



SANTA CLARITA VALLEY ECOLOGICAL CONSERVATION

Identifying Oak Woodland Infested with
the Goldspotted Oak Borer in the Santa
Clarita Valley Using Earth Observations

Madison Elowitt

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Simon Ng

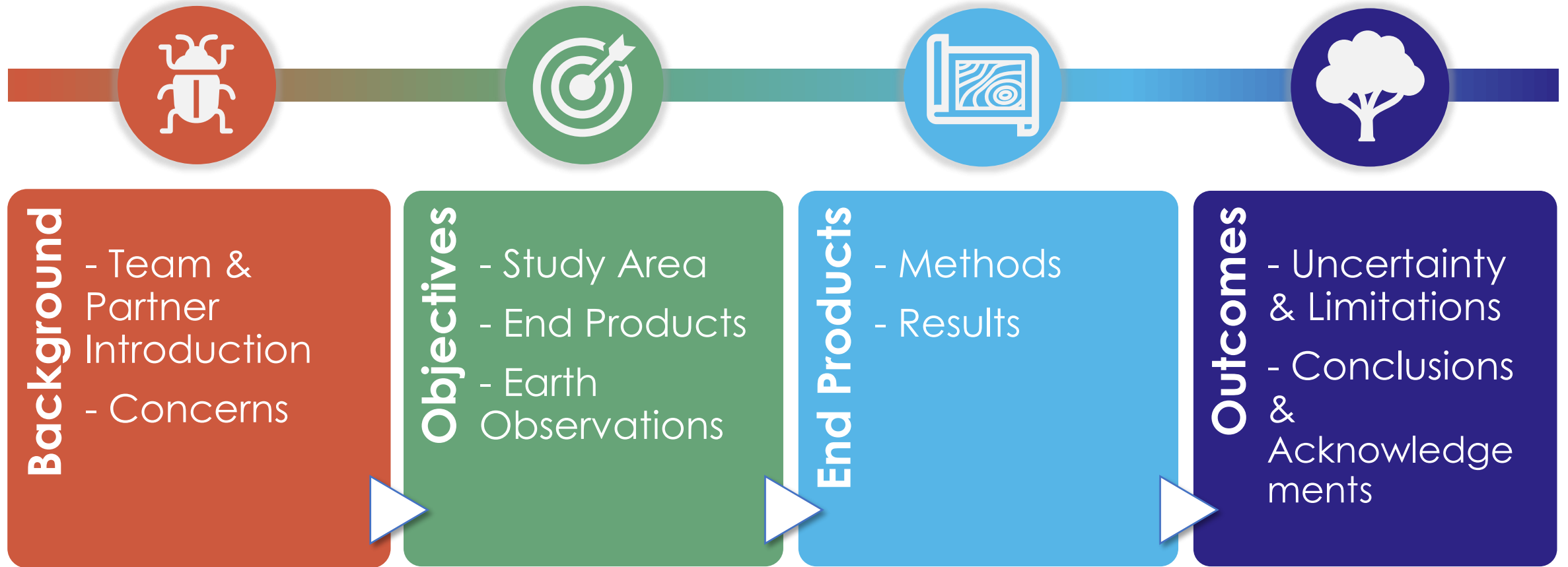
Nathalie Lai



California – JPL | Fall 2024



Outline



Meet the Team



Madison Elowitt,
Project Lead



Justine Pendergraft



Simon Ng



Nathalie Lai

Background – Goldspotted Oak Borer

The invasive Goldspotted Oak Borer (GSOB) presents a major threat to Southern California's native oak woodlands.



Agrilus auroguttatus

GSOB larvae feed on water and nutrients in an oak's cambium.



Infestations can lead to visible damage within 2 – 3 years and eventual widespread mortality.



Coast live oak, *Quercus agrifolia*

Community Concerns – GSOB in SoCal

As a keystone species in SoCal, oak trees provide:



Macro-ecosystem Structure



Shade and Habitat



Food



Cultural Connection



Basemap credits: Earthstar Geographics

Image Credit: Mike Lewis

Partner Concerns

Resource Conservation District of Santa Monica Mountains (RCDSMM)

- Prevent potential spread into the Santa Monica Mountains
- Detect and treat migration early



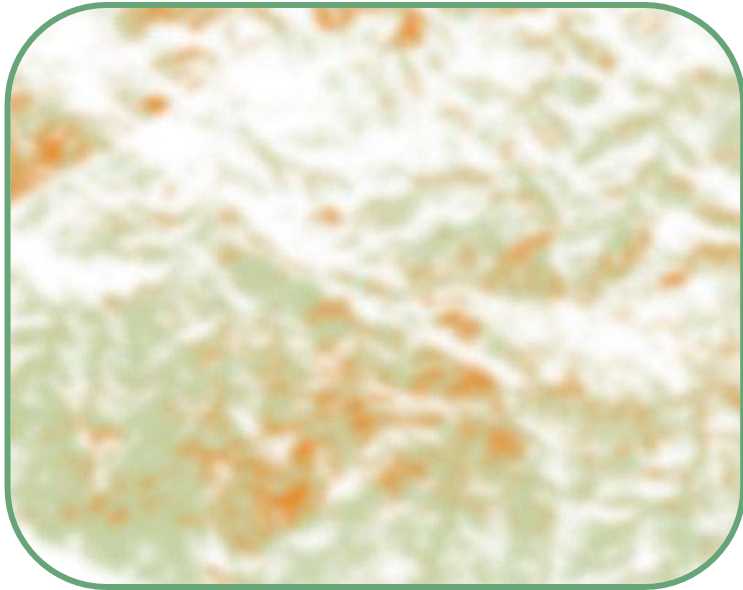
Mountains Recreation & Conservation Authority (MRCA)

- Assess the extent of infestation
- Treat impacted trees
- Mitigate spread within nearby parklands

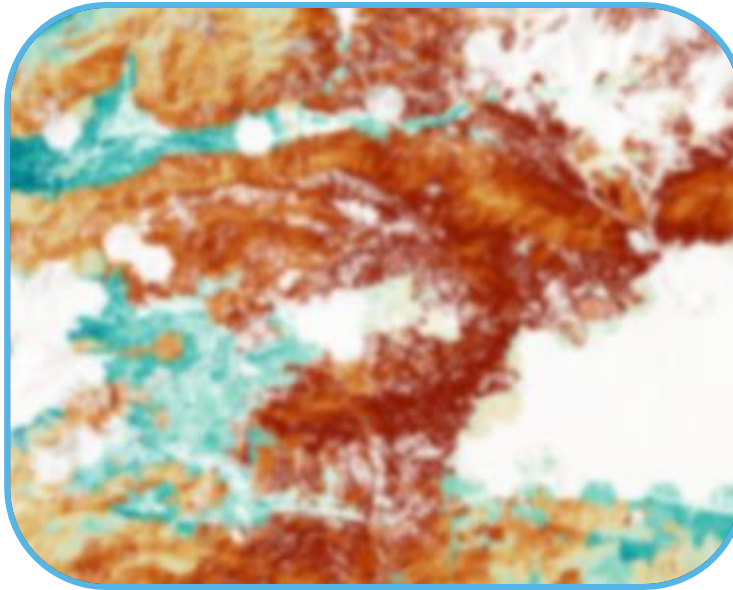
Project Objectives

Identify infested trees and mitigate GSOB spread throughout Santa Clarita Valley

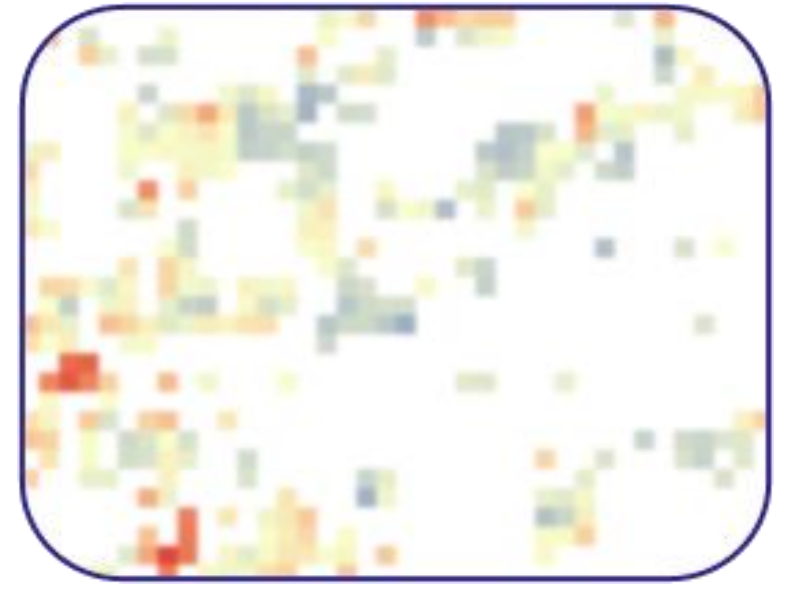
Anticipate and prevent future migration to the Santa Monica Mountains



Infested Oak Tree
Classification Map



Risk Assessment Map



Landcover Change Map

Study Area and Period



Earth Observations – Sensors



AVIRIS-3



Landsat-8 OLI TIRS

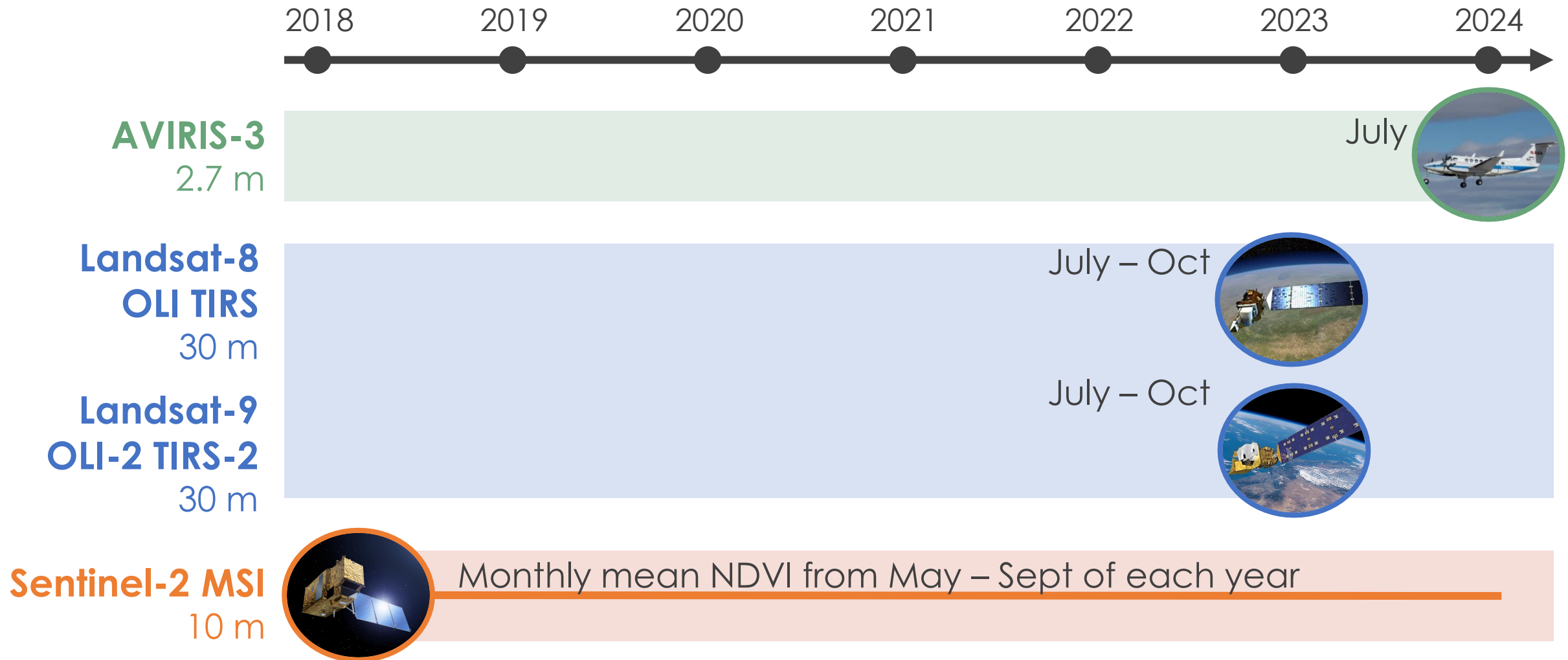


Landsat-9 OLI-2 TIRS-2



Sentinel-2 MSI

Earth Observations – Time Period

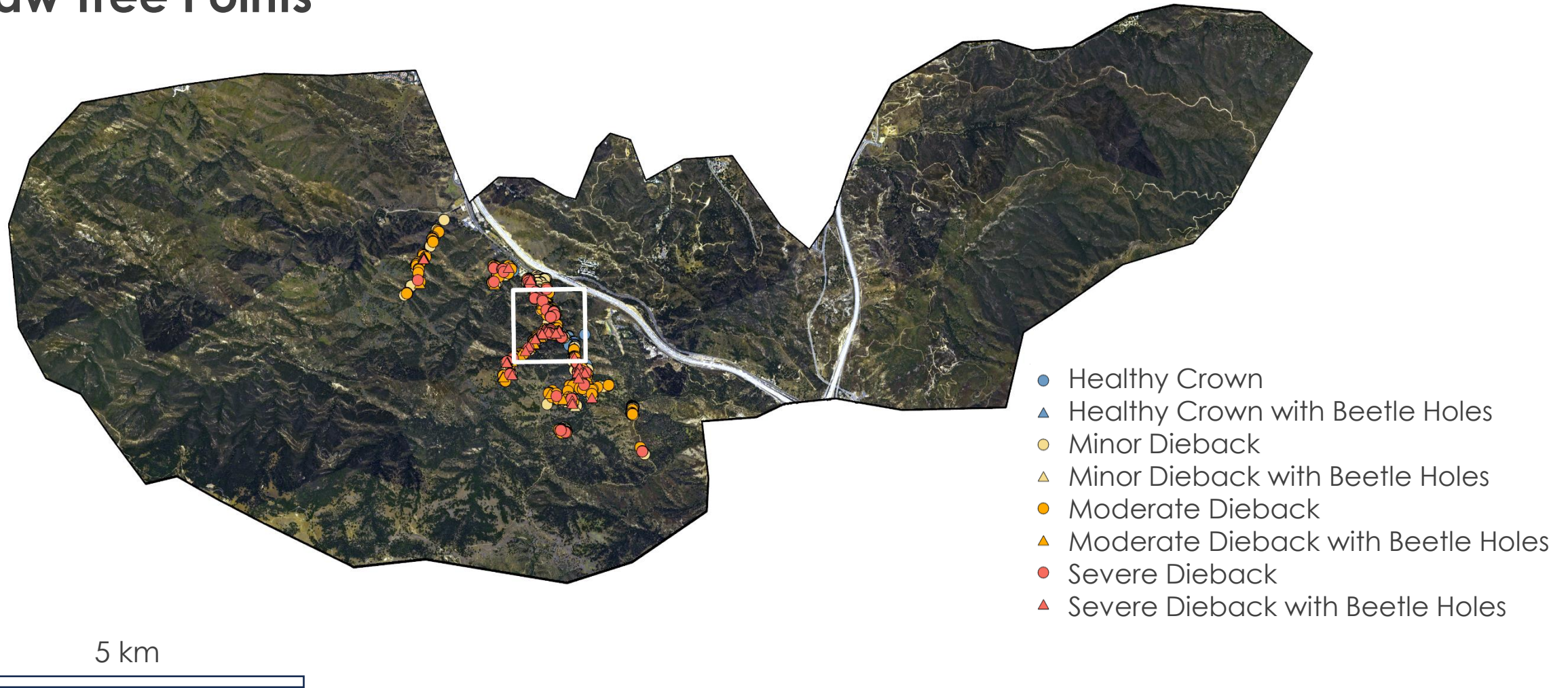


Methods – Classification Overview



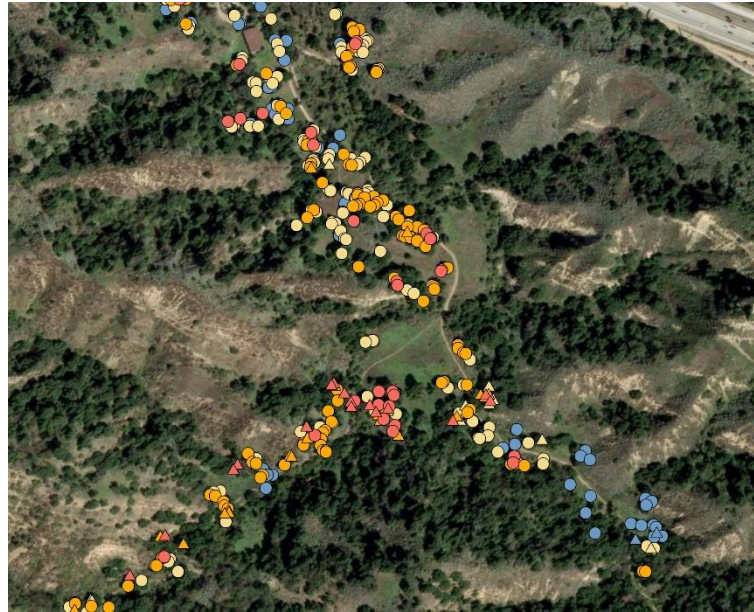
Methods – Ground Truth Data Processing

Raw Tree Points



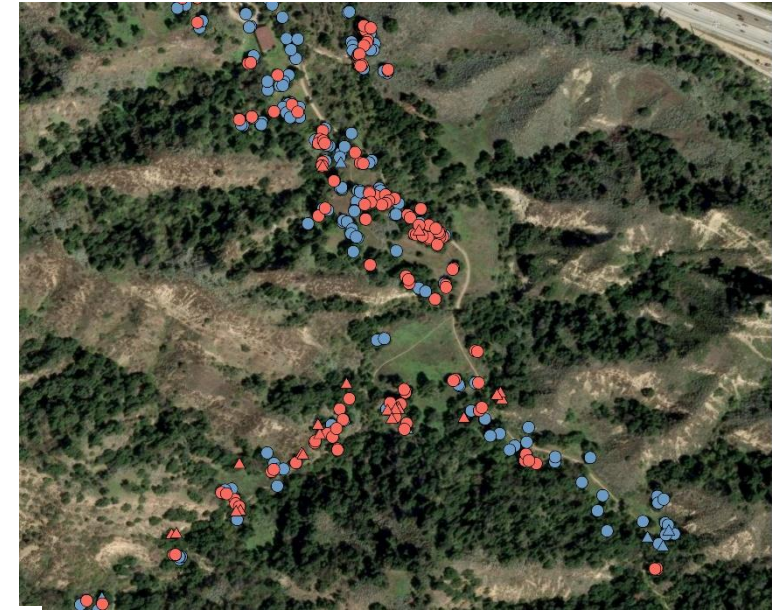
Methods – Ground Truth Data Processing

Raw



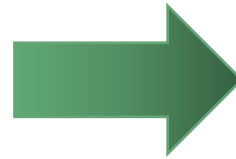
- Healthy Crown
- ▲ Healthy Crown with Beetle Holes
- Minor Dieback
- ▲ Minor Dieback with Beetle Holes
- Moderate Dieback
- ▲ Moderate Dieback with Beetle Holes
- Severe Dieback
- ▲ Severe Dieback with Beetle Holes

Analysis-Ready



- Healthy/Minor Dieback
- ▲ Healthy/Minor Dieback with Beetle Holes
- Moderate/Severe Dieback
- ▲ Moderate/Severe Dieback with Beetle Holes

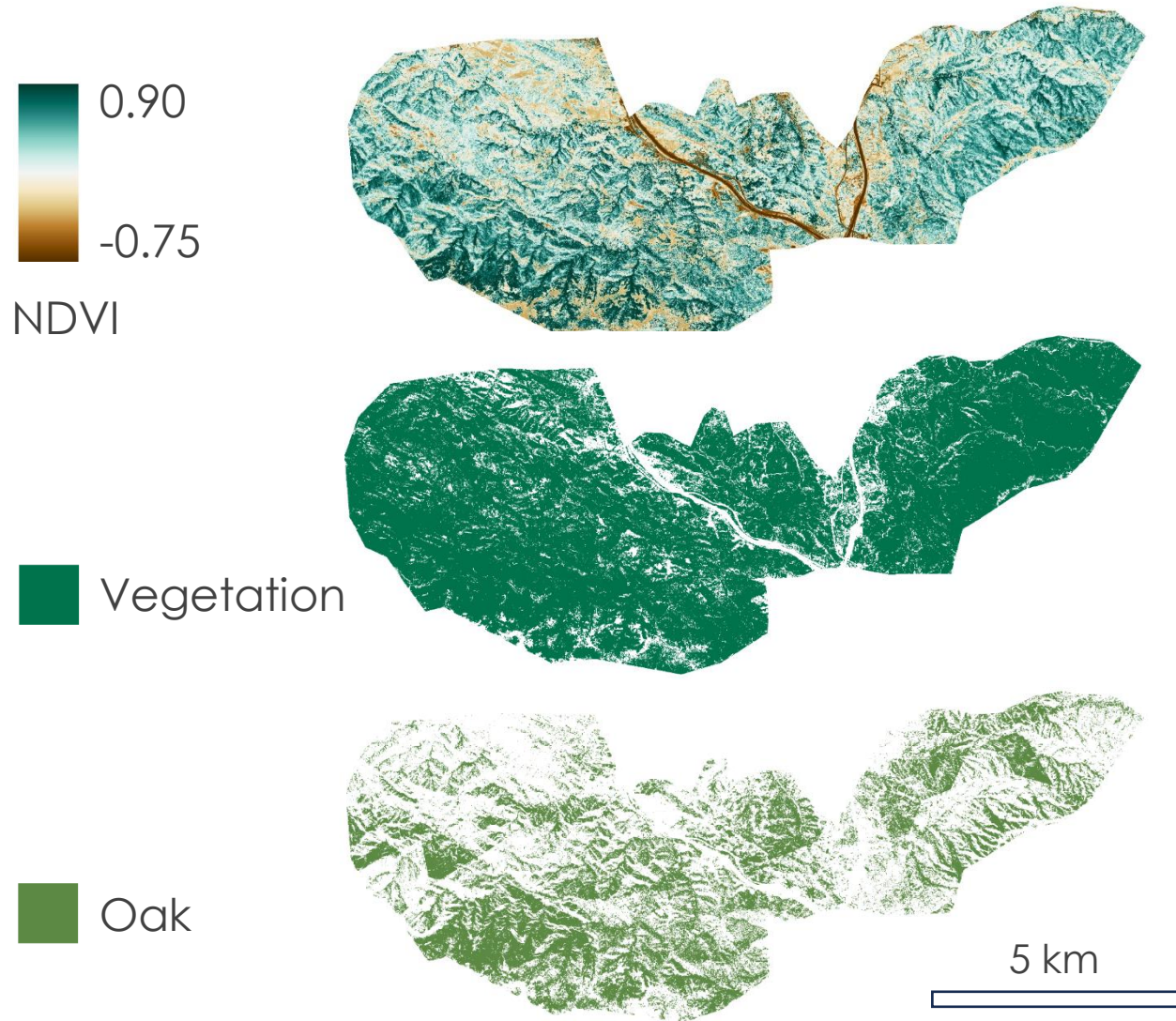
Data
Wrangling



0.5 km



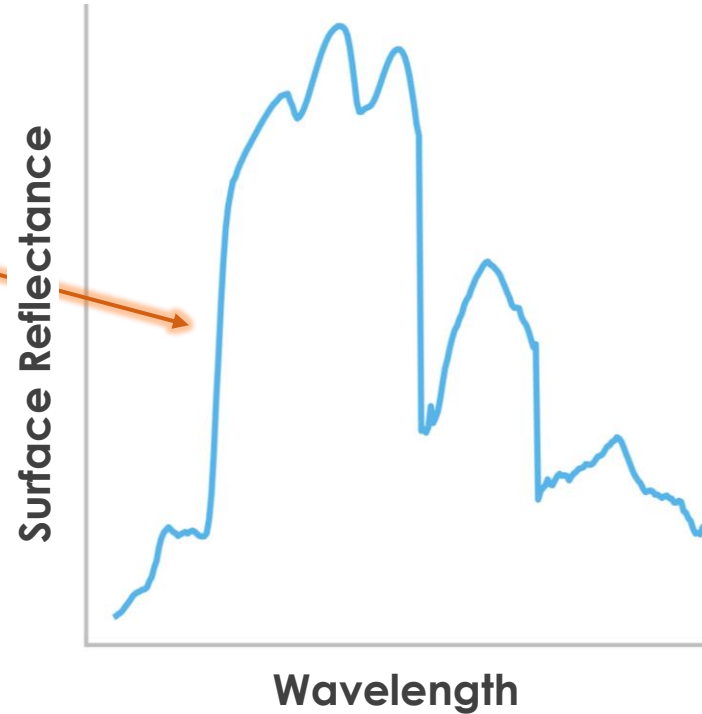
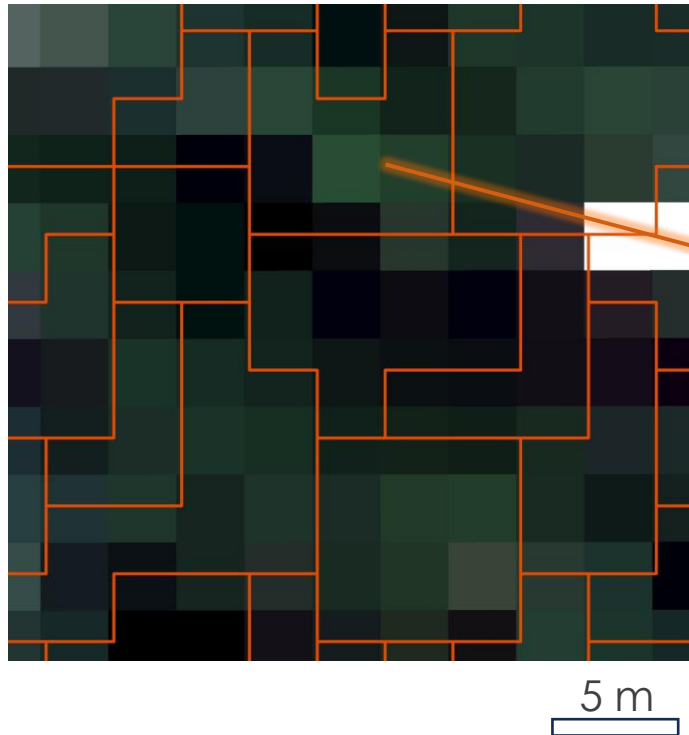
Results – Oak Tree Classification



Results – Oak Tree Classification Accuracy

Classifier	Accuracy	Kappa	AUC	Cross Validation Accuracy
K-Nearest Neighbor (1 Neighbor)	96.3%	0.92	0.95	96%
K-Nearest Neighbor (5 Neighbors)	97.2%	0.92	0.97	96%
Random Forest	100%	0.92	0.97	100%
Support Vector Machine	100%	1	1	100%

Methods – Infested Oak Tree Classification



Train model using spectral profiles of known infested and healthy oak pixels

Classify canopies based on their spectral profiles

Segment oak layer into canopies

Calculate average spectral profile for each canopy

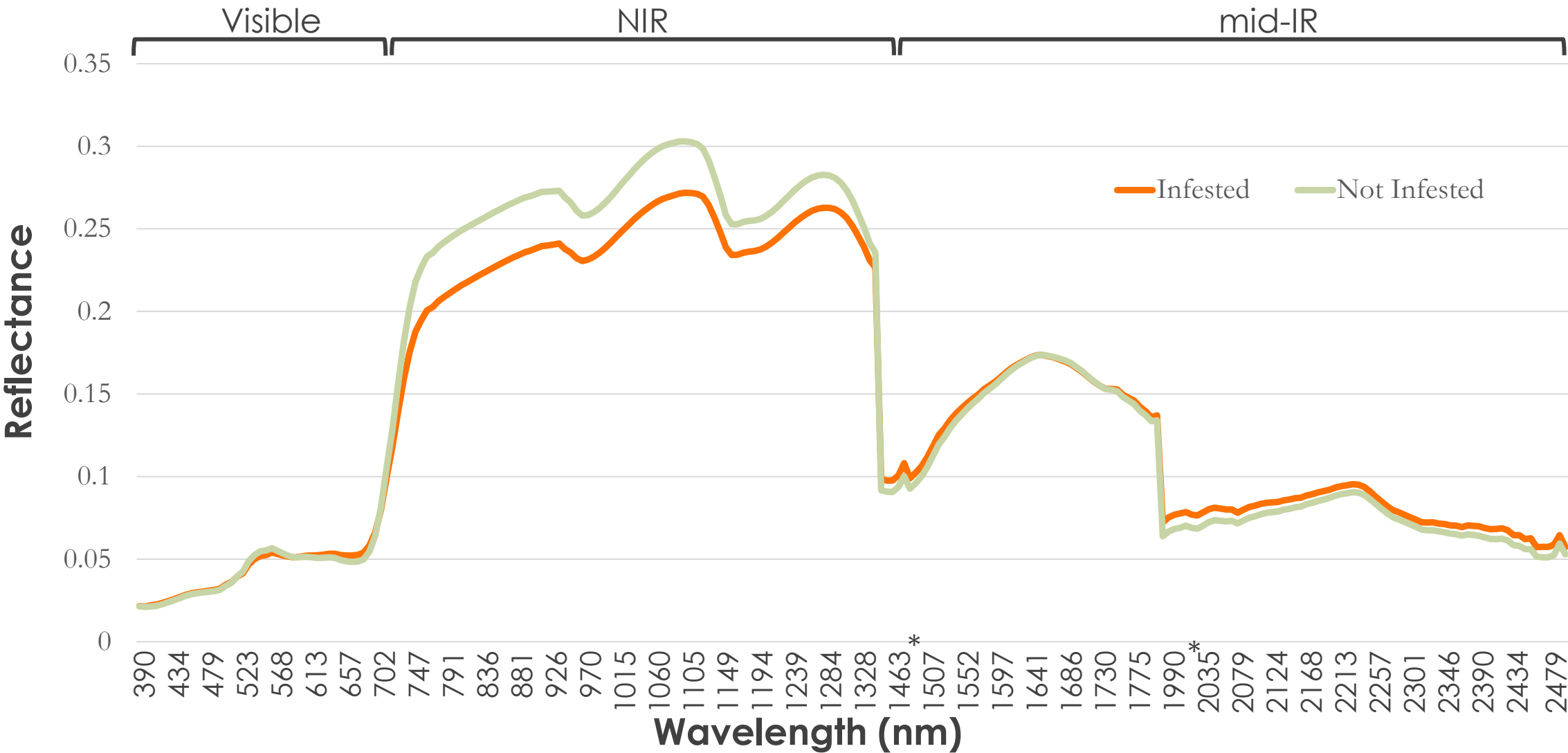


Results – Infested Oak Tree Classification



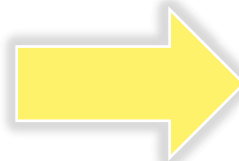
Results – Infested Oak Tree Classification

* "Bad bands" 129-140 & 199-212 were removed from the analysis



Results – Infested Oak Tree Classification

		Testing	
		Infested	Not Infested
Training	Infested	73	26
	Not Infested	16	65



**Overall
Accuracy:
76.67%**

Methods – Risk Assessment

Natural Population
Spread



*Known
GSOB
Infestation*

Environmental
Stressors



Past Wildfires



*Heat (High
Temperatures)*

Potential Human
Movement of
Infested Wood



Campsites

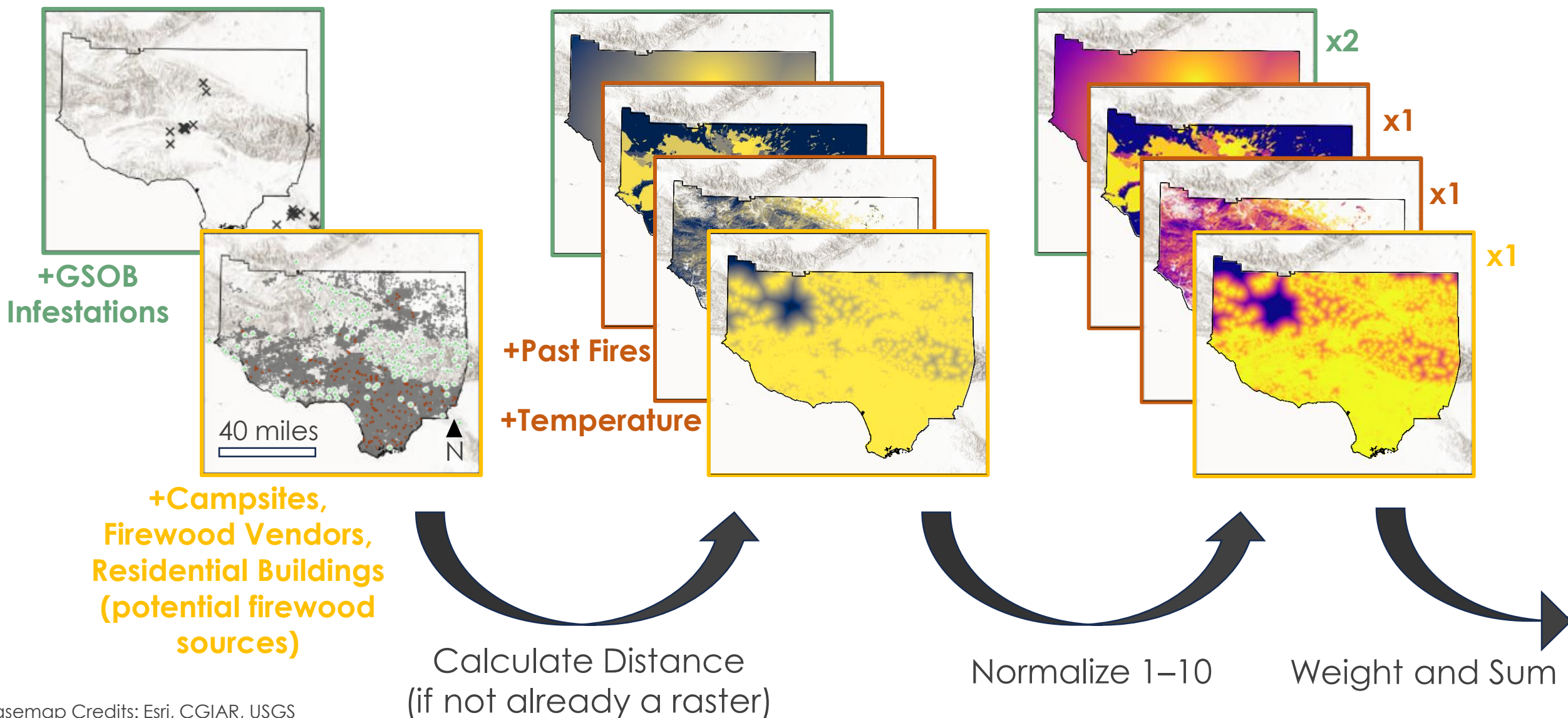


*Firewood
Vendors*

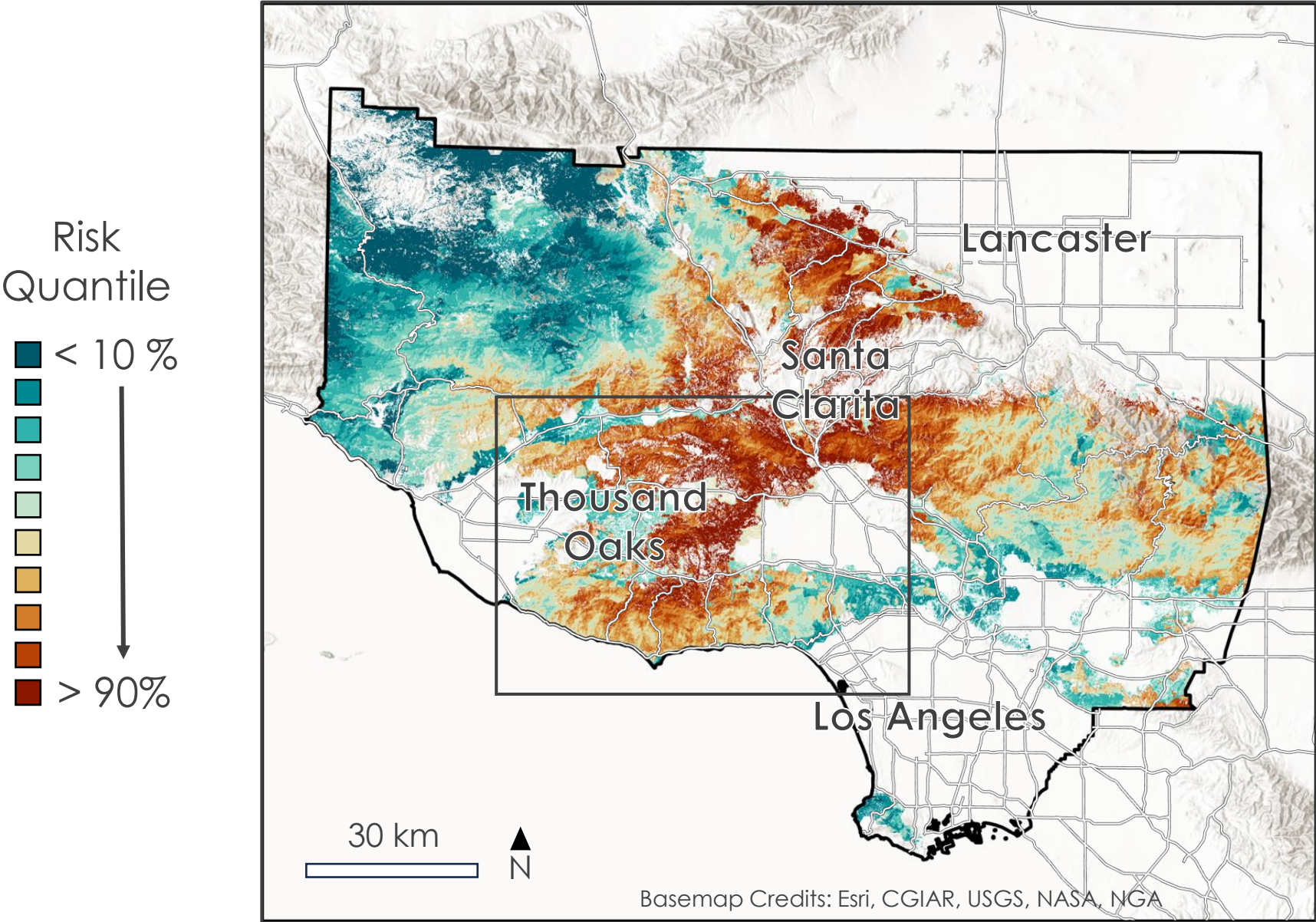


*Residential
Buildings*

Methods – Risk Assessment Inputs

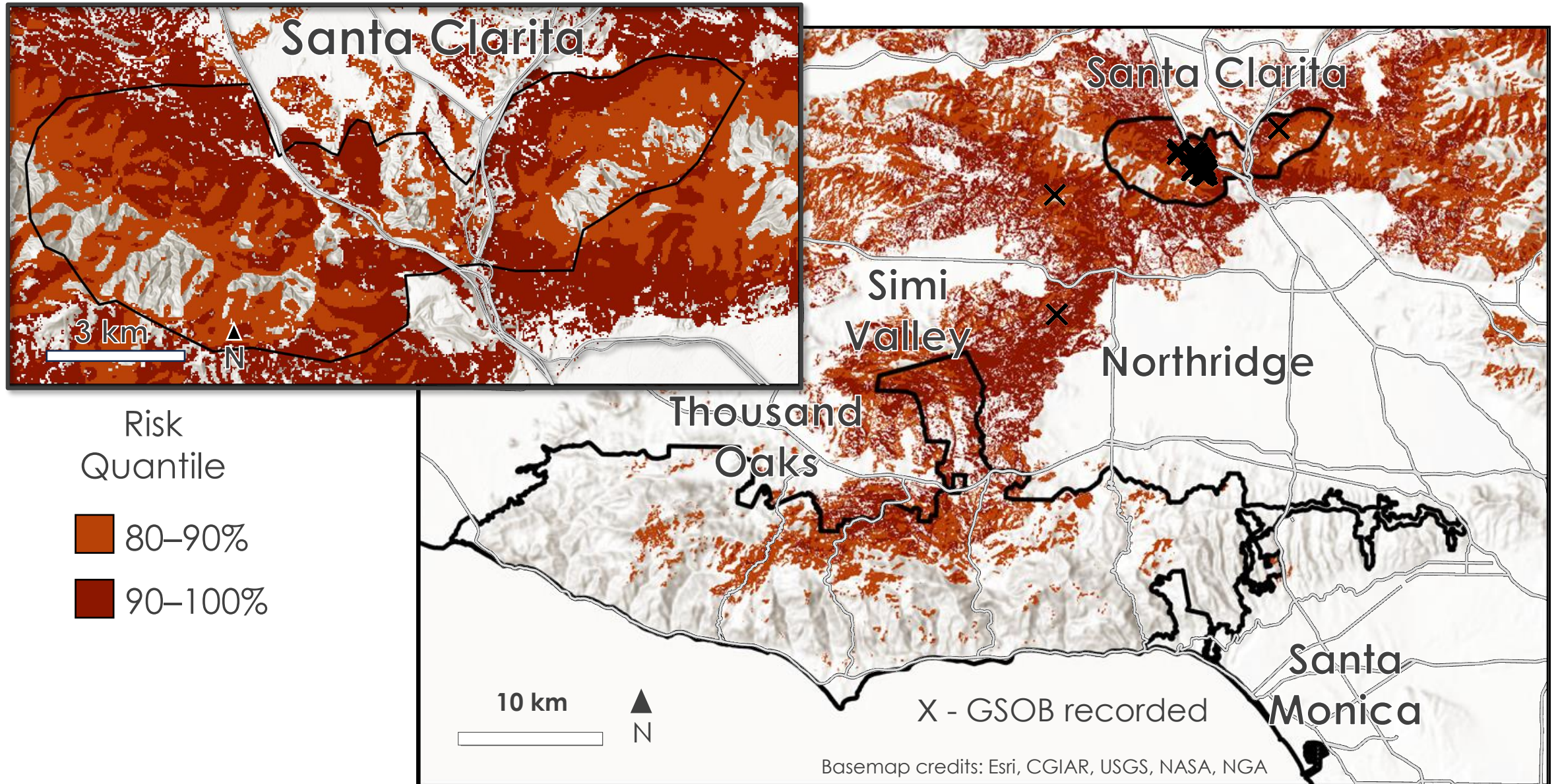


Results – Risk Assessment



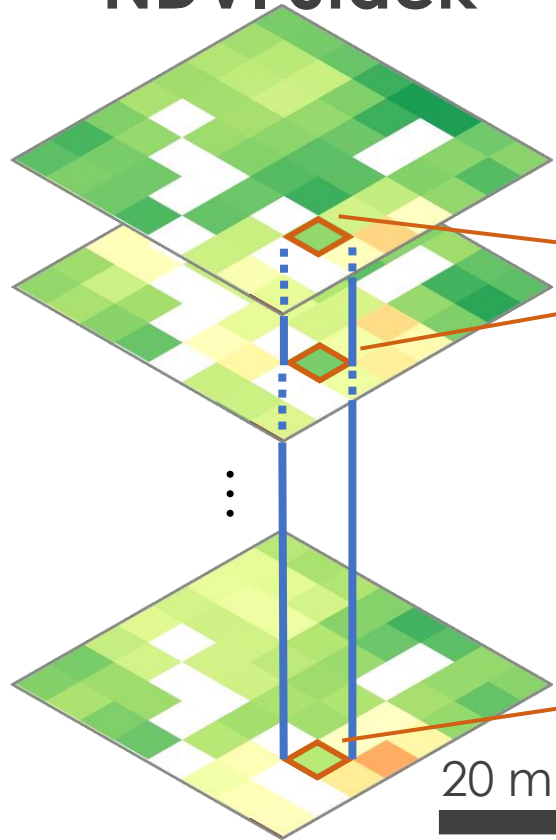
Criteria	Weight
Infestation	x 2
Past Fires	x 1
2023 Temperature	x 1
Firewood Sources	x 1

Results – Risk Assessment

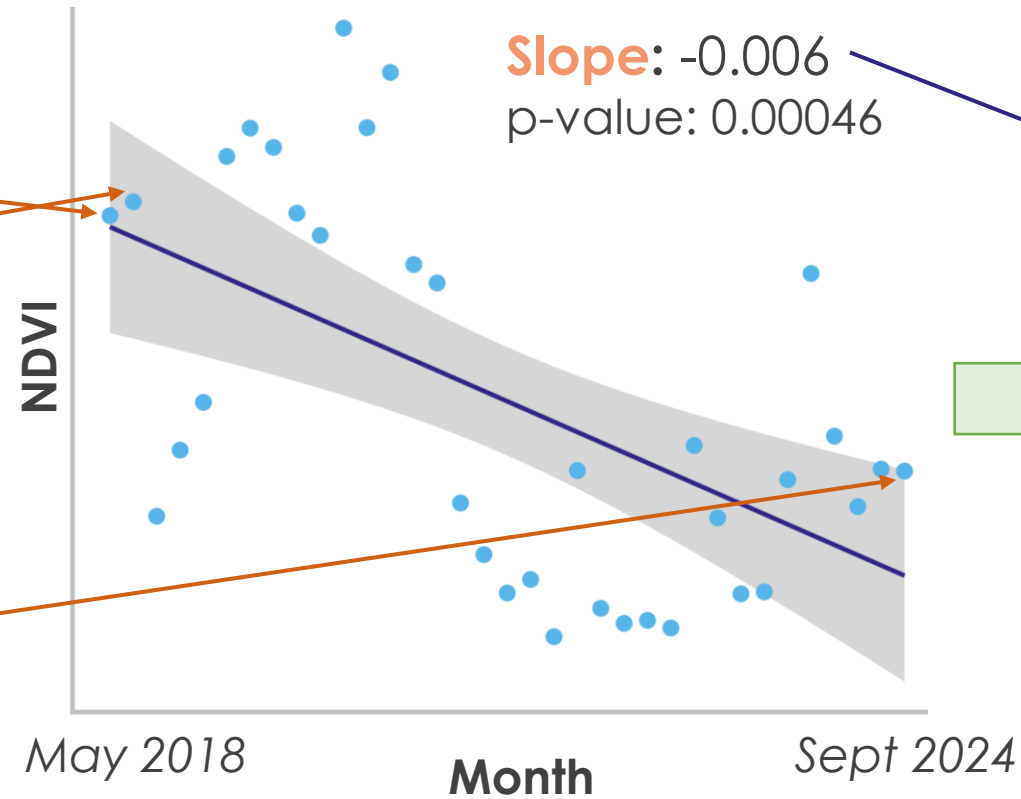


Methods – Landcover Change

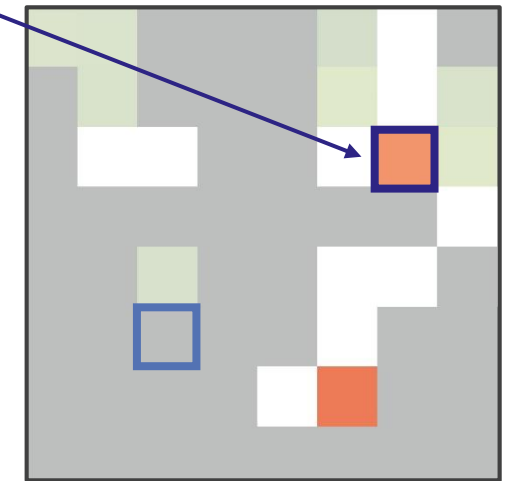
Sentinel-2 NDVI Stack



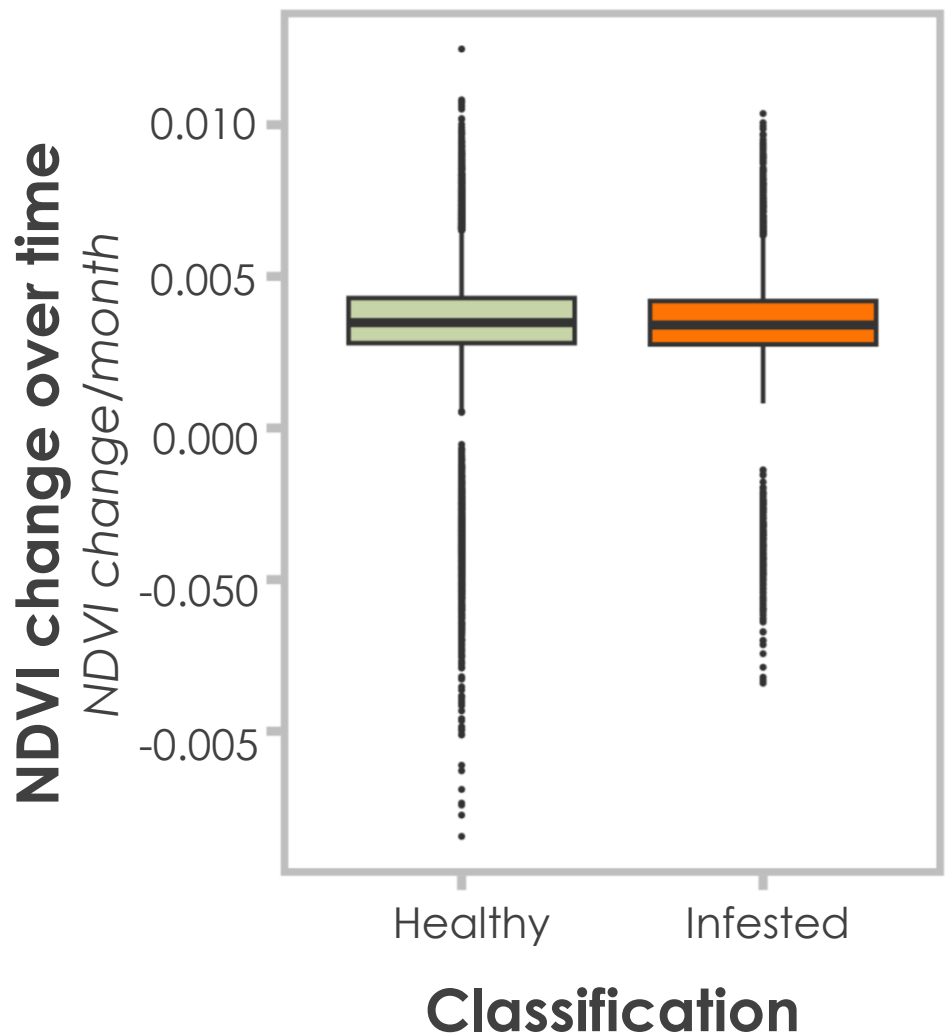
Pixel-Based Linear Regression



Slope Raster



Results – Landcover Change



10-m Sentinel-2 MSI-based NDVI does not provide enough sensitivity to track oak woodland decline as a result of GSOB infestations.

Classification	Mean Slope	% Significant Pixels
Healthy	0.003352	17.3%
Infested	0.003355	19.7%

Difference in mean slopes: not statistically significant
($p=0.93$)

Sources of Error and Uncertainty

Infested Oak Tree Classification

- Ground survey constraints
- No recent LiDAR data

Risk Assessment

- No geographic variability in infested tree points
- Weightings of inputs are not empirically determined

Landcover Change

- Coarse spatial resolution
- Multispectral imagery



Conclusions



Our Work

Demonstrate feasibility of utilizing NASA Earth observations to:

- detect infested oaks
- assess areas at risk

Illustrate limitations of landcover change analyses



Partner Capabilities

Visualize full extent of GSOB infestation in Santa Clarita Valley

Treat infested trees

Target GSOB mitigation and prevention efforts in vulnerable areas, especially in RCDSMM



Public Outreach

Inform firewood users of presence and threat of GSOB

Empower them to safely purchase and burn local firewood

Acknowledgments

Partners (End Users)

- Matthew Ribarich (Mountains Recreation and Conservation Authority)
- Rosi Dagit (Resource District of the Santa Monica Mountains)

Advisors

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- Dr. Latha Baskaran (NASA Jet Propulsion Laboratory, California Institute of Technology)
- Dr. Zoe Pierrat (NASA Jet Propulsion Laboratory, California Institute of Technology)
- Benjamin Holt (NASA Jet Propulsion Laboratory, California Institute of Technology)

Center Lead & Fellow

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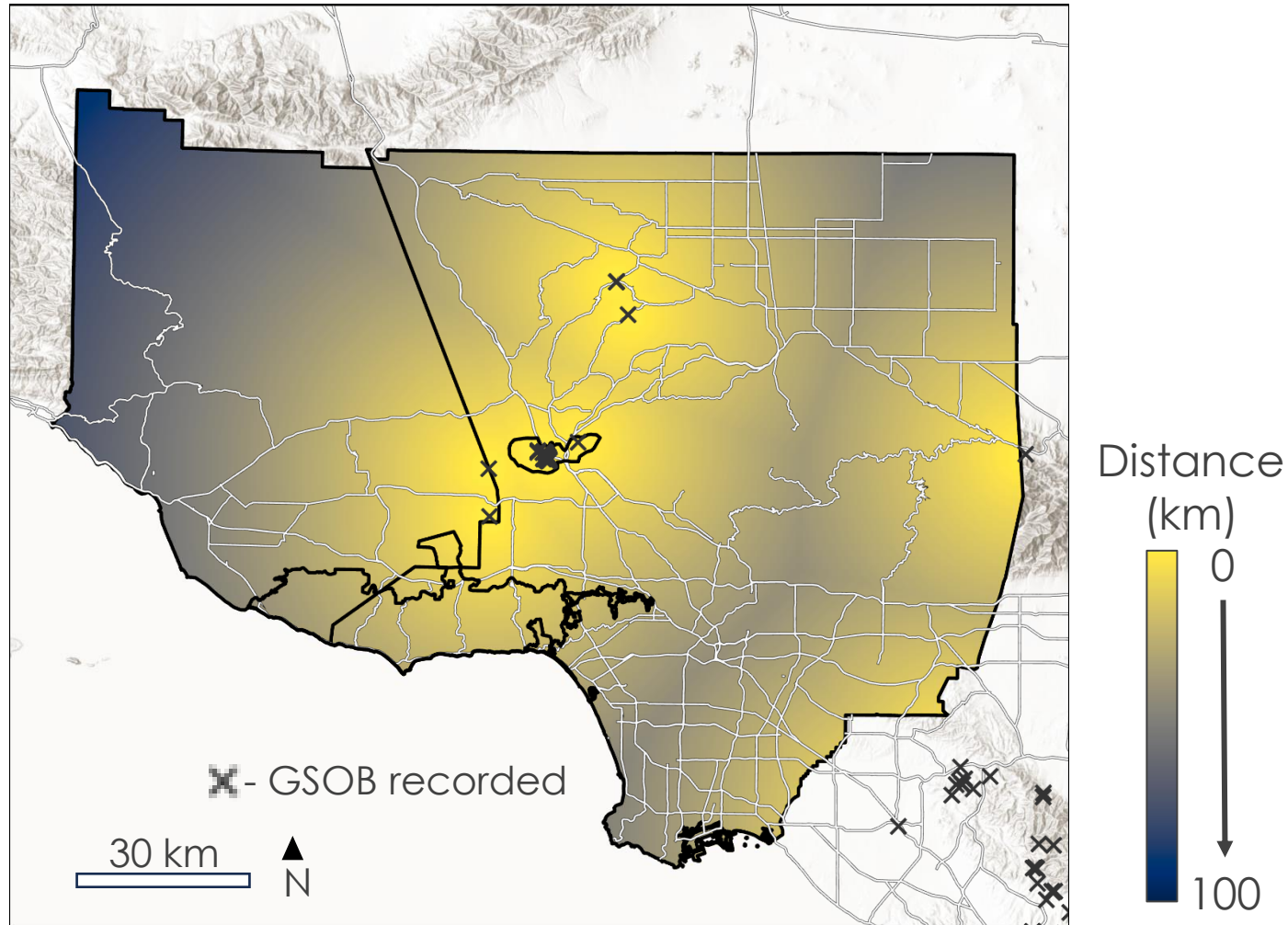
This material contains modified Copernicus Sentinel data (2018-2024), processed by ESA.

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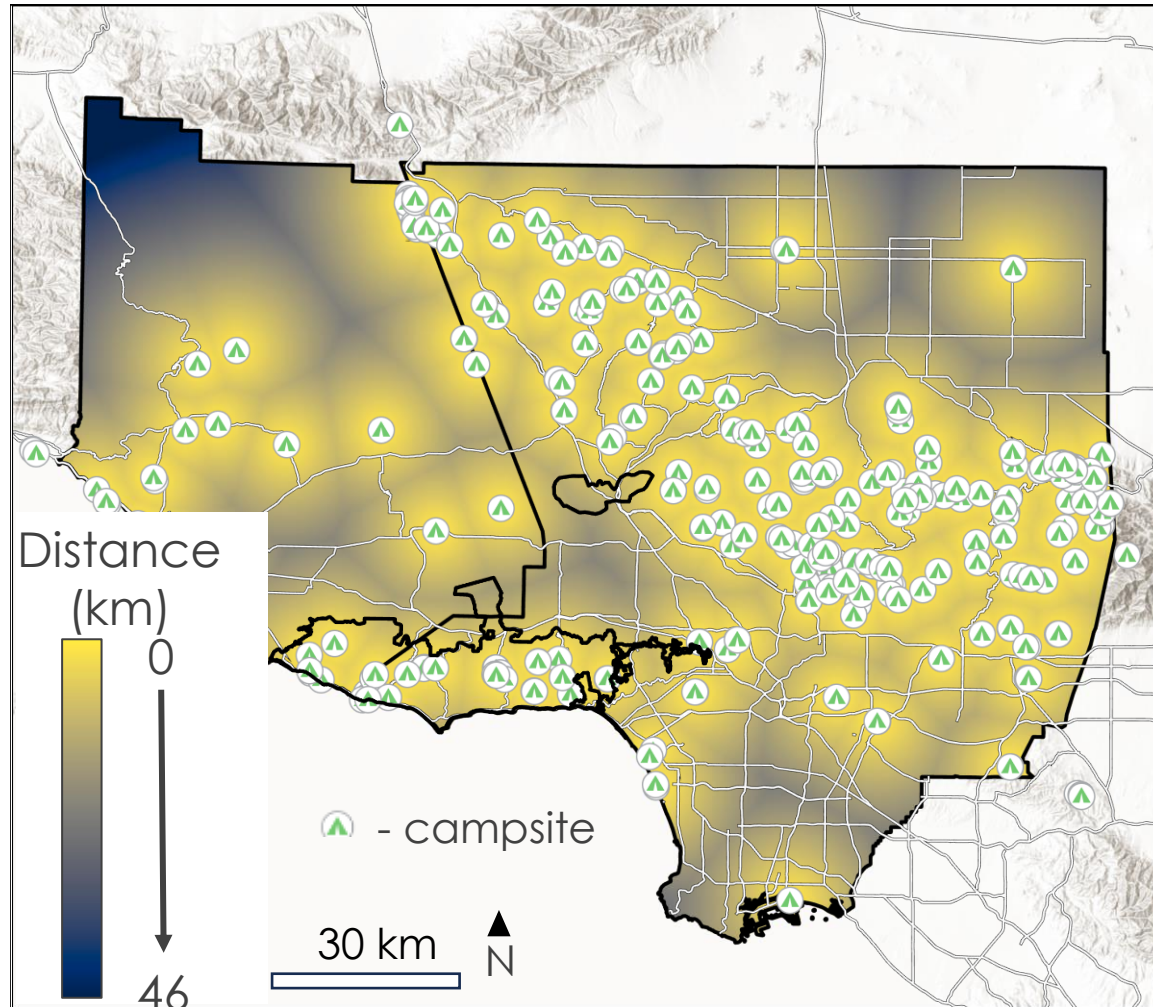
Appendix

Risk Assessment Components: Infestations

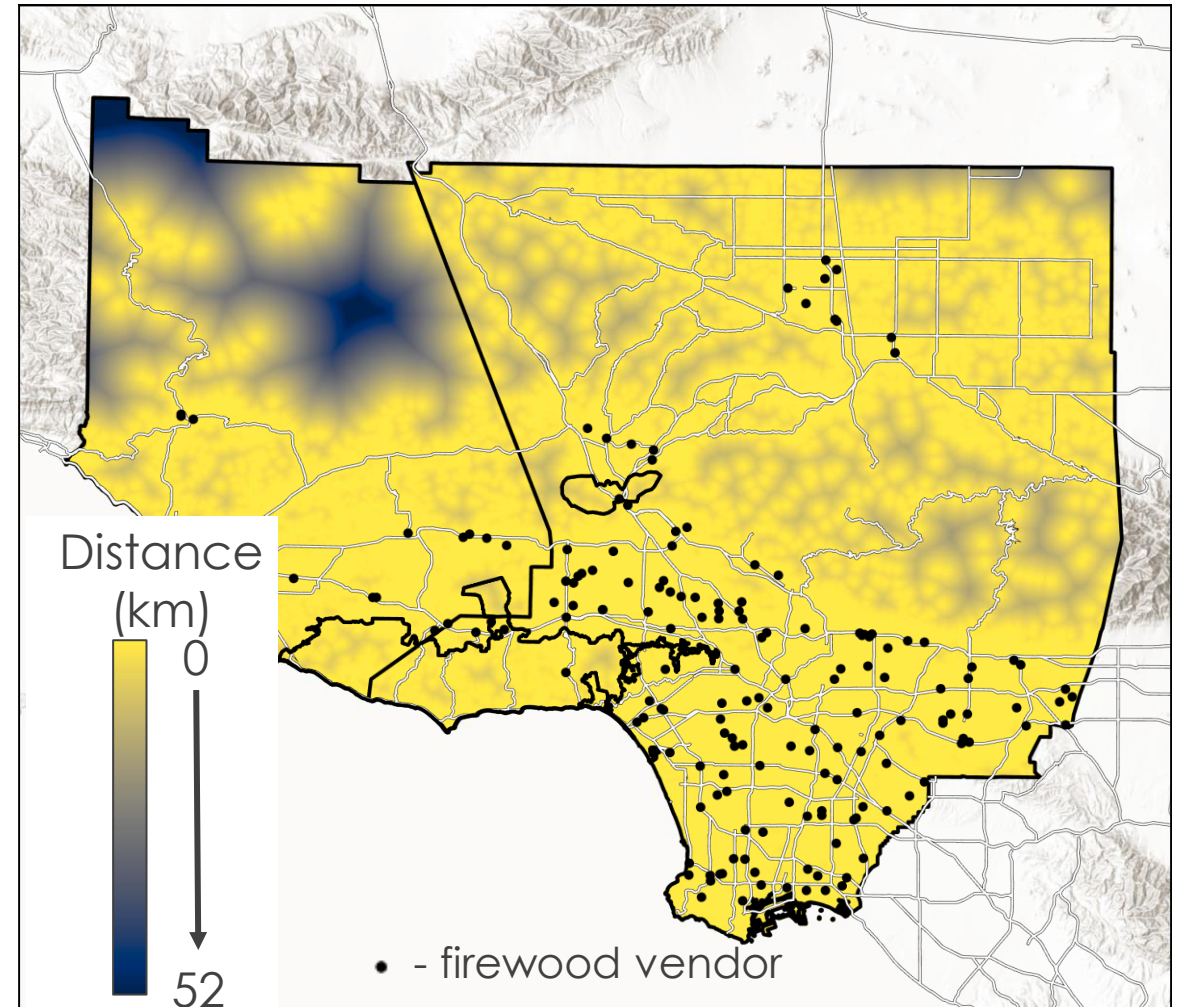


Distance to GSOB Infestations

Risk Assessment Components: Firewood

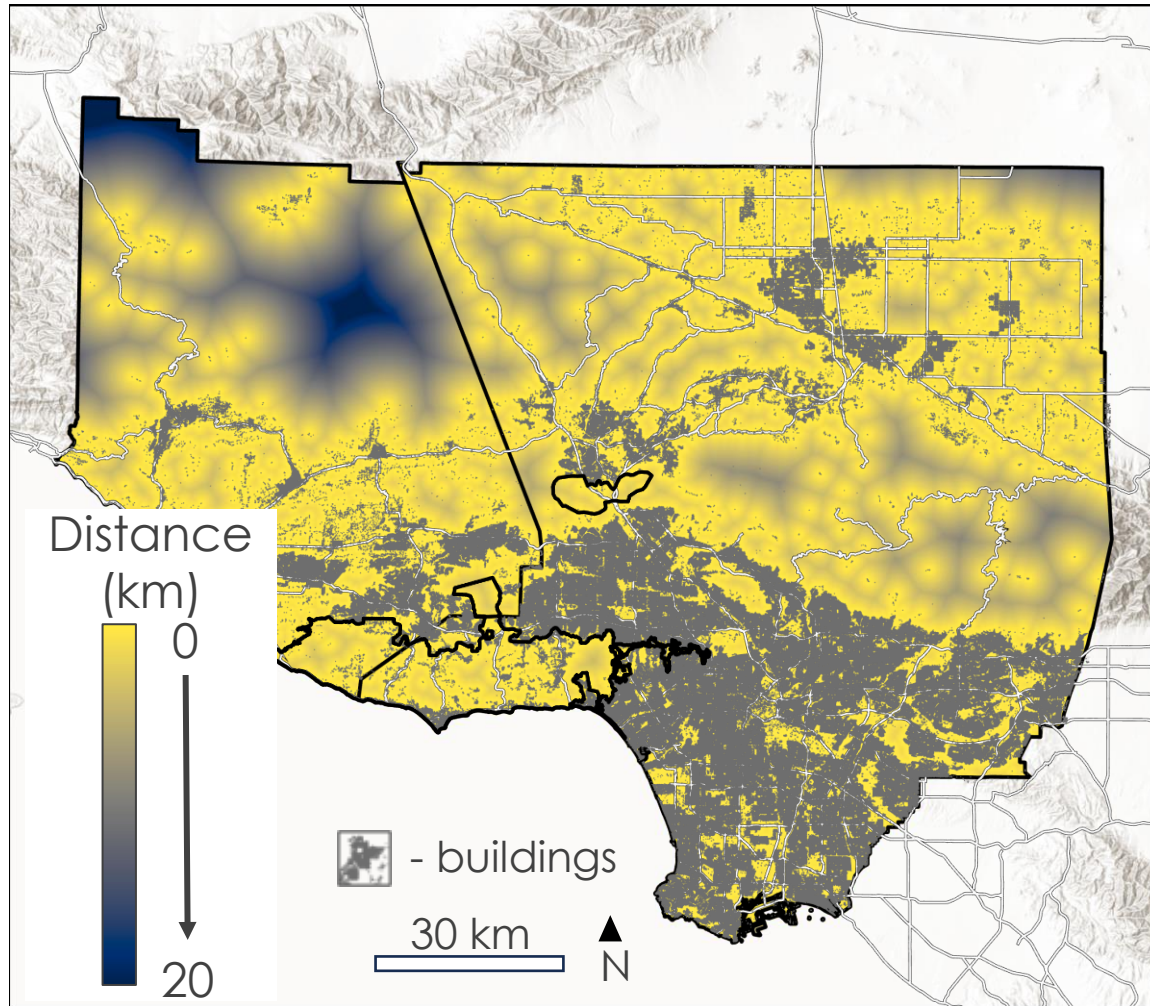


Distance to Campsites

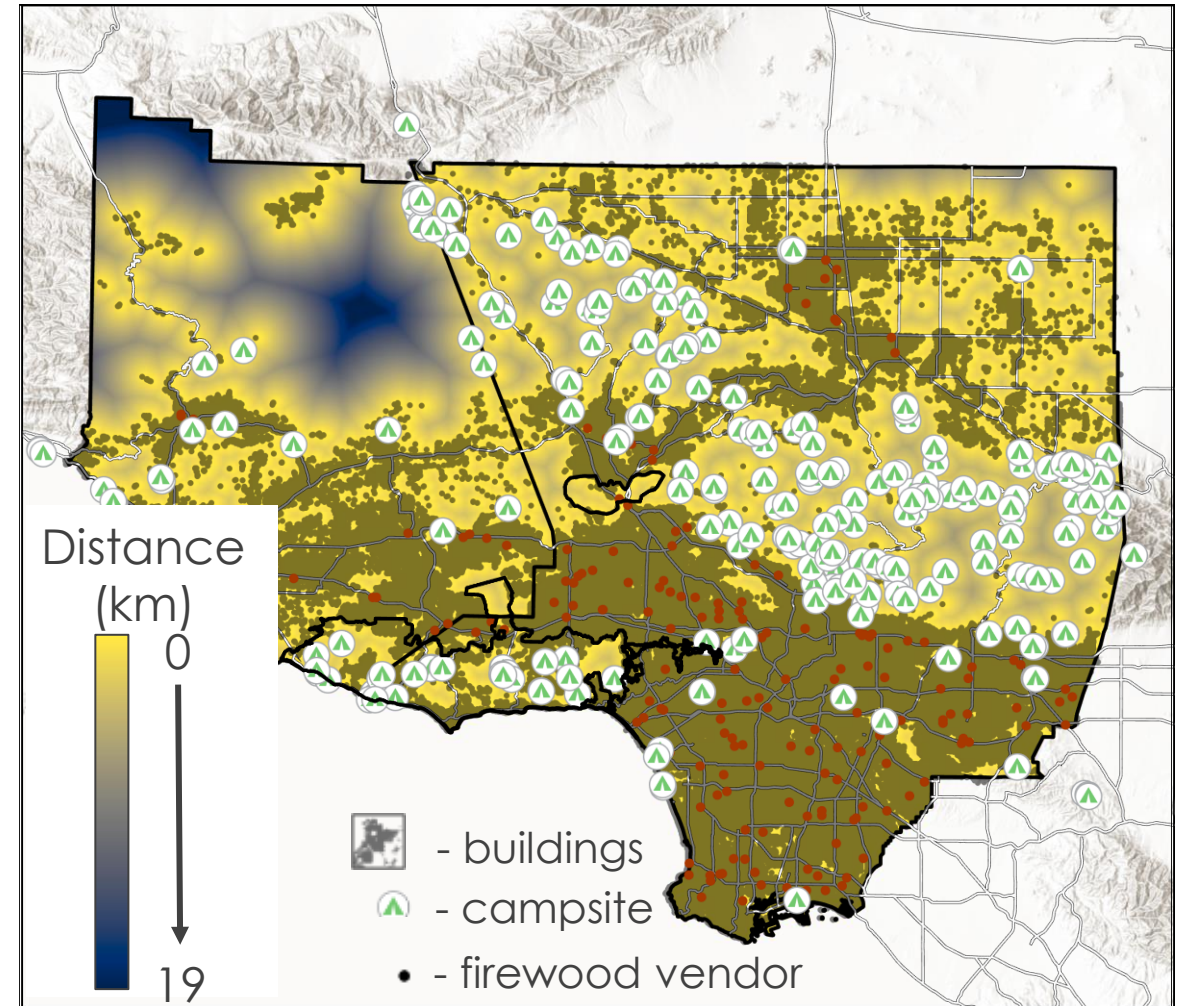


Distance to Firewood Vendors

Risk Assessment Components: Firewood

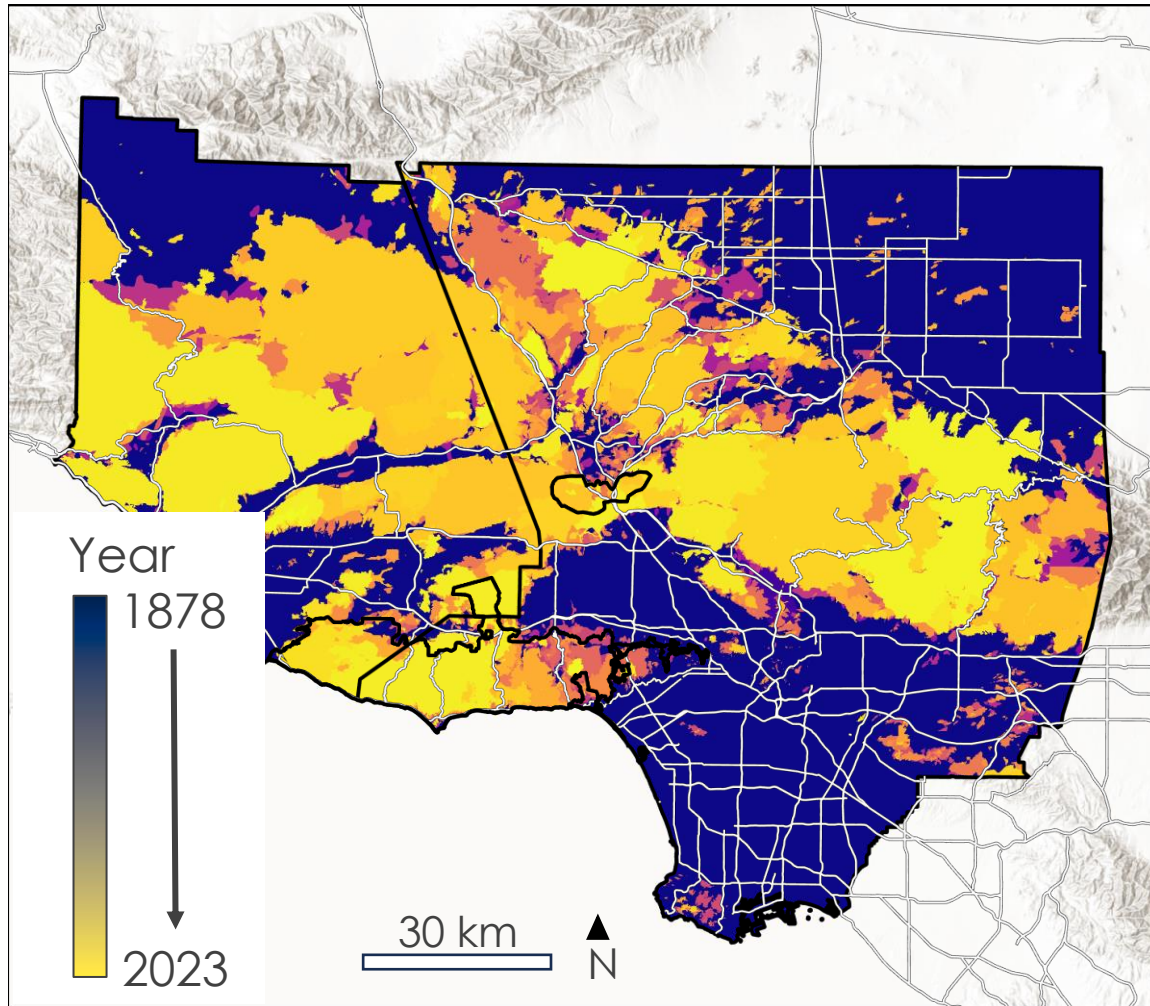


Distance to Residential Buildings

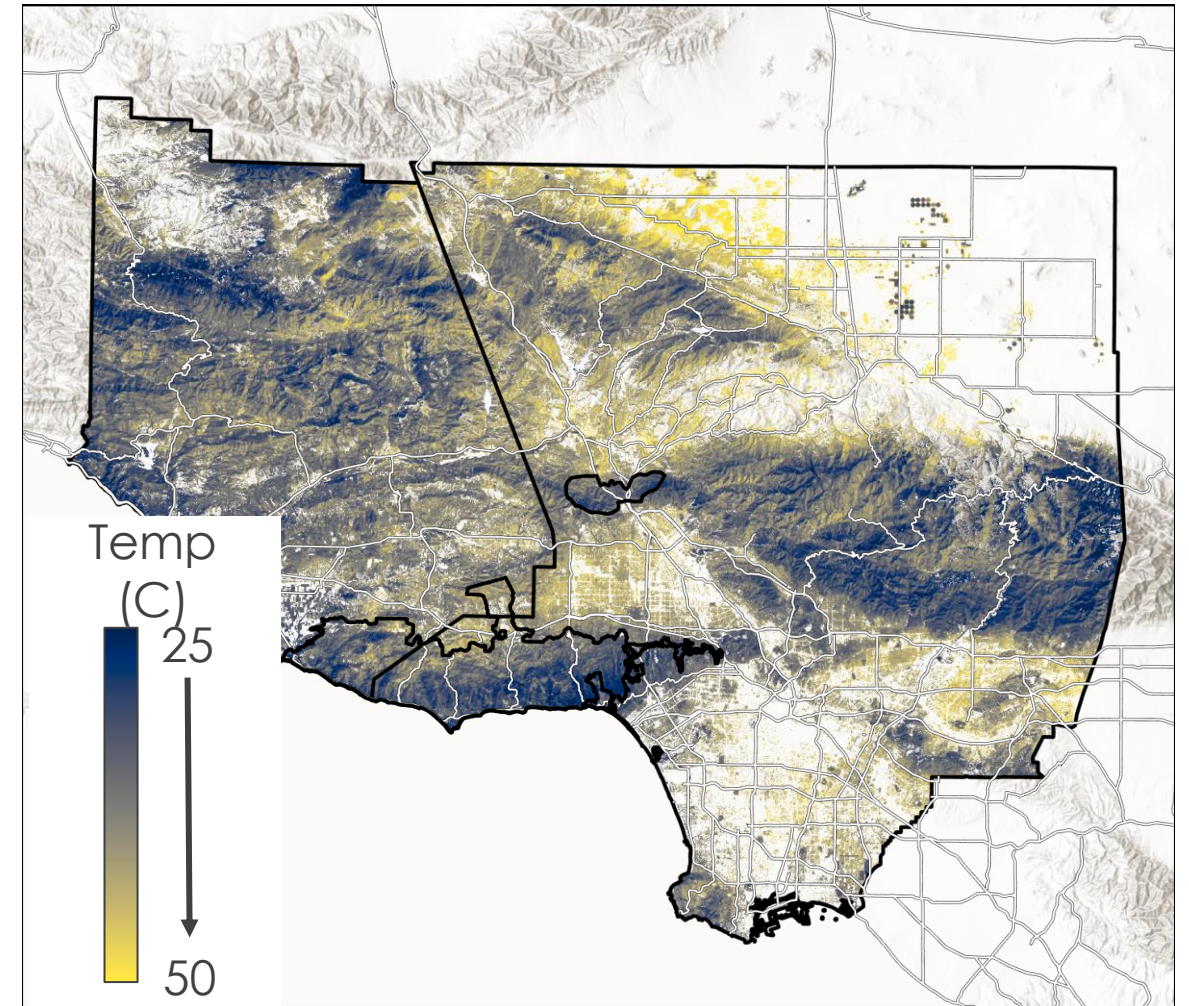


Distance to Residential Buildings, Campsites, and Firewood Vendors Combined

Risk Assessment Components: Environmental

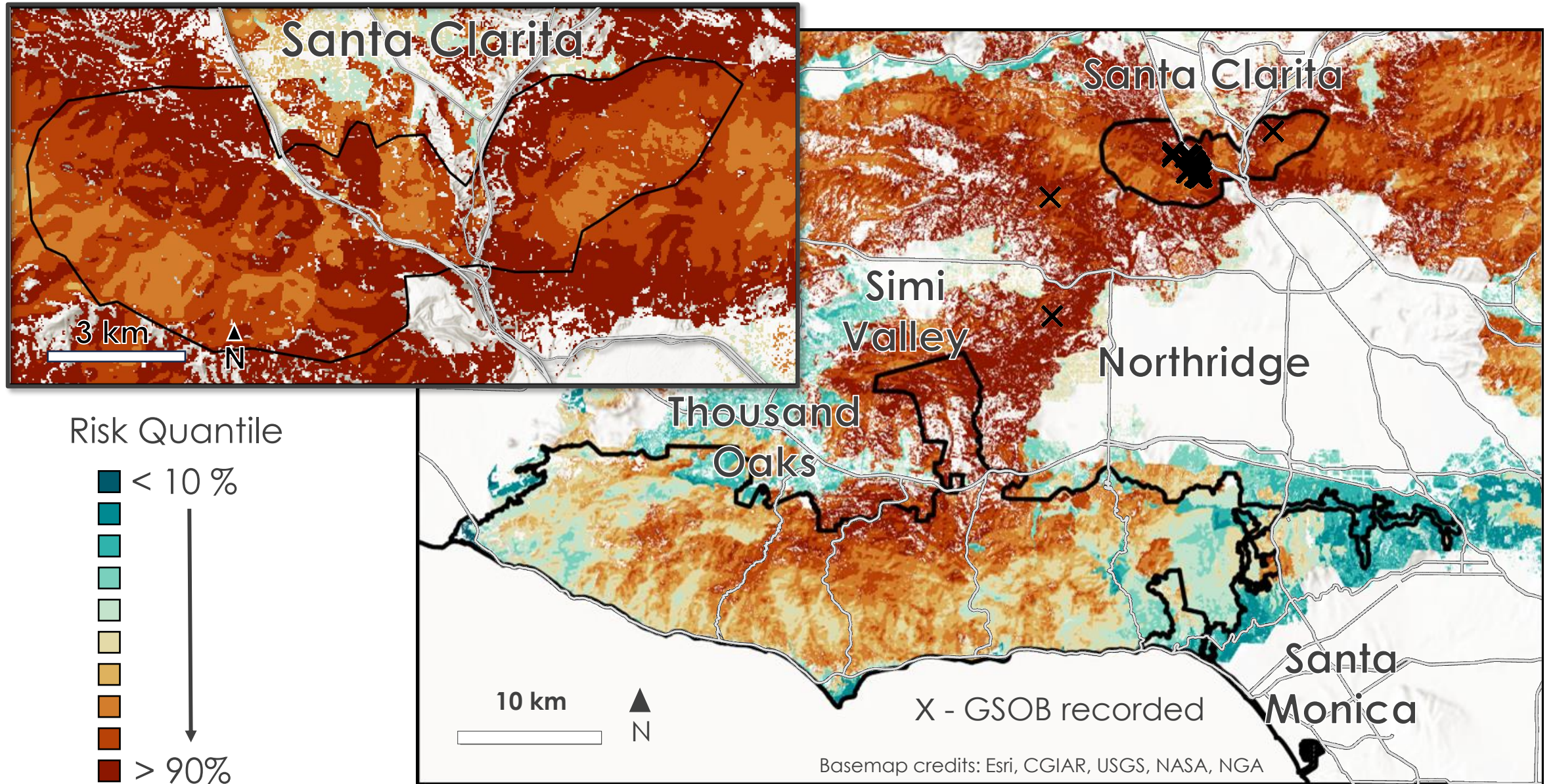


Past Fires

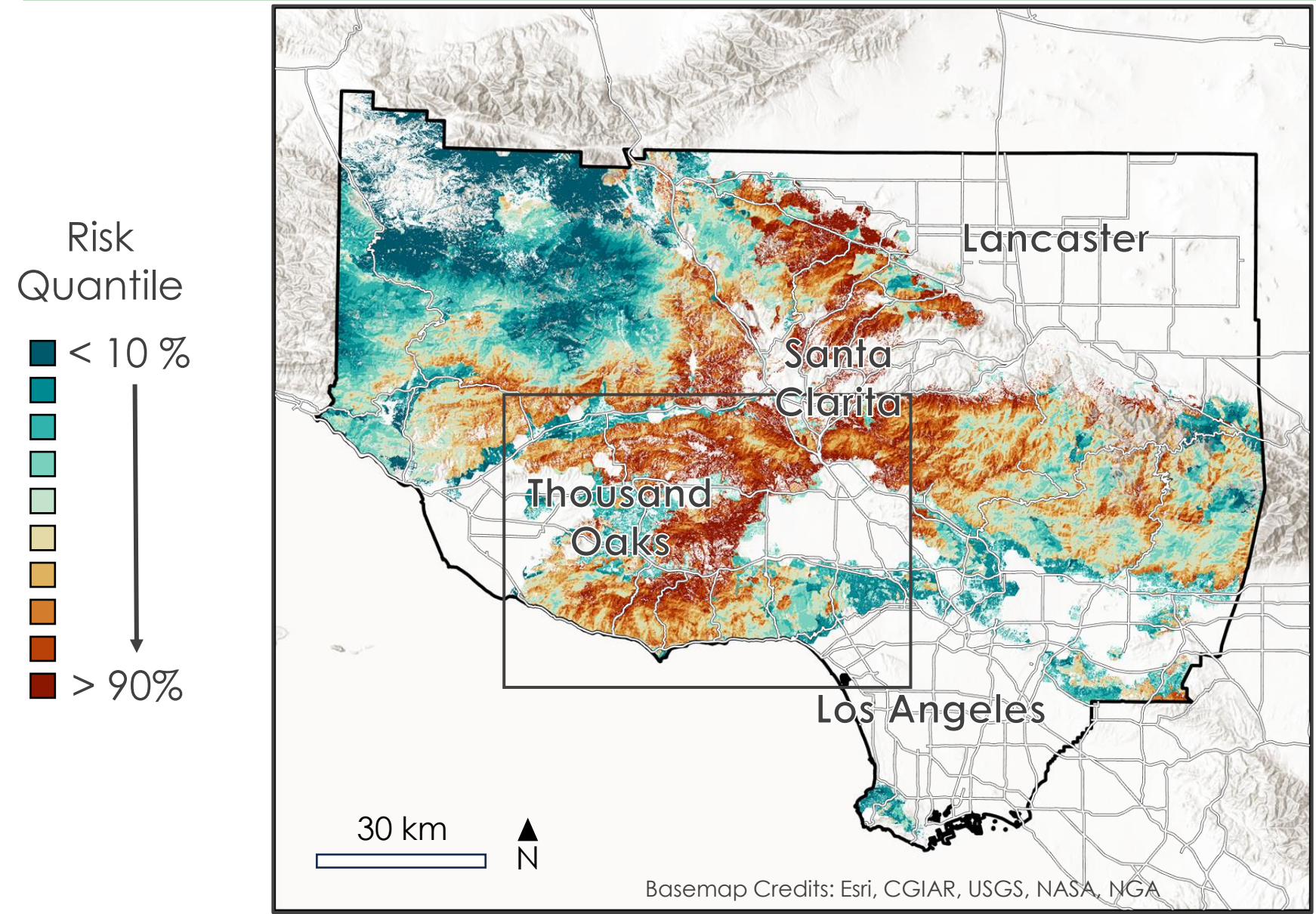


Land Temperature 2023

Results – Risk Assessment, Infestation x2

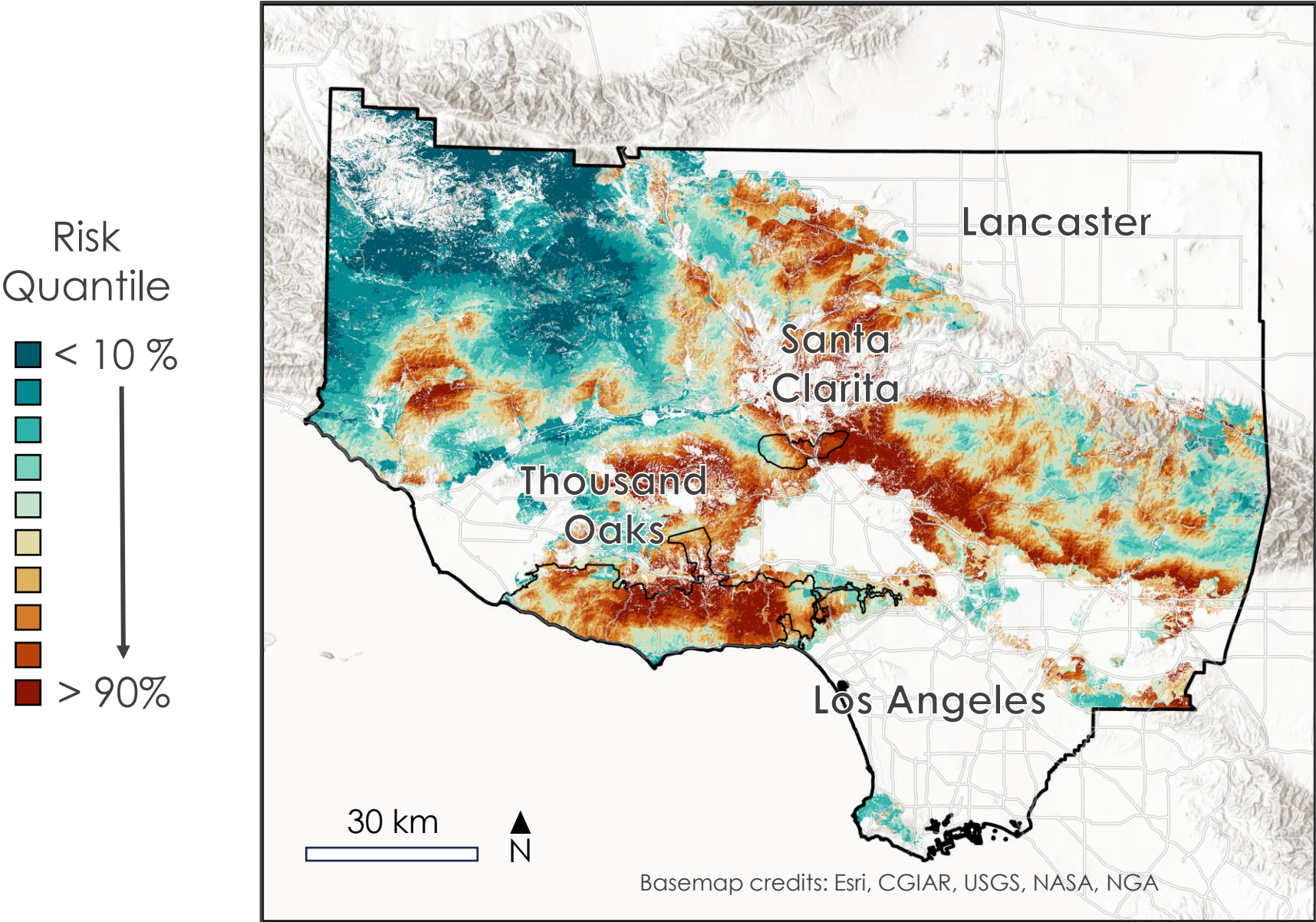


Results – Risk Assessment, Equal weights



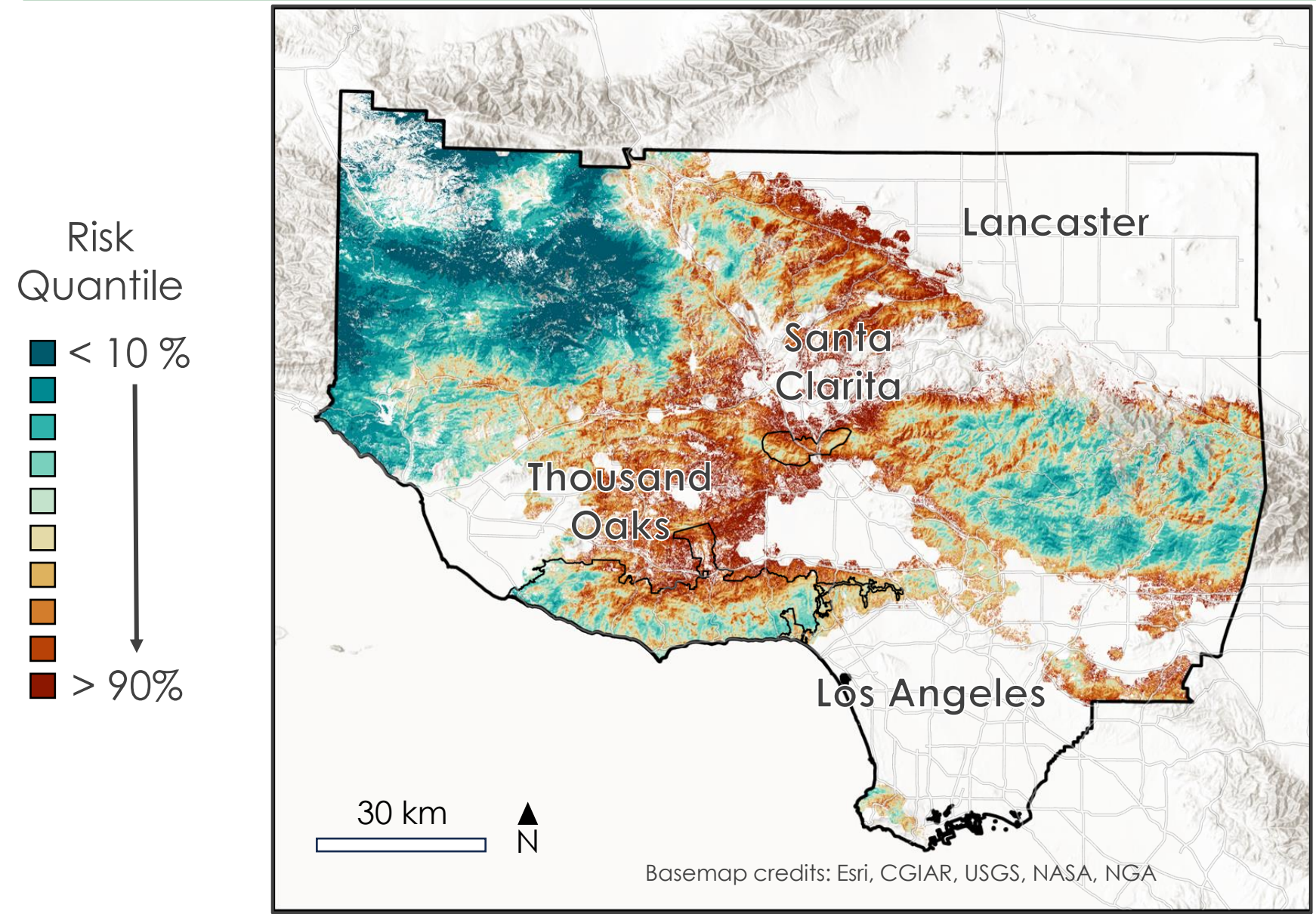
Criteria	Weight
Infestation	x 1
Past Fires	x 1
2023 Temperature	x 1
Firewood Sources	x 1

Results – Risk Assessment, Firewood sources included individually



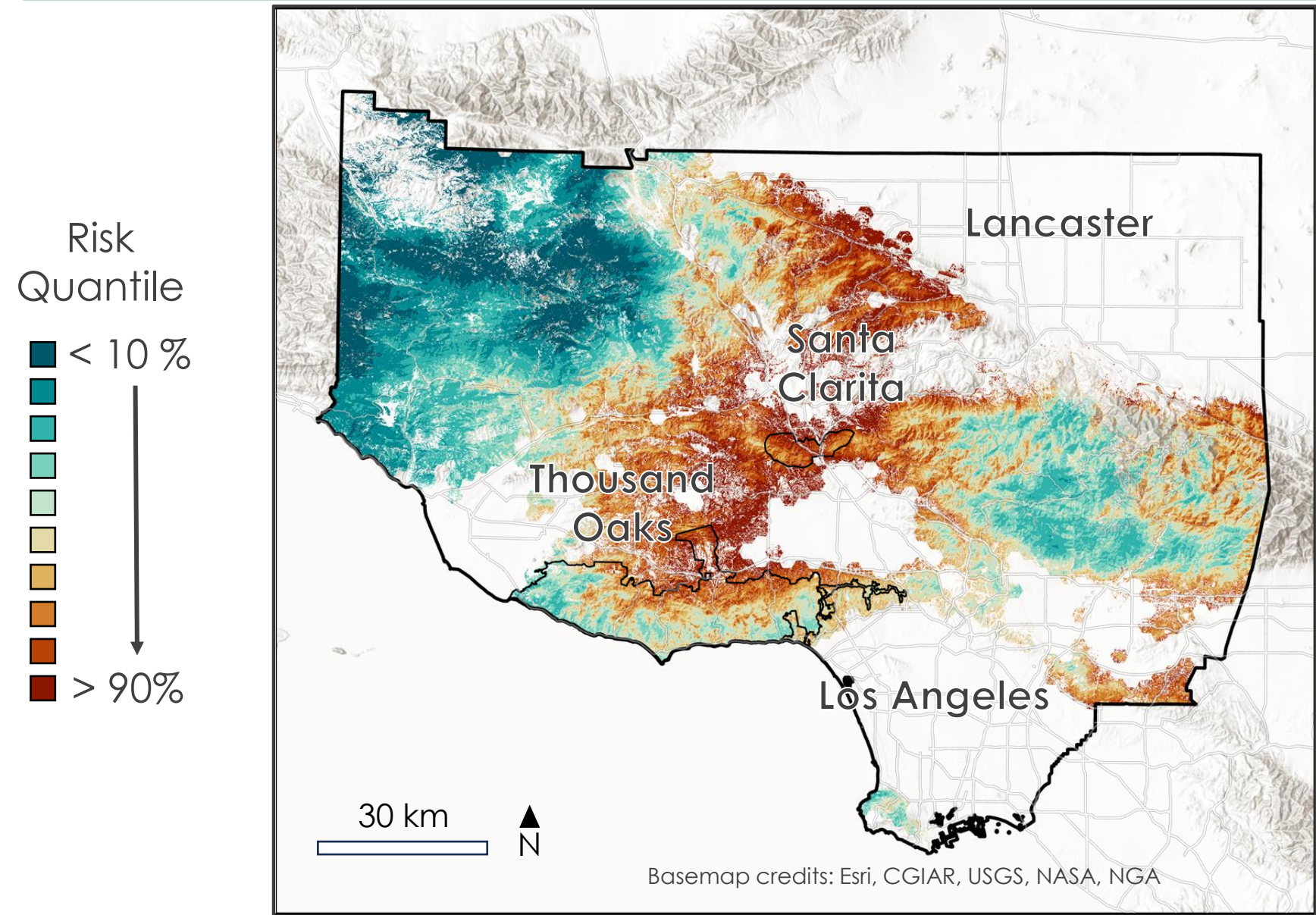
Criteria	Weight
Infestation	x 1
Past fires	x 1
2023 Temperature	x 1
Campsites	x 1
Firewood vendors	x 1
Residential Buildings	x 1

Results – Risk Assessment, Fire excluded



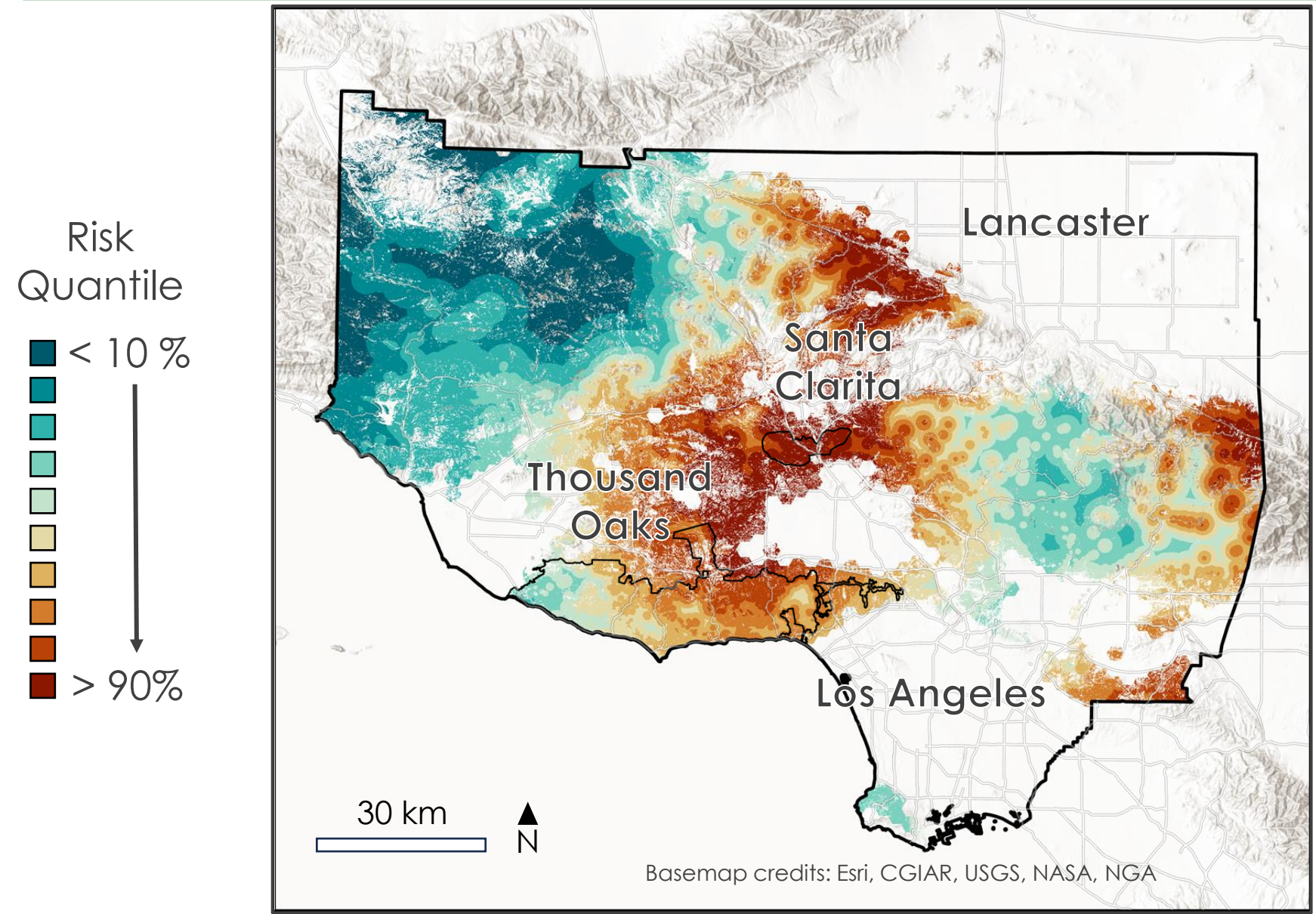
Criteria	Weight
Infestation	x 1
Past Fires	x 0
2023 Temperature	x 1
Firewood Sources	x 1

Results – Risk Assessment, Fire excluded v2



Criteria	Weight
Infestation	x 2
Past Fires	x 0
2023 Temperature	x 1
Firewood Sources	x 1

Results – Risk Assessment, Fire & Temp excluded



Criteria	Weight
Infestation	x 2
Past Fires	x 0
2023 Temperature	x 0
Firewood Sources	x 1

Results – Landcover Change

