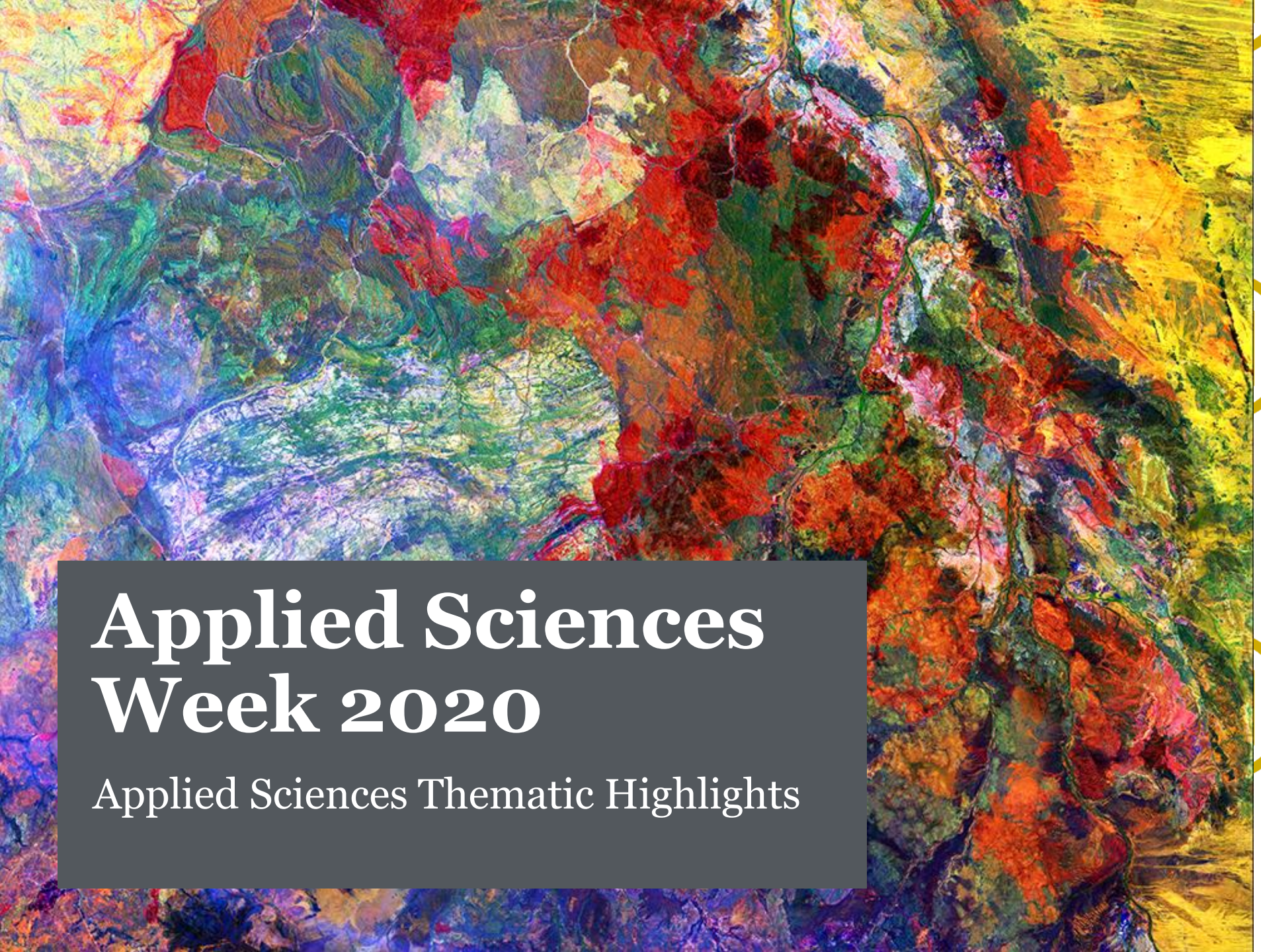


Applied Sciences Week 2020

Applied Sciences Thematic Highlights

EARTH SCIENCE
APPLIED SCIENCES

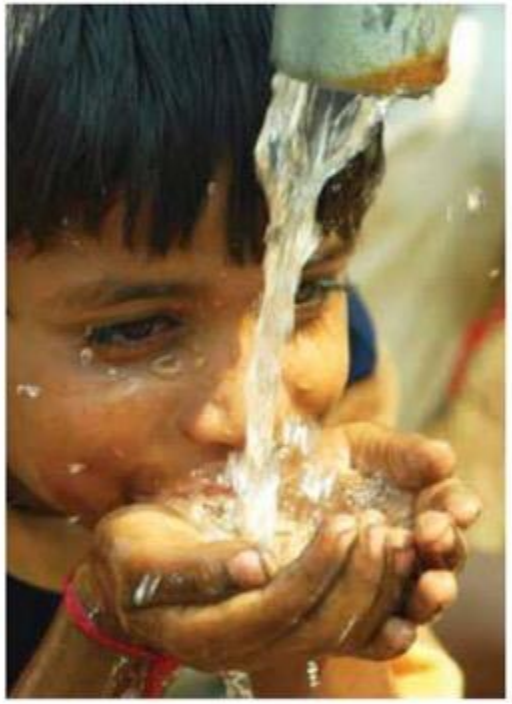
DELIVERING ON THE SUSTAINABLE DEVELOPMENT GOALS USING EARTH OBSERVATIONS

Dr. Argyro Kavvada

Lead, Sustainable Development Goals

@EO4SDG

EARTH SCIENCE
APPLIED SCIENCES



THE GLOBAL GOALS
For Sustainable Development

Social

Economic

Environmental

"Everything happens somewhere."

- Nancy Tosta

TRANSFORMING OUR WORLD: THE 2030 AGENDA FOR SUSTAINABLE DEVELOPMENT

"Everything we do during and after this crisis [COVID-19] must be with a strong focus on building more equal, inclusive and sustainable economies and societies that are more resilient in the face of pandemics, climate change, and the many other global challenges we face" - Secretary-General António Guterres

- Agreed to by nearly all the world's nations, on 25 Sept 2015
- 17 Sustainable Development Goals, accompanied by 169 Targets & a Global Indicator Framework
- Need for investments in data — including Earth observations — and innovation recognized as key to supporting SDG acceleration

2020 SDG Annual Report on "Progress Towards the Sustainable Development Goals"

EARTH OBSERVATIONS FOR SUSTAINABLE DEVELOPMENT GOALS

Countries, stakeholders, and the global community desire additional Earth observations and geospatial information to continue progress on improved social, economic, and environmental sustainability.

Contributors

EO4SDG Initiative Purpose:

Extend uses of Earth observations and geospatial information to advance the 2030 Agenda and enable societal benefits through achievement of the SDGs.

Co-Chairs : U.S., Japan, Mexico

Exec. Sec.: U.S.

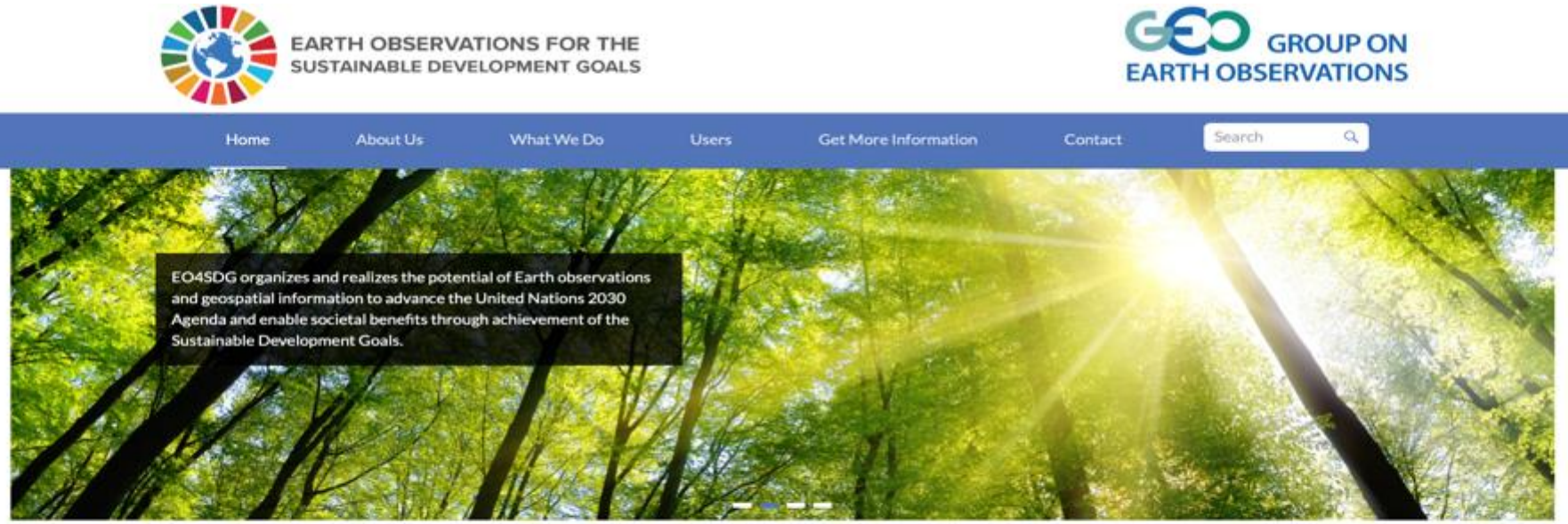
Key Emphasis:

Working with national statistical offices, line ministries, national mapping agencies, cities & municipalities, UN Agencies

Demonstrating benefits, building skills & sharing knowledge on EO uses for SDGs

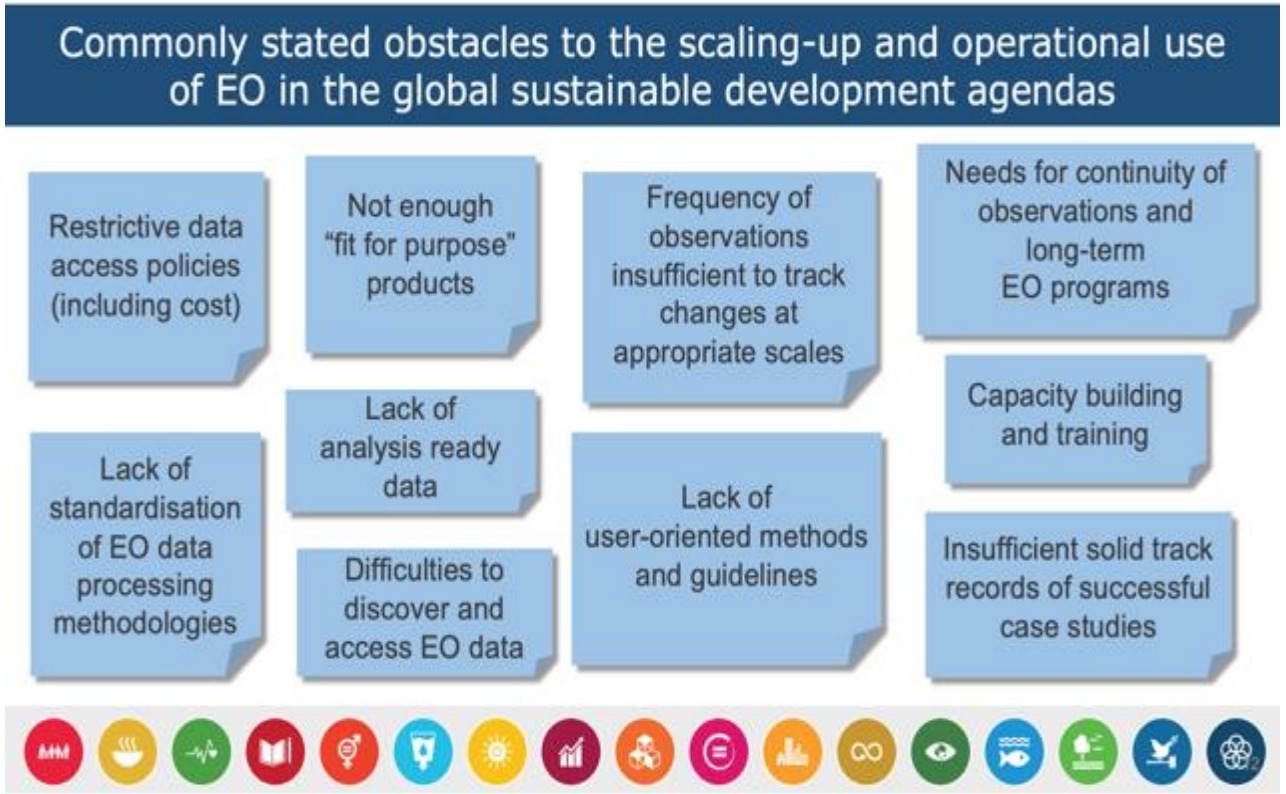
EARTH OBSERVATIONS FOR THE SUSTAINABLE DEVELOPMENT GOALS

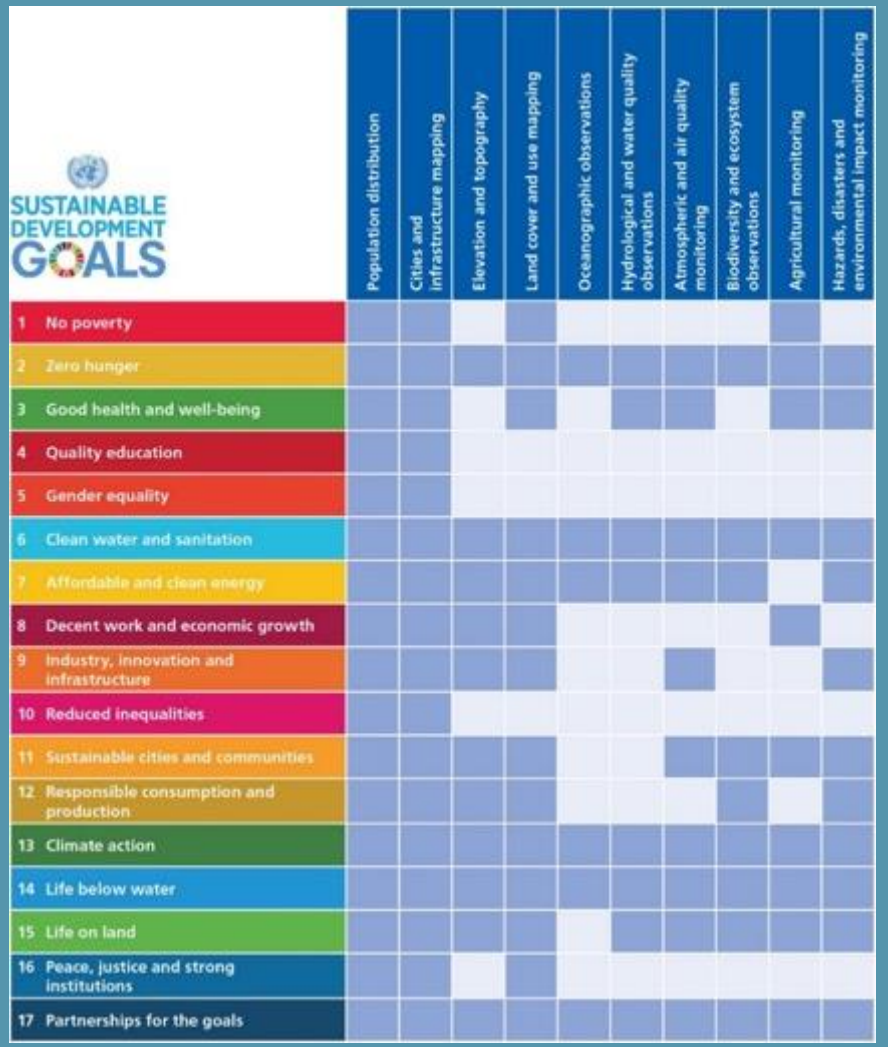
https://eo4sdg.org



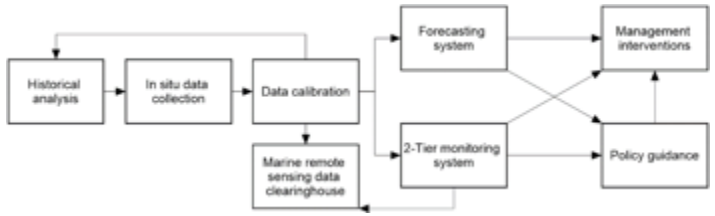
ALIGNMENT OF EARTH OBSERVATIONS TO THE SUSTAINABLE DEVELOPMENT GOALS, TARGETS, AND INDICATORS

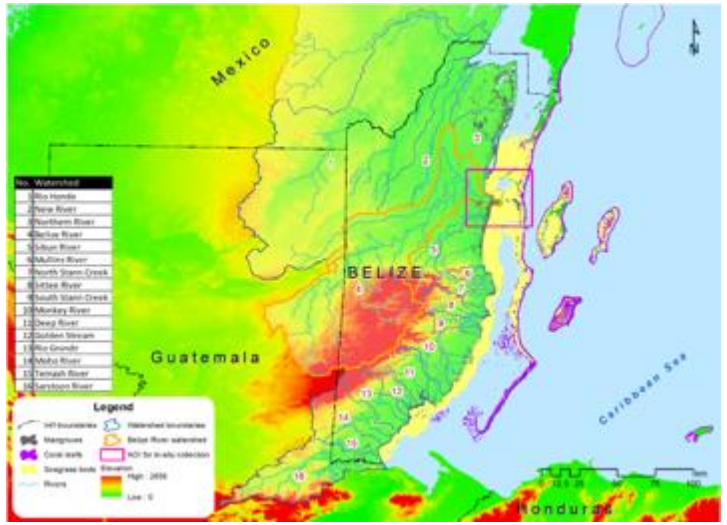
Earth observations offer unprecedented opportunities to modernize national statistical systems and improve the capacities of countries to efficiently track & drive progress on all facets of sustainable development.

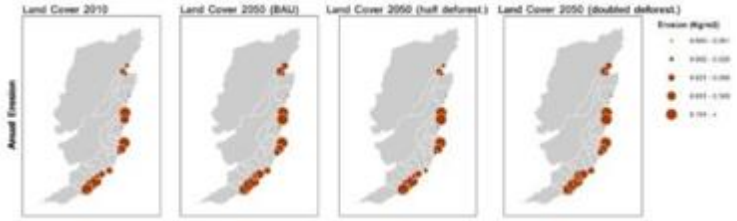




PROTECTING BELIZE'S BARRIER REEF WORLD HERITAGE SITE







Earth Observation and Model Data:

- Coastal water quality: in situ and satellite (Landsat, MODIS, Sentinel-2, Sentinel-3)
- Land cover/ land cover change: Landsat, MODIS, Sentinel-2 derived; scenarios)
- Ocean circulation (NOAA)
- Climate change scenarios: CMIP5 & CMPI6

NASA remote sensing and climate datasets support government and NGOs in Belize in meeting SDG 14, Life below water, with improved monitoring and forecasting of algae and suspended sediments across the Belize Barrier Reef System, a UNESCO World Heritage Site.

PI: Robert Griffin, University of Alabama in Huntsville

OUTREACH & ENGAGEMENT — GEO SDG AWARDS

- Recognize excellence and innovation, generating examples that users can consider and pursue

- 2019 GEO SDG Award Winners:
  - GEO Member Country Award: Uganda [SDG 2]
  - GEO Participating Organization: Conservation International [SDG 15, 11]
  - SDG Custodian Agency: UN Environment [SDG 6]
  - Innovation Award: CSIRO, Australia [SDG 15]
  - Testimonial Award: SANSA, South Africa [SDG 11]
  - Statistical-Geospatial Integration Award: Federal Agency for Cartography and Geodesy, Germany [SDG 15, 11]

GEO GROUP ON EARTH OBSERVATIONS

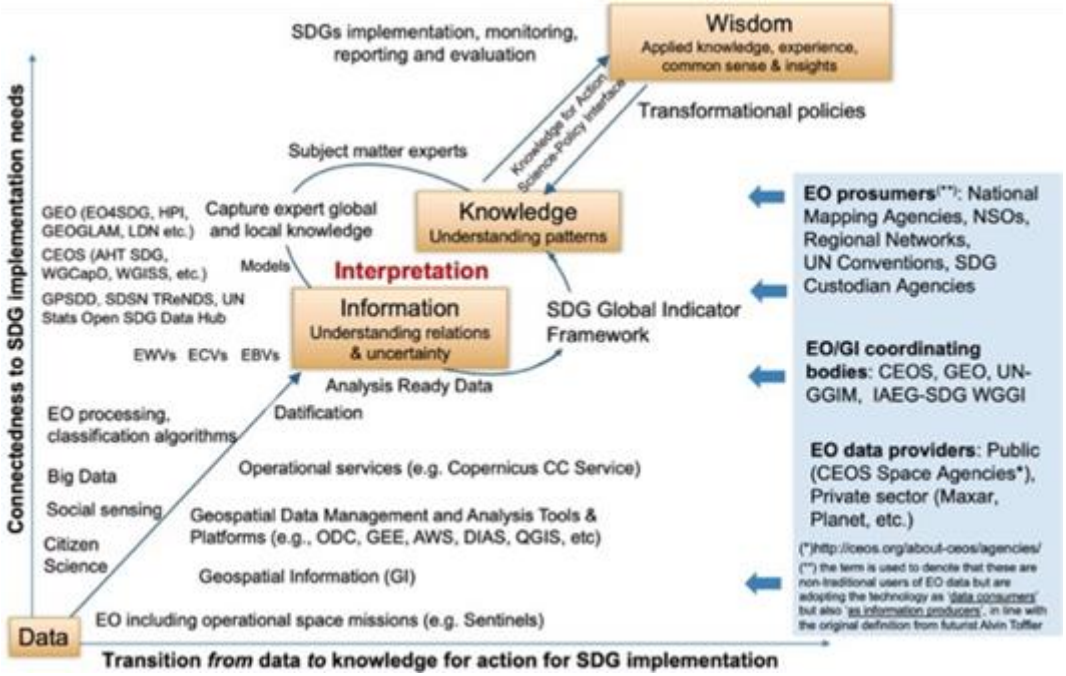
EARTH OBSERVATIONS FOR THE SUSTAINABLE DEVELOPMENT GOALS

Uganda wins the 2019 GEO SDG Award for promoting use of Earth observations for early drought prediction that saved 2.6 million USD.

https://chimpreports.com/uganda-wins-global-award-for-early-drought-prediction-that-saved-2-6-million/

17 publications and an editorial illustrating EO applications to support countries in SDG target setting, baseline determination, tracking progress of implementation, informing planning and decision making.

- SDGs 6 (Water & Sanitation), 15 (Life on Land), 14 (Life Below Water), 11 (Sustainable Cities & Communities)
- Criteria to evaluate progress on establishing an enabling environment for EO for SDG
- Need for a systematic process to generate knowledge from data, for addressing policy goals.
- Highlights from country use cases, global and regional initiatives, and future outlook



EO for SDG Frameworks for focused on 'Knowledge' element of the Data-Information-Knowledge -Wisdom are needed (Kavvada et al., 2020)

https://www.sciencedirect.com/journal/remote-sensing-of-environment/special-issue/10RFDS7BFNH

Thank You.

For further questions, please contact:
Argyro.Kavvada@nasa.gov

@EO4SDG

https://eo4sdg.org

EARTH SCIENCE
APPLIED SCIENCES

Using Earth Sciences Data to Support State and Local Climate-Health Programs

Tabassum Insaf

HEALTH & AIR QUALITY

EPHT Grantee-partners

NEW YORK STATE | Department of Health

NYC Health

Florida HEALTH

Federal grant support

ENVIRONMENTAL PUBLIC HEALTH TRACKING

NASA

Non Traditional Partners

USRA

THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

FLORIDA STATE UNIVERSITY 1851

Stakeholders/End-users

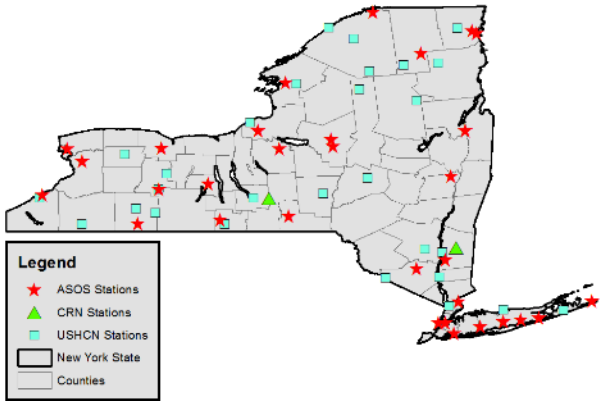
NEW YORK STATE OF OPPORTUNITY. Climate Smart Communities

FloridaClimateCenter Office of the State Climatologist

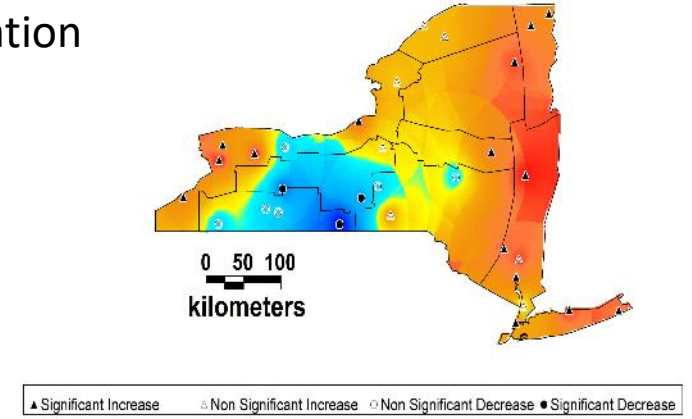
NATIONAL WEATHER SERVICE

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

Monitoring stations in New York State are sparse

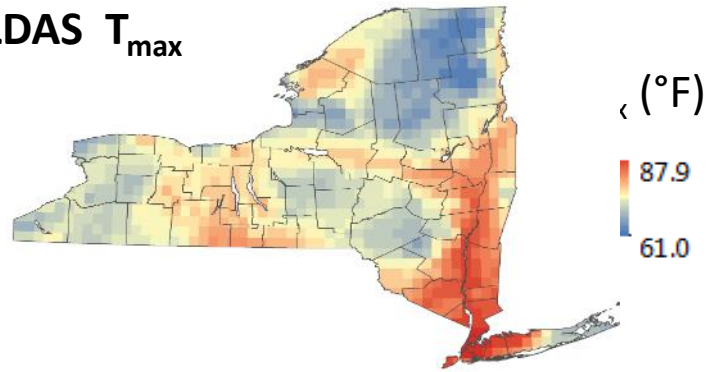


Spatial extrapolation from monitor data can result in misclassification



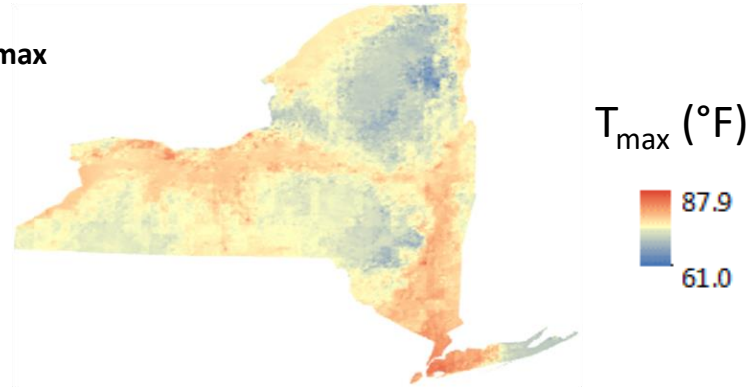
North American Land Data Assimilation System provides uniform exposure surface for health studies

12 Km Native NLDAS T_{max}
July 21, 2010



Downscaling to a 1KM using MODIS land surface temperature improves identification of local effects

Downscaled T_{max}
July 20, 2009



NATIONAL WEATHER SERVICE HEAT ADVISORY

- Regional NWS forecast offices issue excessive heat alerts (advisories, watches, and warnings) based on the maximum heat index forecasts over 24–72 hours
- Previous temperature thresholds for heat advisories and warnings in upstate NYS were established over 20 years ago and were not based on heat-health associations
- The NLDAS reanalysis dataset provides the opportunity to conduct heat-health analysis for all regions of NYS and reassess the criteria for heat advisories, so they are more relevant to temperatures experienced in NYS during the summer

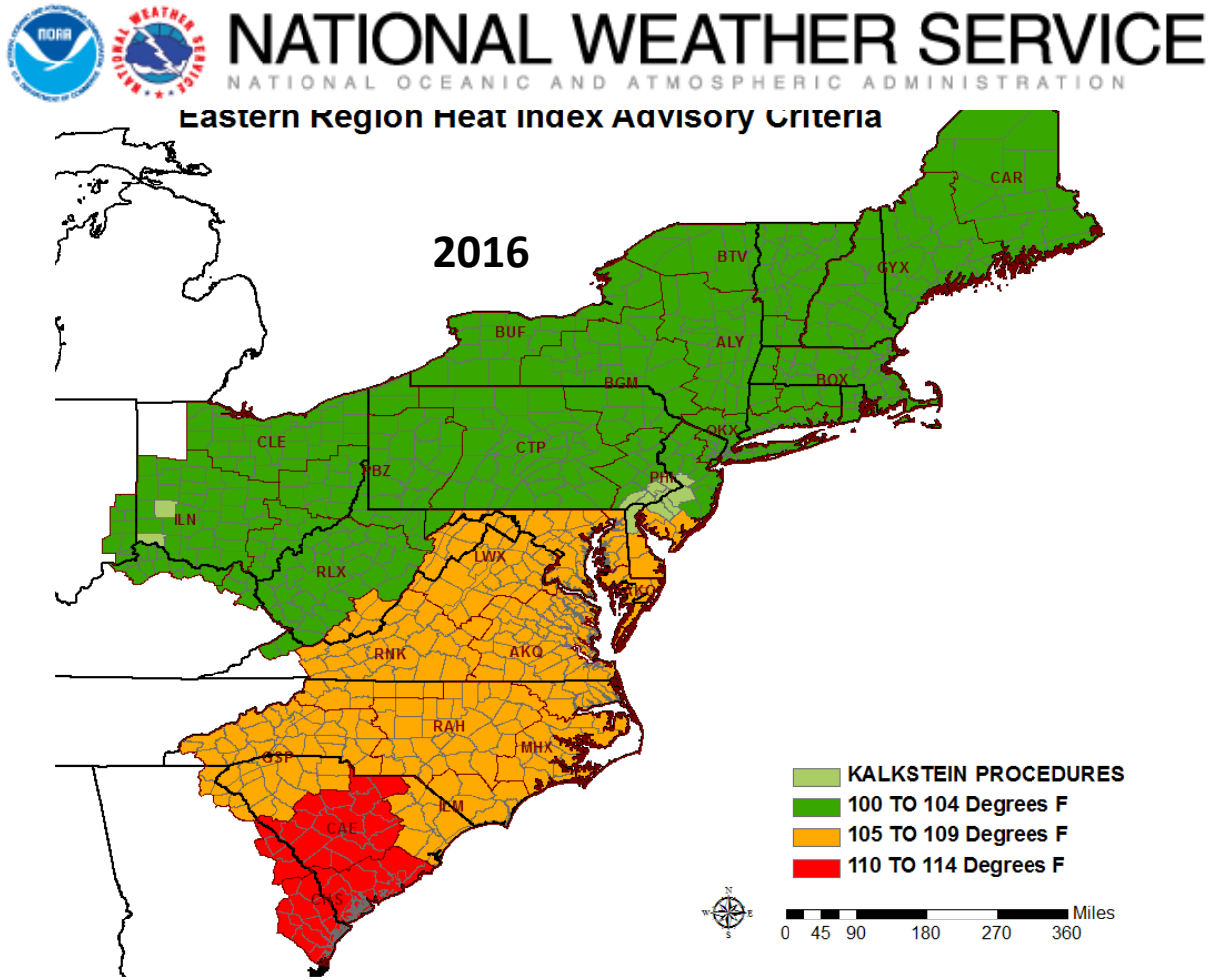
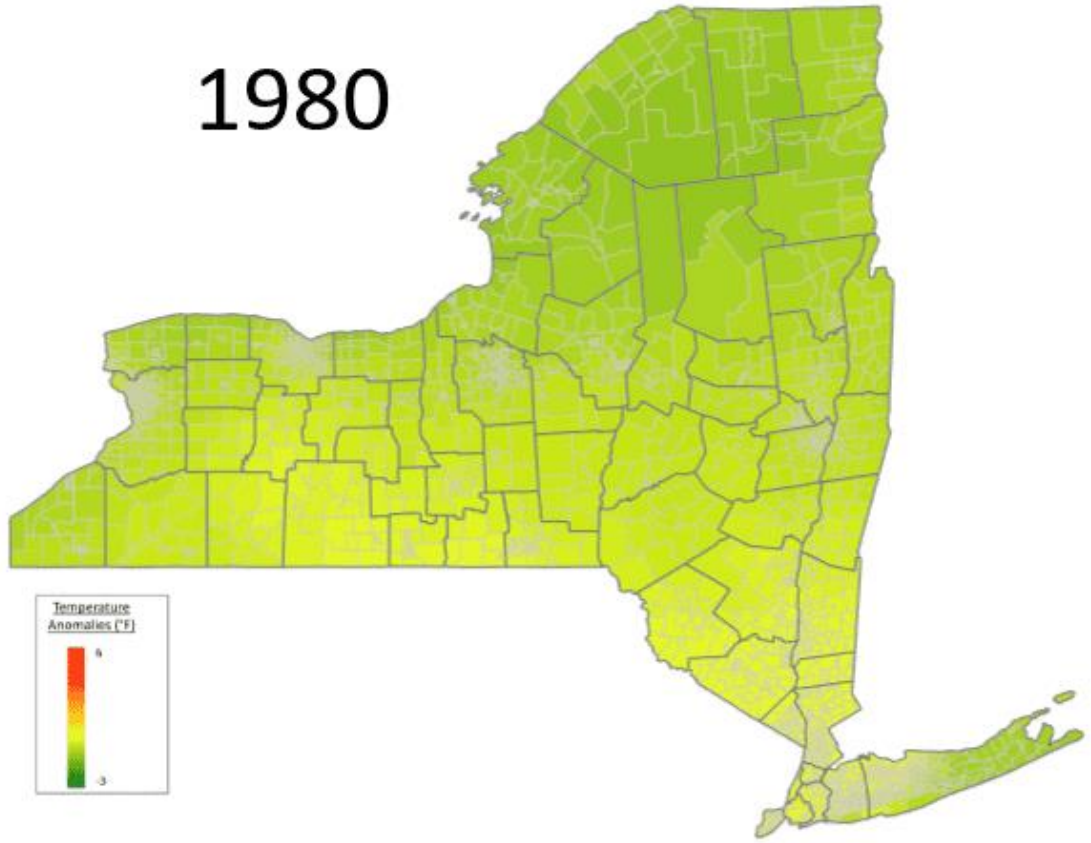
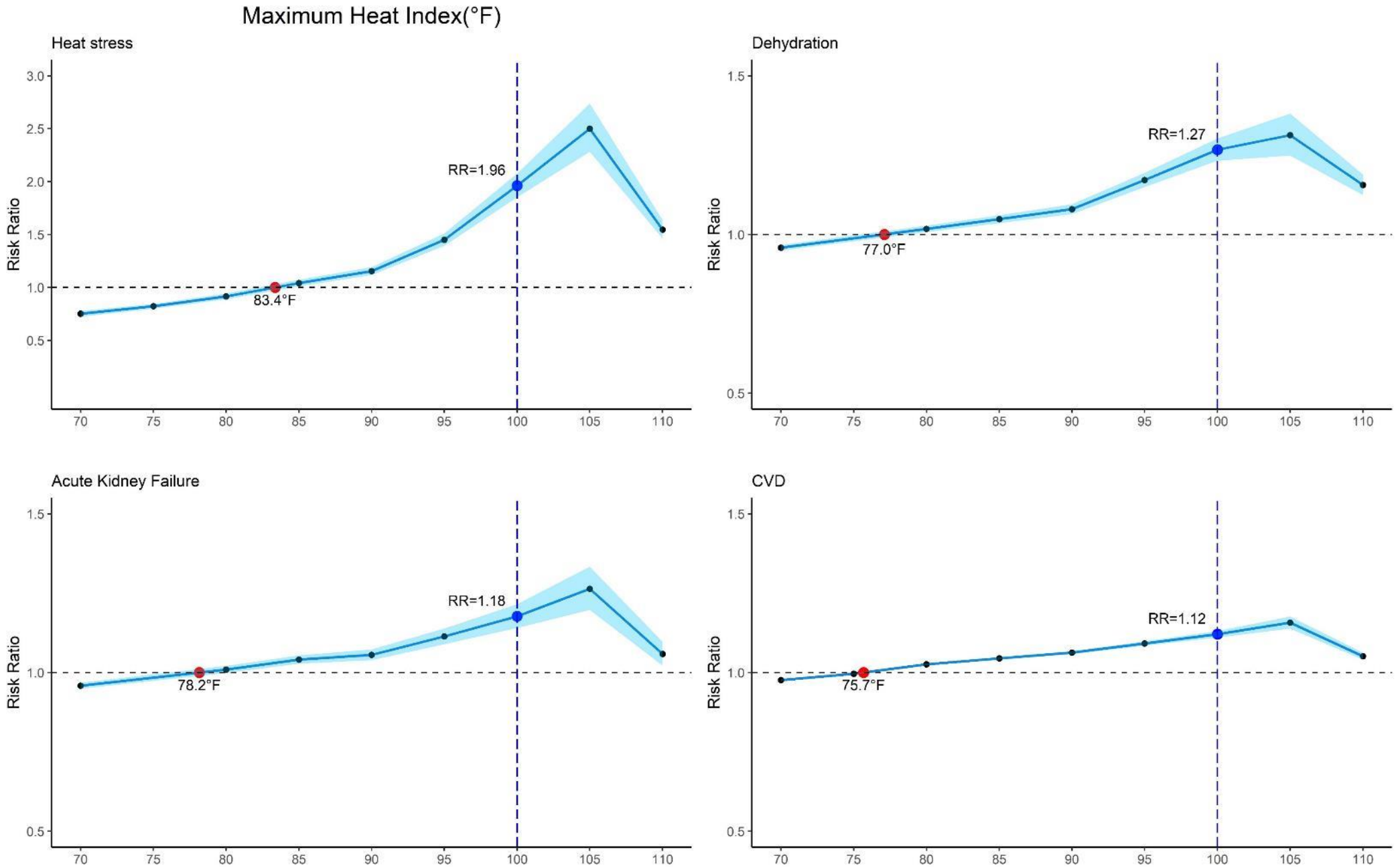


Image Credit: NWS offices, Albany

POLICY RELEVANT HEALTH RESEARCH

- Annual average temperatures have increased by over 2°F since 1970
- Over the next century, average summertime (June-August) temperatures in NYS are projected to increase between 3.6 to 10.8°F
- Almost all areas show increasing temperatures compared to climate norms.
- A 5°F increase in daily maximum summer temperature could double the risk of heat-related illnesses in New Yorkers
- Risk of heat is sustained even 4-5 days after exposure
- Both urban and rural areas are at risk, threshold temperatures for risk appear to be lower in rural areas
- Young adults are at high risk of health effects of heat




Maximum Heat Index(°F)
Heat stress
Risk Ratio
RR=1.96
83.4°F
Dehydration
RR=1.27
77.0°F
Acute Kidney Failure
RR=1.18
78.2°F
CVD
RR=1.12
75.7°F

REVISED NATIONAL WEATHER SERVICE HEAT ADVISORY

- This would capture a high proportion of heat events likely to result in significant morbidity, while avoiding warning fatigue if frequent advisories were issued at lower temperatures

- Based on research findings and recommendations, four NWS offices (Albany, NY; Binghamton, NY; Buffalo, NY; and Burlington, VT) changed their heat advisory criteria for New York, effective on or about June 1st, 2018 to 95 °F or more for two consecutive hours

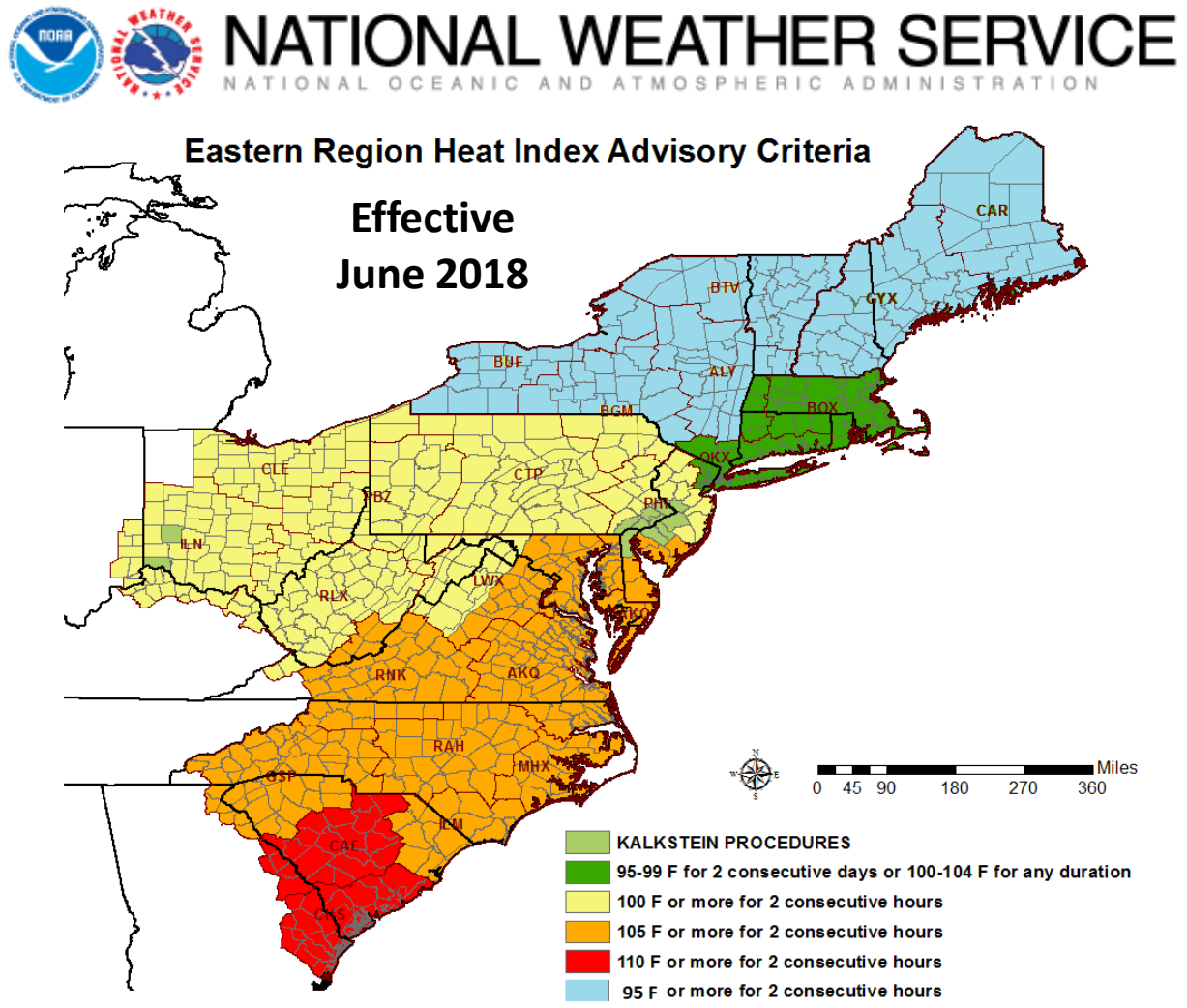
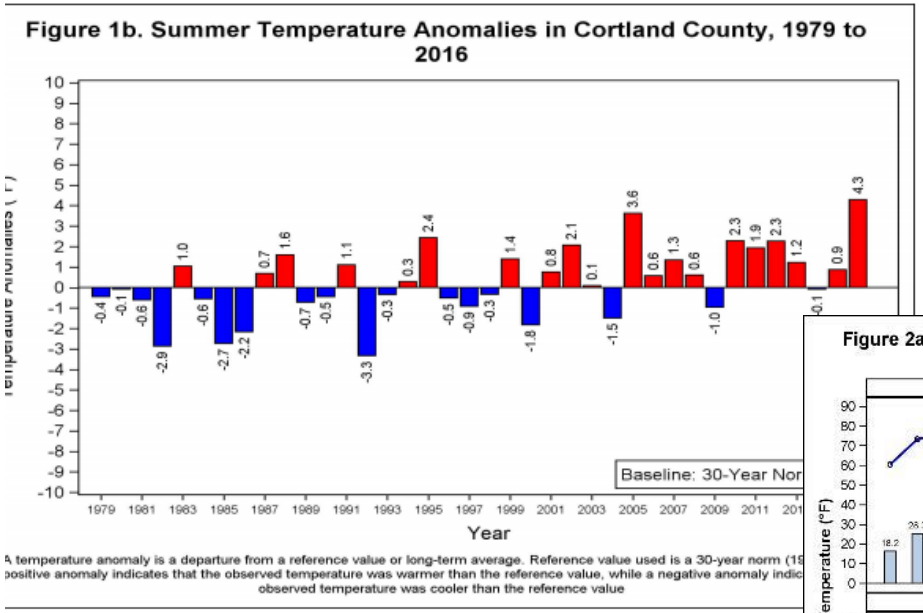


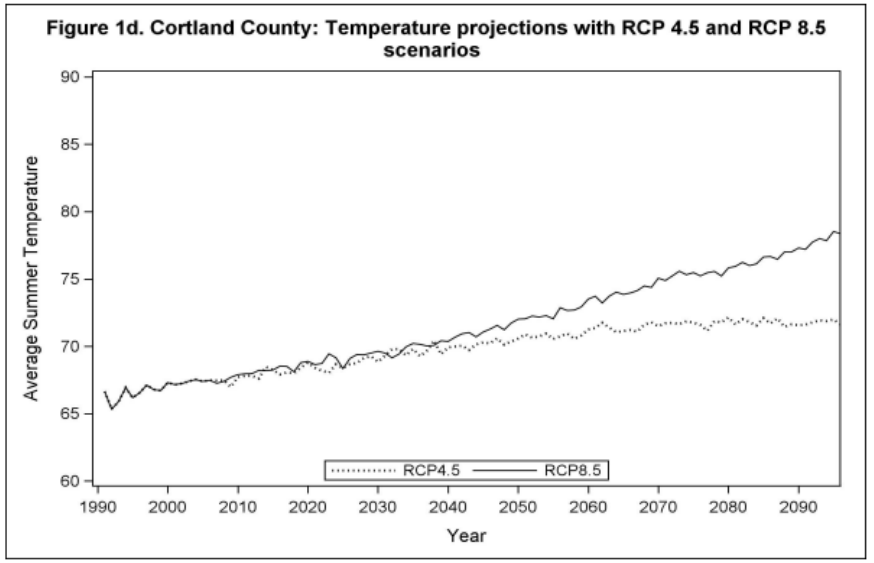
Image Credit: NWS offices, Albany

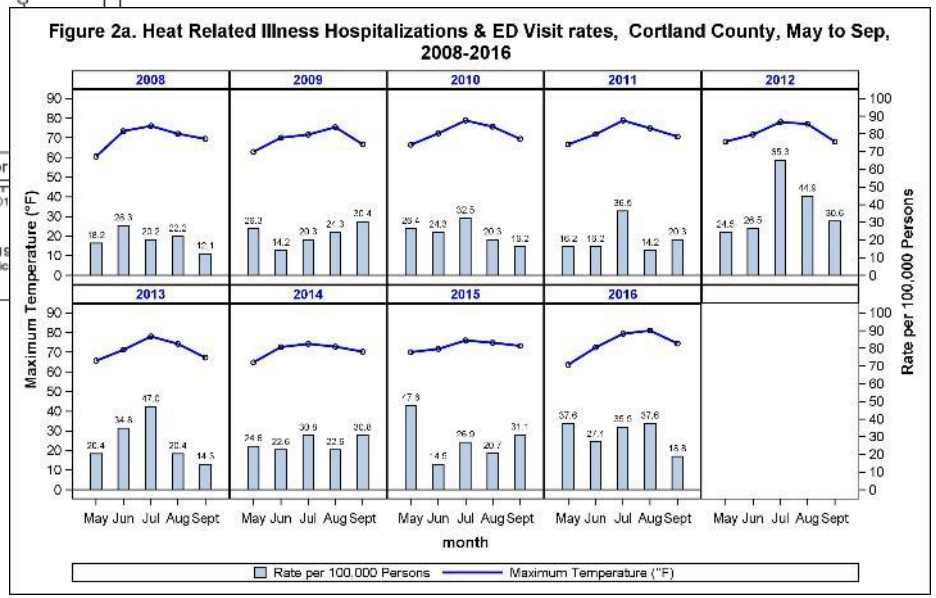
Heat and Health Profile Report
Cortland County

NEW YORK STATE | Department of Health

Exposure: Heat



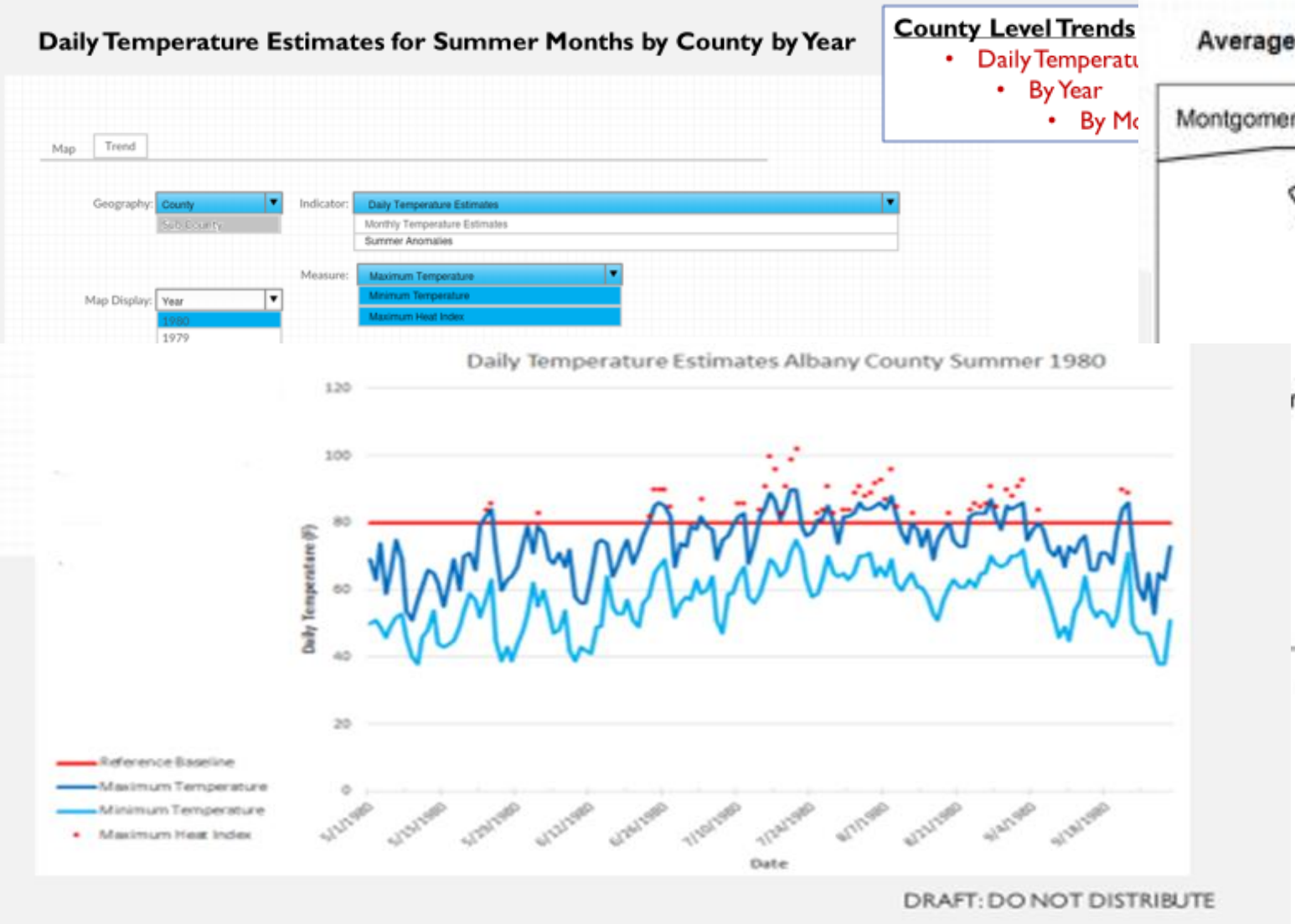


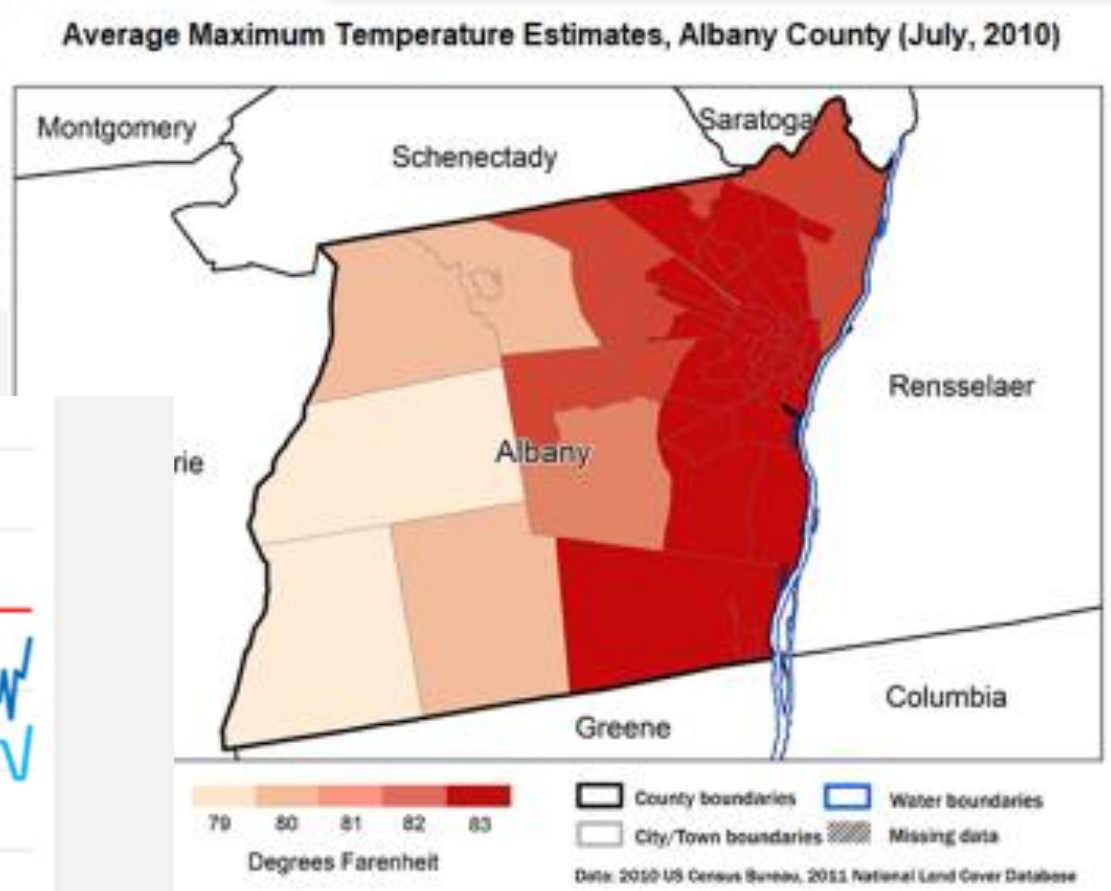


Satellite data allows NYS DOH to provide climate reports for each county in NYS

https://www.health.ny.gov/environmental/weather/profiles/

EPHT SUBCOUNTY PORTAL





Thank You.

For further questions, please contact:
Tabassum.insaf@health.ny.gov

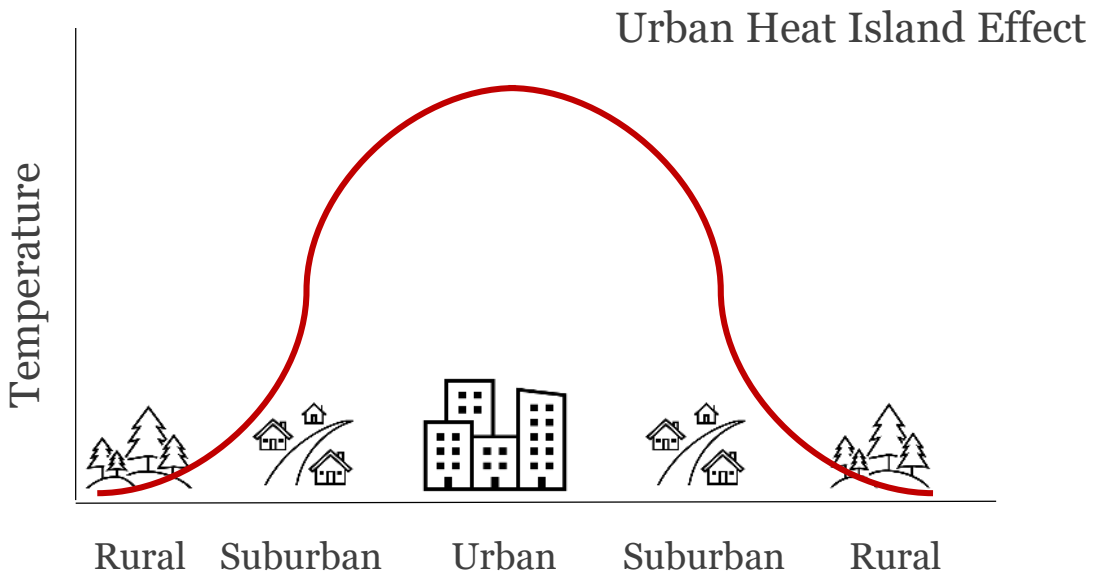
HEALTH &
AIR QUALITY

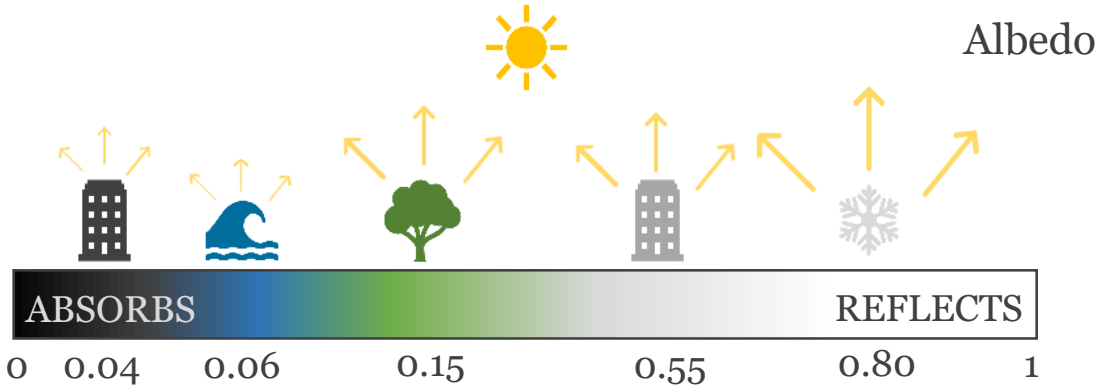
Cambridge Urban Development:
Quantifying Changes in Urban Albedo with NASA Earth Observations to Reduce Urban Heat Island Effect in Cambridge, Massachusetts

Sophie Barrowman*, Nicole Ramberg-Pihl, Liam Bhajan,
Olivia Cronin-Golomb

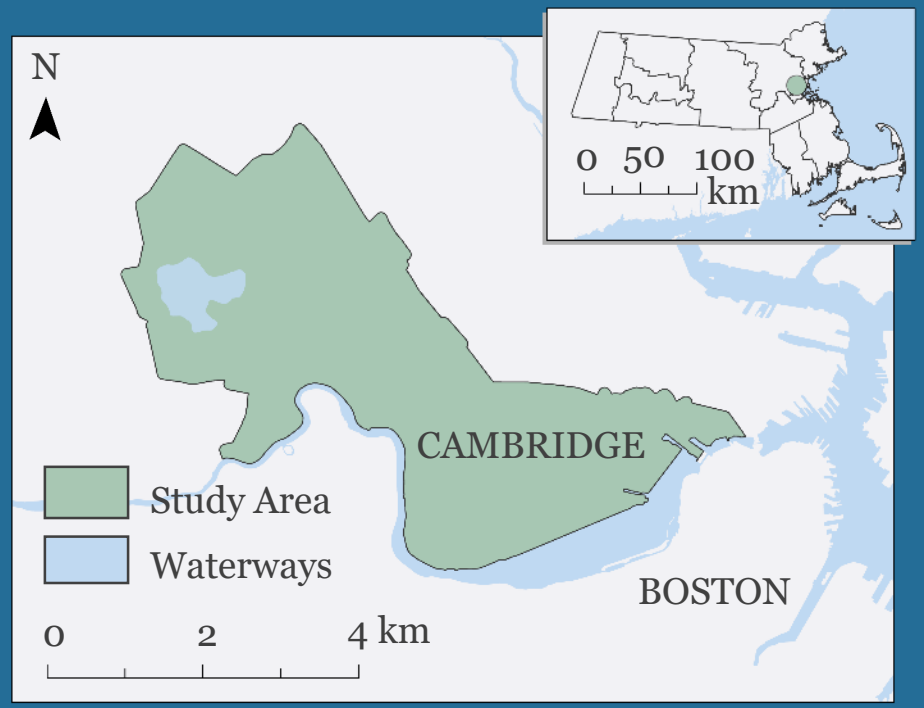
CAPACITY BUILDING

COMMUNITY CONCERNS





For cities like Cambridge that have not historically been affected by extreme heat, community leaders must plan to mitigate the effects of urban heat islands.



PROJECT PARTNERS AND OBJECTIVES

Credit: City of Cambridge

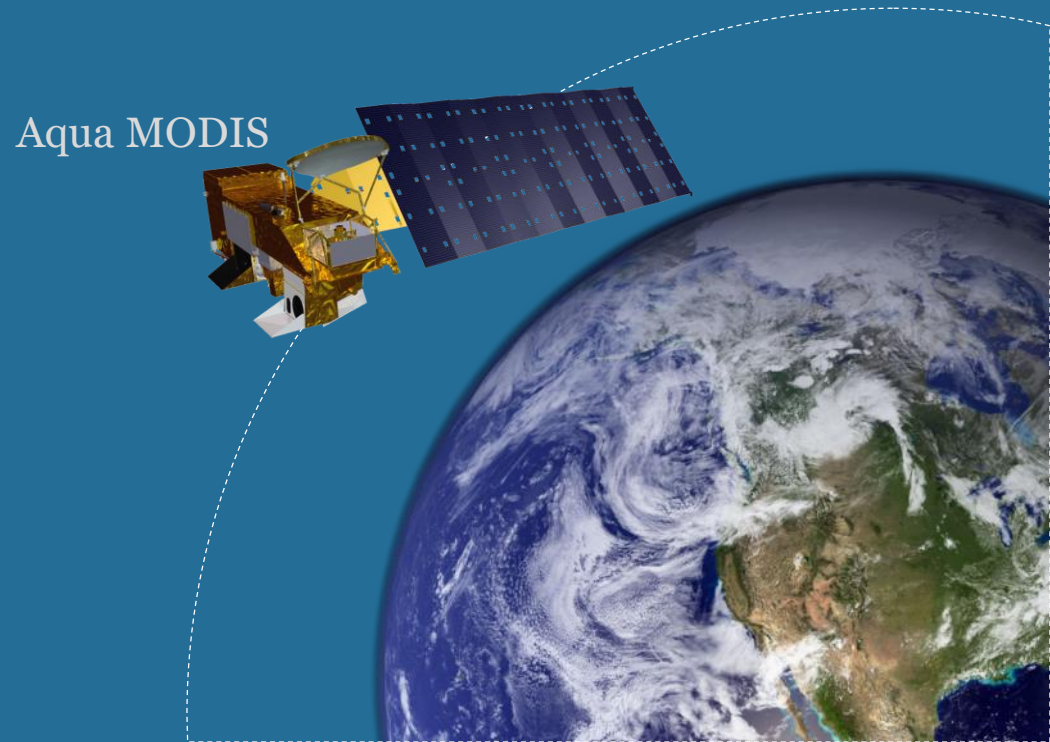
City of Cambridge,
Community Development Department

&

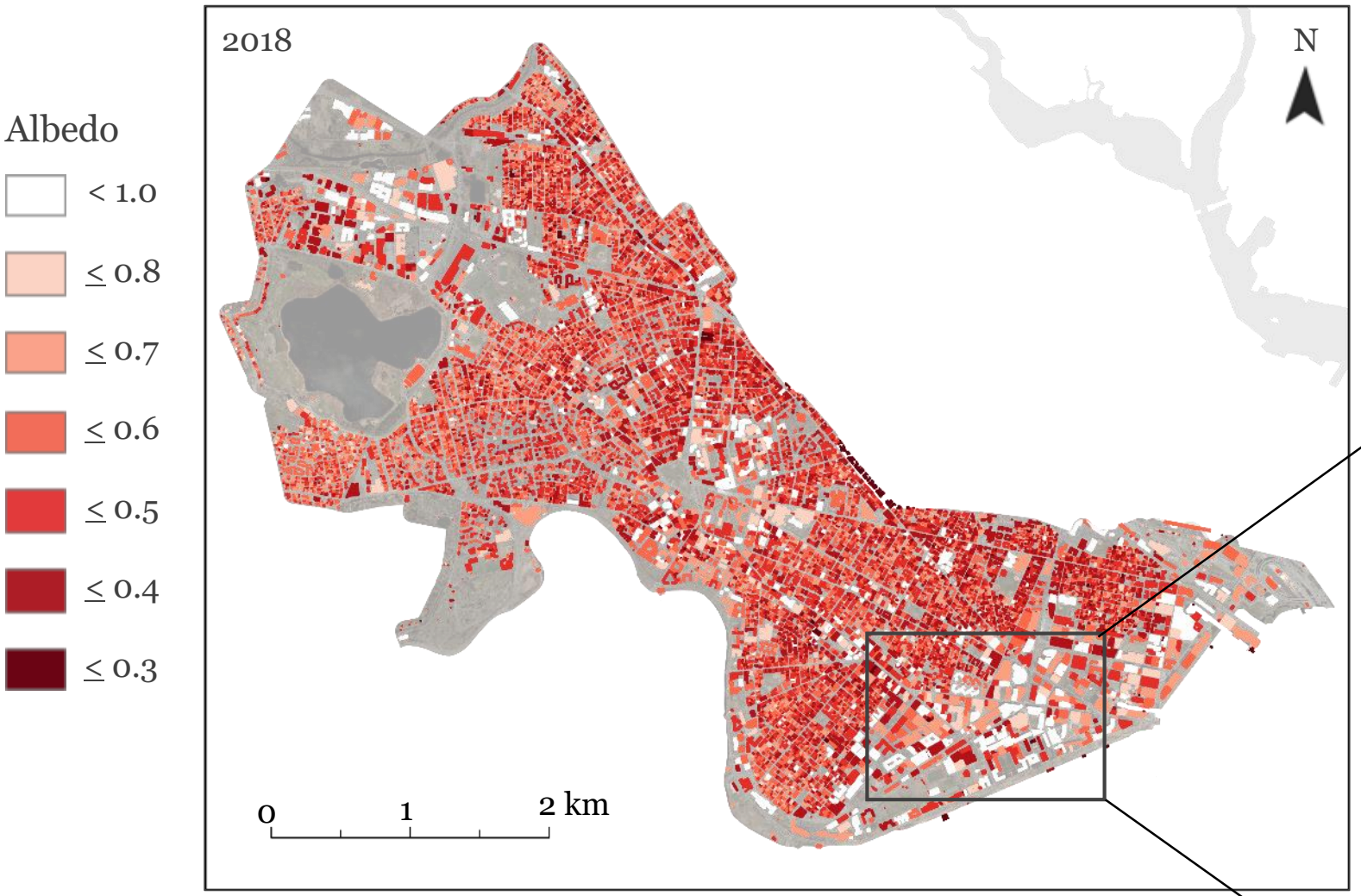
American Geophysical Union's
Thriving Earth Exchange

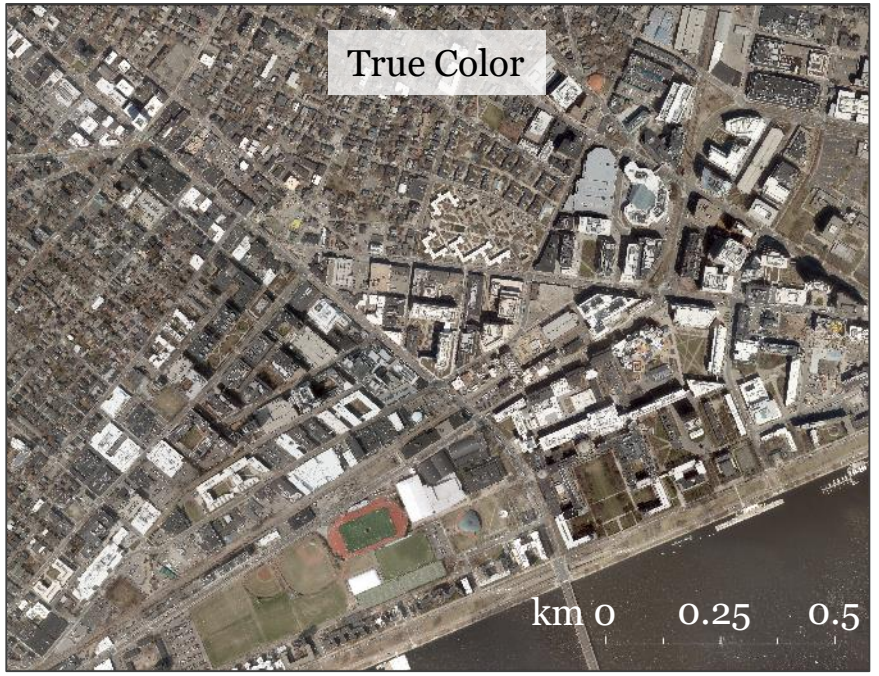
Objectives

- ***Calculate*** changes in rooftop albedo
- ***Map*** temperature "hotspots"
- ***Create*** an interactive ArcGIS Dashboard

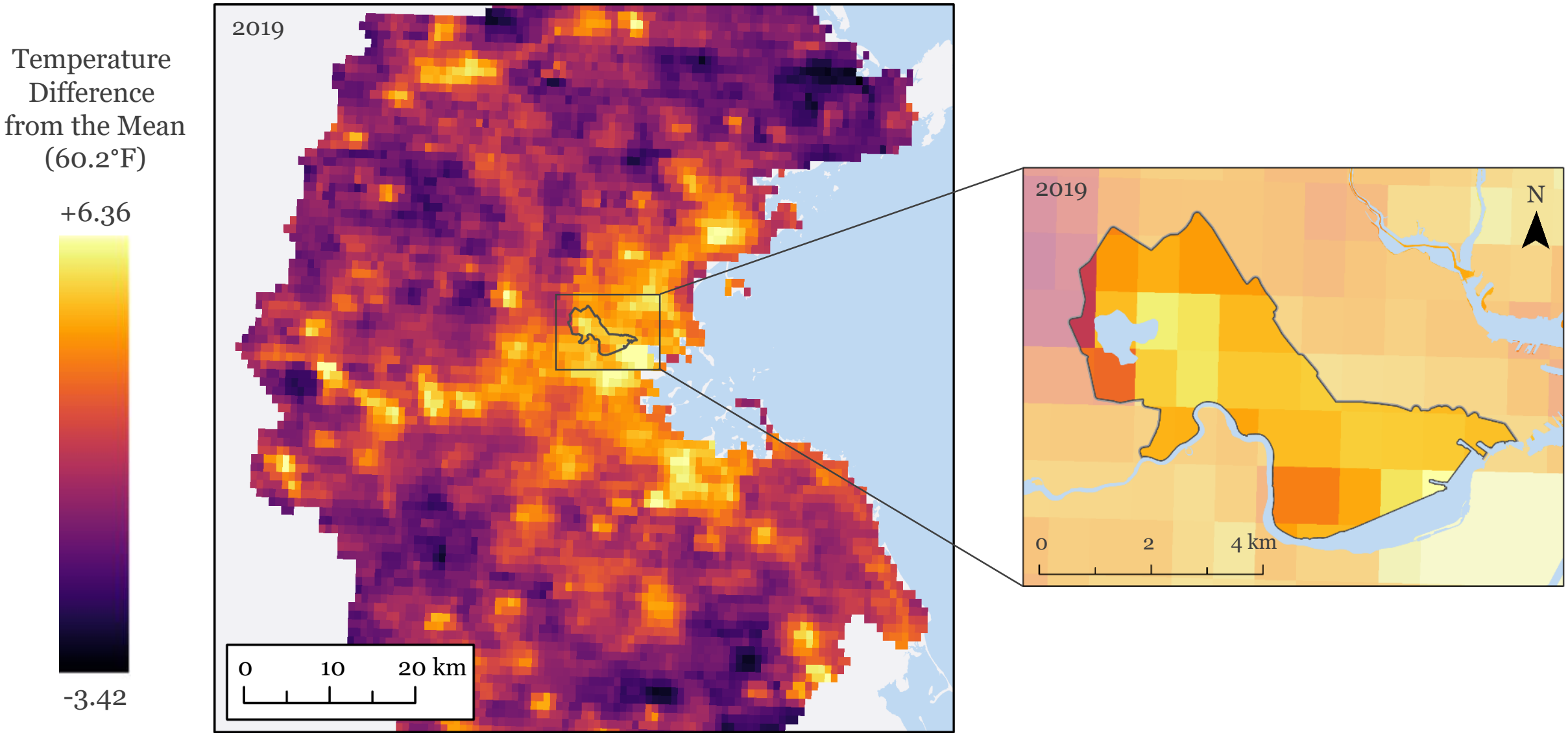


RESULTS AND CONCLUSIONS: ROOFTOP ALBEDO





RESULTS AND CONCLUSIONS: TEMPERATURE ANOMALIES



Thank You.

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

https://develop.larc.nasa.gov

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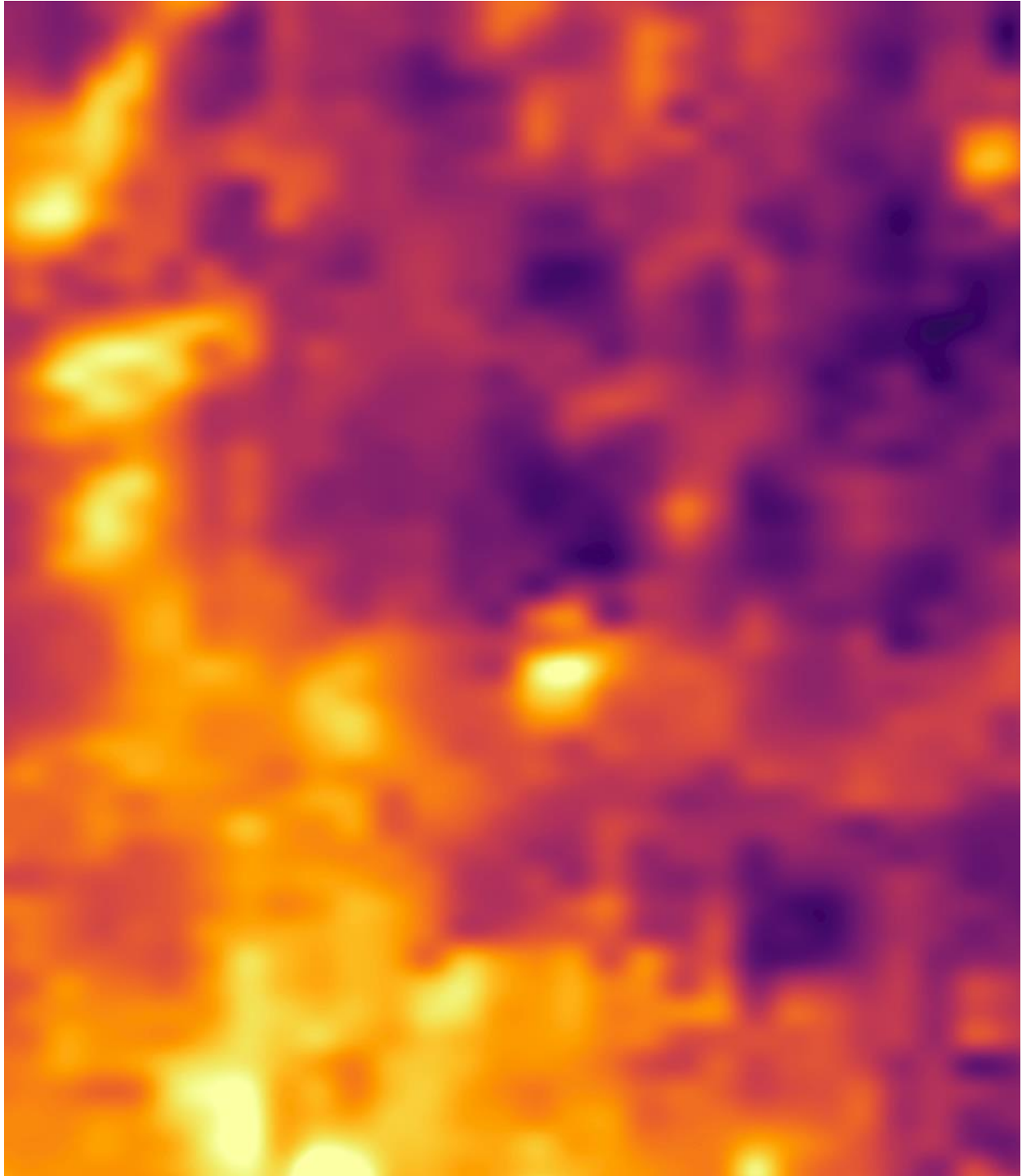
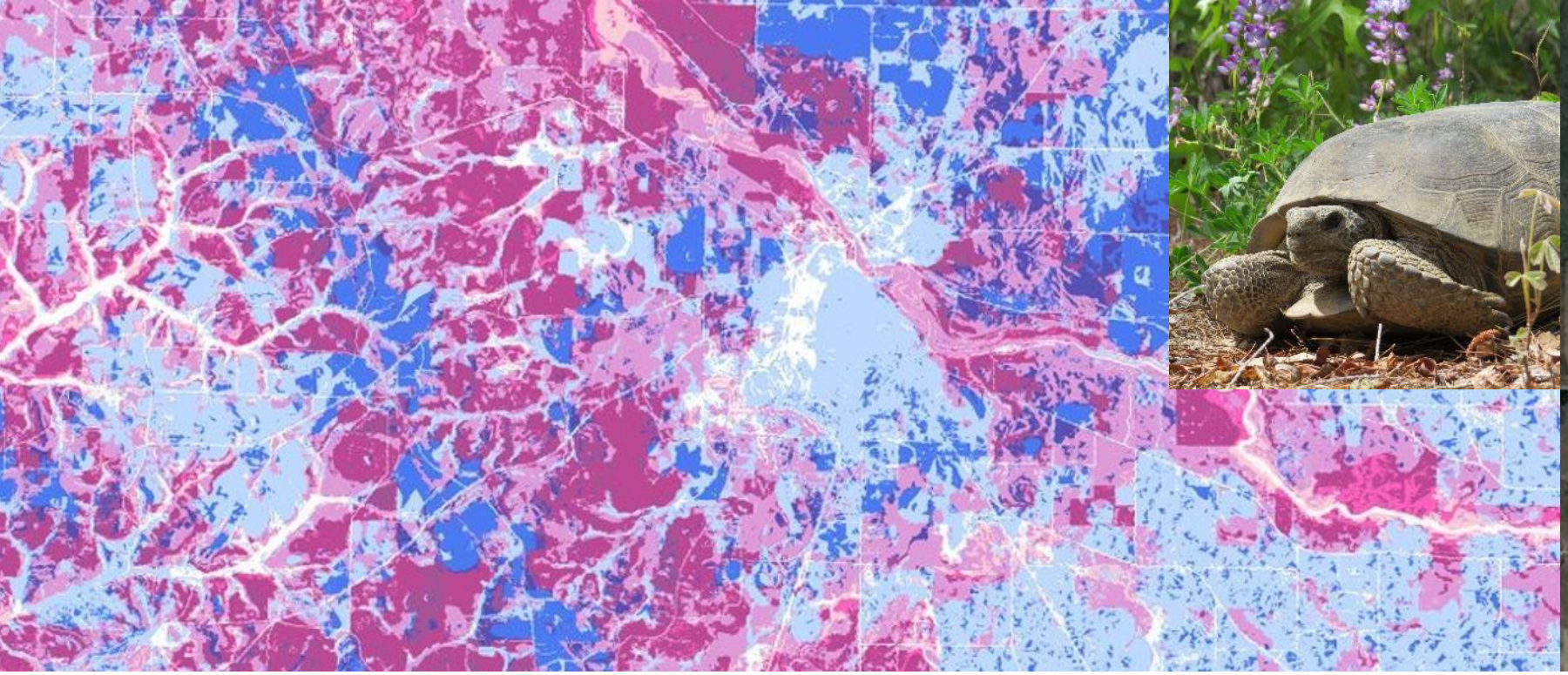
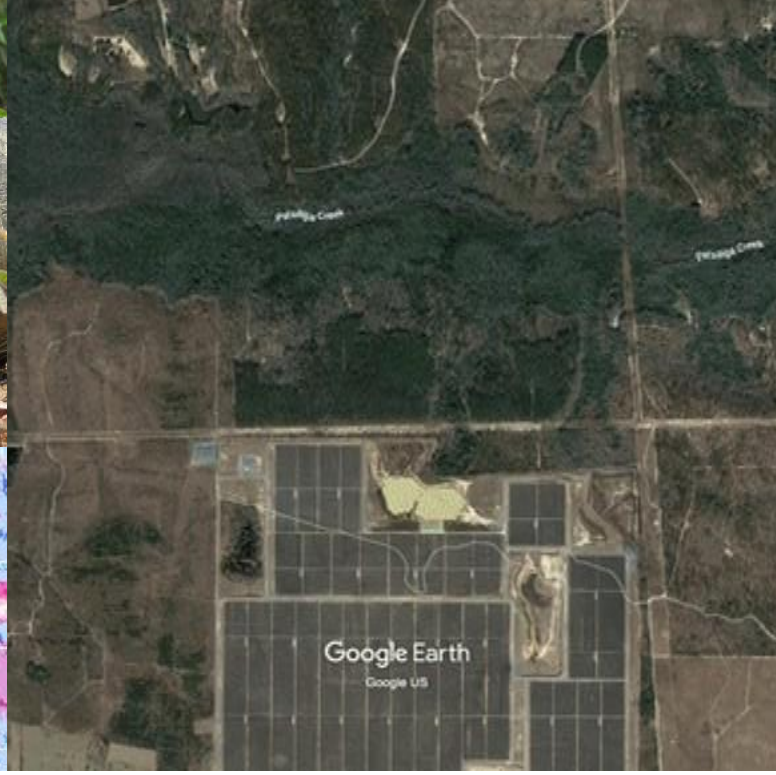






Georgia Energy III:
Identifying Habitat and Solar Site Conflict in Georgia by Developing an Environmental Sensitivity Public Mapping Tool

Vineeth Jason Putti*, Samantha Trust, Alexander Burke,
Jannatul Ferdush,

EARTH SCIENCE
APPLIED SCIENCES

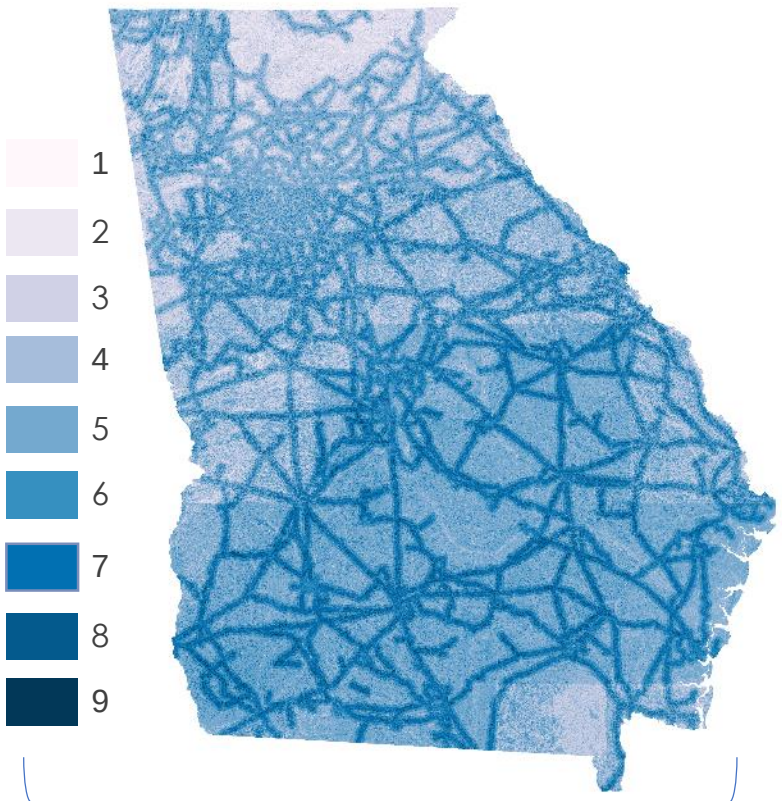
COMMUNITY CONCERNS & PROJECT PARTNERS

The Georgia Department of Natural Resources (GADNR) and The Nature Conservancy (TNC) are interested in promoting low-impact solar development.

- The Environmental Sensitivity Mapping Tool (ESMT) displays data on critical habitat locations and solar suitability to identify areas of potential land use conflict.
- ESMT features a comprehensive data catalog allowing users to visualize the input data and results of our analyses.
- This will serve solar developers and community stakeholders as a decision support tool in the siting of future solar facilities.

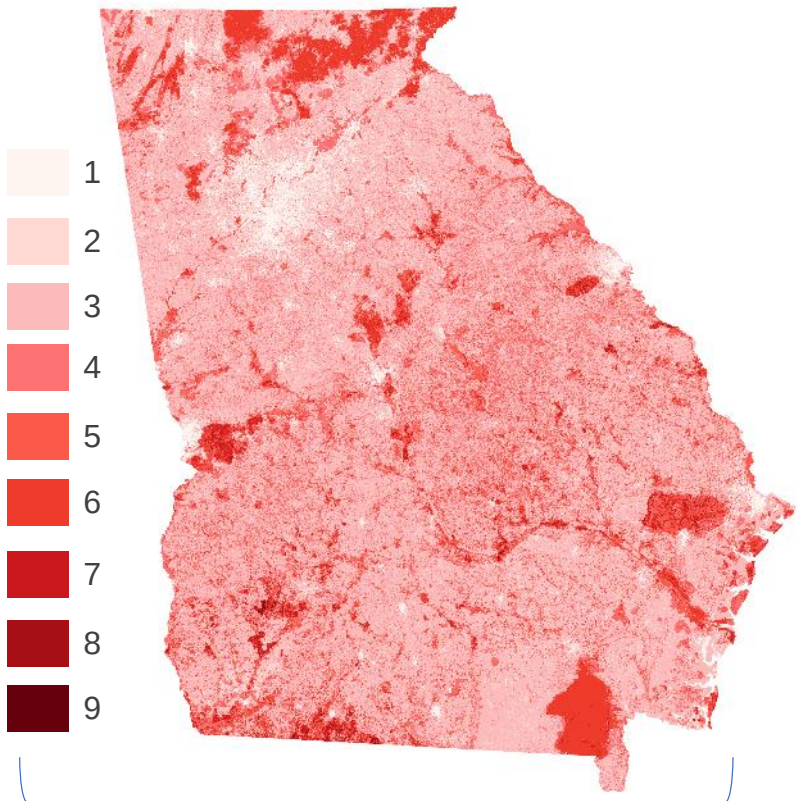
Image Credit:(top) Amy Gutierrez; (bottom) Jaidee

LAND-USE CONFLICT IDENTIFICATION STRATEGY (LUCIS) MODEL



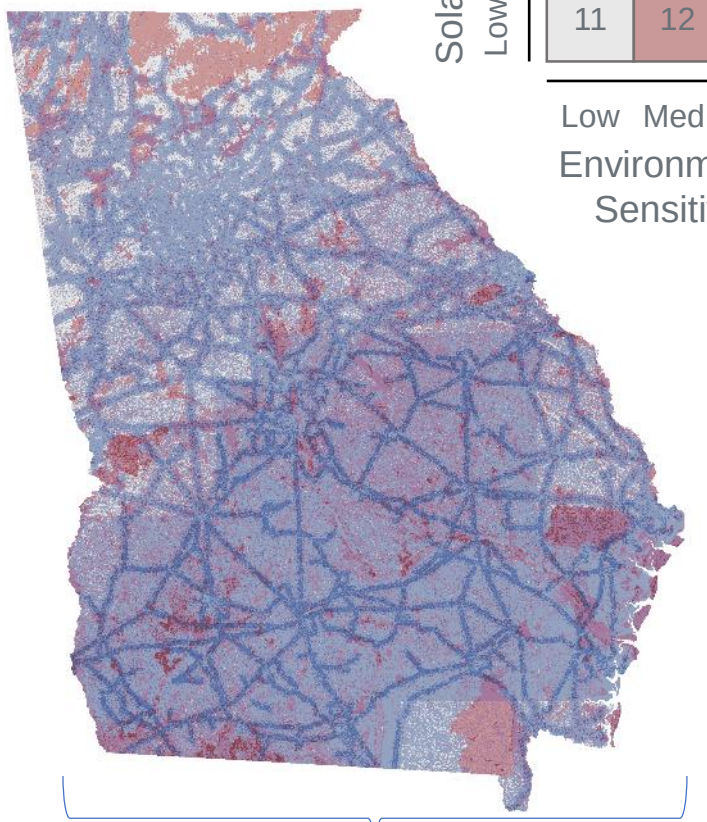
Solar Suitability

+



Environmental Sensitivity

=

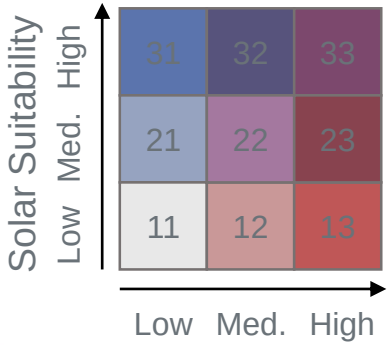


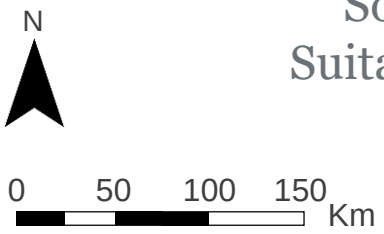
Bivariate Conflict Map

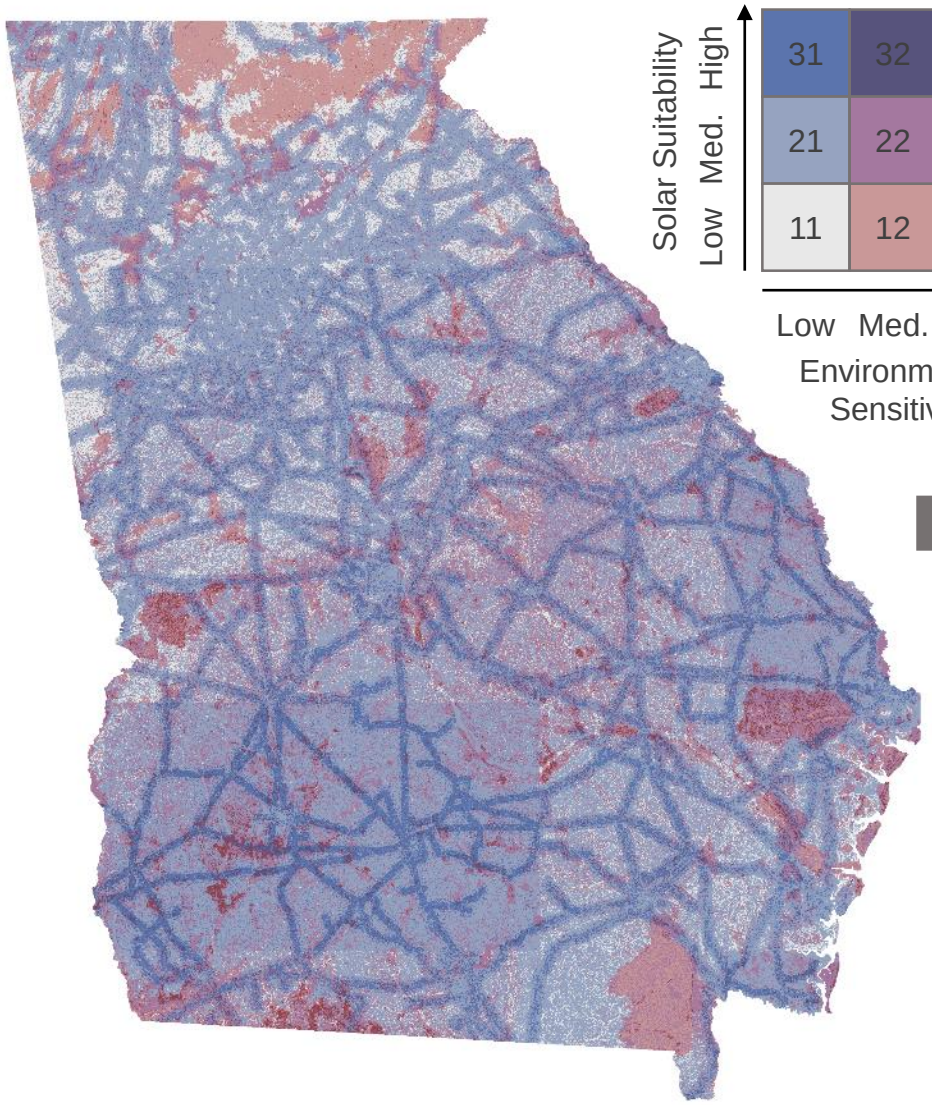
Value = 1 2

Environmental Score

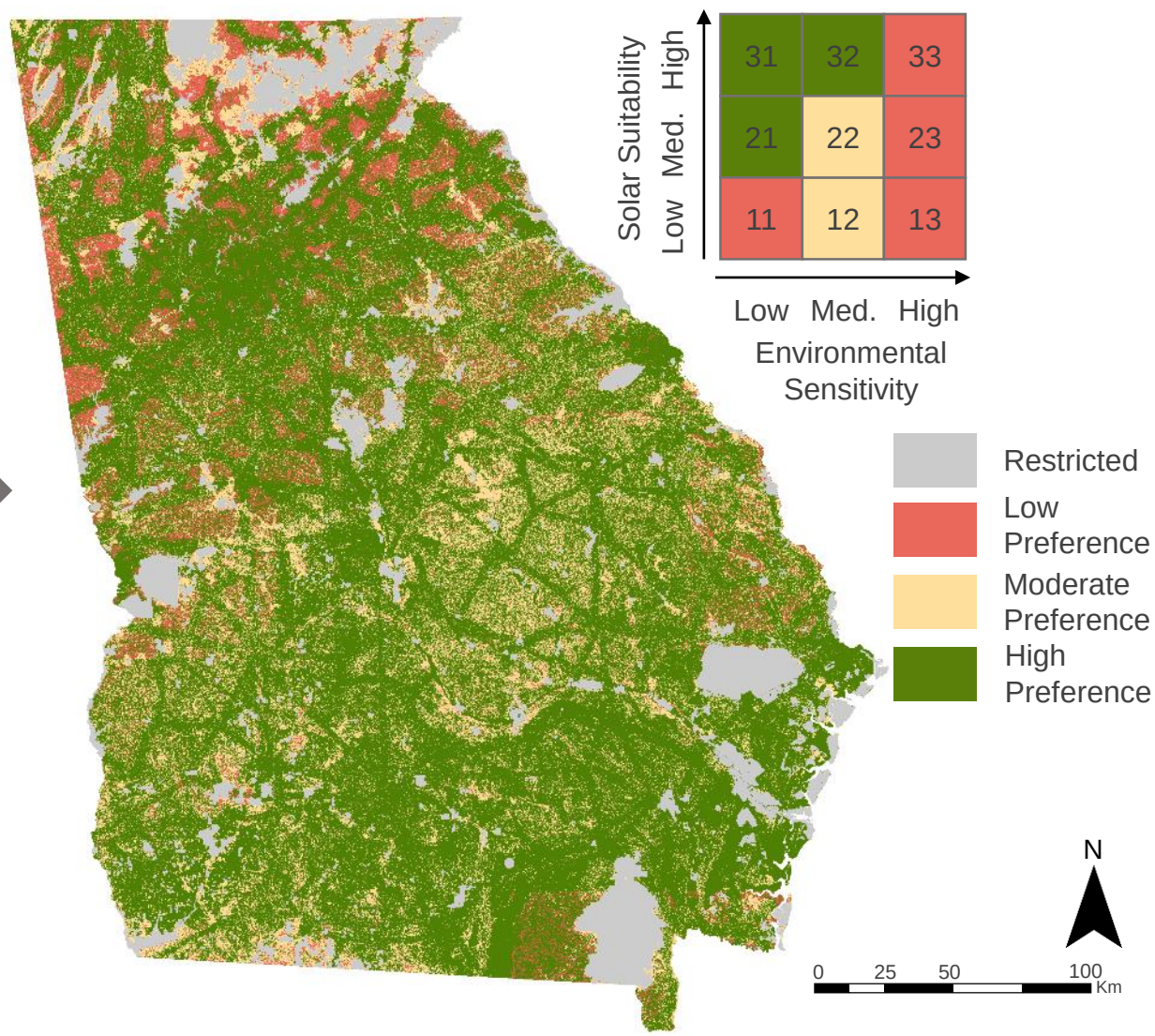
Solar Score





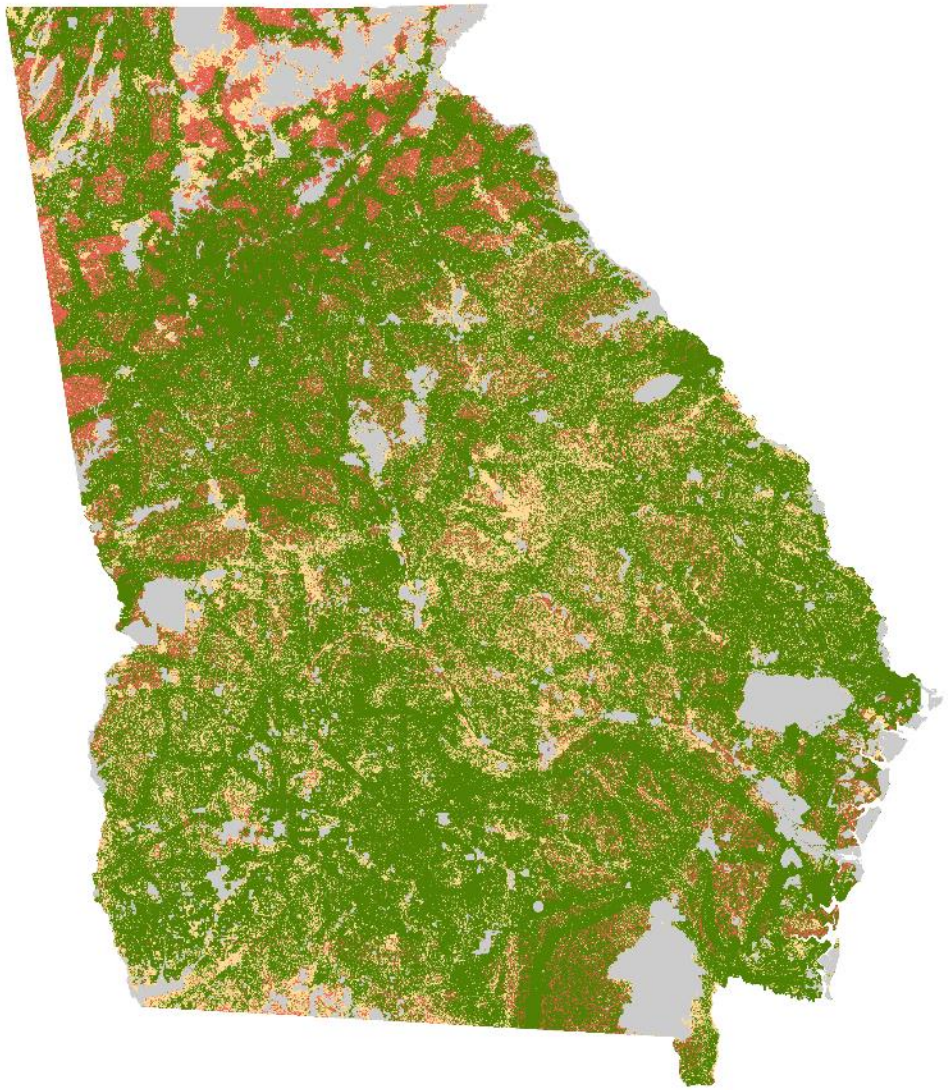


LUCIS Output Map - 2019

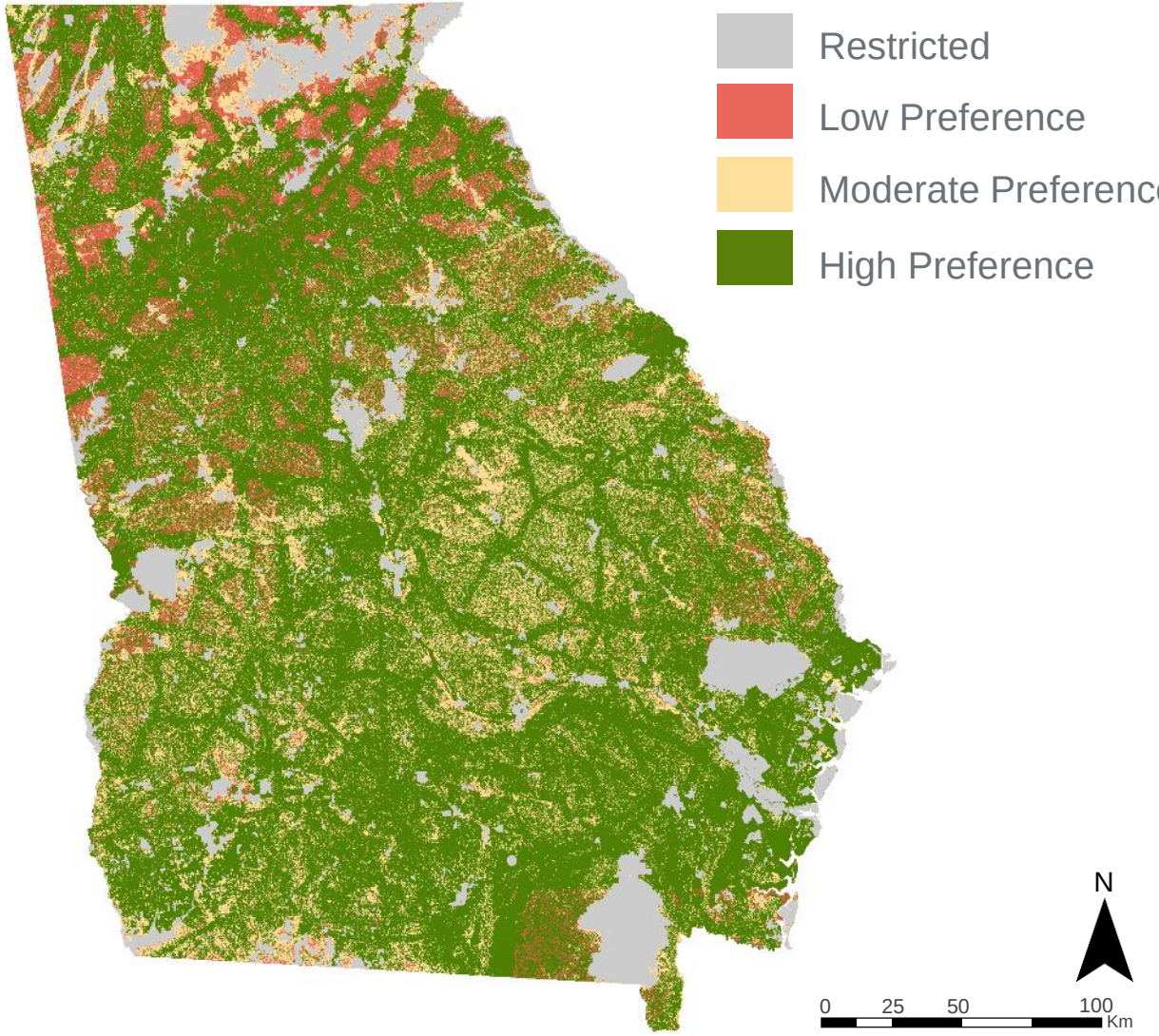


Reclassified LUCIS Map - 2019

CONCLUSIONS



Reclassified LUCIS - 2017



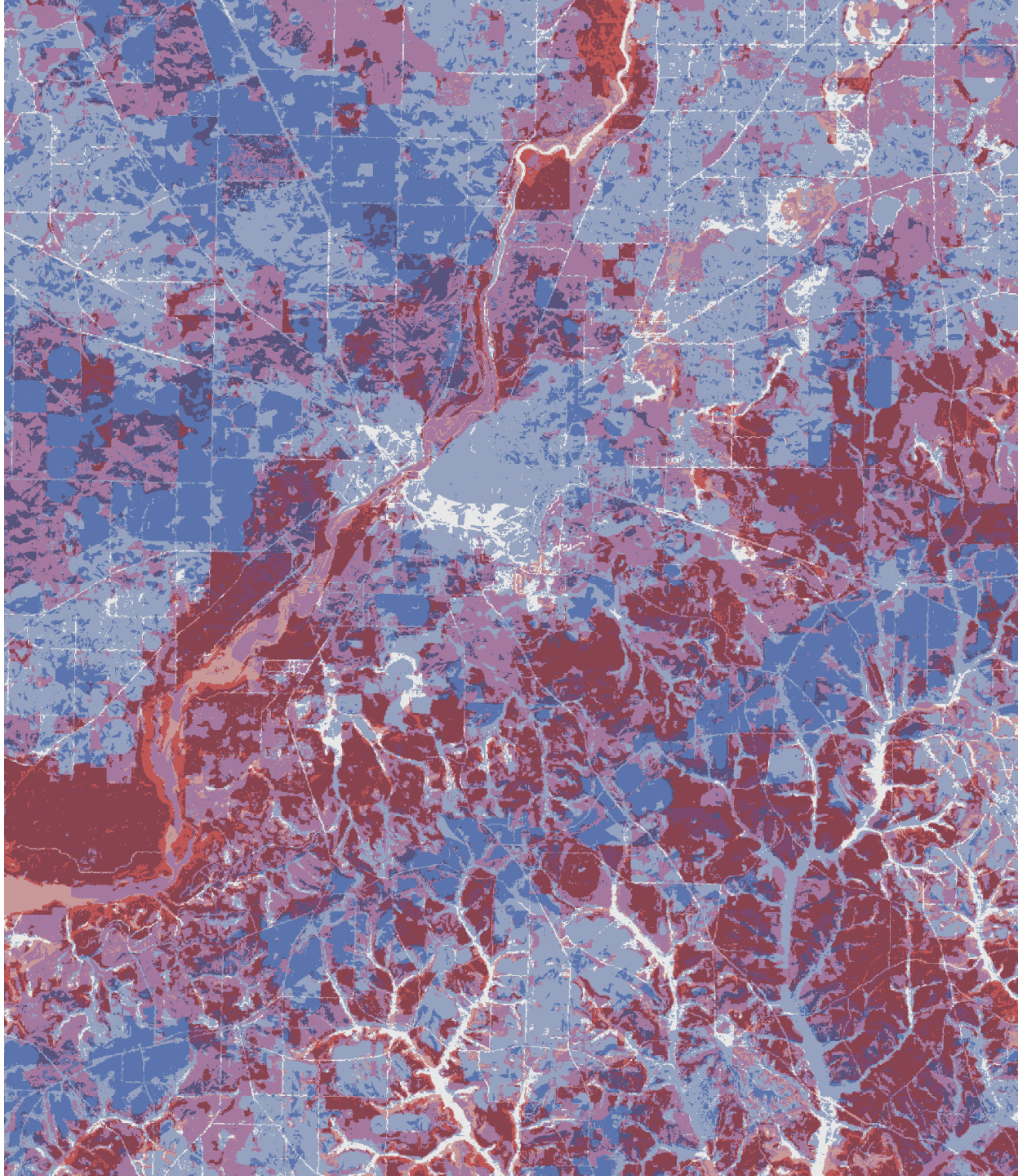
Reclassified LUCIS - 2019

Thank You.

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

https://develop.larc.nasa.gov

EARTH SCIENCE
APPLIED SCIENCES



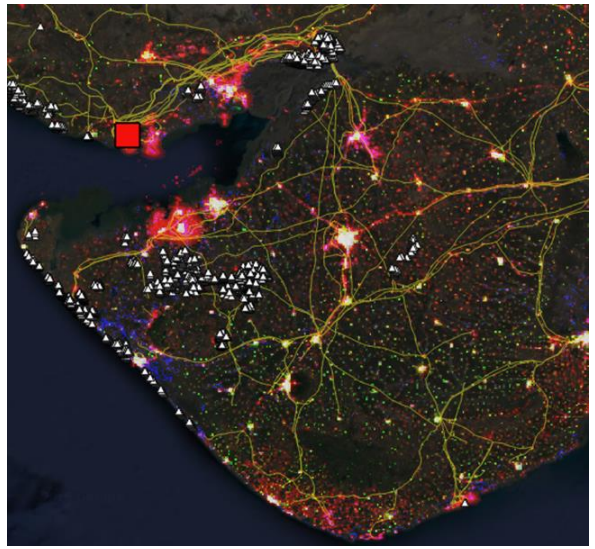
Open Critical Infrastructure Exposure for Disaster Forecasting, Mitigation and Response

Charles K. Huyck

Executive Vice President, ImageCat, Inc.

DISASTERS

When critical infrastructure fails or is significantly disrupted, impacts cascade and disasters turn into catastrophes.

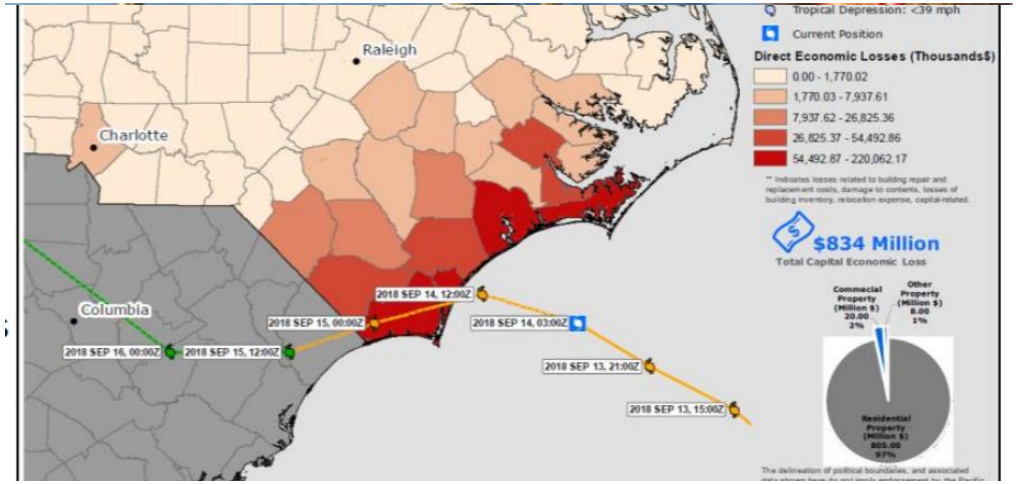


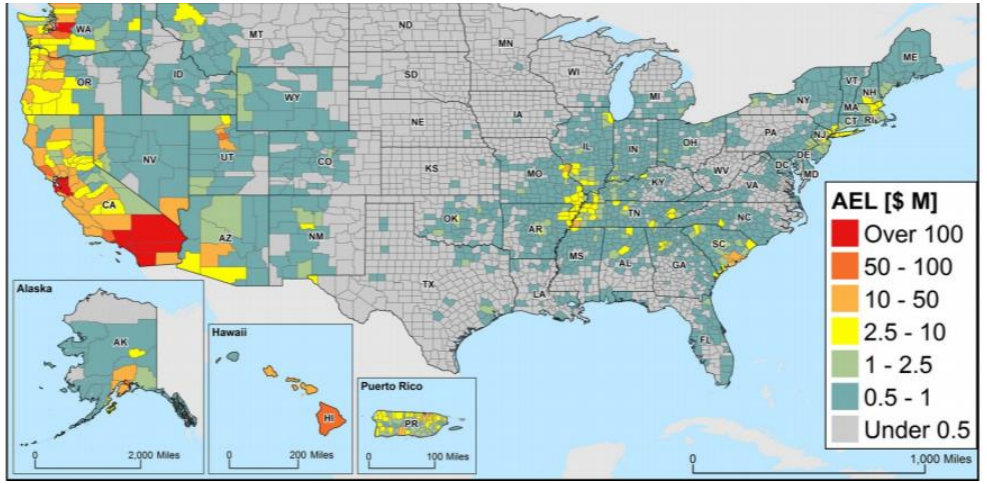
Urban areas are complex systems with interconnected “lifeline” networks and economic engines propelled by CI, and when these sever in a disaster, the resulting economic stagnation is felt far beyond the limited direct damage. In this grant, we are working towards expanding the ability to model catastrophic impacts of infrastructure disruption by providing a foundation for CI exposure development with earth observation (EO).

Data will be delivered openly and globally to developing countries and all those interested in risk, as well as integrated into commercial products for global risk identification and management. The resulting data are suitable for the types of risk studies prioritized by the Sendai Framework/SDGs for Disaster Risk Reduction that are currently being implemented by NGOs in developing countries.

Why Model Risk?- The role of loss estimation

- **Before an event-** What might happen if…? What will we need? Where can we request resources? What areas will be impacted?
- **During an event-** Where is this hurricane going? Who should be evacuated? What should we deploy to the region?
- **After an event-** What just happened? Should we ask international help? Where is the most damage? Where are people without food and shelter?
- **On average-** Where should we build stronger, higher, or farther away? Where should we retrofit, acquire property, or replace facilities? What should be insured? (insurers- how much should that cost?)





What happens can look very different

Wall Street Journal

Thai Floods Disrupt Car Production - WSJ

BANGKOK—Thailand's auto exporters are being hit by supply-chain ... Prior to the floods, Thailand's National Economic and Social Development Board forecast ...

Oct 12, 2011

BBC News

Thailand floods disrupt production and supply chains

Factories and supply chains are facing disruption as some of the worst flooding in decades starts to affect Thailand's economy. Western Digital, Honda Motor ...

Oct 13, 2011

Computerworld

Thailand floods spur rush to SSDs

Thailand floods spur rush to SSDs ... products, including PCs, smartphones and tablet PCs, continued to drop because of sluggish economic conditions. Another ...

Dec 1, 2011

Wall Street Journal

Thai Authorities,Companies Blamed for Extent of Flood Damage

Some experts say yes, and that the international impact of Thailand's floods should ... the monsoon rains turned into such a devastating setback for the economy.

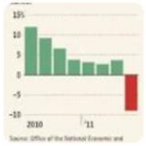
Nov 3, 2011

Wall Street Journal

Thailand GDP Shrinks 10.7%

BANGKOK—Thailand's economy contracted more than expected in the fourth quarter of last year as the country was hit by its worst floods in decades, pulling ...

Feb 20, 2012



Critical infrastructure assets are often unmapped or unshared, making in impossible to identify where the regional risk from infrastructure disruption stands to result in cascading effects.

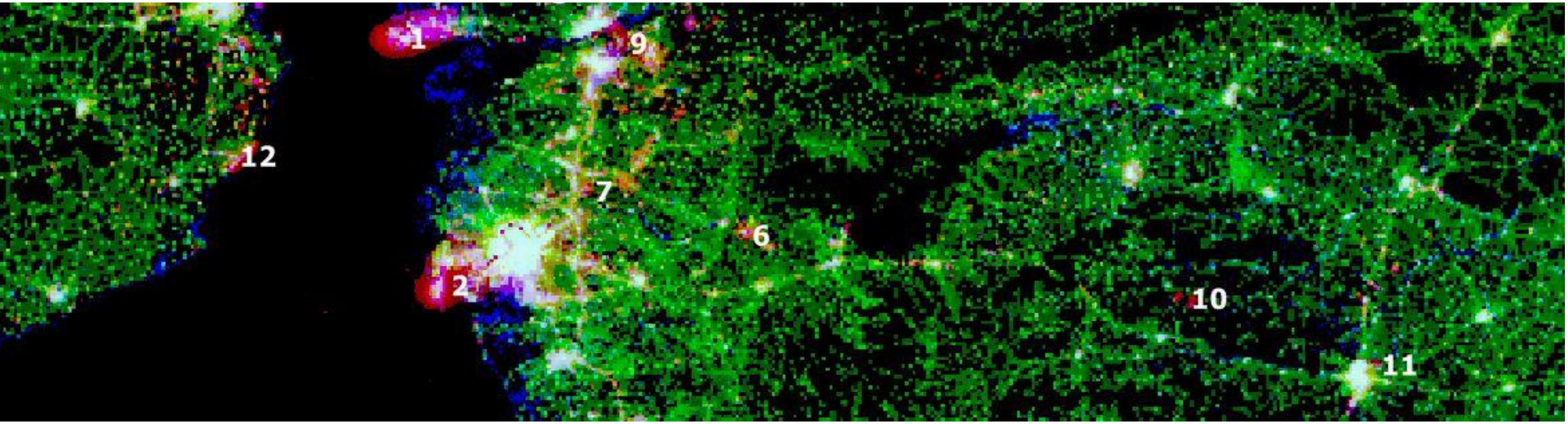
Earth observation data offers several advantages to traditional GIS approaches to collecting infrastructure data.

- It's not discrete
- It's not privately held
- It's not subject to reporting bias
- It's available everywhere
- It can be detected and classified with VIIRS, SAR & optical

But…

- Not all data detectable
- Lacking in attribute data
- Lacking in conductivity
- Identify potential risk for detailed assessment

Sample identification and classification of power plants in Gujarat, India



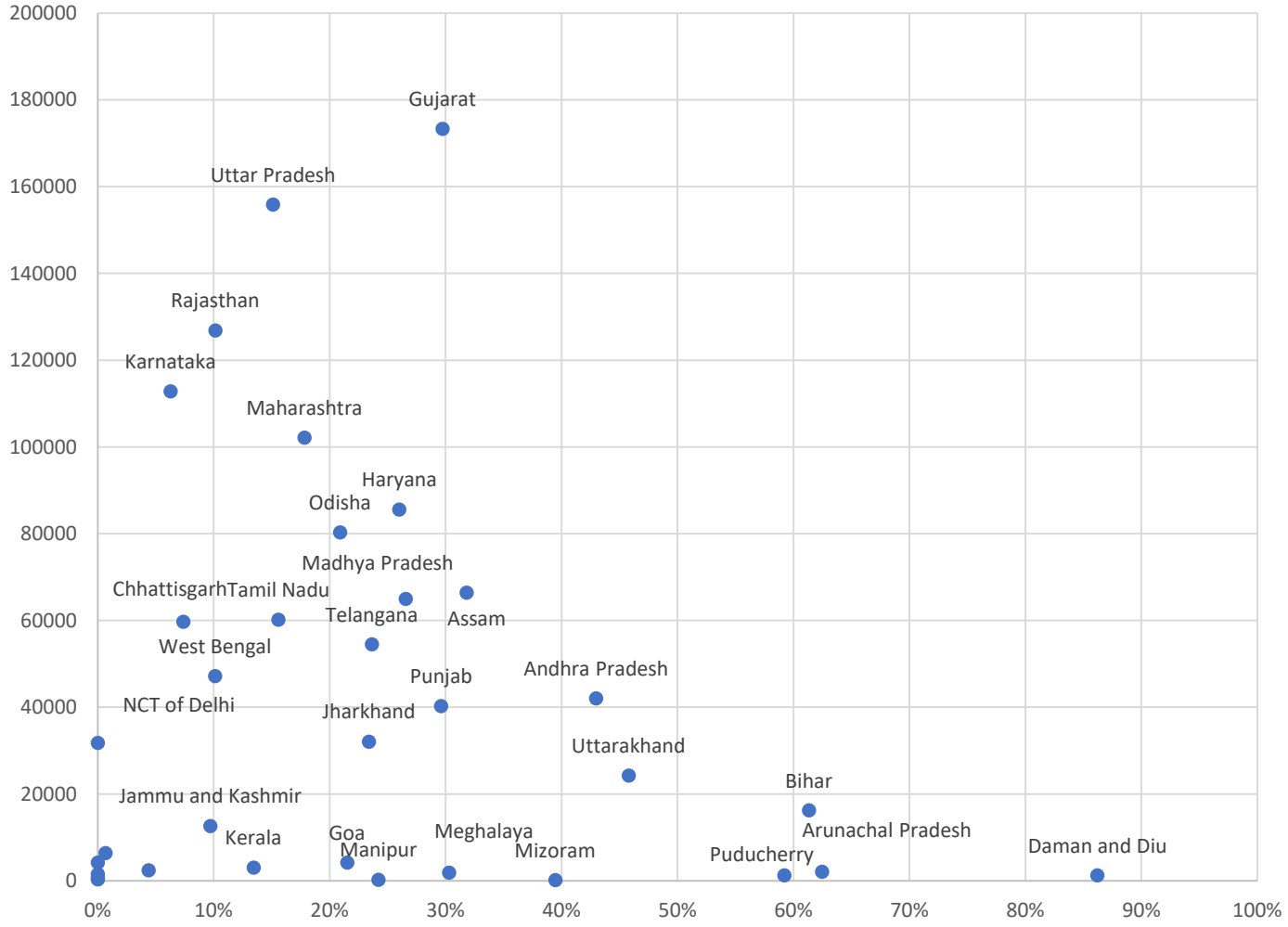
1. Conventional

4. Hydropower

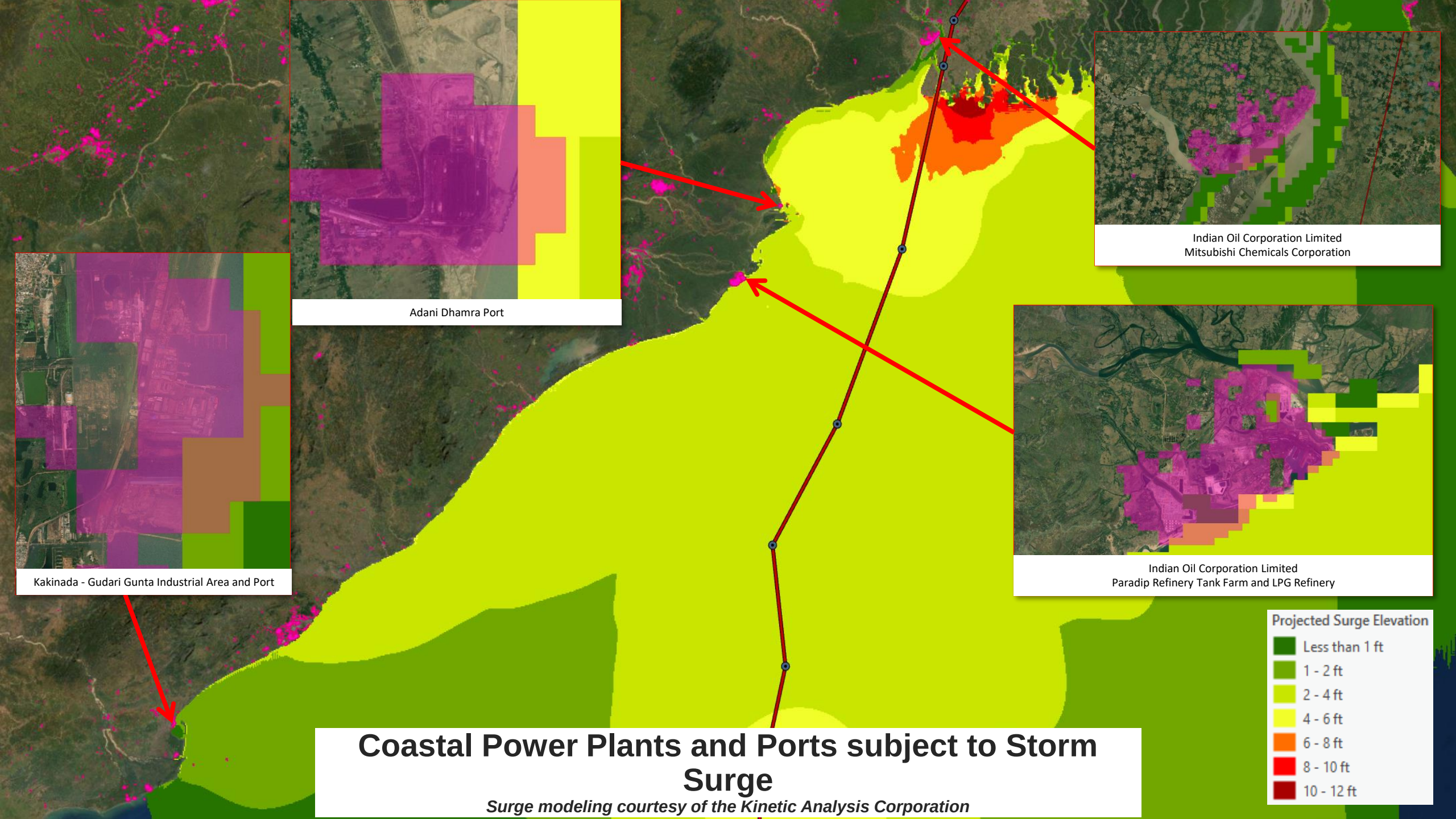
6. Nuclear

10. Solar

Percent of Exposure in a 100 year flood zone, by Industrial Intensity



Theoretical example for India- which states have the most industrial exposure? What percentage of that exposure is at risk from flooding?



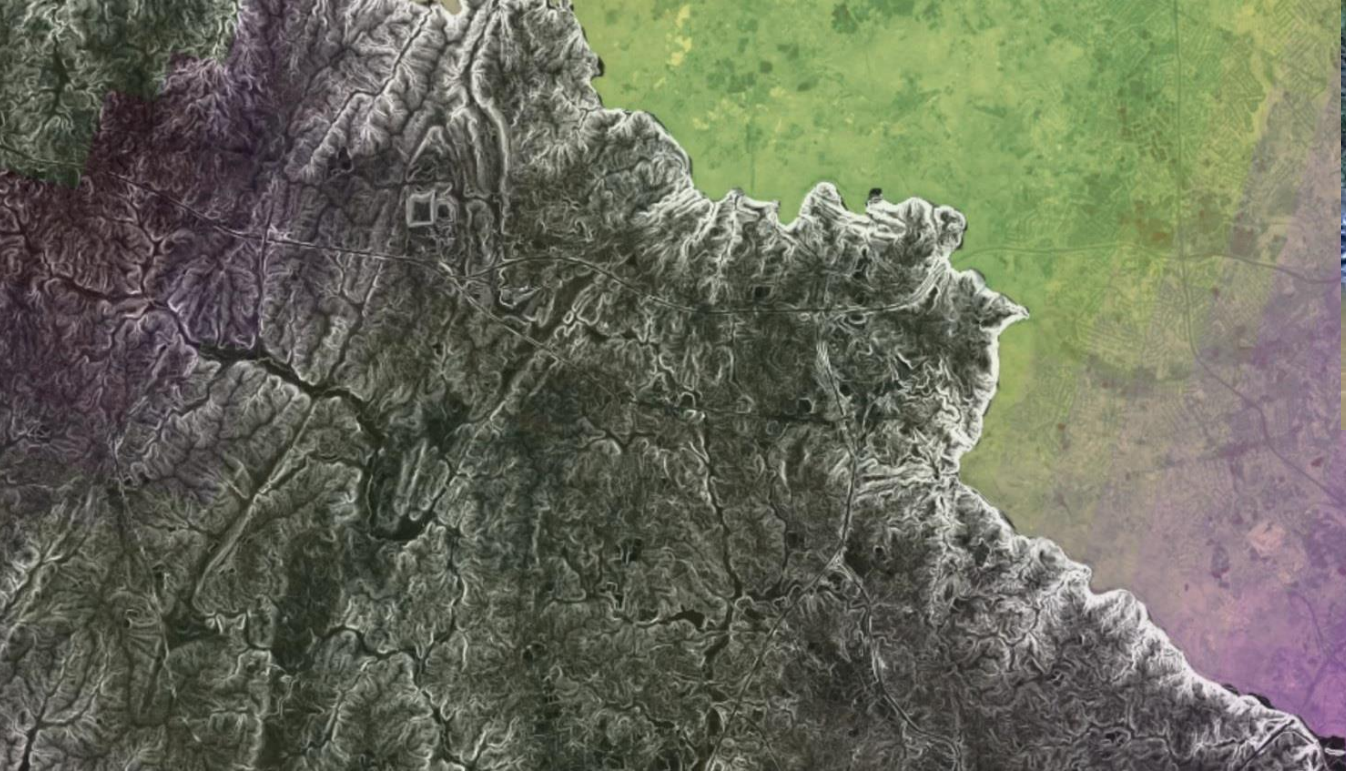
Coastal Power Plants and Ports subject to Storm Surge

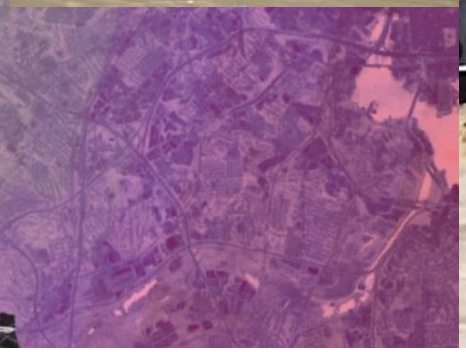
Surge modeling courtesy of the Kinetic Analysis Corporation

Thank You.

For further questions, please contact:
CKH@imagecatinc.com

DISASTERS






Ellicott City Disasters III:
Building a Real-Time Predictive Flood Model for Improving Early Warning Systems in Ellicott City, Maryland

Erika Munshi*, Alina Schulz, Ryan Hammock, Eli Orland

CAPACITY BUILDING

COMMUNITY CONCERNS AND PROJECT PARTNERS

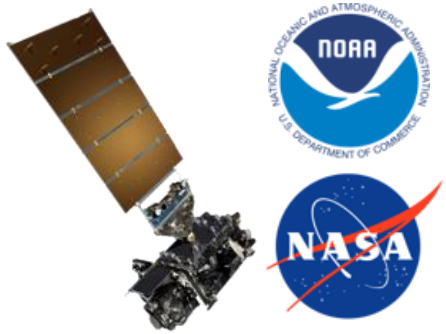
- Ellicott City has been effected by more than 10 devastating floods in the last 100 years
- The intensity of flood events is severe enough to to move cars, destroy buildings, and wash-out roadways.
- Our partners, the NOAA and NWS Weather Forecast Office and the Howard County Stormwater Management Division and Office of Emergency Management, are interested in enhancing their early warning system to alert residents of flooding events

Our objective is to help improve the Howard County Office of Emergency Management's early warning system through implementing a real-time flood forecasting tool.

Video: Ron Peters, Ellicott City Resident

Data Acquisition

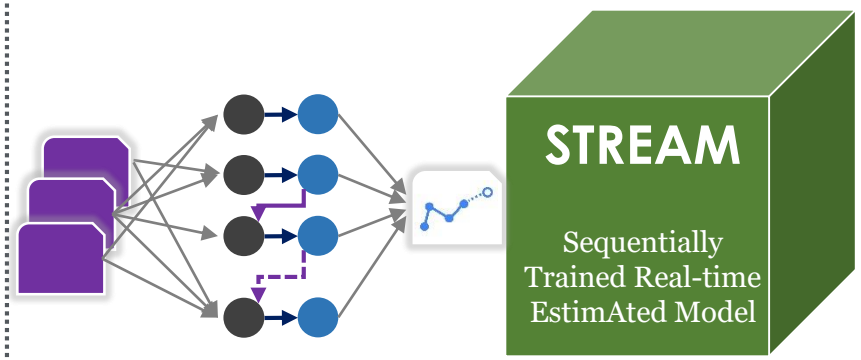
In situ gauges



GOES-16 Earth Observations

NOAA Real-time and Modeled Weather Products

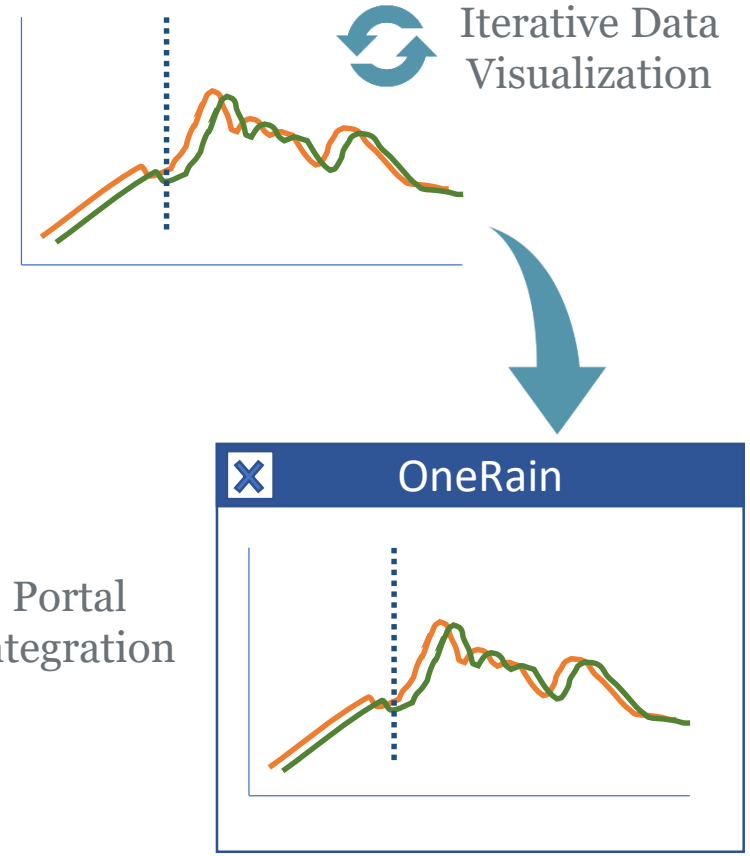
Model Development



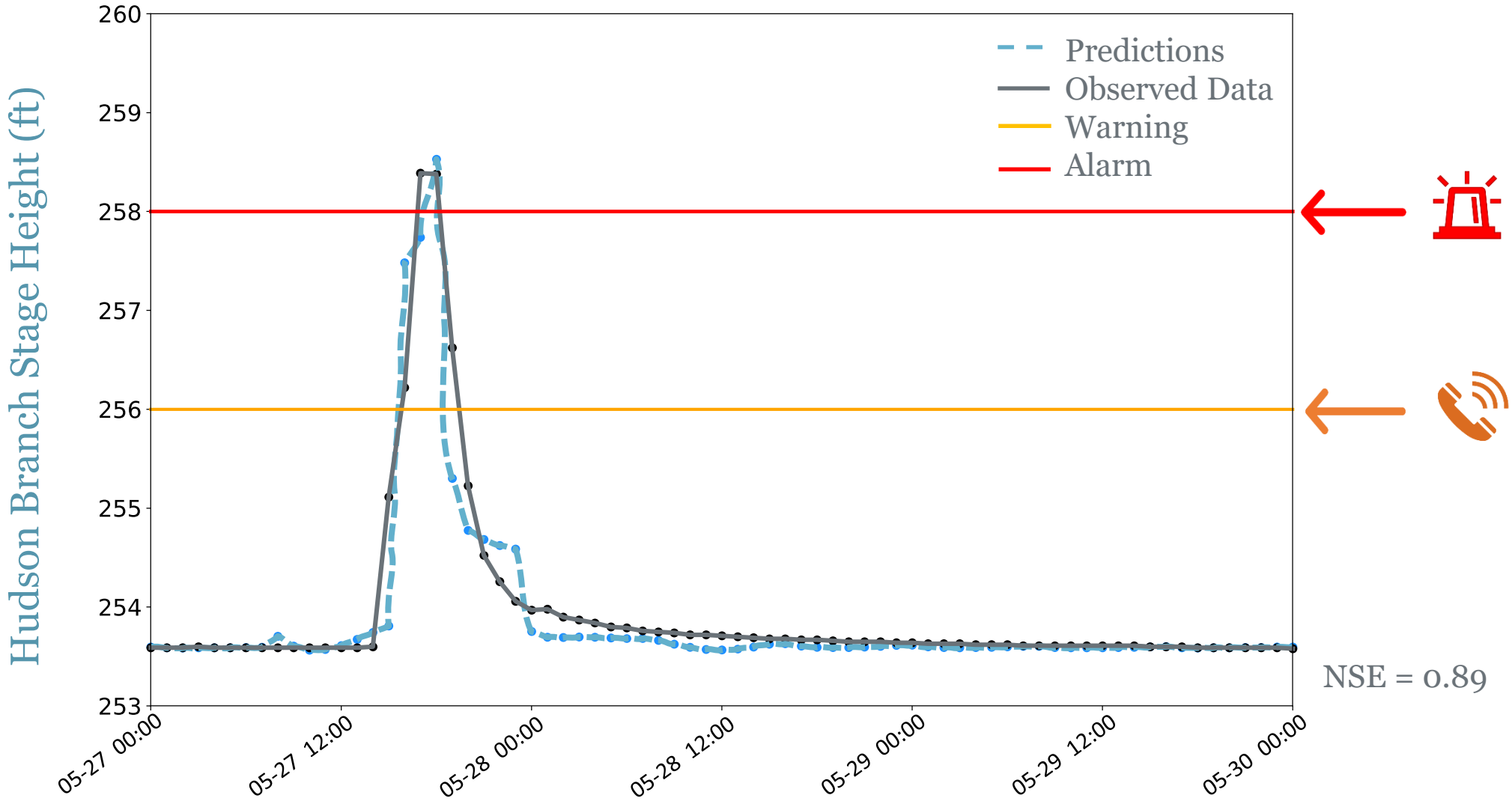
Stage Height Prediction

Sensitivity and Error Analysis

Real-time Model Output



MODEL PERFORMANCE



END USER BENEFIT

- Model outputs are iteratively displayed on a customized dashboard within an online portal called OneRain.
- In addition to our real-time model output, the dashboard includes:
  - Regional radar
  - Local precipitation
  - Twitter feed
  - Real-time camera footage
  - Real-time Gauge data

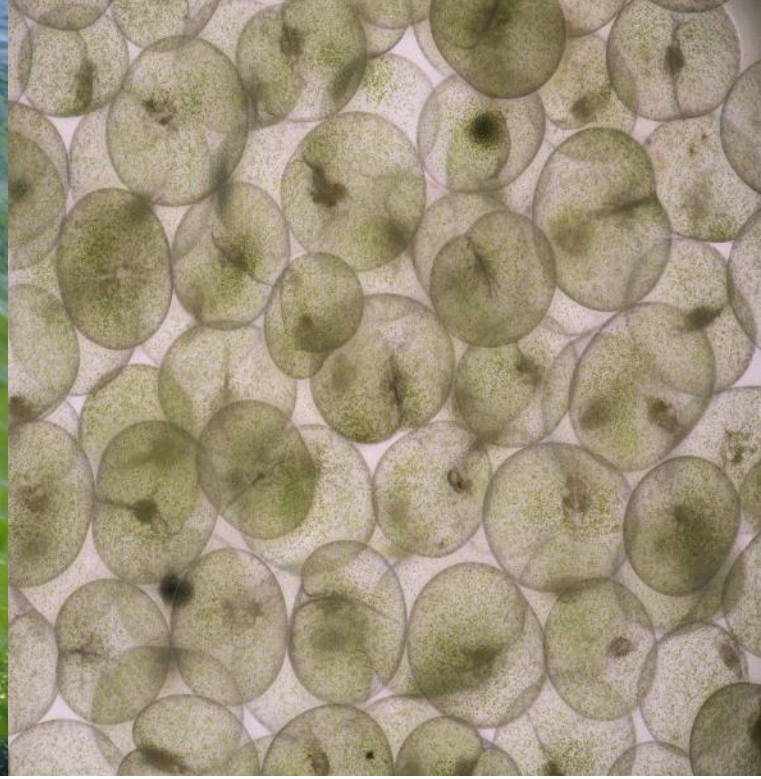
Together, the elements of the dashboard can support a comprehensive early-warning system for our partners in Howard County.

Thank You.

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

https://develop.larc.nasa.gov

EARTH SCIENCE
APPLIED SCIENCES

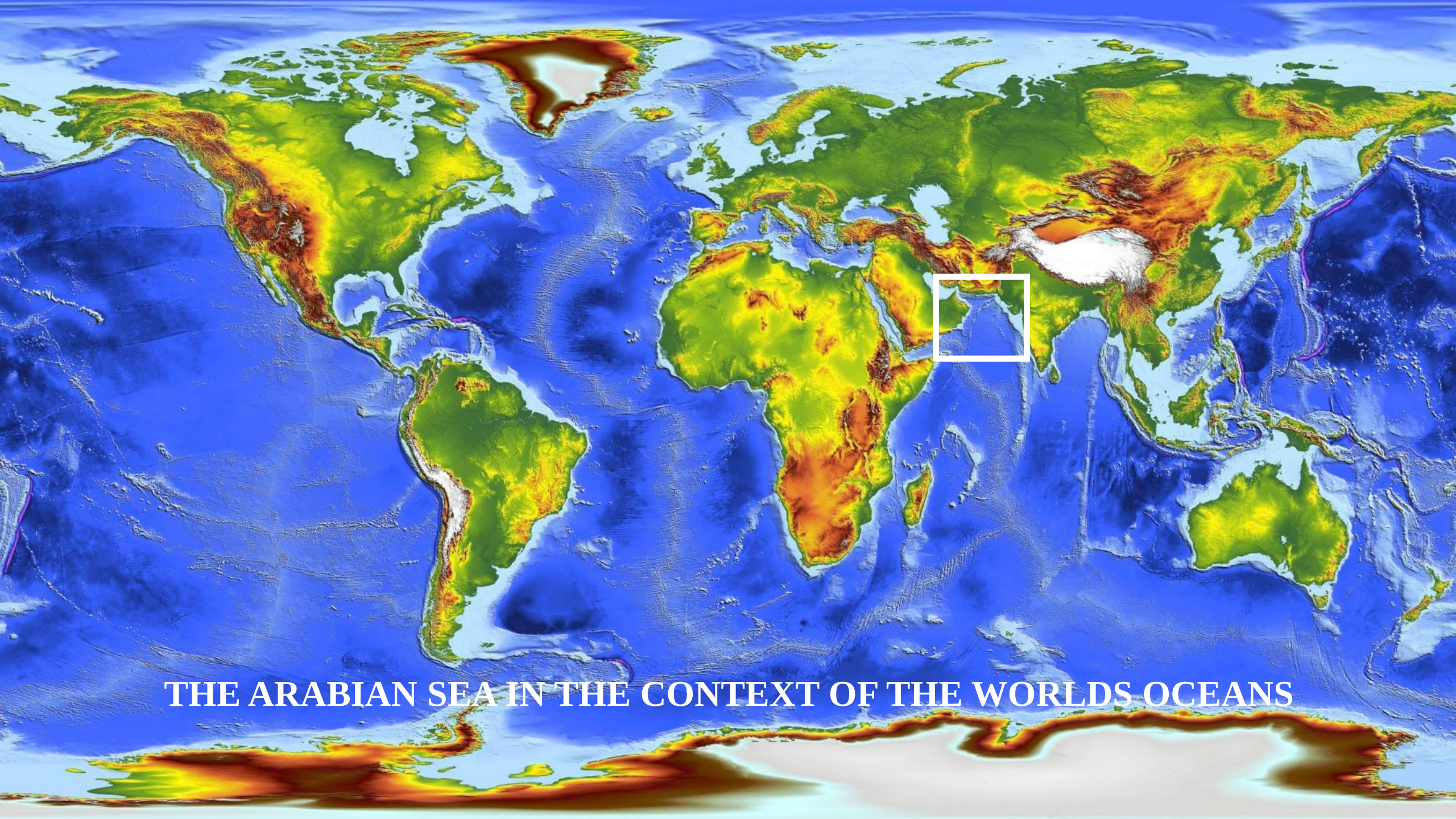



Decision and Information System for the Coastal waters of Oman (DISCO) – An integrative tool for managing coastal resources under changing climate

Joaquim I. Goes, Sergio de Rada, Dale Kiefer, Helga do R. Gomes (USA)

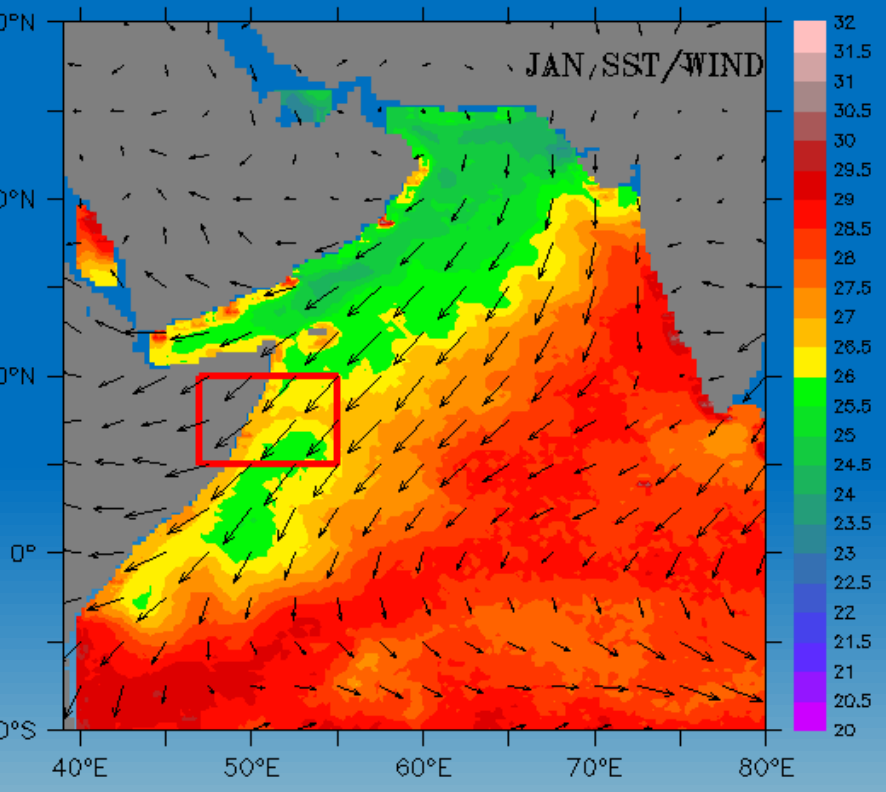
Lubna Al-Kharusi, Adnan Al-Azri and Khalid Al-Hashmi (Oman)

ECOLOGICAL FORECASTING

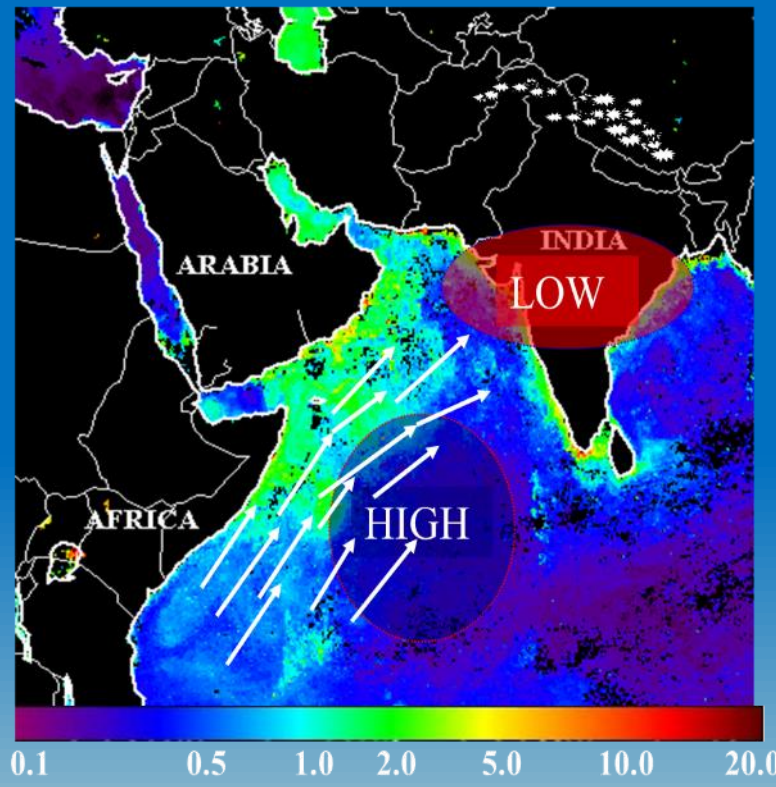

THE ARABIAN SEA IN THE CONTEXT OF THE WORLDS OCEANS

ARABIAN SEA

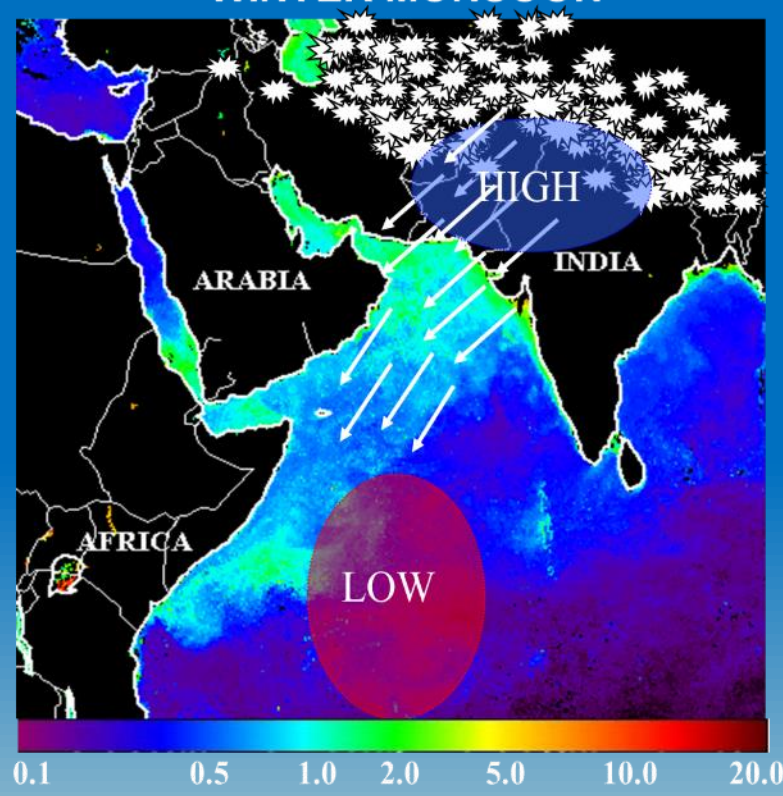
MONSOONAL WIND DRIVEN CIRCULATION AND PRODUCTIVITY

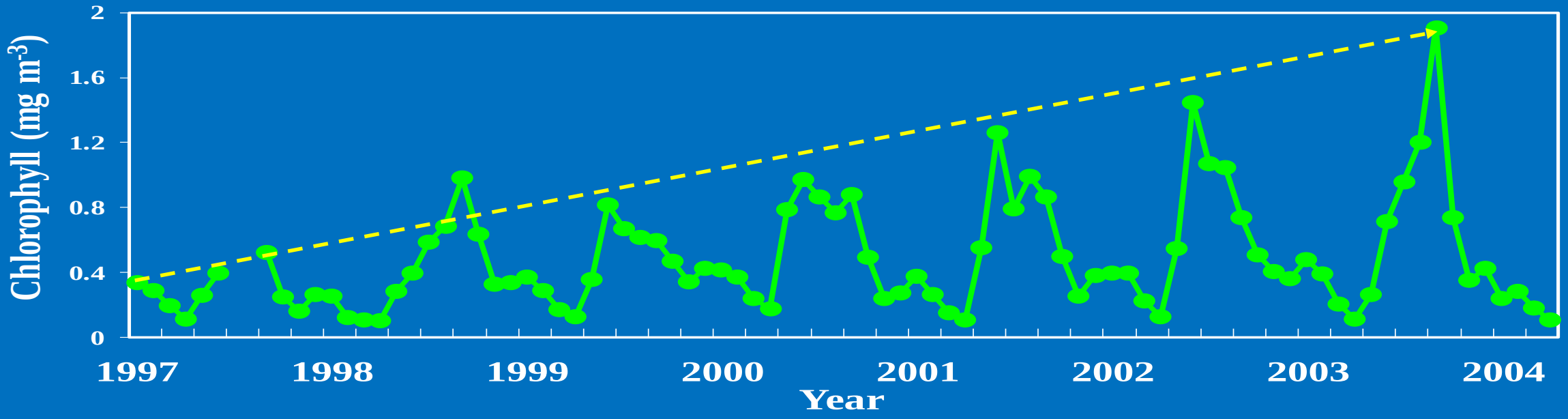


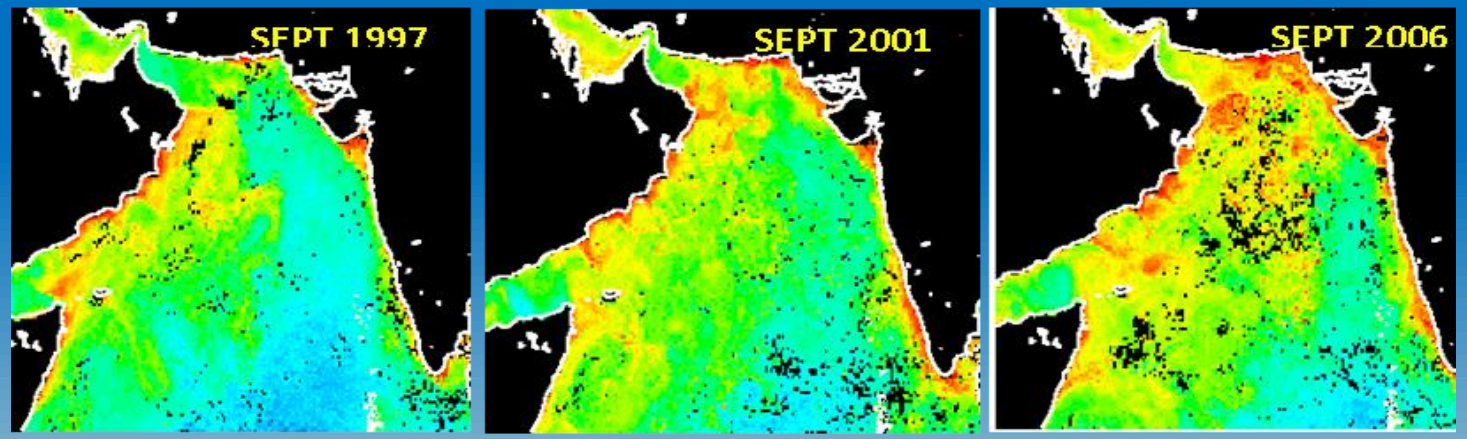
SUMMER MONSOON



WINTER MONSOON

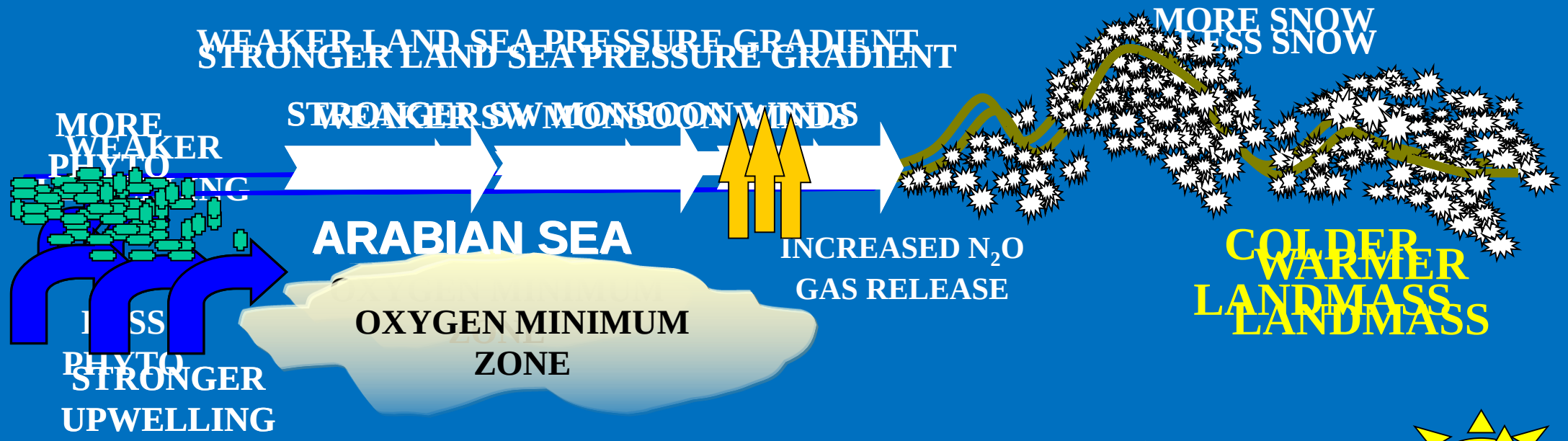




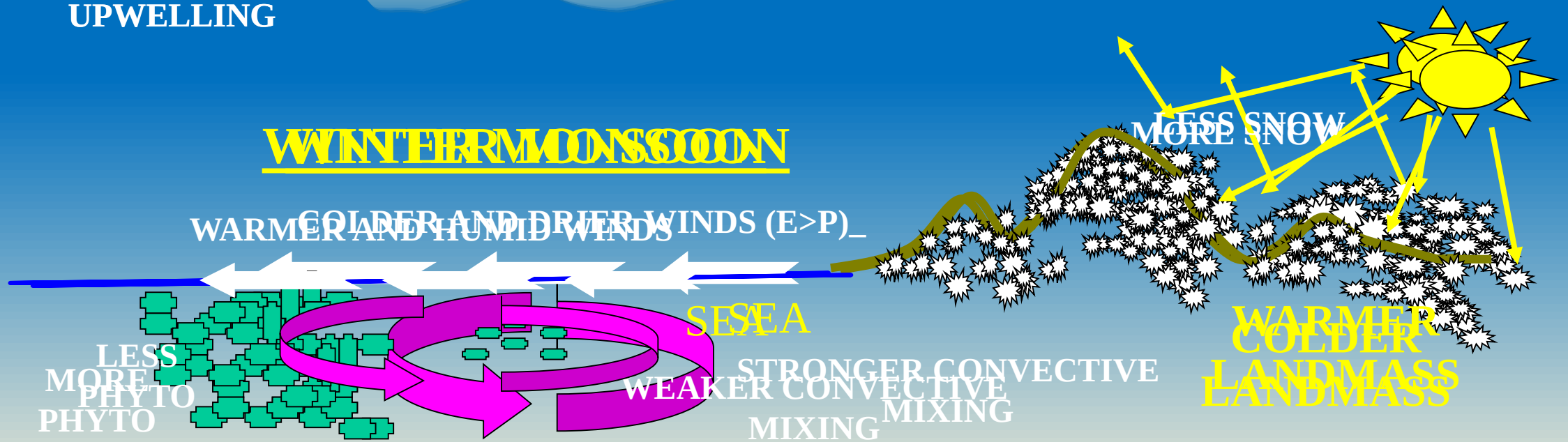


Area averaged in Chl *a* fields in the core of the upwelling during the peak southwest monsoon. The intensification of winds and coastal upwelling was linked to reduction in size of snow caps in the Himalayan-Tibetan Plateau (*Goes et al. Science, 2005*).

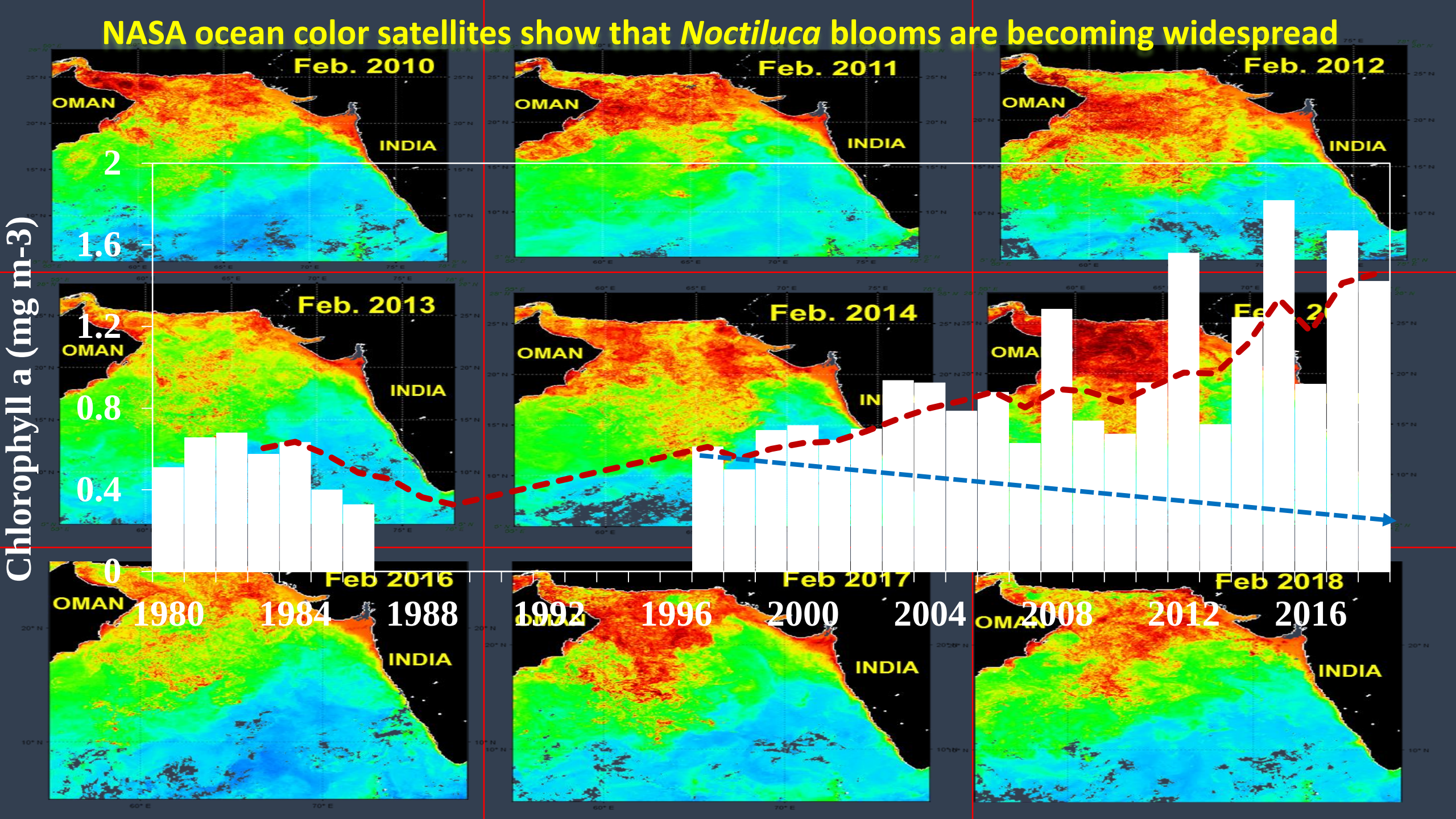
SUMMER MONSOON

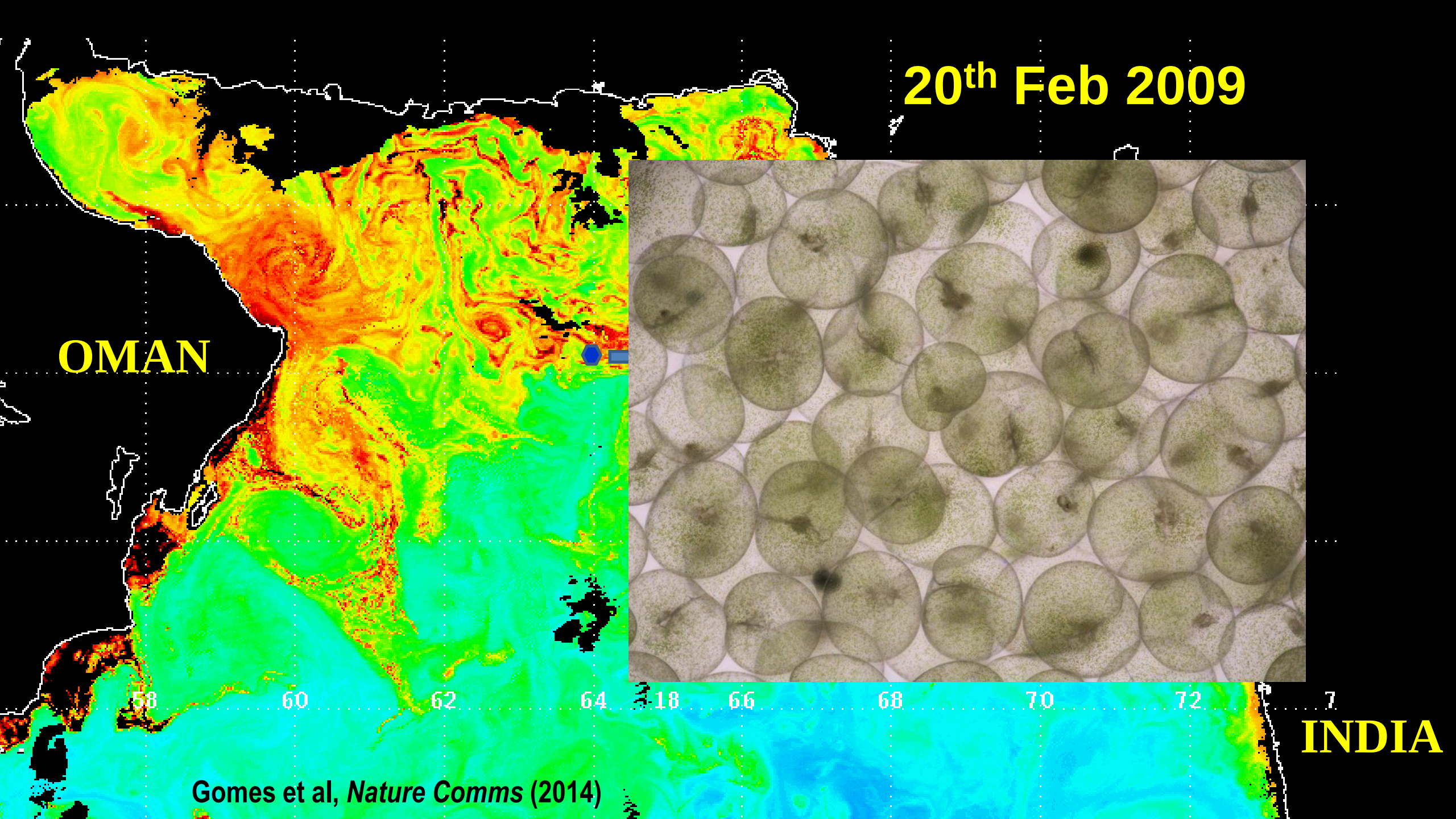


WINTER MONSOON

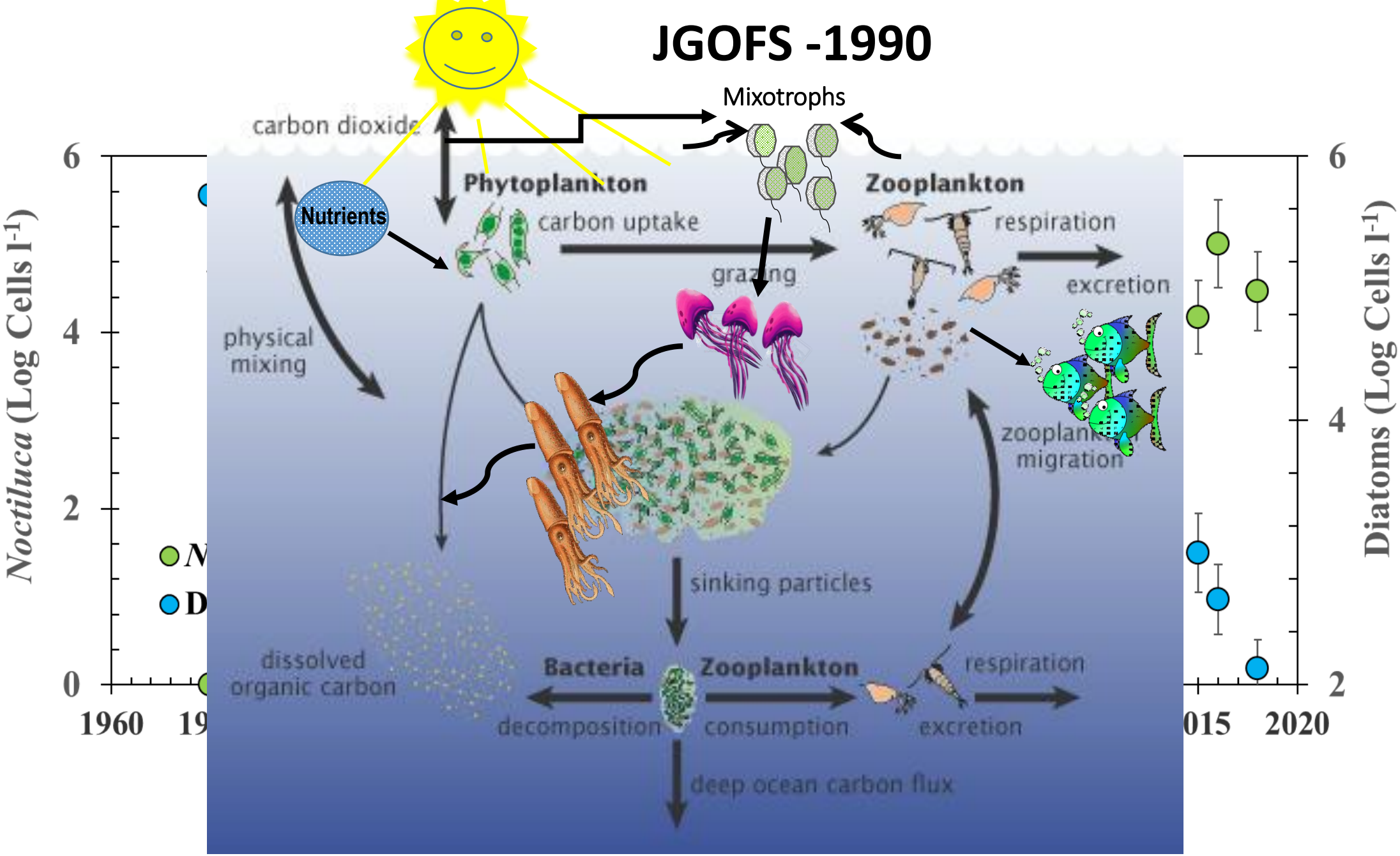


NASA ocean color satellites show that *Noctiluca* blooms are becoming widespread



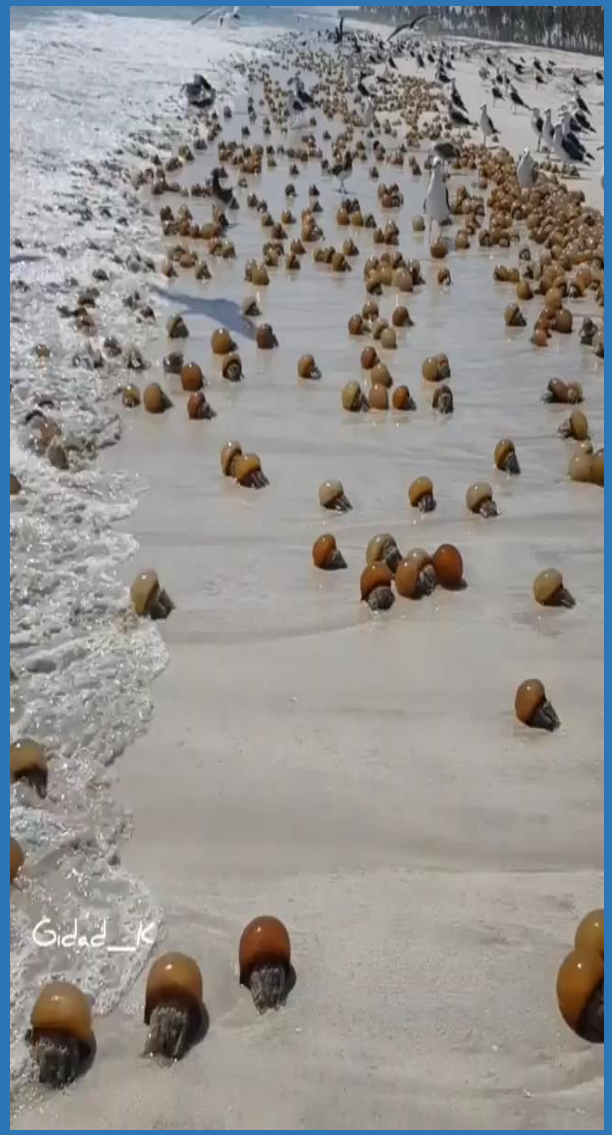


Gomes et al, *Nature Comms* (2014)



Changing food web of the Arabian Sea (Goes et al. *Sci. Rep.* 2020)

Noctiluca blooms are short-circuiting the Arabian Sea's food chain

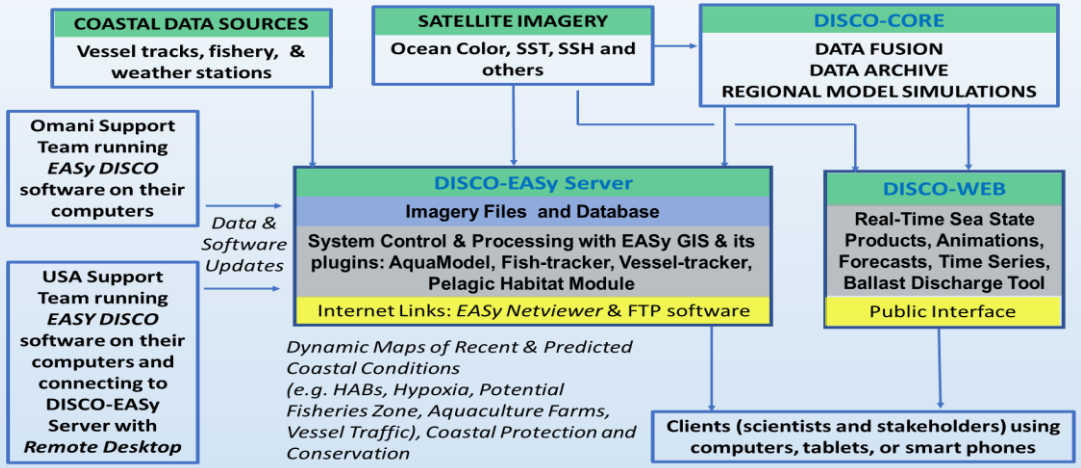


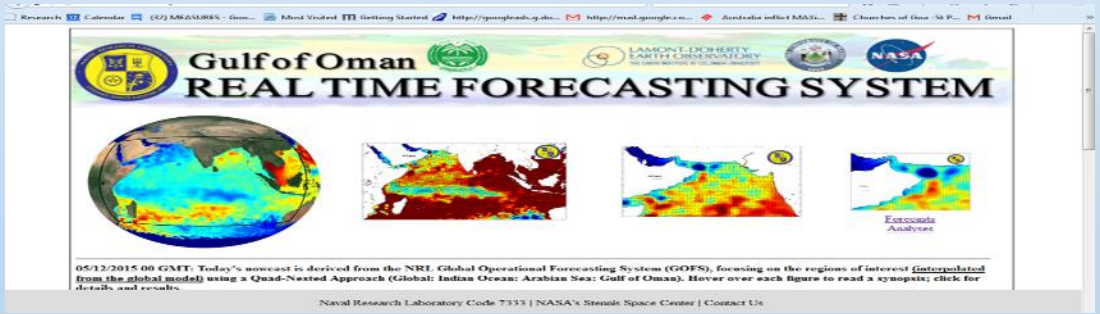
Salalah, Oman 2019

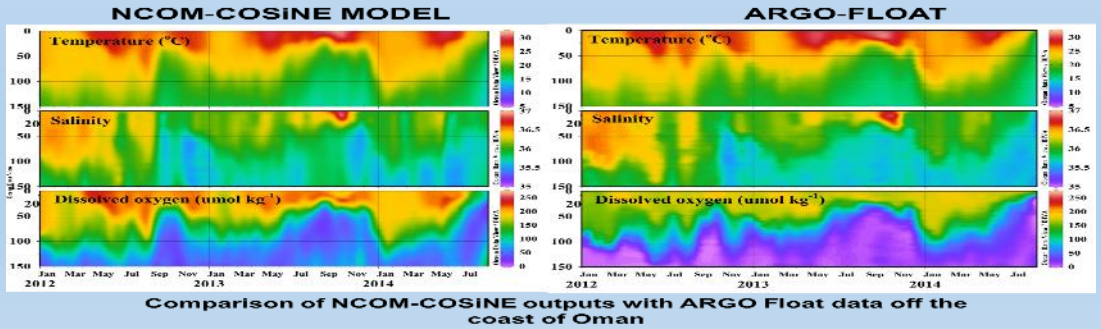
Musandam, Oman 2019

Fishing in the Arabian Sea 2019
and intake at industrial plat

DISCO- An Operational Capability for Forecasting Environmental Threats to Coastal Resources

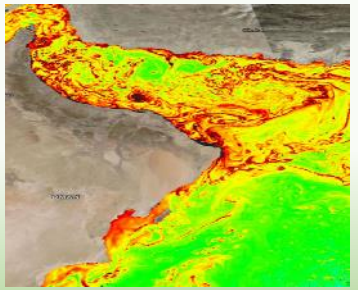


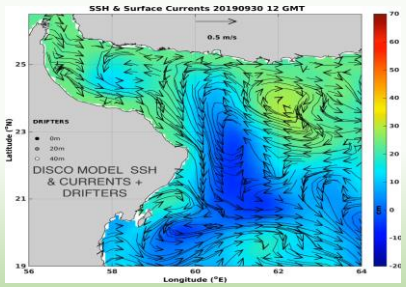




Comparison of NCOM-COSINE outputs with ARGO Float data off the coast of Oman

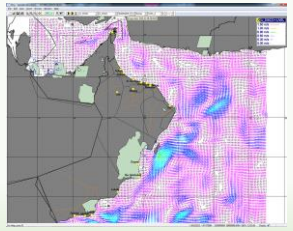
FIELD OBSERVATIONS, CROWD SOURCING, SATELLITE DATA AND NCOM-COSiNE MODEL OUTPUTS



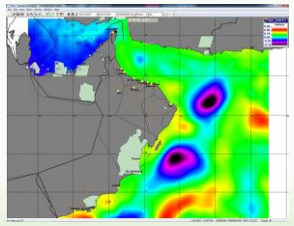


DISCO-EASy DATA INTEGRATION, ANALYSIS AND DECISION SUPPORT TOOLS

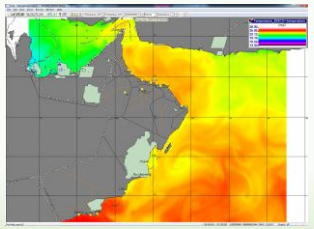
SEA SURACE CURRENTS



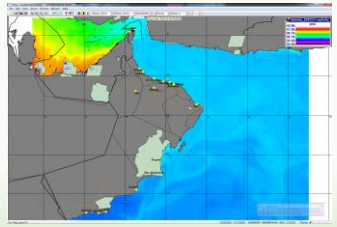
SEA SURACE HEIGHT



SEA SURACE TEMPERATURE



SEA SURACE SALINITY



Among key data sources utilized by DISCO are satellite imagery and output from our 3-D biogeochemical model. Satellite imagery includes SST, SSH, ocean color and wind speed, providing a continuous stream of data on circulation, hypoxia and algal bloom outbreaks and trajectories.

DESALINATION PLANTS

OIL REFINERIES

ARTISANAL FISHERIES

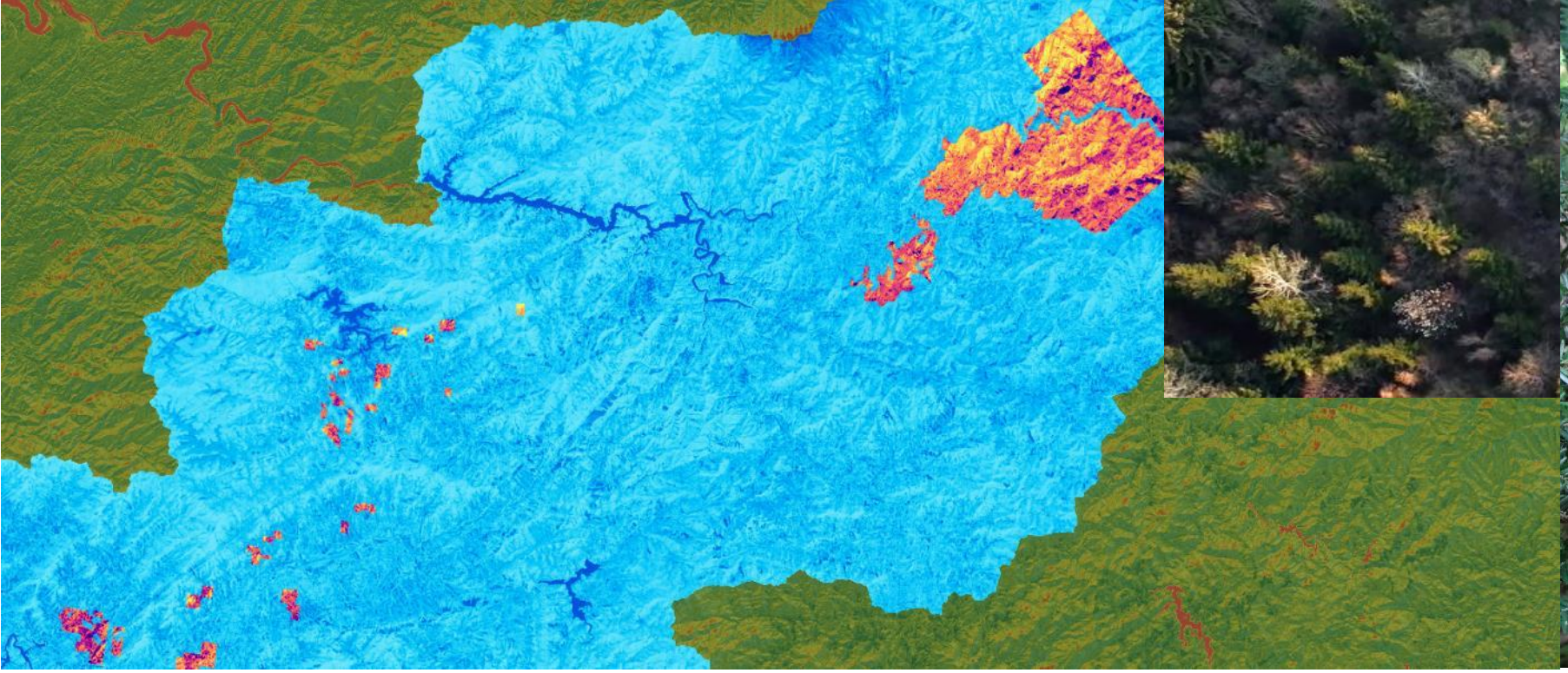
AQUACULTURE FARMS

Oman's economy is intertwined with its coastal resources. Blooms of *Noctiluca* and jellyfish swarms threaten Oman's desalination plants and cooling water for industry such as oil refineries. Blooms and hypoxia damage artisanal fishing and fish aquaculture farms.

Thank You

For further questions, please contact:
jig@ldeo.columbia.edu

ECOLOGICAL FORECASTING



Cherokee Water Resources:

Mapping Forest Health and Hemlock Tree Composition Using NASA Earth Observations to Enhance Drought and Watershed Health-Related Forest Management for the Eastern Band of the Cherokee Indians

Wilson Goode*, Travis Newton, Chloe Schneider, Richard Murray

CAPACITY BUILDING

COMMUNITY CONCERNS & PROJECT PARTNERS

The hemlock woolly adelgid (HWA) has caused widespread hemlock mortality throughout the Appalachians. The Eastern Band of Cherokee Indians Natural Resources Department wanted to investigate how hemlocks have been effected in their area to enhance forest management techniques.

Project partner: Eastern Band of Cherokee Indians (EBCI) Natural Resources Department

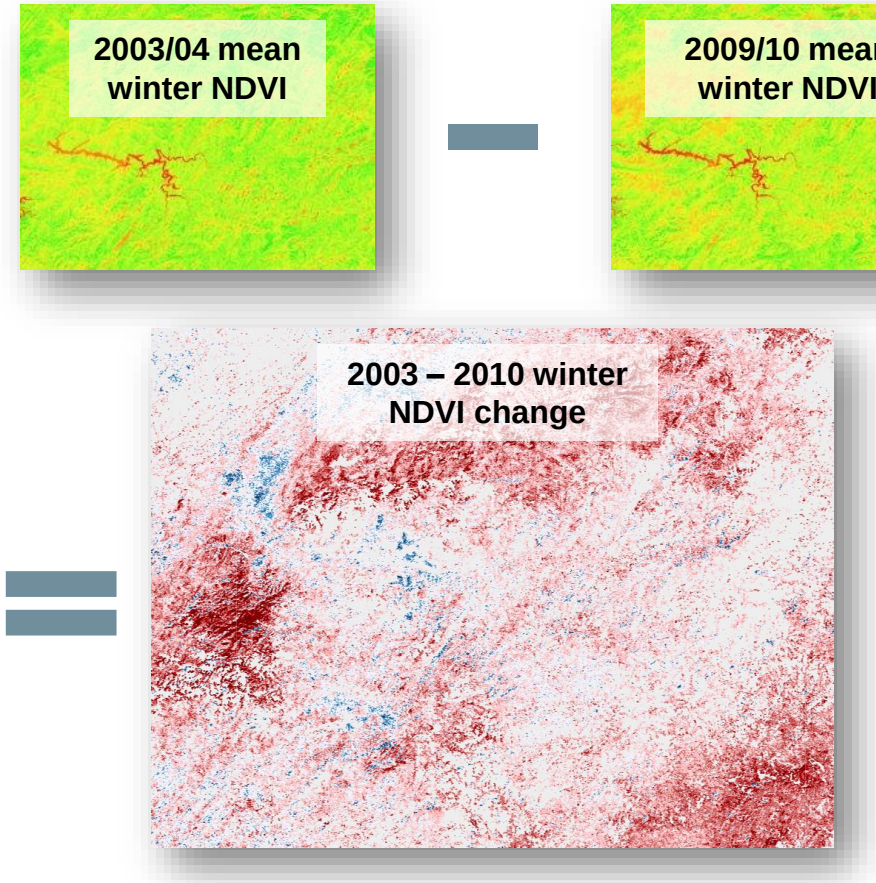
Concern: Decline of hemlocks due to HWA

Goal: Introduction and case-study of some remote sensing methods for forest management that the EBCI could implement.

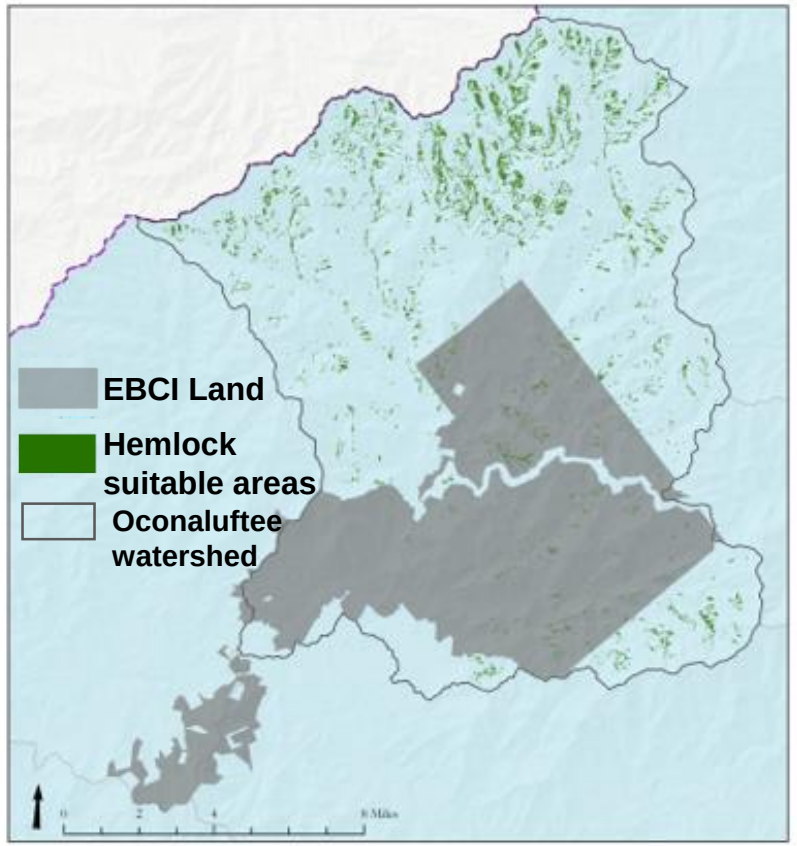
Images: *top* - Mary Pahlke (Pixabay), *bottom* - Steve Norman (USDA Forest Service, Eastern Forest Environmental Threat Assessment Center)

METHODS

To identify potential hemlock change over time, the team produced NDVI change maps from 2003-2010 winter images.

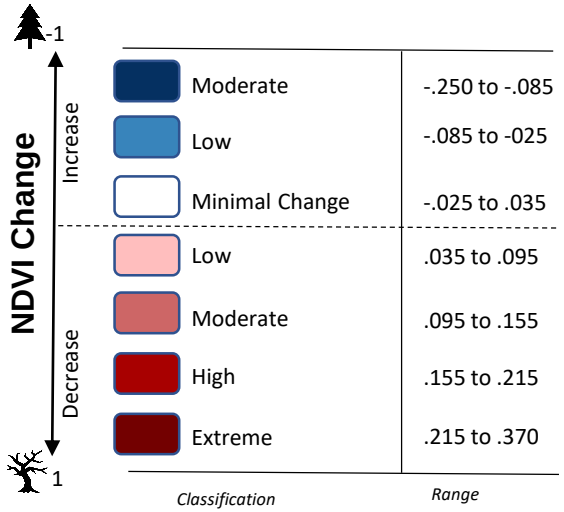


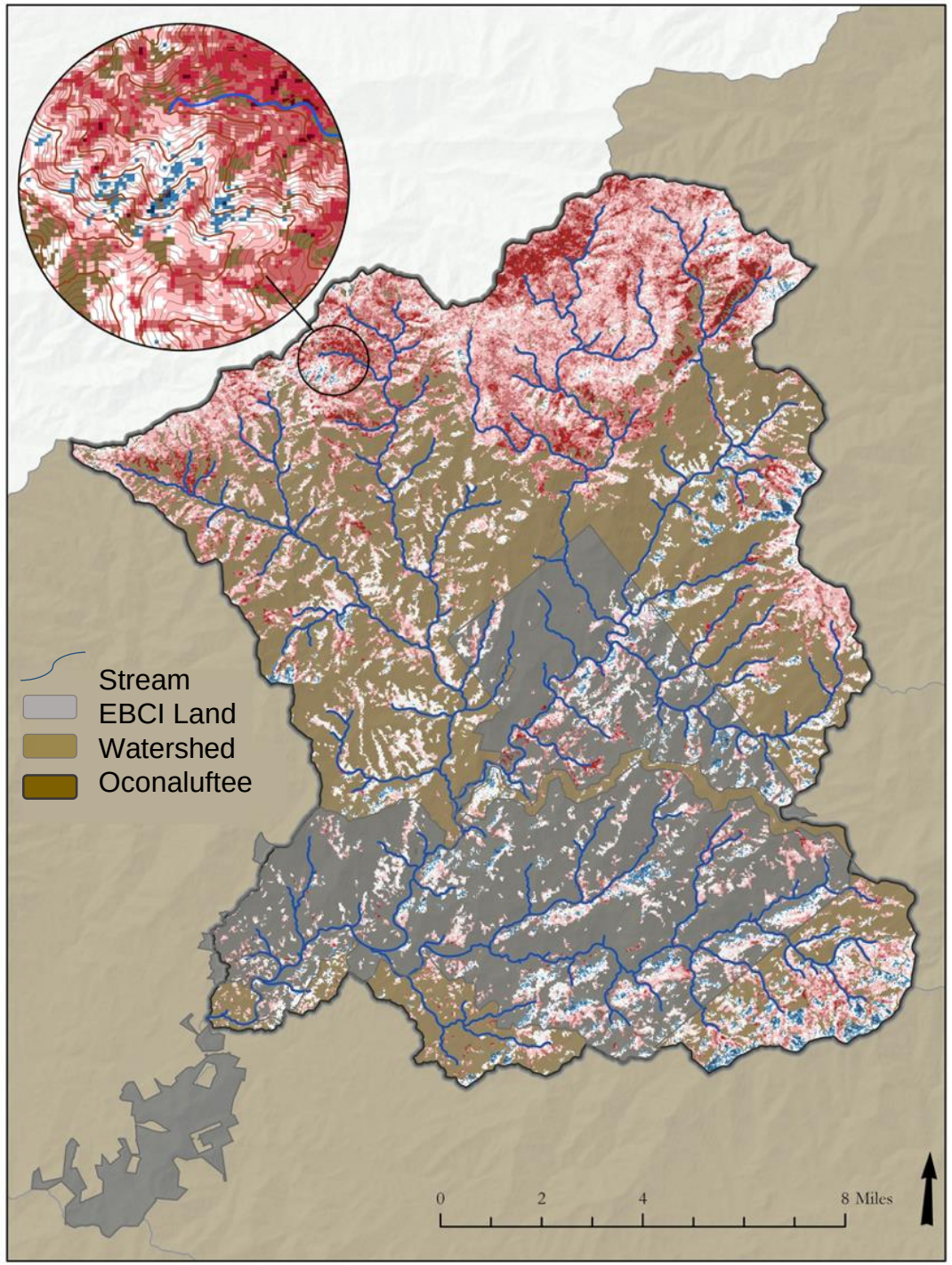
To map areas of favorable conditions for hemlock, the team assessed user-identified suitability criteria through a weighted suitability analysis.



CONCLUSIONS

- Almost **2/3 of evergreen and mixed forest** in the Oconoluftee watershed exhibited a **decrease in winter NDVI** from 2003-2010.
- **28% of the evergreen forests** in the Oconaluftee contained areas that were **suitable for hemlock** based on the example weighted suitability analysis.
- Between **4.5 - 9.5%** of Oconaluftee land was hemlock suitable land in 2018.





"We always try to tie everything to our culture, language, revitalization, and I think protecting our natural resources is our vital link to those things. So, any of the information this develops can help us do that."

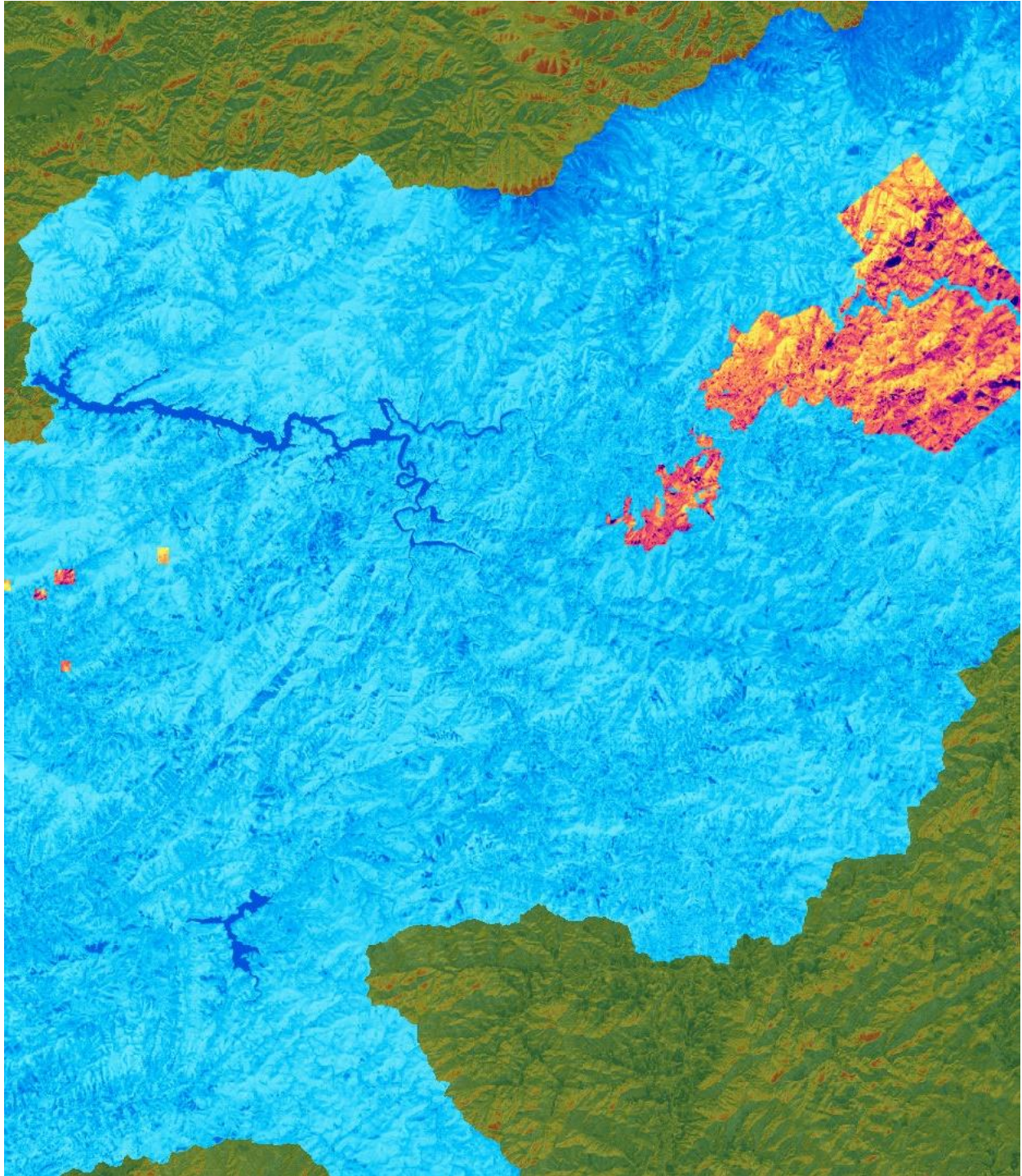
- Dr. Caleb Hickman, *Supervisory Fisheries & Wildlife Biologist, EBCI Natural Resources*

Thank You.

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

https://develop.larc.nasa.gov

EARTH SCIENCE
APPLIED SCIENCES

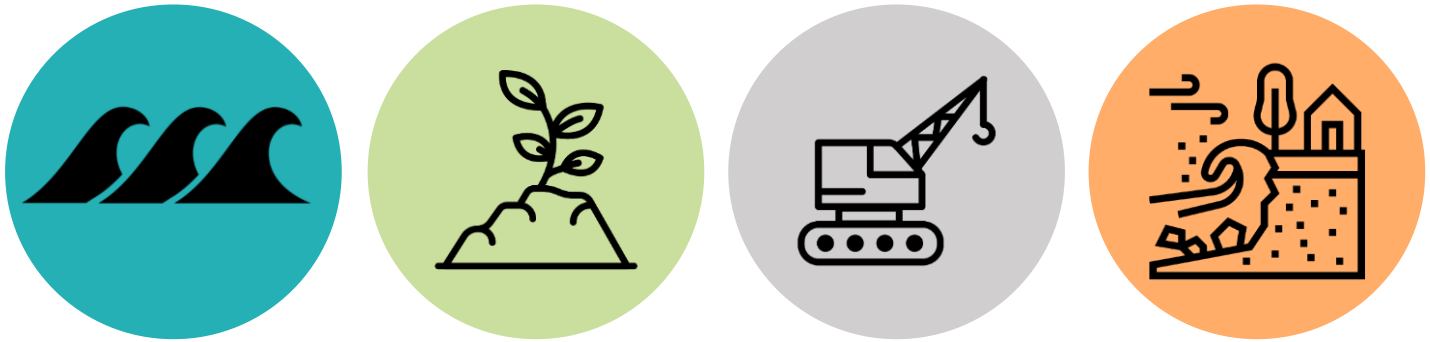


South Carolina Water Resources:
Utilizing Airborne and Space-Based Remote Sensing Imagery to Implement the Unvegetated-Vegetated Ratio to Assess Salt Marsh Vulnerability in South Carolina

Jake Stid*, Elspeth Gates, Derek Nguyen & Adriana Le Compte

CAPACITY BUILDING

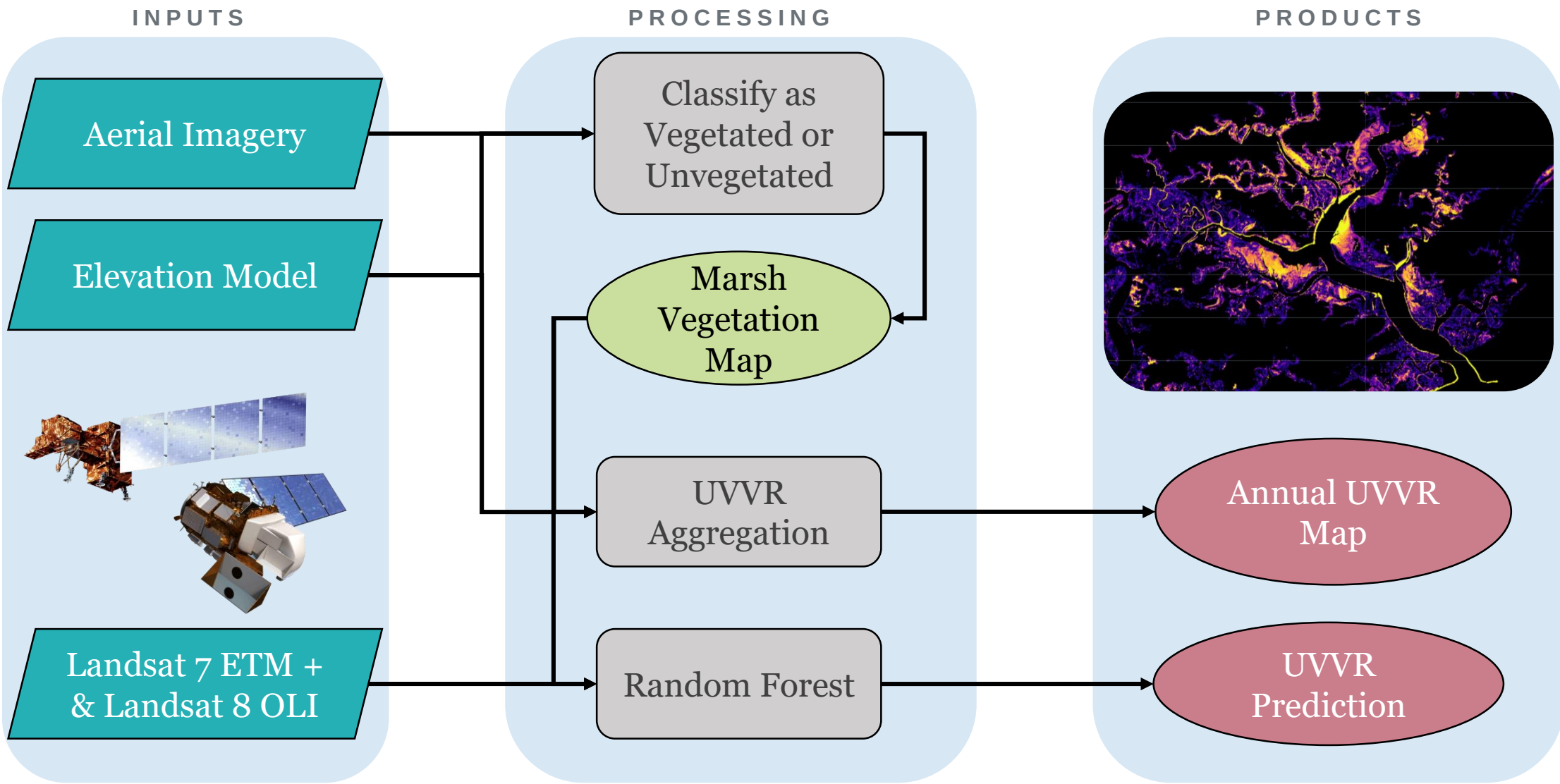
COMMUNITY CONCERNS & PROJECT PARTNERS



- South Carolina Department of Natural Resources
- USGS Woods Hole Coastal and Marine Science Center
- South Carolina Department of Health and Environmental Control

Icons by Nathaniel Diesel, Philipp Petzka, Wichai Wi & Ben Davis

EARTH OBSERVATIONS AND METHODS



High UVVR
(less vegetation)

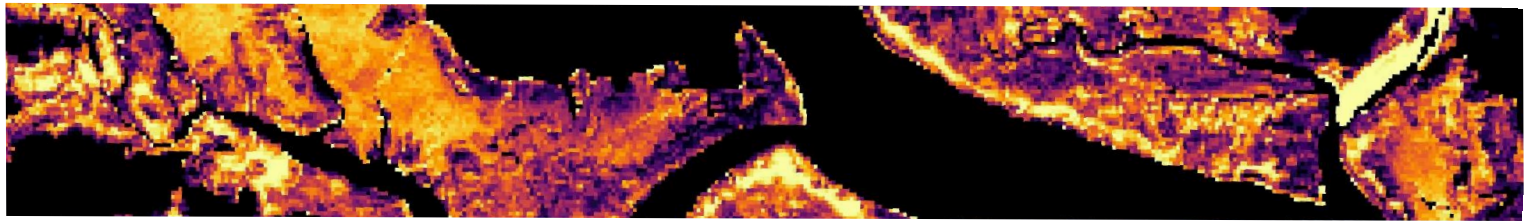
Low UVVR
(more vegetation)

High Probability of Prediction
Correctness (65%)

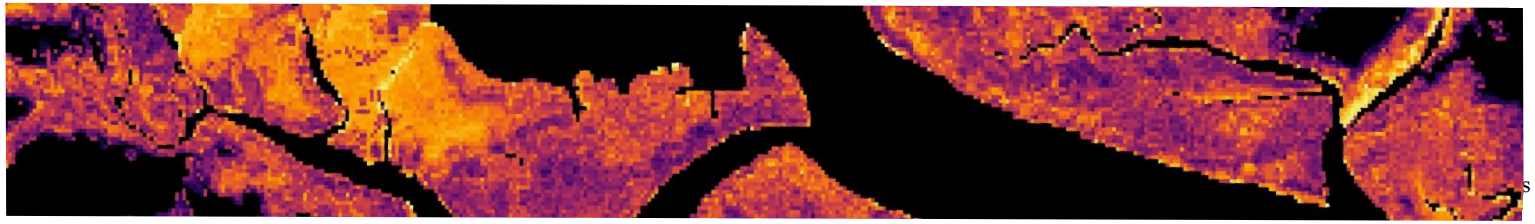
Low Probability of Prediction
Correctness (0.2%)

A. NAIP Natural Color

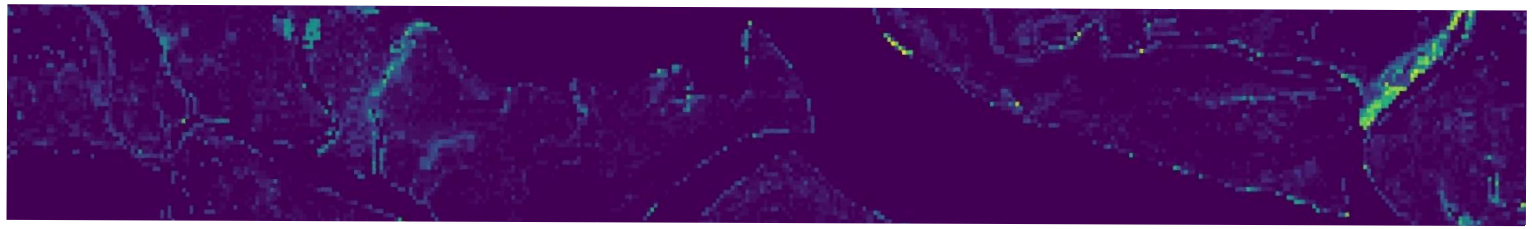
B. UVVR Landsat Aggregate

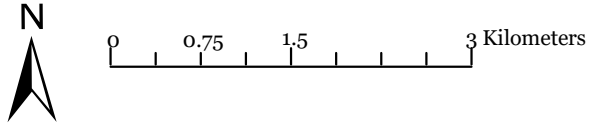


C. Random Forest Regression UVVR Prediction



D. Random Forest Regression Probability





END USER BENEFIT

Identify vulnerable marsh regions to focus preservation

Full coastal UVVR implementation back to 1984

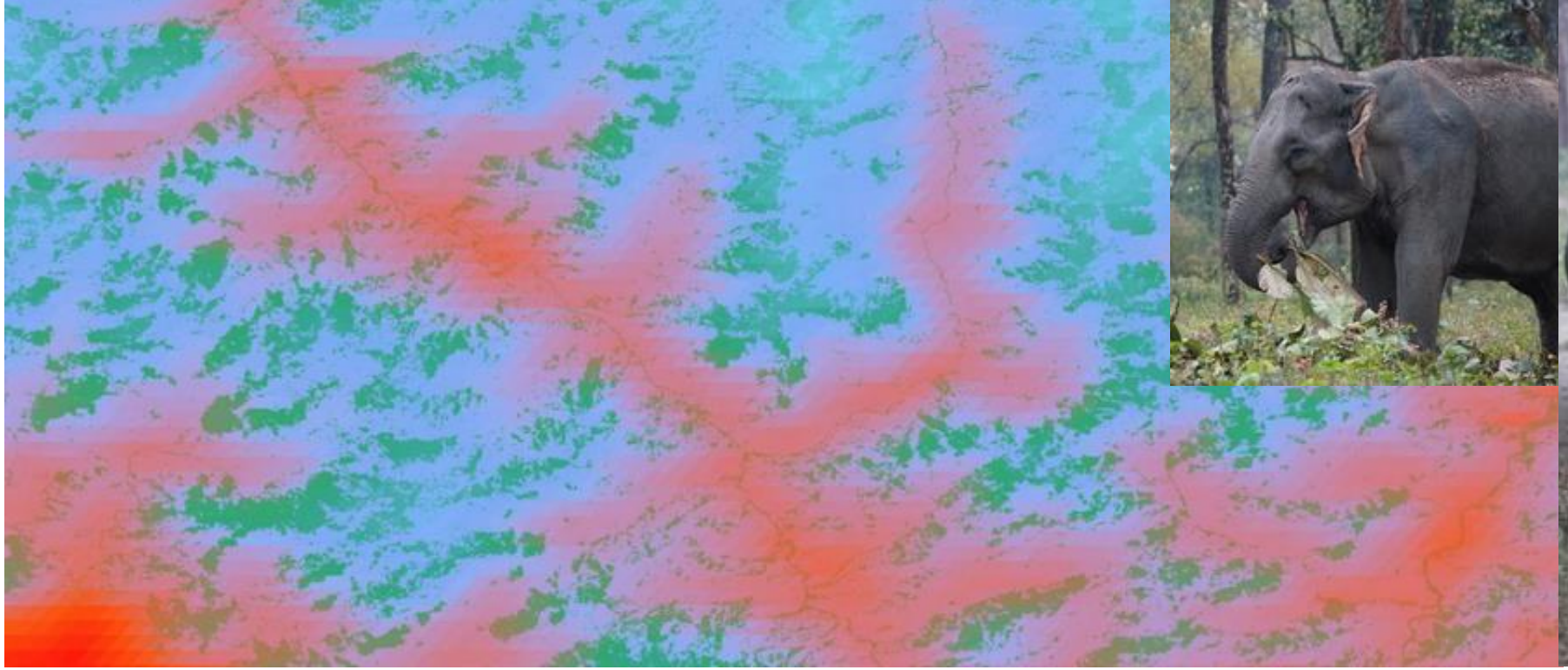
Image: South Carolina Department of Natural Resources

Thank You.

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

https://develop.larc.nasa.gov

EARTH SCIENCE
APPLIED SCIENCES



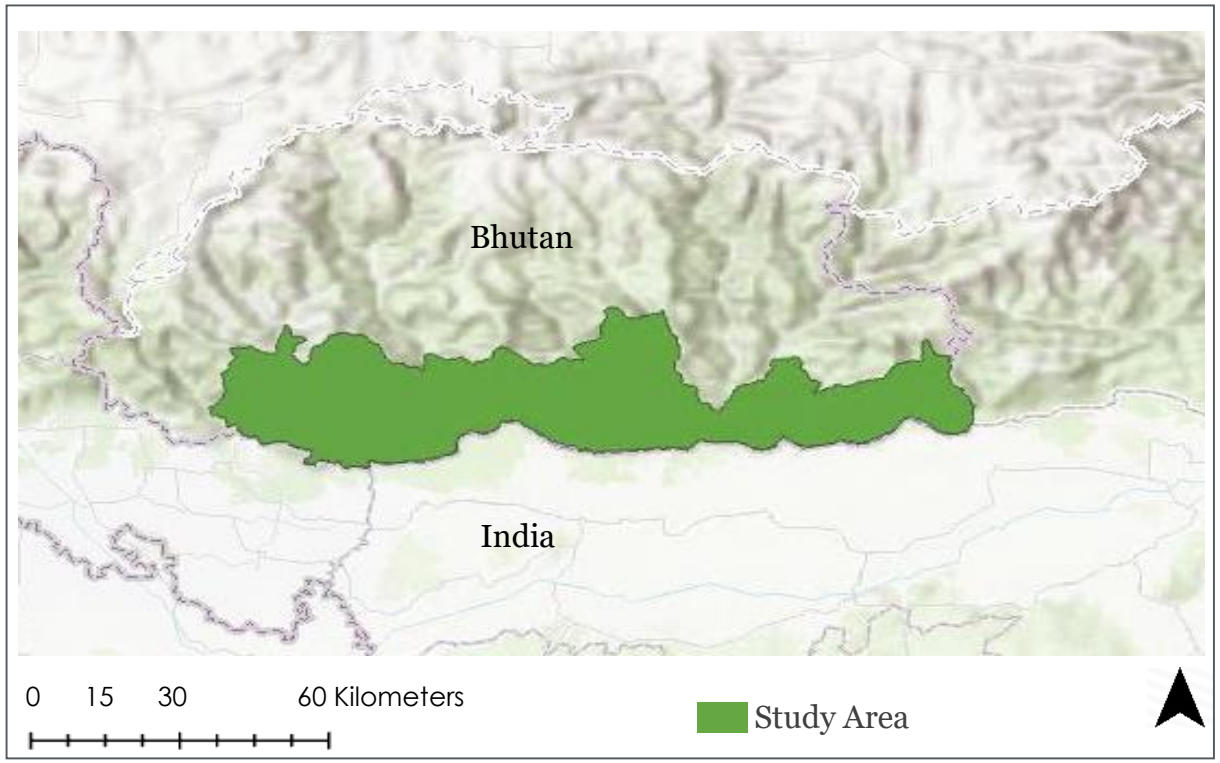
Southern Bhutan Ecological Forecasting:
Modeling Asian Elephant (*Elephas maximus*) Habitat Suitability Along the Southern Bhutan Border with NASA Earth Observations

Palchen Wangchuk*, Tashi Choden, Kuenley Pem Dem,
Sonam Choden, Kelzang Jigme

CAPACITY BUILDING

COMMUNITY CONCERNS & PROJECT PARTNERS

The Asian elephant faces threats of extinction throughout its range mainly due to an increasing number of Human Elephant Conflicts resulting from close proximity of human settlements to forested areas.



- **Partners**:
  - Bhutan Foundation
  - Bhutan Tiger Center
- **Study Area**: Gelephu
- **Study Period**: 1999 - 2019

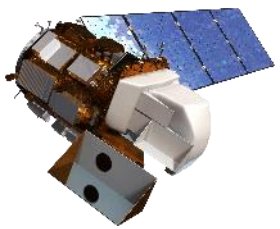
EARTH OBSERVATIONS

Landsat 5

- Land Cover and NDVI

SRTM

- Elevation and Rivers



Landsat 8

- Land Cover and NDVI

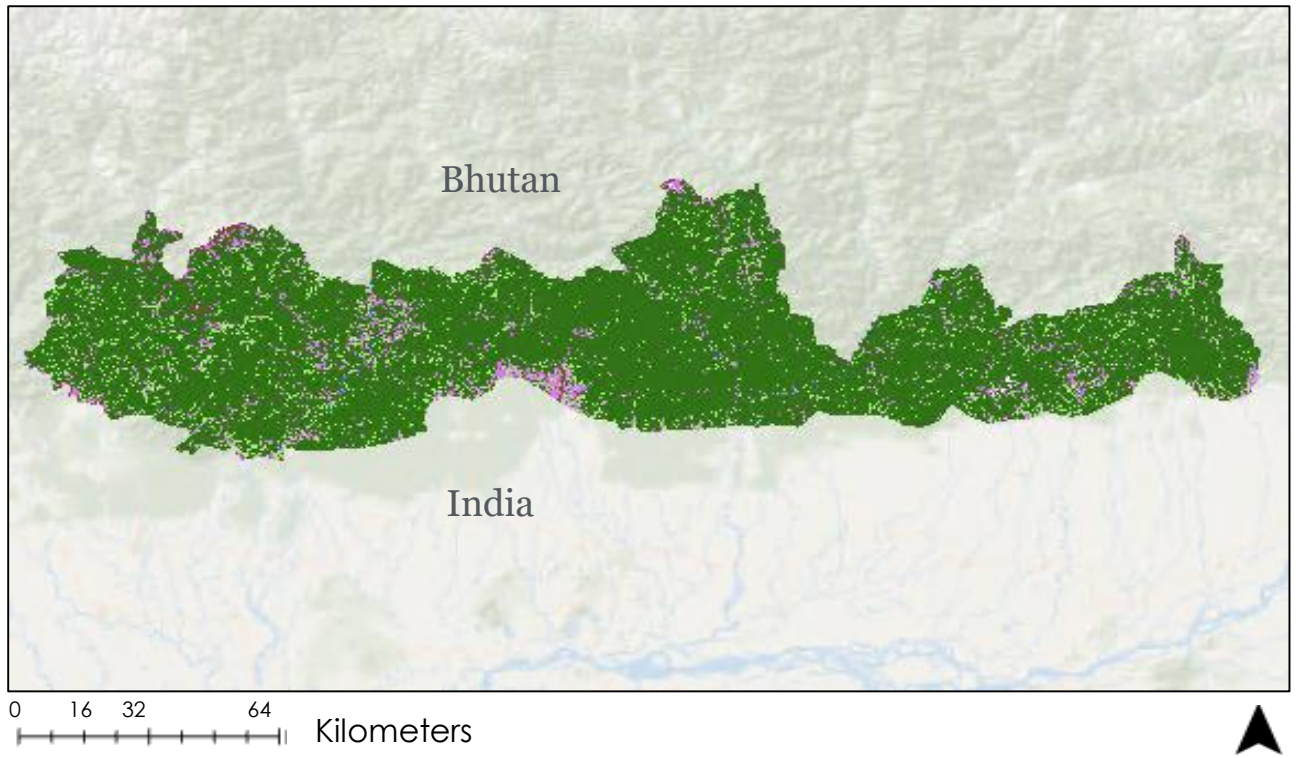
Terra

- Land Surface Temperature

- **SEDAC (Socioeconomic Data and Applications Center)** Population Density
- **CHIRPS (Climate Hazards Group InfraRed Precipitation with Station)** Precipitation

Data Processing & Analysis

- **ArcGIS Pro**
  - Mosaic Landsat Scenes
  - Compute NDVI and Population of the region
  - Create LULC Map
  - Distance to Roads and Rivers
  - Analyze LULC Map
- **Software for Assisted Habitat Modeling**
  - Pre-processing data
  - Formatting data
  - Standardizing data from different sources for modeling
  - Analyze model results



2019 Land Cover Classification

- Immature Forests
- Mature Forests
- Cultivated Area
- Water
- Barren Land
- Snow

Conclusions

- Importance of roads and waterways to elephant occurrence

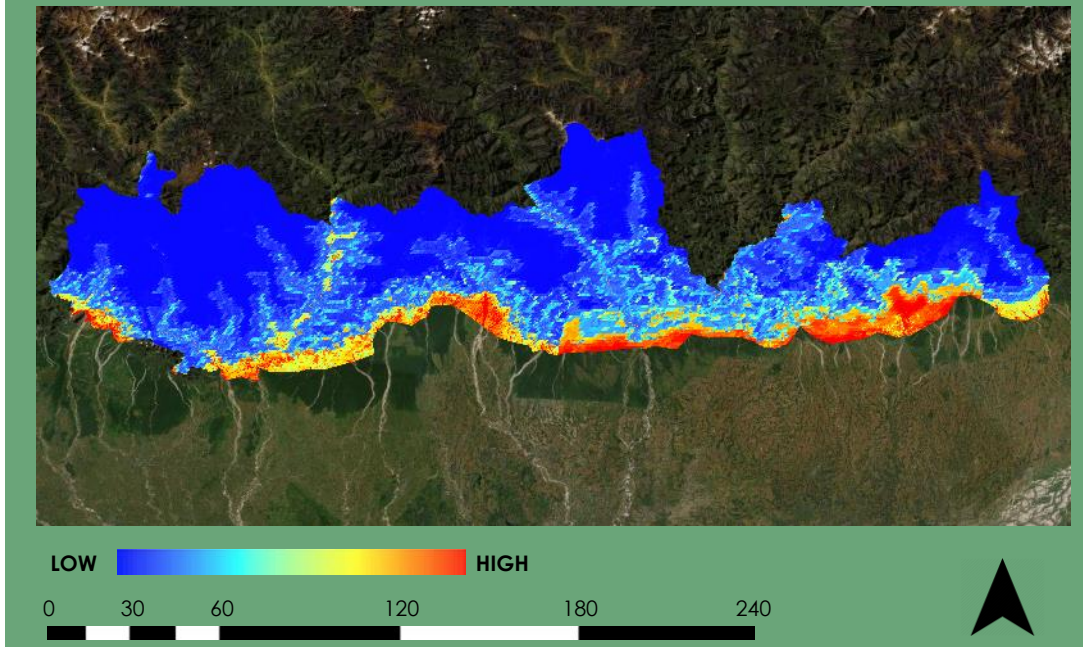
- Habitat Suitability maps suggest where more camera traps can be set up to expand understanding

Future Work

- Habitat suitability analysis for multiple years to increase variety in results to draw from

- Additional data variables should be considered for future models

Boosted Regression Tree Probability Map



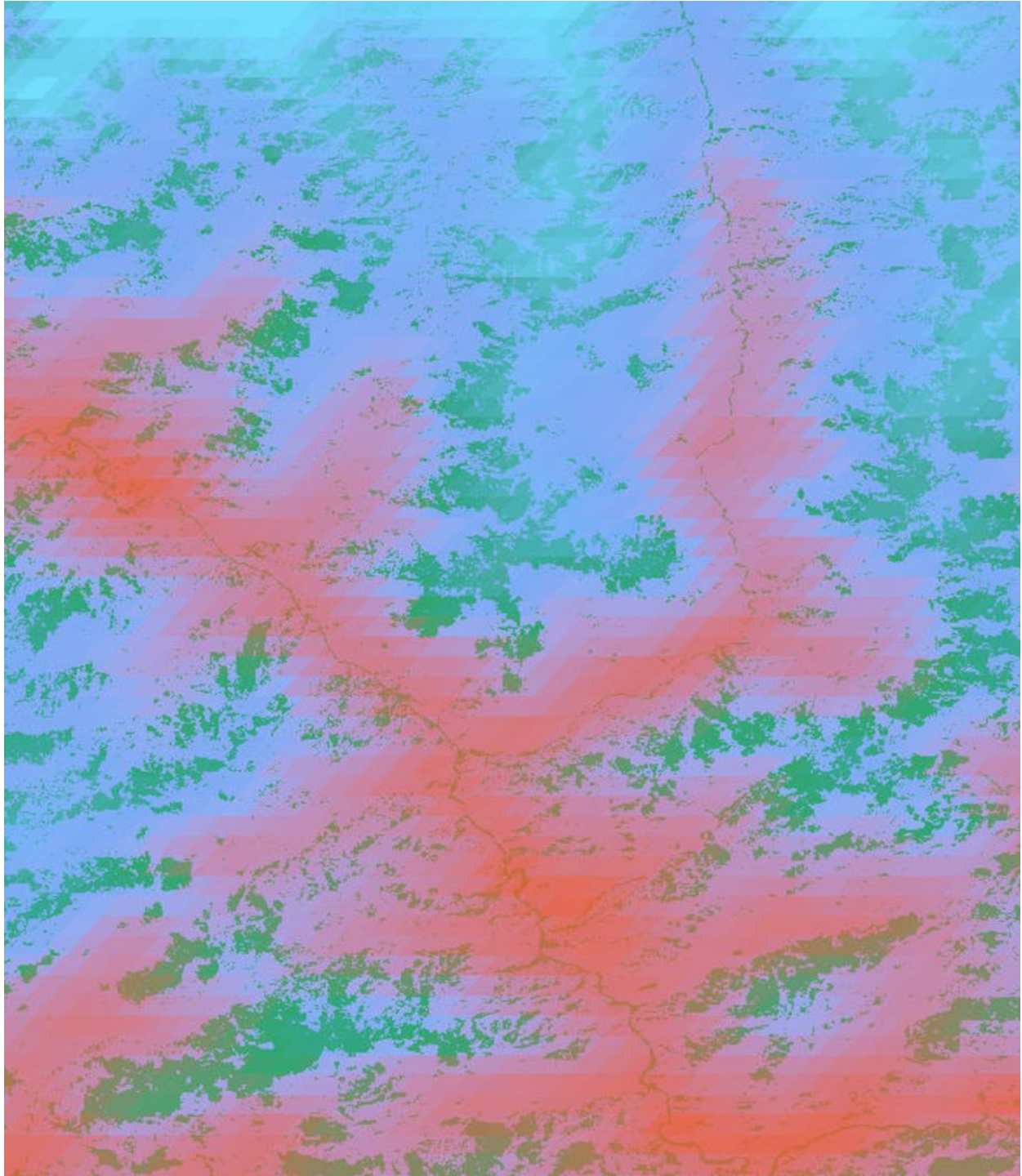
Credit: Adam Singer

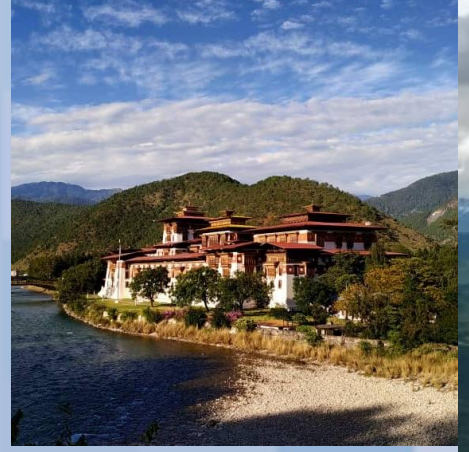
Thank You.

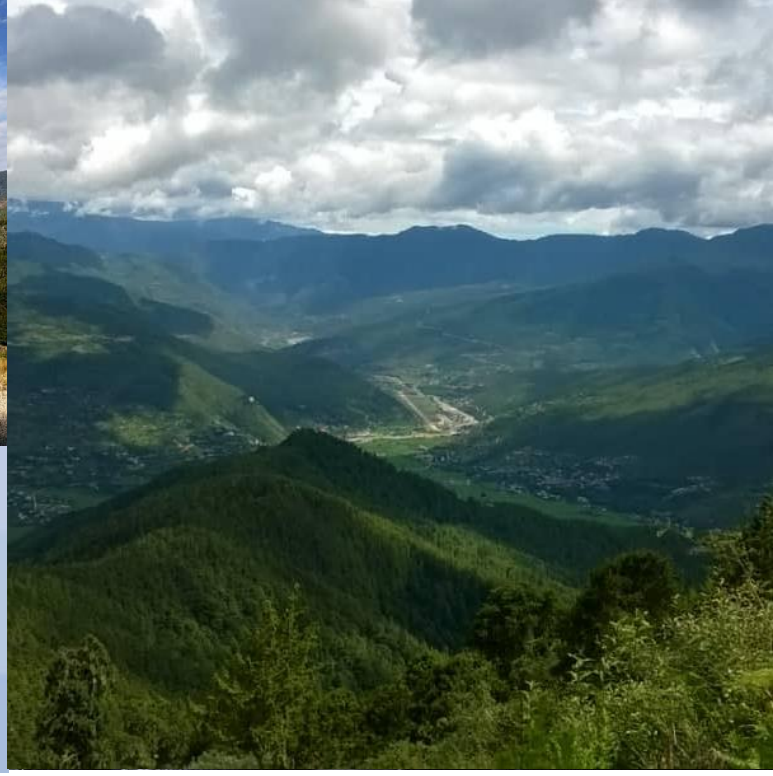
For further questions, please contact us at NASA-DL-DEVELOP@mail.nasa.gov

https://develop.larc.nasa.gov

EARTH SCIENCE
APPLIED SCIENCES







Bhutan Water Resources:
Comparing Precipitation, Temperature, and Phenology Data Trends in Bhutan to Assist the Himalayan Environmental Rhythm Observation and Evaluation System (HEROES) Project

Tashi Kaneko *, Kinley Dorji, Tenzin Wangmo & Deki Namgyal

CAPACITY BUILDING

BACKGROUND

Project Partners

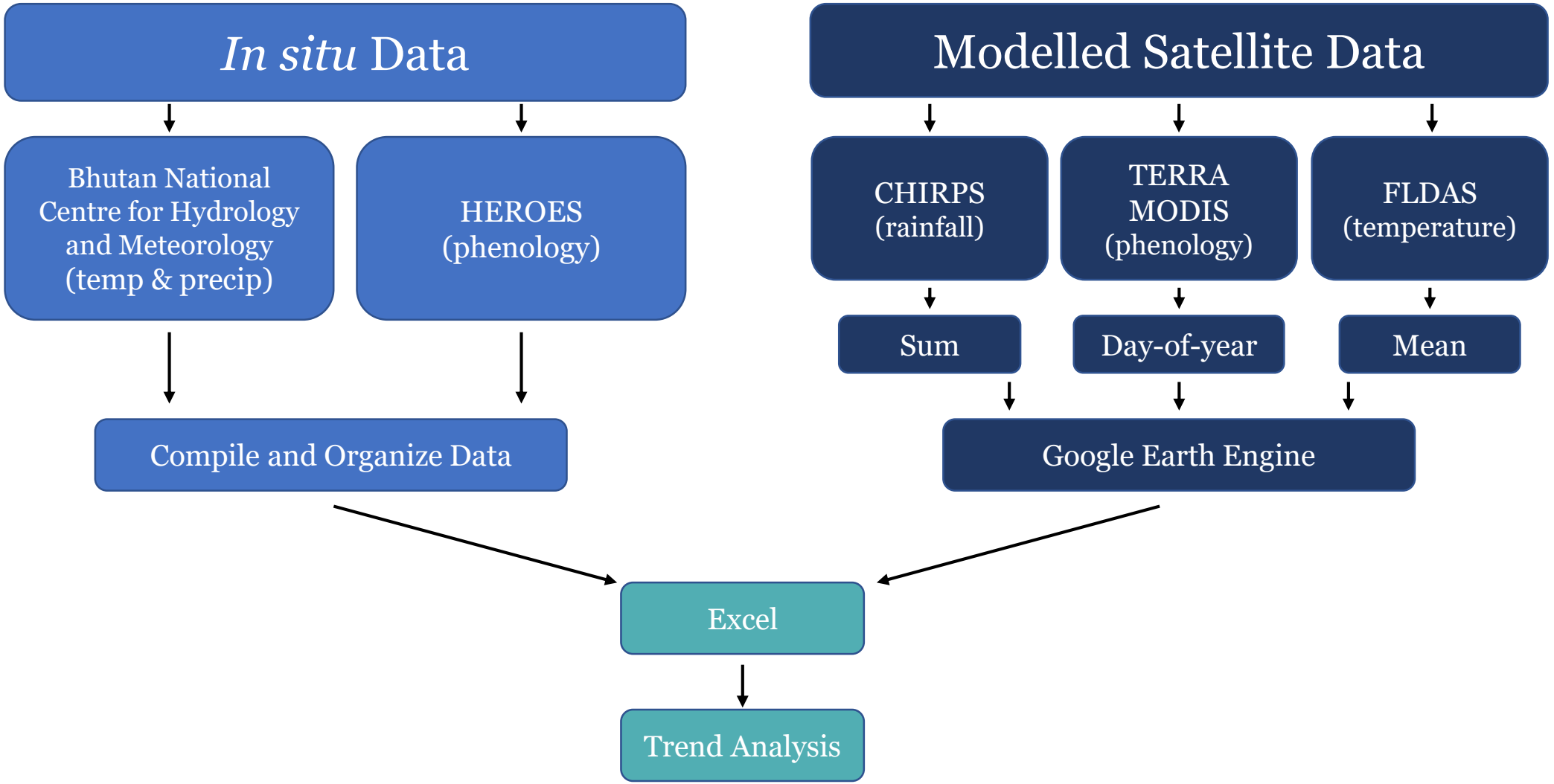
- Bhutan Foundation
- Himalayan Environmental Rhythms Observation and Evaluation System (HEROES) project
- Ugyen Wangchuk Institute for Conservation and Environmental Research (UWICER)

Community Concerns

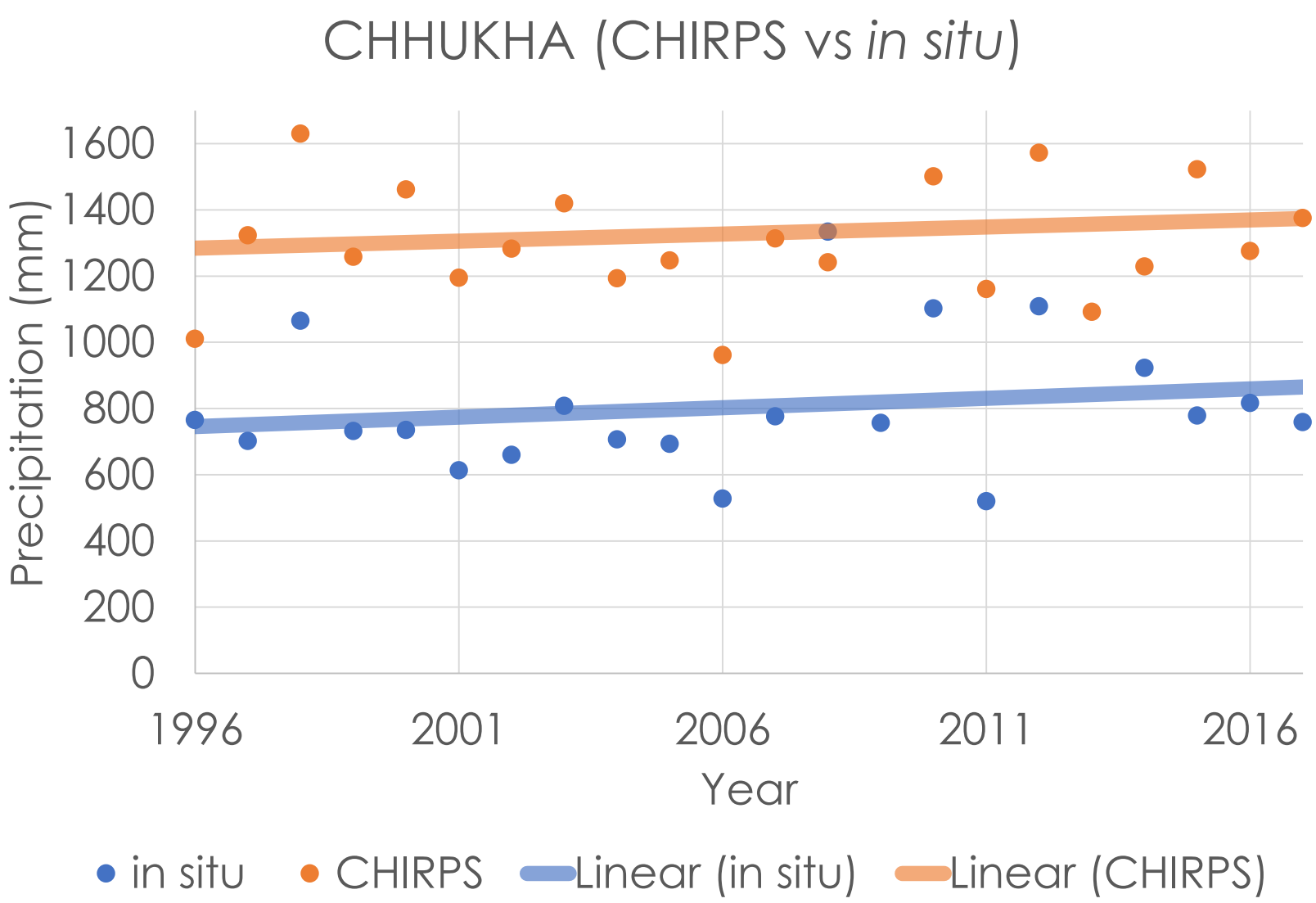
- Increasing potential melt and decreasing likelihood of precipitation falling as snow
- Glacial lake outbursts
- Growing and delayed farming seasons

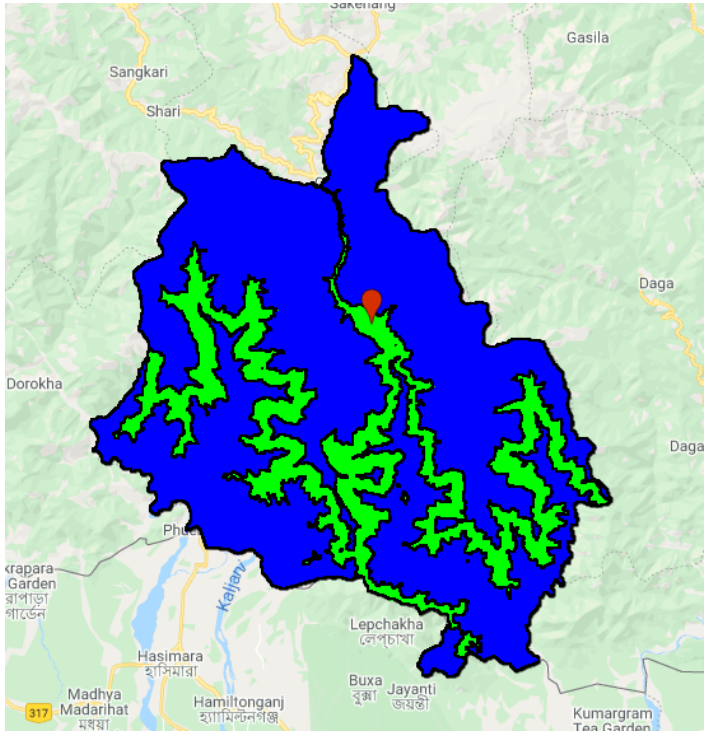
Objectives

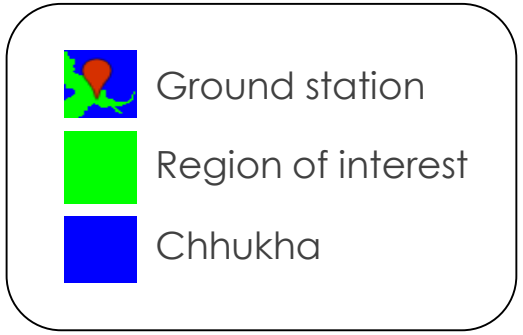
- Provide a trend analysis between *in situ* and modelled satellite data
- Provide satellite data found for phenology and create a trend analysis
- Prepare a foundation for future research


In situ Data
Bhutan National Centre for Hydrology and Meteorology (temp & precip)
HEROES (phenology)
Compile and Organize Data
Modelled Satellite Data
CHIRPS (rainfall)
TERRA MODIS (phenology)
FLDAS (temperature)
Sum
Day-of-year
Mean
Google Earth Engine
Excel
Trend Analysis

RAINFALL RESULTS (CHHUKHA)





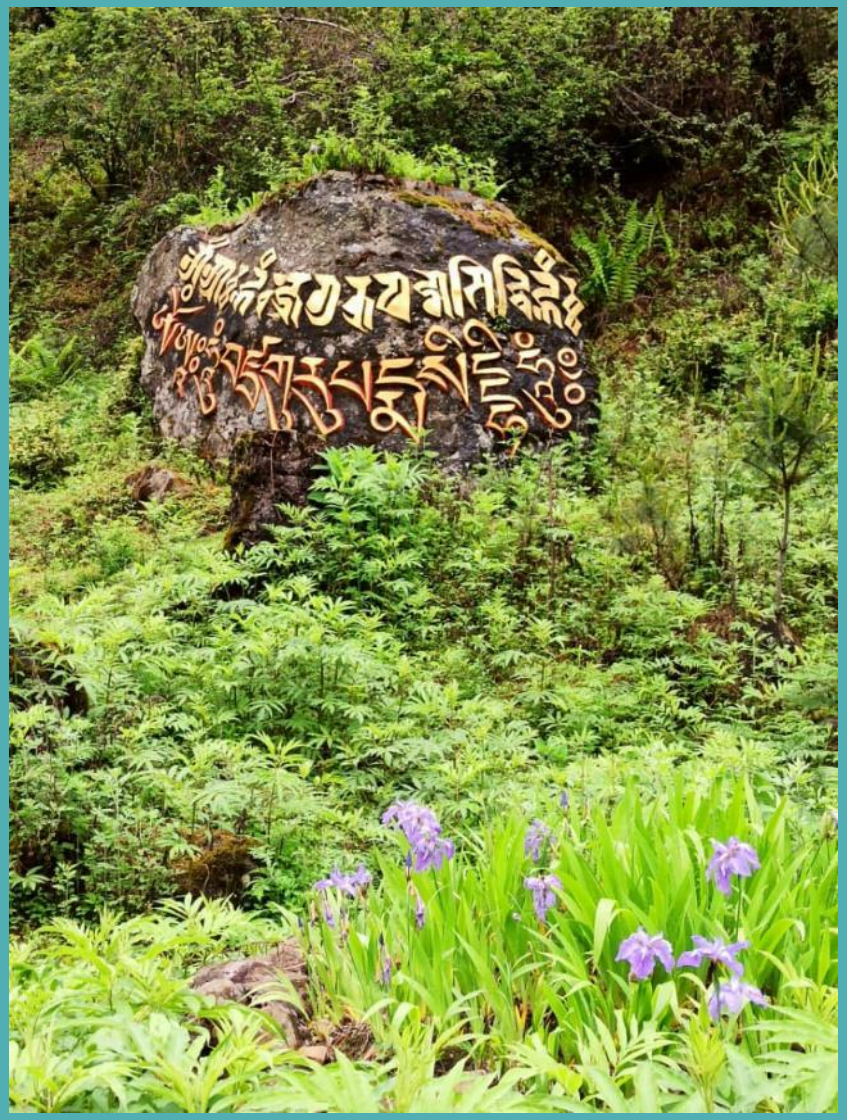


Conclusions

- CHIRPS, FLDAS and MODIS were used to assess trends in precipitation, temperature and phenology
- Satellite precipitation data are challenged in the Himalayas
- Satellite data suggests spring is arriving later

Future work

- Analyze variability in climate trends and its effect on local farmers in Bhutan
- Examine the role of precipitation and temperature in influencing phenological trends
- Use NOAA Advanced Very High Resolution Radiometer (AVHRR) to look at phenology data over past 40 years



Credit: Chuki Gyaltshen

MONITORING SURFACE WATER STORAGE CHANGES OVER LOWER MEKONG

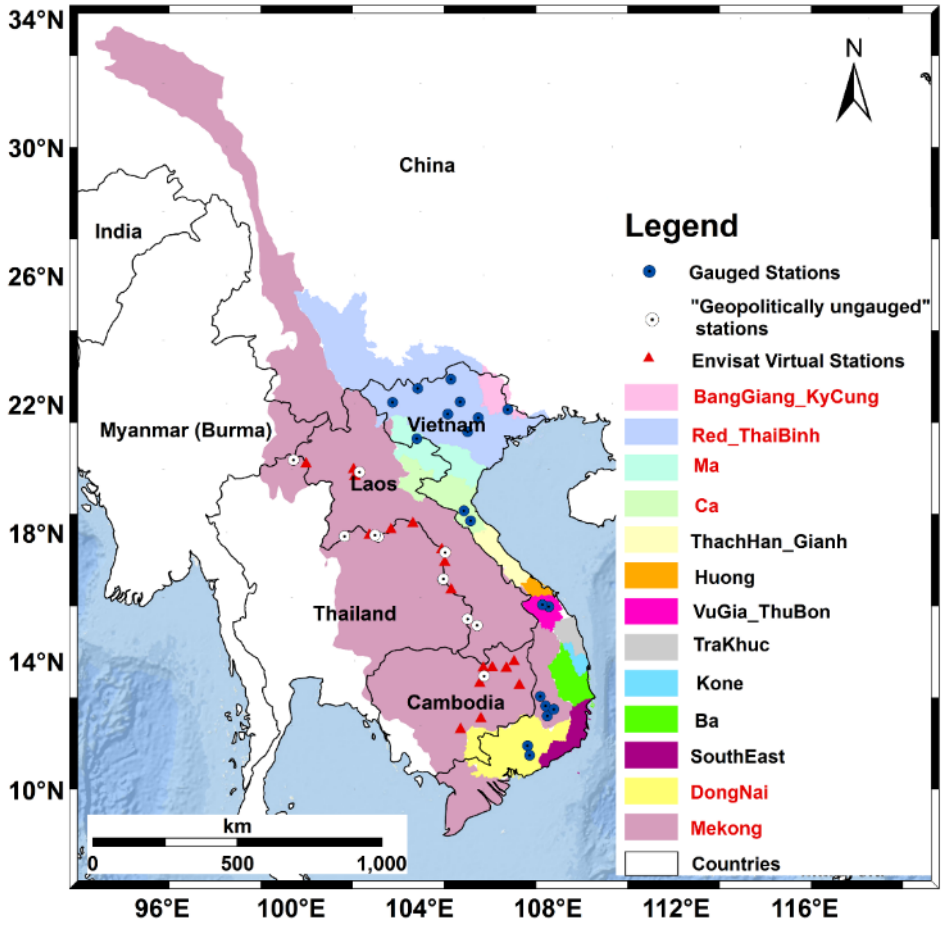
Hyongki Lee, University of Houston

Contributors: Chi-Hung Chang & Tien Du (UH),
Duong Du Bui (NAWAPI), SERVIR-Mekong, SMHI

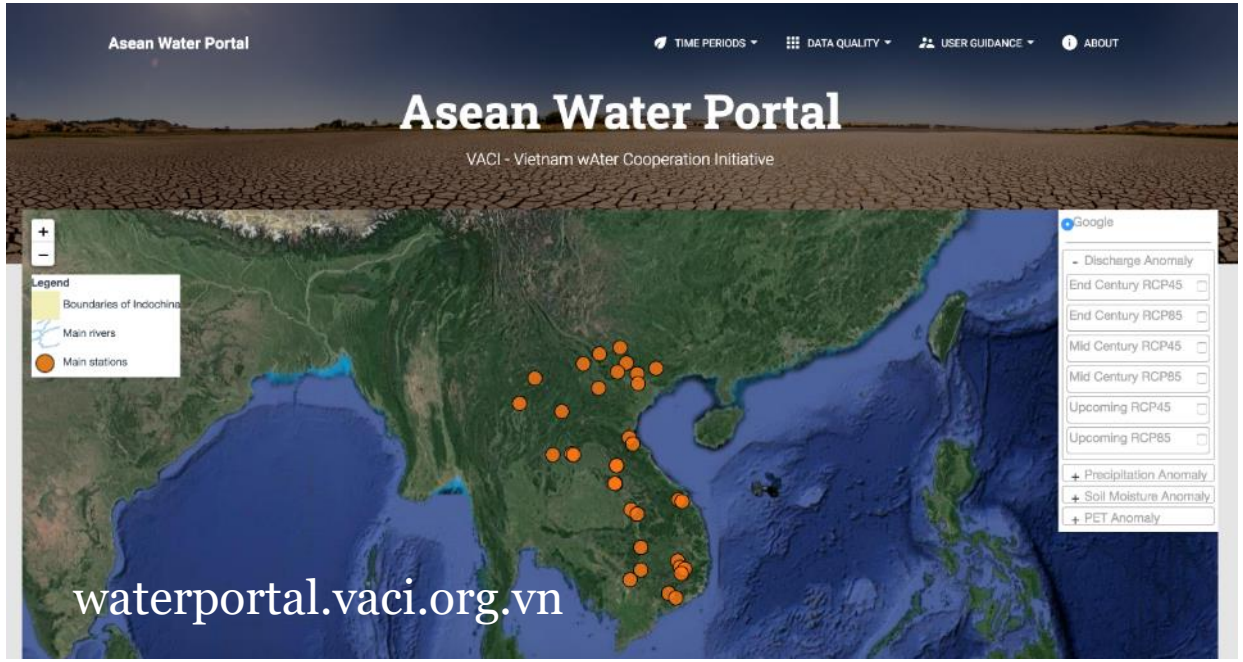
WATER RESOURCES

"GEOPOLITICALLY UNGAUGED" BASINS

HYPE Model



- How can we transfer information from gauged to ungauged catchments?
  - ➡ Physiography and climate-based regionalization
- How can we evaluate model performance at ungauged basins?
  - ➡ Altimetry-derived water level based flow correlation



Du et al., J Hydrol 2020

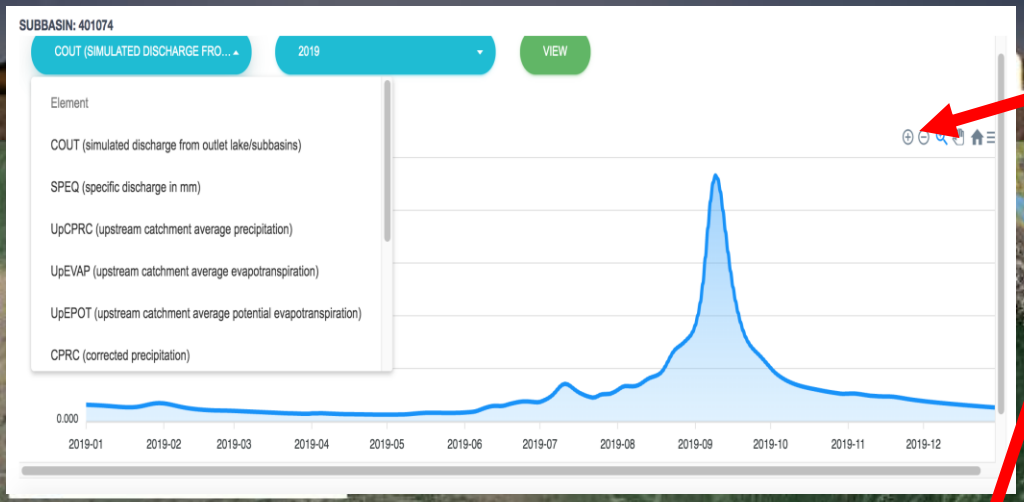
UNIVERSITY of HOUSTON

National Center for Water Resources Planning and Investigation (NAWAPI)

Waterportal.vaci.org.vn

Asean Water Portal

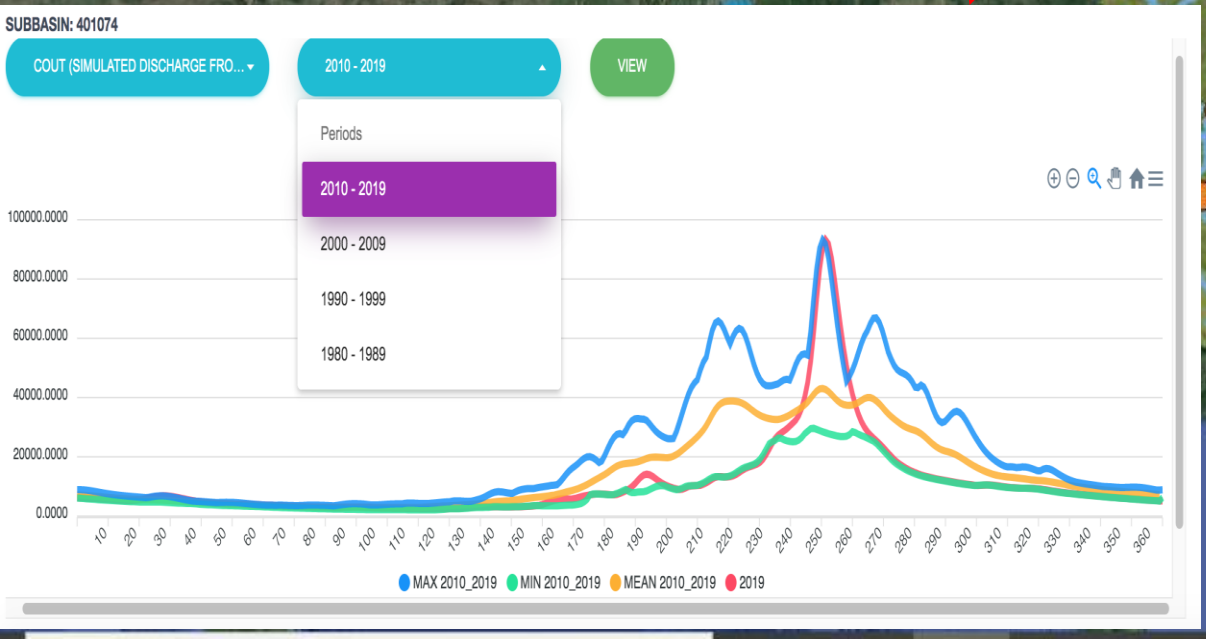
TIME PERIODS | DATA QUALITY | USER GUIDANCE | ABOUT



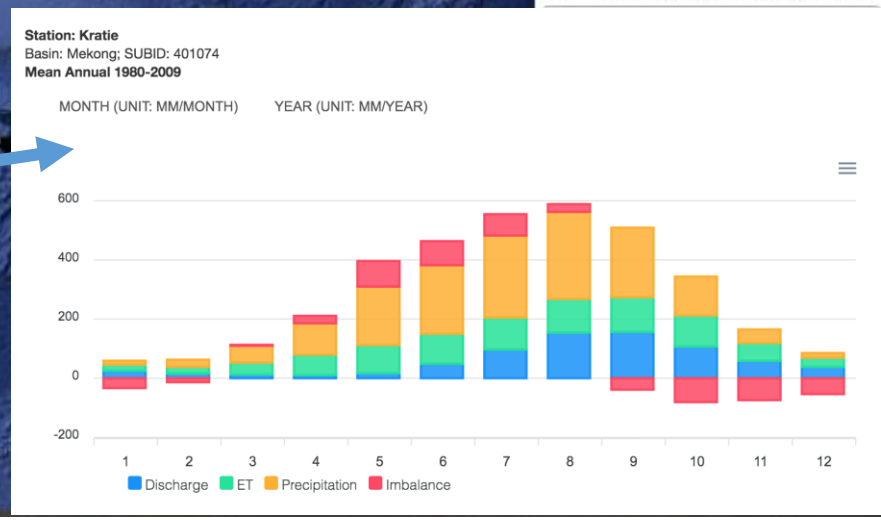
- Historical Data
- Seasonal Forecast Data
- Climate Change Data

updating..

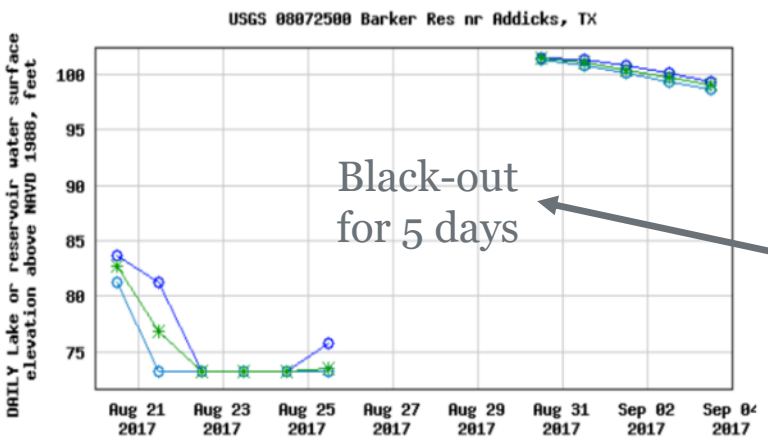
- Model Performances



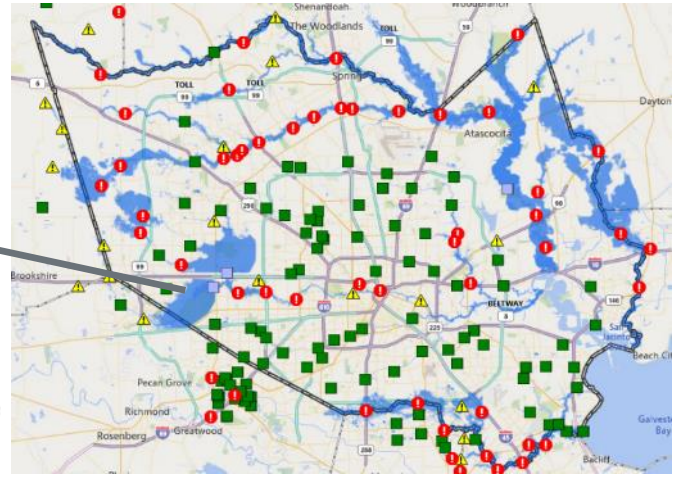
HOME PAGE
WATER BUDGET



FLOOD IS NO JOKE!!



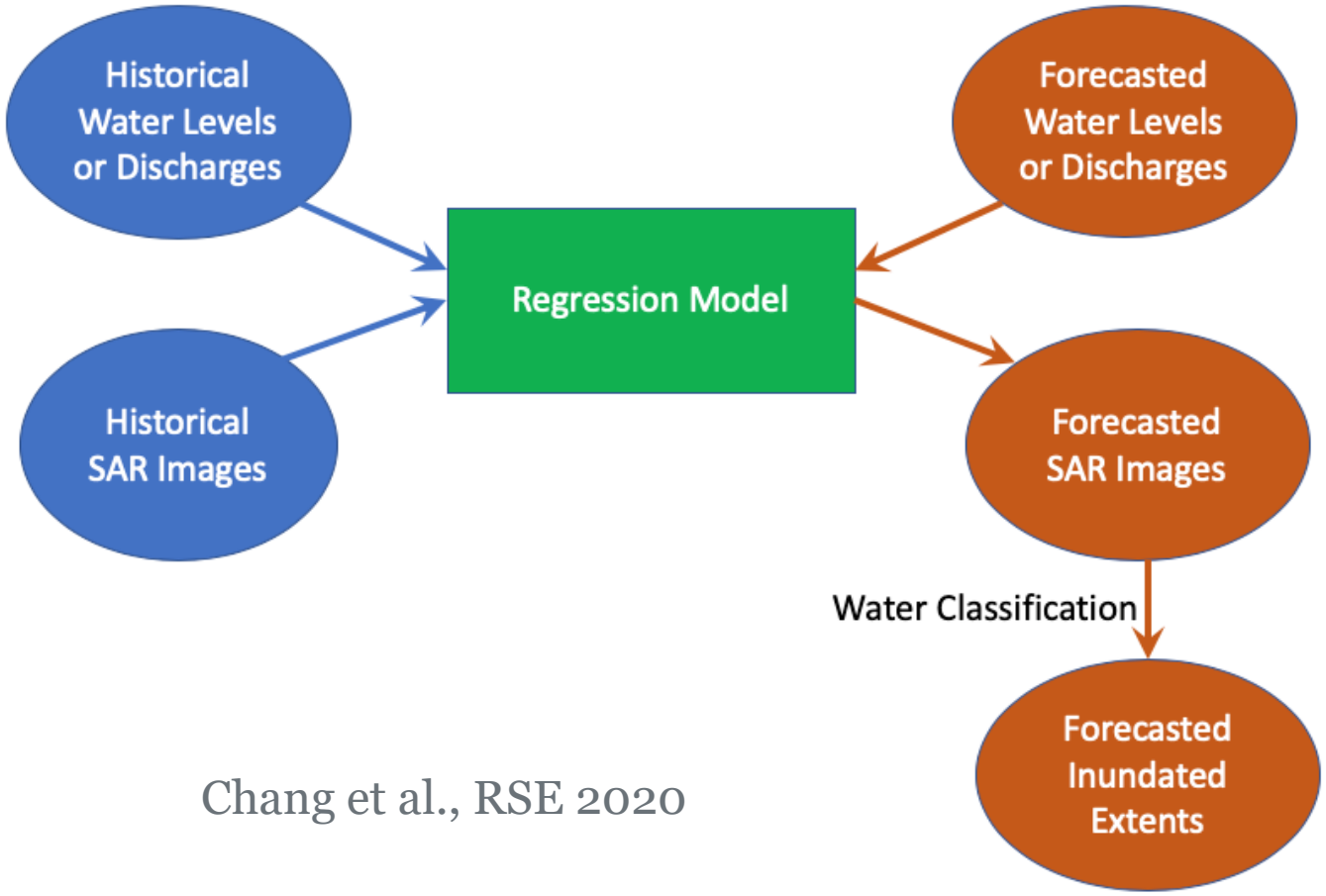
But there is NO INUNDATION FORECASTING even for H-Town!!



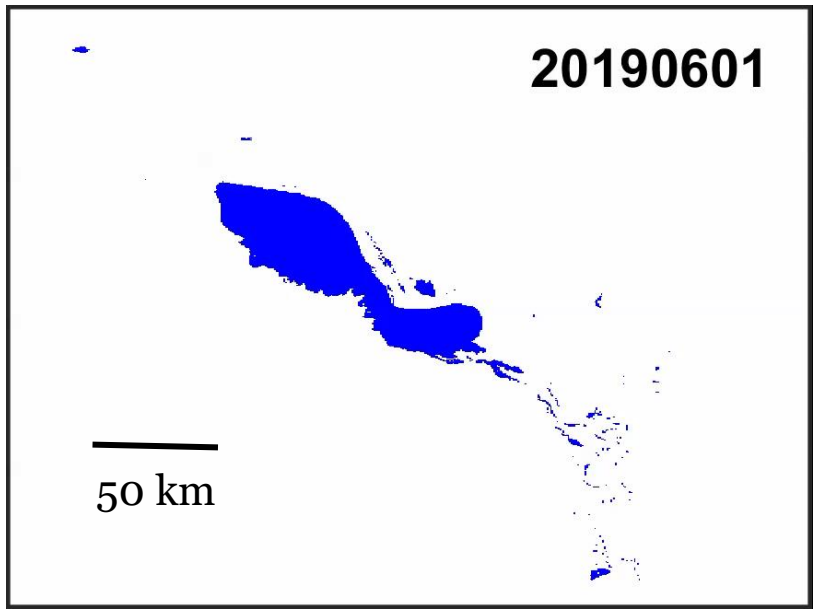
Operational Real-Time Flood Map by HCFCD (Aug 30, 2017).

- People in Lower Mekong is well adapted to seasonal flood cycle, but remain highly susceptible to extreme events (Oddo et al., 2018).
- Existing methods – Hydrodynamic models or Non-modeling GIS-based techniques may be too complex or less skillful to be applied over Lower Mekong.
- Simple, but skillful approach?

FORECASTING INUNDATION EXTENTS USING REOF (FIER)



Chang et al., RSE 2020

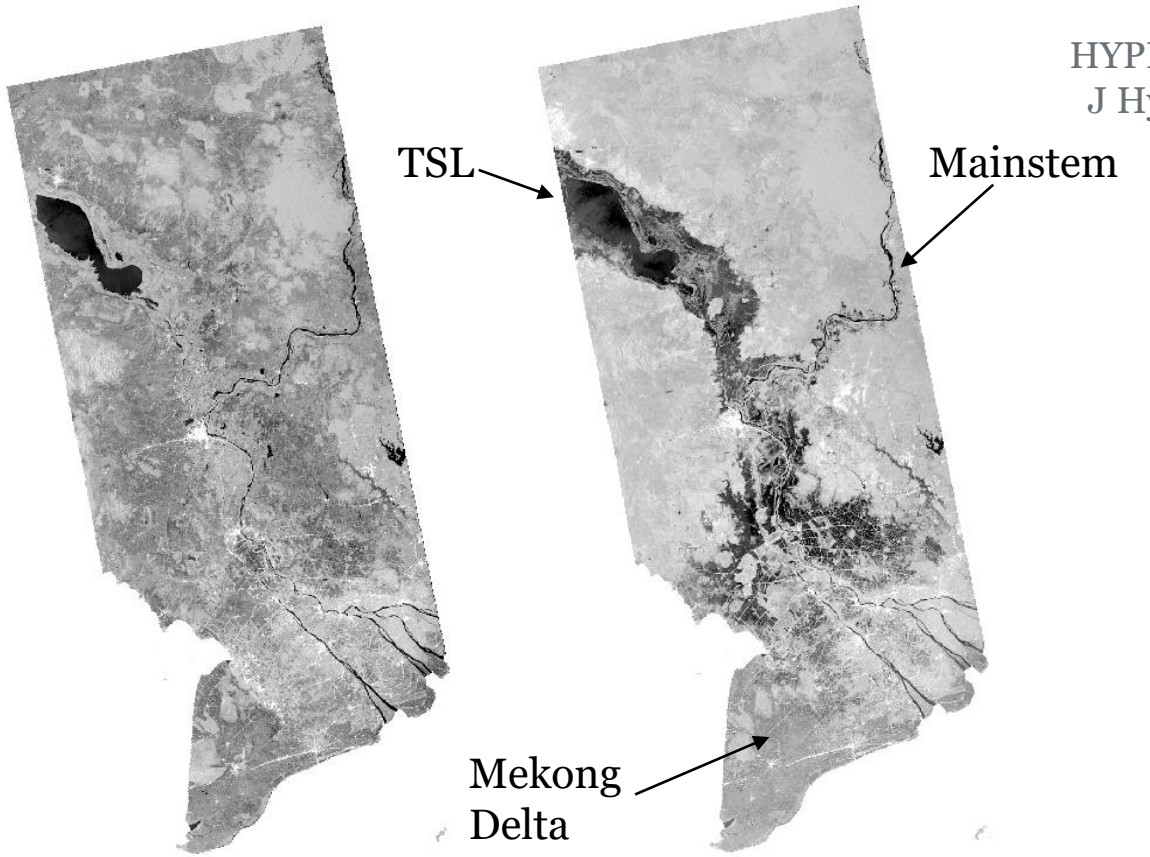


Forecasted Inundation for 2019

FIER FOR LOWER MEKONG AND …

Dry season example

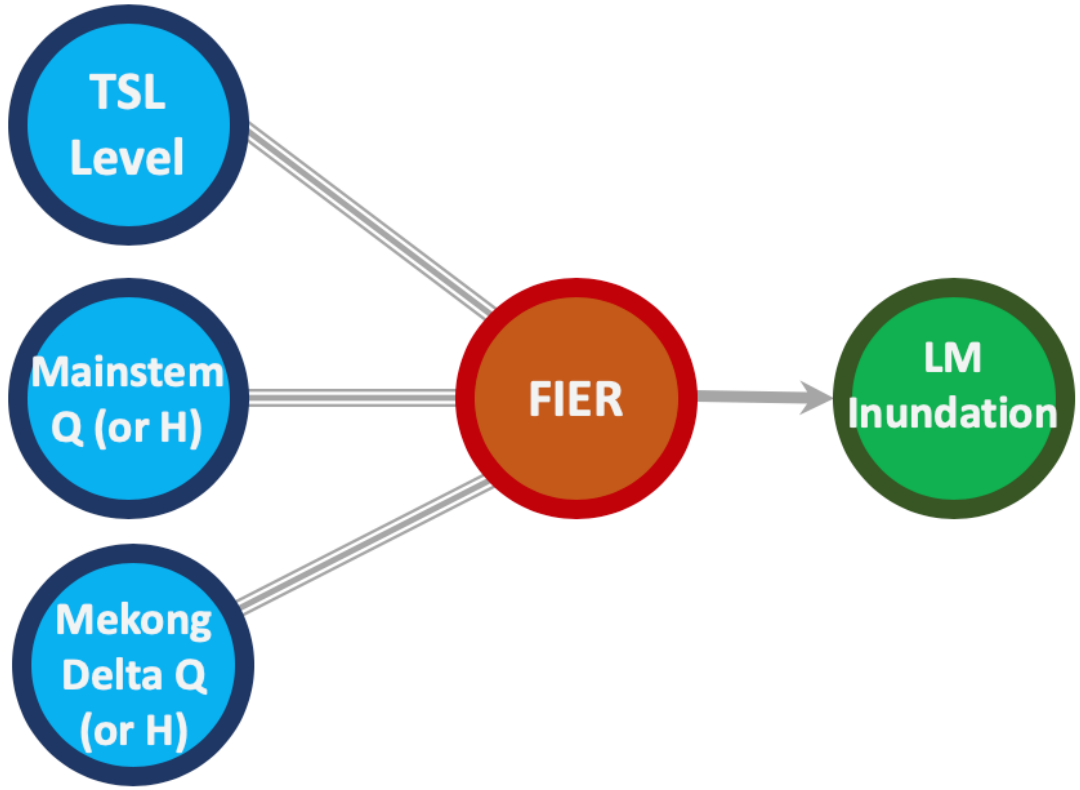
Wet season example

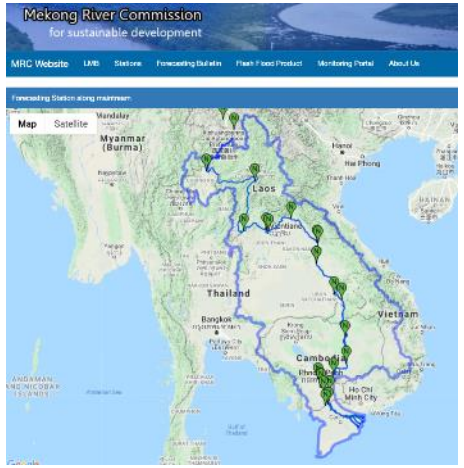


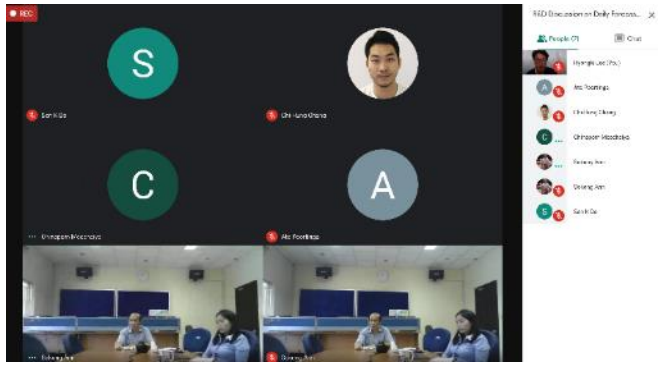
Chang et al., RSE 2020

MRC's RFDMC Or HYPE: Du et al., J Hydrol 2020

Kim et al. RS 2019



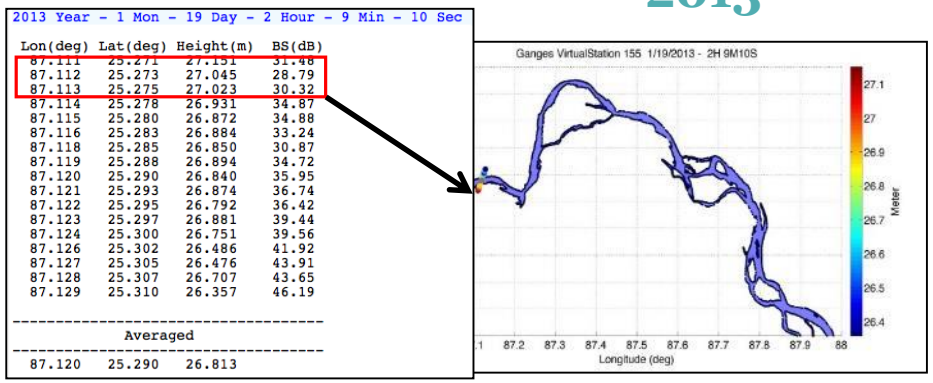




MRC's Regional Flood and Drought Management Centre

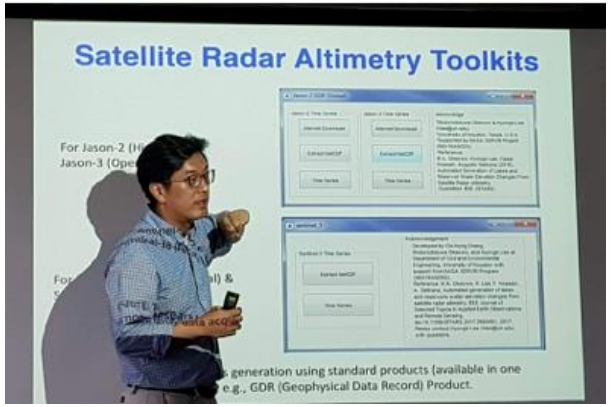
THINKING BIG …

2013



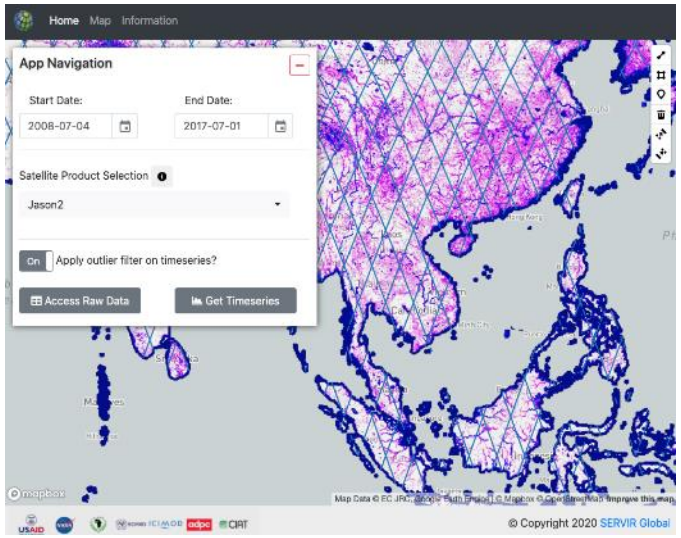
The very first version of Jason-2 altimetry tool used by Flood Forecasting and Warning Centre (FFWC) of Bangladesh

2017



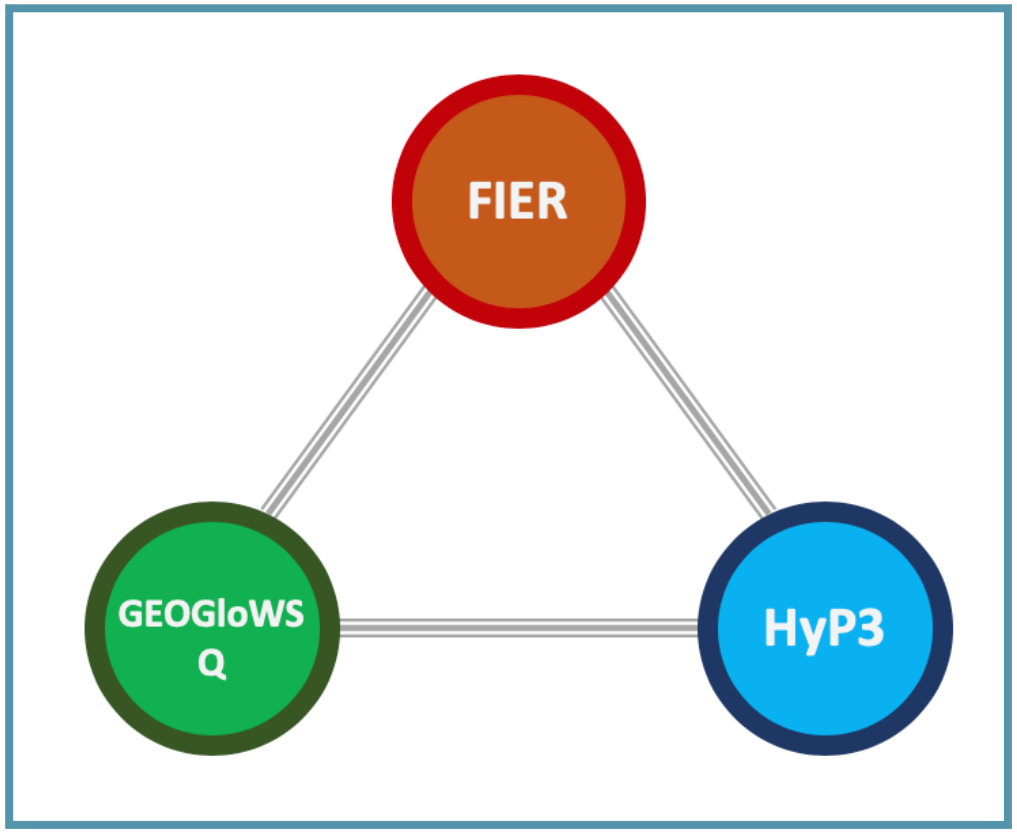
Automated Version
Okeowo et al.,
JSTARS 2017

2020



https://altex.servirglobal.net/
Credit: Kel Markert

Global Inundation Monitoring & Forecasting System



Thank You.

For further questions, please contact:
hlee@uh.edu

WATER
RESOURCES



SERVIR Asia Hubs: Overview & Highlights

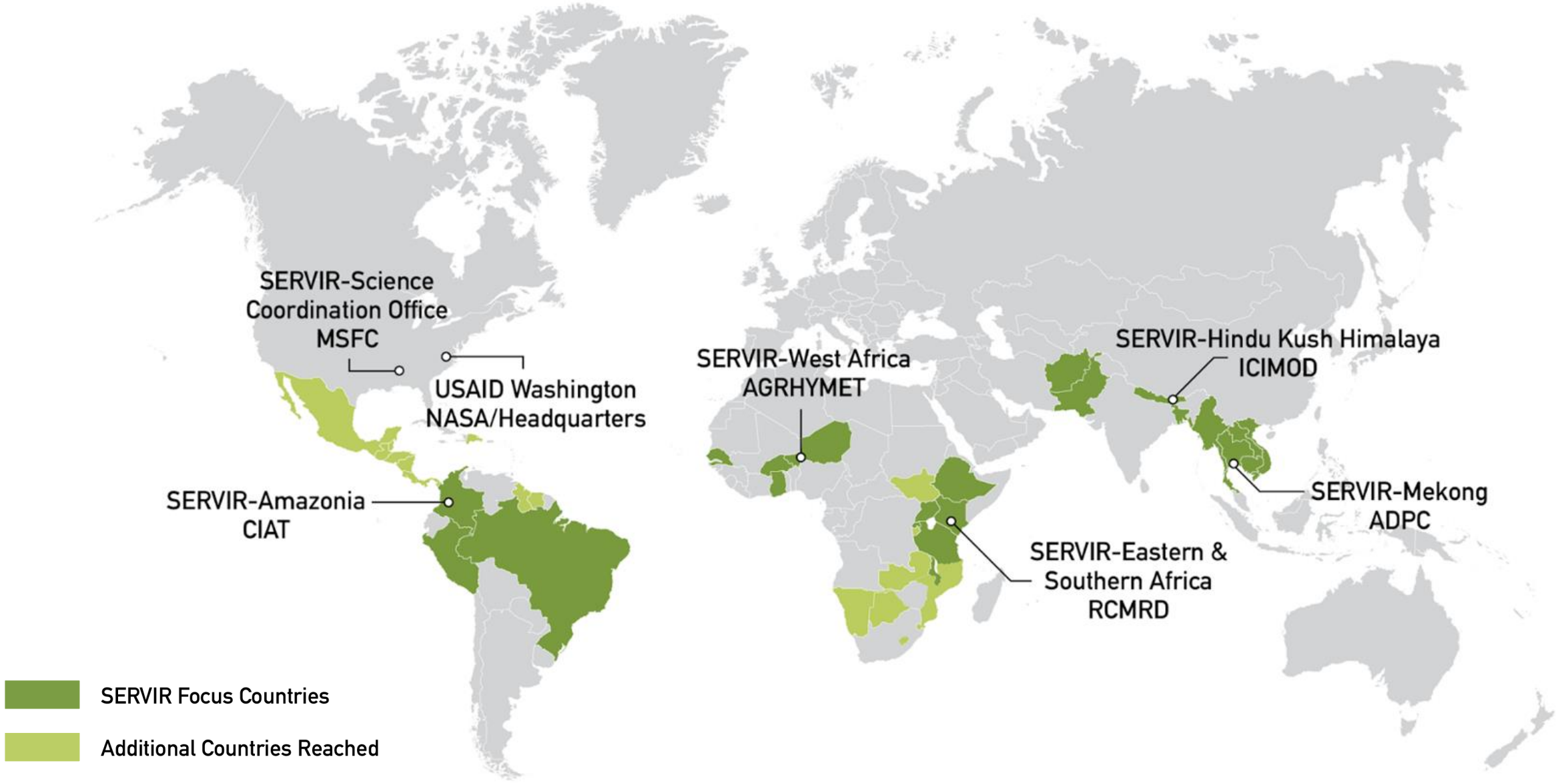
Timothy Mayer

NASA – SERVIR Regional Science Coordination Lead
Hindu Kush Himalaya

EARTH SCIENCE
APPLIED SCIENCES

SERVIR GLOBAL

CONNECTING SPACE TO VILLAGE



Agriculture and Food Security

Water and Water Related Disasters

Land Use and Ecosystems

Weather and Climate

SERVIR HINDU KUSH HIMALAYA

ICIMOD

Services

- **Regional land cover monitoring service**
- Regional drought monitoring and early warning
- Agro-met advisory for national and local level planning in Nepal, Bangladesh, and Pakistan
- Food security vulnerability information system of Nepal
- In-season wheat crop sown area assessment for Afghanistan
- Enhancing flood early warning systems
- River and flood plain information management system
- Forest vulnerability and management information system in Nepal
- Monitoring extreme weather

HKH: Applied Sciences Team (AST-3) Principal Investigators

Dr. Liping Di, George Mason University

Remote sensing and agro-geoinformatics based products & services for supporting agricultural & food-security decision making in HKH region

Dr. Franz Meyer, University Of Alaska, Fairbanks

A cloud computing toolbox for SAR-based monitoring of the hydrologic cycle in the SERVIR HKH region

Dr. Peter Potapov, University of Maryland, College Park

Supporting operational regional land cover monitoring at high spatial and temporal resolution for the HKH region

Dr. Emily Berndt (left) NASA Marshall Space Flight Center
Co-I/Science PI: Dr. Aaron Naeger (right), U. of Alabama, Huntsville

Advancing air quality monitoring and prediction capabilities in the HKH region

SERVIR MEKONG

SERVIR Focus Countries

Additional Countries Reached

adpc

SEI Stockholm Environment Institute

Spatial Informatics Group

Deltares

Services

- **Regional land cover monitoring service**
- **Supporting Myanmar to respond to floods**
- Improving agricultural planning in Vietnam
- Supporting Mekong River Commission's regional drought forecasting
- Crop-type mapping in Vietnam to improve agriculture management and support food security
- Improving rainfall estimates for flood forecasting in Cambodia
- Improving Mekong River Commission’s regional flood modelling using land cover information

Mekong: Applied Sciences Team (AST-3) Principal Investigators

Dr. Robert Kennedy, Oregon State University

Leveraging cloud-computing and an integrated disturbance and vegetation mapping framework for protected areas monitoring in the Lower Mekong

Dr. Hyongki Lee, University of Houston

Operational Services For Water, Disaster and Hydropower Applications for Lower Mekong Populations Using Nasa Earth Observations And Models

Dr. Narendra Das, NASA JPL

Enhancement of the RHEAS Capabilities for Monitoring and Forecasting of Seasonal Rice Crop Productivity for the Lower Mekong Basin Countries

Dr. Dalia Kirschbaum, NASA GSFC

A Landslide Hazard and Risk Assessment System for Servir-Mekong

NASA SERVIR:
Land Use and Ecosystems Highlight

SERVIR LCLUC & ECOSYSTEMS

REGIONAL LAND COVER MONITORING SERVICE

The Hindu Kush Himalaya and Lower Mekong Regions have experienced dramatic and rapid land cover change in recent years.

SERVIR Hub organizations build the capacity of end users through service Co-Development.

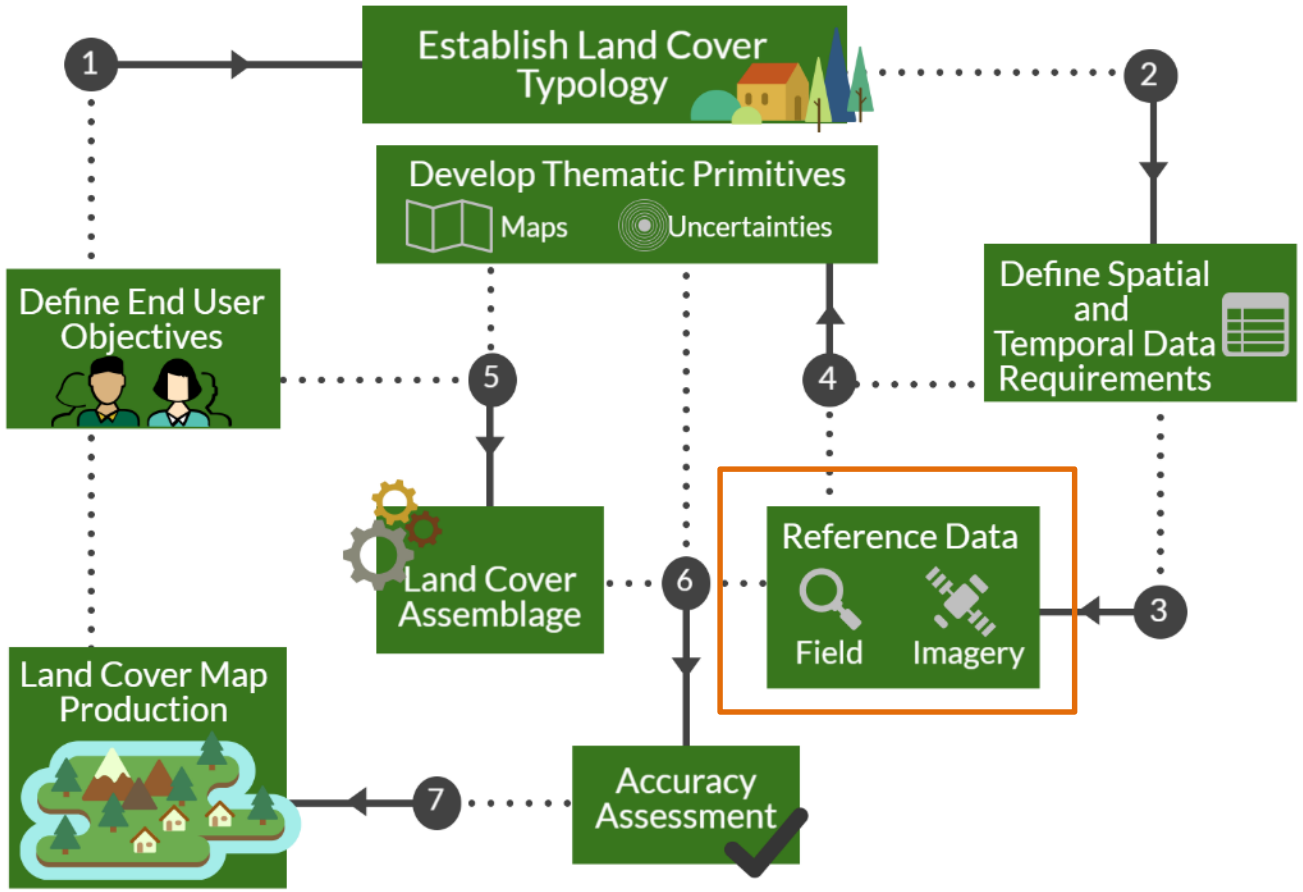
Regional Land Cover Monitoring Service

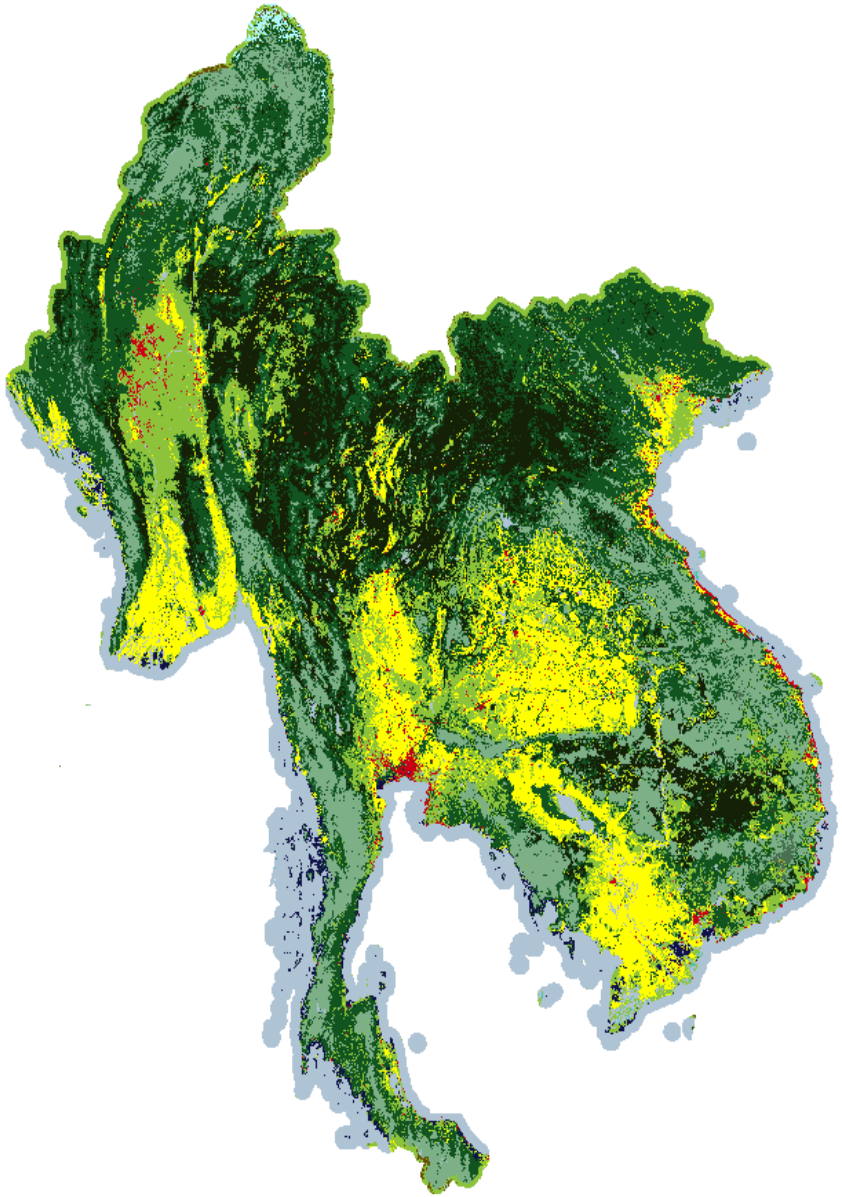
RLCMS is a web-based tool being developed using cloud-based technology to produce land cover maps on a yearly basis.

SERVIR MEKONG

SERVIR HINDU KUSH HIMALAYA

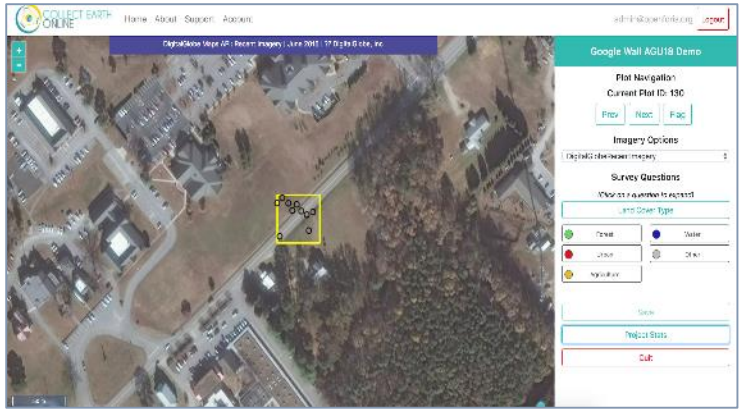
Regional Land Cover Monitoring Service

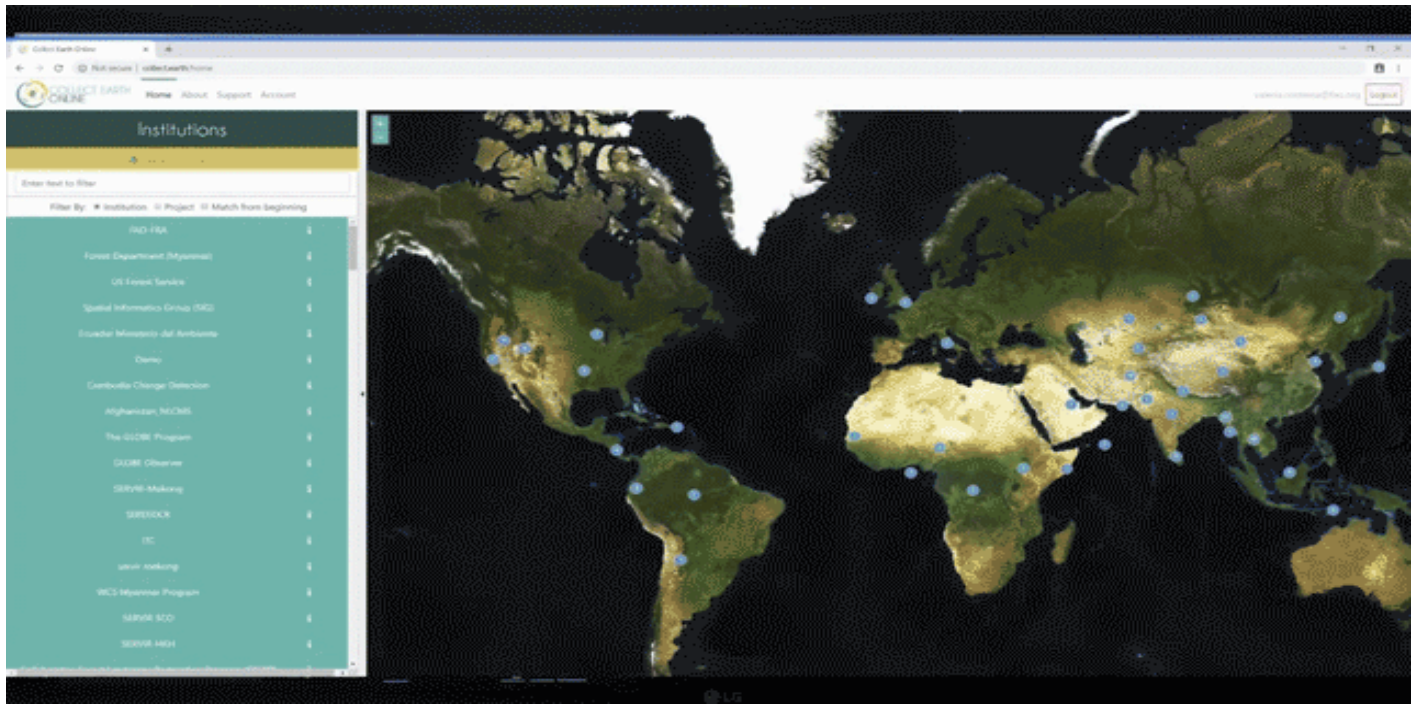




Collect Earth Online (CEO)

CEO is an open source platform for global data collection essential for forest monitoring and reporting.





NASA SERVIR:
Water and Water Related Disasters Highlight

Water & Water Related Disasters

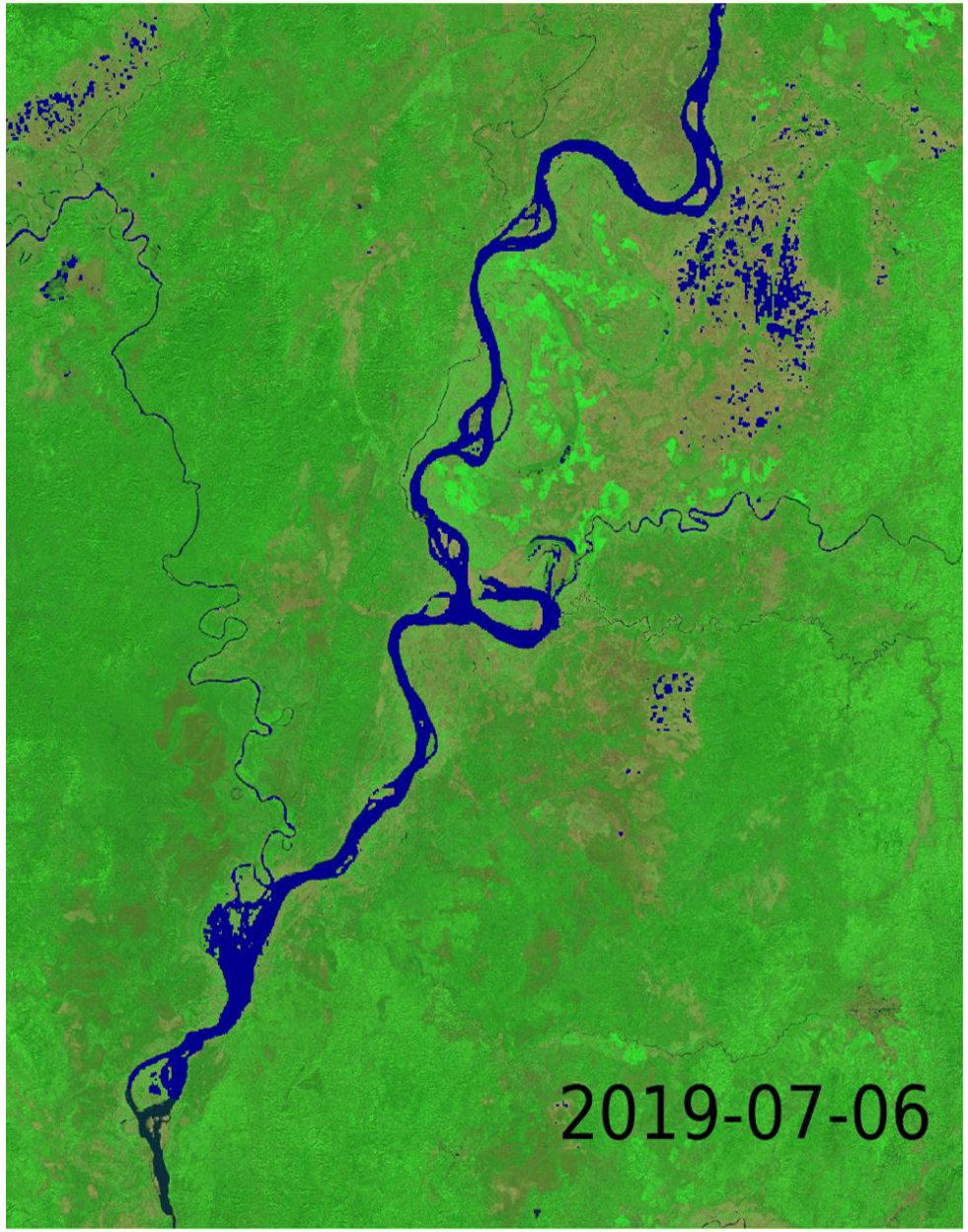
Supporting Near Real-Time Flood Monitoring in Myanmar

SERVIR MEKONG

Myanmar is greatly affected due to monsoon rains and tropical cyclones.

Co-Development of geospatial tools is a mechanism for preparedness and capacity building.

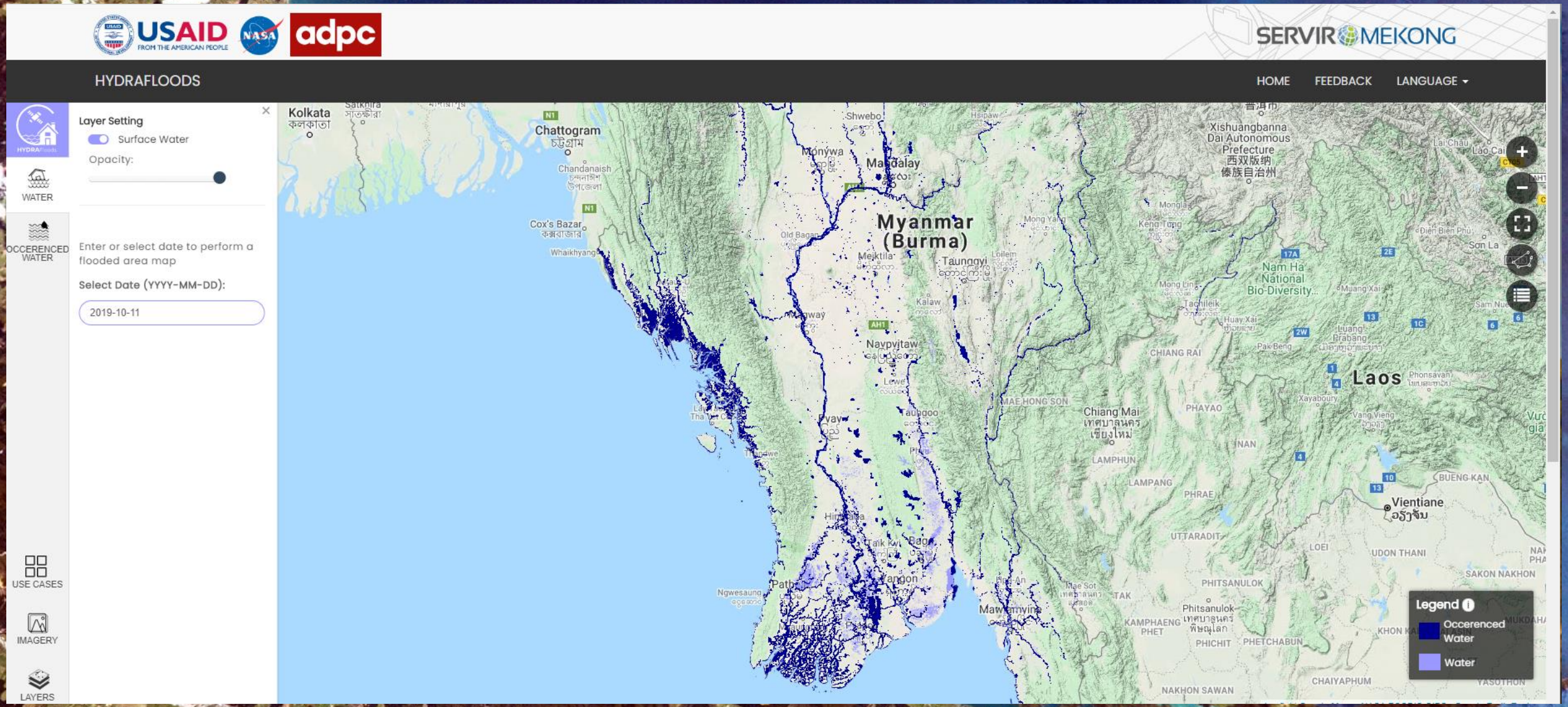
Flooding Event
Date: July 2019
Location: Myitkyina,Myanmar



Hydrological Remote Sensing Analysis of Floods

HYDRAFloods is a web-based multiple satellite tool that generate daily flood water maps.

Hydrological Remote Sensing Analysis of Floods



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Thank You.

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EARTH SCIENCE
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