



# Monitoring Biodiversity from Space

**Cindy Schmidt**

Associate Program Manager, NASA Ecological Forecasting  
NASA Ames Research Center

Digital Data in Biodiversity Research Conference



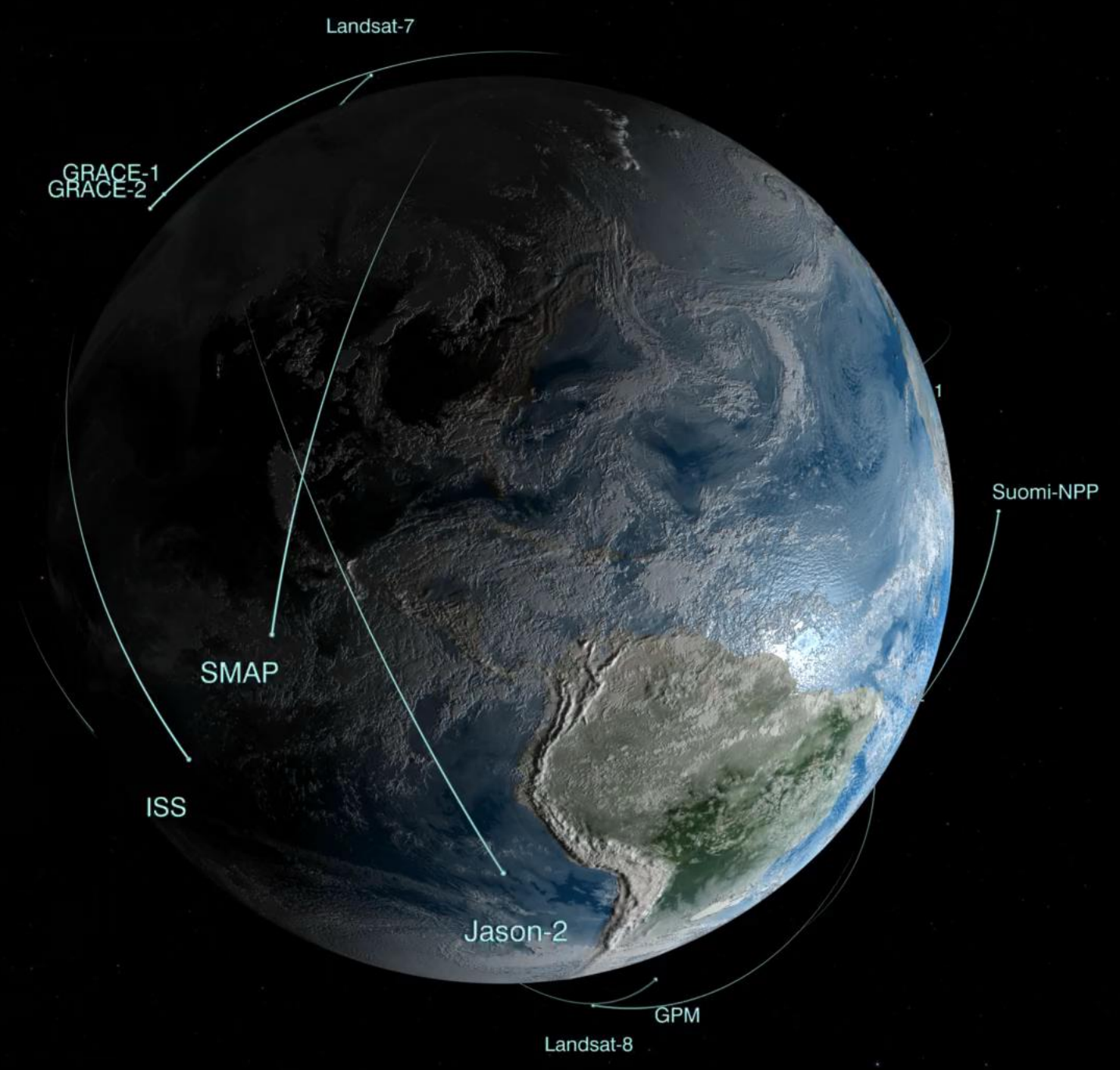


How is the global Earth changing?

What causes these changes in the Earth system?

How will the Earth system change in the future?

How can Earth system science provide societal benefit?



Landsat-7

GRACE-1  
GRACE-2

SMAP

ISS

Jason-2

GPM

Landsat-8

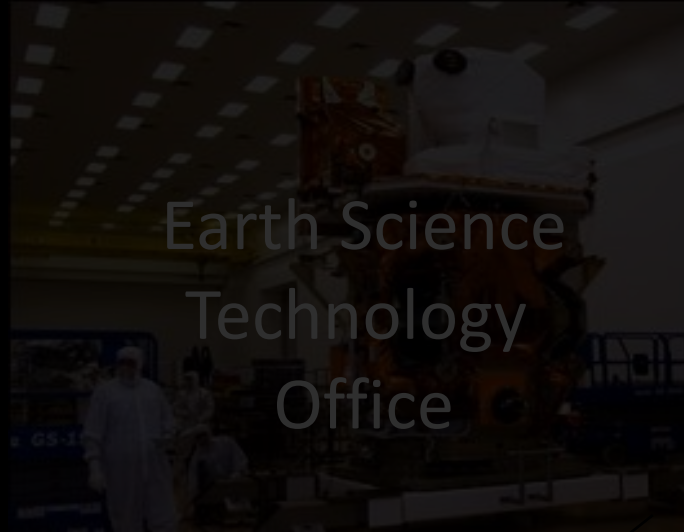
Suomi-NPP



# Earth Science at NASA



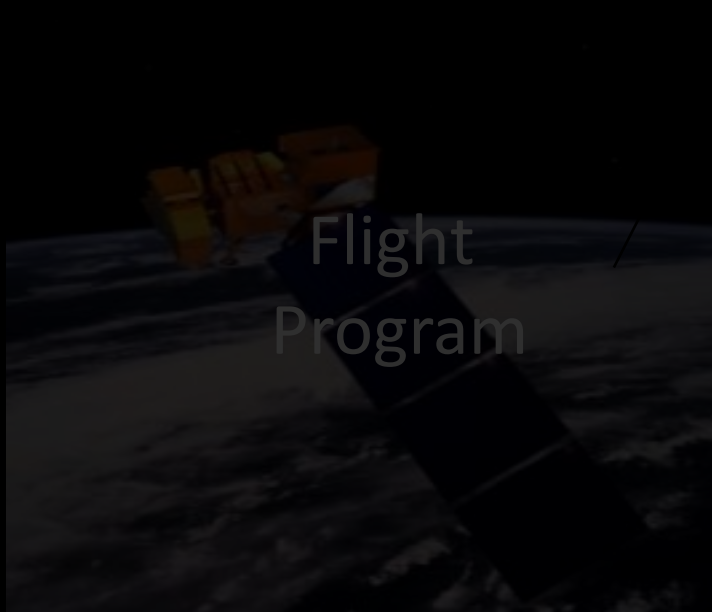
# Earth Science at NASA



Earth Science  
Technology  
Office



Research and  
Analysis  
Program



Flight  
Program



Applied  
Sciences  
Program

# Earth Science at NASA

A photograph of a tropical river flowing through a lush green forest under a cloudy sky.

Research and  
Analysis  
Program

A collage of three images: a forklift at night, a mountain valley with a river, and a white egret in a field.

Applied  
Sciences  
Program

# Earth Science at NASA



## Applied Sciences Program



## Research and Analysis Program

Health and  
Air Quality

Disasters

Water Resources

Ecological  
Forecasting

## Carbon Cycle and Ecosystems

Terrestrial Ecology

Biodiversity

Ocean Biology and  
Biogeochemistry

Land Cover/  
Land Use Change



# Earth Science at NASA



Applied  
Sciences  
Program



Research and  
Analysis  
Program

## Carbon Cycle and Ecosystems

Health and  
Air Quality

Disasters

Water Resources

Ecological  
Forecasting



Biodiversity

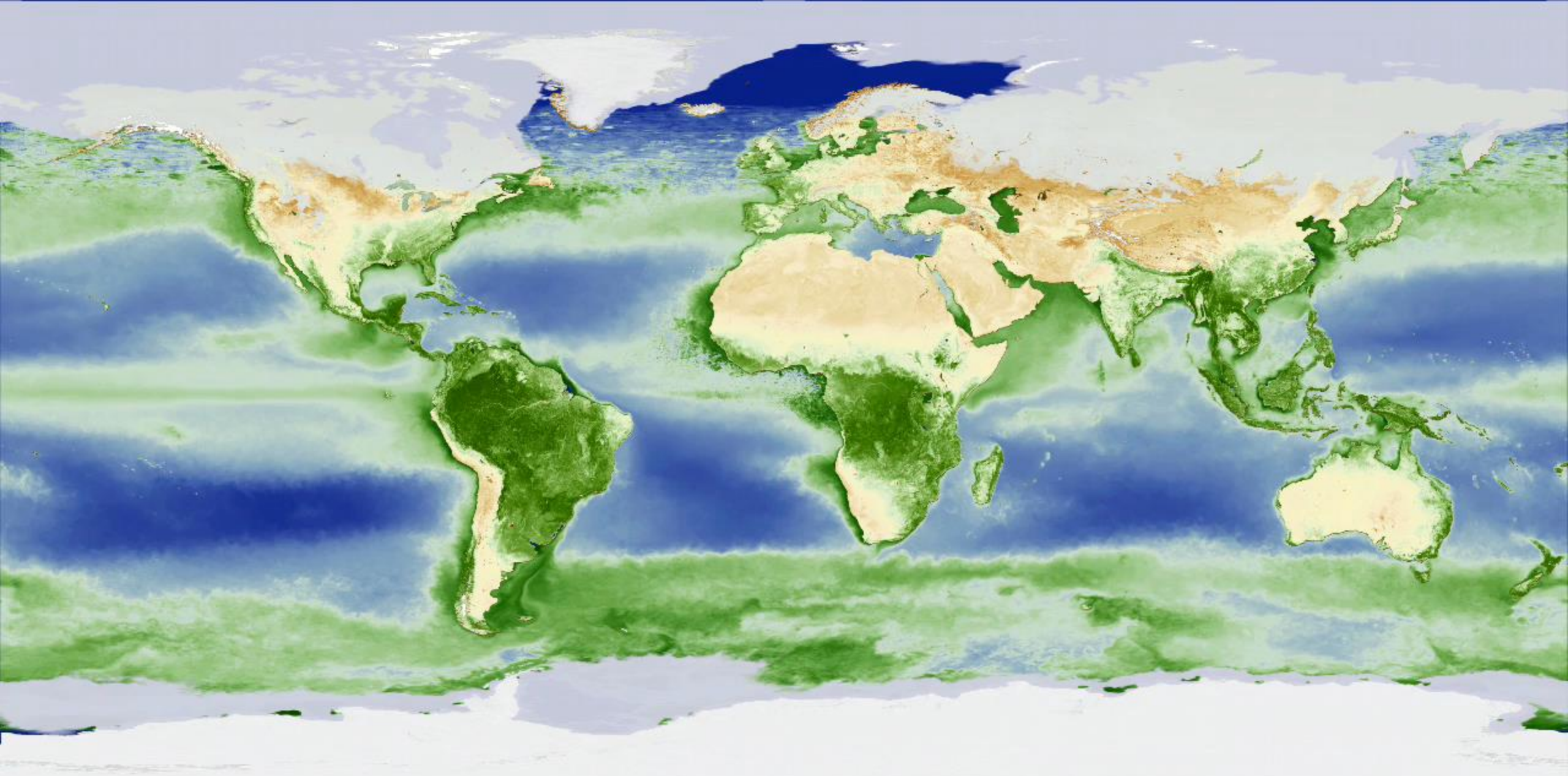
Woody Turner, Program Manager

Terrestrial Ecology

Ocean Biology and  
Biogeochemistry

Land Cover/  
Land Use Change





Land Vegetation (NDVI)

-0.1 0.9

Ocean Chlorophyll Concentration (mg/m<sup>3</sup>)

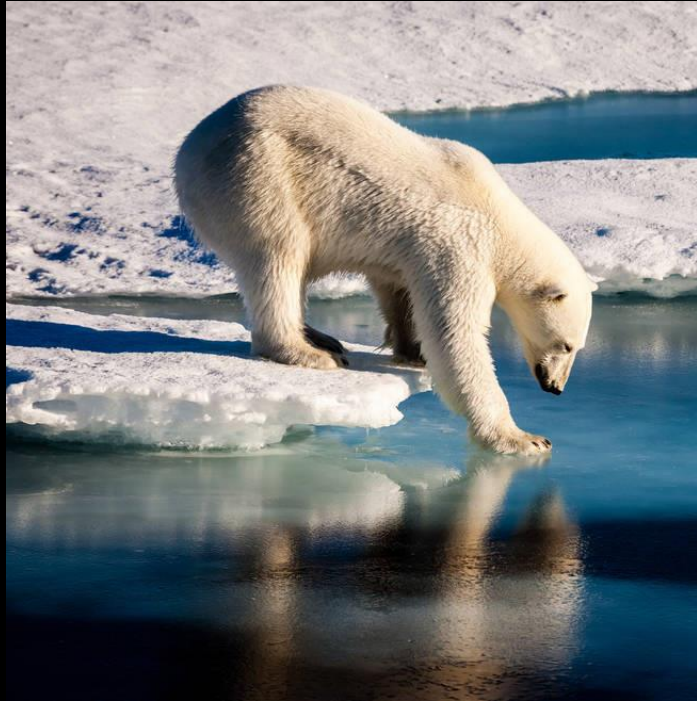
0.01 0.1 1 10 20

Jan Dec





# Biodiversity



Uses Earth Observations and models to improve our understanding of biological diversity, how and why it's changing and its effects on and interactions with the Earth system



# Ecological Forecasting



Integrates Earth observations and models to enable better conservation and more sustainable natural resource management



Snapshot Wisconsin

Pattern	Color	Horns	Tail	Build
Bear	Deer		Raccoon	
Bobcat	Fox		Snowshoe Hare	
Bird	Porcupine		Squirrel	
Coyote	Rabbit		Wolf	

How many Behavior

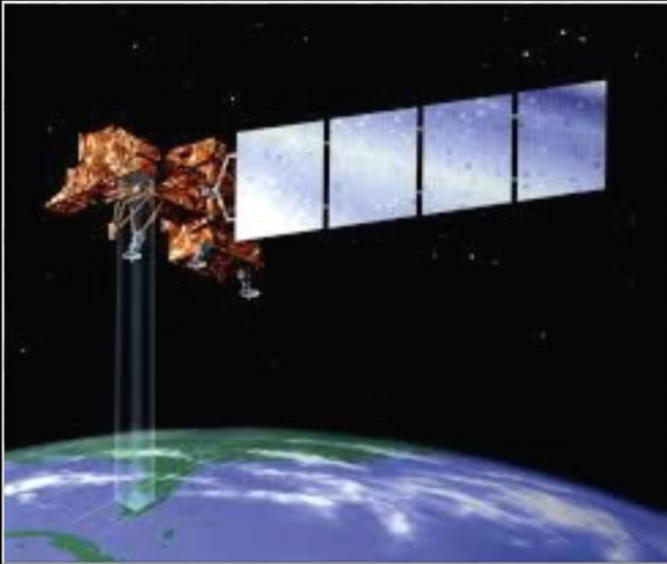
Nothing here Human Finish Tutorial Clear Filters ?

NASA Satellite Data Helps Protect Endangered Whales





# The Benefits



## Land

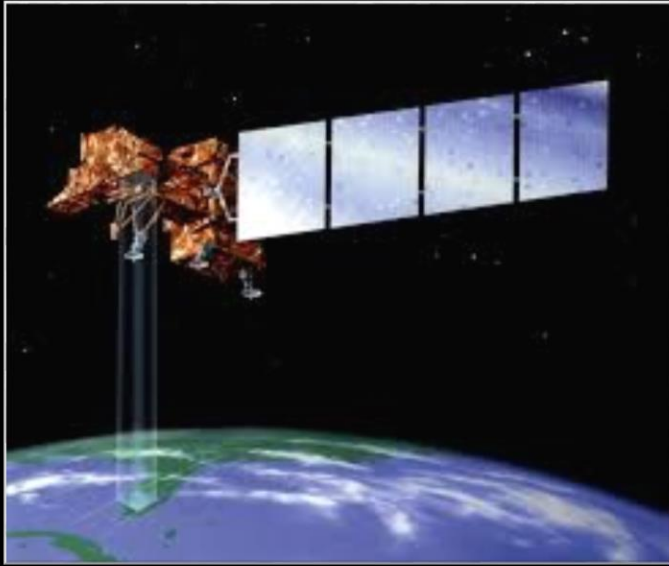
Land cover  
Topography  
Snow cover  
Disturbance

## Ocean

Sea Surface Temperature  
Sea Surface Height  
Chlorophyll concentration

Satellite imagery provides a relatively inexpensive method to collect multi-temporal information over large areas

# The Challenge



## Land

Land cover  
Topography  
Snow cover  
Disturbance

## Ocean

Sea Surface Temperature  
Sea Surface Height  
Chlorophyll concentration



# Group on Earth Observations Biodiversity Observation Network (GEO BON)

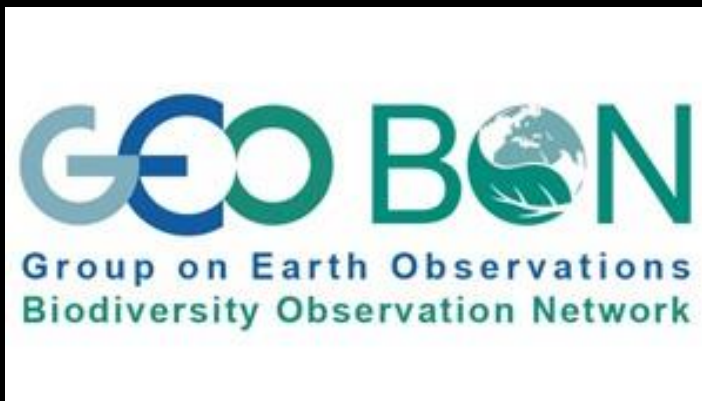


A global biodiversity observation network that contributes to effective management policies for the world's biodiversity and ecosystem services

Activities to advance, build, and deliver remote sensing supported species distribution and species abundance Essential Biodiversity Variables (Walter Jetz, Yale University)

Integration of Earth observations for decision making on biodiversity management and conservation in Colombia (Victor Gutierrez-Velez, Temple University)

Laying the foundation of the Pole-to-Pole Marine Biodiversity Observation Network of the Americas (Enrique Montes, University of South Florida-Tampa)



<https://geobon.org>





# Citizen Science and Crowd Sourcing

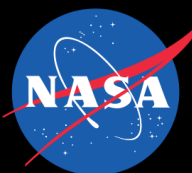


*Integrating camera traps, remote sensing and citizen science to improve ecological forecasting*

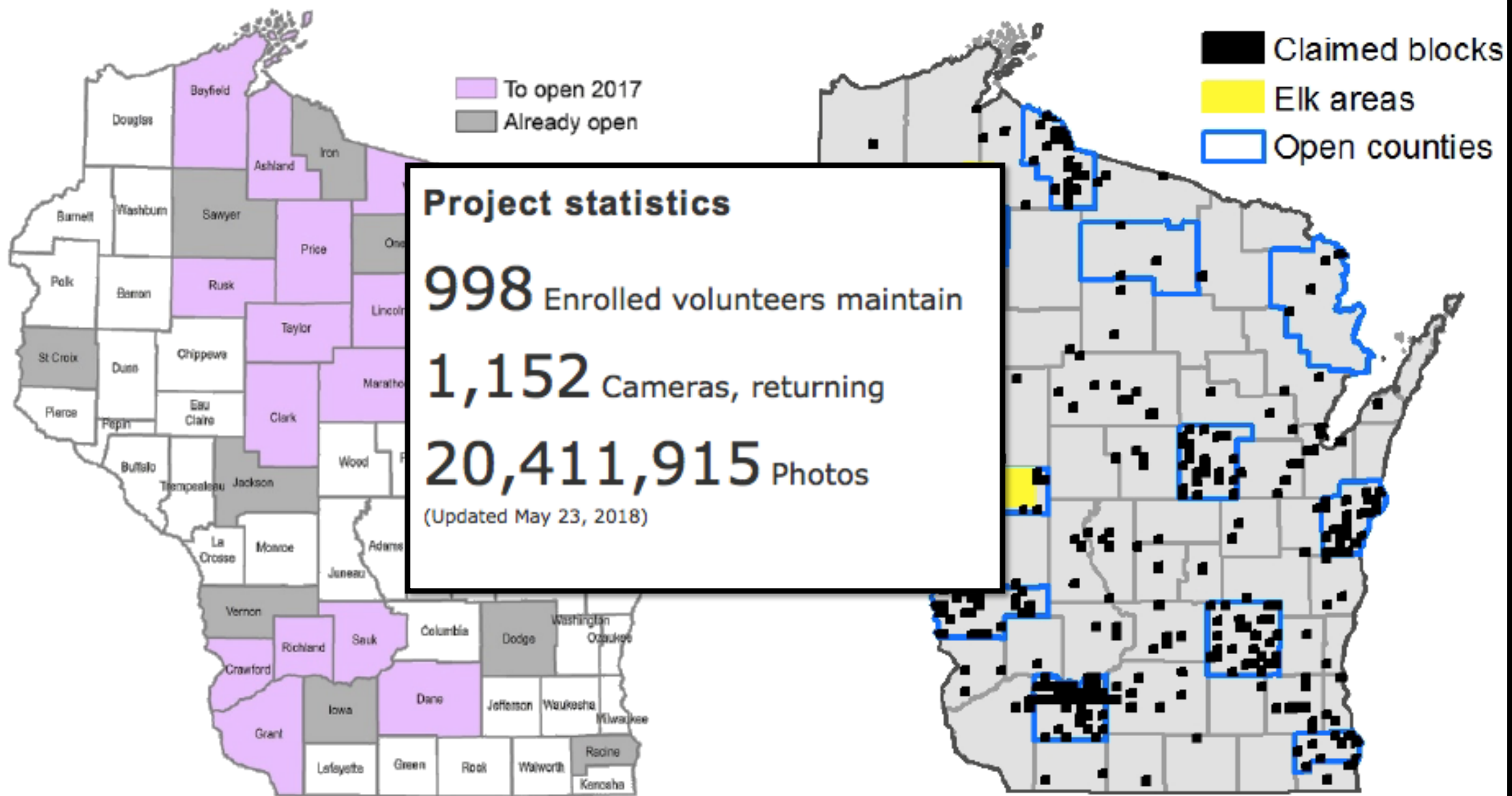




PI Phil Townsend, University of Wisconsin



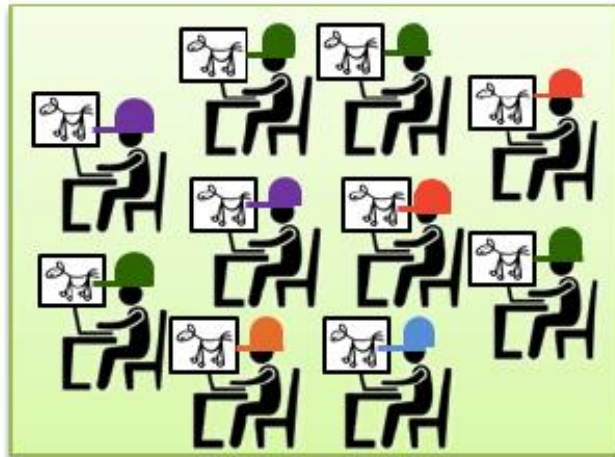
# 600 volunteers 800 cameras 10 million photos



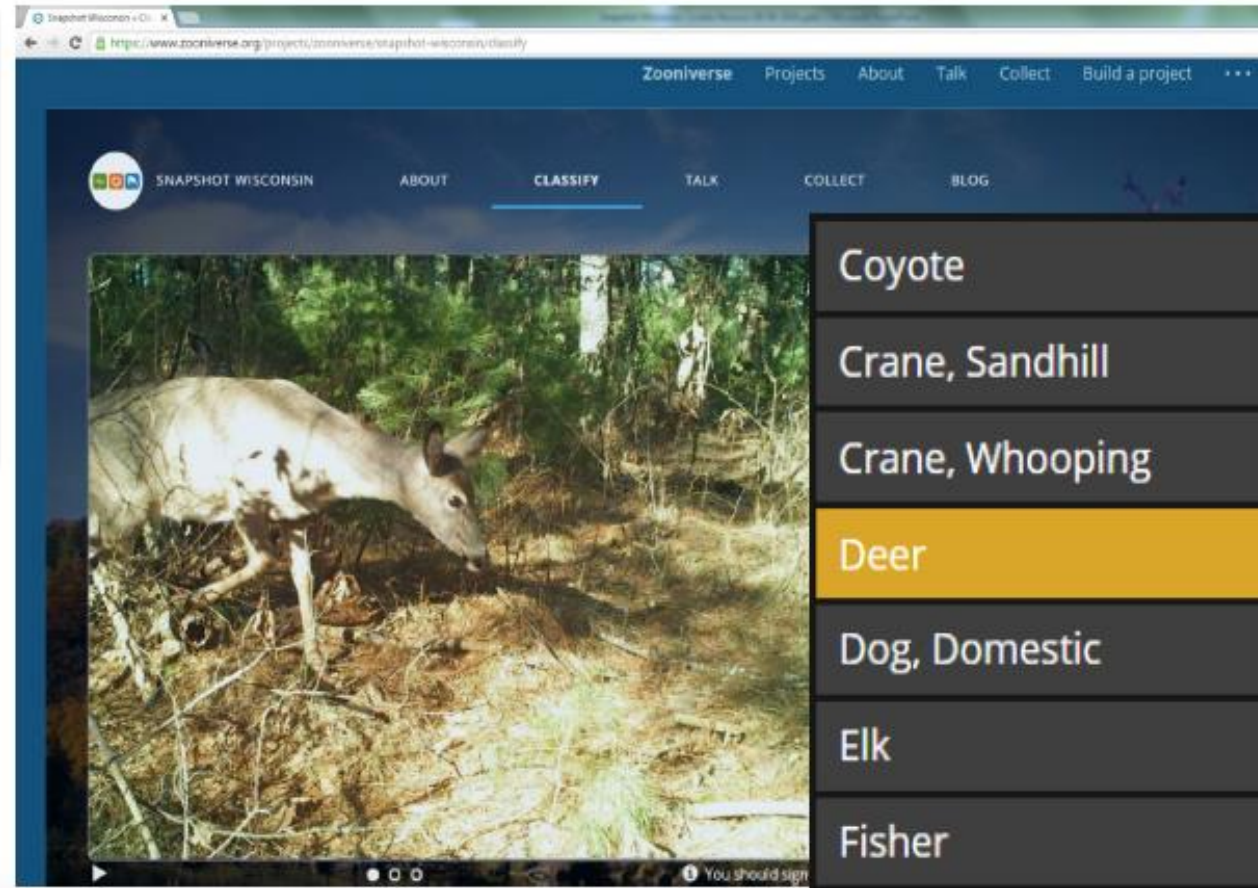


# Crowdsourcing with Zooniverse

**5,000** volunteers | **1 million** classifications  
**Online Global Community**



snapshotwisconsin.org







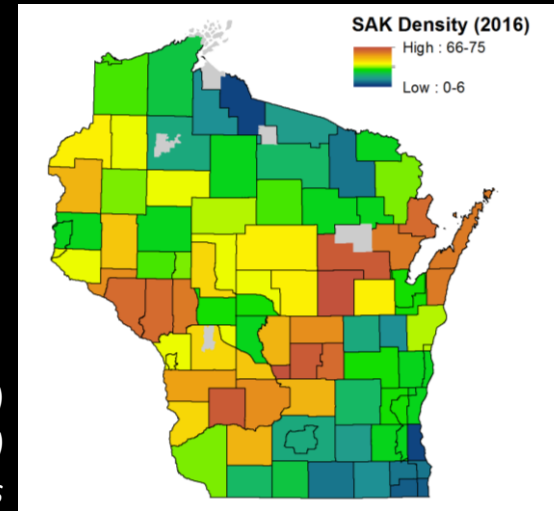
# Estimating animal distributions

WNDR currently estimates animal distributions using fall harvest statistics and assumptions related to doe productivity and other factors

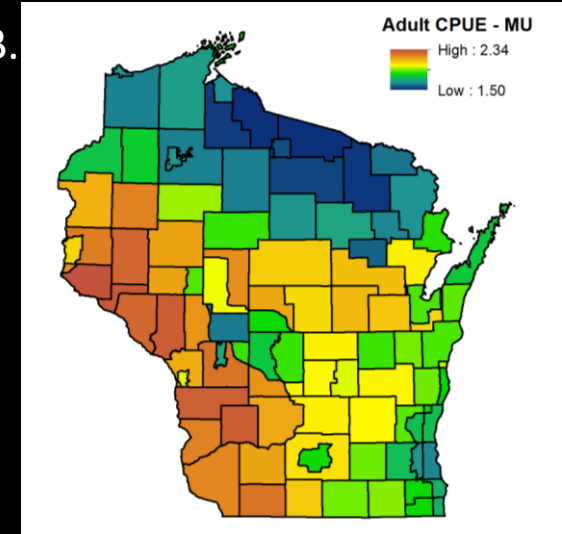
Models predict:

- Relatively few deer in the north and central part of the state; more deer in the west
- Greater carnivore richness in the north
- Lower deer abundance in the north due to greater carnivore richness and temperature

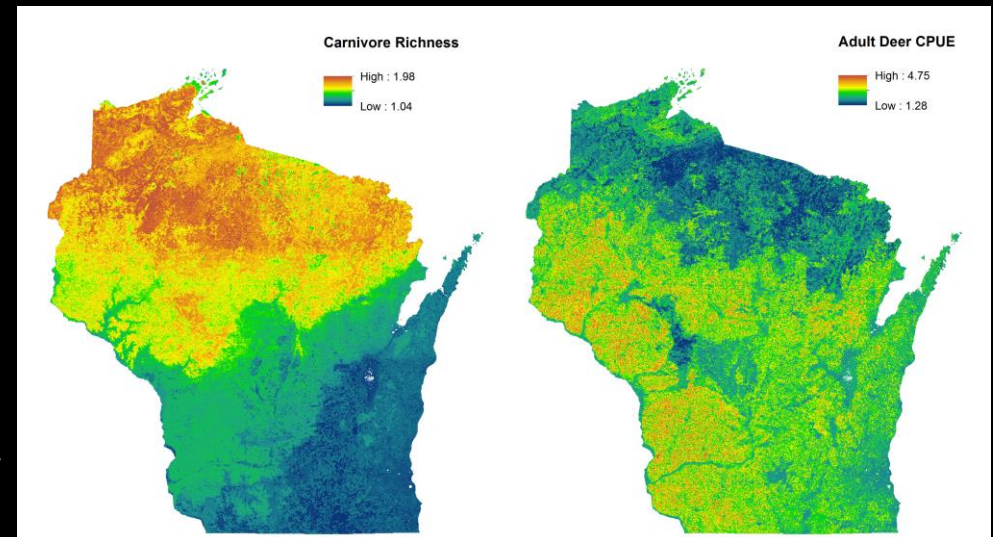
A.



B.



Deer abundance: A)  
Data used by DNR; B)  
Project model results



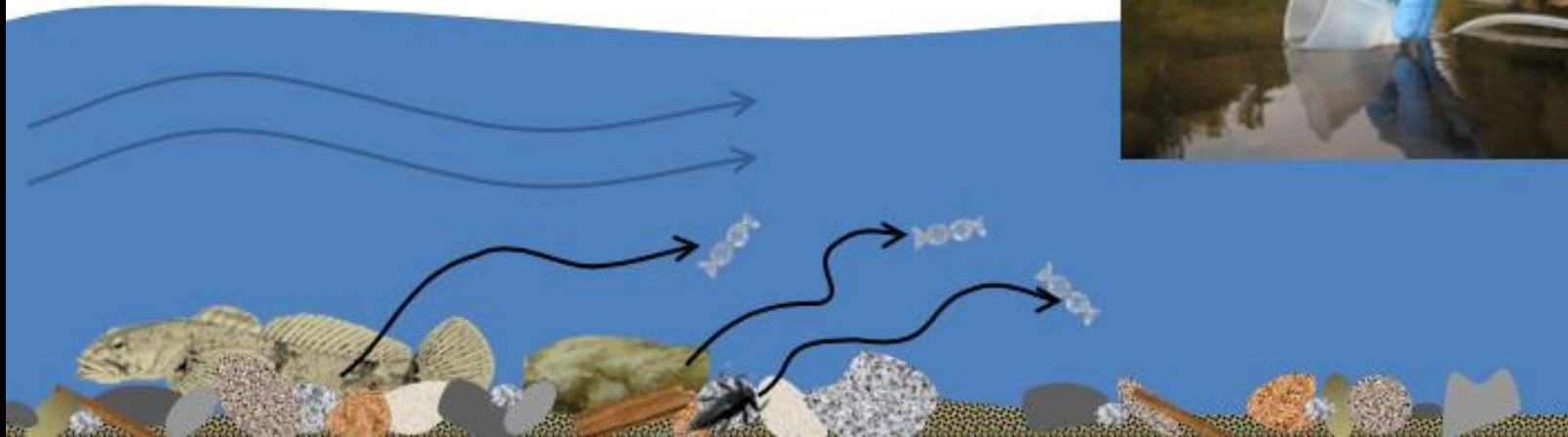
Comparison of carnivore richness (left) with deer abundance (right)



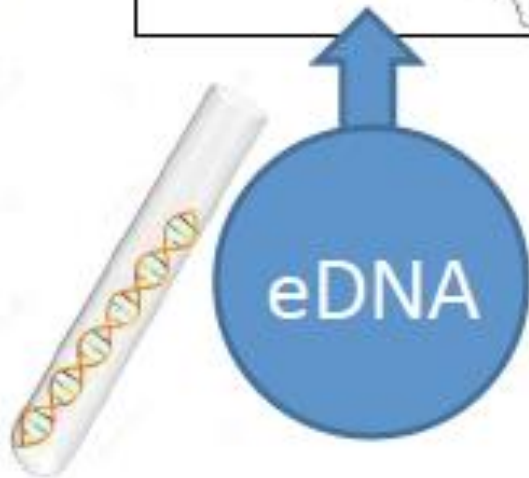
# ENVIRONMENTAL DNA



## Environmental DNA (eDNA)



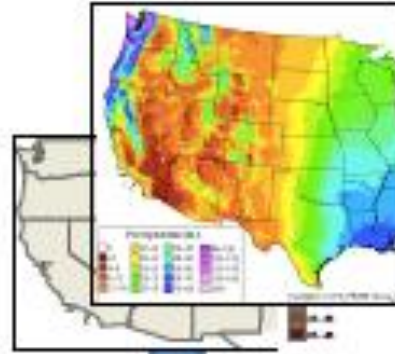
Existing  
Biological  
Data



Species  
Distribution  
Models



Satellite



Predicted  
occurrences

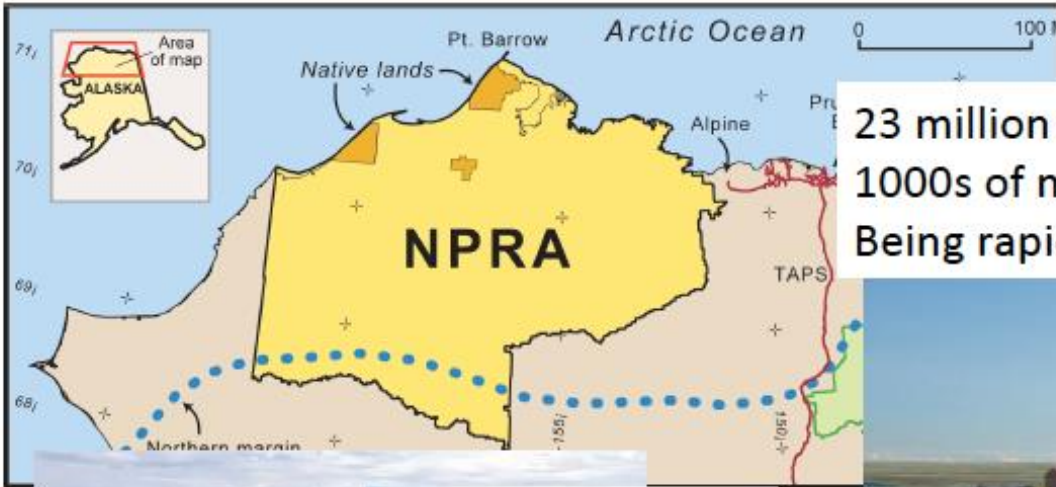




# System for Mapping and Predicting Species of Concern

PI: John Olson, CSU Monterey Bay

## National Petroleum Reserve - Alaska



23 million acres  
1000s of miles of streams  
Being rapidly developed





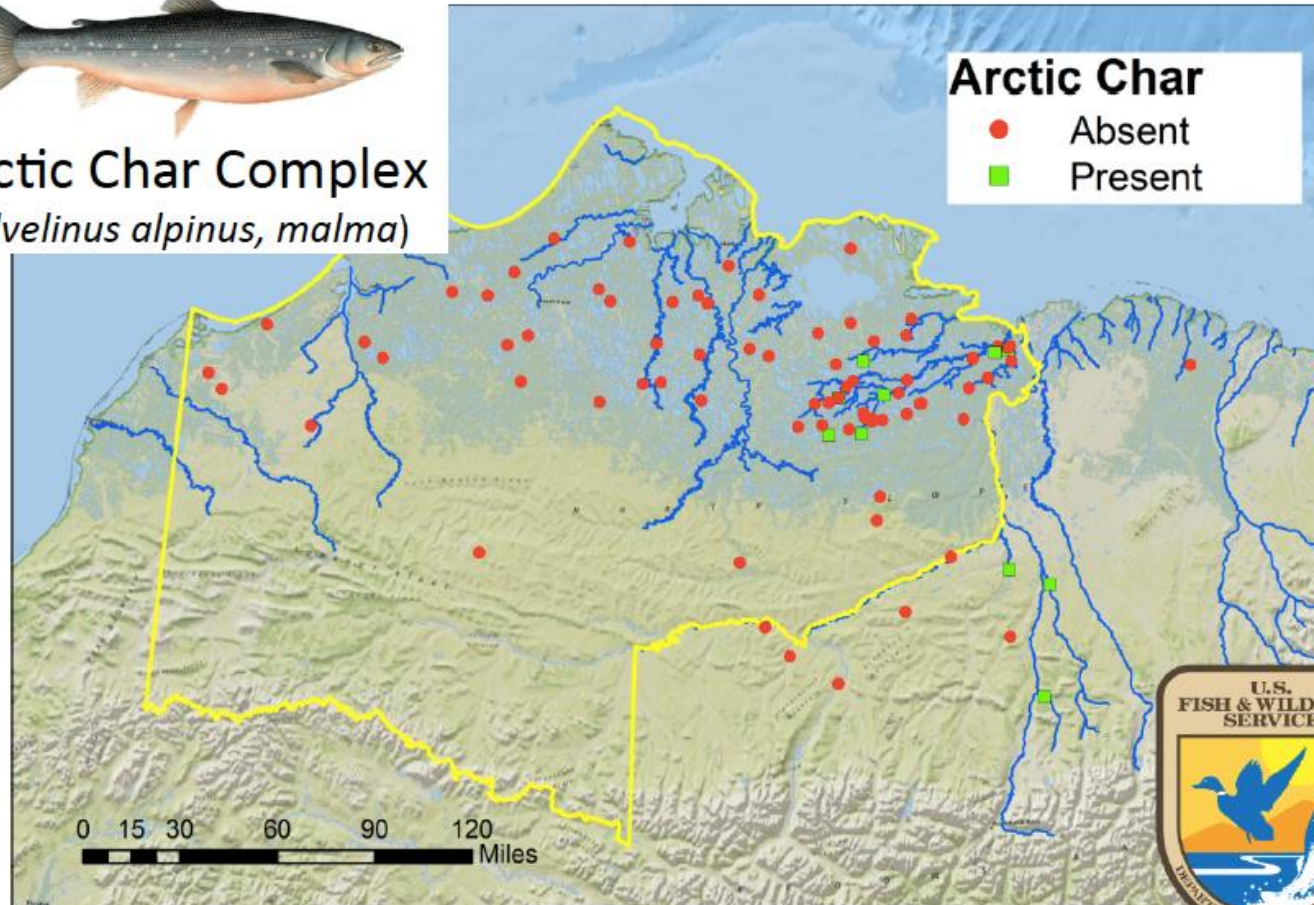
# System for Mapping and Predicting Species of Concern

PI: John Olson, CSU Monterey Bay

Develop & apply eDNA assays



Arctic Char Complex  
(*Salvelinus alpinus, malma*)







# Bayesian data-model synthesis for biological conservation and management in Antarctica

Heather J. Lynch<sup>1</sup>, Mathew Schwaller<sup>2</sup>

Chris Che-Castaldo<sup>1</sup>, Grant Humphries<sup>1</sup>, Michael Schrimpf<sup>1</sup>

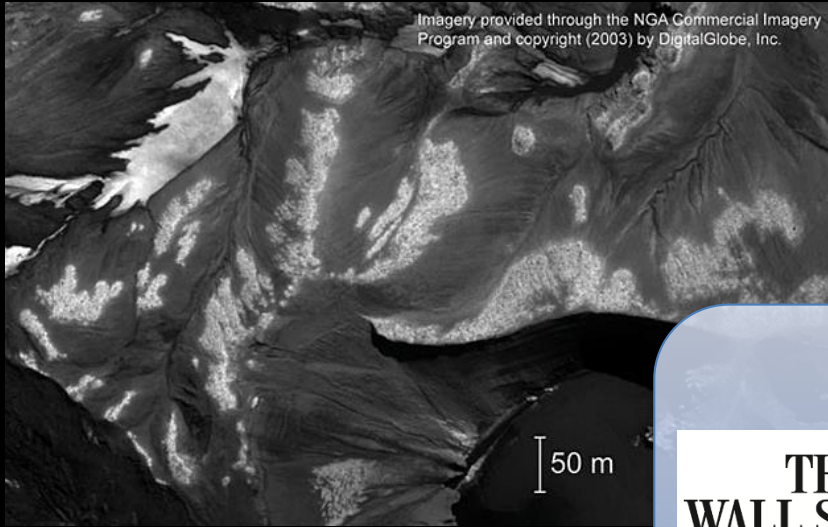
<sup>1</sup>Stony Brook University Ecology & Evolution

<sup>2</sup>NASA Goddard



# From Research to Governance in Antarctica

Heather Lynch (Stony Brook University) & Matthew Schwaller (NASA Goddard)



>300 stories in major media press (national & international)

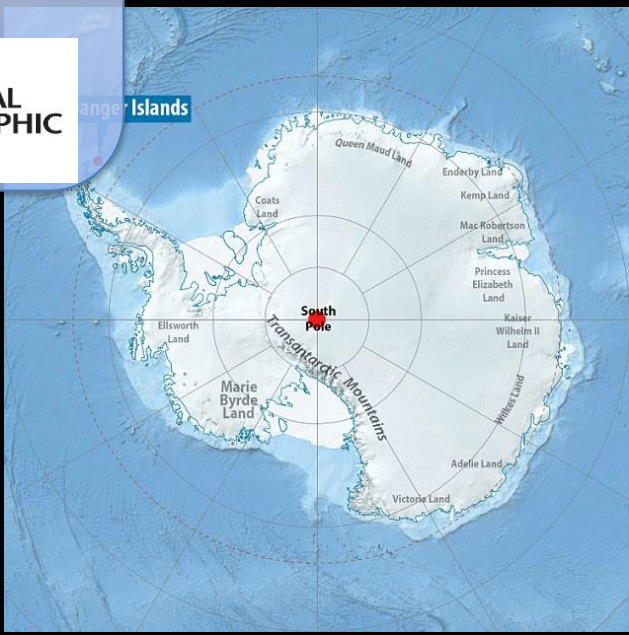
THE WALL STREET JOURNAL. The New York Times BBC NEWS POPULAR MECHANICS INDEPENDENT abc NEWS NATIONAL GEOGRAPHIC



understanding of seabird biogeography.

**3 – Ground validation:** Landsat-enabled exploration of previously unsurveyed territory

**4 – Influencing management:** Danger Islands colonies were not considered a high priority for conservation but this is now being revised as a direct result of discoveries made using Landsat imagery under NASA funding





A satellite view of Earth from space, showing the Americas, Europe, and Africa. The text "How can you find and use NASA data?" is overlaid in white. The image shows the Earth's surface with blue oceans, green and brown landmasses, and white clouds. The text is centered horizontally and vertically over the image.

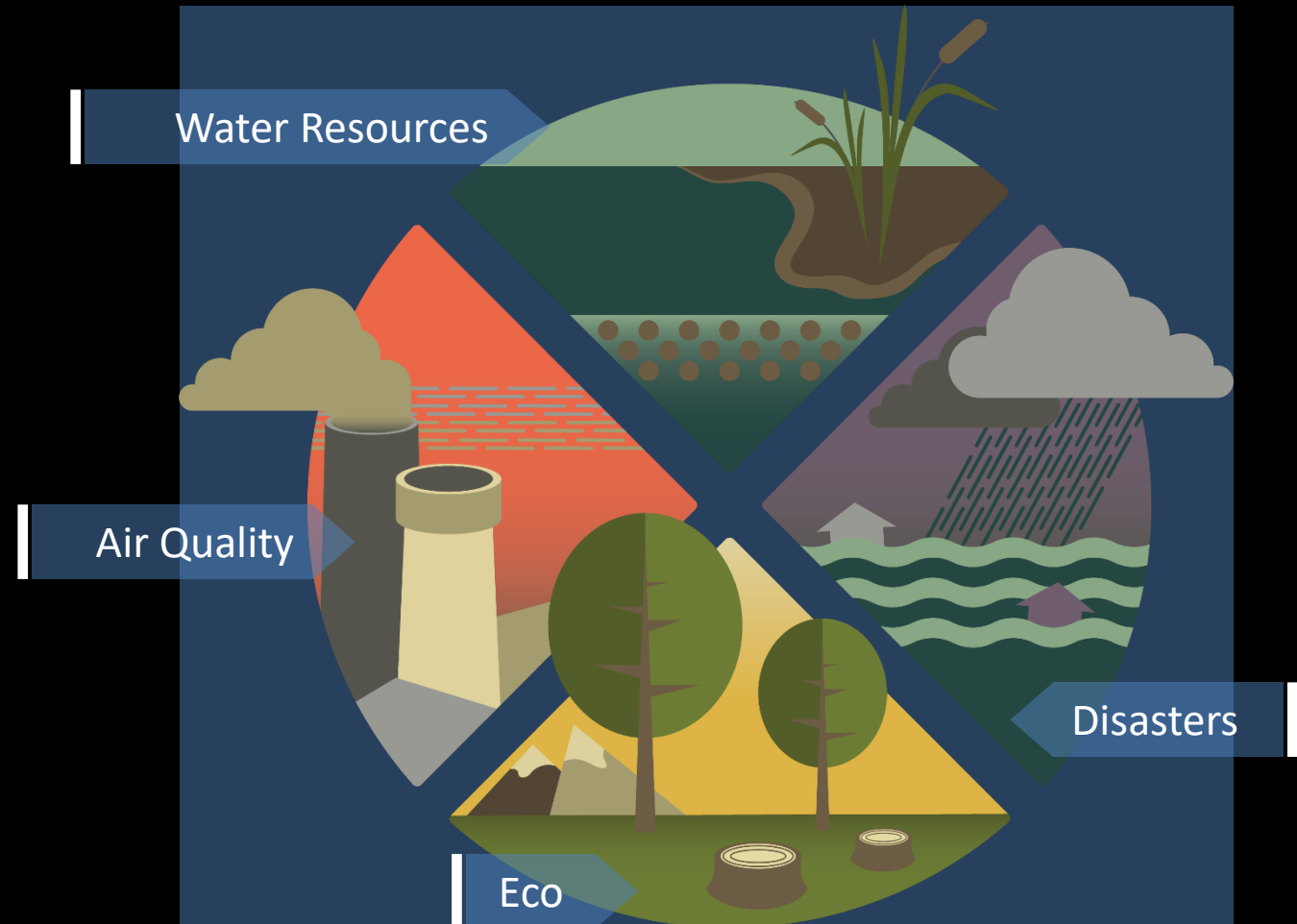
**How can you find and use NASA data?**

# NASA's Applied Remote Sensing Training Program (ARSET)

<https://arset.gsfc.nasa.gov>

- Empowering the global community through remote sensing training
- Part of NASA's Applied Sciences Capacity Building Program
- Goal to increase the use of Earth science in decision-making through training for:
  - policy makers
  - environmental managers
  - other professionals in the public and private sector

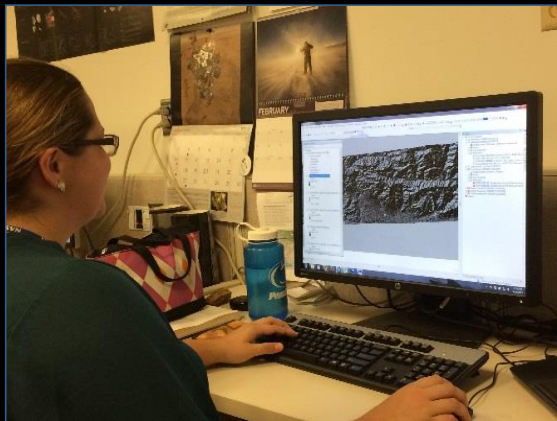
Topics for Trainings Include:



# DEVELOP National Internship Program

*“Shaping the future by integrating Earth observations into global decision making.”*

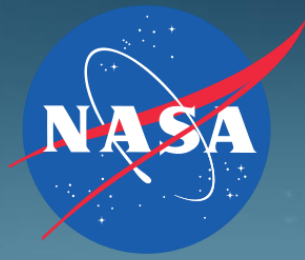
Participants + Earth Observations + Decision Makers



**DEVELOP bridges the gap between NASA Earth Science and society, building capacity in both its participants and end-user organizations to better prepare them to handle the environmental challenges that face society.**

<https://develop.larc.nasa.gov>





# Thank You!

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