EARTH SCIENCE
APPLIED SCIENCES

STRENGTHENING ECOSYSTEMS

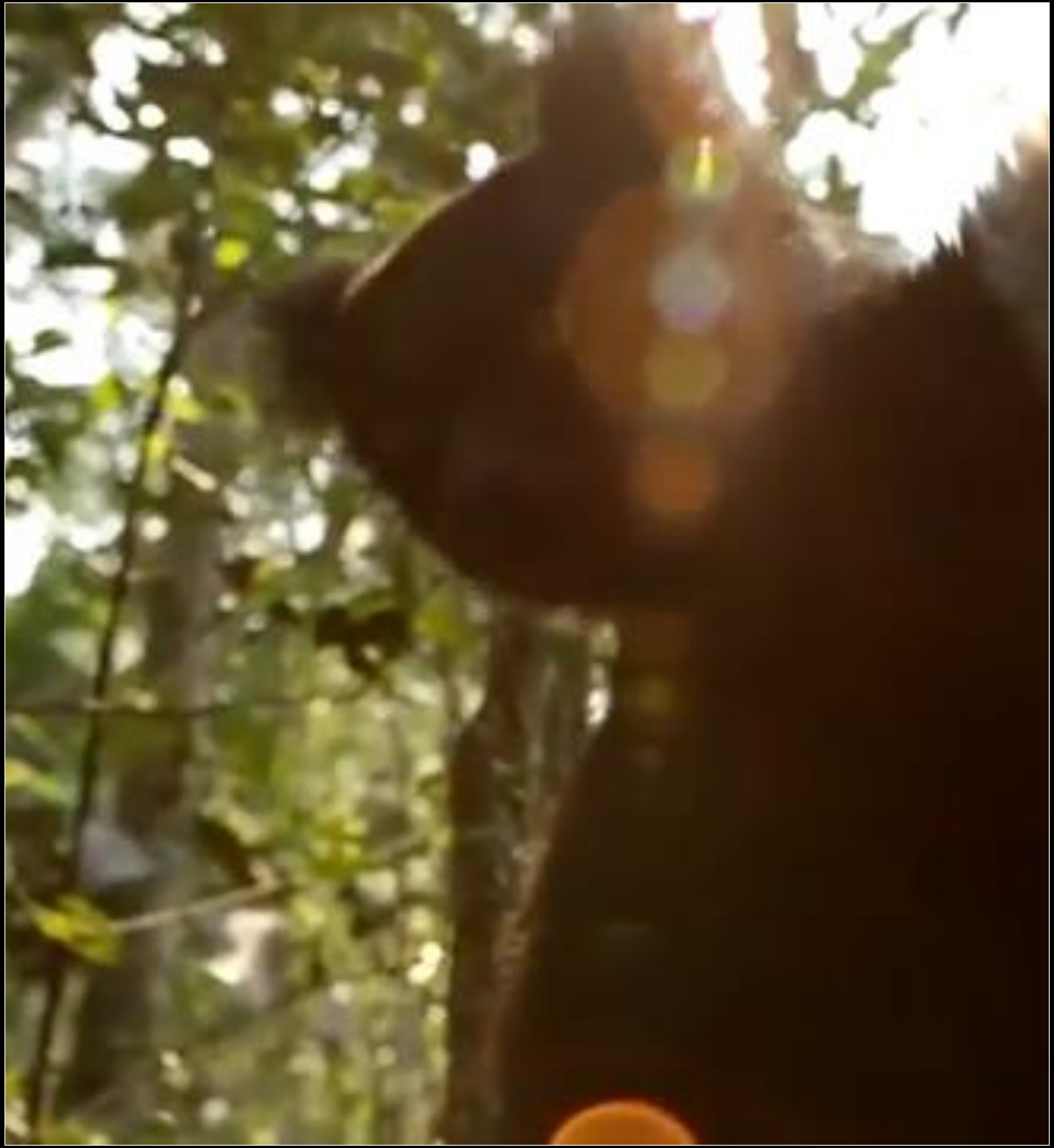
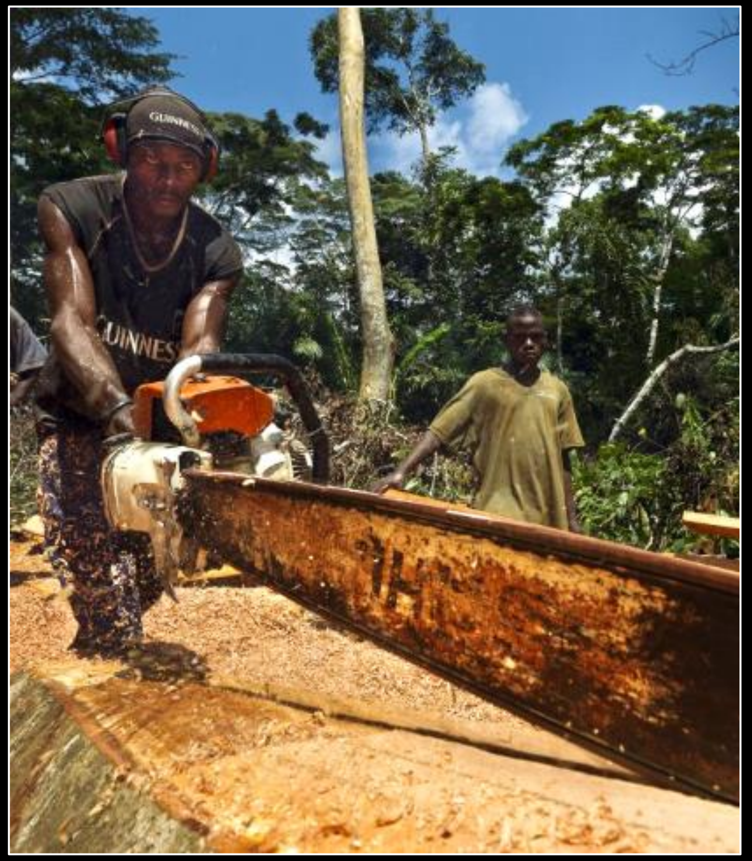
EARTH SCIENCE APPLICATIONS WEEK 2021

EARTH SCIENCE
APPLIED SCIENCES

Ecological Forecasting Program Overview

Dr. Keith Gaddis
Program Manager

EARTH SCIENCE APPLICATIONS WEEK 2021







Overview: Projects By The Numbers

End Users

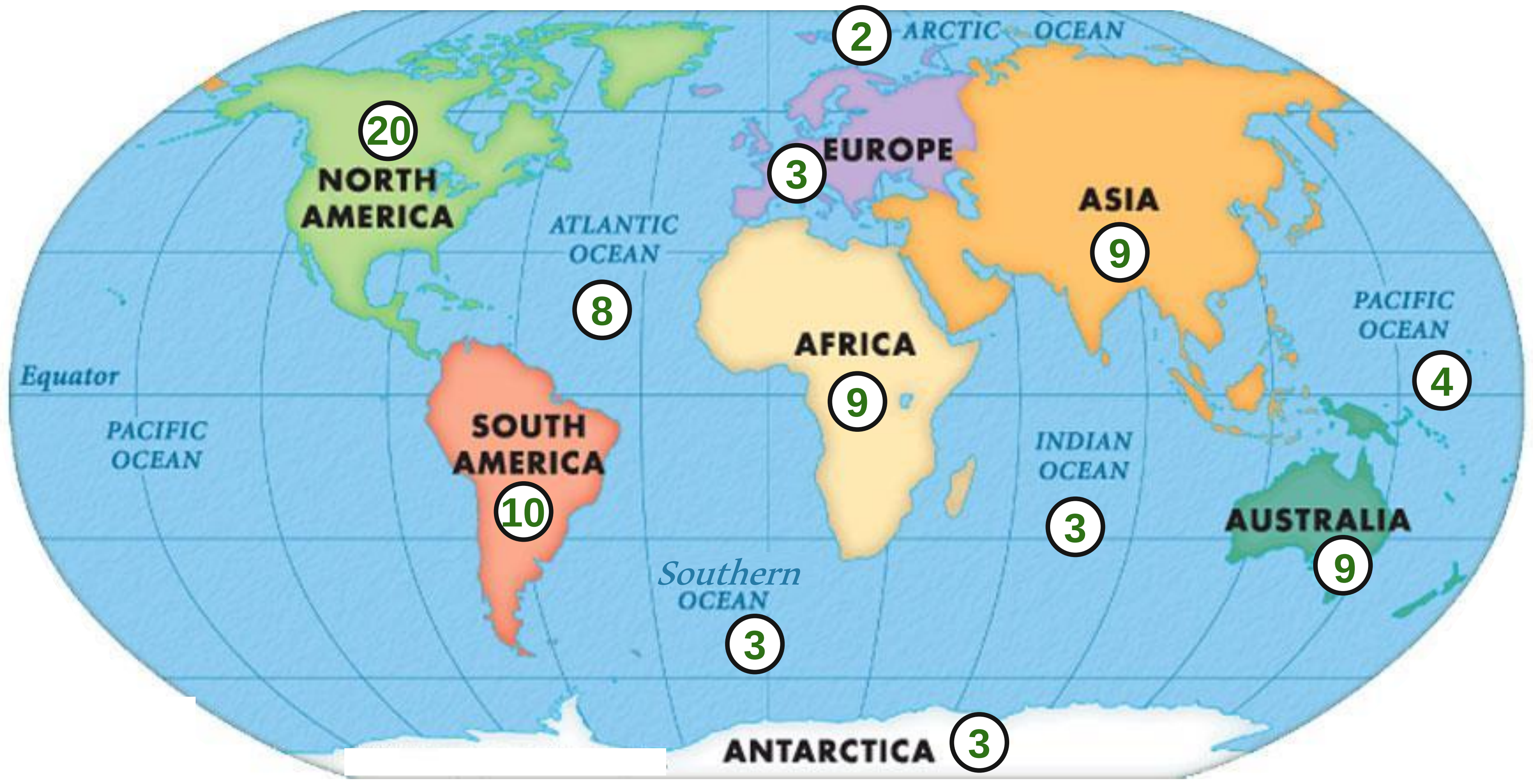
21
Government Agency

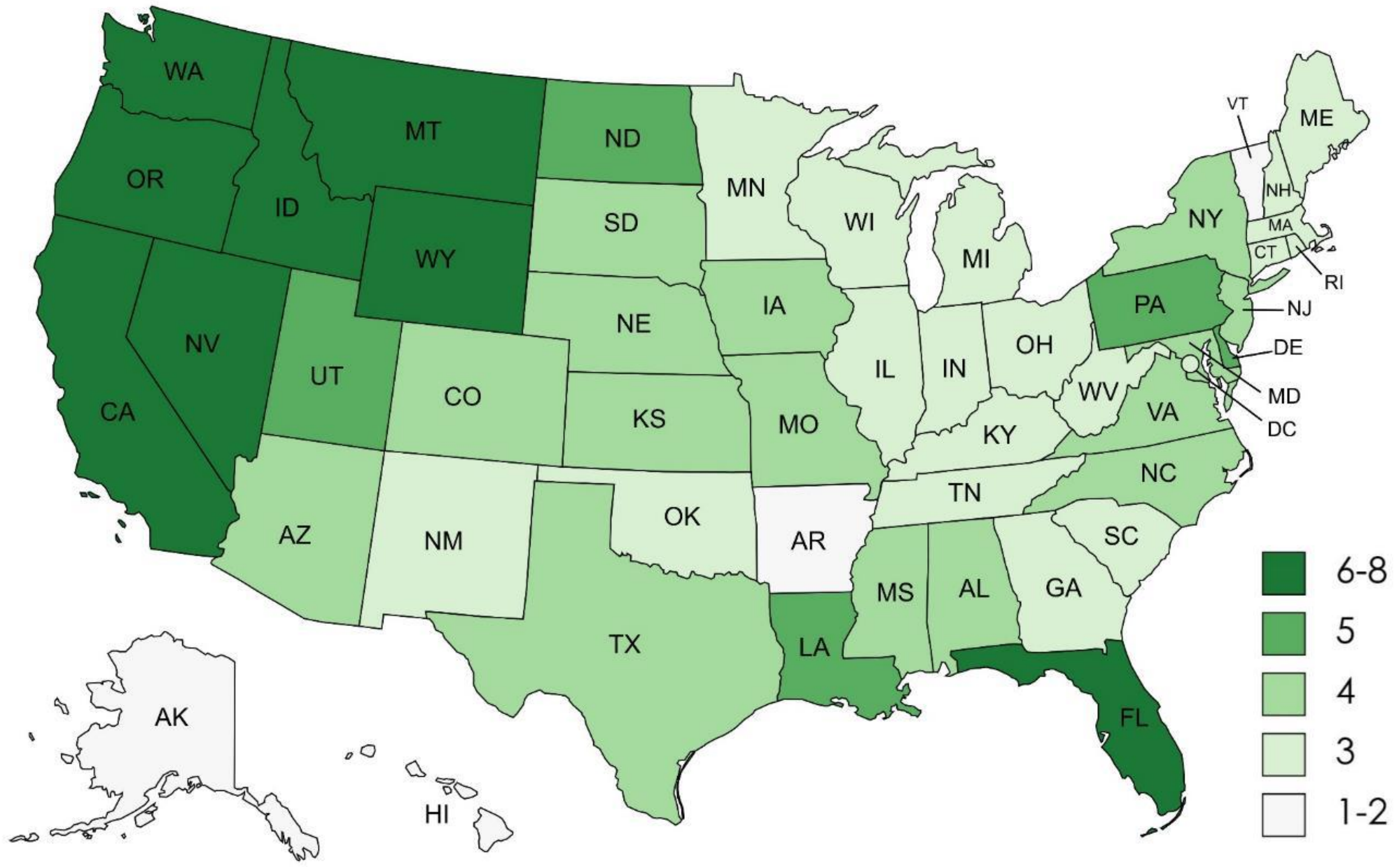
8
International Body

13
Conservation Agency

2
Private Company

Geographic Extent





Thematic Program Topics

8
Protected Area Management

10
Ecosystem Conservation

26
International Standards

4
Ecosystem Services

5
Rewilding and Restoration

6
Citizen Engagement

Biomes

31
Terrestrial

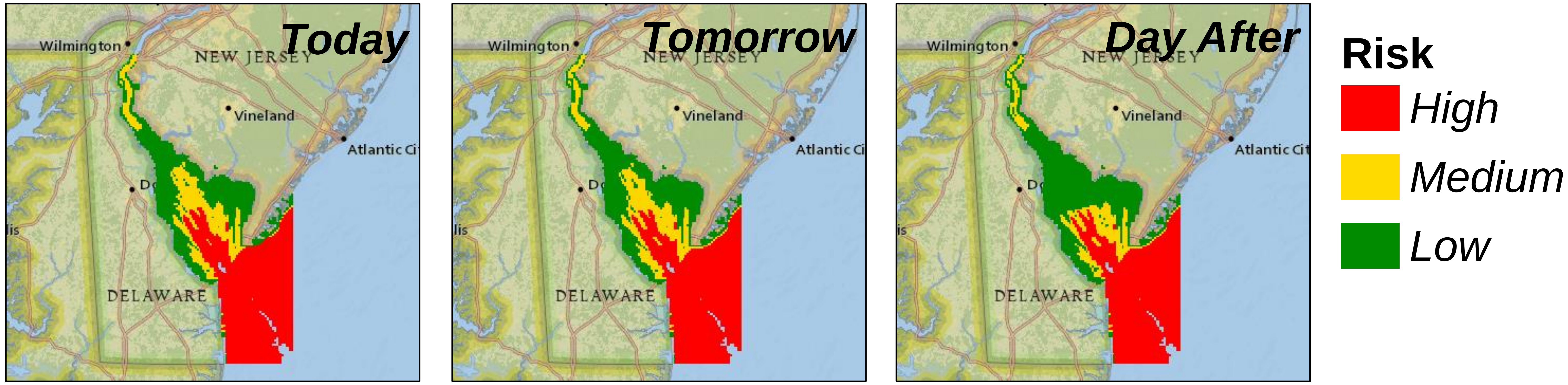
4
Freshwater

11
Marine

Outcomes

Keeping Fisheries from Encountering the Endangered Atlantic Sturgeon

Commercial fisheries in the Delaware Bay are more than happy to avoid the endangered Atlantic Sturgeon. With risk alerts from the Atlantic Sturgeon Forecast Warning System, they can.



EARTH SCIENCE
APPLIED SCIENCES

Sustainable Science for the Sustainable Cashmere Project, South Gobi, Mongolia

Becky Chaplin Kramer

EARTH SCIENCE APPLICATIONS WEEK 2021

Sustainable Science for the Sustainable Cashmere Project, South Gobi, Mongolia

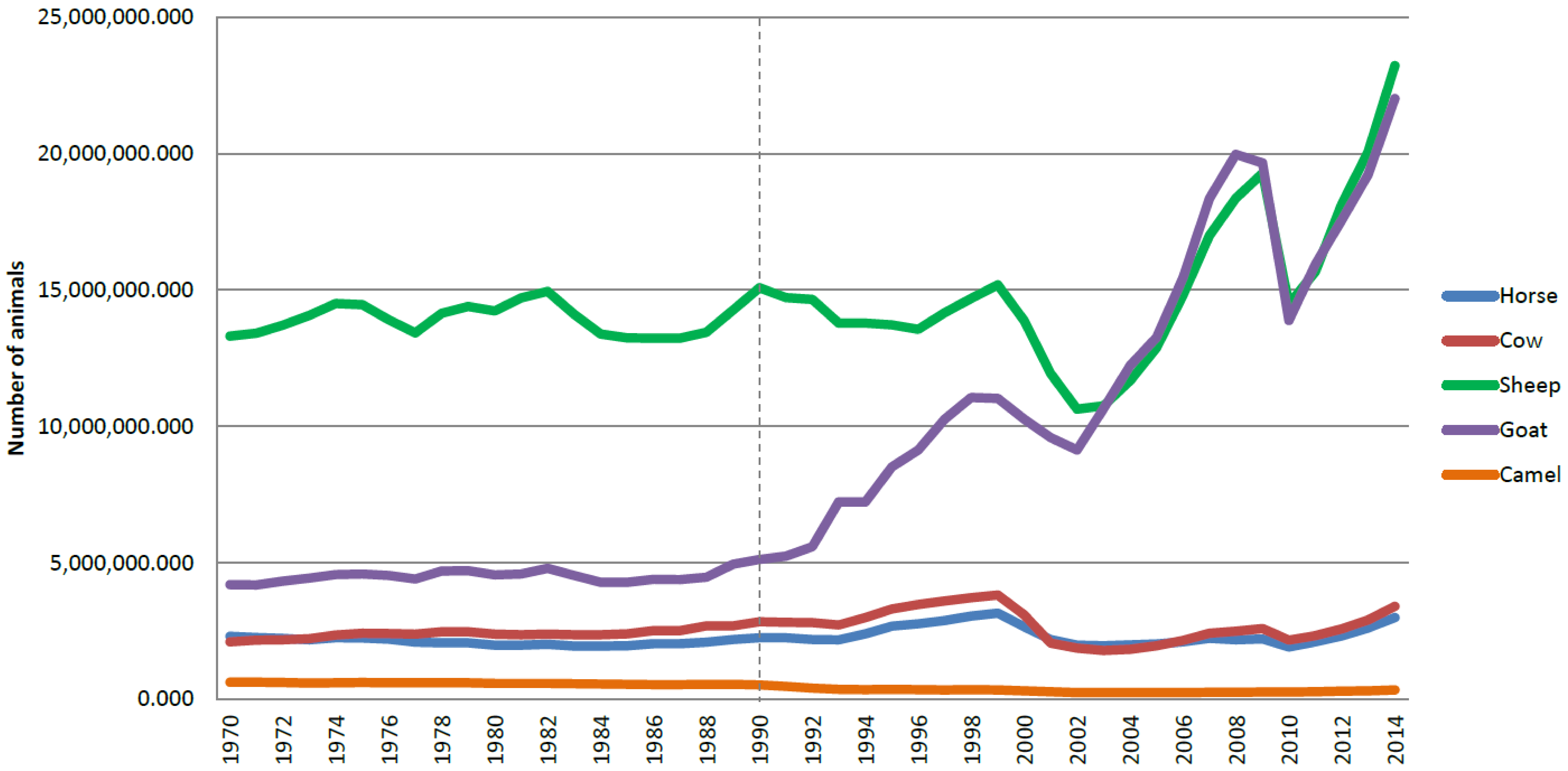
Becky Chaplin-Kramer
Natural Capital Project
Stanford University & University of Minnesota

@beckyck
@natcapproject

natural capital PROJECT


© ganbayar/hureelen
© Dan & Sandy Ciske,
Wild Mongolia
© WCS Mongolia

Livestock trends in Mongolia, post deregulation



The Sustainable Cashmere Project is a new initiative that aims to use market mechanisms to foster sustainable practices and deliver measurable improvements on rangelands, wildlife and livelihoods through the cashmere supply chain in Mongolia.

Sustainable Cashmere Project

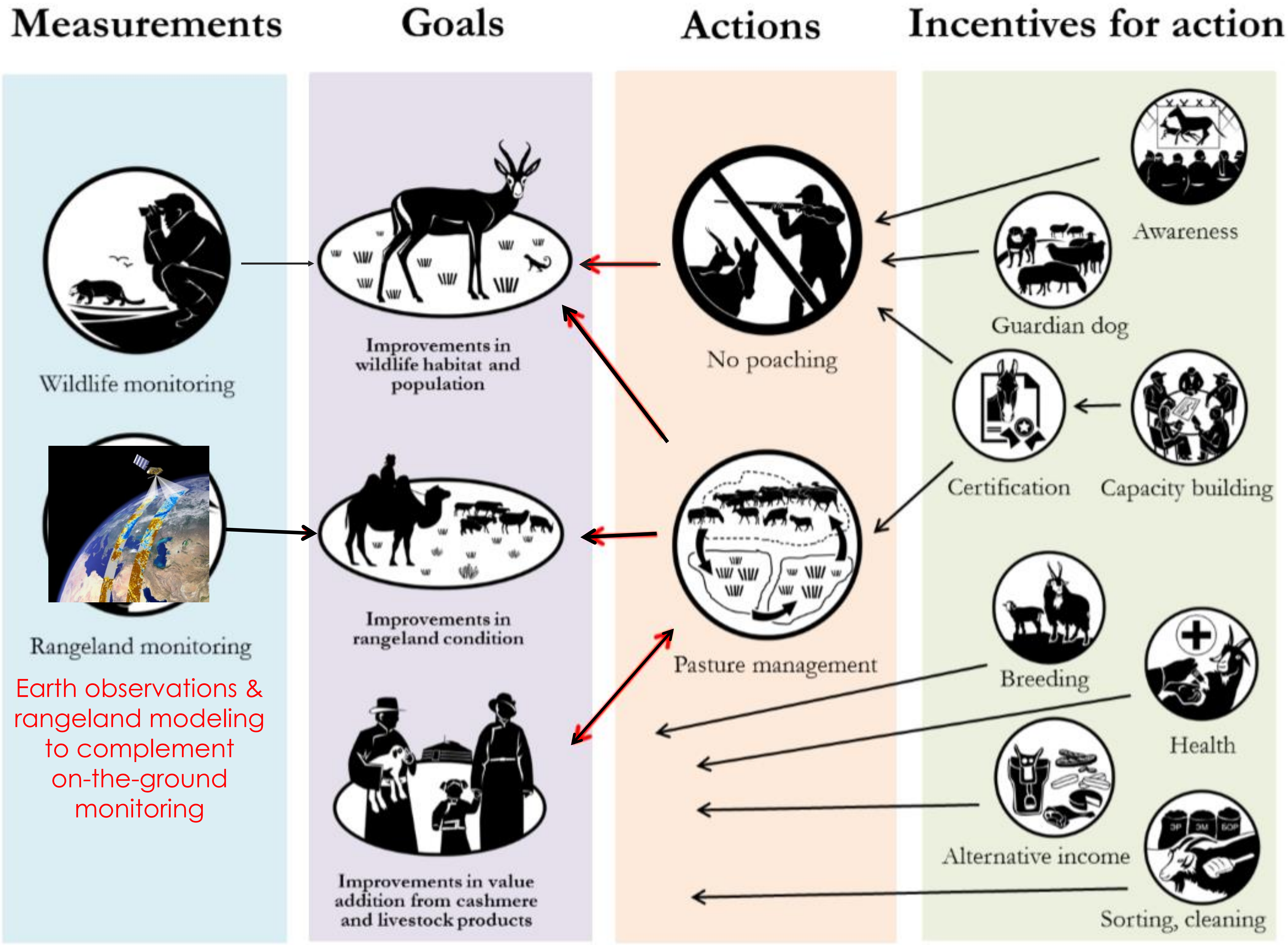
KERING

Оюу Толгой

WCS

natural capital PROJECT

NASA



Where should field resources be deployed?
How should herd size be adapted to changing conditions?
What are the risks of management strategies and how can they be managed?

Are changes in grazing management able to offset mining impacts enough to have a net positive impact?

How much can management contribute to rangeland health and ecosystem services?

And will this be adequate to support wildlife and maintain herder livelihoods, amidst climate change?

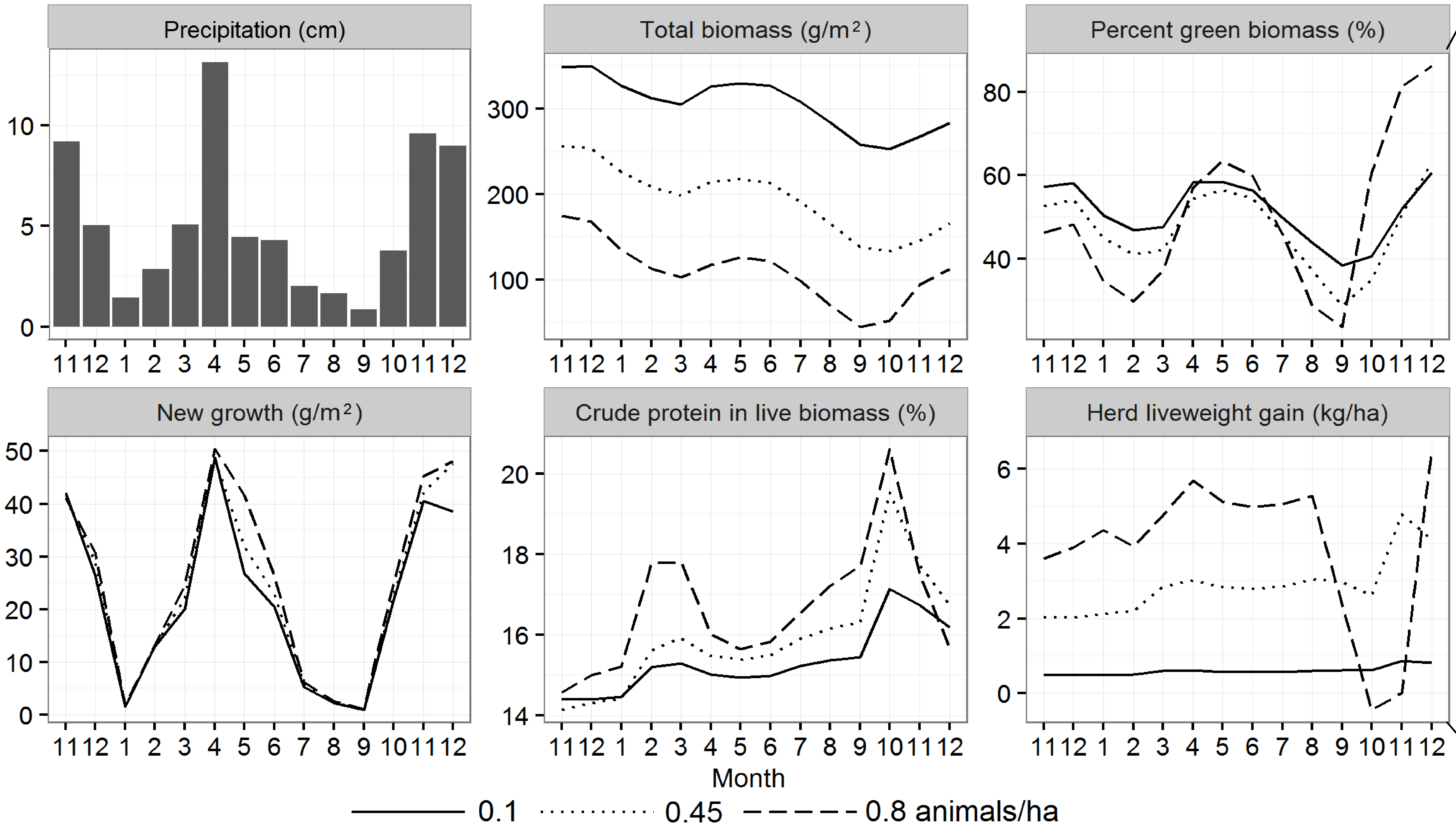
What role can management play amidst climate change?

KERING

WCS

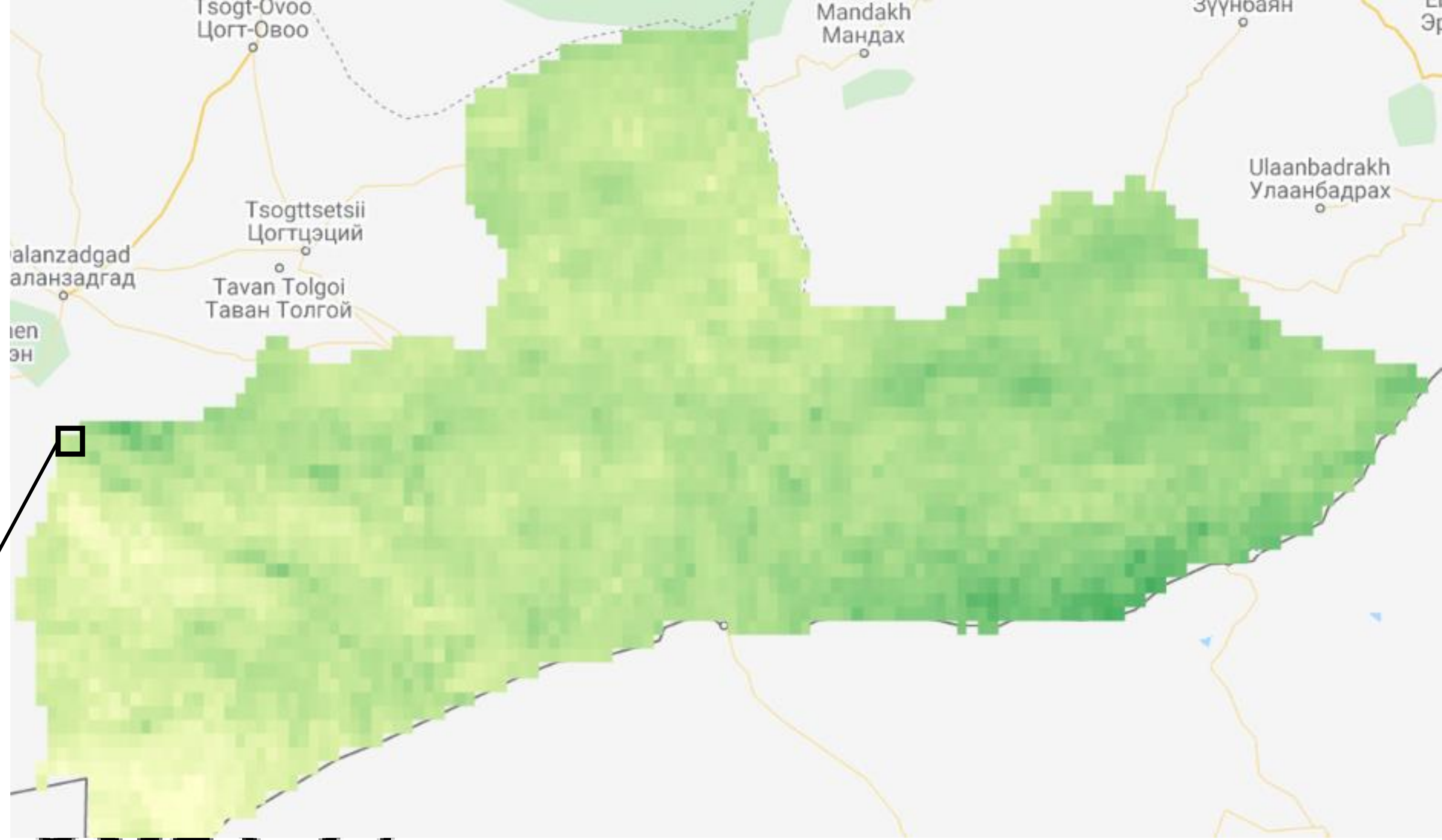
The Good Growth Company

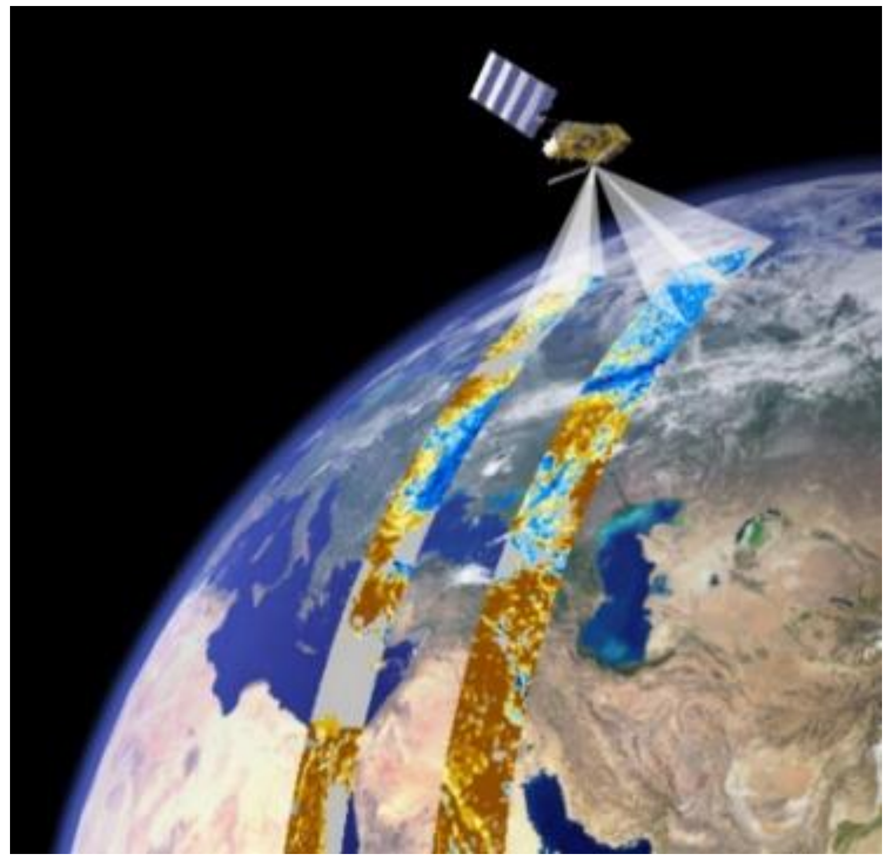
Rangeland Production Model (RPM)

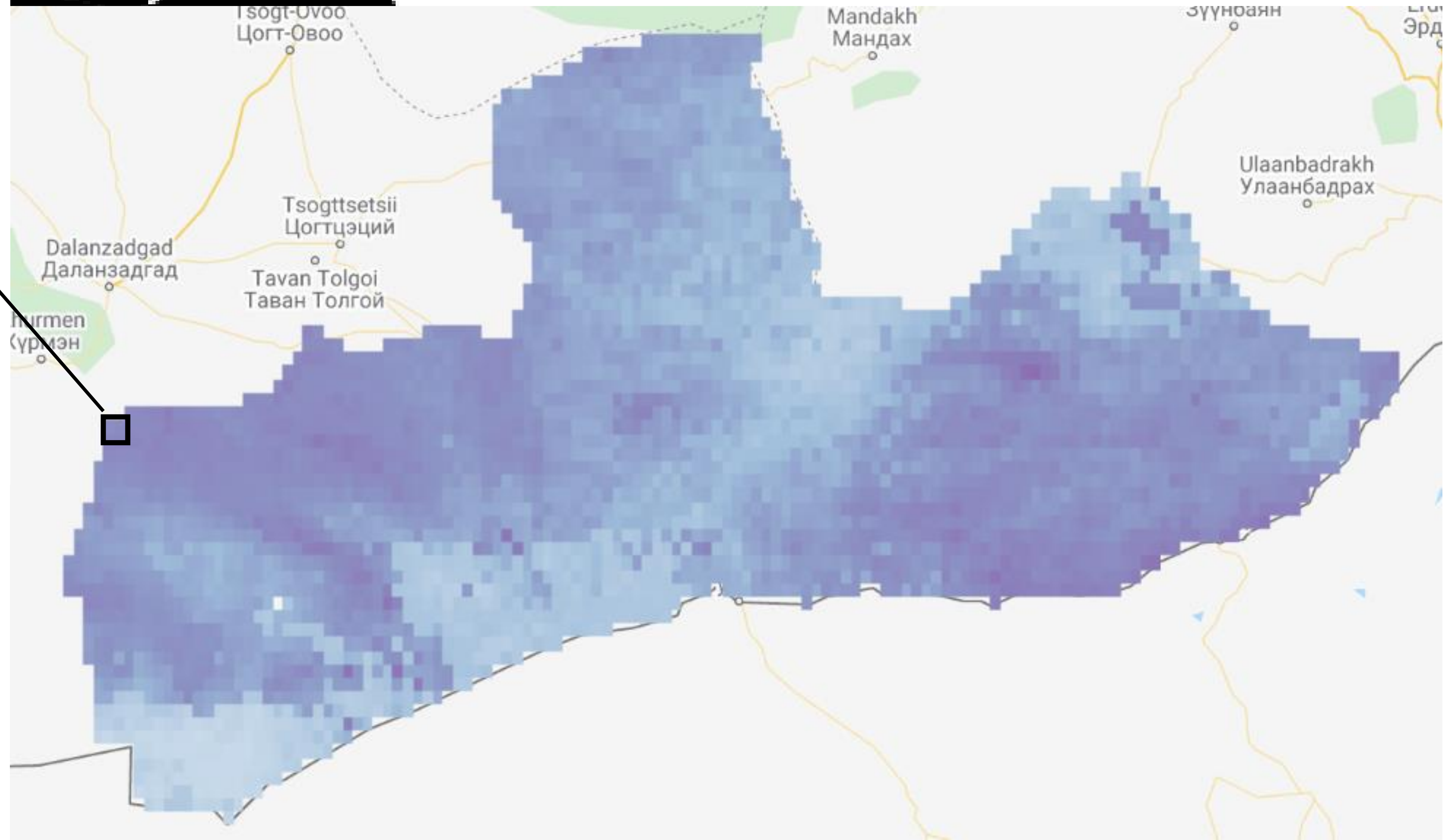


Mean observed biomass

- Low observed biomass
- High observed biomass







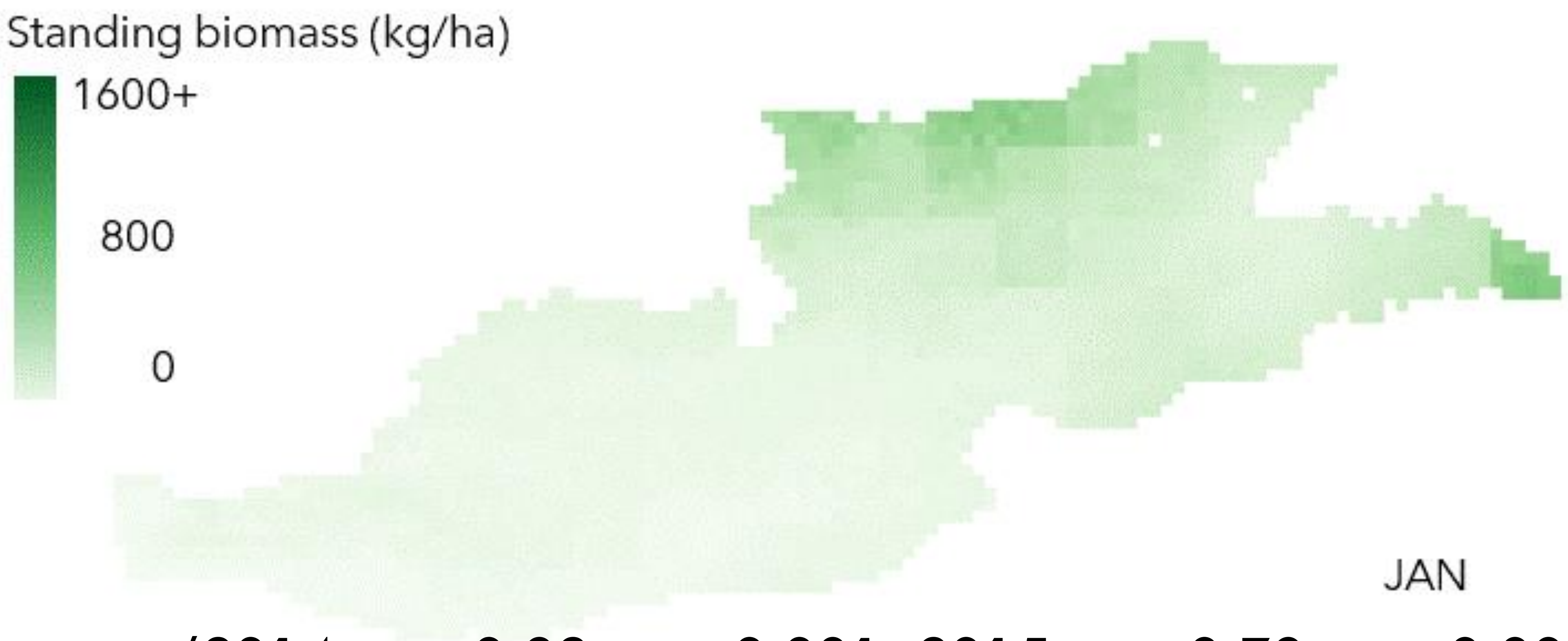
Mean animal diet sufficiency

- Low (animal losing weight or condition)
- Median (animal maintaining weight or condition)
- High (animal gaining weight or condition)

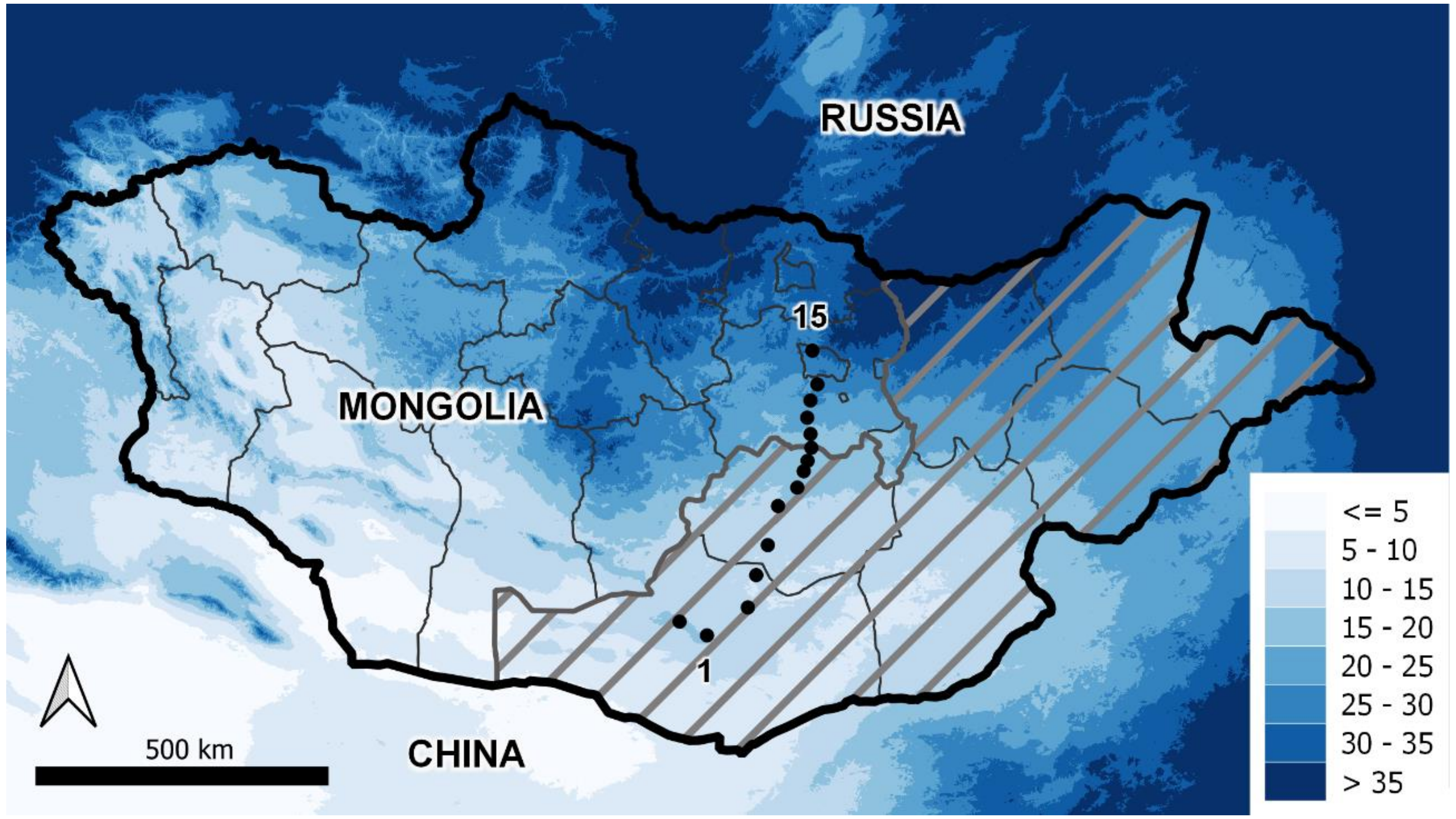
http://viz.naturalcapitalproject.org/rangelands/

Validation across a precipitation gradient

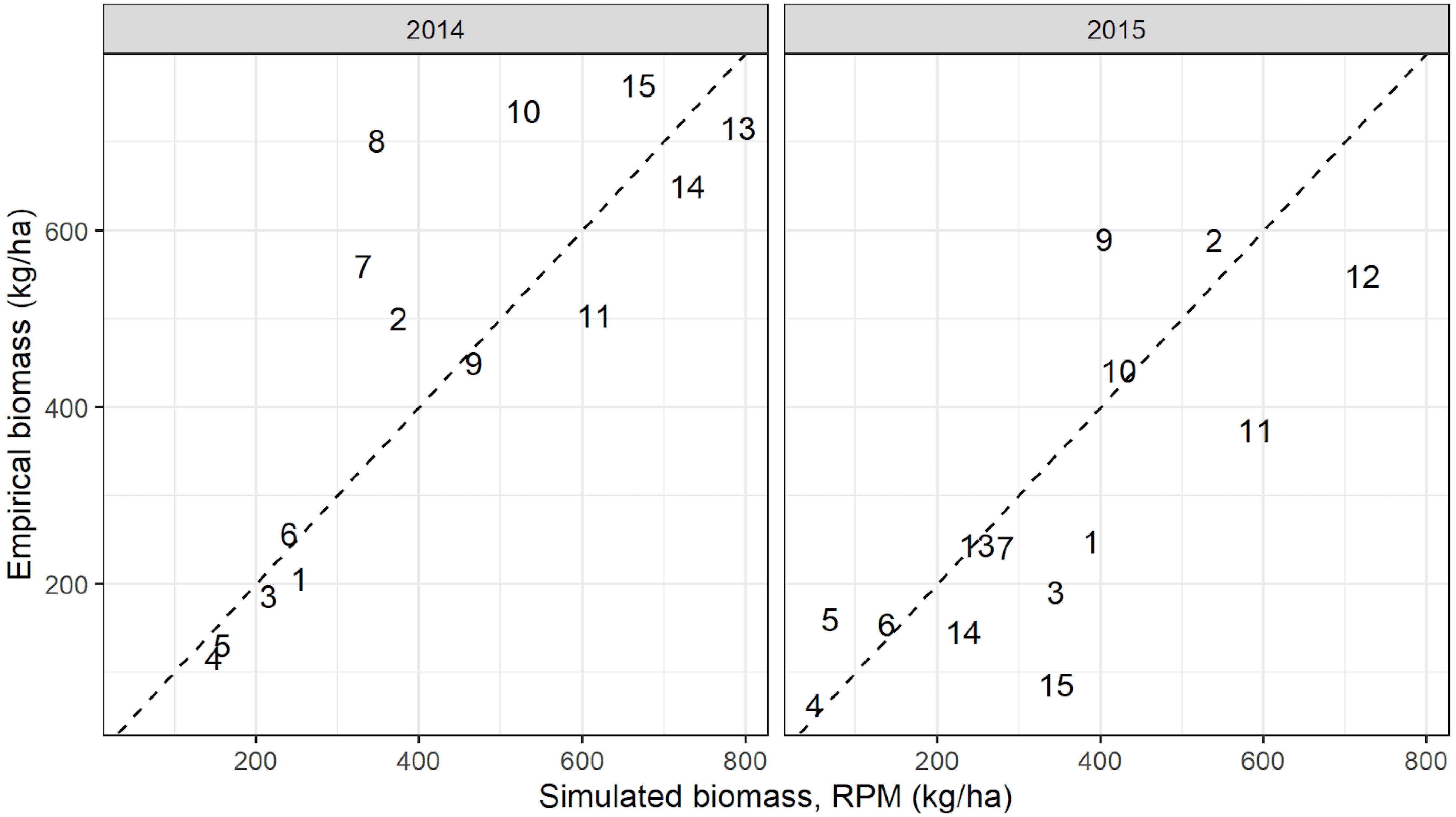
Model accuracy improved using satellite climate data (CHIRPS precipitation, MODIS LST) and calibrated with vegetation indices (MODIS NDVI)



15 transects, 5 replicates each = 75 sites across Mongolia

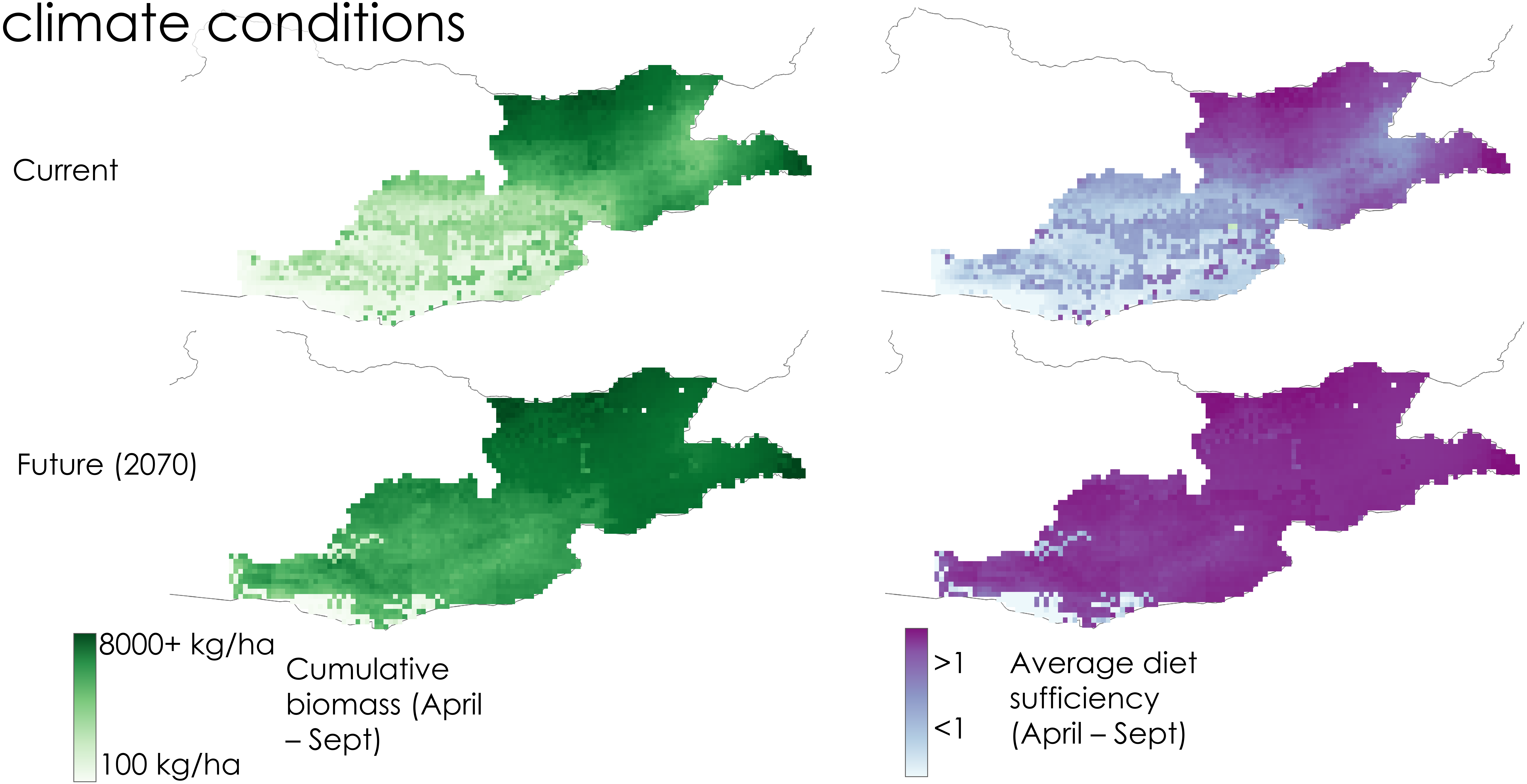


(2014: $\rho = 0.82$, $p < 0.001$; 2015: $\rho = 0.78$, $p = 0.001$)



Rangeland production modeling

Change under future climate conditions

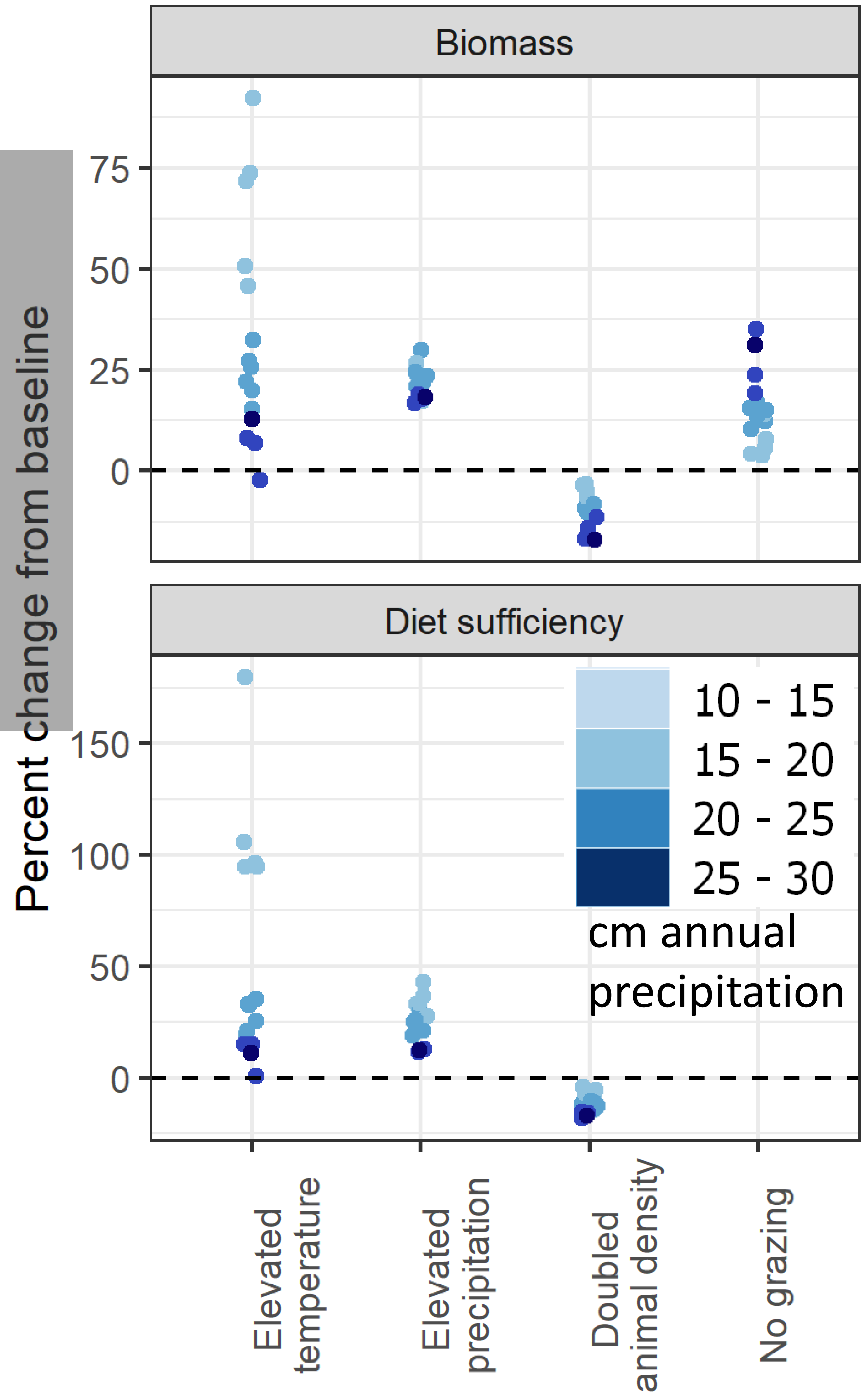


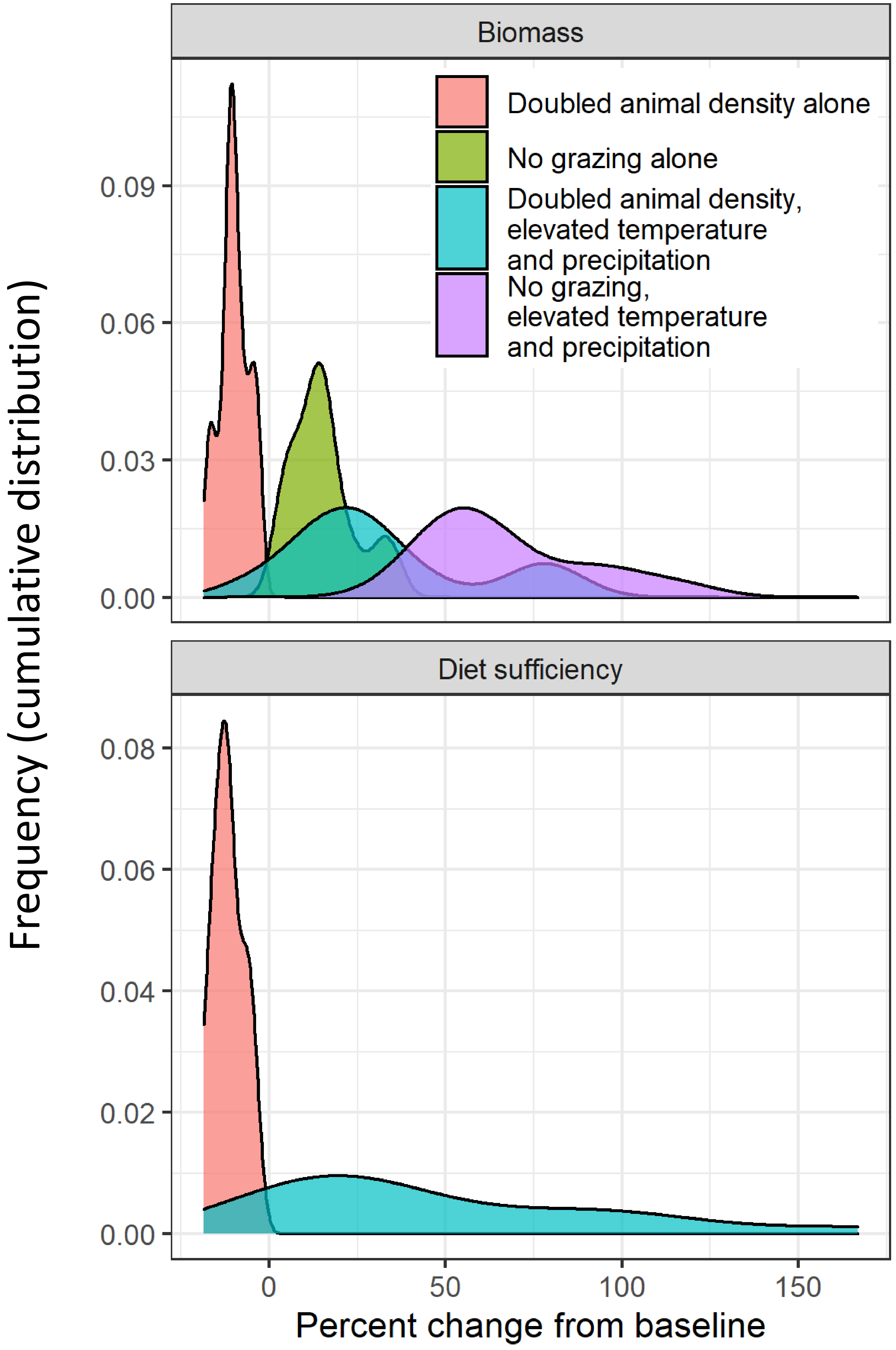
What role can management play amidst climate change?

WCS

KERING

Grazing impacts matter more in more productive climates;
will matter more under future climate



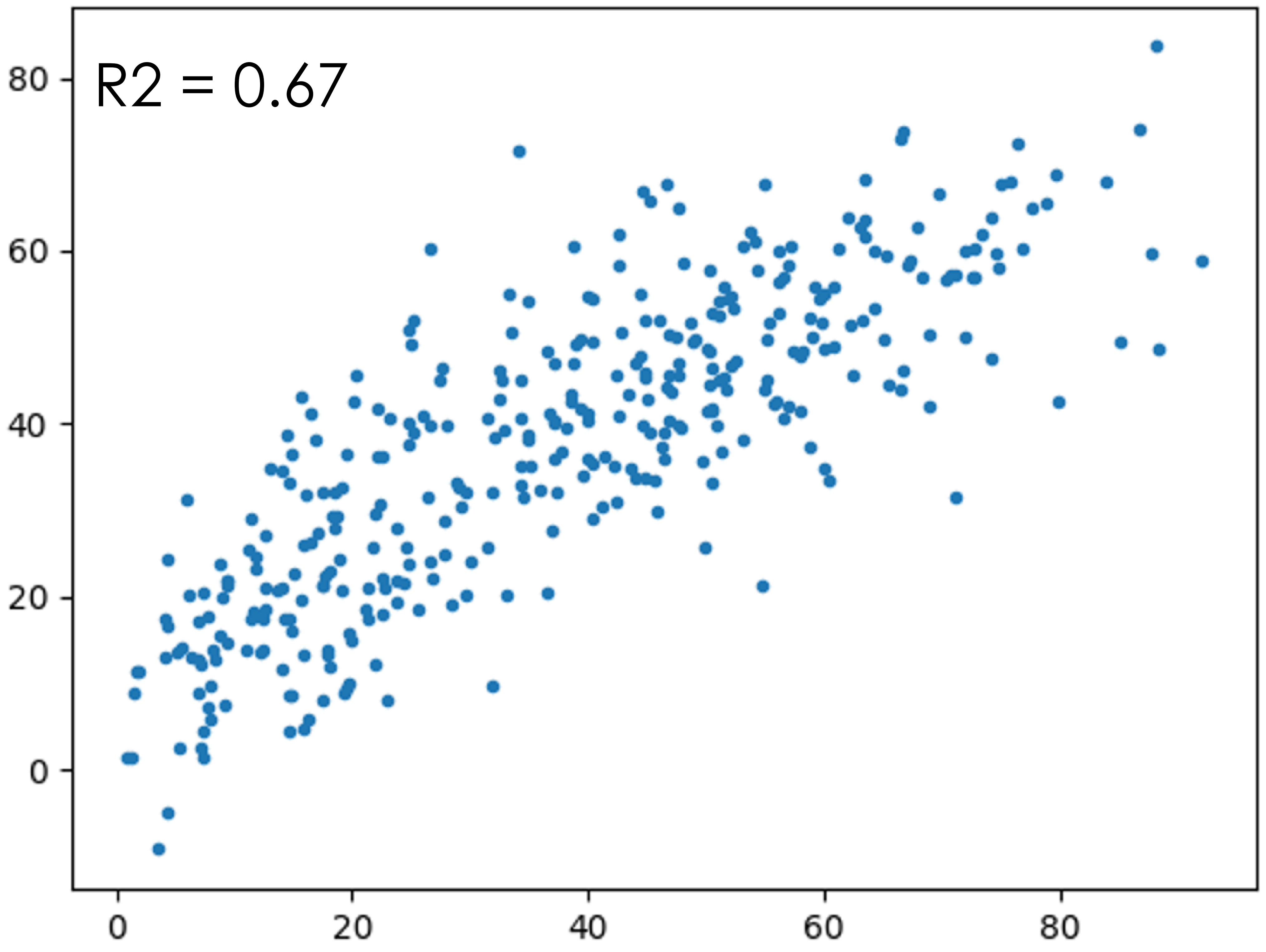


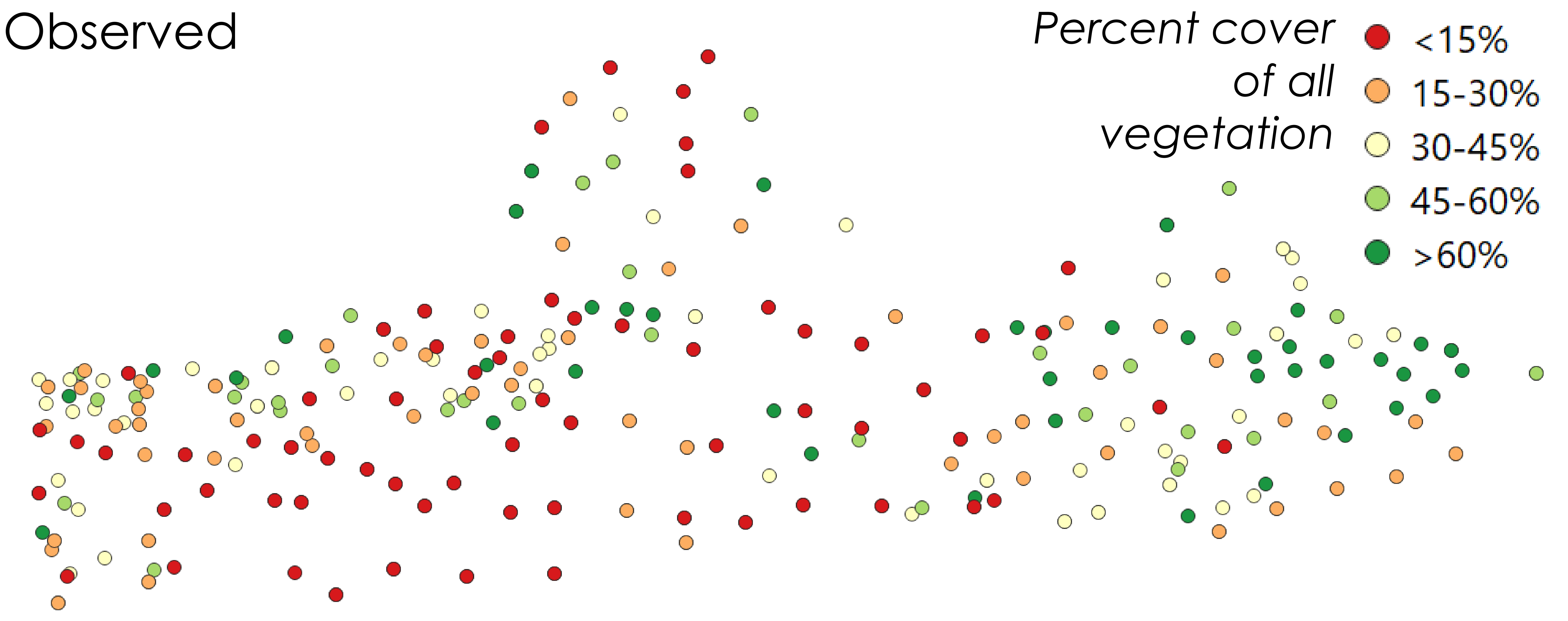
How much has management contributed to rangeland health?

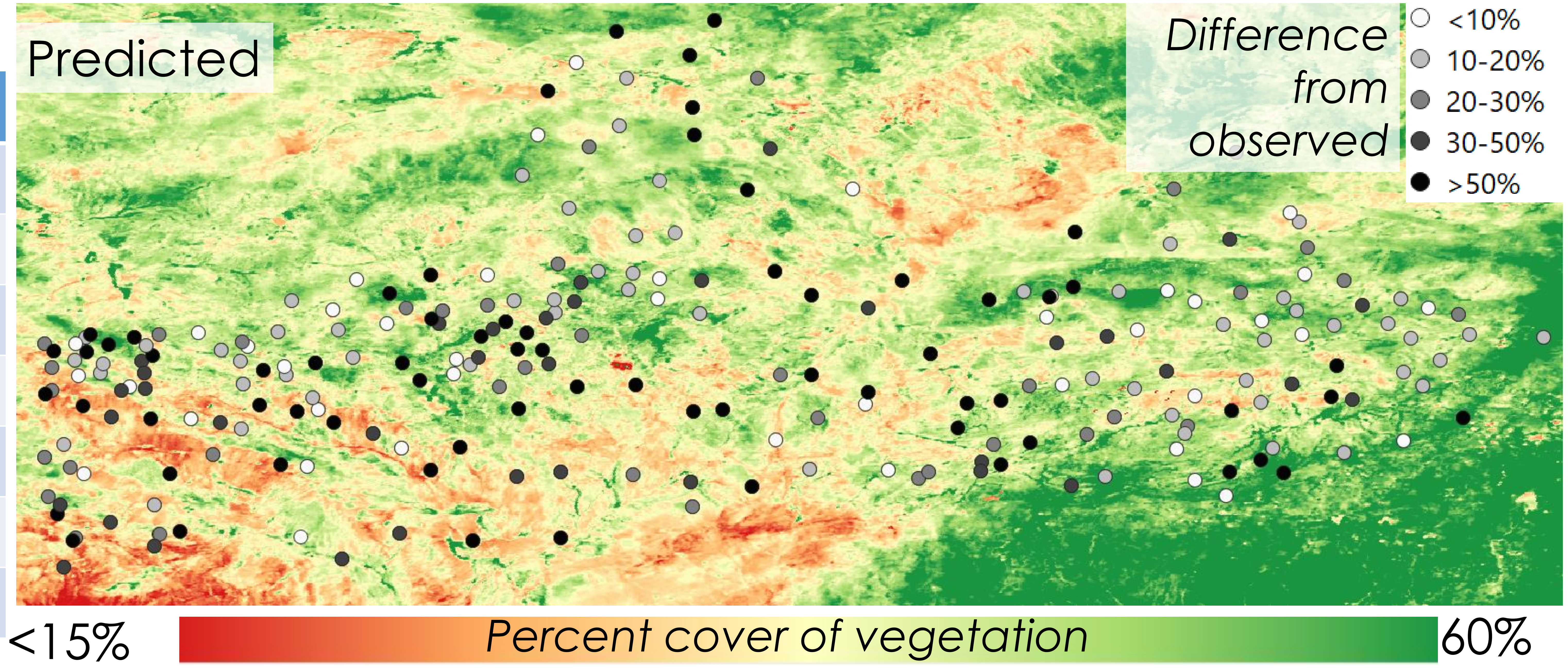
Are changes in grazing management able to offset mining impacts enough to have a net positive impact?

How accurately (and cost-effectively) can we detect changes in rangeland condition?

Satellite monitoring

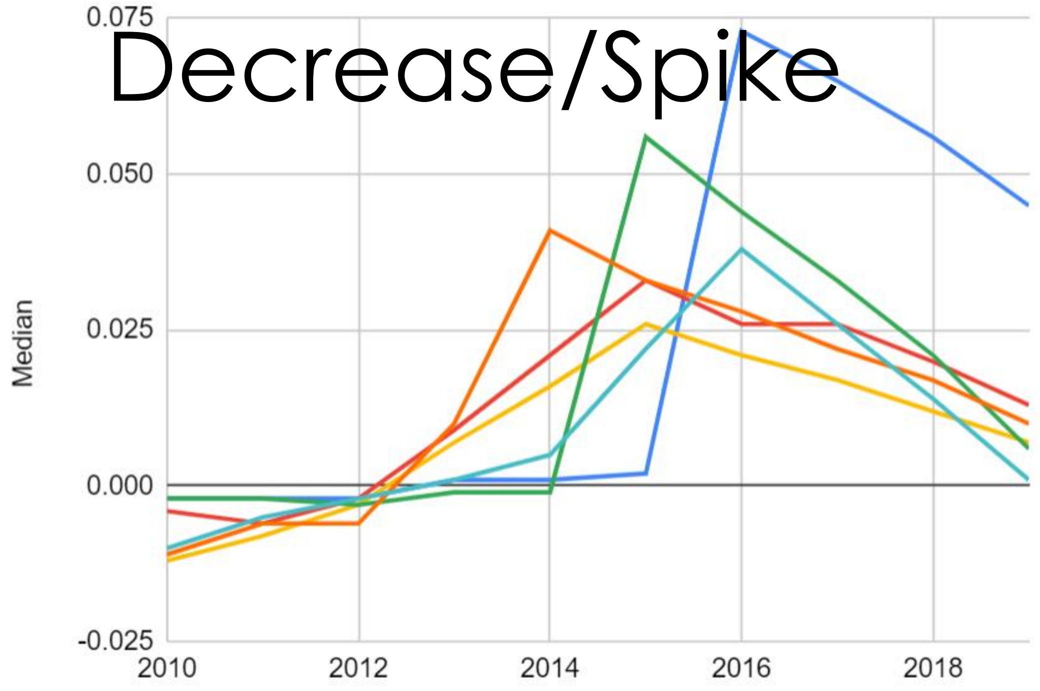


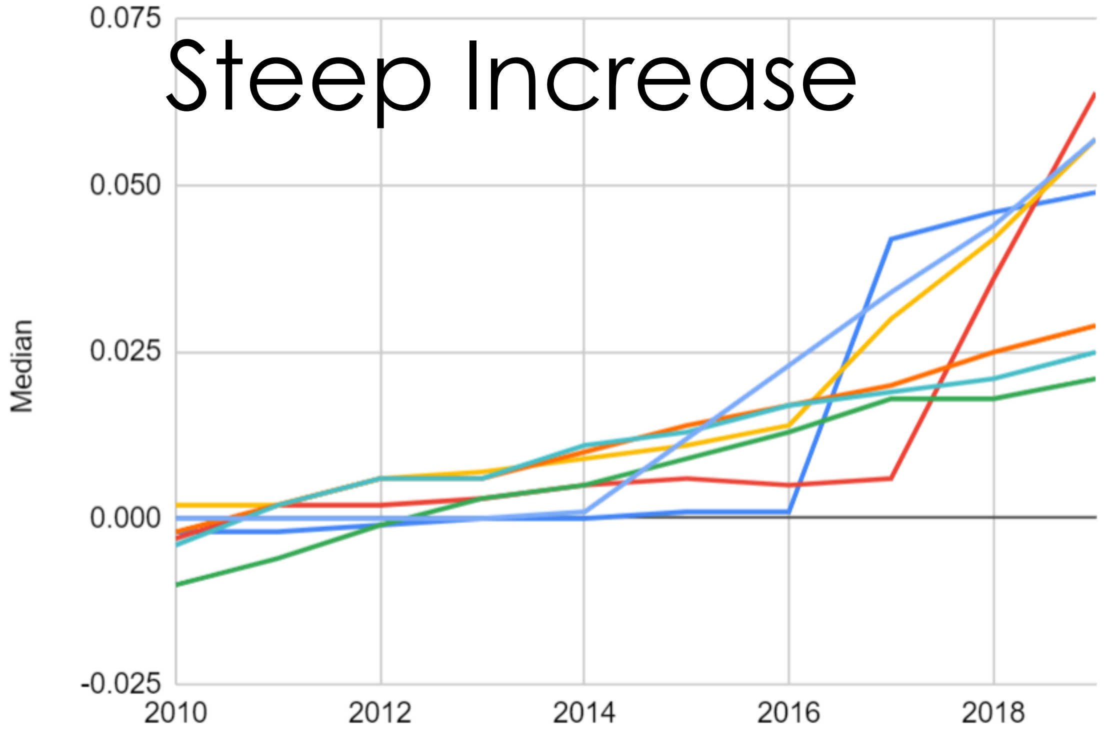




Significant predictors (LASSO model)
Early fall precipitation x Range in NDVI
Early spring minimum temperature
Mid-fall minimum temperature
Summer minimum temperature
Spring precipitation x NDVI near sampling date
Fall max temperature x NDVI near sampling date
NDVI near sampling date

Satellite monitoring

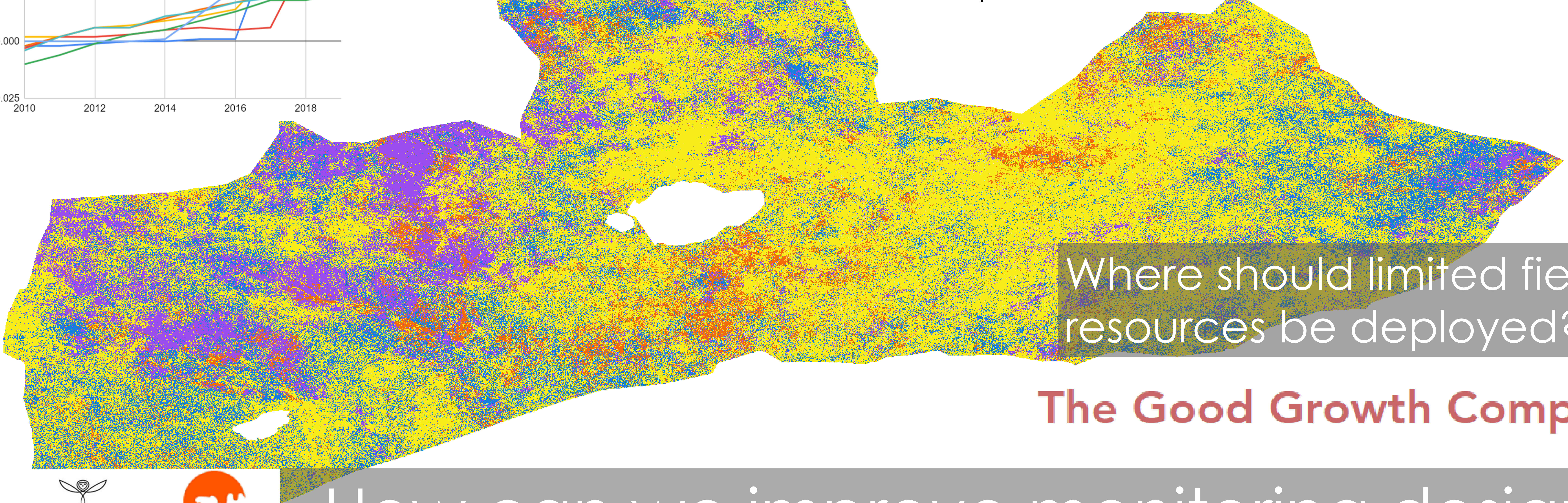




LandTrendr
(Landsat past 10 years)
Different trajectories of the relationship between precipitation & greenness
Positive residuals = better than average

LandTrendr Clusters

- Decrease/Spike — Degradation?
- Increase
- Stasis/Gradual Increase
- Steep Increase



Where should limited field resources be deployed?

The Good Growth Company

KERING

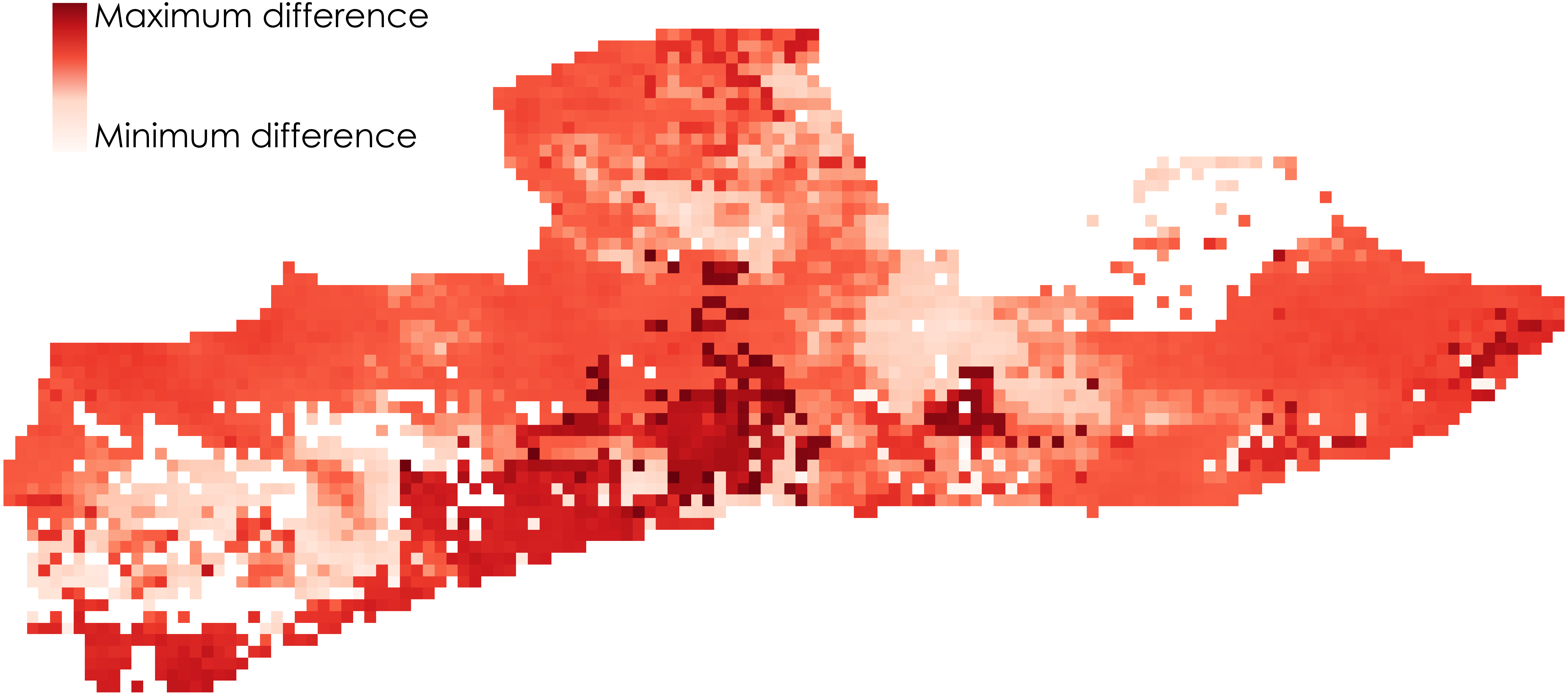
Оюу Толгой

How can we improve monitoring design?

Rangeland production modeling

Wet year (2018)

Grazing difference
(Cumulative live biomass)



Wet year (2018)

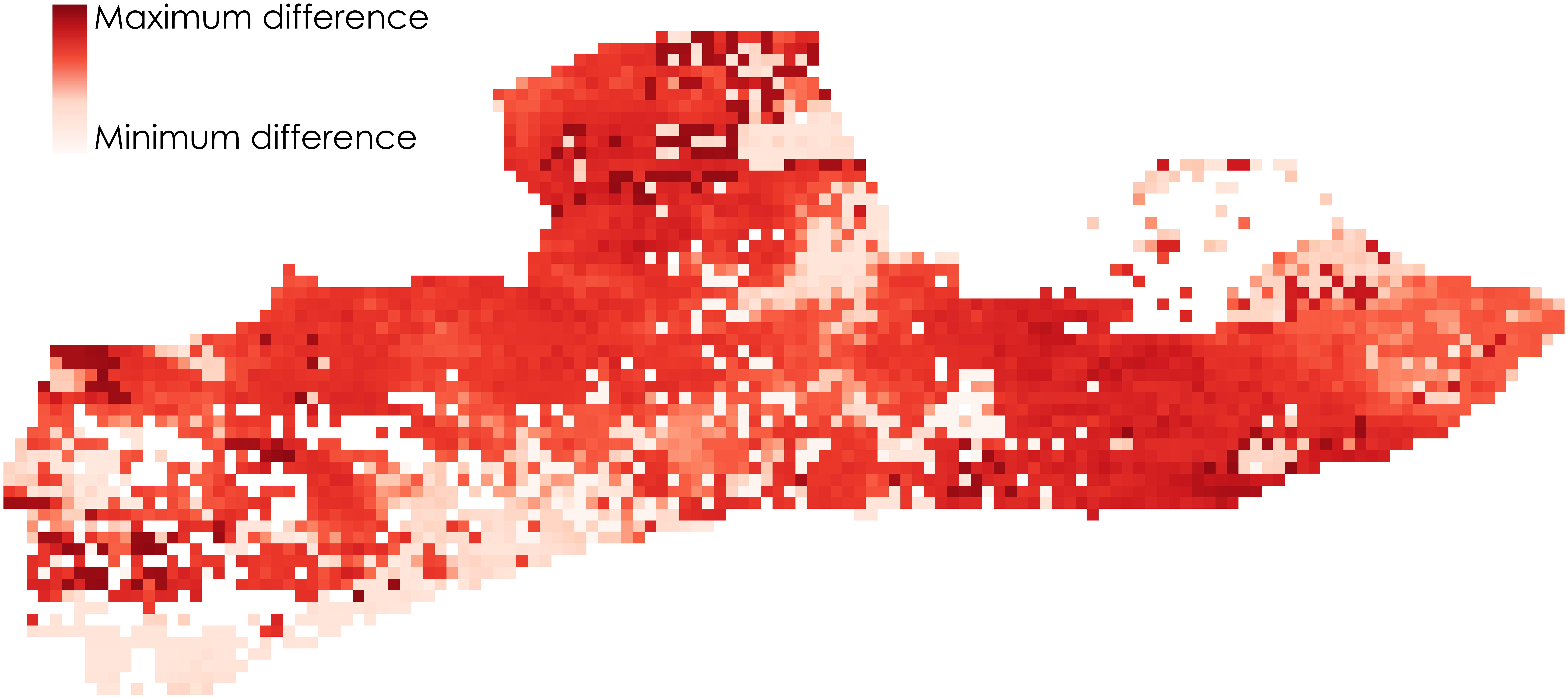
Combined modeling & monitoring

Grazing difference **on degraded pixels**
(Cumulative live biomass)

Dry year (2019)

Rangeland production modeling

Grazing difference
(Cumulative live biomass)



Combined modeling & monitoring

Dry year (2019)

Grazing difference **on degraded pixels**
(Cumulative live biomass)

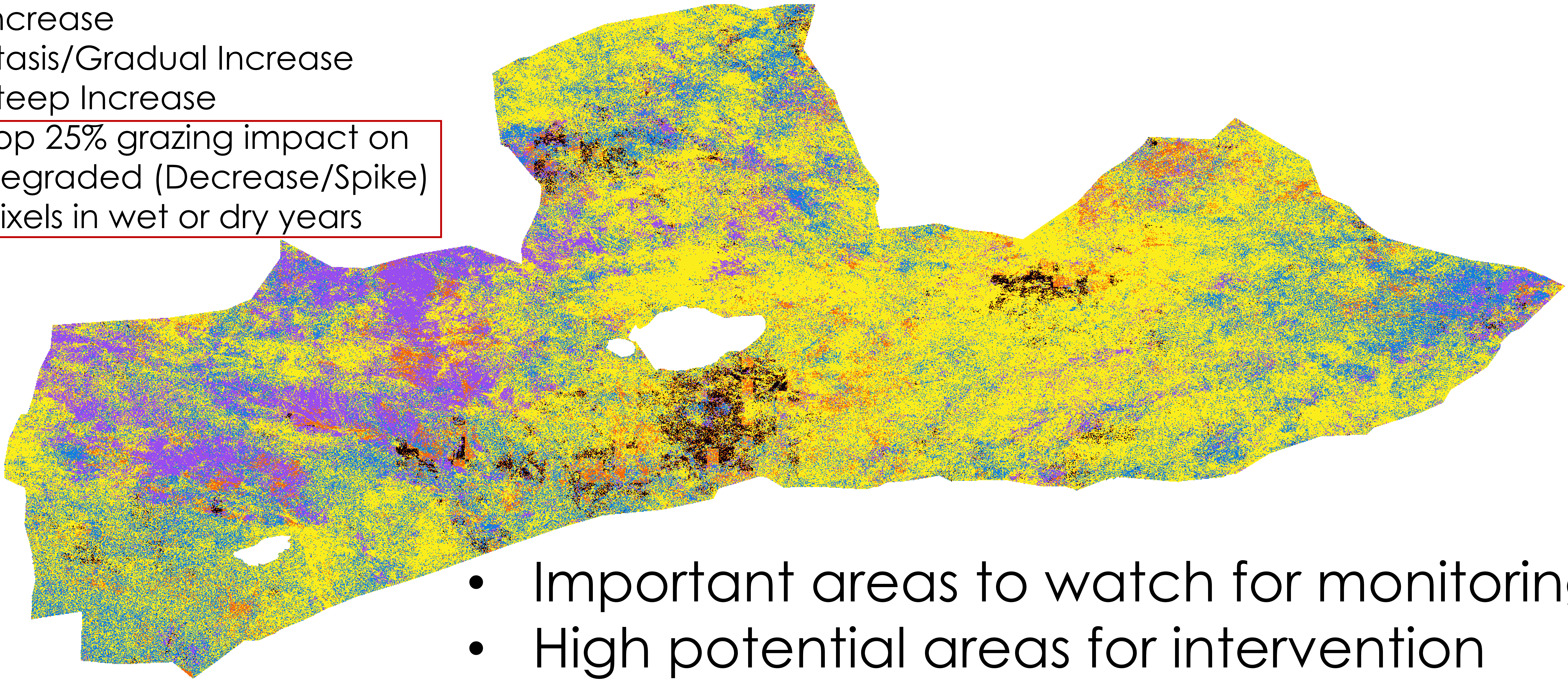
Maximum difference

Minimum difference

How can we improve monitoring design?

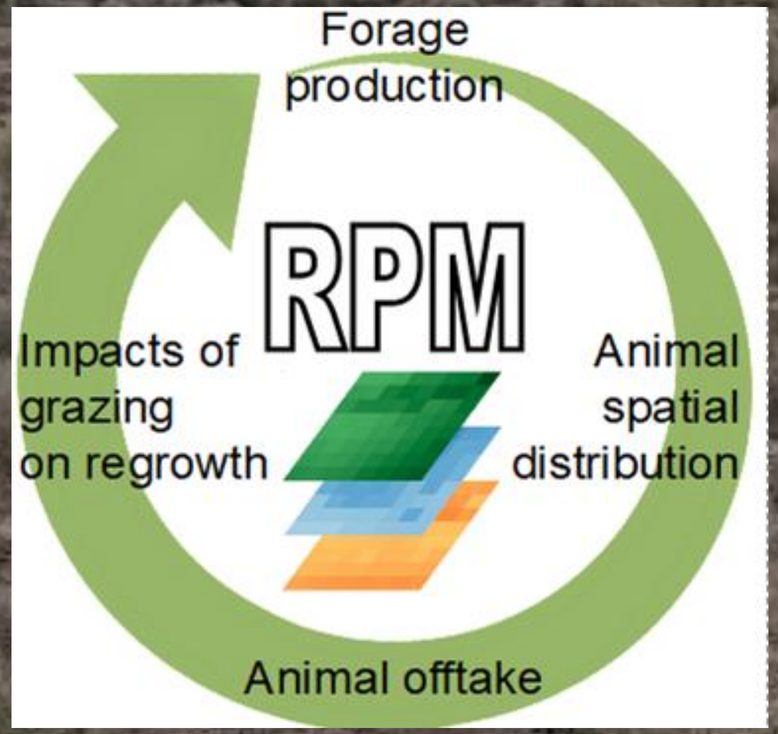
LandTrendr Clusters
(Landsat past 10 years)

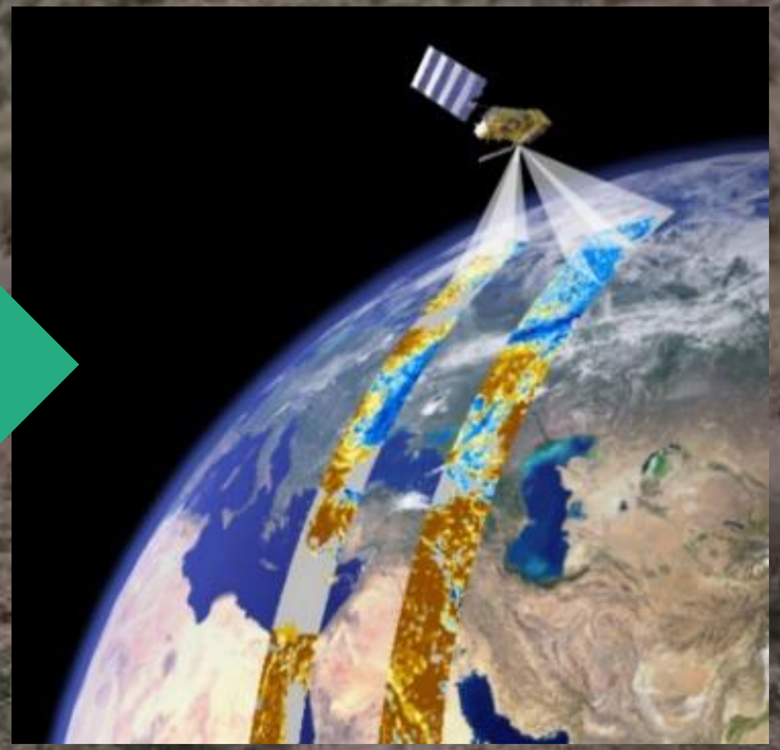
- Decrease/Spike
- Increase
- Stasis/Gradual Increase
- Steep Increase
- Top 25% grazing impact on degraded (Decrease/Spike) pixels in wet or dry years



- Important areas to watch for monitoring
- High potential areas for intervention

Scaling up regenerative grazing through combined modeling & monitoring





bchaplin@stanford.edu
rchaplin@umn.edu
@beckyck @natcapproject

The Good Growth Company

Where should field resources be deployed?

How should herd size be adapted to changing conditions?

What are the risks of different management strategies and how can they be managed?

https://www.goodgrowth.earth/

"Putting regeneration at the center of business, using the best available science to define regeneration"

WCS Оюу Толгой KERING NASA natural capital PROJECT

EARTH SCIENCE
APPLIED SCIENCES

Coral disease forecasting in the tropical Pacific

A new tool hosted by NOAA Coral Reef Watch

Megan Donahue

EARTH SCIENCE APPLICATIONS WEEK 2021

Our Team

Megan Donahue
Jamie Caldwell
Austin Greene

University of Hawai'i

Mark Eakin
Erick Geiger
Gang Liu
Jacquie De La Cour
Derek Manzello

NOAA Coral Reef Watch

Scott Heron

James Cook University Australia

Tracy Ainsworth

UNSW The University of New South Wales

Bill Leggat
Tess Moriarty

The University of Newcastle Australia

Laurie Raymundo

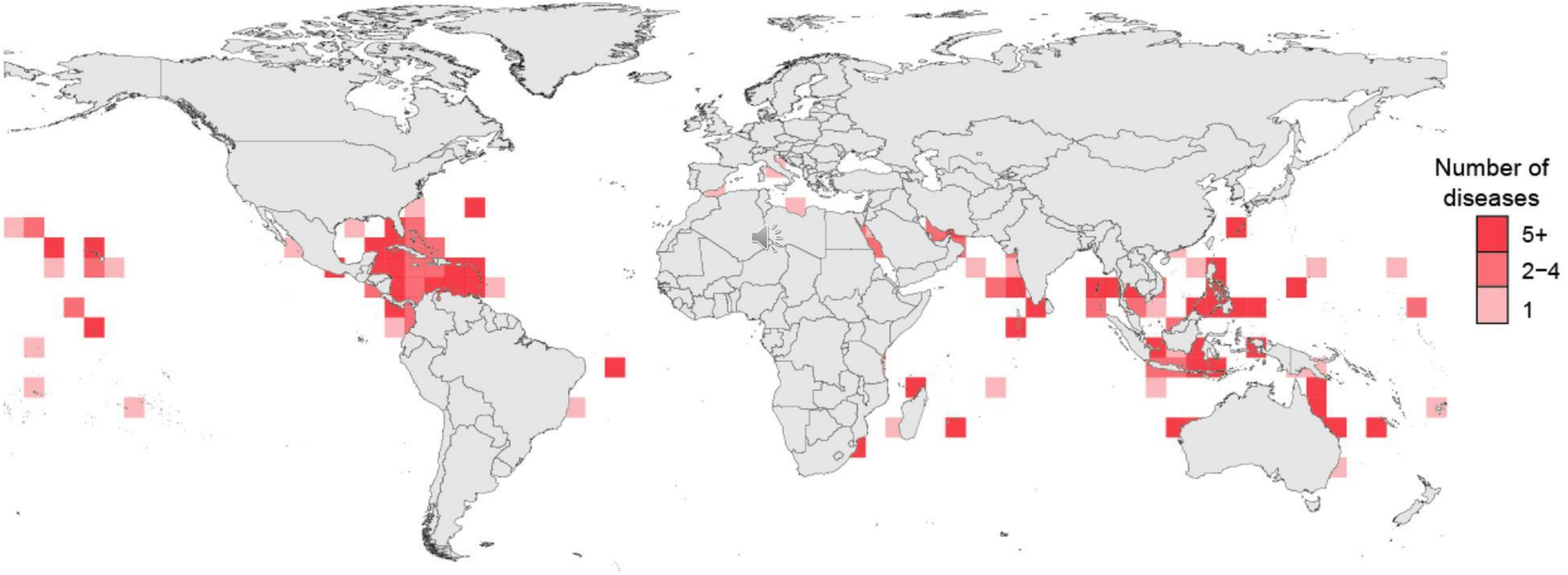
University of Guam Unibetsedåt Guåhan

Understanding coral disease

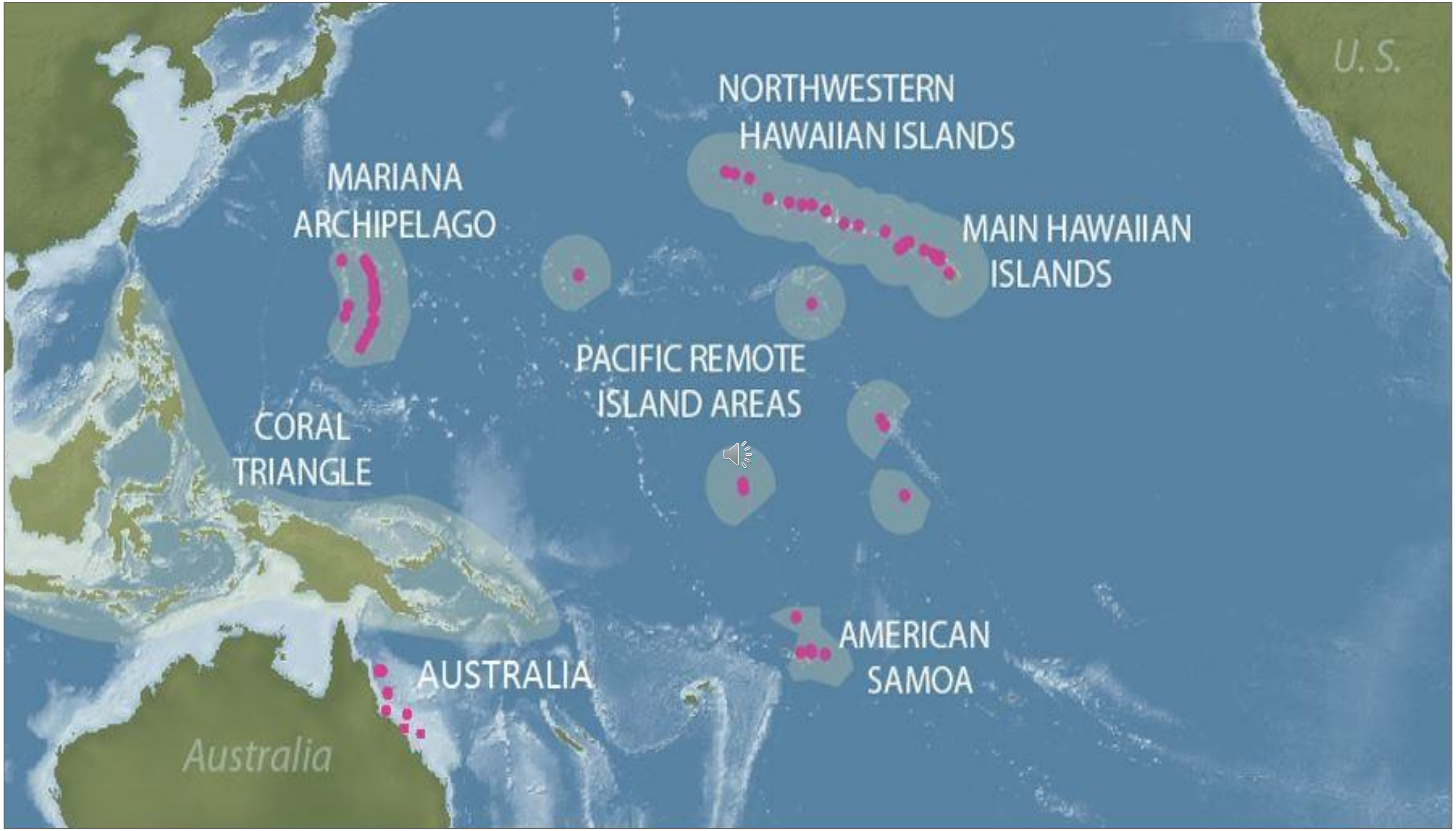
Credit: Shaun Wolfe / Ocean Image Bank

EARTH SCIENCE APPLICATIONS WEEK 2021

Coral disease impacts are widespread

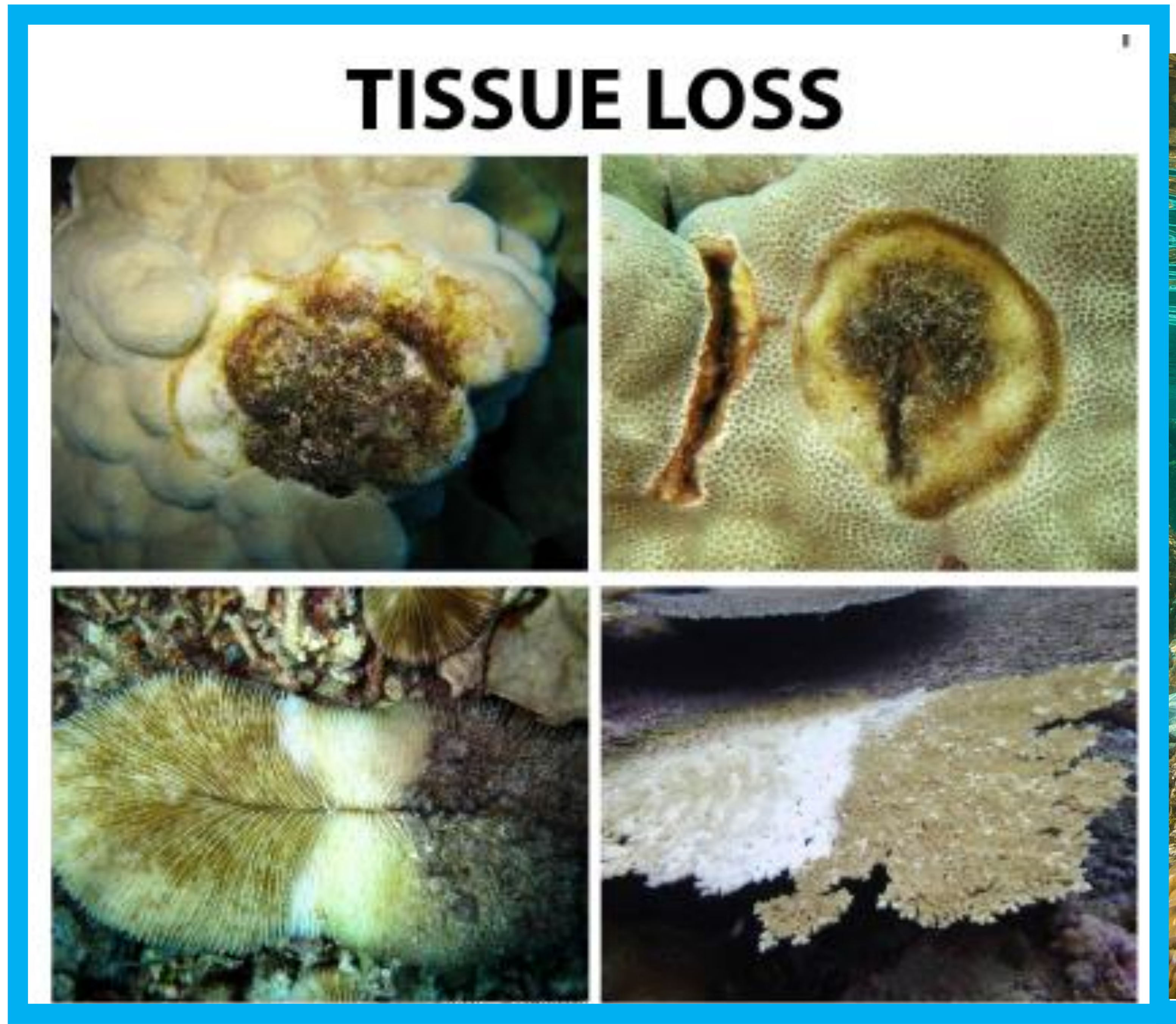


Vega Thurber et al 2020

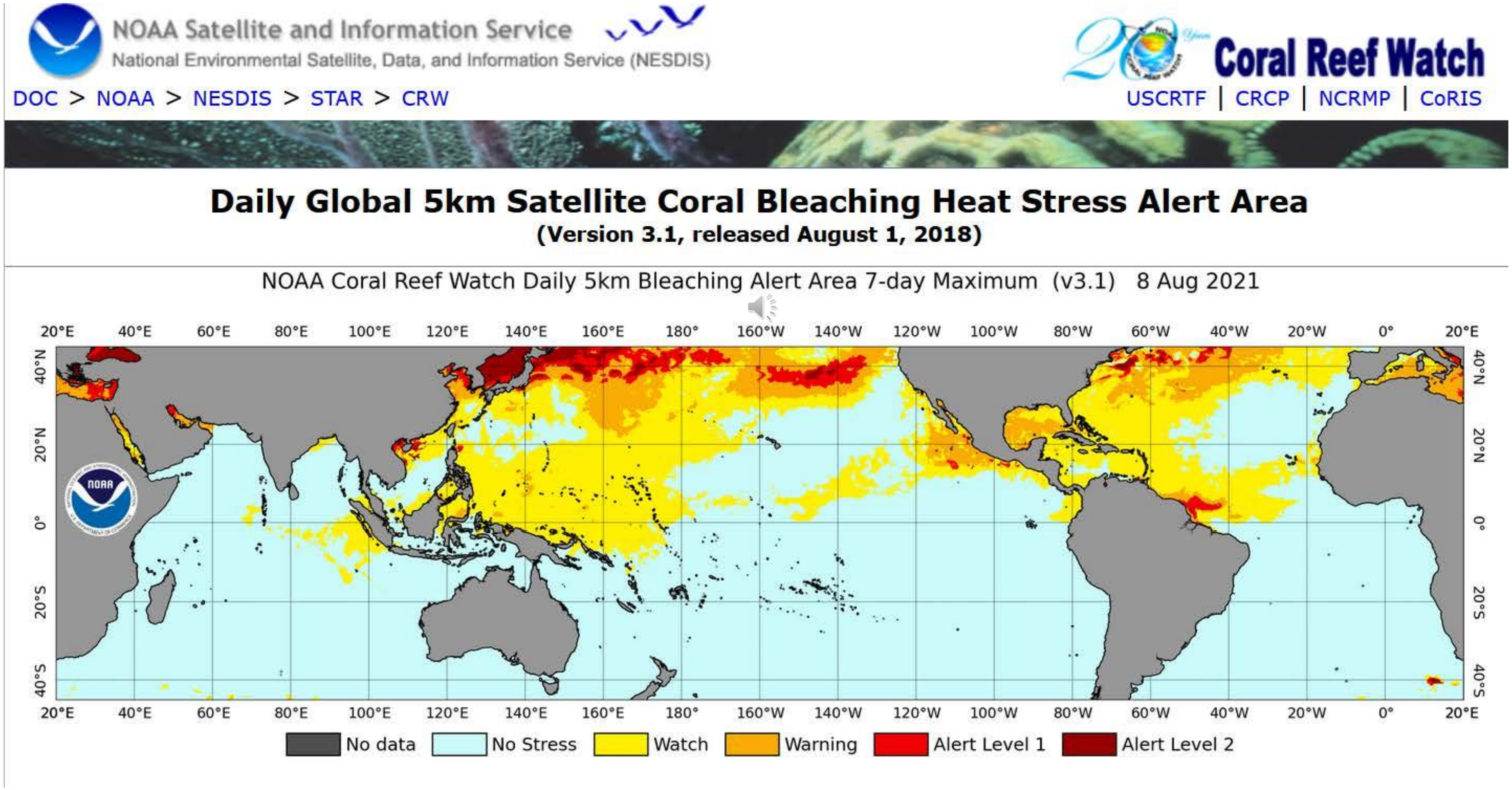

U.S.
NORTHWESTERN
HAWAIIAN ISLANDS
MARIANA
ARCHIPELAGO
MAIN HAWAIIAN
ISLANDS
PACIFIC REMOTE
ISLAND AREAS
CORAL
TRIANGLE
AMERICAN
SAMOA
AUSTRALIA
Australia

An early warning system for coral disease

- Five Pacific regions
- Multiple disease types
- Multiple host species
- Satellite-derived environmental drivers



Our partners and end-users



Forecasting coral disease: a new tool

Credit: Shaun Wolfe / Ocean Image Bank

New experimental product

NOAA Satellite and Information Service
National Environmental Satellite, Data, and Information Service (NESDIS)

DOC > NOAA > NESDIS > STAR > CRW

Coral Reef Watch

USCRTF | CRCP | NCRMP | CoRIS

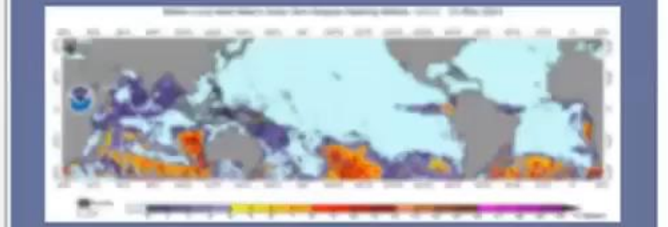
Coral Reef Watch Home

About Us

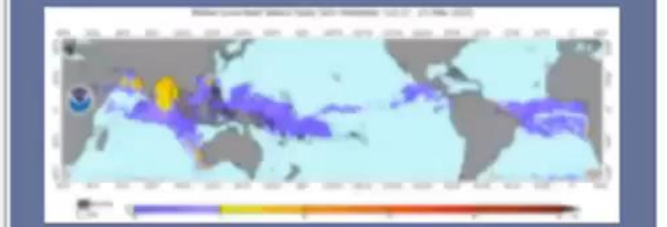
Products Overview

Near-Real-Time Data
(5km Resolution)

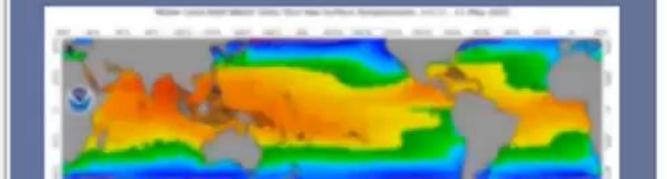
Bleaching Alert Area (Alerts)



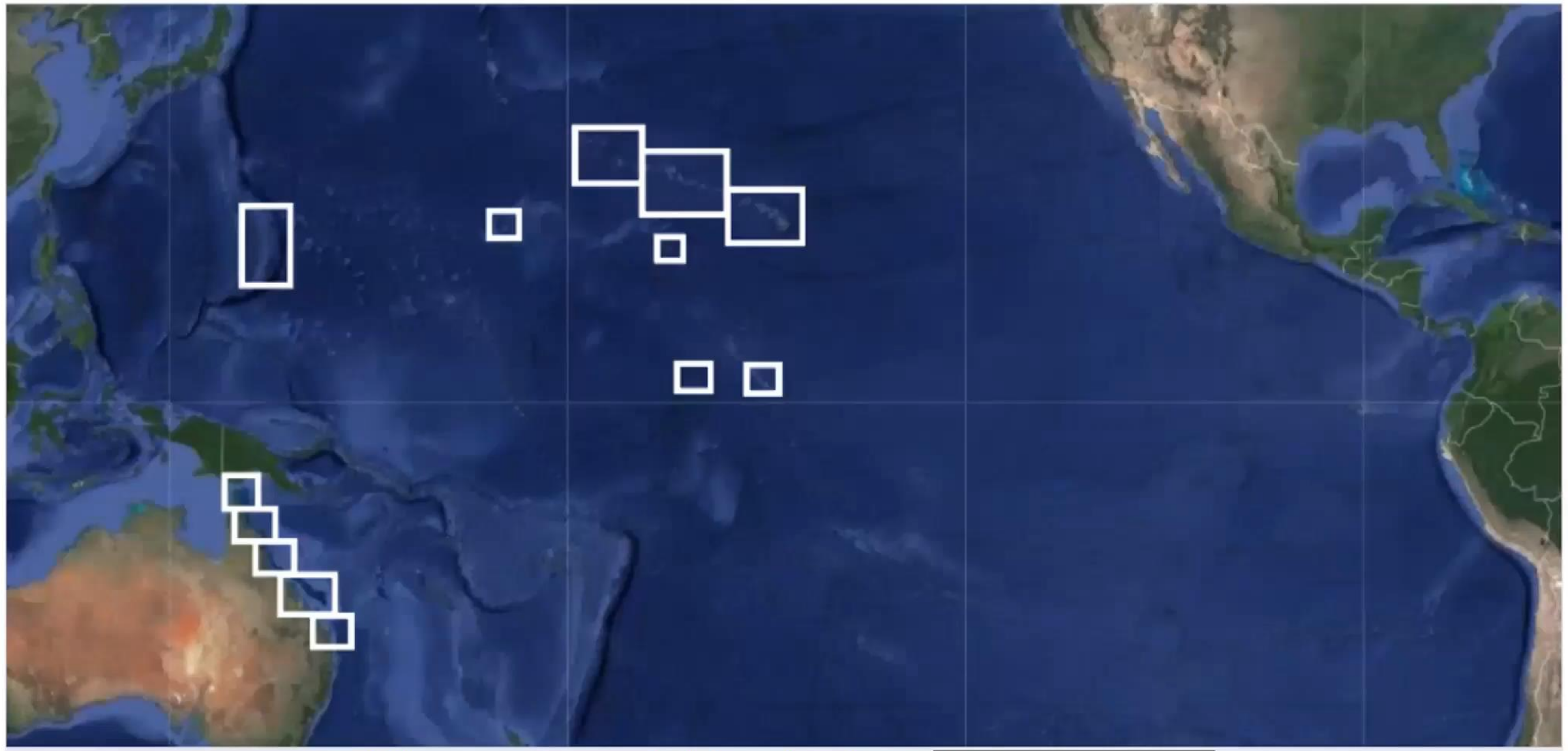
Degree Heating Week (DHW)



HotSpot



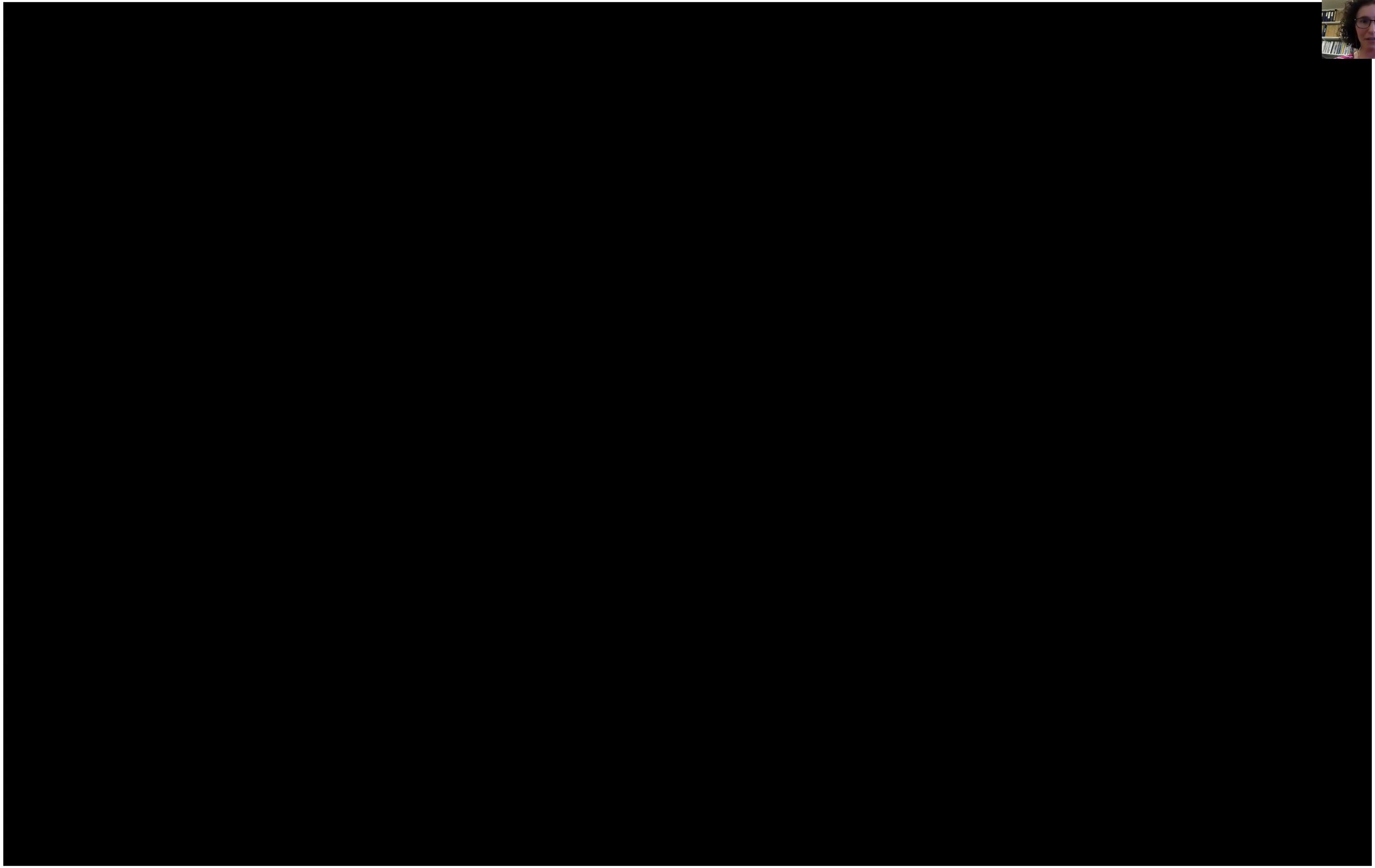
Multi-Factor Coral Disease Forecast
(Version 1.0, released May 4, 2021, experimental product)



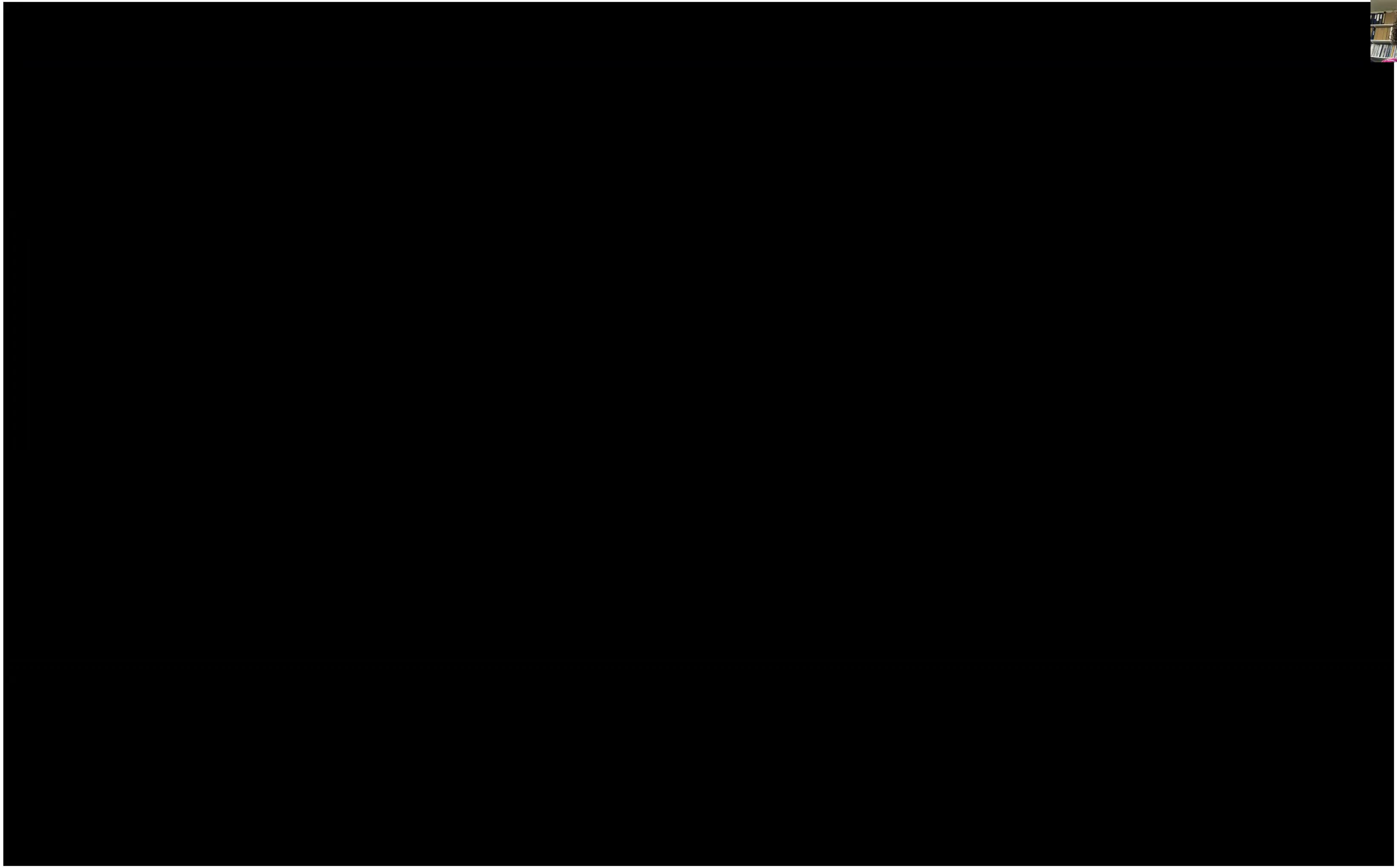
Click on a region or select from dropdown: Region

Multi-Factor Coral Disease Forecast Product Description

Forecasts



Scenarios



Upcoming Trainings & Tool Demos

Reef Futures 2021
December 12-17, 2021
Key Largo, Florida

ICRI

reeffutures.com

Ocean Sciences
Feb 27 – Mar 22, 2022
Honolulu, Hawaii

OCEAN SCIENCES MEETING | FEBRUARY 27 – MARCH 4, 2022 HONOLULU, HI, USA

www.aslo.org/osm2022

Derek Manzello, NOAA Coral Reef Watch

Thank you

megan.donahue@hawaii.edu

Credit: Shaun Wolfe / Ocean Image Bank

EARTH SCIENCE
APPLIED SCIENCES

Colorado Ecological Forecasting

Monitoring Post-Fire Cheatgrass (*Bromus tectorum*) Distribution to Inform Management Planning

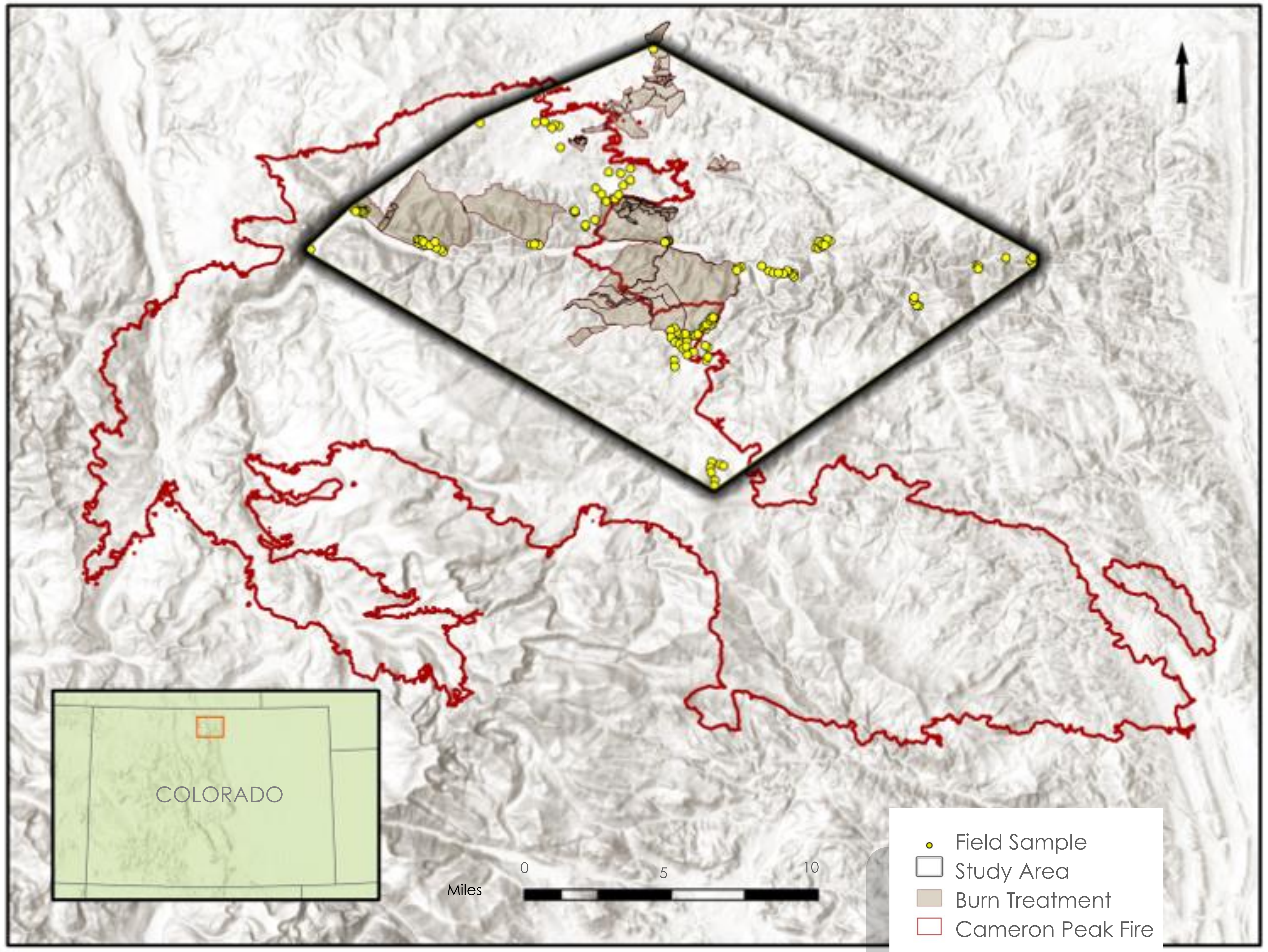
Alix Bakke*, Christopher Tsz Hin Choi, Alex Posen, Monika Rock, & Nikole Vannest

EARTH SCIENCE APPLICATIONS WEEK 2021

Project Overview

Cheatgrass & Wildfires

- Cheatgrass is an invasive species in the U.S.
- Fire has the potential to create more cheatgrass habitat
- Cheatgrass has the potential to create more frequent fires

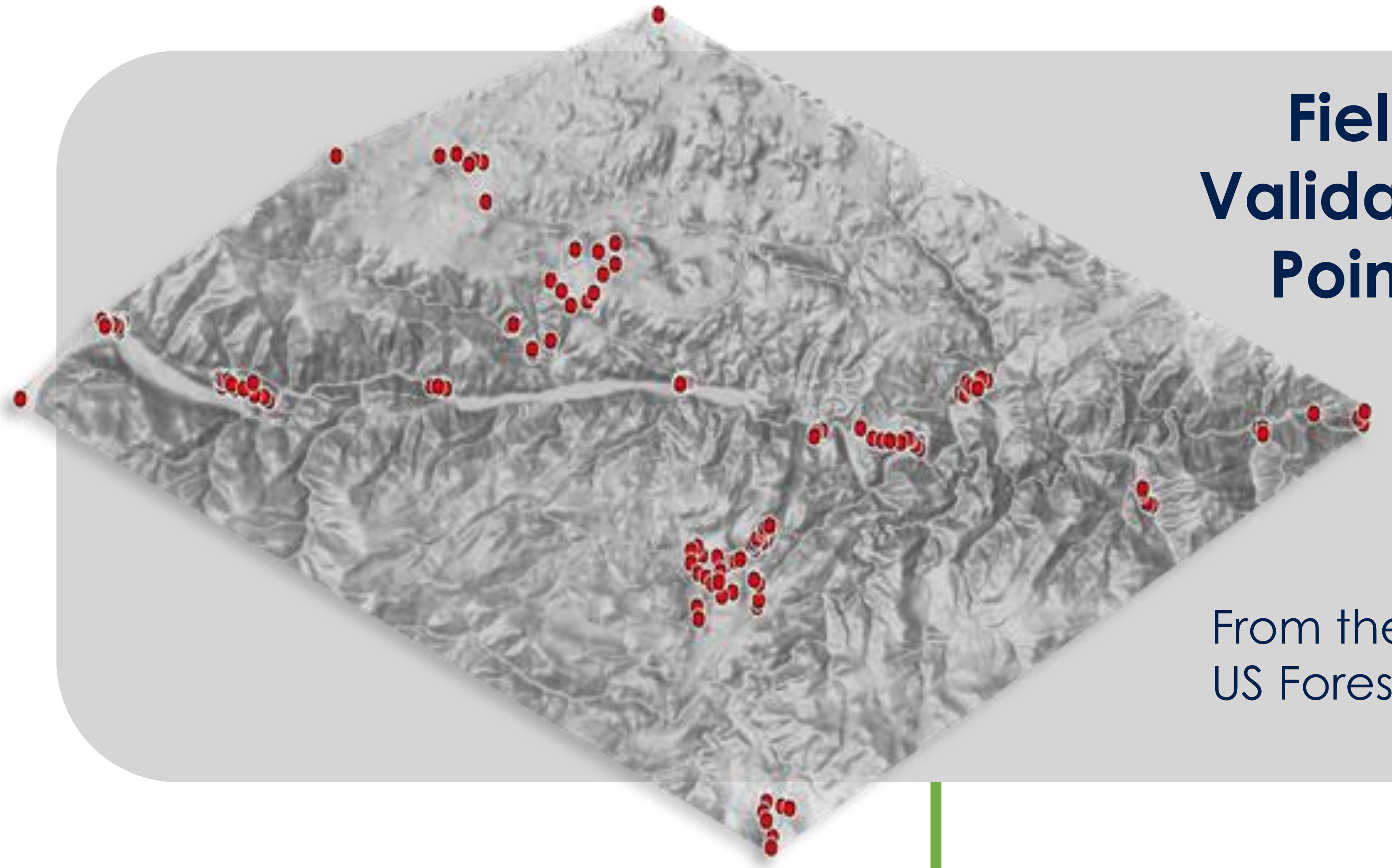


Objectives

Determine preferred post-disturbance cheatgrass growing conditions

Detect and map cheatgrass within the predicted area of suitable habitat

Methodology
Habitat Suitability & Detection Models

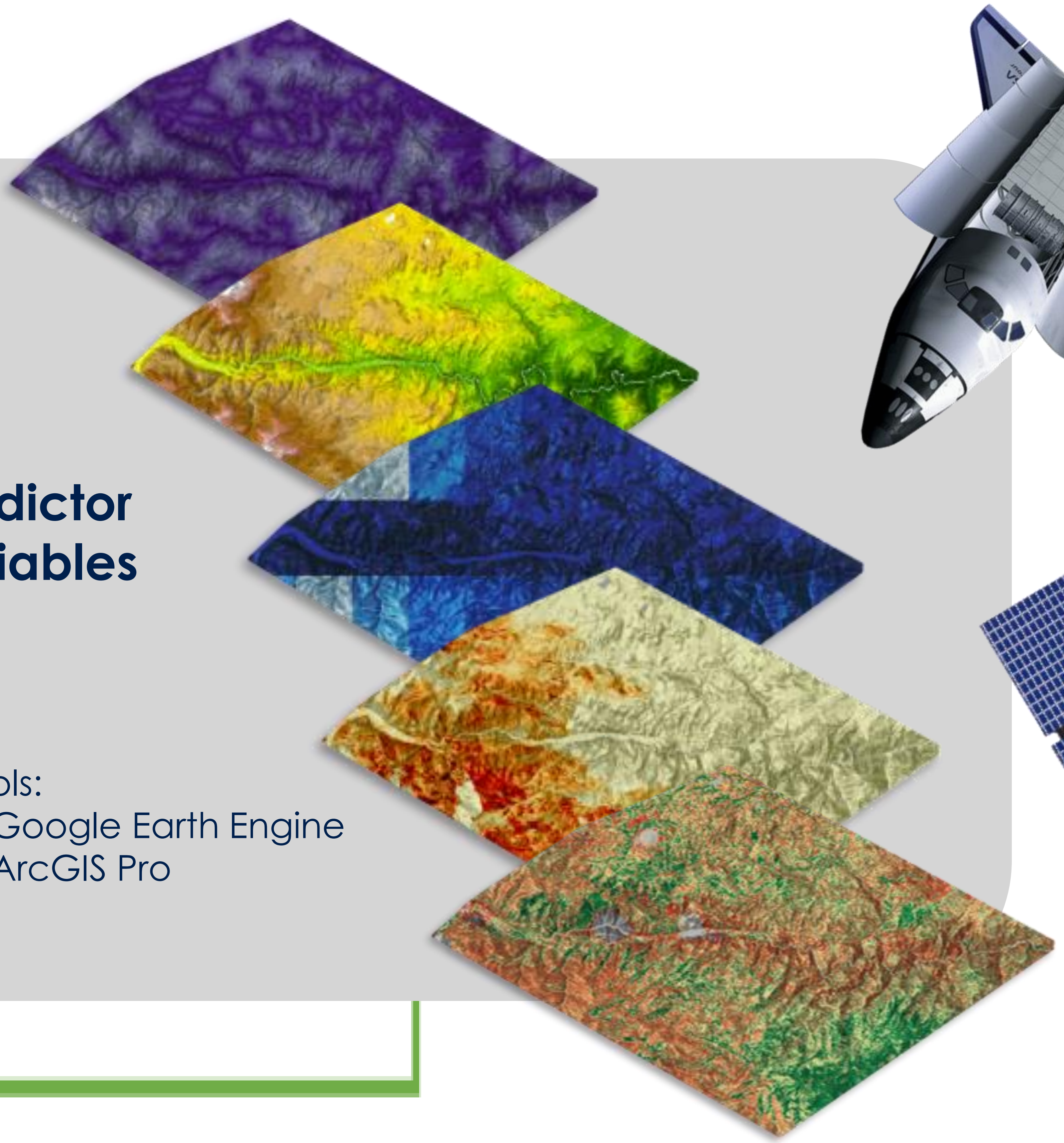


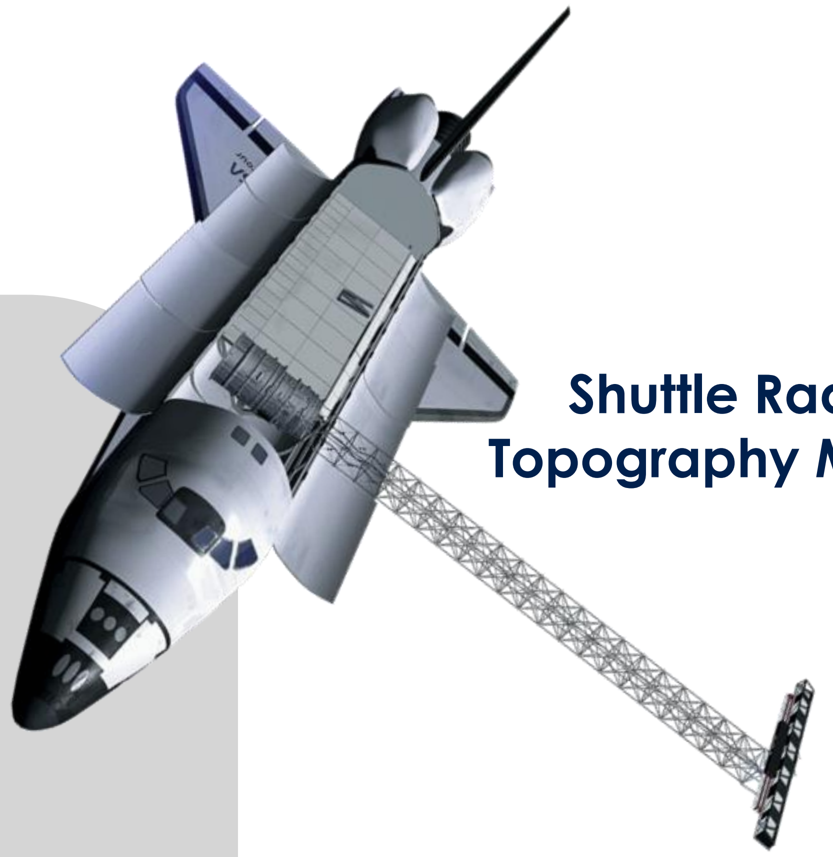
Field Validation Points

From the US Forest Service

Predictor Variables

Tools:
- Google Earth Engine
- ArcGIS Pro





Shuttle Radar Topography Mission

Sentinel-2 MSI

Software For Assisted Habitat Modeling **(SAHM)**

Random Forest Model

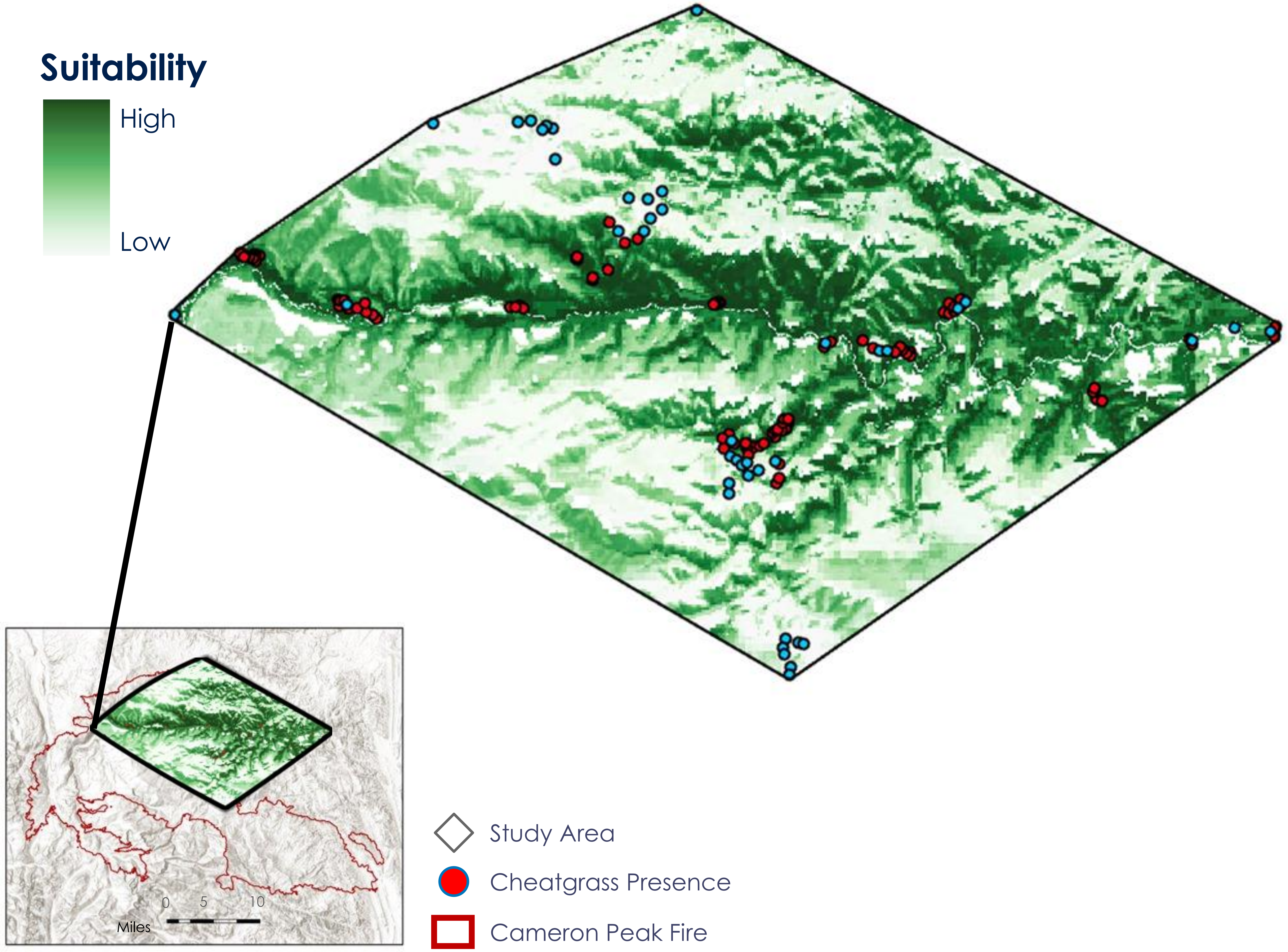
Generalized Linear Model

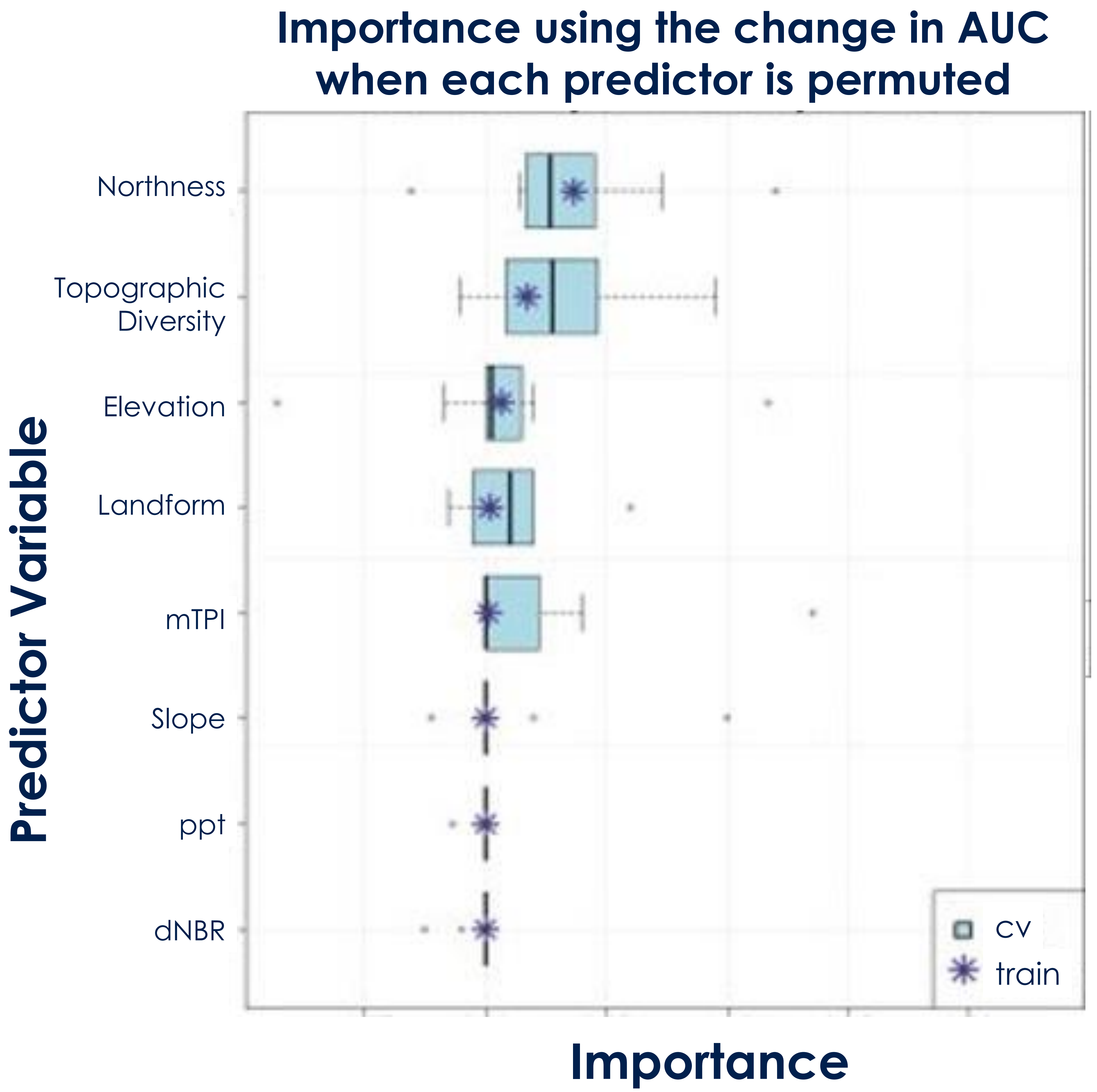
Boosted Regression Model

Habitat Suitability & Detection Maps

Results

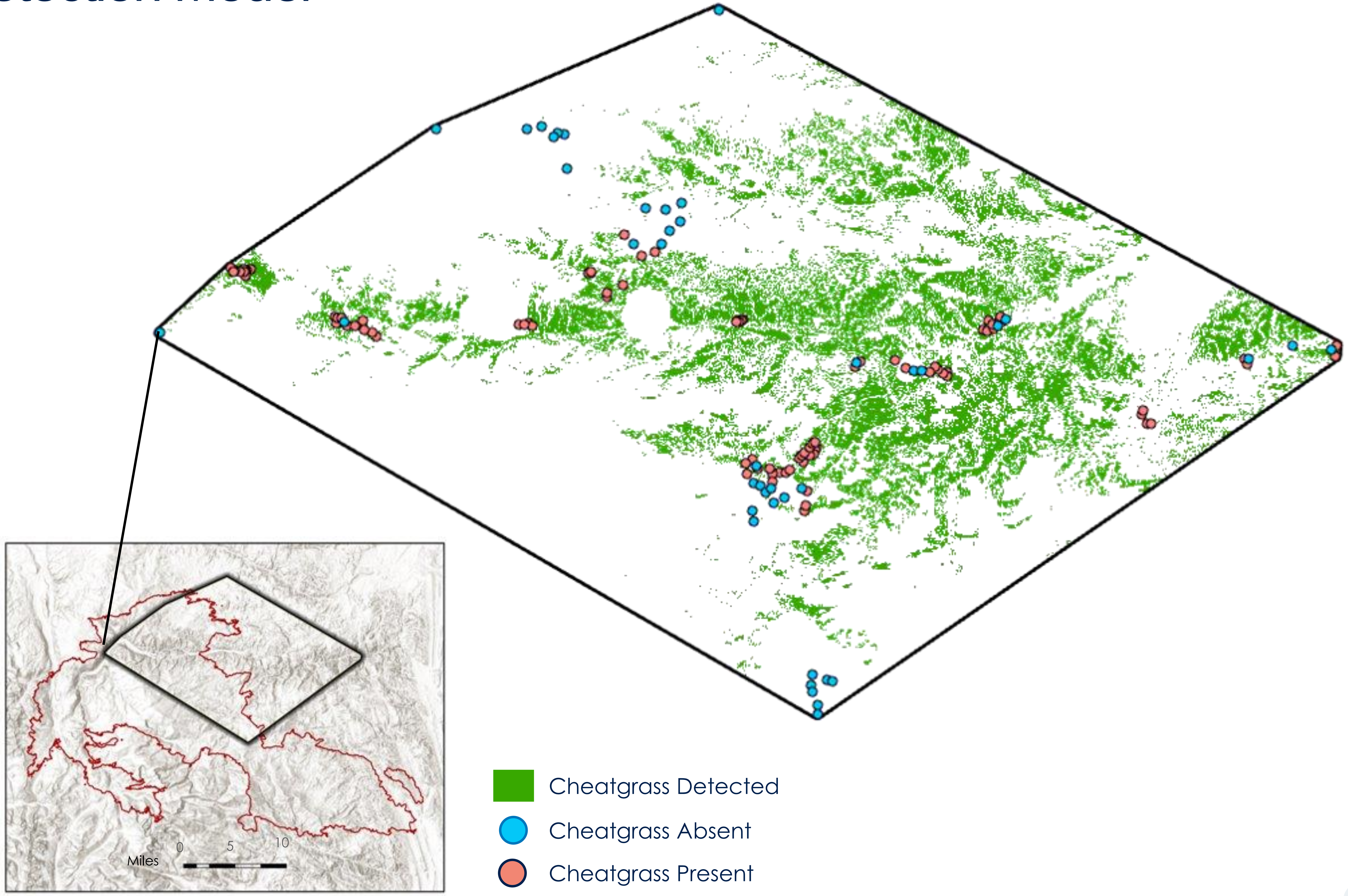
Habitat Suitability Model

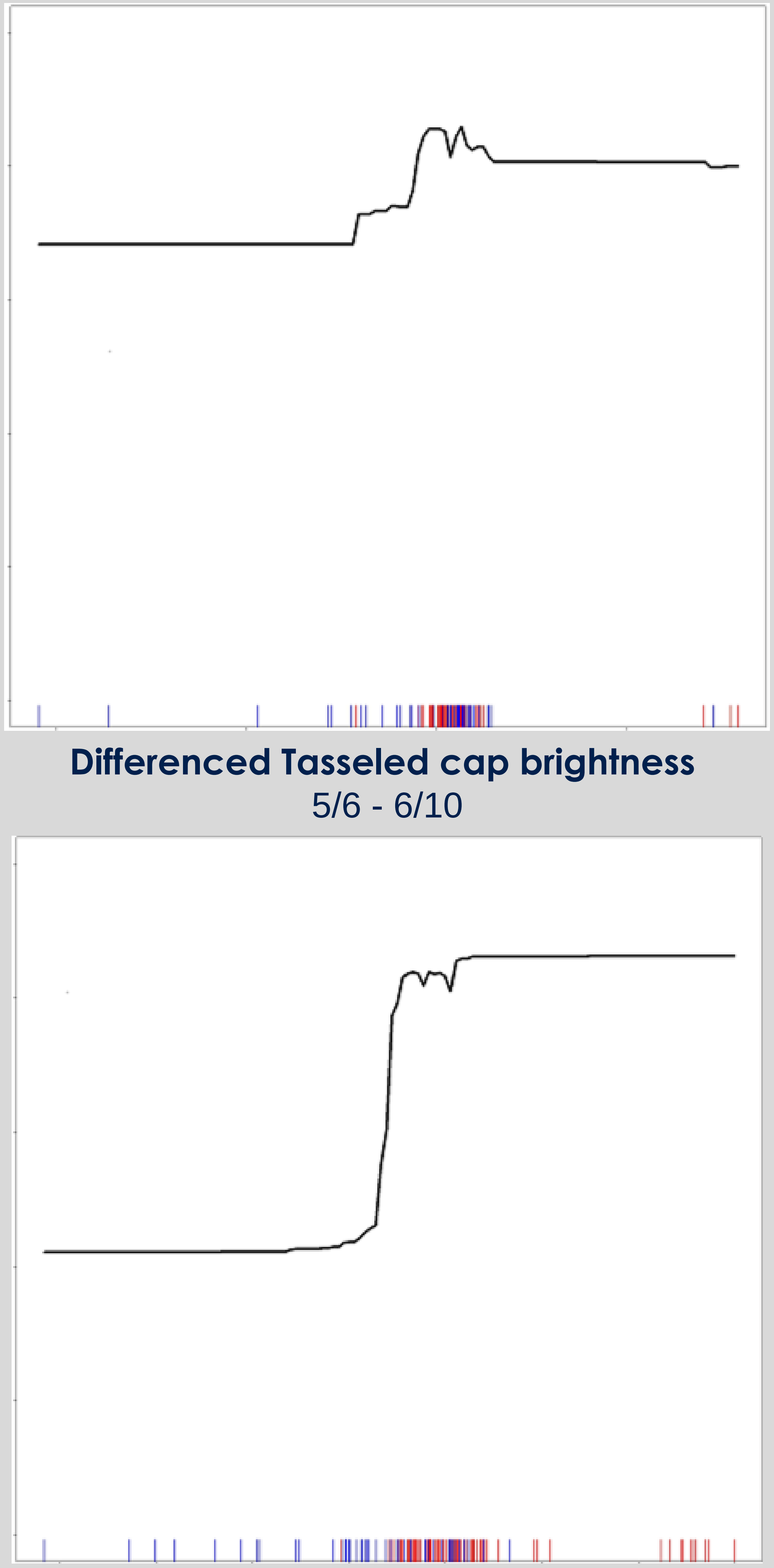




Results

Detection Model





Differenced Tasseled cap brightness
5/6 - 6/10

Differenced Tasseled cap wetness
5/6 - 6/20

Conclusion

Using a combined approach of habitat suitability and detection models created accurate cheatgrass maps.

Post-fire cheatgrass detection is possible within a short time frame if there's changes in vegetation.

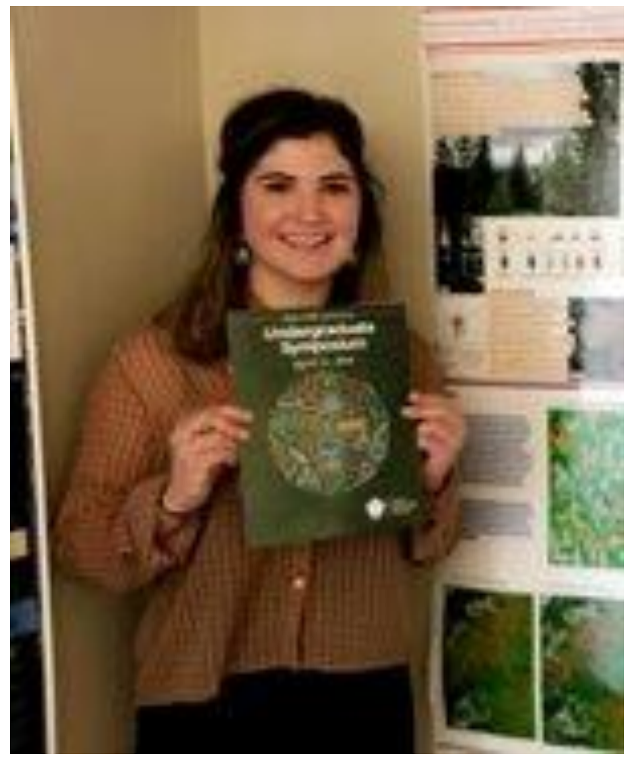
Remote sensing provides a time and money saving method for mapping cheatgrass.

Acknowledgements

Colorado Ecological Forecasting Team

Christopher Tsz Hin Choi

Nikole Vannest



Monika Rock

Alex Posen

Alix Bakke

Science Advisors

Peder Engelstad

Nicholas Young

Dr. Tony Vorster

Brian Woodward

Dr. Paul Evangelista

Dr. Catherine Jarnevich

Partner

Tom Bates

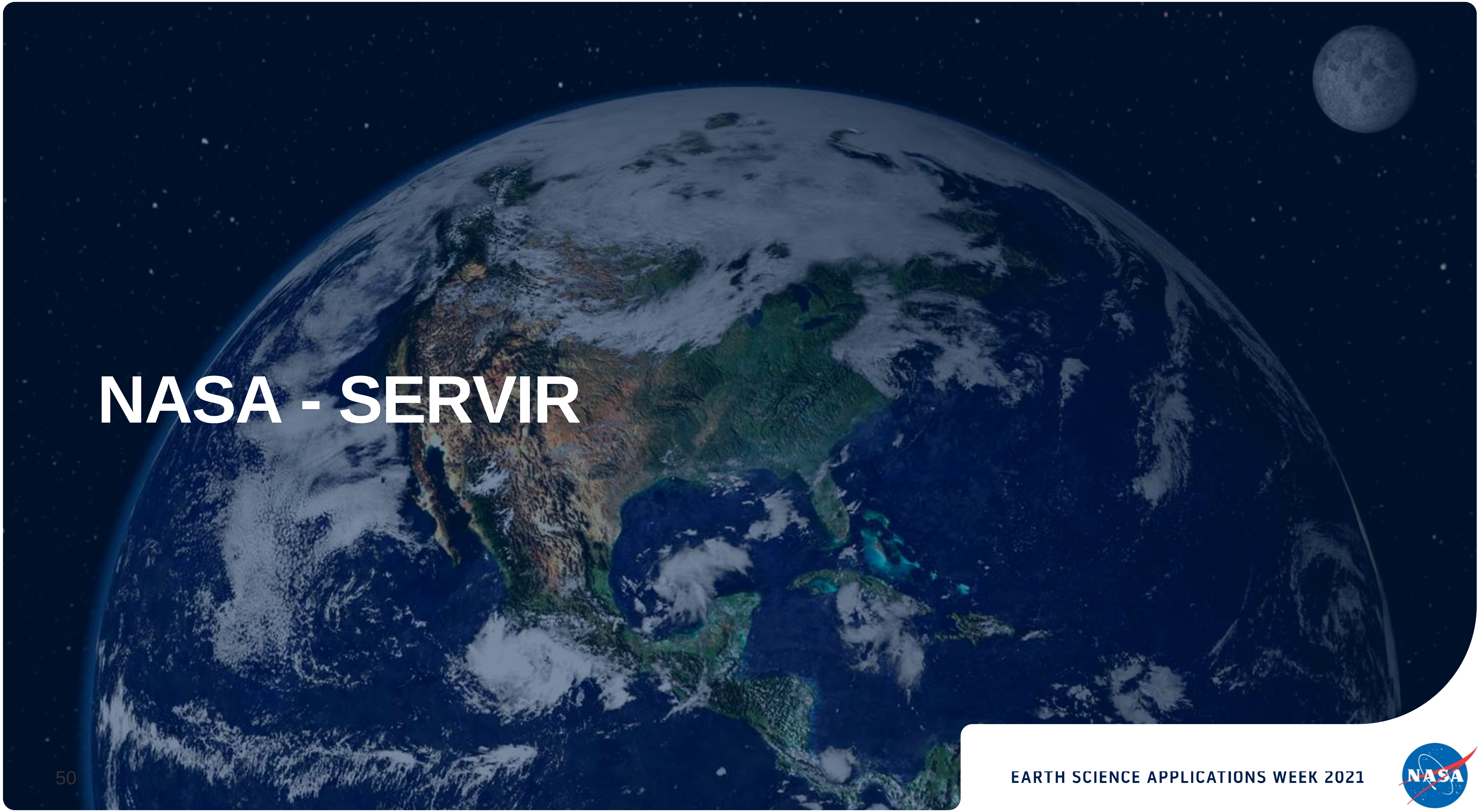
EARTH SCIENCE
APPLIED SCIENCES

Land-cover change and capacity building across Amazonia and beyond

Stephanie Spera, PhD
University of Richmond
NASA-SERVIR

EARTH SCIENCE APPLICATIONS WEEK 2021

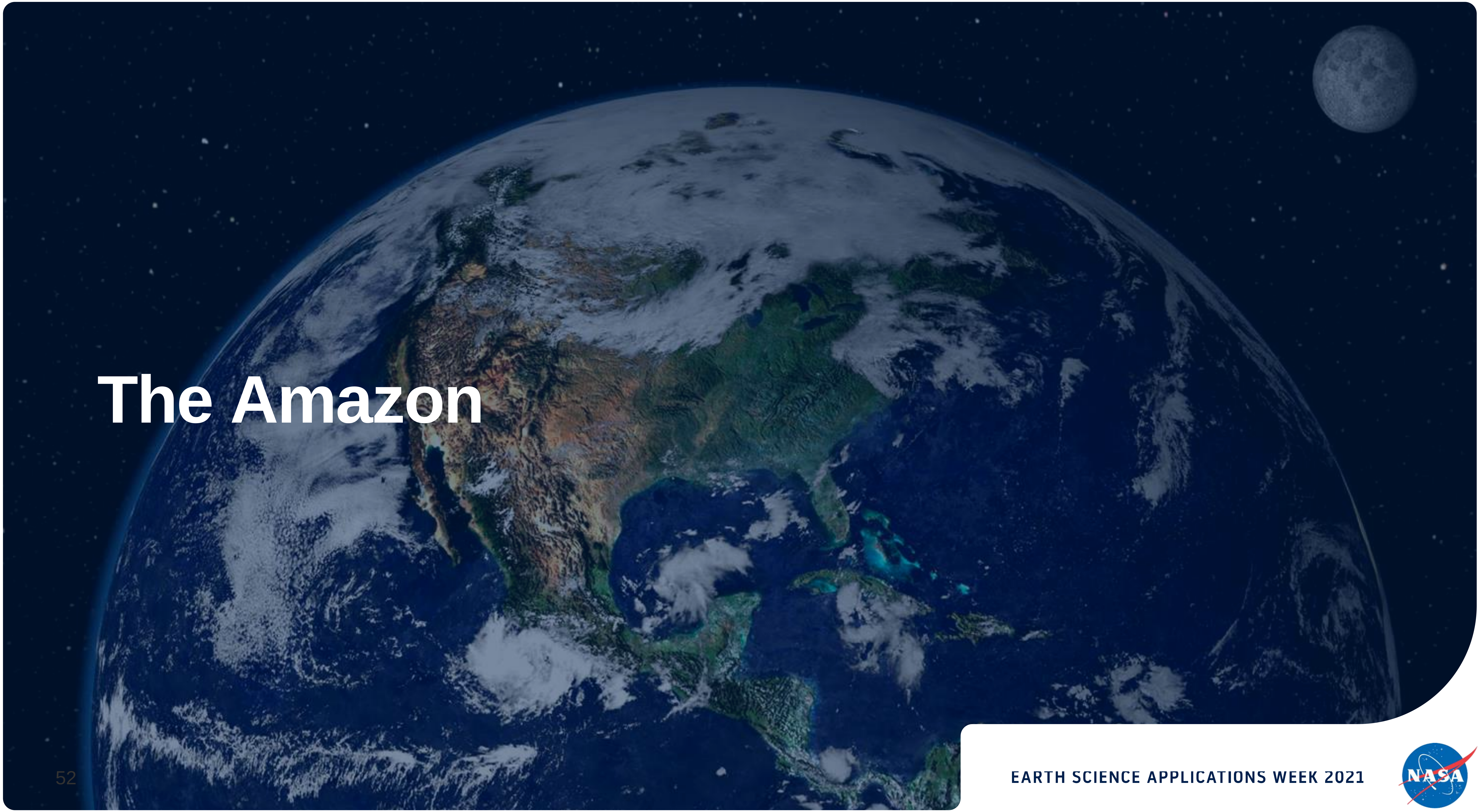
NASA - SERVIR



What is SERVIR

- Space to Village
- Working Together
- Applied Sciences Teams

The Amazon



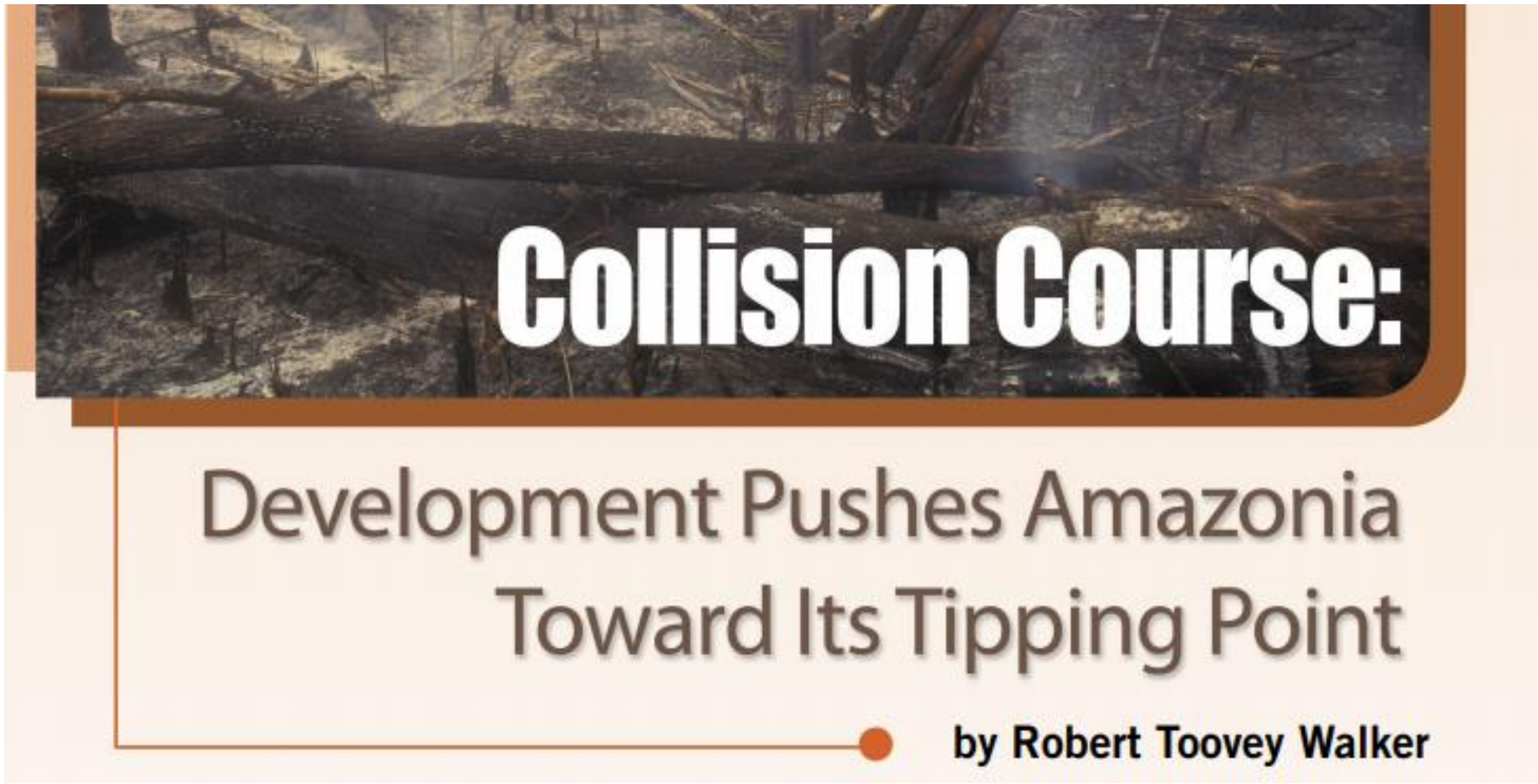
nature

NEWS FEATURE | 25 February 2020

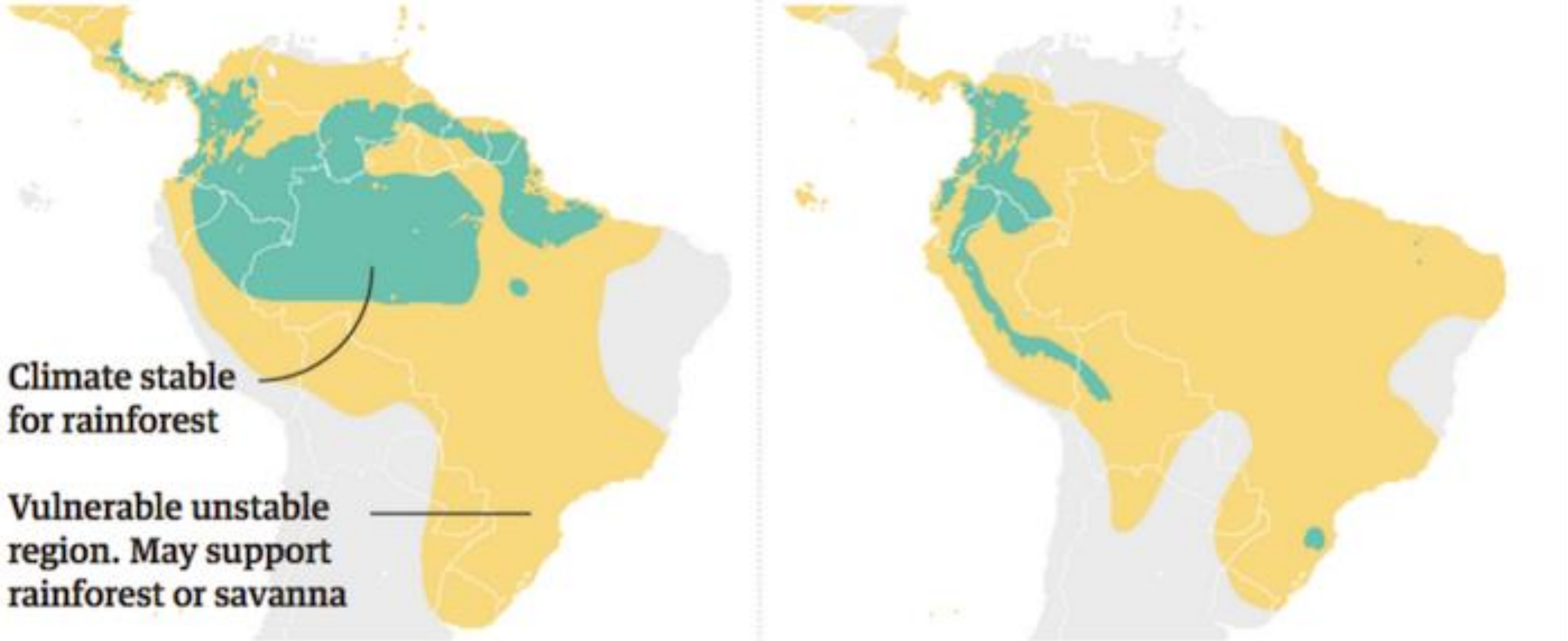
When will the Amazon hit a tipping point?

Scientists say climate change, deforestation and fires could cause the world's largest rainforest to dry out. The big question is how soon that might happen.

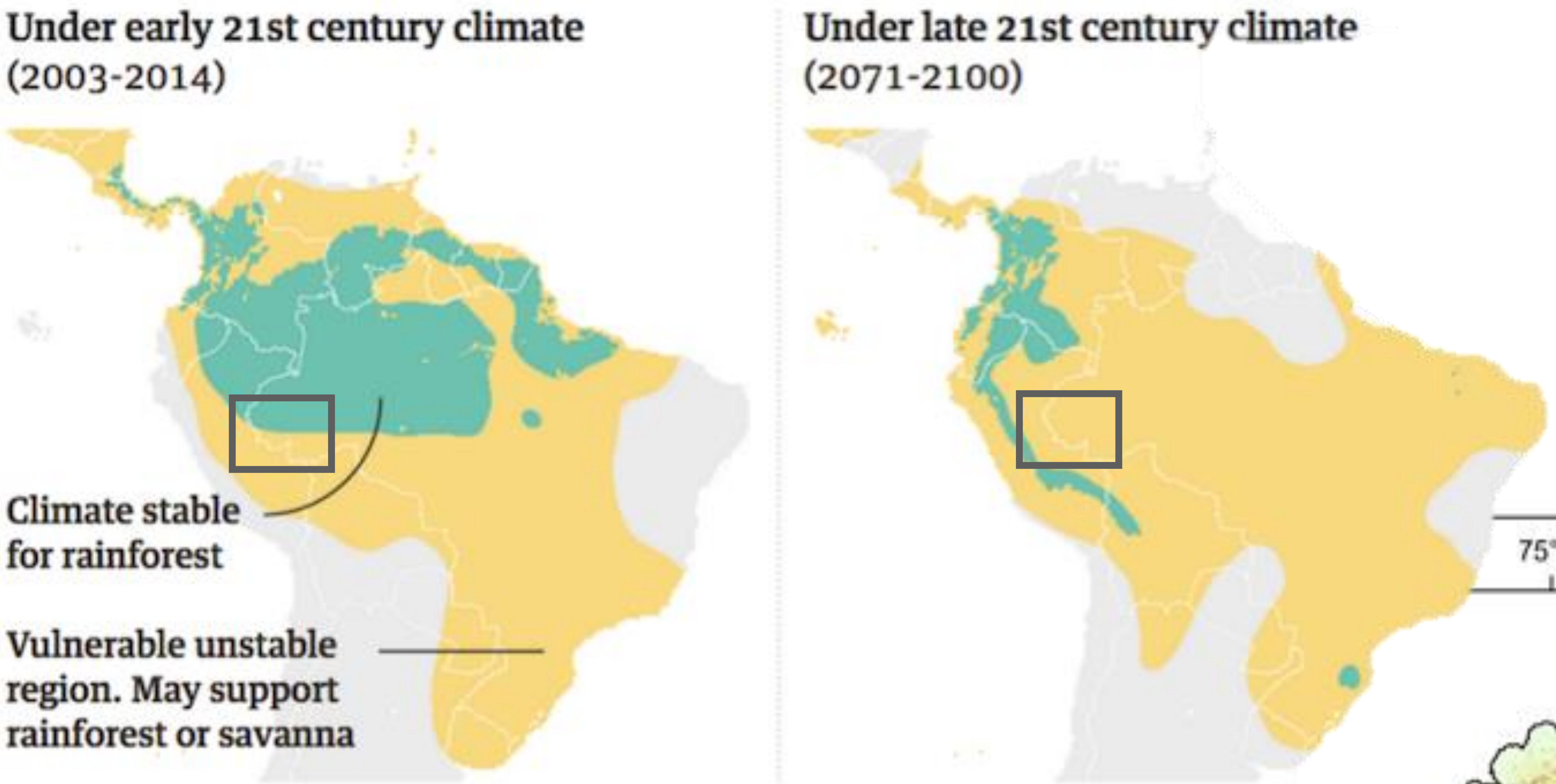
Ignacio Amigo



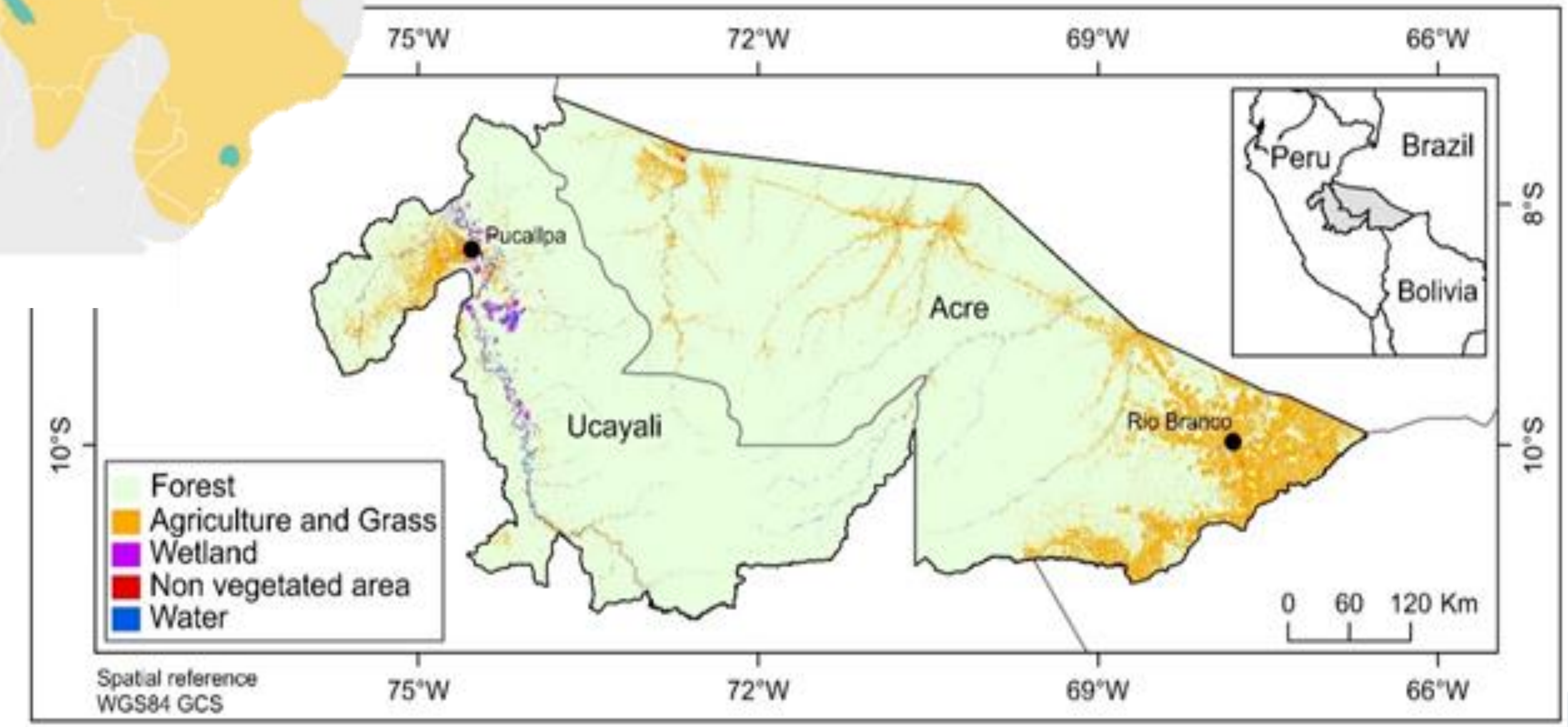
Projected changes in rainfall and climate could radically reduce the Amazon rainforest before the end of this century



Guardian graphic. Source: Staal et al, Nature Communications, Obbe Tuinenburg



Guardian graphic. Source: Staal et al, Nature Communications, Obbe Tuinenburg



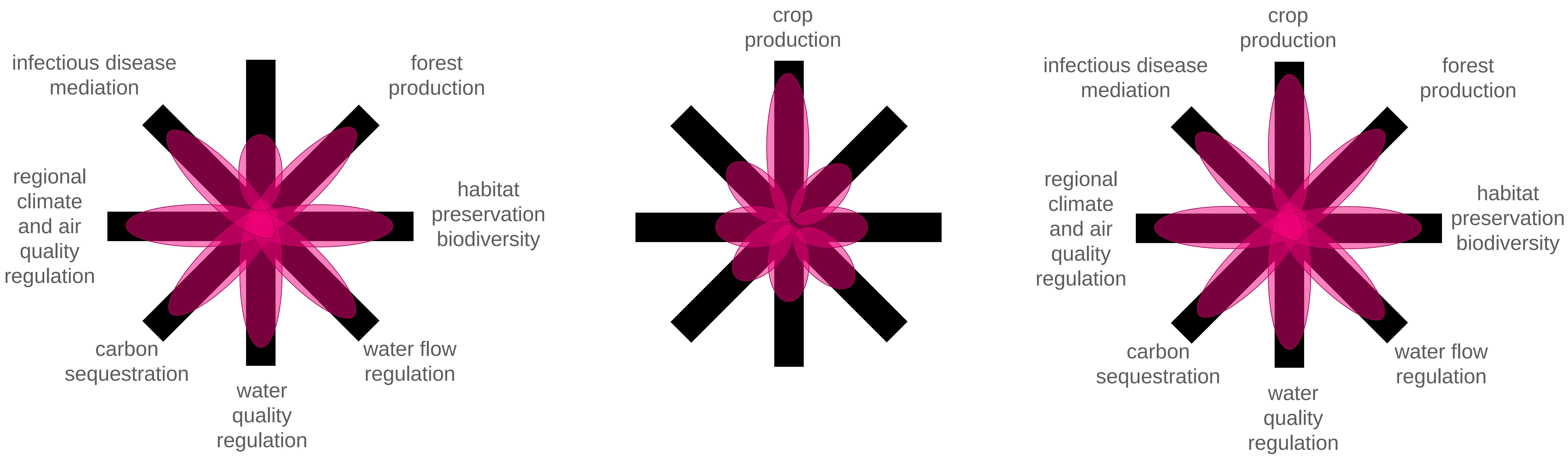
Yurúa Indigenous Communities 2013

2013 workshop in Yurúa, Peru

50 participants from indigenous groups along the Yurúa headwaters

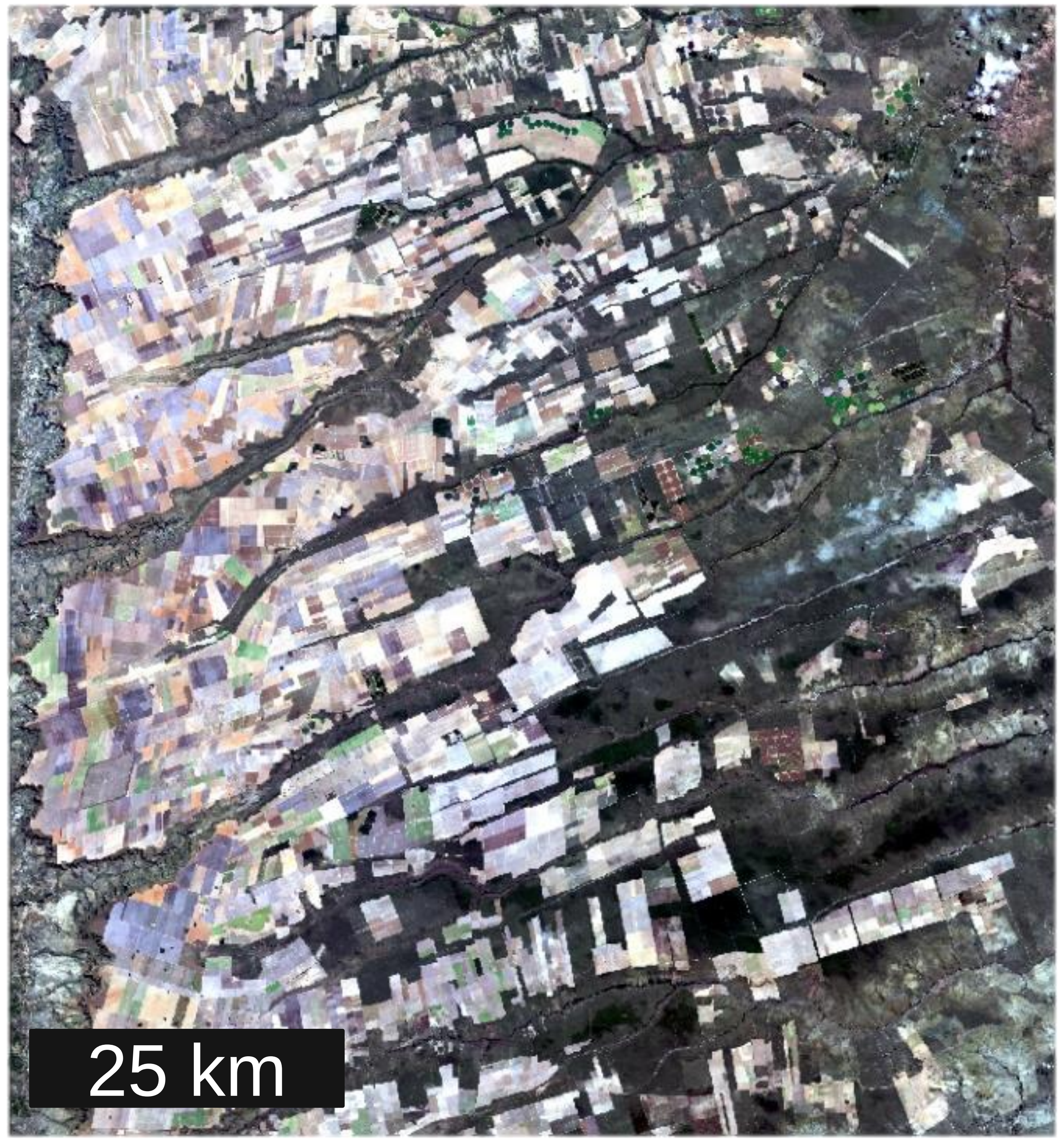
2014 Climate Change Declaration in follow up workshop

Ecosystem services

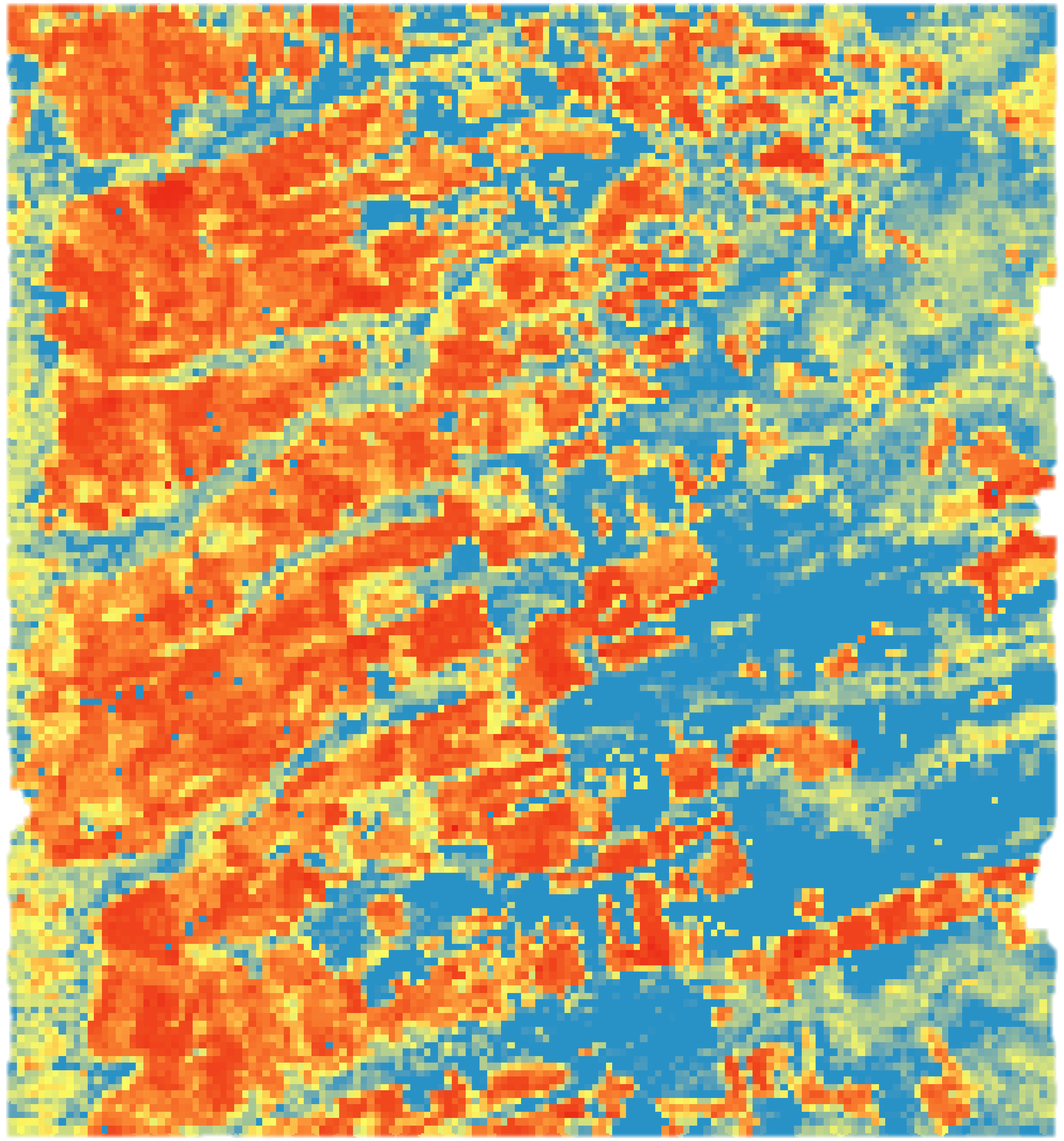


Ruth DeFries et al. 2004, Foley et al. 2007

Observed effects of land-clearing on the local hydrologic cycle in the Eastern Brazilian Amazon



Landsat 8 Data


MODIS ET Data

High ET rates

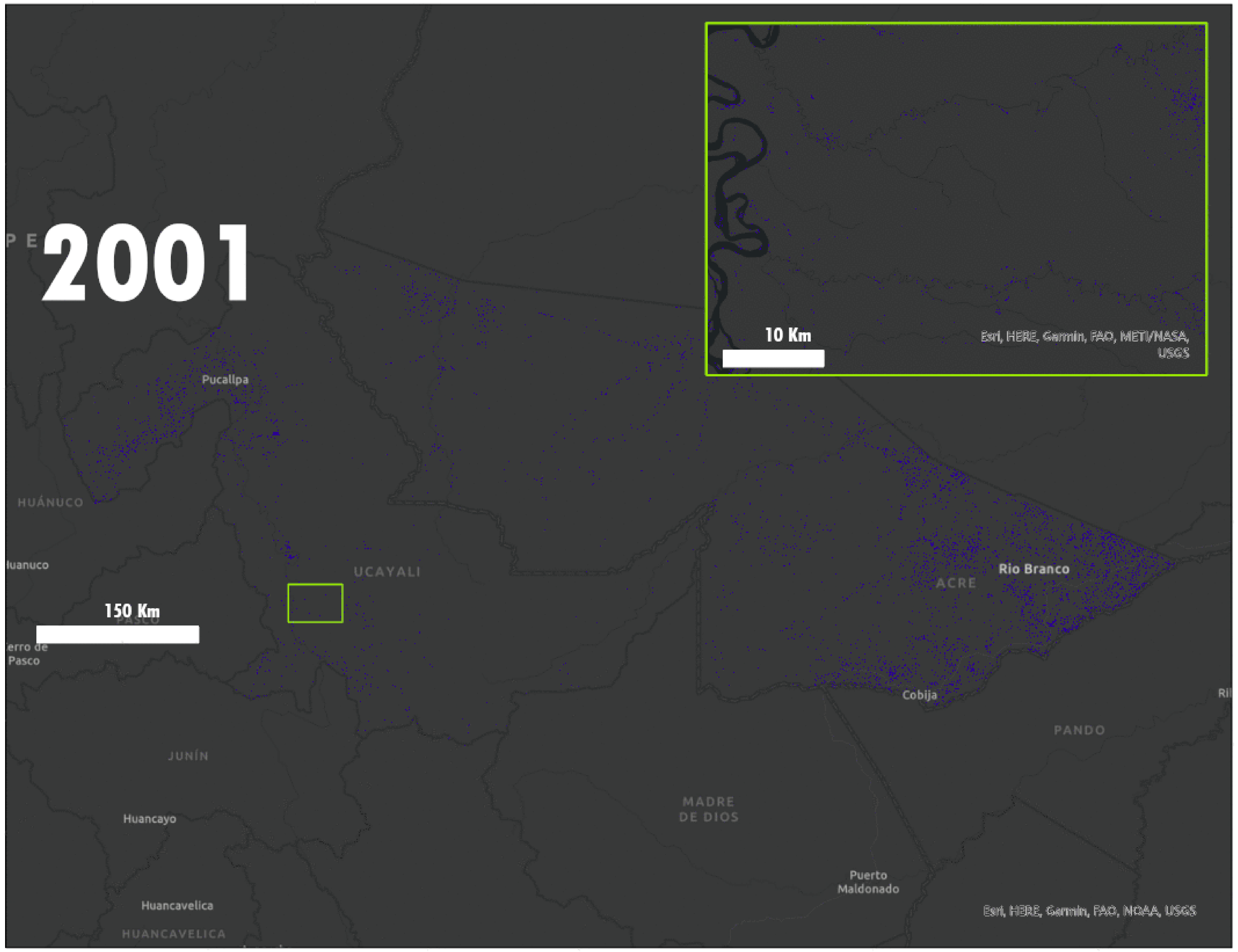
Somewhere in the middle ET-wise

Low ET rates

How has land use and land cover changed?

What are the effects on these land-cover changes on ecosystem services?

How has land use and land cover changed?



Reygadas et al. *Under review*

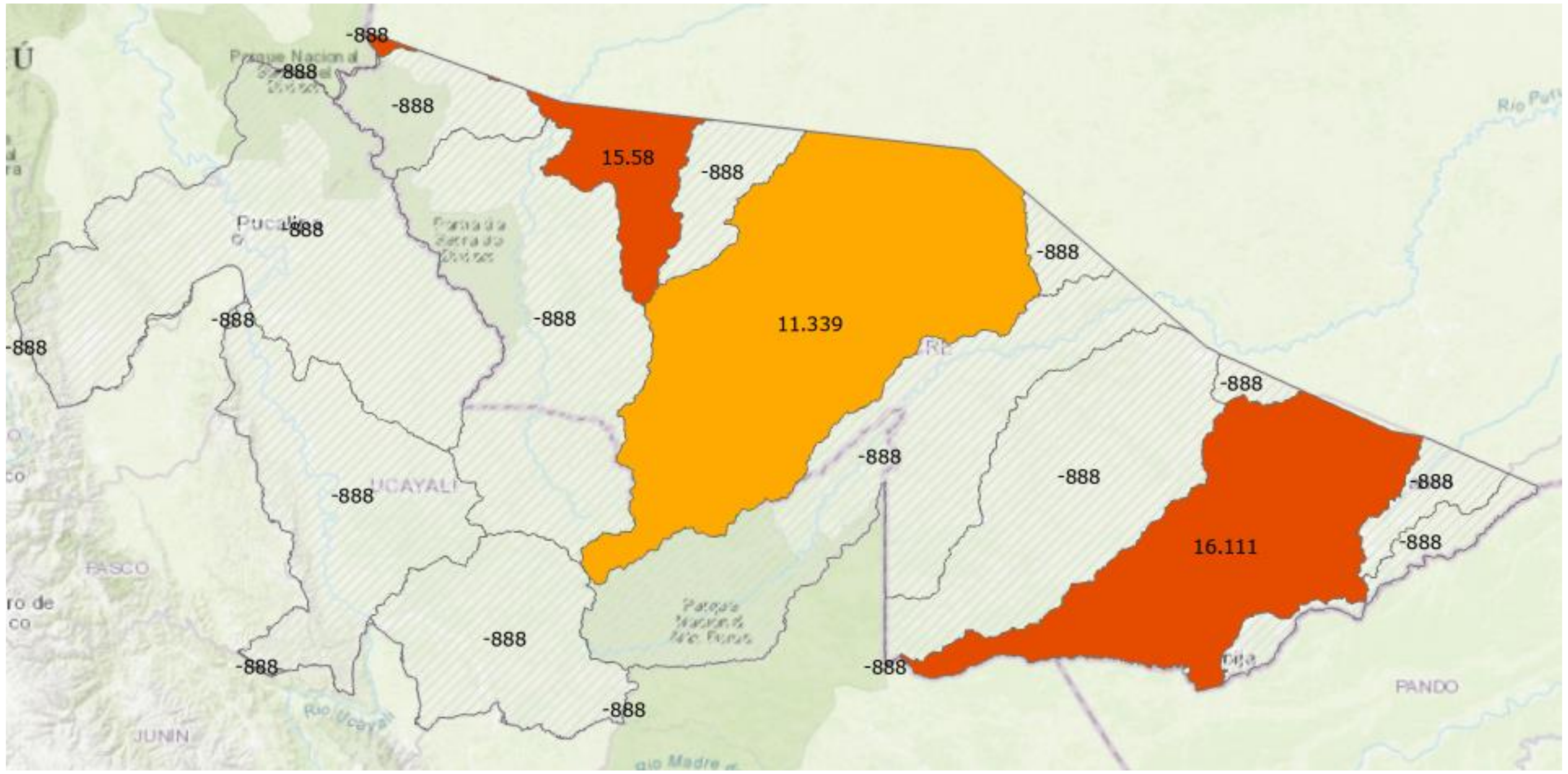
Deforestation and degradation

Open source tools

Transferable knowledge

What are the effects on ecosystem services

Station observations



Minimum temperatures increasing

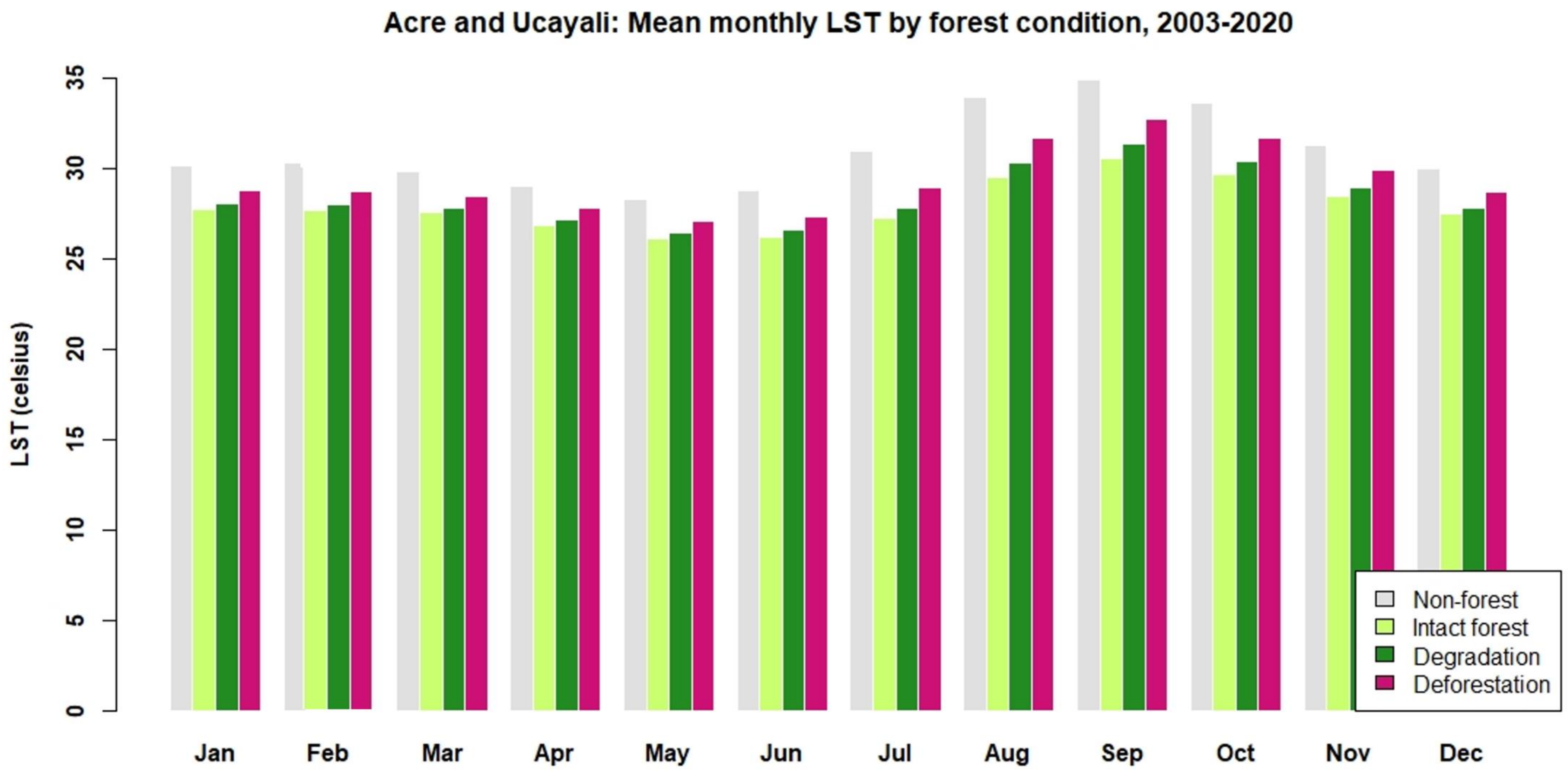
Maximum temperatures increasing

Not correlated with forest disturbance

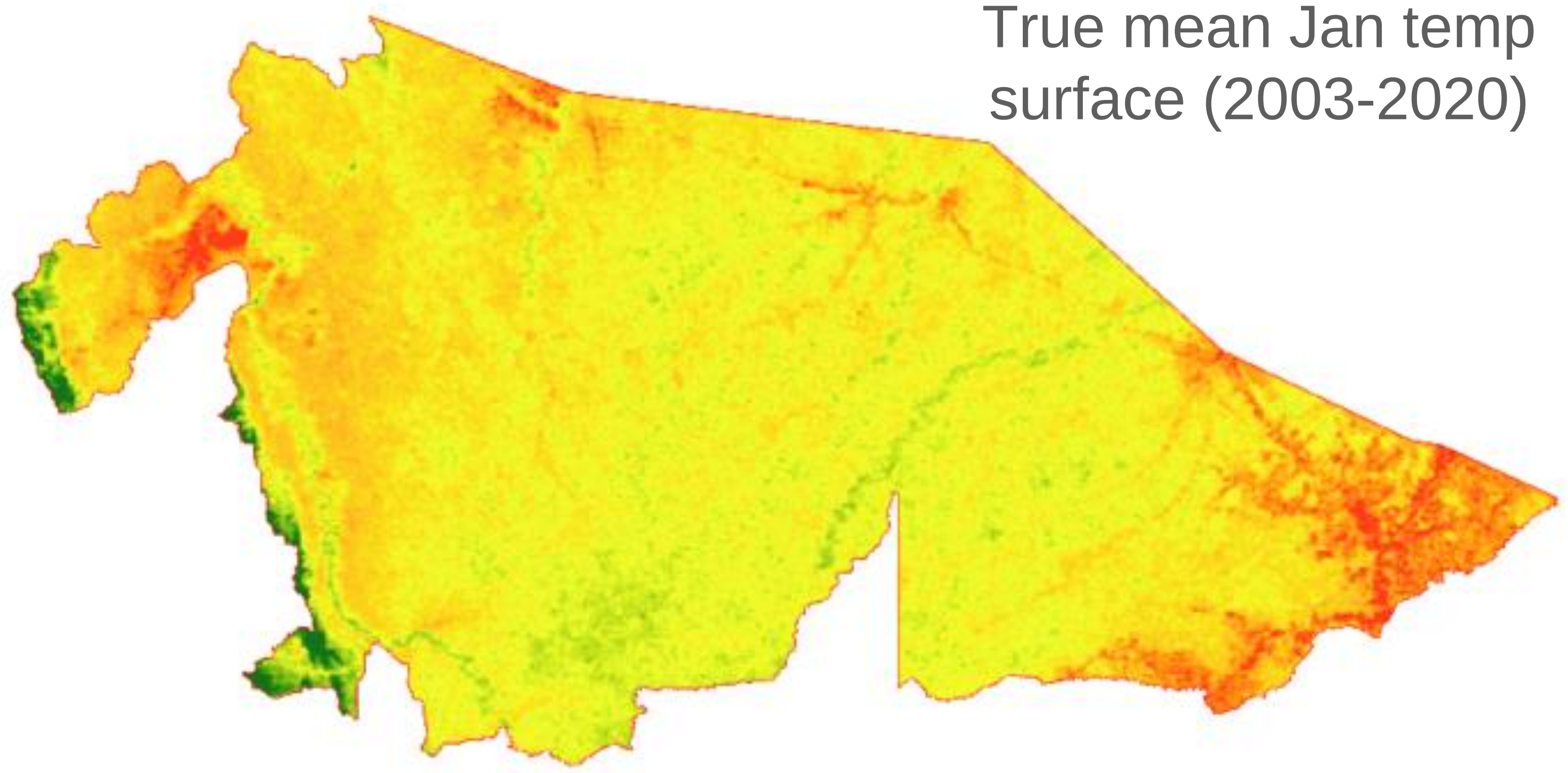
Correlated with ENSO & NAO

What are the effects on ecosystem services

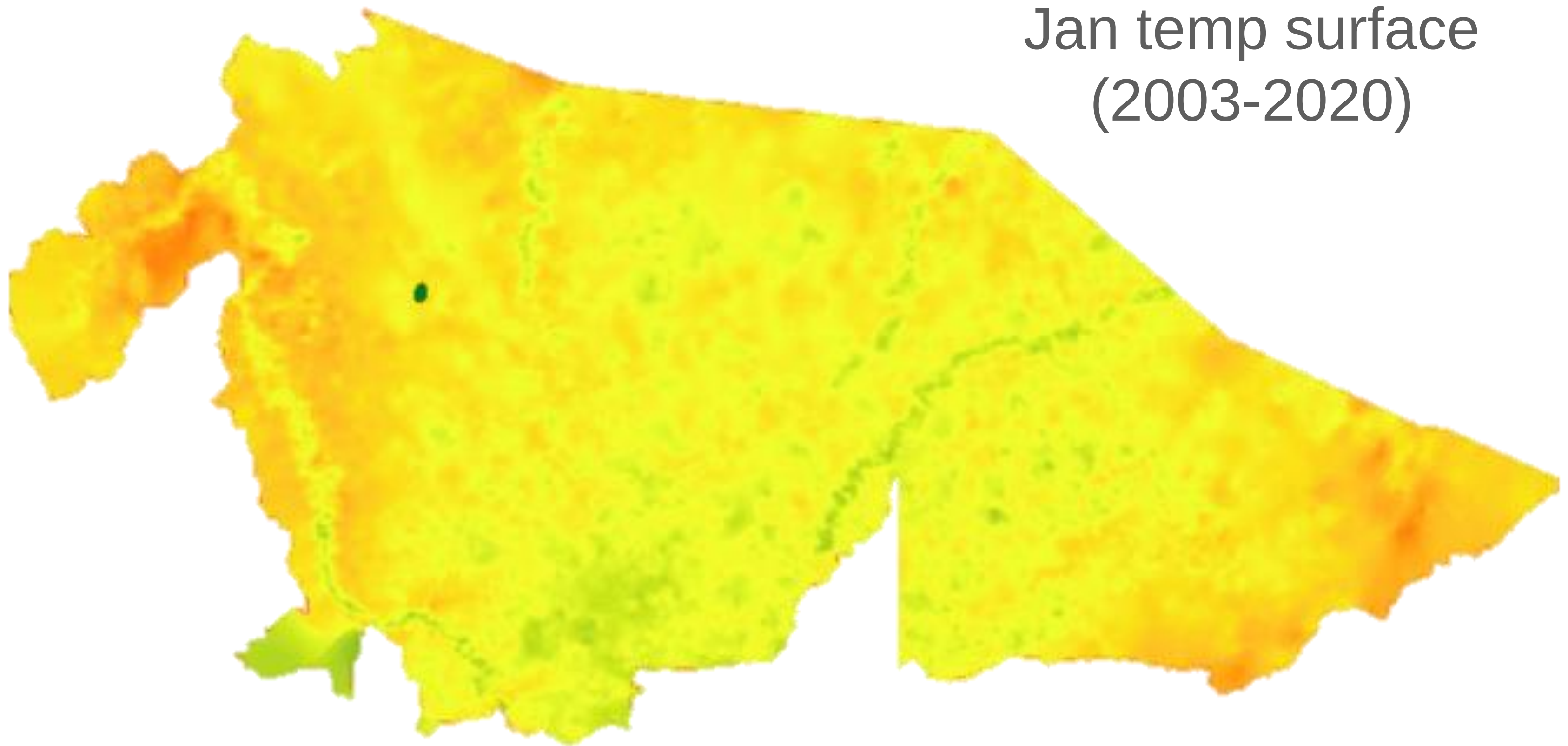
Remotely-sensed data



MODIS 1 km LST data

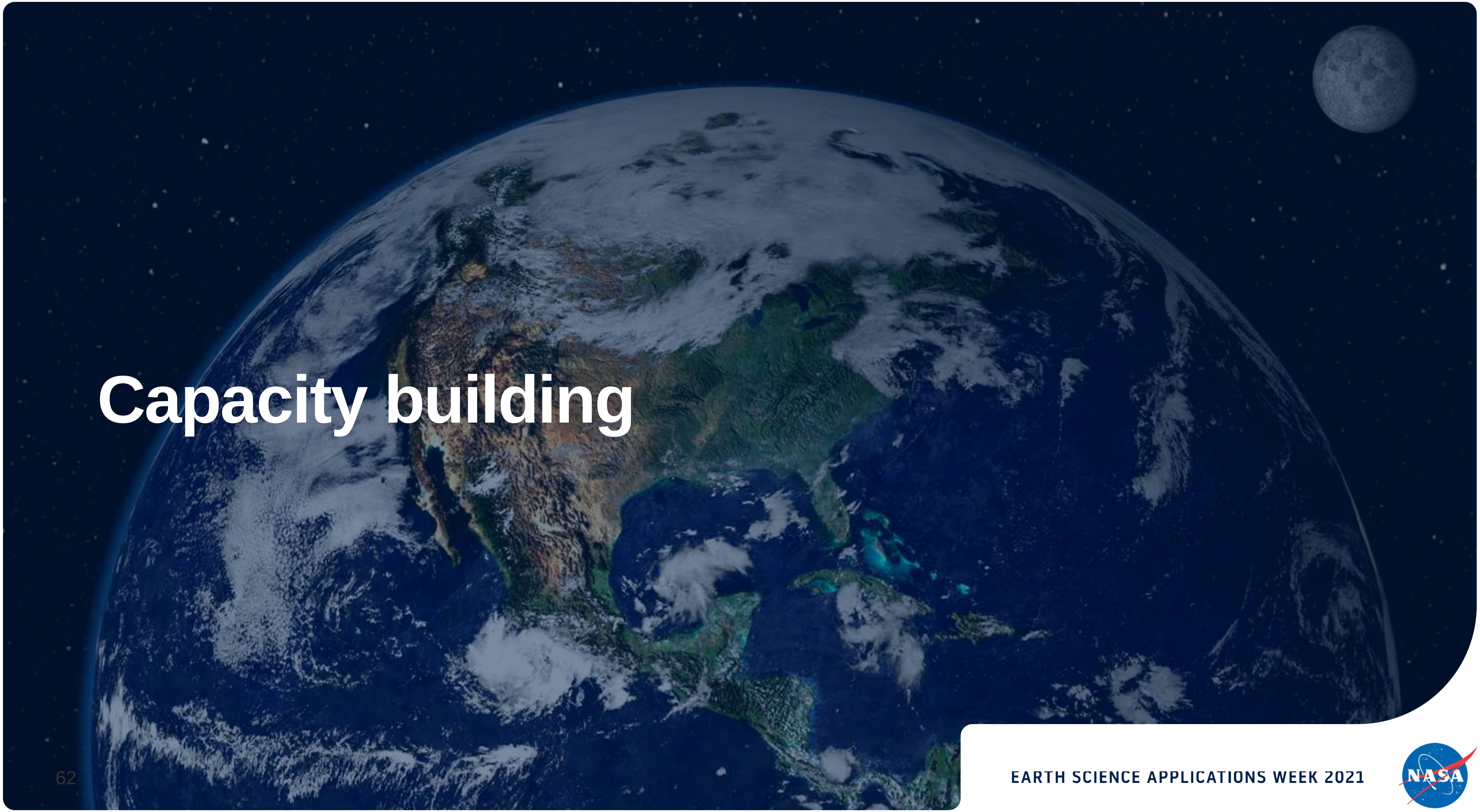


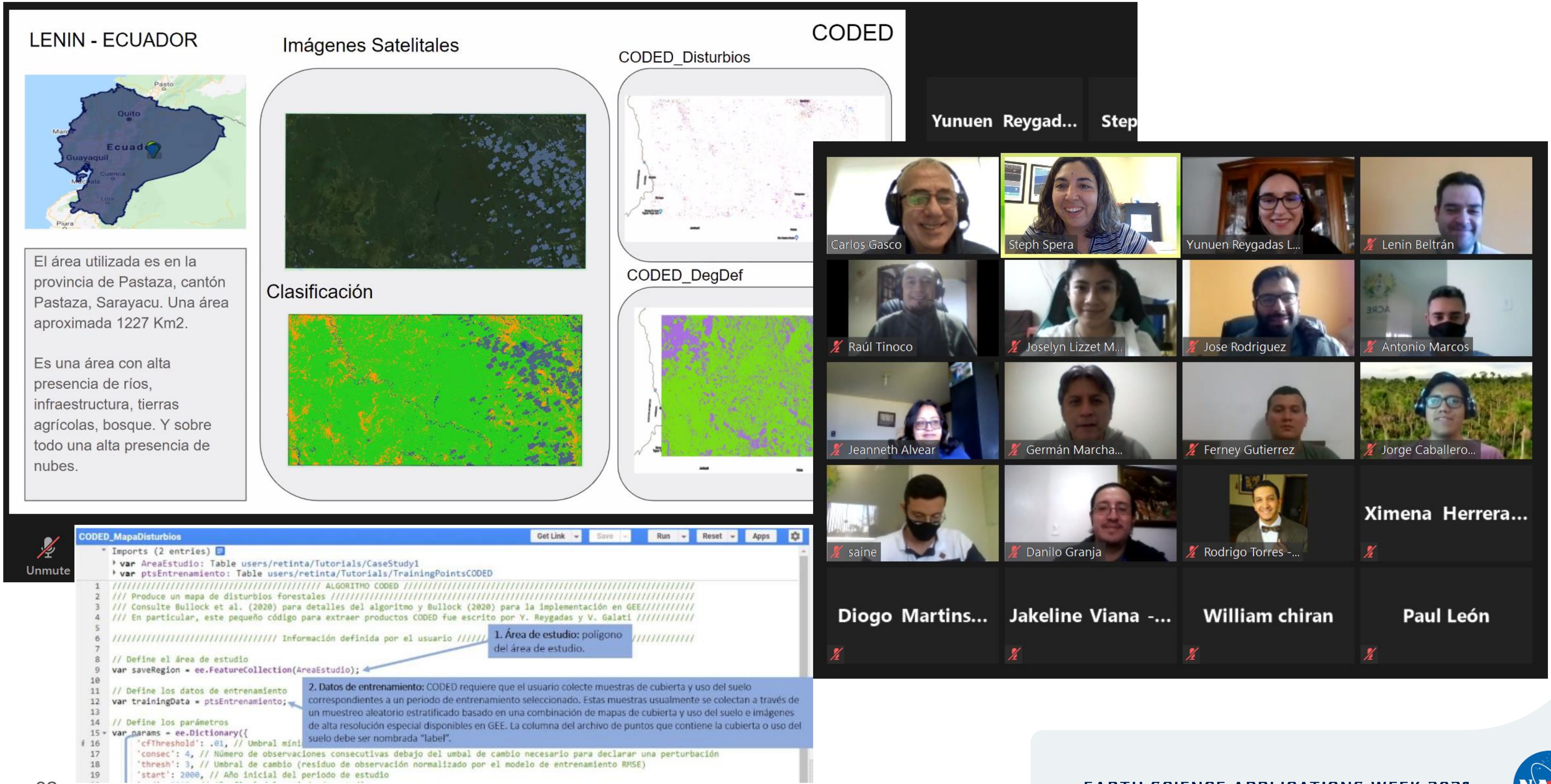
True mean Jan temp surface (2003-2020)



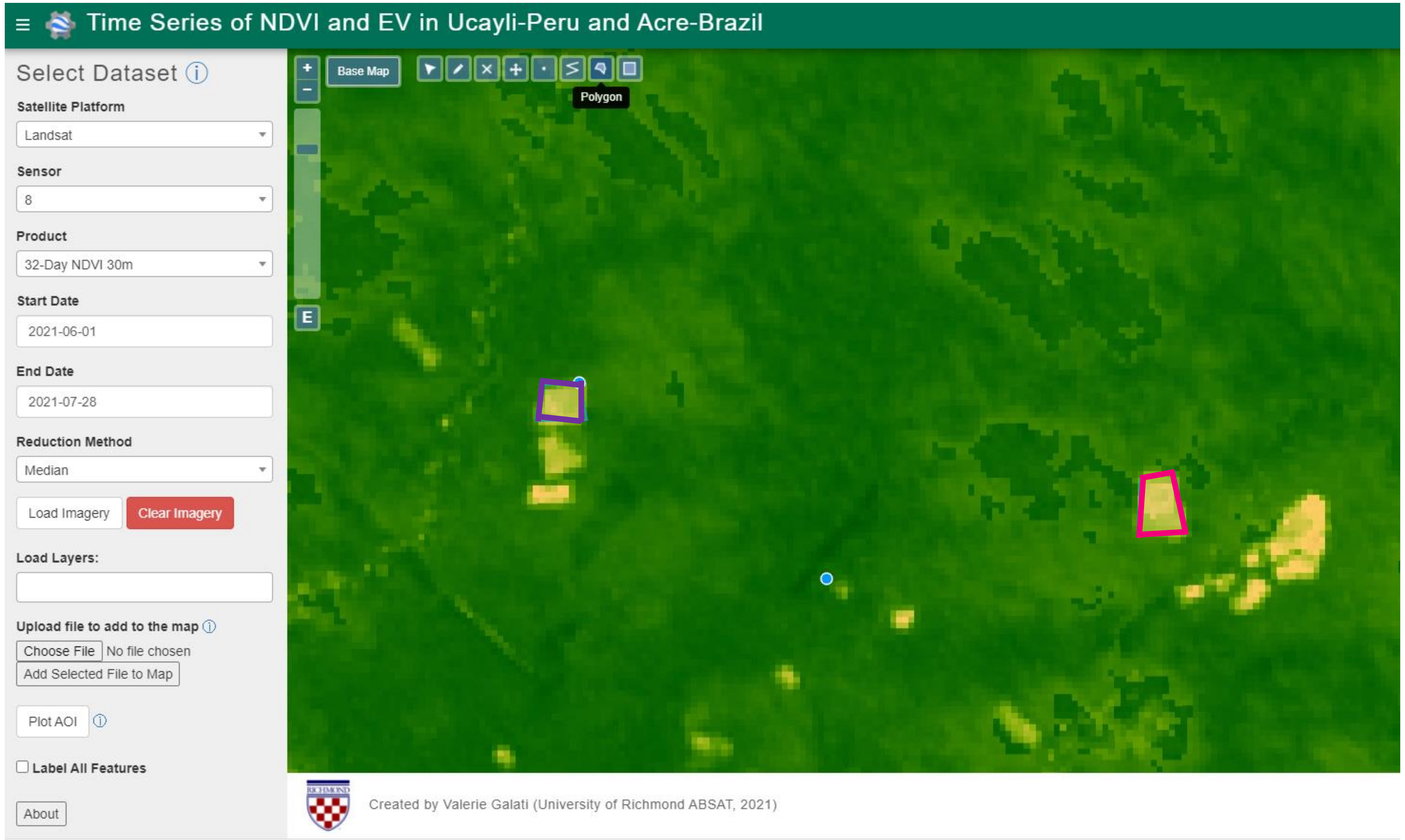
Hypothetical mean Jan temp surface (2003-2020)

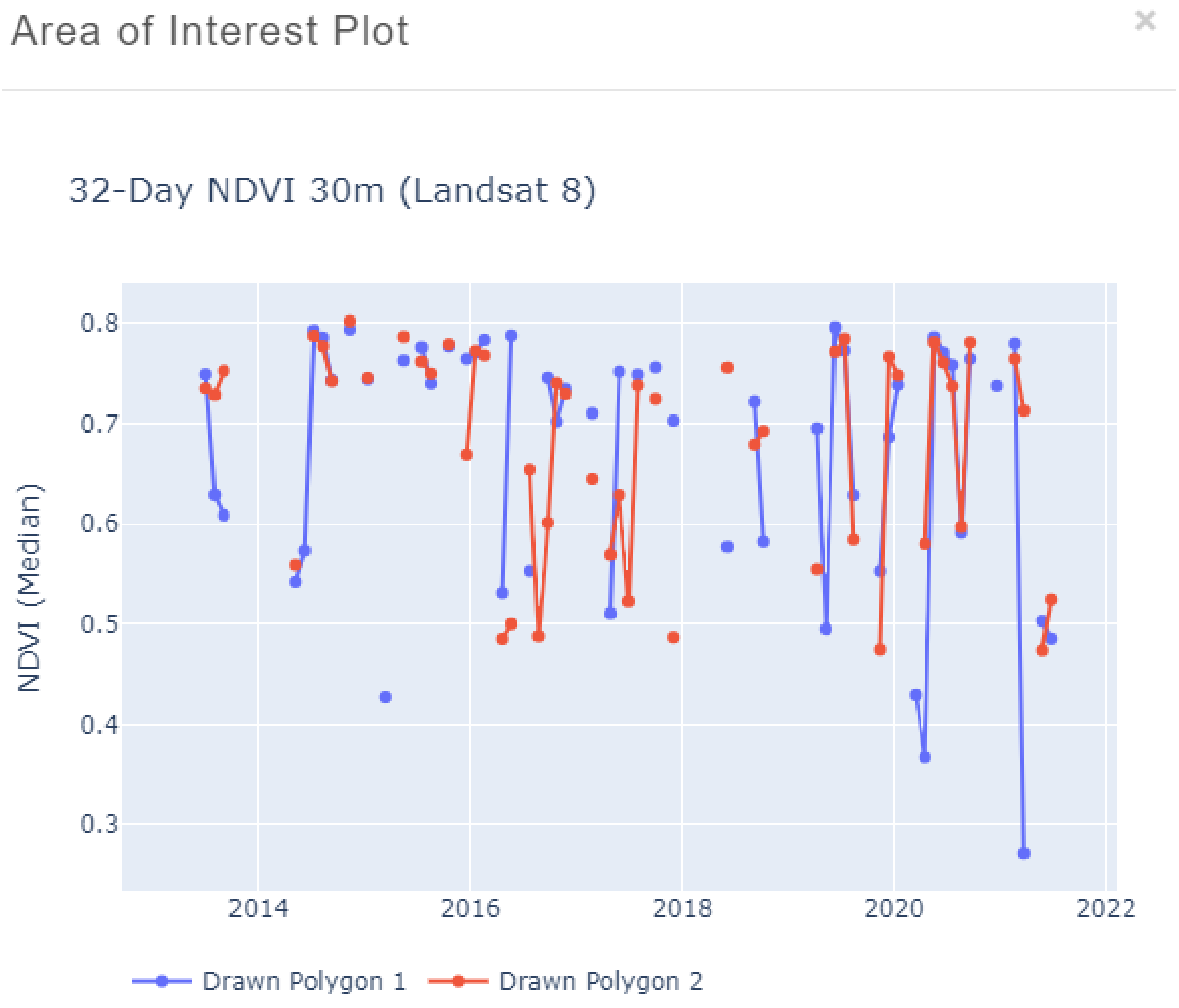
Capacity building



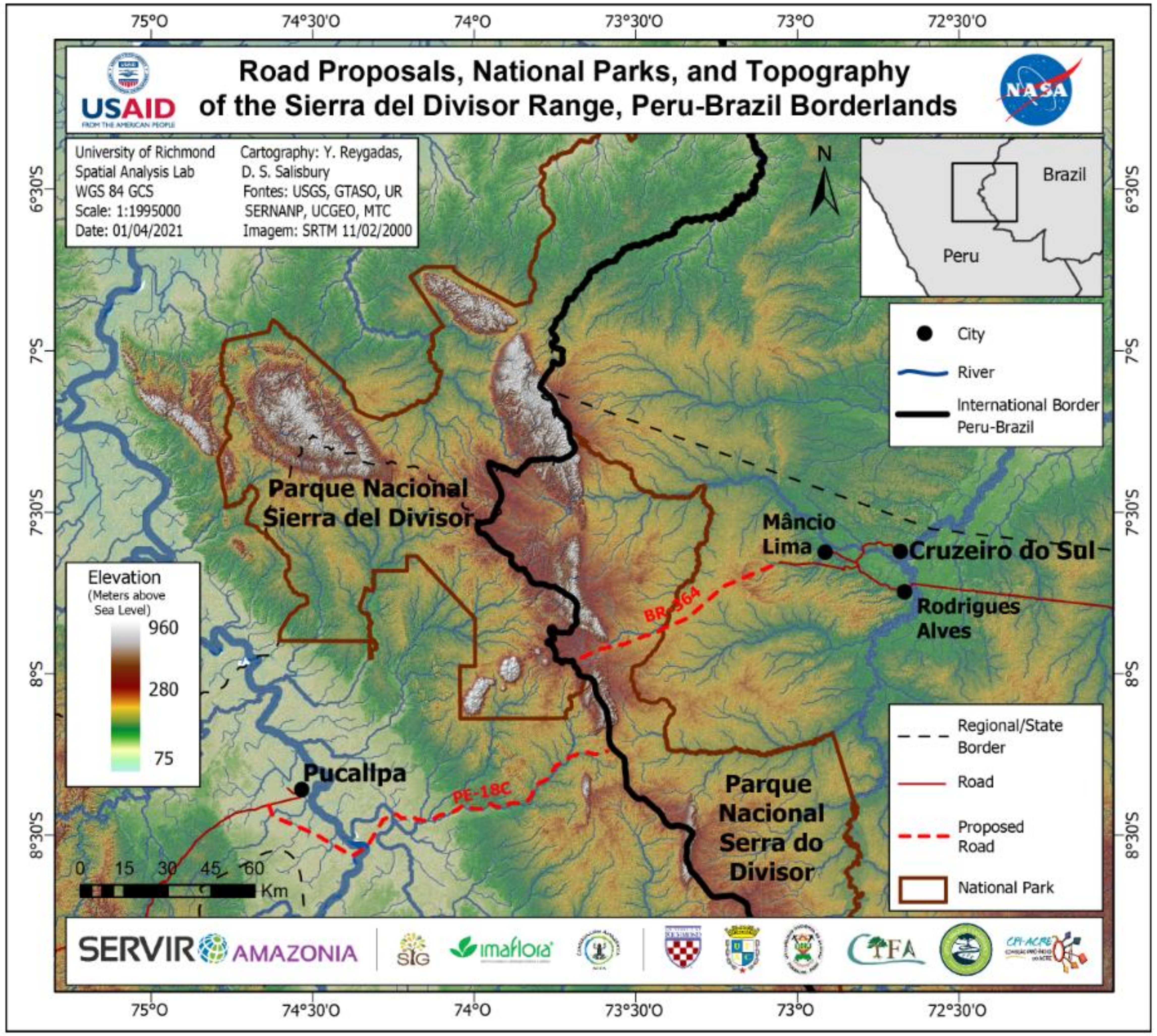

LENIN - ECUADOR
Imágenes Satelitales
CODED
CODED_Disturbios
Pasto
Quito
Ecuad
Guayaquil
Cuenca
Loja
Piura
El área utilizada es en la provincia de Pastaza, cantón Pastaza, Sarayacu. Una área aproximada 1227 Km2.
Es una área con alta presencia de ríos, infraestructura, tierras agrícolas, bosque. Y sobre todo una alta presencia de nubes.
Clasificación
CODED_DegDef
Unmute
CODED_MapaDisturbios
Get Link
Save
Run
Reset
Apps
Imports (2 entries)
var AreaEstudio: Table users/retinta/Tutorials/CaseStudy1
var ptsEntrenamiento: Table users/retinta/Tutorials/TrainingPointsCODED
/////////////////////////////////////// ALGORITMO CODED ///
/// Produce un mapa de disturbios forestales ///
/// Consulte Bullock et al. (2020) para detalles del algoritmo y Bullock (2020) para la implementación en GEE//////////
/// En particular, este pequeño código para extraer productos CODED fue escrito por Y. Reygadas y V. Galati ///////////
////////////////////////////////// Información definida por el usuario //////
// Define el área de estudio
var saveRegion = ee.FeatureCollection(AreaEstudio);
// Define los datos de entrenamiento
var trainingData = ptsEntrenamiento;
// Define los parámetros
var params = ee.Dictionary({
'cfThreshold': .01, // Umbral míni
'consec': 4, // Número de observaciones consecutivas debajo del umbal de cambio necesario para declarar una perturbación
'thresh': 3, // Umbral de cambio (residuo de observación normalizado por el modelo de entrenamiento RMSE)
'start': 2000, // Año inicial del periodo de estudio
1. Área de estudio: polígono del área de estudio.
2. Datos de entrenamiento: CODED requiere que el usuario colecte muestras de cubierta y uso del suelo correspondientes a un periodo de entrenamiento seleccionado. Estas muestras usualmente se colectan a través de un muestreo aleatorio estratificado basado en una combinación de mapas de cubierta y uso del suelo e imágenes de alta resolución especial disponibles en GEE. La columna del archivo de puntos que contiene la cubierta o uso del suelo debe ser nombrada "label".
Yunuen Reygad...
Step
Carlos Gasco
Steph Spera
Yunuen Reygadas L...
Lenin Beltrán
Raúl Tinoco
Joselyn Lizzet M...
Jose Rodriguez
Antonio Marcos
Jeanneth Alvear
Germán Marcha...
Ferney Gutierrez
Jorge Caballero...
saine
Danilo Granja
Rodrigo Torres -...
Ximena Herrera...
Diogo Martins...
Jakeline Viana -...
William chiran
Paul León

Mapping changes in real time

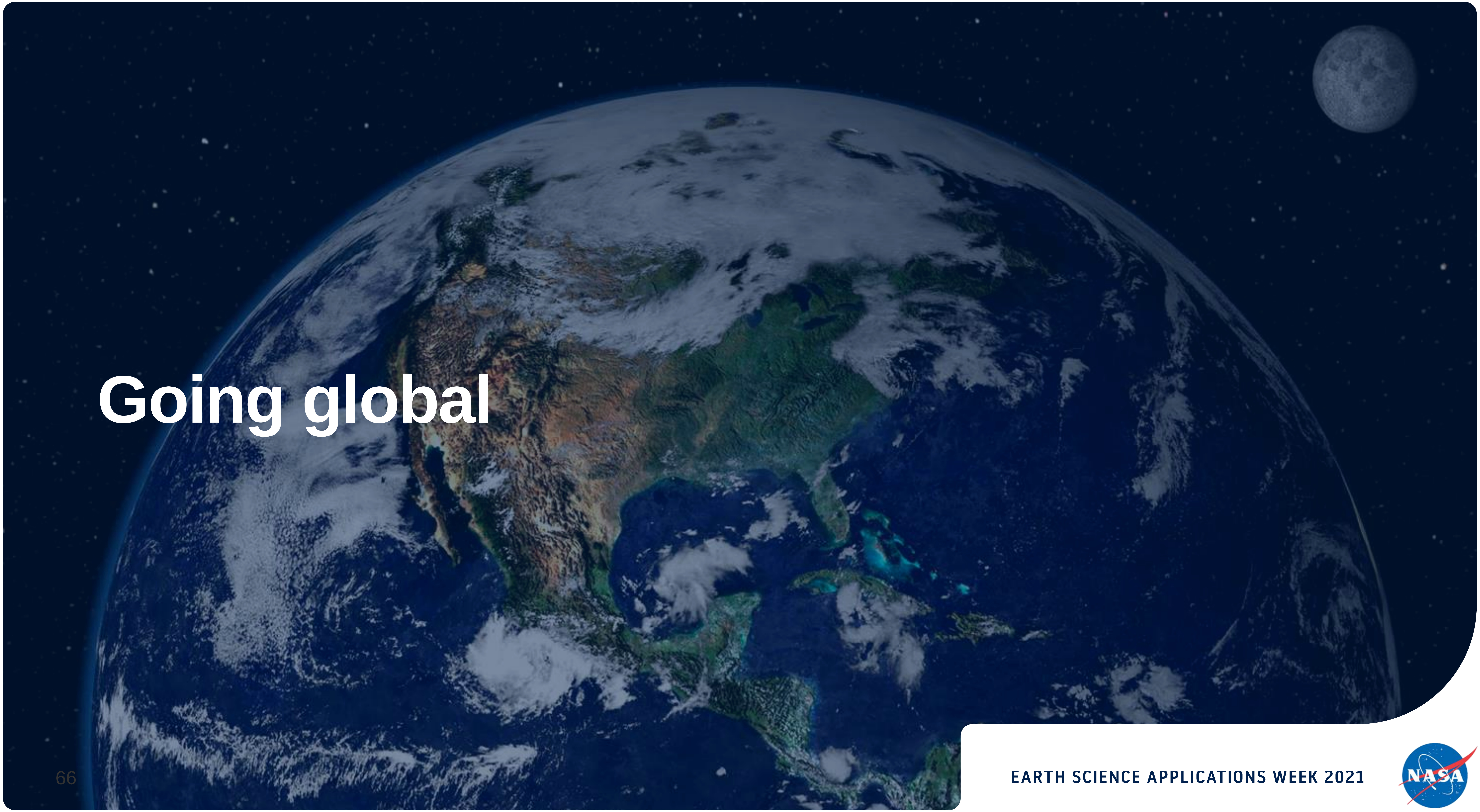




Proposed roads



Going global



SERVIR

- Global LCLUC mapping collaboration
- Cross-hub and cross-theme collaborations

Thank you!

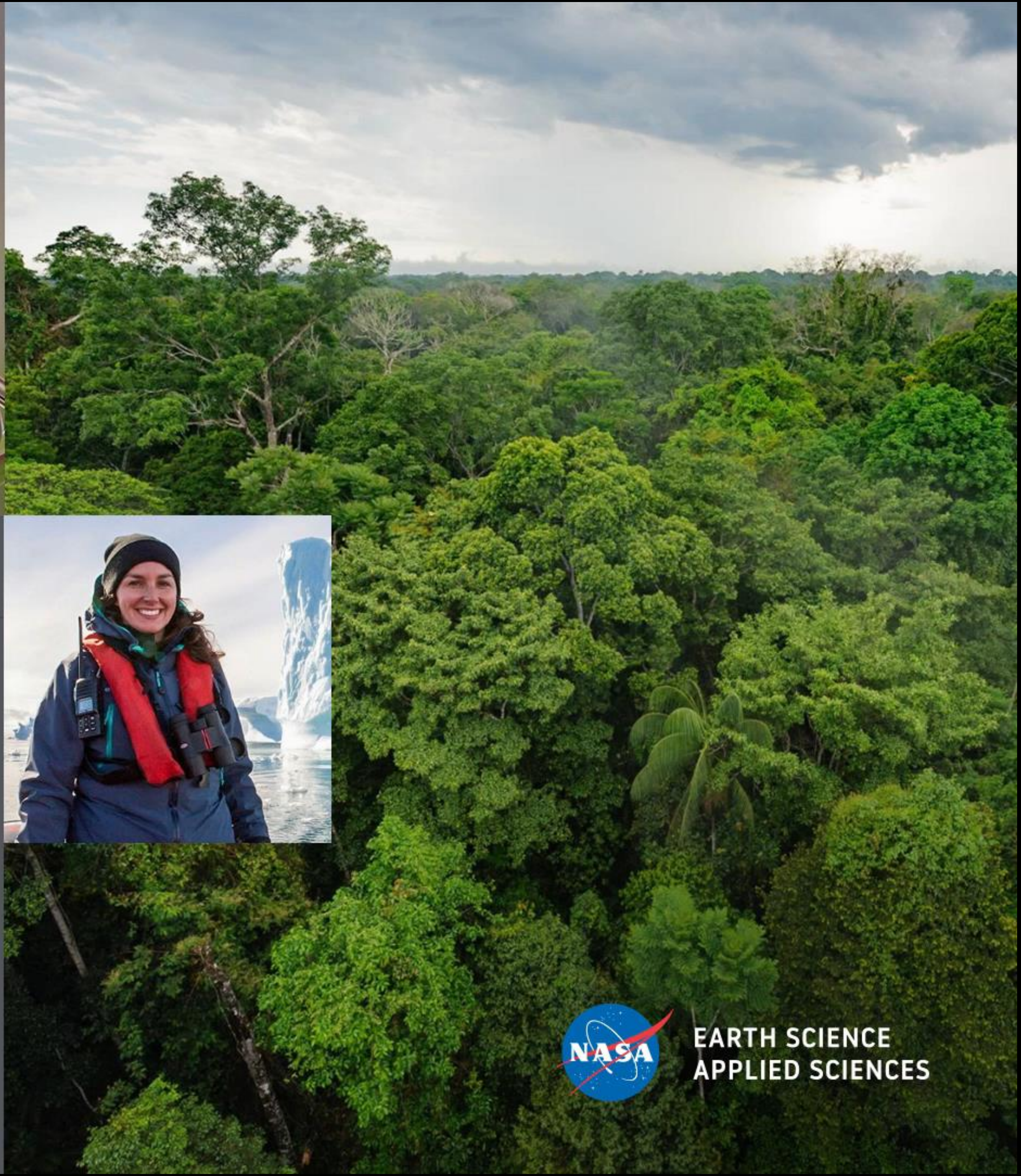
sspera@richmond.edu

and thanks to my collaborators D. Salisbury, Y. Reygadas, and V. Galati , and the Amazon Borderlands Spatial Analysis Team at URichmond

EARTH SCIENCE
APPLIED SCIENCES

Partner Testimonial Video

EARTH SCIENCE APPLICATIONS WEEK 2021



Ecological Forecasting Project Testimonials

Keith Gaddis
Program Manager, Ecological Forecasting

EARTH SCIENCE
APPLIED SCIENCES

THANK YOU!

EARTH SCIENCE APPLICATIONS WEEK 2021