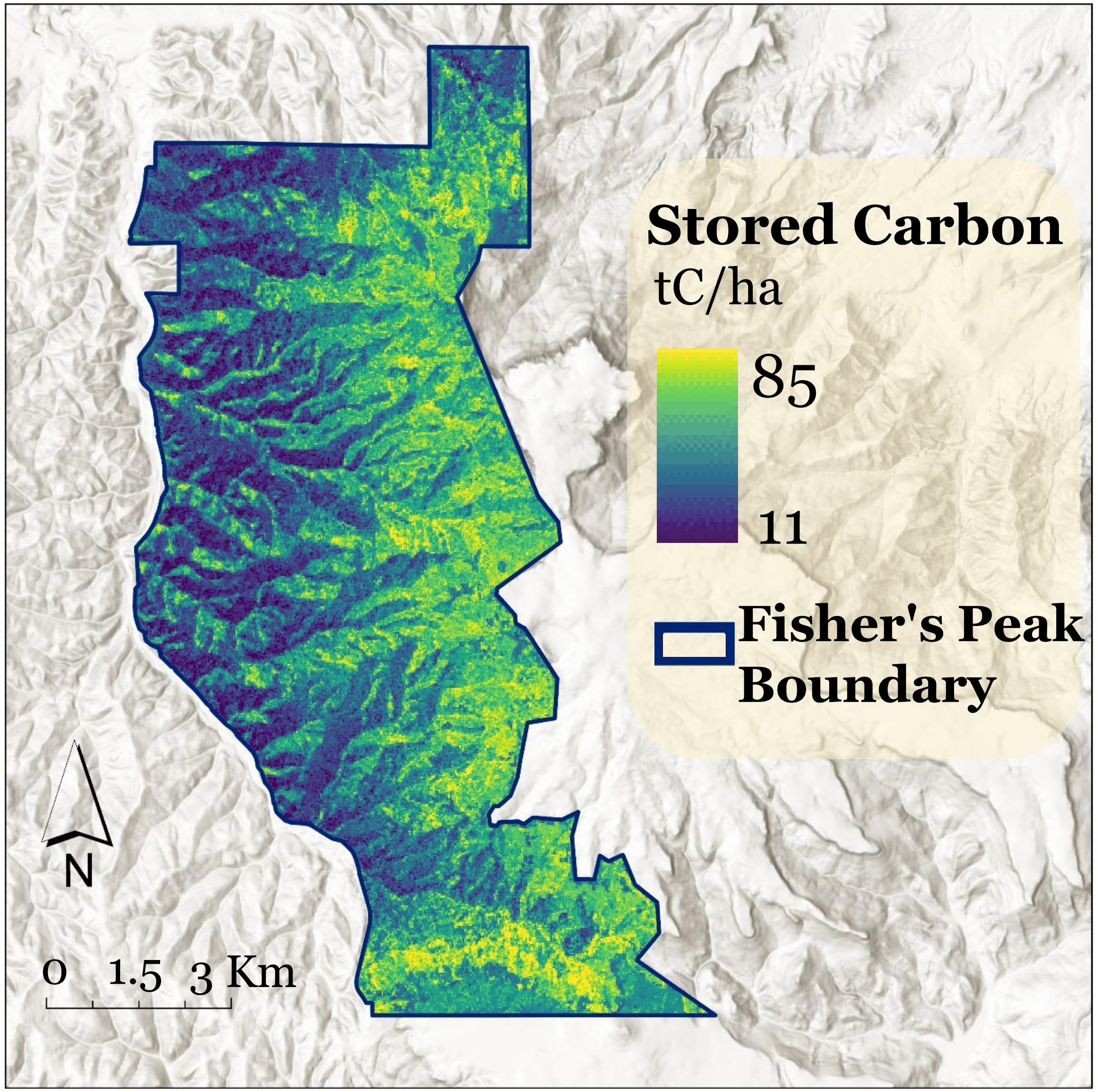
Out-of-bag Accuracy Metrics

RMSE: 54.98 Mg/ha

R^2: 11.66

CONCLUSIONS



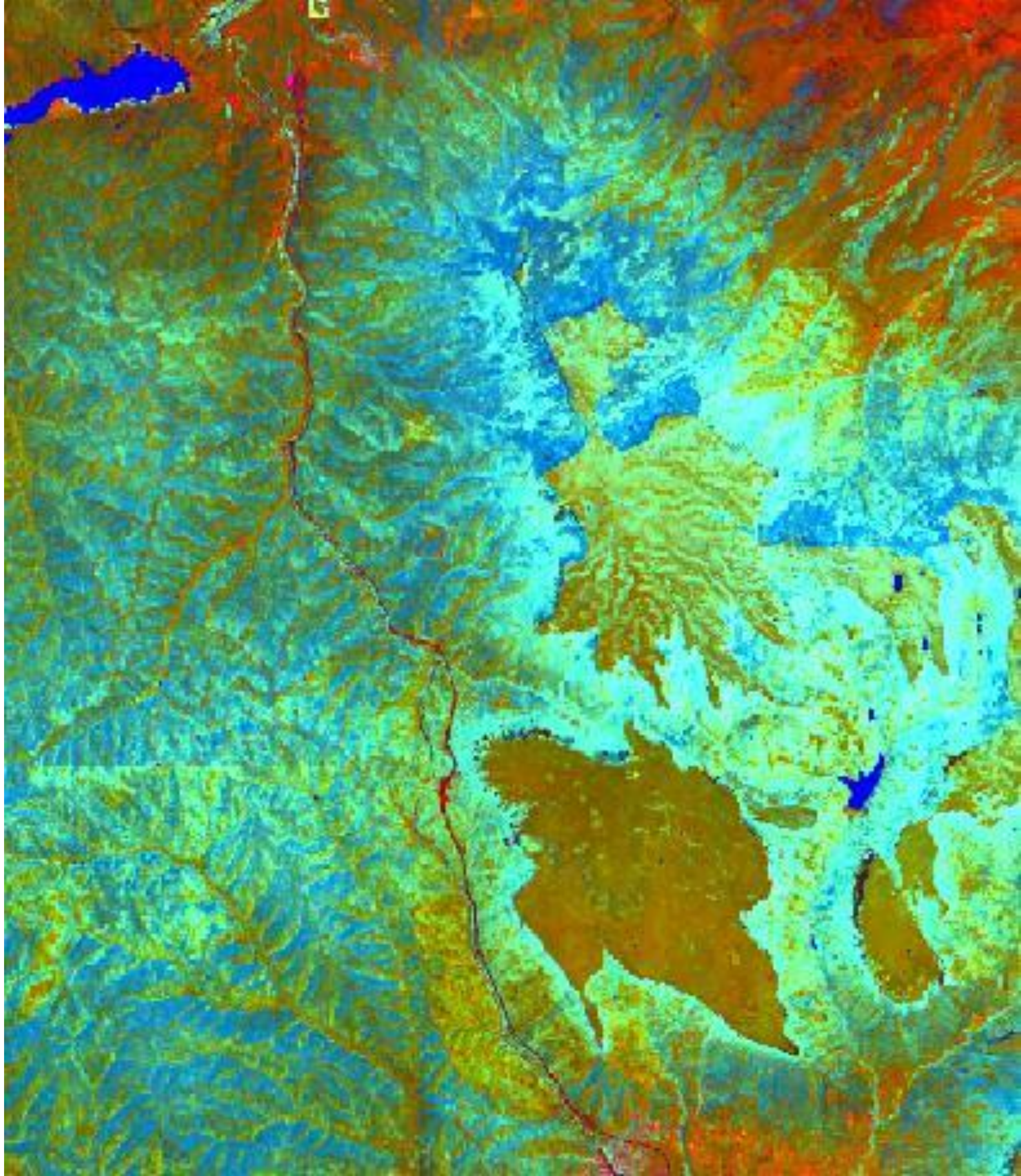


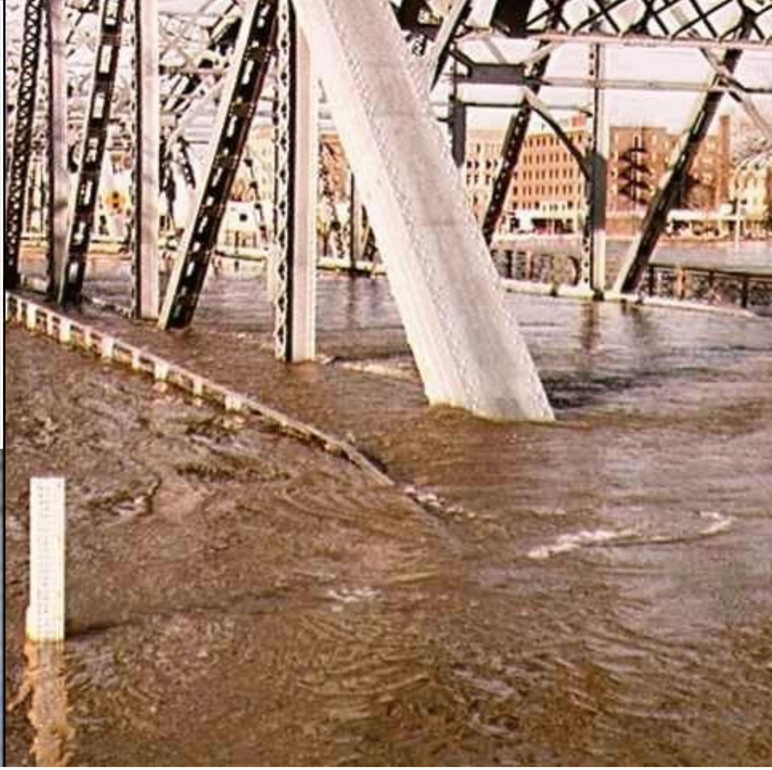
Thank You.

For further questions, please contact us at NASA-DL-DEVELOP@mail.nasa.gov

https://develop.larc.nasa.gov

EARTH SCIENCE
APPLIED SCIENCES





CEOS Working Group on Disasters Flood Pilot: Mapping the Red River of the North

Andrew Molthan

DISASTERS

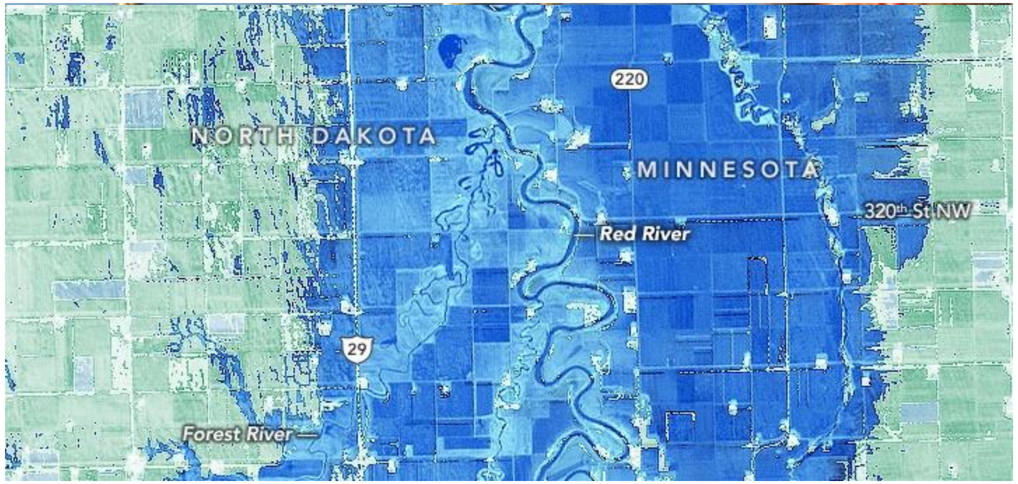
The Red River of the North experiences frequent flooding spanning Manitoba and the Dakotas, highlighting a transboundary water mapping challenge.

Red River of the North flows northward from North Dakota and Minnesota into Manitoba, Canada, and includes a flat, wide, and expansive flood plain.

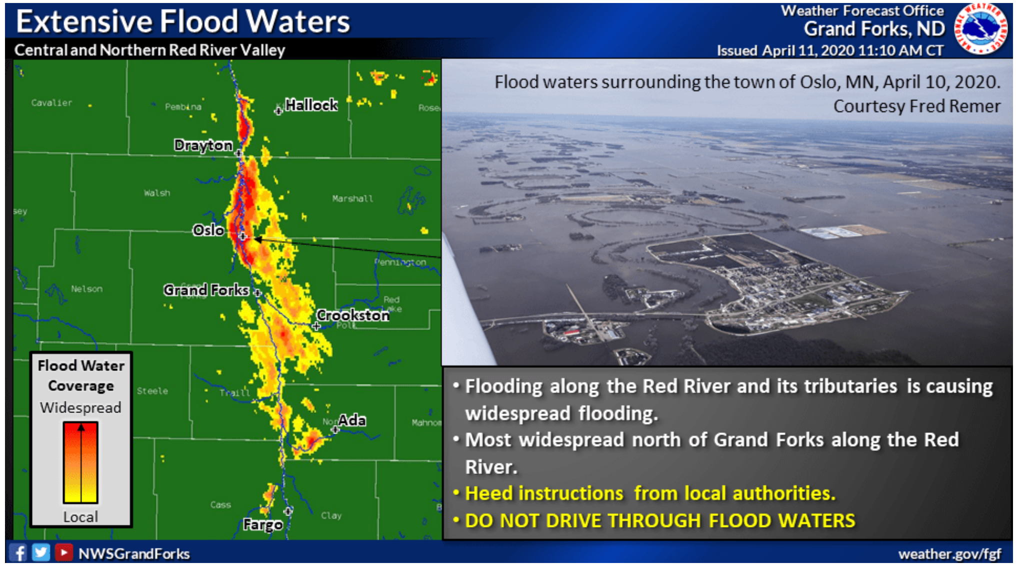
- Significant floods occur here on a frequent basis, especially in years with extensive, deep snowpack, rapid seasonal warming, and in combination with heavy rainfall events.
- Major events have occurred in 2009 and 2011, with other events in recent years to include 2013, 2014, 2019, and 2020.
- The CEOS Working Group on Disasters Flood Pilot brings together scientists and mapping capabilities from a broad range of platforms to help improve mapping of these and similar events.
    - Combining ***GEO*** (geostationary), ***LEO*** (low-Earth orbit) and ***SAR*** (synthetic aperture radar) capabilities to provide comprehensive mapping.
    - From this, a ***GEO-LEO-SAR*** focused Flood Pilot was developed.

Combining information from multiple platforms combines the strengths of each capability to result in overall improved mapping capabilities.

- ***Geostationary*** data from NOAA's operational GOES-R Series (-16, -17) provide high temporal repeat over the same area, helpful for detecting water between clouds and shadows, albeit at a relatively lower spatial resolution.
- ***Low-Earth orbit*** imagery are often at a higher spatial resolution (< 30 m) but may be available once or twice per week from a given platform, and may have a view blocked by clouds or shadows.
- ***Synthetic aperture radars*** have similar spatial resolutions (< 30 m) and limited repeat viewing opportunities for a given event but see through most clouds and precipitation that may linger through a given flood event.



Water extent via NDWI, Landsat 8, April 17, 2020 and courtesy of [Earth Observatory]

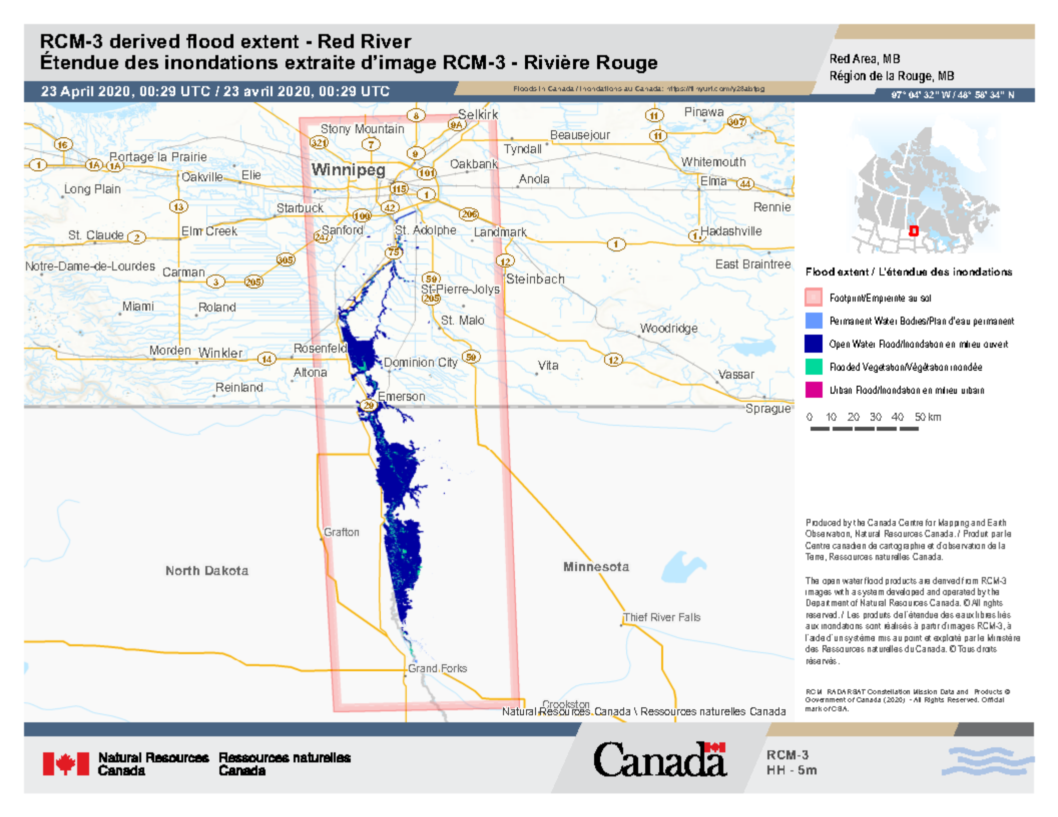


NOAA/NWS detections of flood water (left) and advisory update from the forecast office in Grand Forks, ND issued on April 11, 2020. ([link])

MAPPING THE RED RIVER OF THE NORTH

- A goal of the CEOS Working Group on Disasters is to bring together our international colleagues for shared access to Earth observations – satellite remote sensing, modeling, in situ – and work collaboratively to encourage sharing of both data and capabilities.
- For the Red River, collaborations include access to and use of data from:
  - NASA's Landsat 7 and 8 missions
  - NASA/NOAA S-NPP and NOAA JPSS (VIIRS) data
  - NOAA/NASA GOES-R Series (-16, -17 with ABI)
  - ESA Sentinel-1 (SAR) and Sentinel-1 (optical)
  - RADARSAT-2 and Radarsat Constellation Mission (RCM)
  - Contributions from other international partners, their platforms, and sensors:
    - ALOS, TerraSAR-X, Cosmo-Skymed

Research and Collaboration Question: How do we best combine data from multiple missions and platforms to create the highest quality analyses?

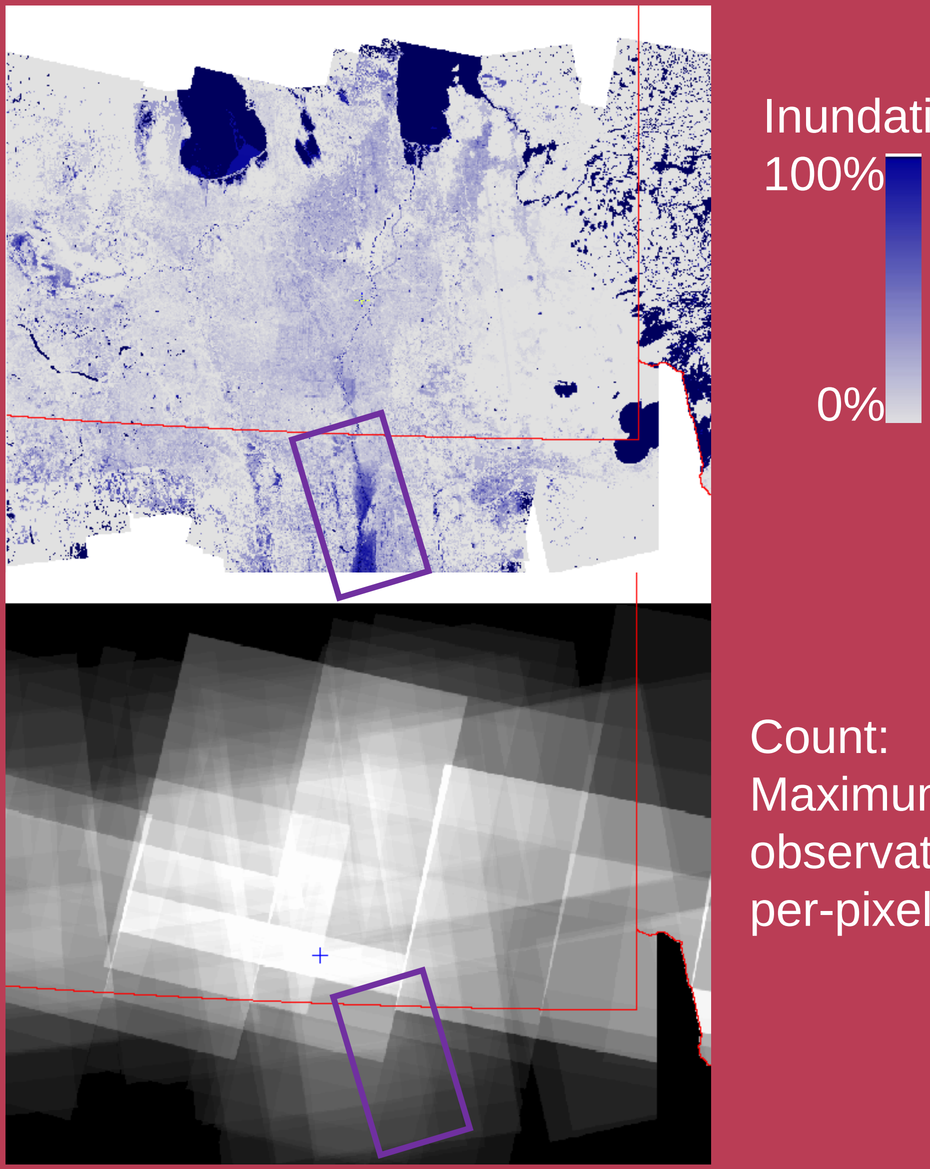


Results courtesy of Ian Olthof, Emergency Geomatics Services, Canada Centre for Remote Sensing / Natural Resource Canada

MAPPING THE RED RIVER OF THE NORTH

- Earth observations can also inform our understanding of flood risk through recurrence and return period.
- Long-term series of observations capture the frequency of water present in a pixel, from optical, SAR, and their combination.
- In combination with flood plain knowledge, digital elevation maps, and locations of infrastructure, partners can use Earth observations and mapping techniques to assess the spatial extent and recurrence interval of flood impacts.
- Here, examples from colleagues in the Canada Centre for Remote Sensing / Natural Resource Canada highlight the repeated flooding that occurs in the Red River valley.
    - Data provided by RadarSat-2, exploring how to improve results and add data in combination with international partners and additional observations.
    - In this case:
        - 533 images from RADARSAT-2
        - Landsat 5, 7, and 8 from USGS for 1985+
        - RadarSat Constellation Mission (24 scenes, 2020+)
        - More from Sentinel-1, Sentinel-2, and RapidEye

RadarSat-2

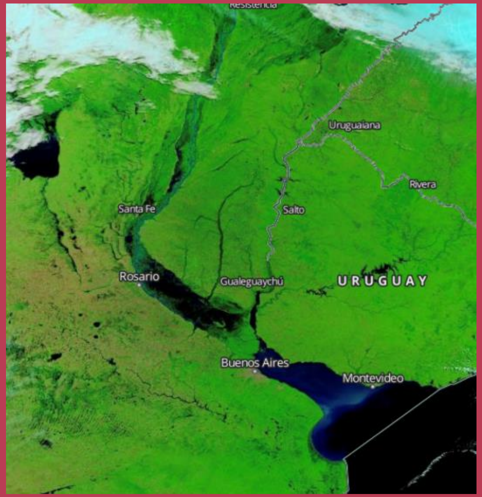


Results courtesy of Ian Olthof, Emergency Geomatics Services, Canada Centre for Remote Sensing / Natural Resource Canada

MAPPING THE RED RIVER OF THE NORTH

- CEOS Flood Pilot efforts will continue to bring partners together around regional areas of interest, led by international partners and with collaborations around data sharing and algorithm exchange:
    - Red River of the North
    - Transboundary waters in Bolivia/Paraguay/Argentina
    - Flood impacts in coastal and inland India
    - Typhoon rainfall and flooding in eastern China
- Emphasis of collaborations spurs increased sharing of data, thoughts about improving access and ease of use for data and explore preliminary methods for analysis.

Red River of the North
Leads: NOAA, NASA, Natural Resources Canada



Rio de la Plata Basin
Leads: CONAE, Partners

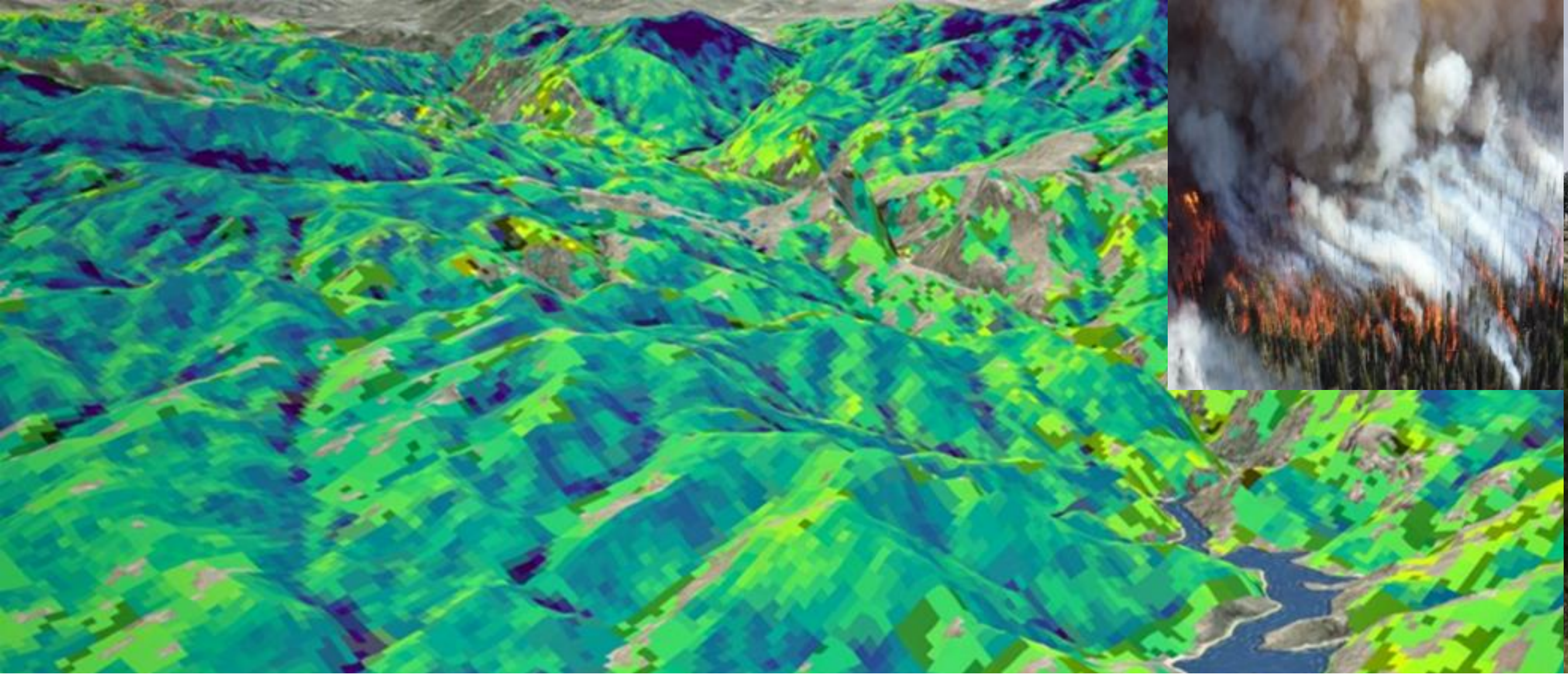
Mahanadi River Delta
Leads: ISRO, Partners

In development:
Pearl River Basin, China

Thank You.

For further questions, please contact:
andrew.molthan@nasa.gov

DISASTERS




Rocky Mountain Disasters:
Using NASA Earth Observations to Monitor Post-Fire Vegetation Recovery in the Colorado Front Range

Eric Jensen*, Audrey Colley, Lauren Kremer, Zackary Werner

DISASTERS

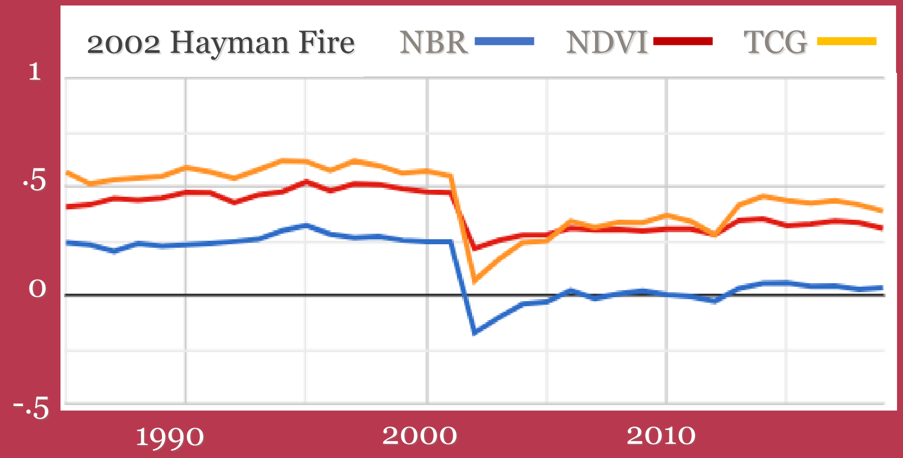
CAPACITY BUILDING

COMMUNITY CONCERNS & PROJECT PARTNERS

The **US Forest Service's Rocky Mountain Research Station** provides research to managers and decision makers related to post-fire forest recovery in Colorado Front Range Forests. However, field-based studies are cumbersome at the scale of many fires.

In particular, the project partners were interested in remote sensing analysis to address a suite of related issues:

- Extensive high severity fire patches in recent fires
- Loss of tree canopy in moderate and high severity burns
- Reduction in post-fire conifer regeneration
- Resulting impacts to watershed health

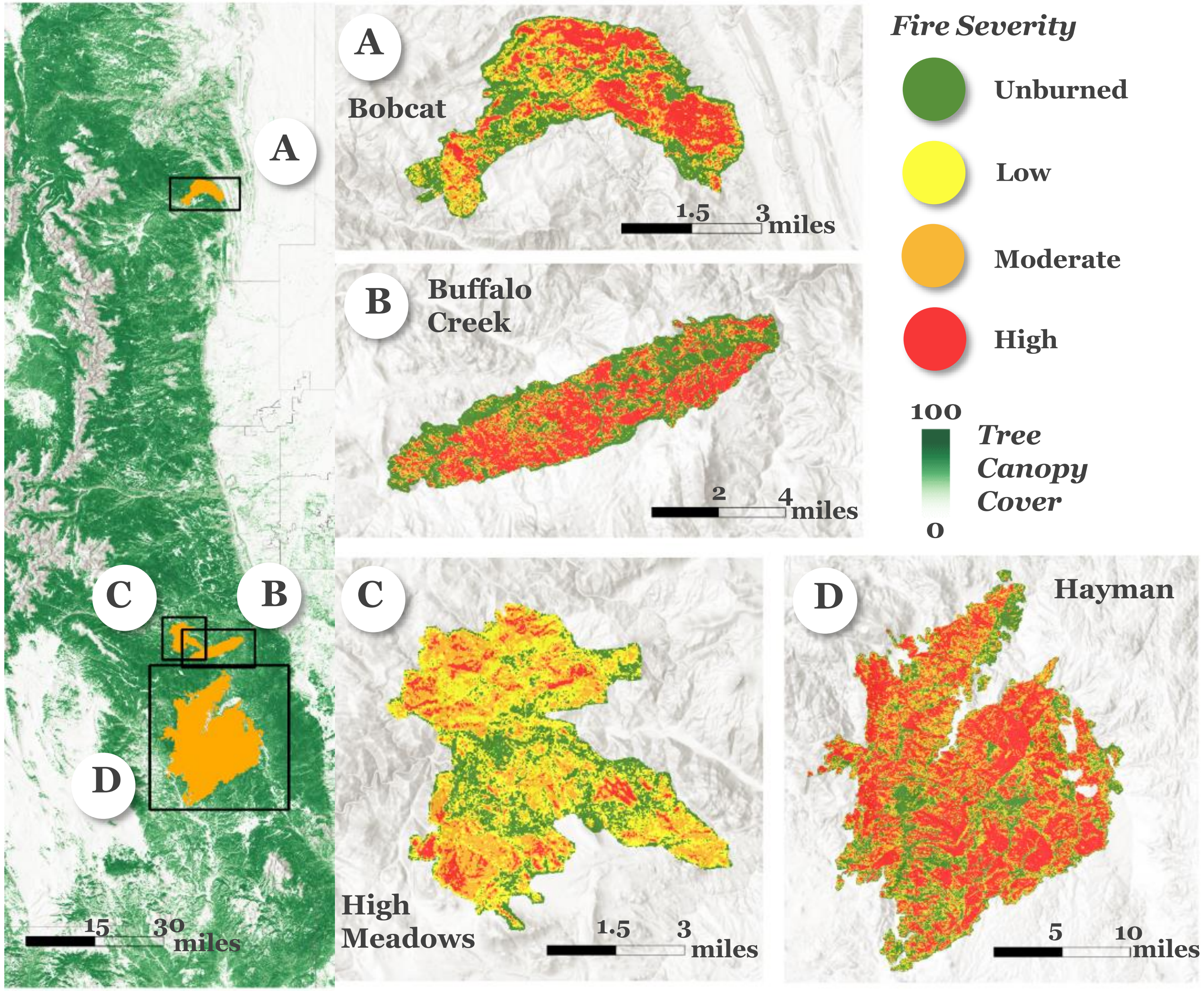


PROJECT OBJECTIVES

With estimates that more than 190 million acres of federal public forests are unnaturally dense, the risk of future high severity fires in Front Range communities is high.

To aid in post-fire management decision making we analyzed four fires that occurred between 1996–2002. Our objectives were to:

1. Apply **remote sensing data** to **detect** current tree cover percentage on the landscape
2. Apply **environmental variables** to **predict** probabilities of post-fire tree regeneration



EARTH OBSERVATIONS & METHODS

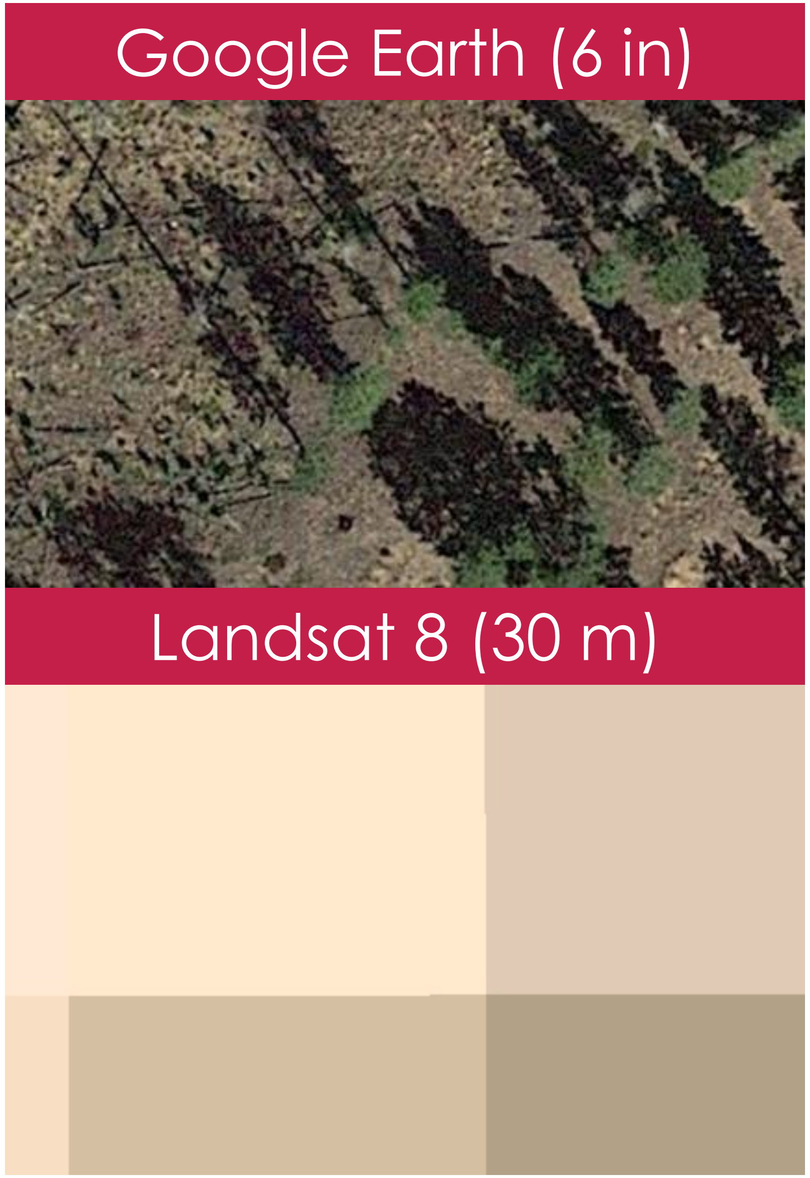
Google Earth imagery enabled us to estimate tree cover and to detect small trees.

To detect post-fire **tree canopy** we applied **remote sensing** variables:

- **Landsat** time-series calculations of common vegetation indices
- **Synthetic aperture radar** vegetation structure variables
- **Topographic** variables

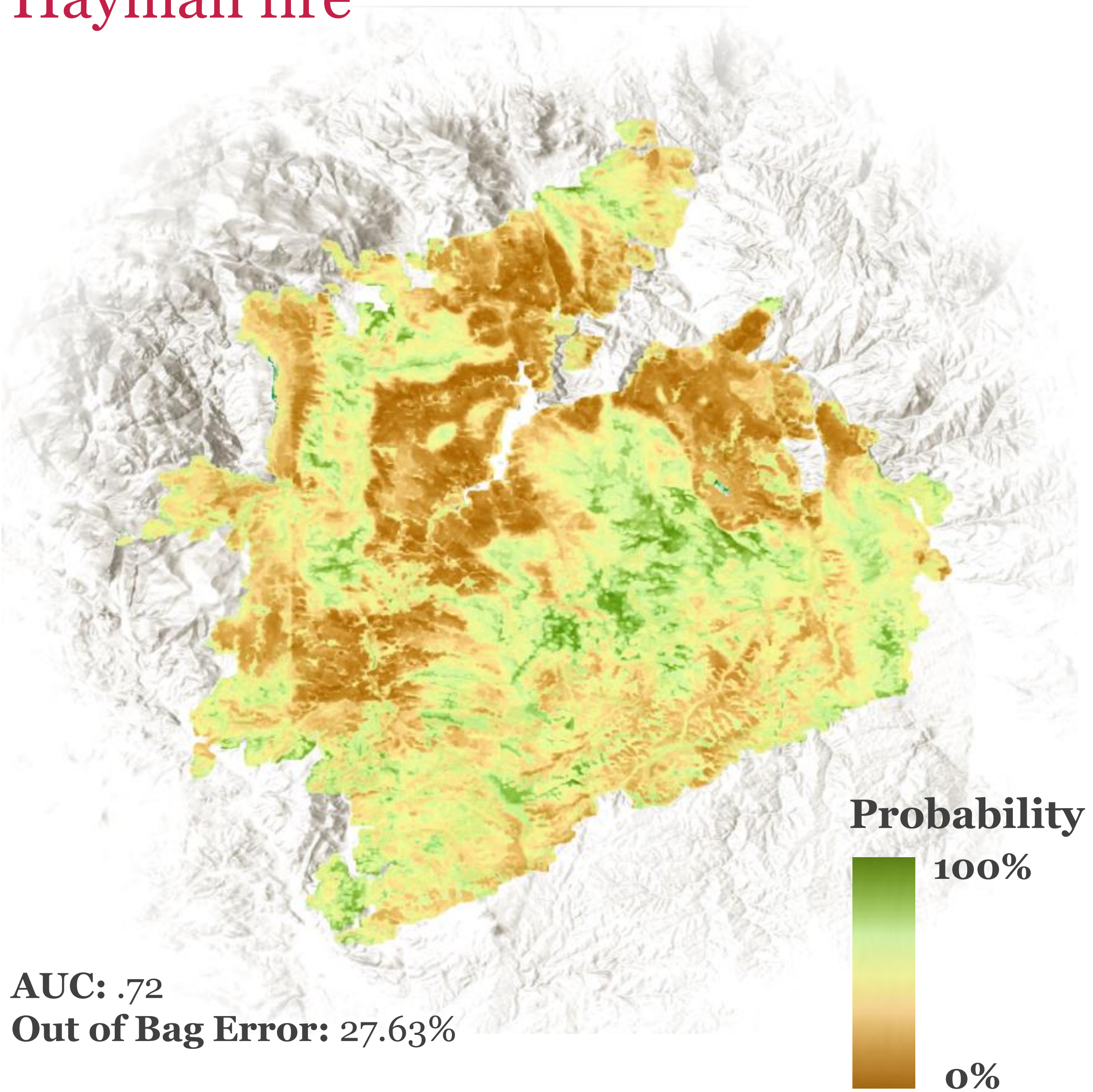
To predict post-fire **tree seedling regeneration** we applied environmental variables:

- **Climate** variables
- **Soils** properties
- **Fire** severity and recovery metrics
- **Topographic** and **hydrographic** variables



RESULTS & CONCLUSIONS

Conifer regeneration suitability
Hayman fire



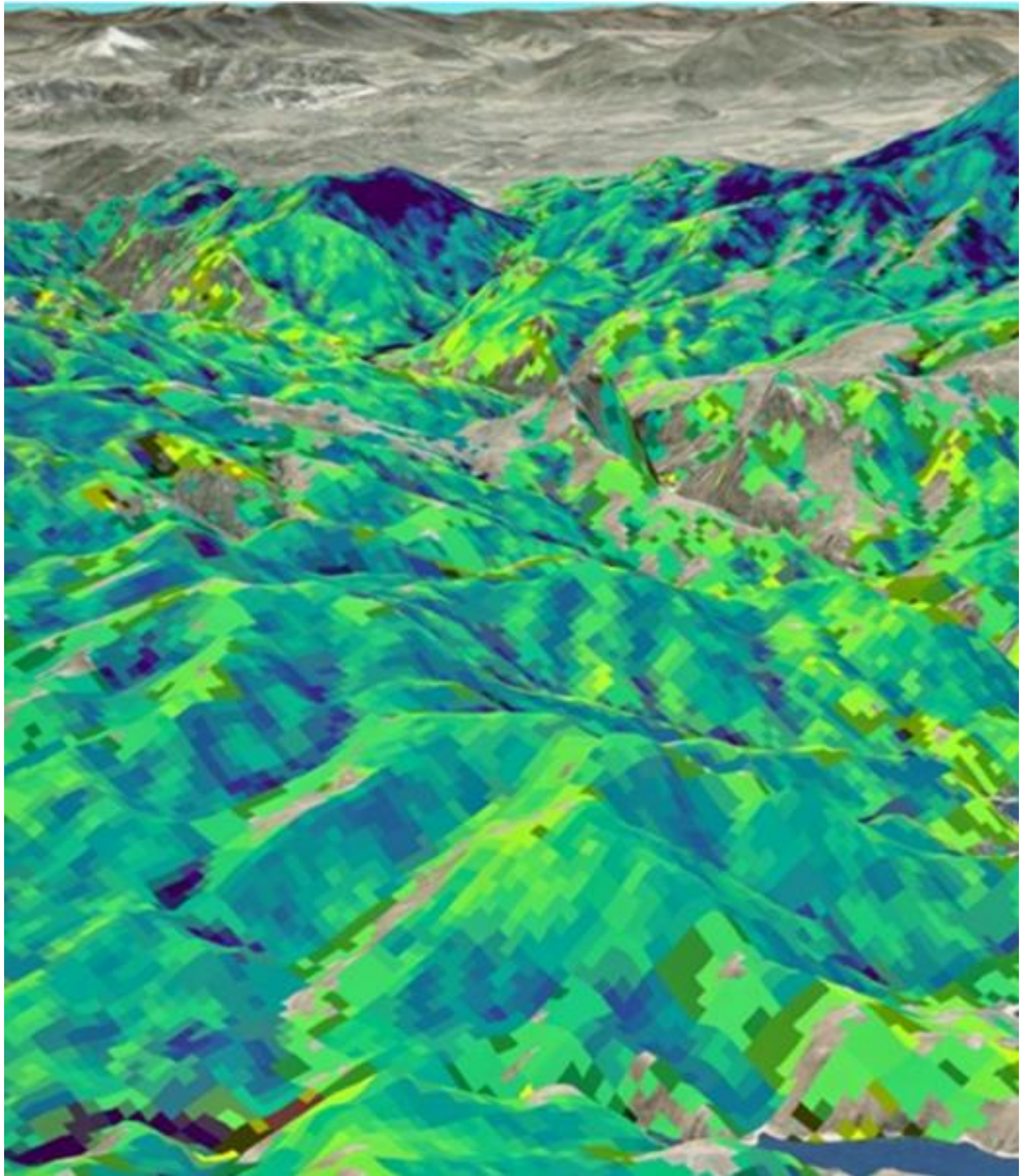
AUC: .72
Out of Bag Error: 27.63%

Conifer percent cover
Hayman fire

Thank You.

For further questions, please contact
us at NASA-DL-DEVELOP@mail.nasa.gov

https://develop.larc.nasa.gov



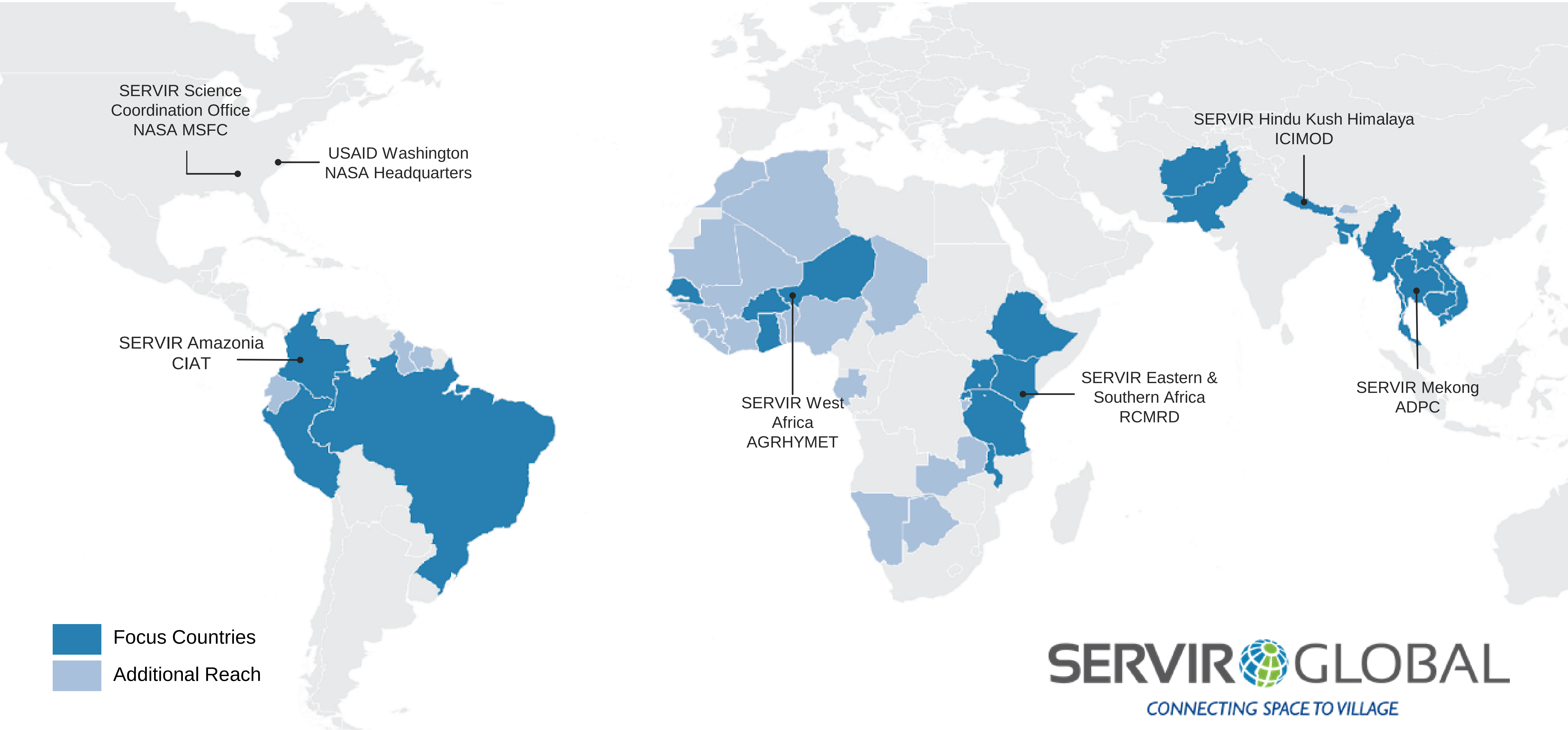
EARTH SCIENCE
APPLIED SCIENCES

SERVIR Amazonia Overview and Highlights

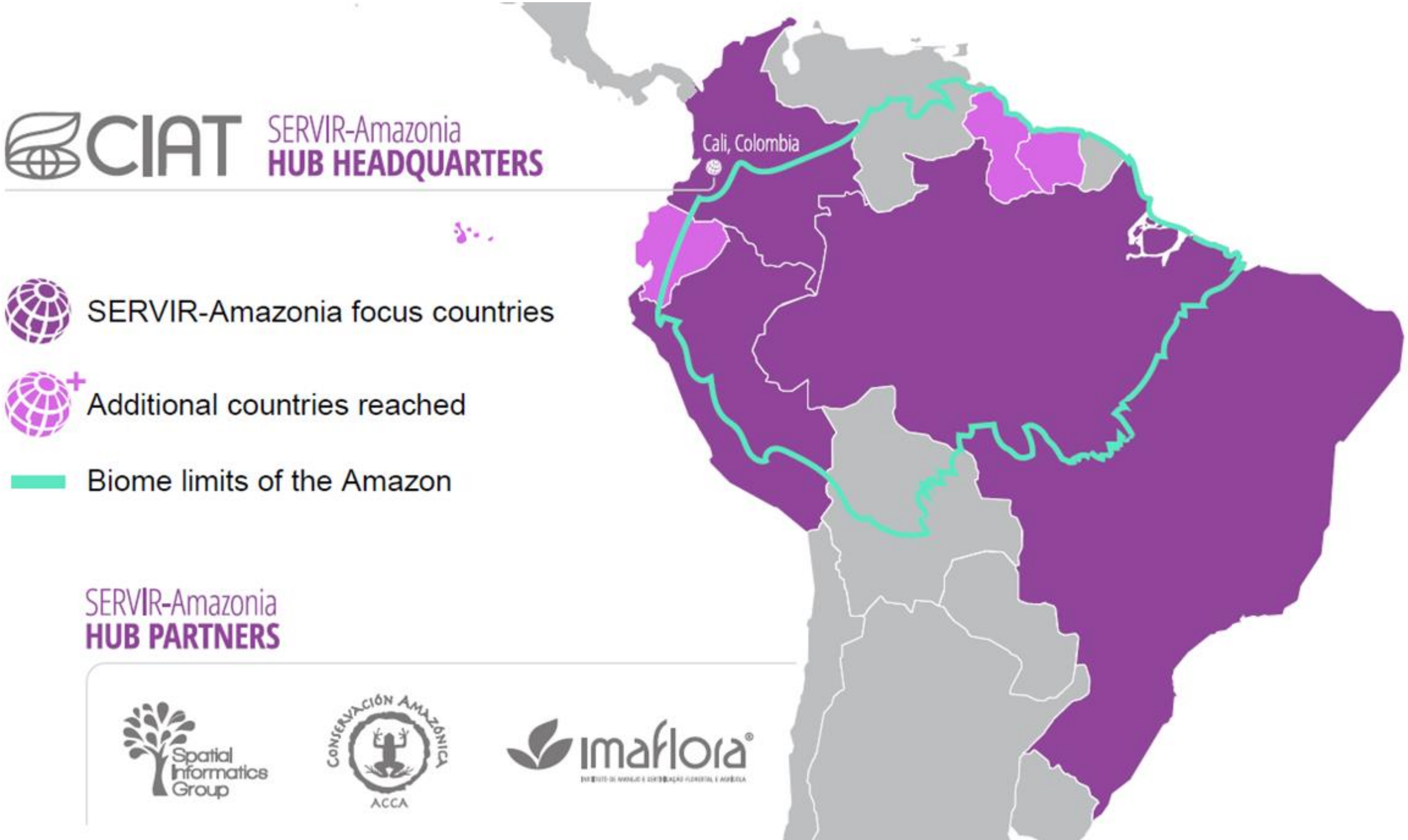
Andrea Nicolau
NASA SERVIR Regional Science Associate, Mekong

CAPACITY BUILDING

SERVIR SERVICES MEET NEEDS IN ASIA, AFRICA, AND THE AMERICAS



SERVIR AMAZONIA - FOCUS COUNTRIES



SERVICE AREAS

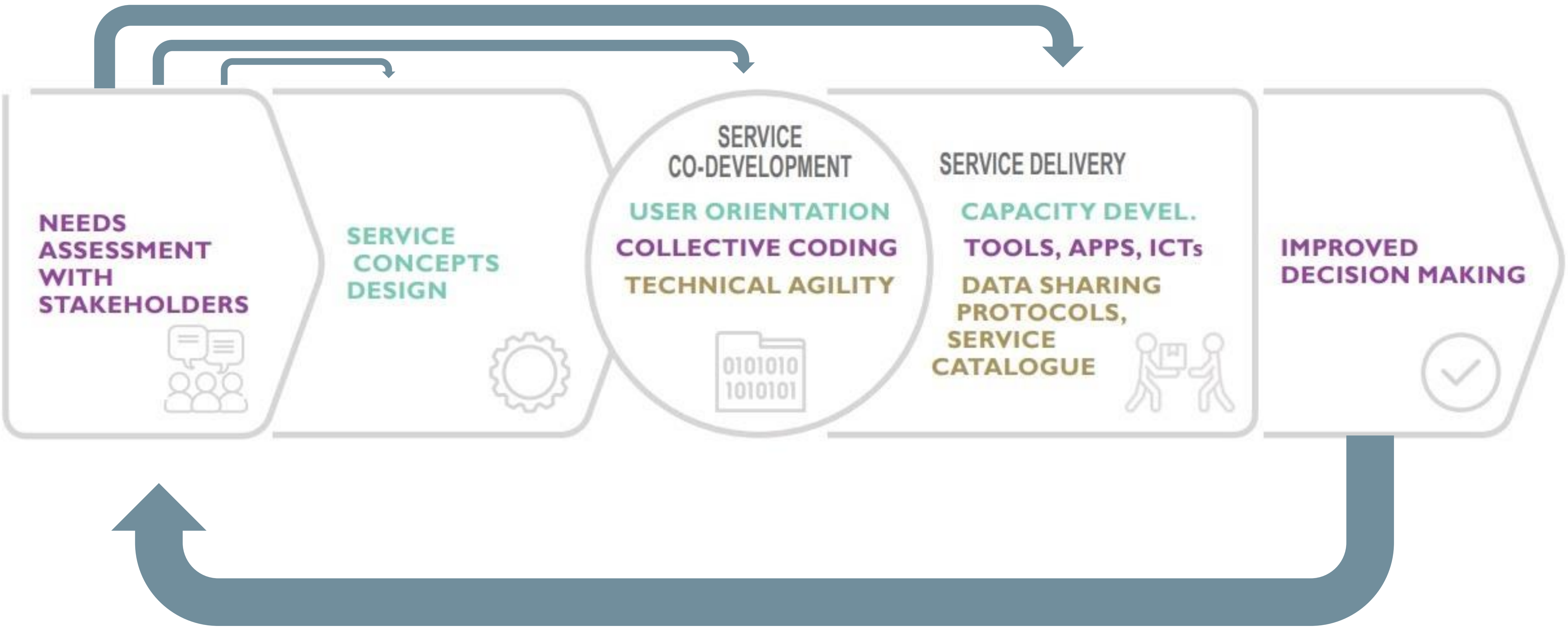
Drought and Fire Risk

Water Resource Management and Hydro-Climatic Disasters

Weather and Climate

Ecosystem Management

SERVICE CO-DEVELOPMENT



SERVICES

- Radar for detecting forest change
- Monitoring & evaluation of mangroves in Guyana
- Deforestation monitoring and reporting in Ecuador
- Monitoring of gold mining in the Peruvian Amazon
- Monitoring of gold mining in the Colombian Amazon
- Forecasting seasonal to sub seasonal fire and agricultural risk from drought
- Improving resilience and reducing risk of extreme hydrological events
- Ecosystem services modeling in the Amazon's forest-agriculture interface
- Quantifying the effects of forest change on provisioning and regulating ecosystem services
- Monitoring forest dynamics from space to enable sustainable livelihoods and biodiversity conservation in the Amazon (TerraBio)
- Increase the protection of forests with traditional communities and indigenous peoples (Origins)
- Amazon landscape and biodiversity Atlas

Indigenous People

- Most of the Amazon Basin is traditional territory of indigenous peoples now subject to enclosure for legal and illegal purposes.
- To ensure IPs know about, can access and benefit from SERVIR-Amazonia services, the Program engages representative IPOs, includes their needs, priorities in planning, training events.
- The leading IPOs in the region already use GIS services that we help strengthen.

Gender

- Improving women’s leadership and creating an environment that provides opportunities to all, regardless of gender: Community of Practice
- Integrating a gender lens in services
- Increasing the use of remote sensing and GIS to address gender equity

Photo credit: SERVIR-Amazonia

Naiara Pinto
Jet Propulsion Laboratory

Unlocking the Power of Active Remote Sensing for Ecosystem Services Modeling in the Amazon's Forest-Agriculture Interface

Jim Nelson
Brigham Young University

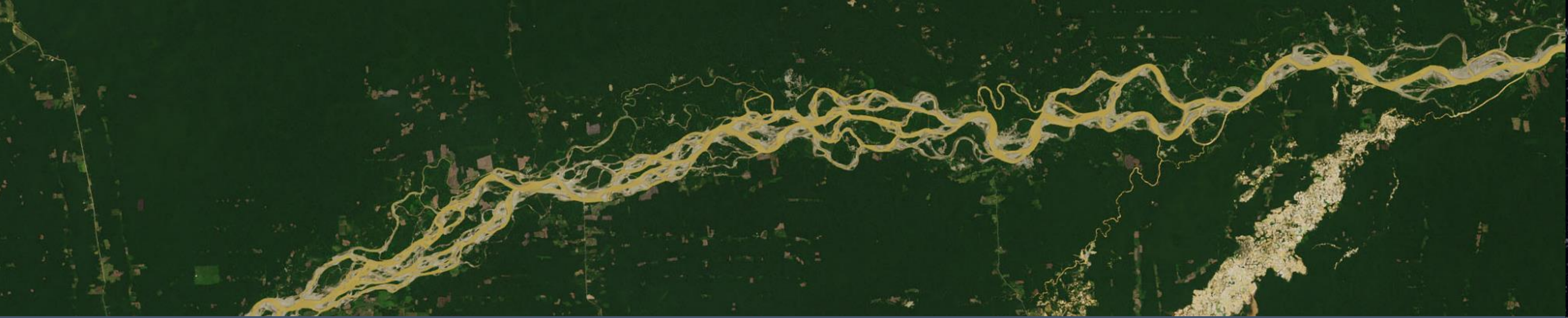
Improving Resiliency and Reducing Risk of Extreme Hydrologic Events through Application of Earth Observations and In Situ Monitoring Information

Douglas Morton
Goddard Space Flight Center

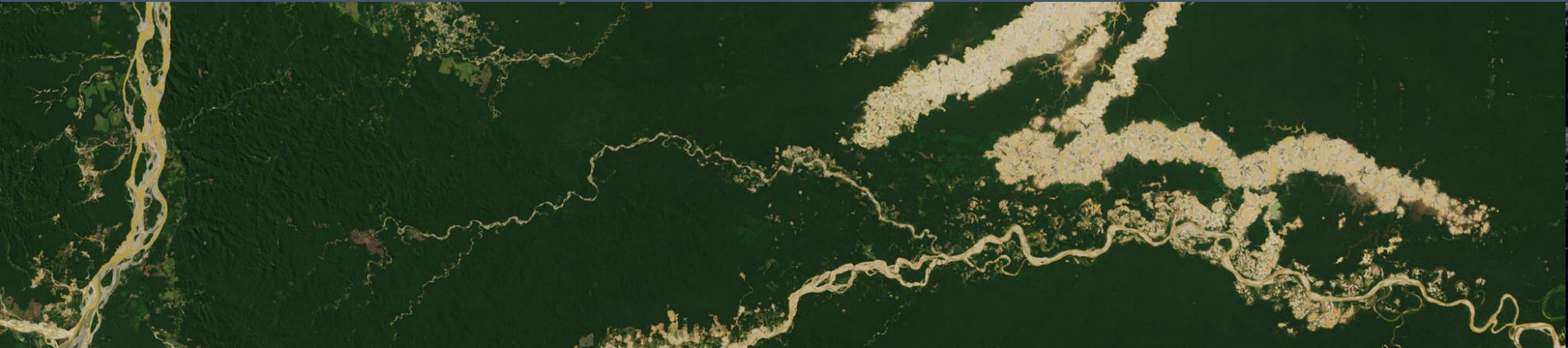
Forecasting Seasonal to Sub-Seasonal Fire and Agricultural Risk from Drought in Amazonia

Stephanie Spera
University of Richmond

Quantifying the Effects of Forest Cover Changes on Provisioning and Regulating Ecosystem Services in the Southwestern Amazon



Monitoring of Gold Mining in the Peruvian Amazon



Produce near real time information about gold mining-related deforestation

- Rapid identification of possible illegal mining fronts in priority areas
- Differentiate the occurrence type (illegal, informal, formal) to better inform actions to authorities

Photo credit: The Nation

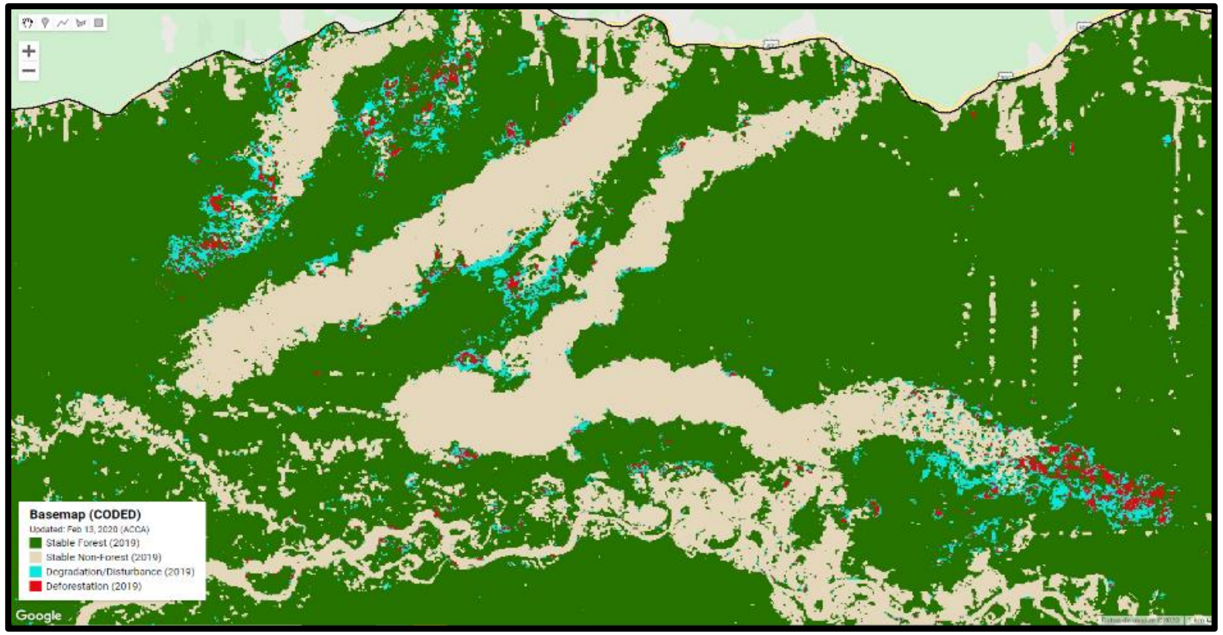
SERVIR AMAZONIA

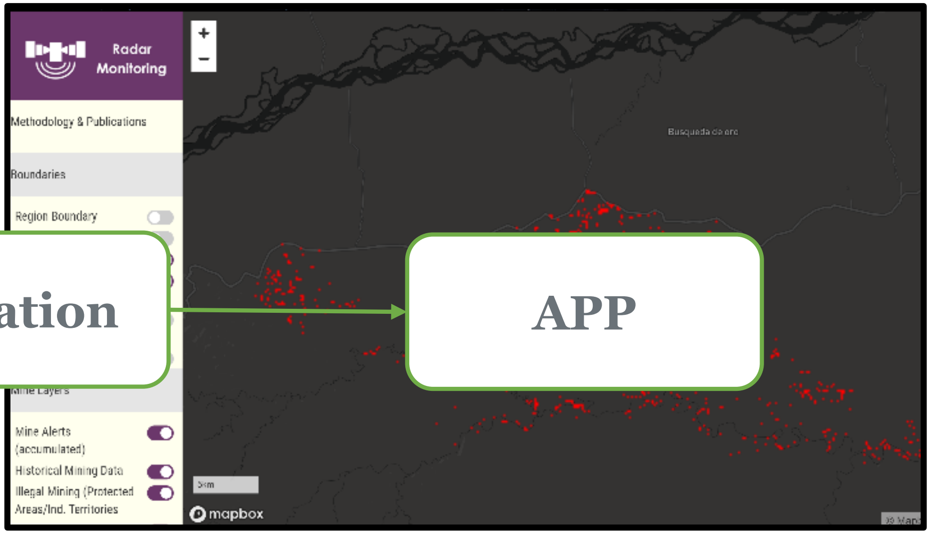
CONSERVACIÓN AMAZÓNICA ACCA

PERÚ Ministerio del Ambiente

10 años BOSQUES

ACCA works extensively with the Government of Peru to provide actionable data using methods that combine multiple remote sensing products, computing platforms such as Google Earth Engine, SAR and high-resolution data.



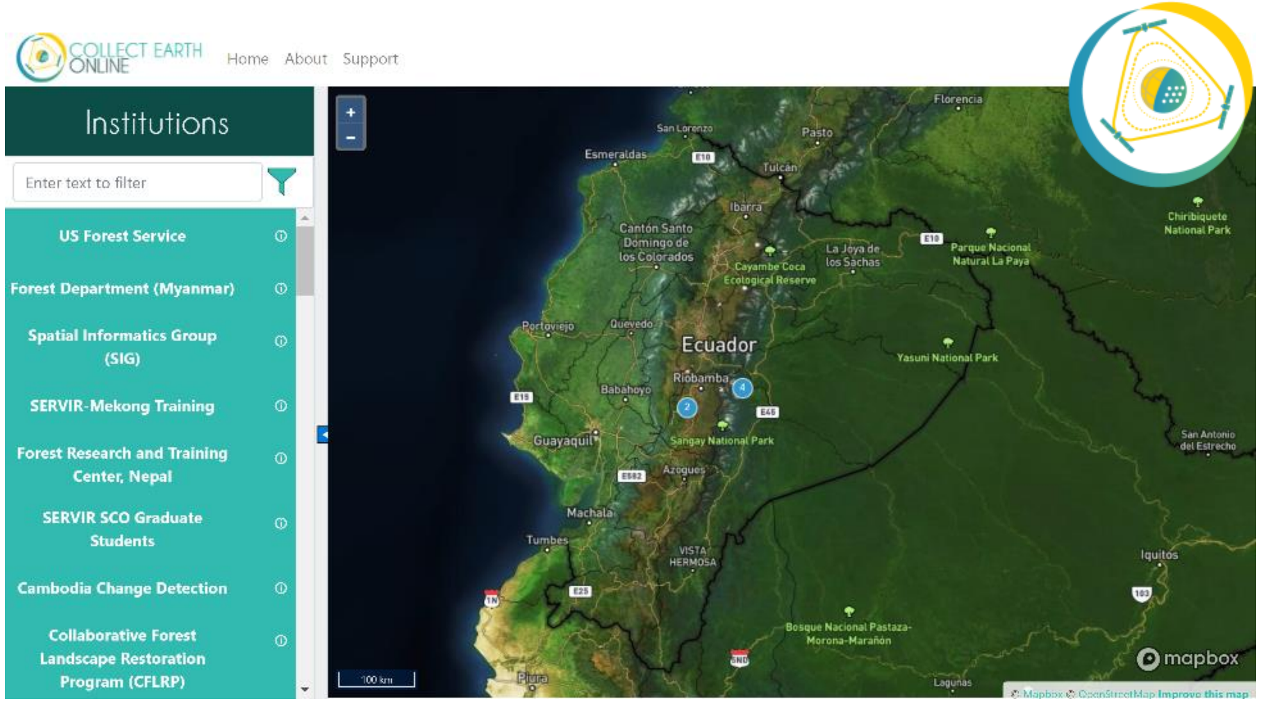


Change Detection → Alerts
Base Layers → Alerts
Alerts → Validation → APP

Deforestation Monitoring and Reporting in Ecuador

BACKGROUND

- Ecuador has been engaging in national efforts to reduce carbon emissions from the forest sector, as an integral part of the National Action Plan for REDD+
- SERVIR-Amazonia, in collaboration with FAO, is now contributing to Ecuador's efforts to effectively reduce carbon emissions by implementing methodologies to reduce uncertainties in area estimation



SERVIR AMAZONIA

FAO FIAT PANIS

Ministerio del Ambiente

Thank You.

For further questions, please contact:
andrea.puzzinicolau@nasa.gov
africa.flores@nasa.gov – SERVIR Amazonia Regional Science Coordination Lead

EARTH SCIENCE
APPLIED SCIENCES

Overview & Highlights of NASA's Engagement With The Central American Integration System (SICA)

Betzy Hernandez & Ricardo Quiroga

EARTH SCIENCE
APPLIED SCIENCES

NASA / SICA Joint Statement

- Building off earlier NASA-CCAD agreement (1998-2013)
- Support Earth observation research + applications in Central America & DR
- Priorities span ASP program areas
- Specific geographic priority zones also identified (Dry Corridor, MBC, etc.)
- Explore concrete joint activities

SICA / World Bank Agreement

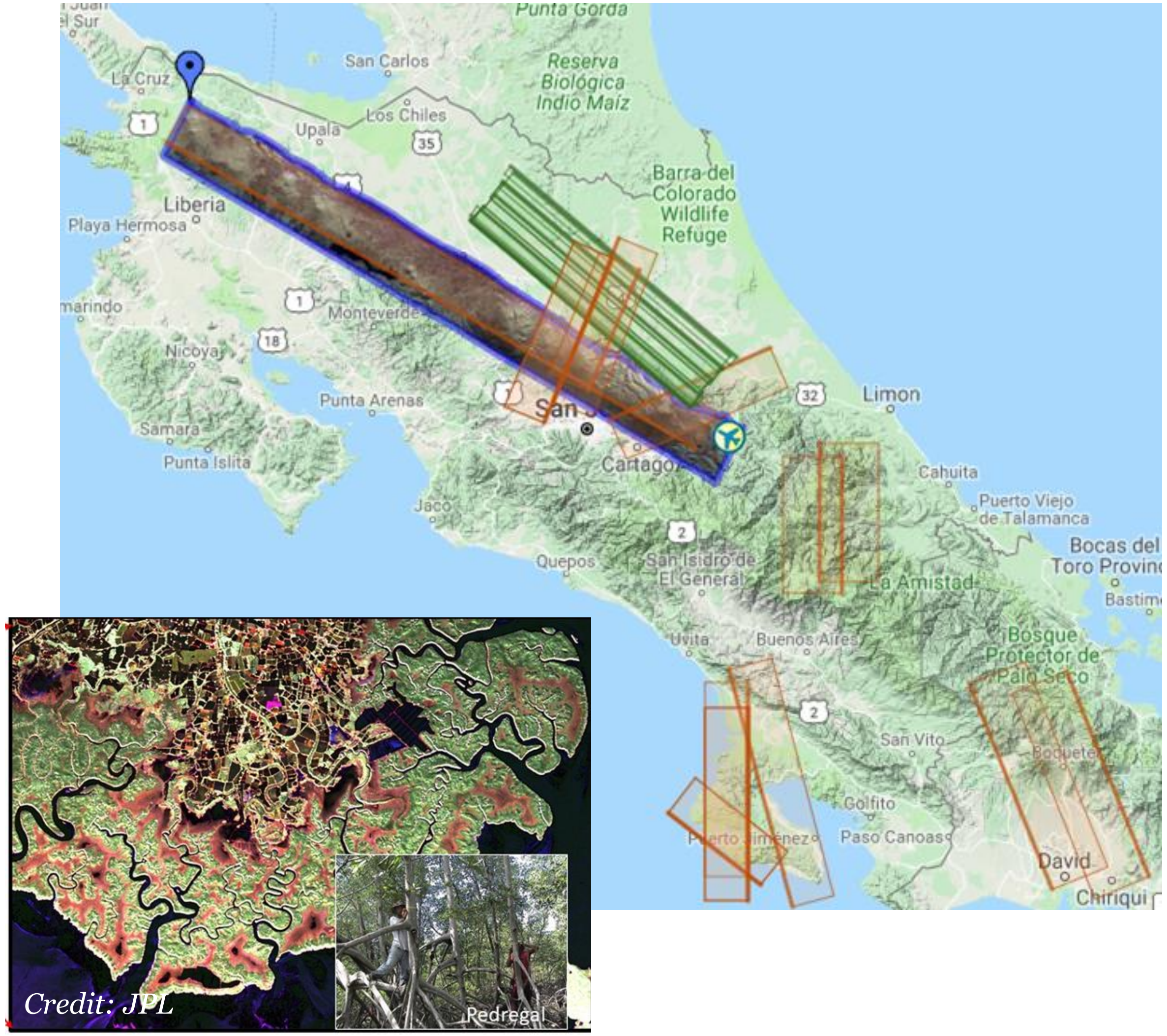
- Provide additional support to the NASA-SICA joint statement

March 2019: *NASA-SICA Joint Statement (ESD level)*

Feb. 2020: *SICA-World Bank agreement*

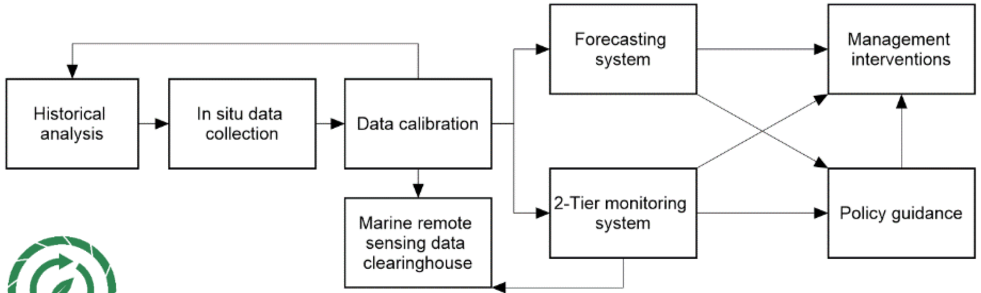
SICA sub-secretariats	NASA Equivalent Programs	GEO SBAs
CEPREDENAC	ASP Disasters R&A Earth Surface & Interior	Public Health Surveillance
CCAD	ASP Ecological Forecasting R&A Carbon Cycle & Ecosystems R&A Climate Variability & Change ASP Air Quality	Biodiversity and Ecosystem Sustainability Public Health Surveillance*
CRRH	ASP Water R&A Water & Energy Cycle R&A Weather	Water Resource Management
CAC	ASP Agriculture & Food Security	Agriculture and Food Security
COMISCA	ASP Health ASP Air Quality	Public Health Surveillance
CSUCA	ASP Capacity Building	Capacity Building (foundational activity)
OSPESCA	ASP Agriculture & Food Security ASP Ecological Forecasting	Agriculture and Food Security Biodiversity and Ecosystem Sustainability

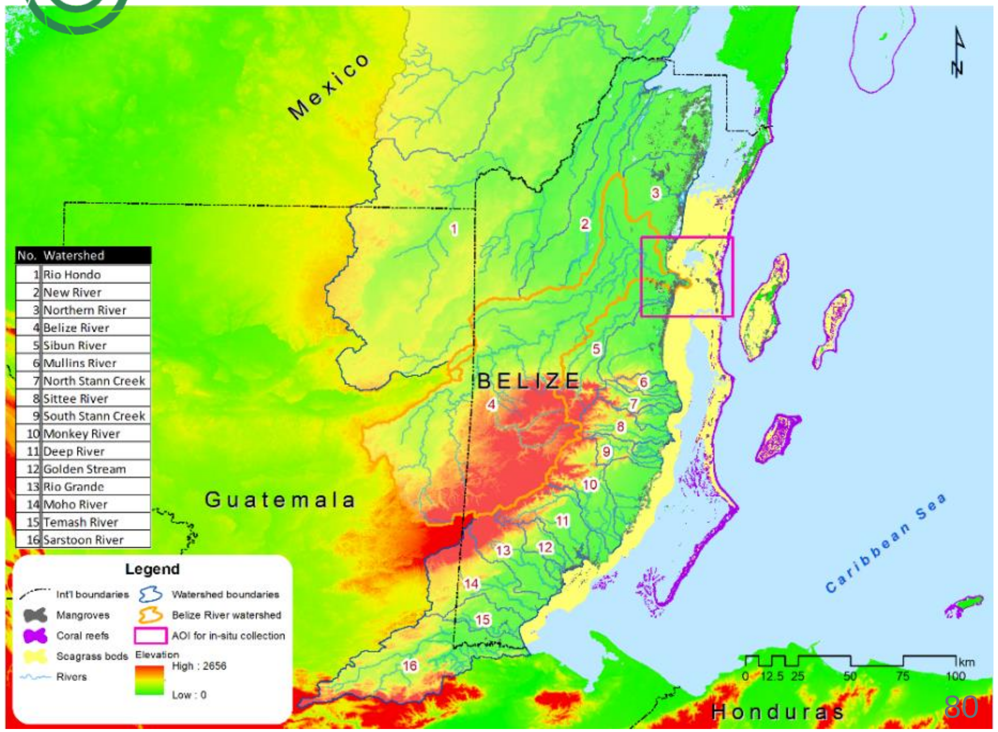
UAVSAR flights



A.8 Belize SDG project

14 LIFE BELOW WATER

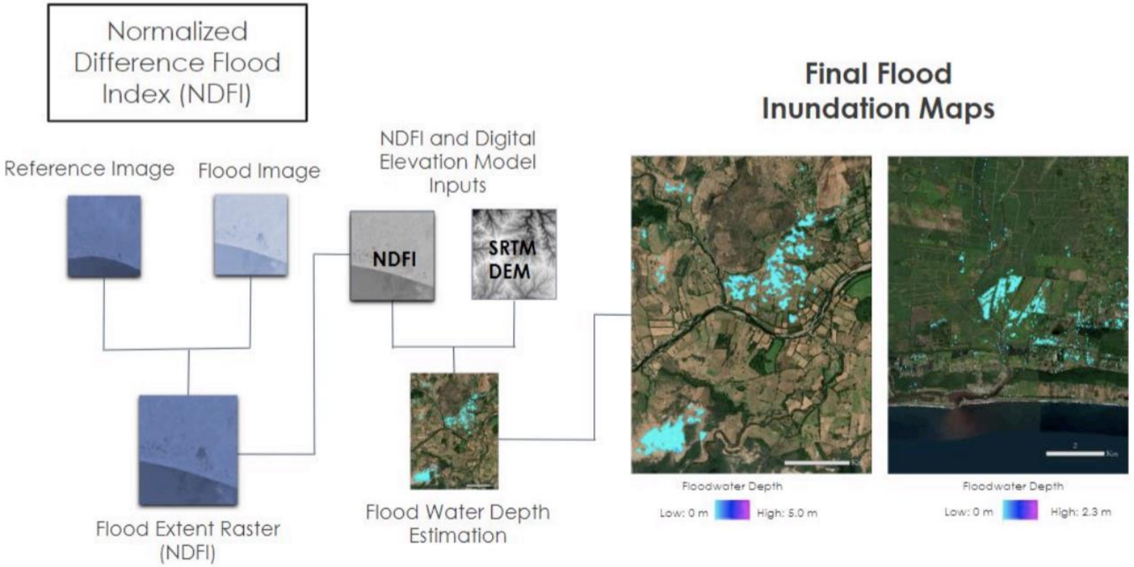




CAPACITY BUILDING PROGRAM SUPPORT

- DEVELOP
- SERVIR
- ARSET
- Indigenous Peoples
- AmeriGEO projects

Summer 2019: *DEVELOP and members of Guatemala's National Coordinator for Disaster Reduction (CONRED)*



Summer 2019: *DEVELOP project on mapping flooding events in El Salvador and Guatemala*

To date:

- 70 webinars: awareness raising, skill-building
- 1,500 participants
- 20 universities from the region involved
- 8 DEVELOP projects
- 6 ongoing NASA ASP projects in the region
- 4 countries joined GEO
- Taking advantage of resources from NASA, other partners, e.g. Copernicus, JAXA
- Leveraging private sector resources, e.g. Google (GEE), Planet

Countries that were GEO members before 2019

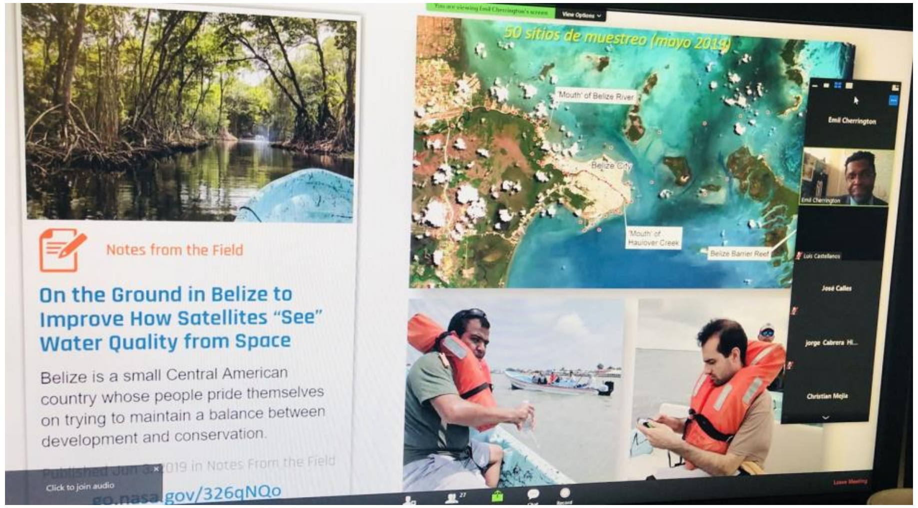
Countries that joined GEO after the signing of the joint statement

WHAT'S NEXT…

- Deep Dive discussions among NASA, SICA, & World Bank
- Identification of areas of collaboration and work
- Capacity building activities
- SERVIR Central America?

Credit: SERVIR

SERVIR - Dan Irwin and Emil Cherrington providing a webinar to SICA



Webinar on the Belize SDG project

CENTRAL AMERICA INTEGRATION (SICA) HIGH RISK REGION

Latin America and Caribbean INFORM Risk Index, 2019

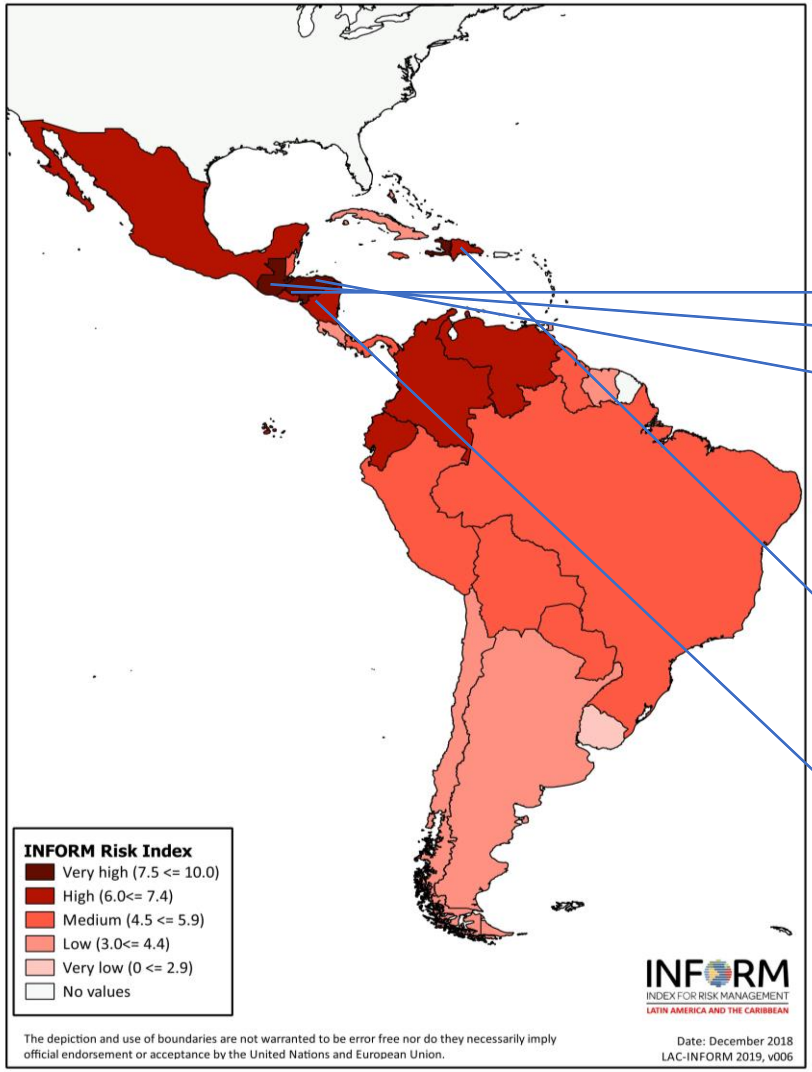


Table 7: Latin America and Caribbean countries grouped by LAC-INFORM risk level

INFORM RISK IS VERY HIGH

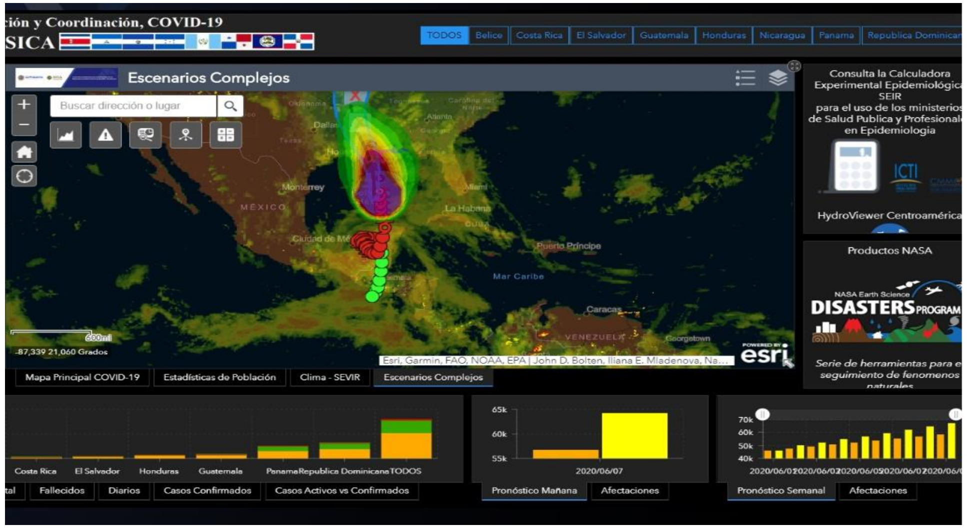
	INFORM RISK	HAZARD & EXPOSURE	*Natural*	*Human*	VULNERABILITY	*Socio-economic*	*Vulnerable groups*	LACK OF COPING	*Institutional*	*Infrastructure*
El Salvador	7.8	8.5	7.6	9.1	7.3	6.2	8.1	7.7	8.8	6.0
Guatemala	8.5	8.6	8.4	8.7	8.4	8.8	8.0	8.5	8.5	8.5
Haiti	8.4	7.6	7.7	7.4	8.9	9.6	7.8	8.7	7.2	9.6
Honduras	8.3	8.4	8.1	8.7	8.3	8.7	7.8	8.1	8.7	7.3

INFORM RISK IS HIGH

	INFORM RISK	HAZARD & EXPOSURE	*Natural*	*Human*	VULNERABILITY	*Socio-economic*	*Vulnerable groups*	LACK OF COPING	*Institutional*	*Infrastructure*
Bolivia	6.0	5.4	5.9	4.9	6.3	7.4	5.0	6.5	6.7	6.3
Colombia	7.1	7.9	7.8	8.0	7.0	4.9	8.4	6.5	7.1	5.9
Dominican Republic	6.1	6.2	7.3	4.9	5.2	5.9	4.4	7.1	7.5	6.6
Ecuador	6.4	6.5	7.7	5.0	6.5	5.1	7.5	6.3	6.2	6.4
Mexico	6.5	8.4	8.5	8.3	5.8	4.7	6.7	5.6	6.2	5.0
Nicaragua	6.6	6.7	8.3	4.2	5.8	6.7	4.6	7.4	6.9	7.8
Peru	6.0	5.9	7.3	4.1	5.9	5.3	6.4	6.2	5.8	6.5
Venezuela	6.8	7.6	7.0	8.1	6.1	4.7	7.2	6.7	7.8	5.2

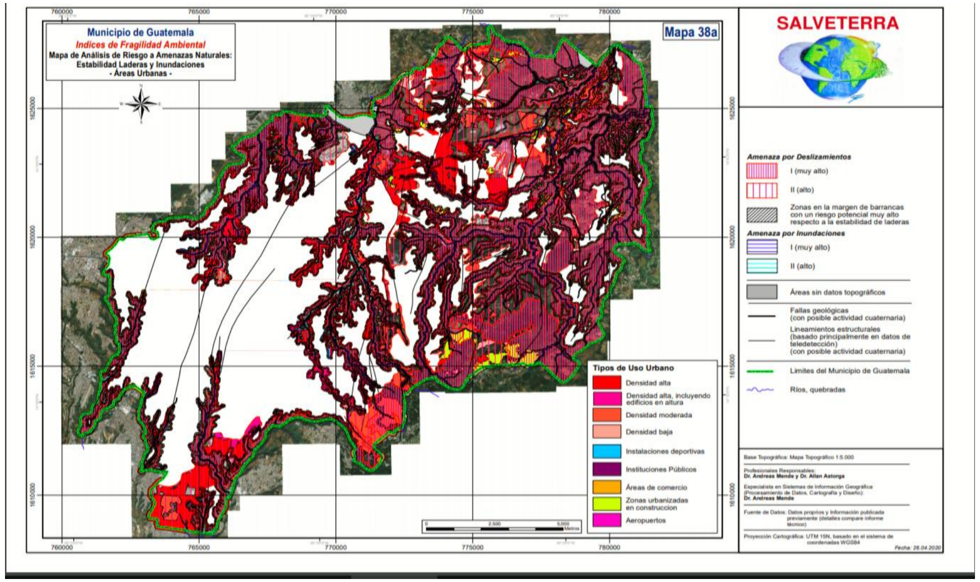
- Partnership with SICA, World Bank planning Understanding Risk conference in Costa Rica 2020. More than 500 participants.

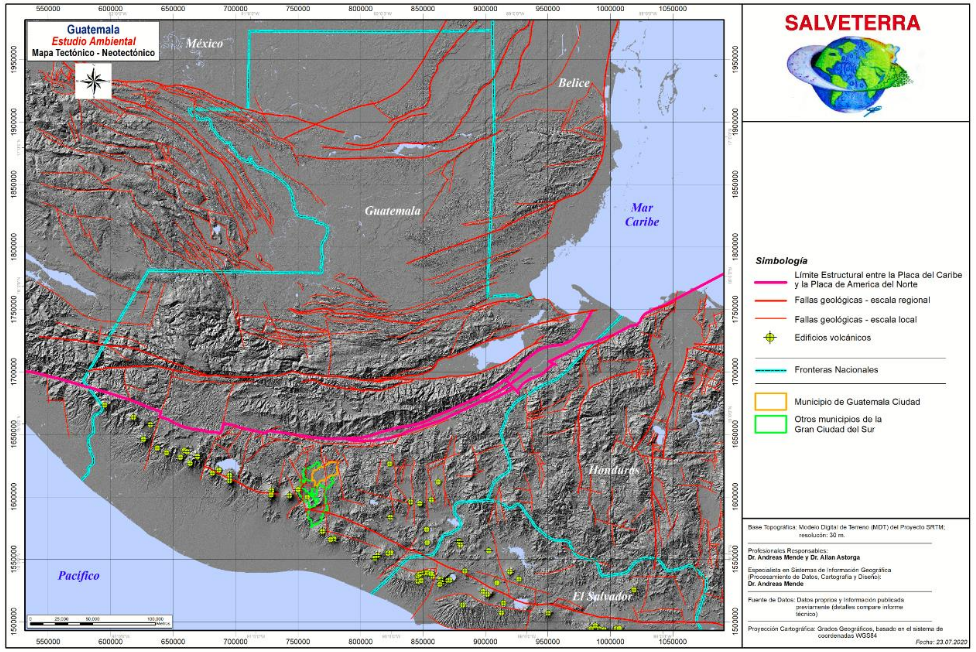
- CEPREDENAC in Partnership NASA Disaster Program is using NASA Real-Time Data to create Complex Risk Scenarios for decision-making including COVID19 Situational Awareness.

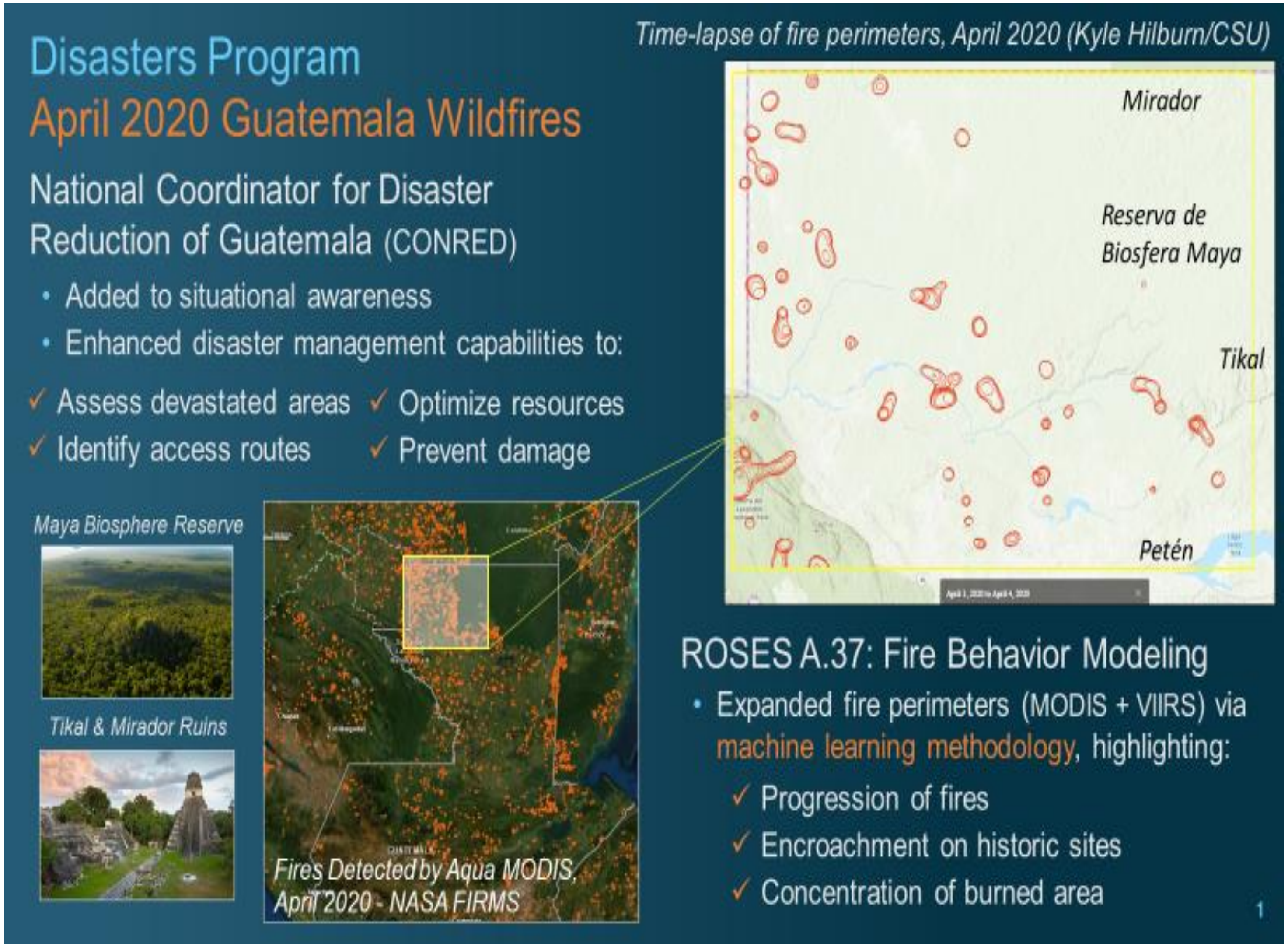


MAPPING URBAN RISK IN GUATEMALA CITY

- Supporting multi-risk assessment pilot in Guatemalan City to land planning as a baseline to build resilience
- Data will be integrated to CEPREDENAC platform, also connected with AmeriGEOSS Platform
- Guatemala City has a population of 1,870,000
- Landsat, GPM, LHASA







"We are very grateful to the NASA Disasters Program for this cooperation"

- CONRED

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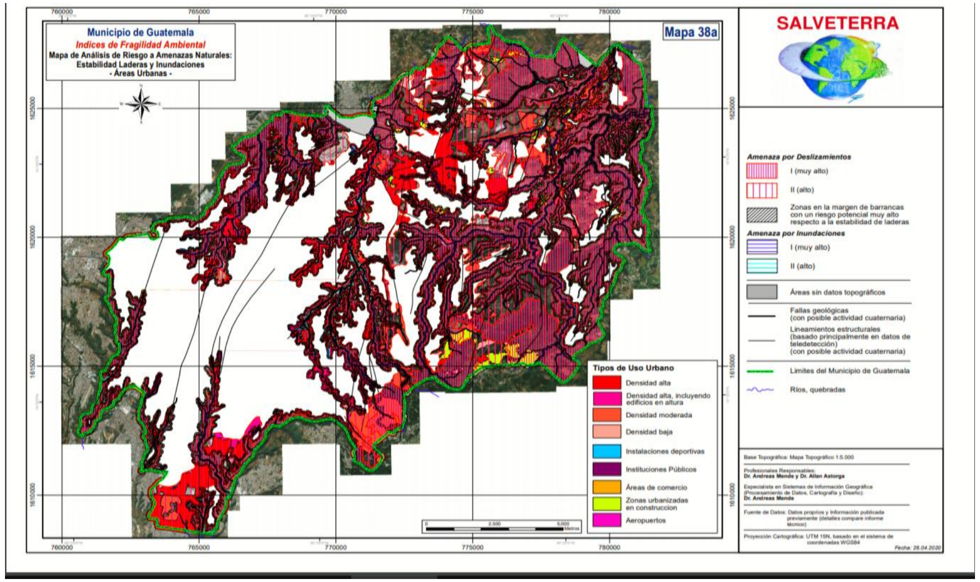
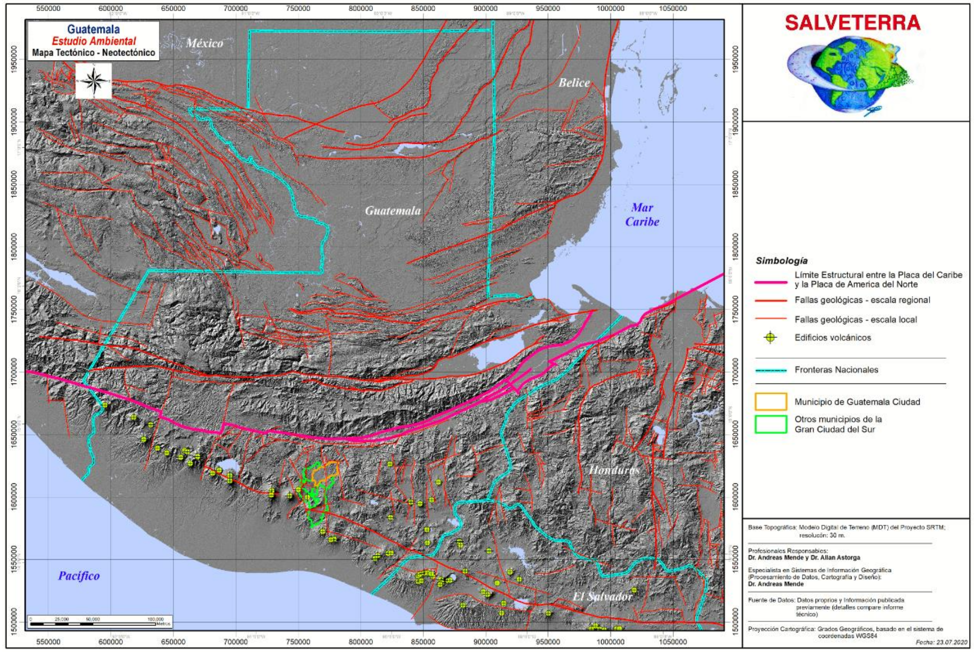


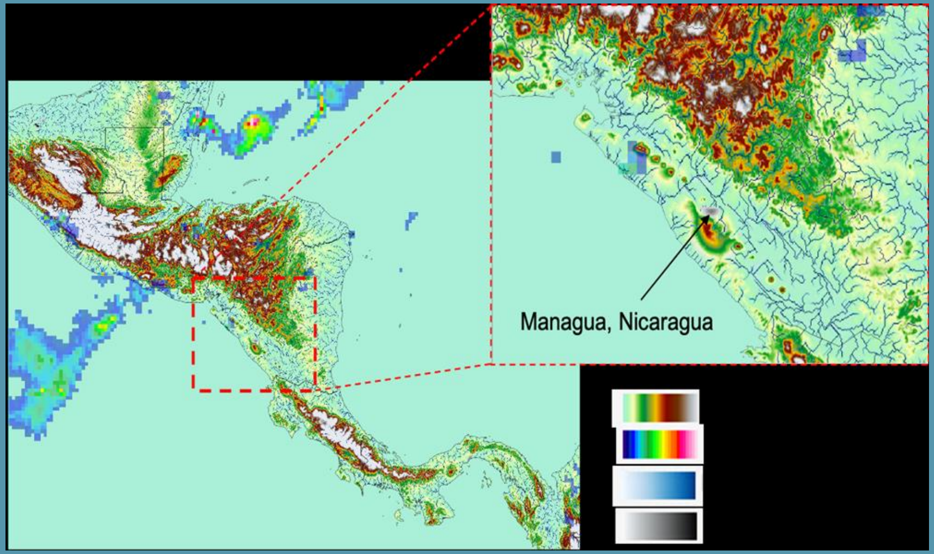


NASA Applied Sciences DISASTERS

DEVELOPING VOLCANO OBSERVATORY IN PARTNERSHIP WITH CEPREDENAC – GEOLOGICAL SERVICES FROM SICA

- Supporting **Geo Hazards Supersites and Natural Laboratories (GSNL)**
  - Proposals for: El Salvador, Guatemala, Honduras, Costa Rica, Nicaragua.
  - Link with NASA A37 ROSES Projects on Volcanoes

- Central American Hydro Resources Committee **(CRRH) 8 National Meteorological Services**
  - Oklahoma University providing expertise
  - NASA data: DEM-IMERG-GPM-FEWS-NET-MODIS-SRTM



Guevara H, 2020, Sample of various satellite-based geospatial datasets used in EF5 for flash flood forecasting over Central America: DEM from SRTM-based HYDROSHEDS, GPM's IMERG precipitation, Flow accumulation from DEM, and Impervious Surfaces based on MODIS and SRTM.

Thank You.

For further questions, please contact:

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EARTH SCIENCE
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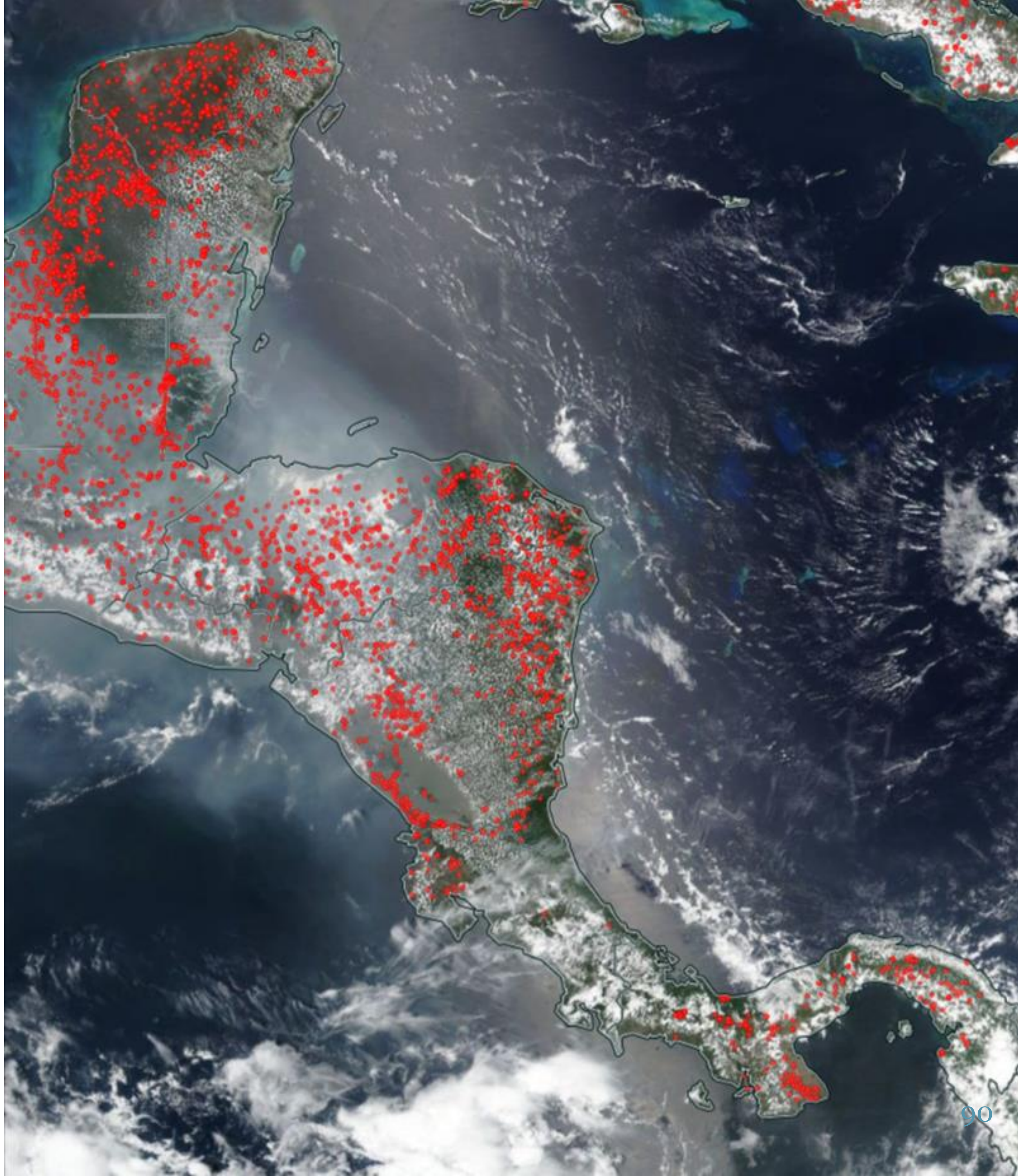


Measuring How Earth Observations Benefit Society When We Use Them to Make Decisions

Bethany Mabee

EARTH SCIENCE
APPLIED SCIENCES

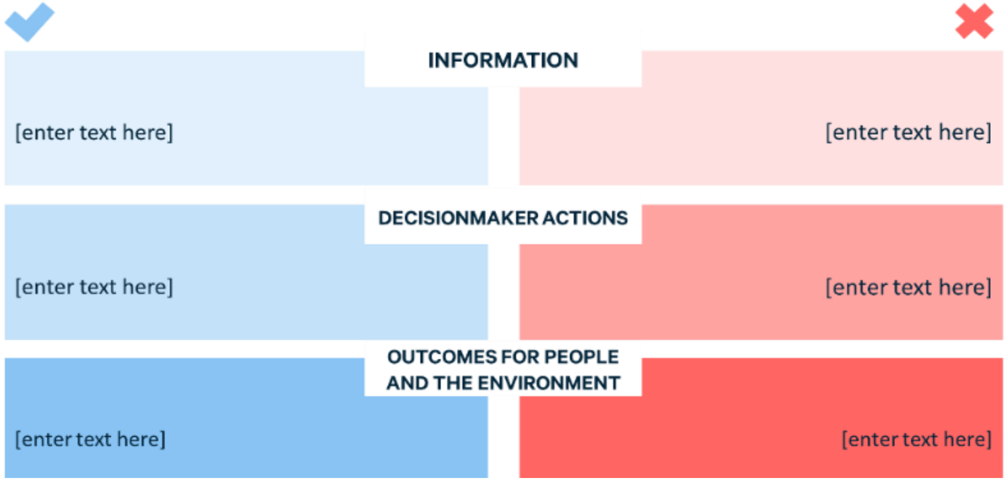
VALUABLES is a collaboration between Resources for the Future (RFF) and NASA to measure how satellite information benefits people and the environment when we use it to make decisions.

What makes VALUABLES unique?

- Large, sustained effort to measure societal benefits of Earth observations
- Goes beyond anecdotes to quantify these benefits, often in dollar terms
- Focuses on things that are beneficial to society, including **lives saved, increase in profits**, and **increase in crop yields**
- Rather than things that are not directly beneficial to society in and of themselves, like peer-reviewed publications, data downloads, and "improved understanding"

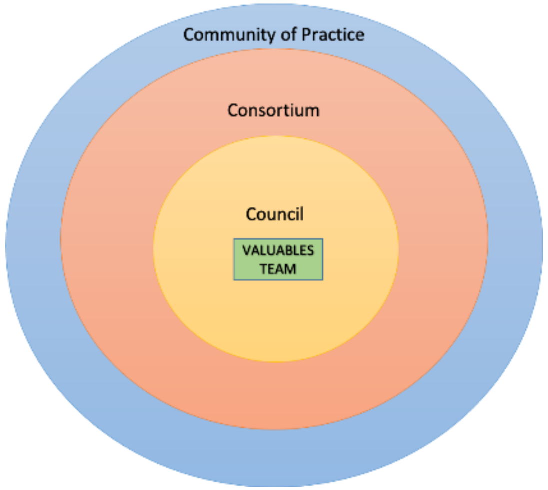
We focus on two types of activities:

- Conducting **impact assessments**
  - Apply existing methods and develop new methods
  - Build impact assessment literature on Earth observations for decisionmaking
- Developing **educational materials and activities** to build capacity within the Earth science community to quantify the value of its work. This includes:
  - Improving understanding of impact assessment terms, concepts and methods
  - Developing a value of information (VOI) framework the scientific community can use to design rigorous impact assessments
  - Using this VOI framework as the basis for VALUABLES' tutorials, webinars and workshops



CONSORTIUM STRUCTURE

- **VALUABLES team** at RFF and NASA
- **Scientific council:** Diverse, interdisciplinary group of Earth and social scientists engaging in IA activities and advising and serving as advocates for consortium within relevant communities
- **Consortium members:** Organizations with expressed interests/activities in valuing societal benefits of Earth observations and Earth science information
- **Community of practice:** A growing interdisciplinary community that shares a common language and is prepared to do VOI impact assessments



Consortium Members

Case studies that measure the value of using satellite data to protect endangered species, detect harmful algal blooms and protect human health, inform post-wildfire response, improve predictability of corn and soybean prices, and enforce air quality standards.

- **Ecosystems:** What is the value of incorporating satellite data into a tool that helps commercial ships avoid whale strikes off the Pacific Coast? For blue whale conservation objectives of 15 and 7.5 fatal ship strikes per year at a probability of 90%, cost savings to commercial shipping of **$0.3 billion** and **$1.1 billion.**
- **Water quality:** What was the value of using satellite data to detect a harmful algal bloom and manage recreational advisories in Utah Lake, UT, in summer 2017? ~**$370,000 in socioeconomic benefits** associated with improved human health outcomes (sensitive to stated assumptions).
- **Wildfire:** What were the cost savings from using Landsat imagery to prioritize post-wildfire response activities for 2013 Elk Complex wildfire? **Over $51,000** for Elk Complex fire and **up to $7.7 per year** for federal use of Landsat for BAER program nationally.
- **Agriculture:** What is the value of a 30% reduction in weather-related uncertainty in corn and soybean futures markets? **$0.9 billion** for U.S. corn and **$0.5 billion** for U.S. soybeans annually.
- **Air quality:** What would be the value of using satellite data to enforce the Clean Air Act's National Ambient Air Quality Standards? **5,452 premature deaths could have been avoided** in 2016 and 2017, a gain to society of **$49 billion.**

IMPACT ASSESSMENTS IN 2020-2021

Three impact assessments funded through VALUABLES' recent grant competition:

- Quantifying the benefits of using satellite derived early warning system to predict cholera in Bangladesh (PI: Sonia Aziz, Moravian College)
- Estimating the societal benefits of satellite imagery used to enforce the Brazilian Forest Code and reduce deforestation (PI: Jill Caviglia-Harris, Salisbury University)
- Valuing satellite data for harmful algal bloom early warning systems (PI: Stephen Newbold, U. of Wyoming)

Four additional impact assessments in 2020-2021 on topics including

- Value of Earth observations in a humanitarian decision context
- Value of remotely sensed evapotranspiration data for managing water transfers in New Mexico

GET INVOLVED

- Connect with a member of the VALUABLES team
- Talk to a VALUABLES scientific council member
- Join the consortium as a member (organizational level)
  - Complete this form to get started: https://airtable.com/shrzPJiLHfz2HLte9
- Join VALUABLES' community of practice (individual level)
  - Sign up for email alerts about upcoming activities at www.rff.org/valuables
  - Submit relevant items to our community newsletter
- Help us identify future study ideas!
  - Submit ideas at https://airtable.com/shrBD062UEgmwQV4g

Thank You.

For further questions, please contact:
mabee@rff.org

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