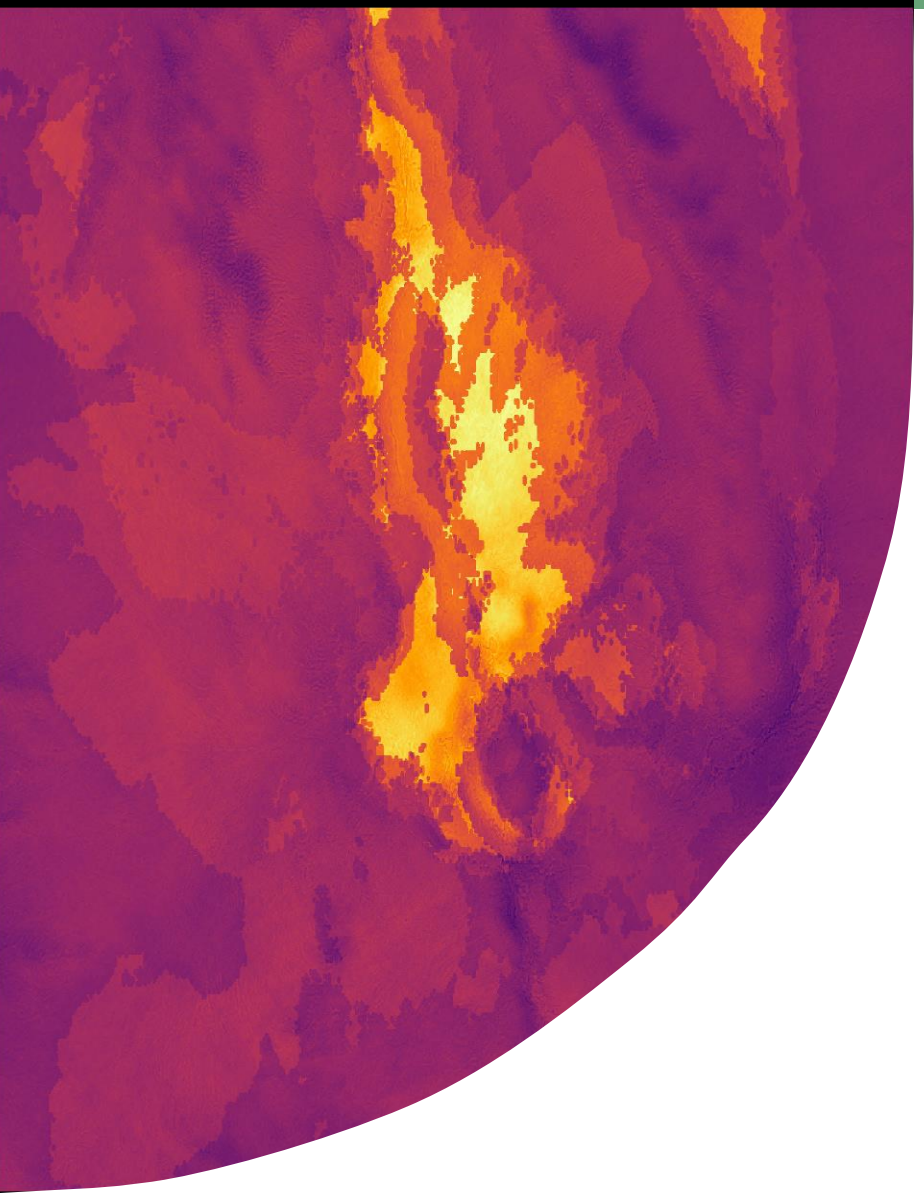
National Aeronautics and Space Administration



Amargosa Basin Ecological Conservation II

Using Earth Observations to Track Seasonal Changes in Amargosa Basin Vole Habitats to Assess Health

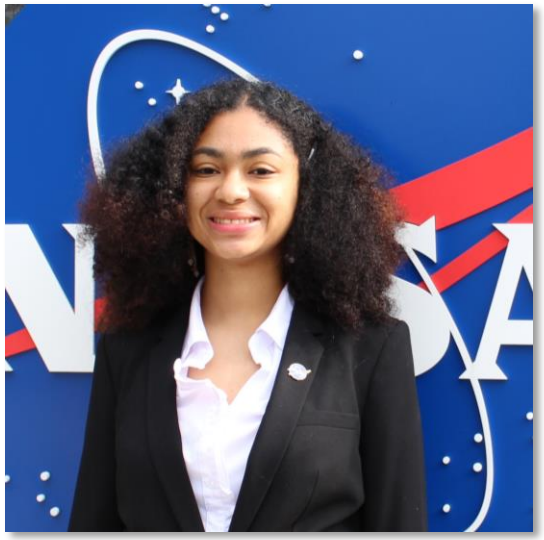
Zahar A. Chonnad, Omaia Olivas,
Clelia Davis Del Piccolo, & Paige Rohwer
(Analytical Mechanics Associates)

California – JPL | Summer 2025

Meet the Team

Zahar
A. Chonnad

Clelia Davis
Del Piccolo



Omaia Olivas

Paige Rohwer

Amargosa River Basin

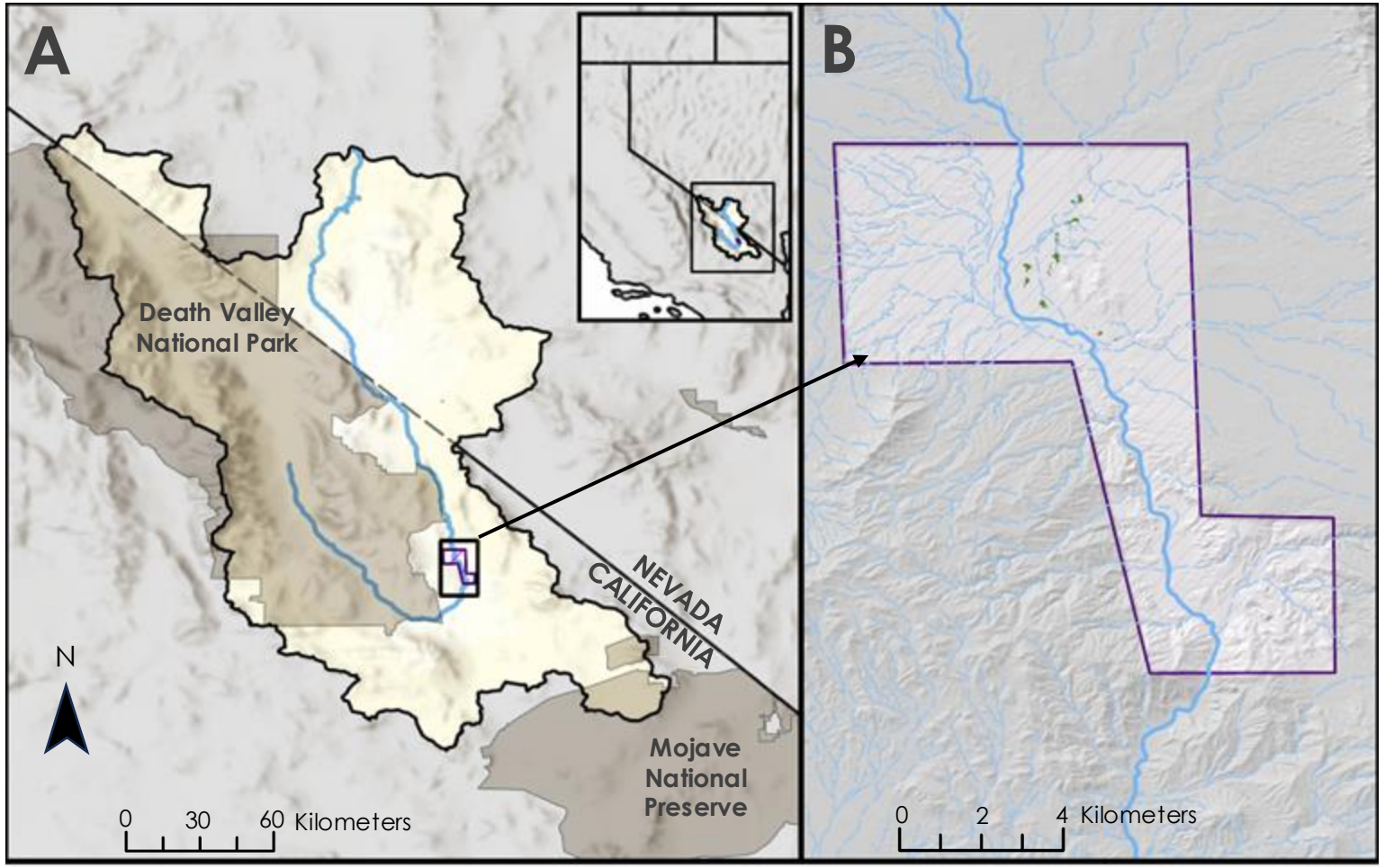
- Between Death Valley and the Mojave Desert
- Water from geothermal springs and Amargosa River
- Fragmented wetland marsh


Image Credit: Clelia Davis Del Piccolo


Image Credit: Austin Roy

- Olney's three-square bulrush
- Habitat for endangered Amargosa vole (*Microtus californicus scirpensis*)
- Bulrush dependent on Standing Water Extent (SWE)

Amargosa River Basin



Ephemeral Streams

Amargosa River

Amargosa Basin

Vole Area of Interest

National Park Boundaries

Bulrush Habitat

Map A: Amargosa Basin

Map B: Vole Habitat Extent

ESRI, USGS, U.S. Census Bureau, NASA, FEMA

Partners & Community Concerns

This project partners with:

- Friends of the Amargosa Basin
- California Department of Fish and Wildlife
- US Fish and Wildlife Service (Southern Nevada Fish and Wildlife Office, Partners for Fish and Wildlife Program)
- Timbisha Shoshone Tribe

Image Credit: Caroline Baumann

Advocating for **national monument status** to conserve, protect and restore the region.

Project Objectives

Use **Earth observations** to:

- **Map** standing water extent and land surface temperature in area of interest
- **Identify** environmental factors that contribute to good habitats for voles
- **Analyze** seasonal and long-term changes in habitat extent
- **Provide** partners with data to aid in conservation decisions

Study Period: 2014 – 2024

2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024

Time Series of Standing Water

Time Series of Land Surface Temperature

Image Credit: BLM/ Don Preisler

2024 Standing Water Maps

2024 Land Surface Temperature Maps

Earth Observations

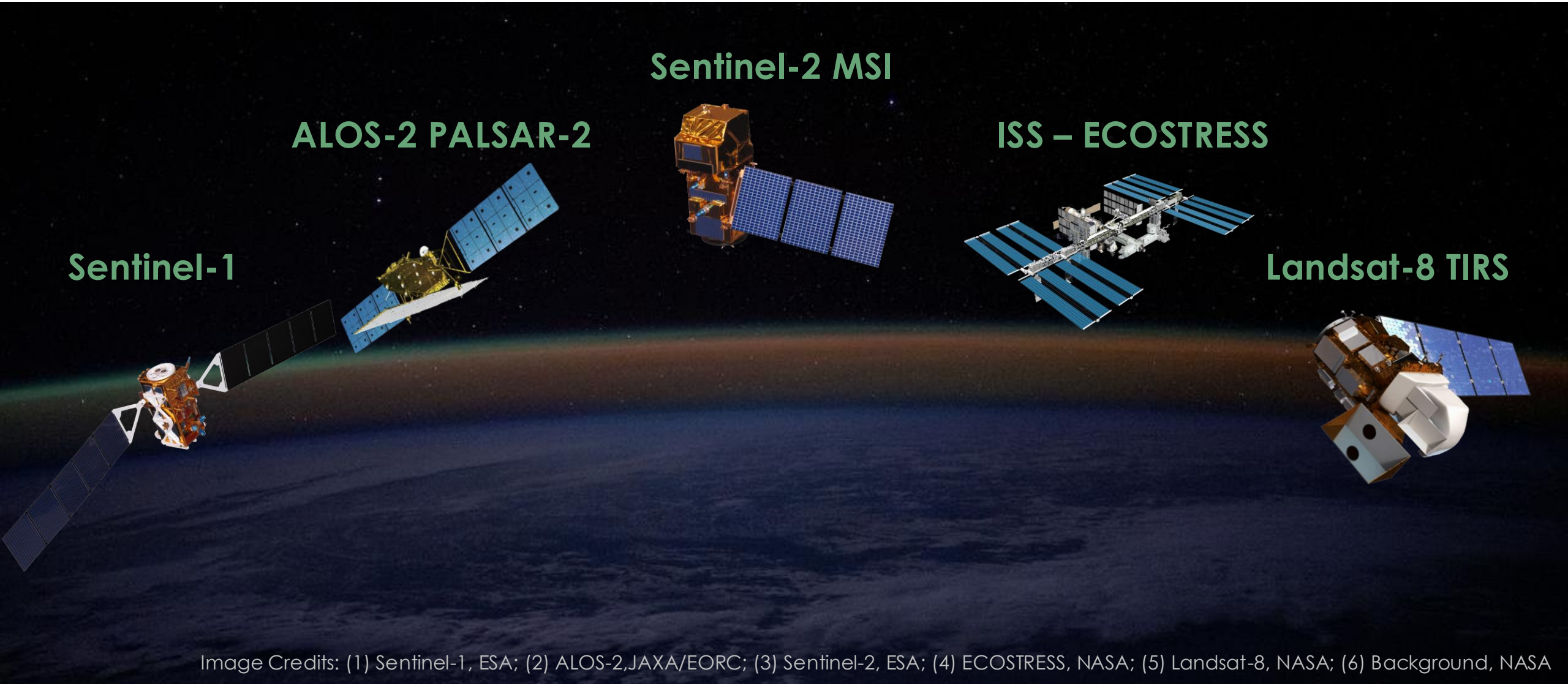


Image Credits: (1) Sentinel-1, ESA; (2) ALOS-2,JAXA/EORC; (3) Sentinel-2, ESA; (4) ECOSTRESS, NASA; (5) Landsat-8, NASA; (6) Background, NASA

Methodology

Earth Observation	Method	End Product
Landsat 8 TIRS	Mean Seasonal & Monthly Composites	Hot Spot Analysis Map (2024)
ISS ECOSTRESS	Mean Monthly Composites	Surface Temperature Time Series (2014 – 2024)
Sentinel-2 MSI	Normalized Difference Vegetation Index (NDVI)	NDVI and Temperature Comparative Analysis
Sentinel-1 C- Band SAR	Dual Polarization Ratio Threshold	Inundated Vegetation Map (2024)
ALOS-2 PALSAR-2 L-Band SAR	Dual Polarization Ratio Threshold	Standing Water Time Series (2015 – 2023)

SAR Detection of Water and Inundated Vegetation

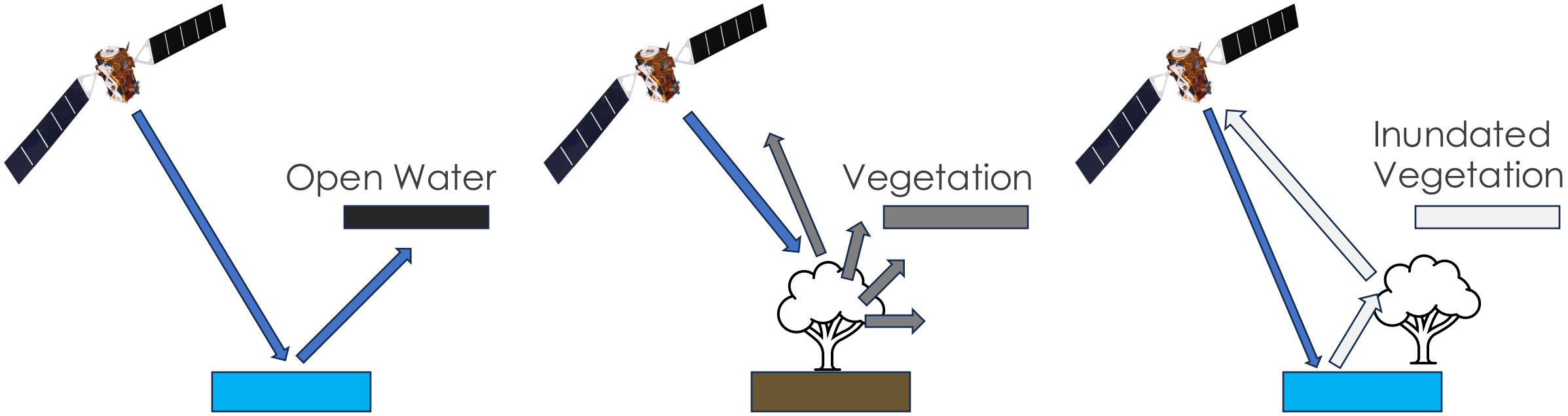
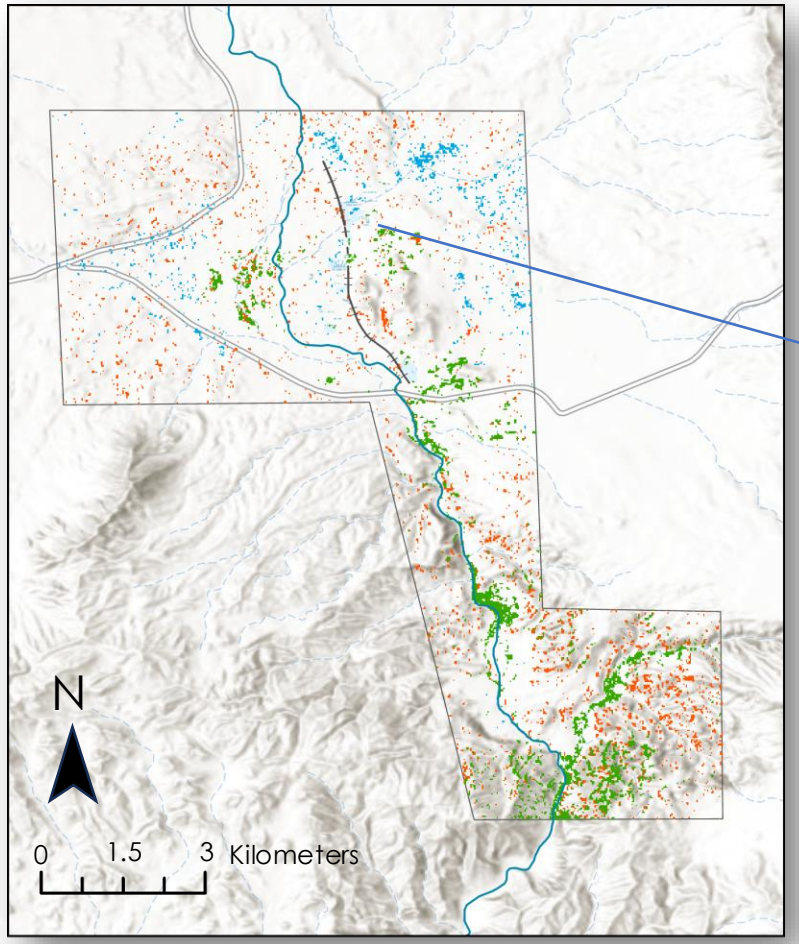


Image Credits: Sentinel-1, ESA

PALSAR Time Series 2015 – 2023

Limitations

- Temporal resolution
- Spatial resolution
- Slope
- Thresholding uncertainties



2023 Land Cover Classification

Ephemeral Streams

Amargosa River

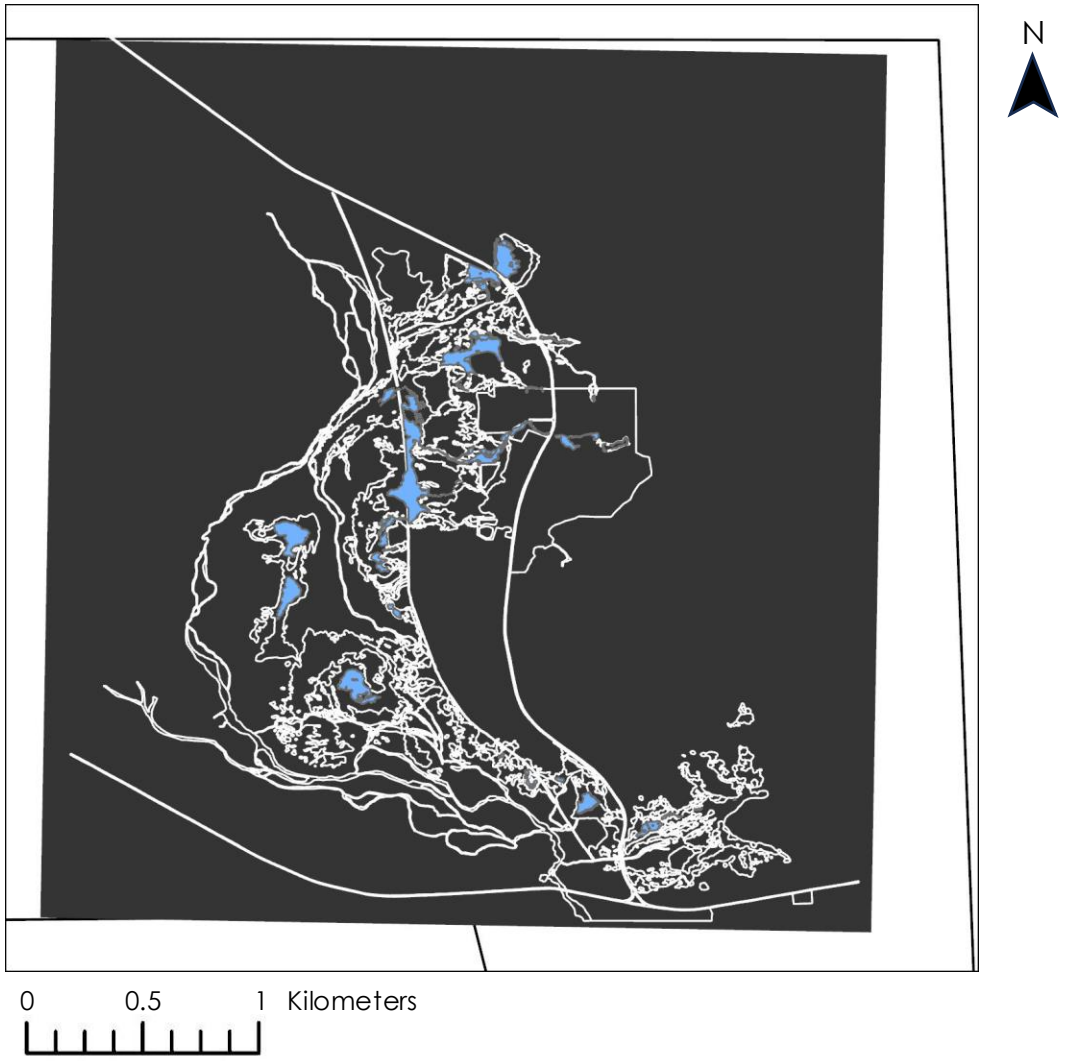
Surface Water Extent

Vegetation

Inundated Vegetation

Borehole Spring

Sentinel-1 – Sampling Points to Determine SWE

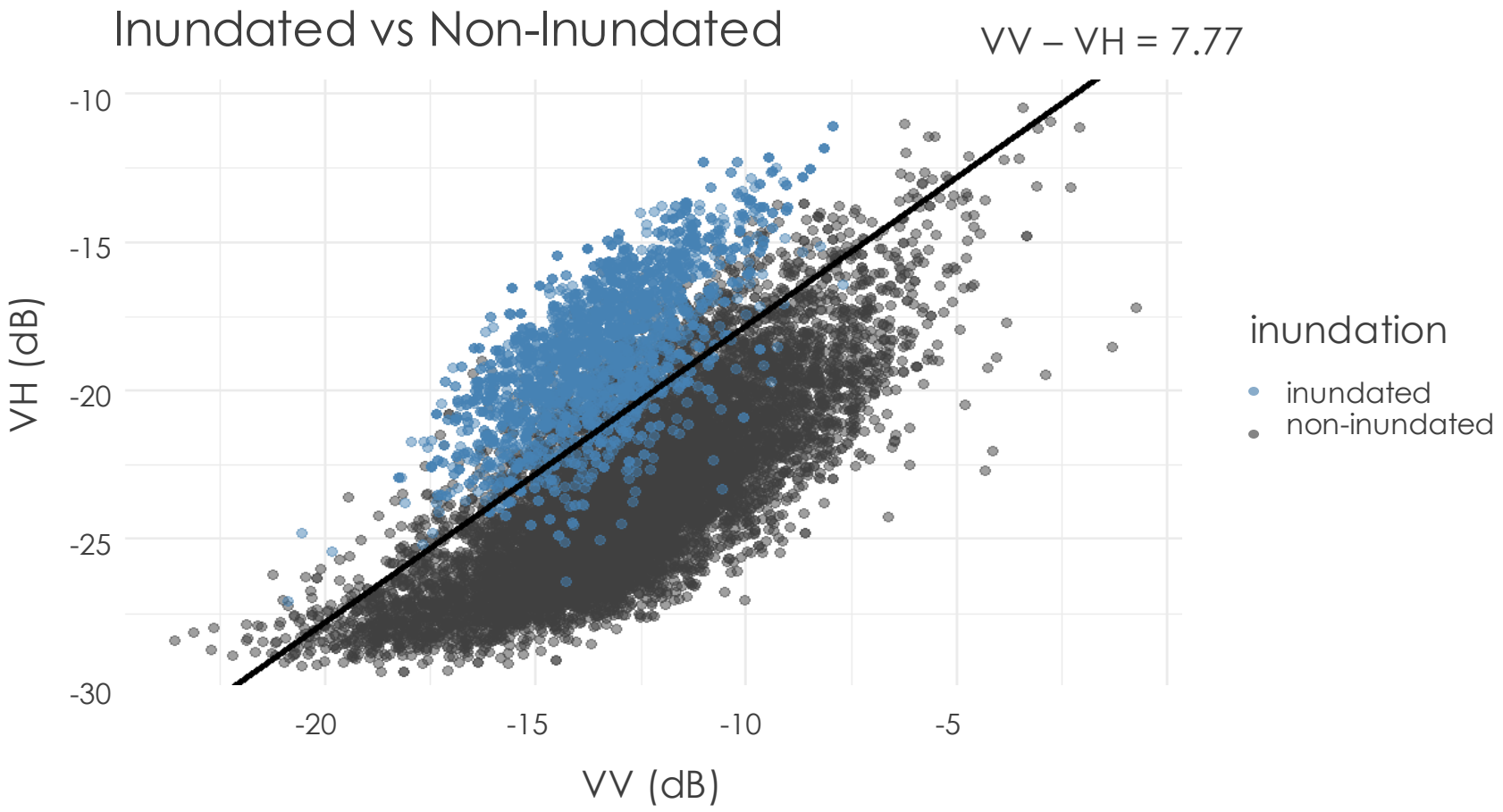


Non-inundated

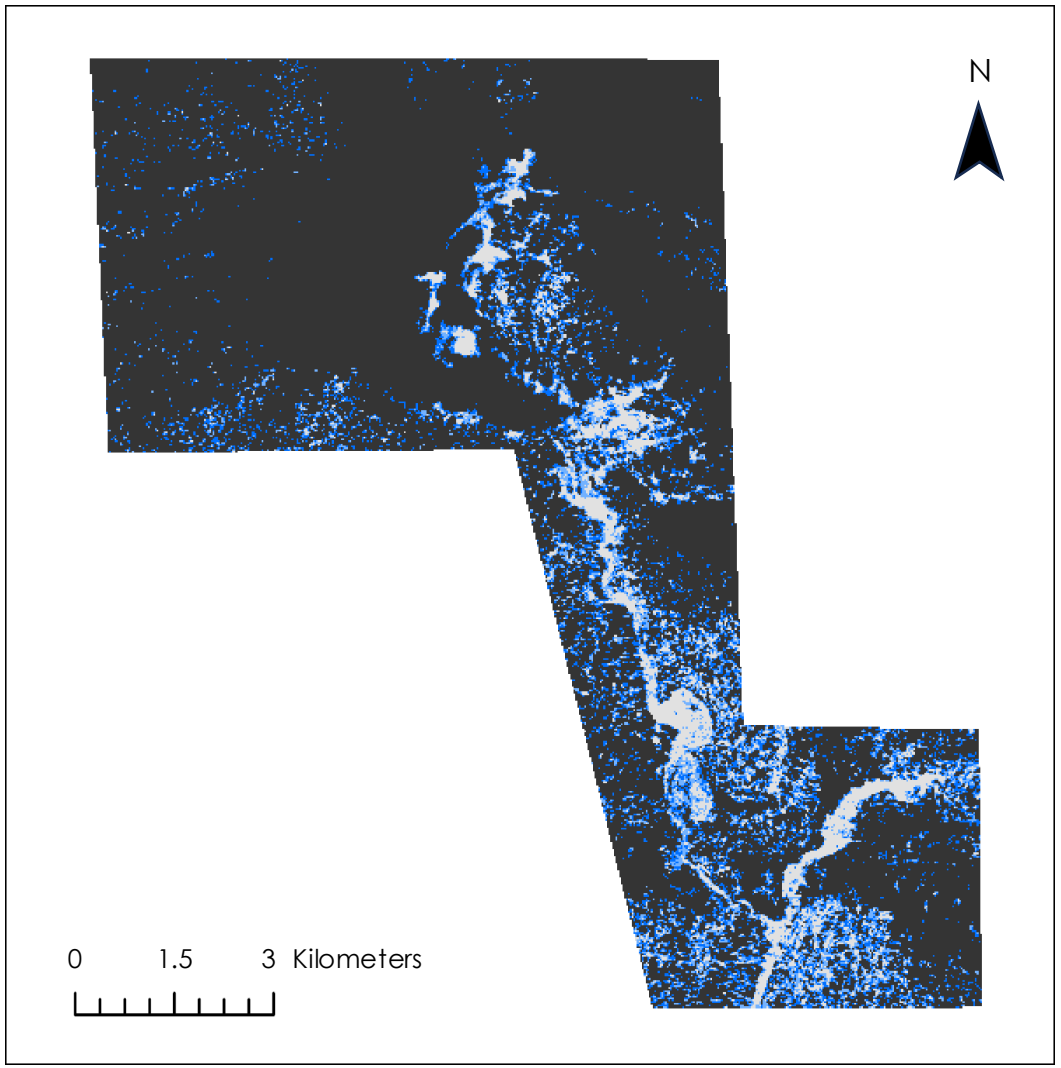
Inundated

Vegetation and Structures

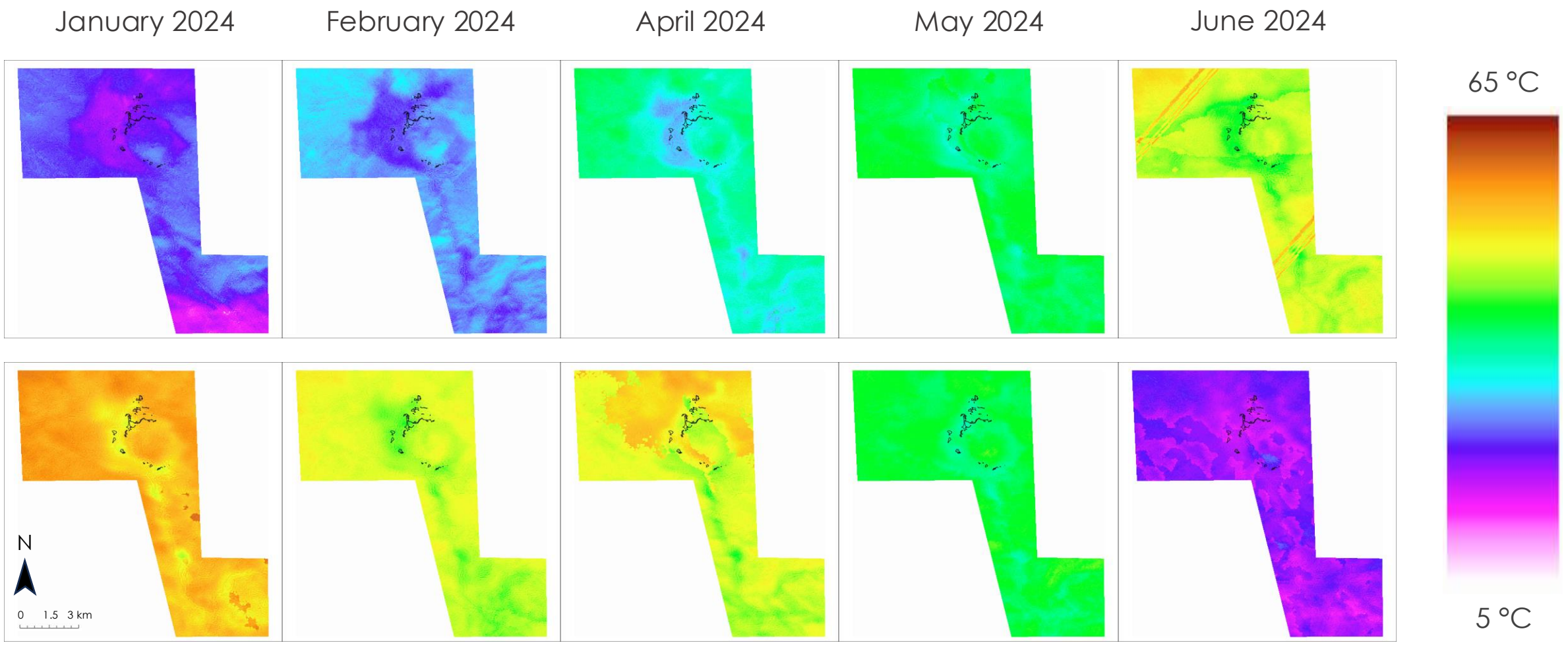
Sentinel-1 – Determining Inundation Threshold



Sentinel-1 – 2024 Inundated Vegetation Extent

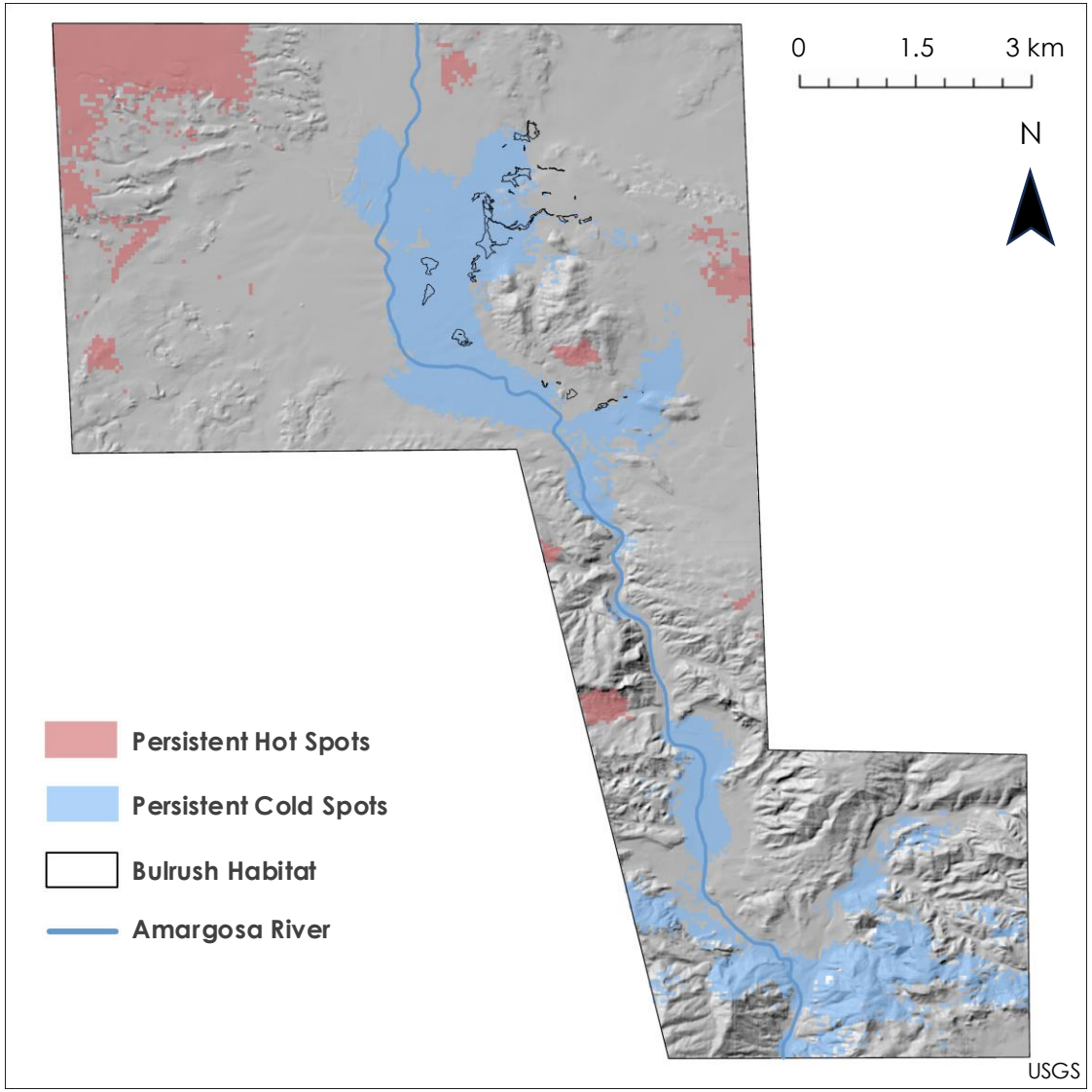


ECO – 2024 Land Surface Temperature Map



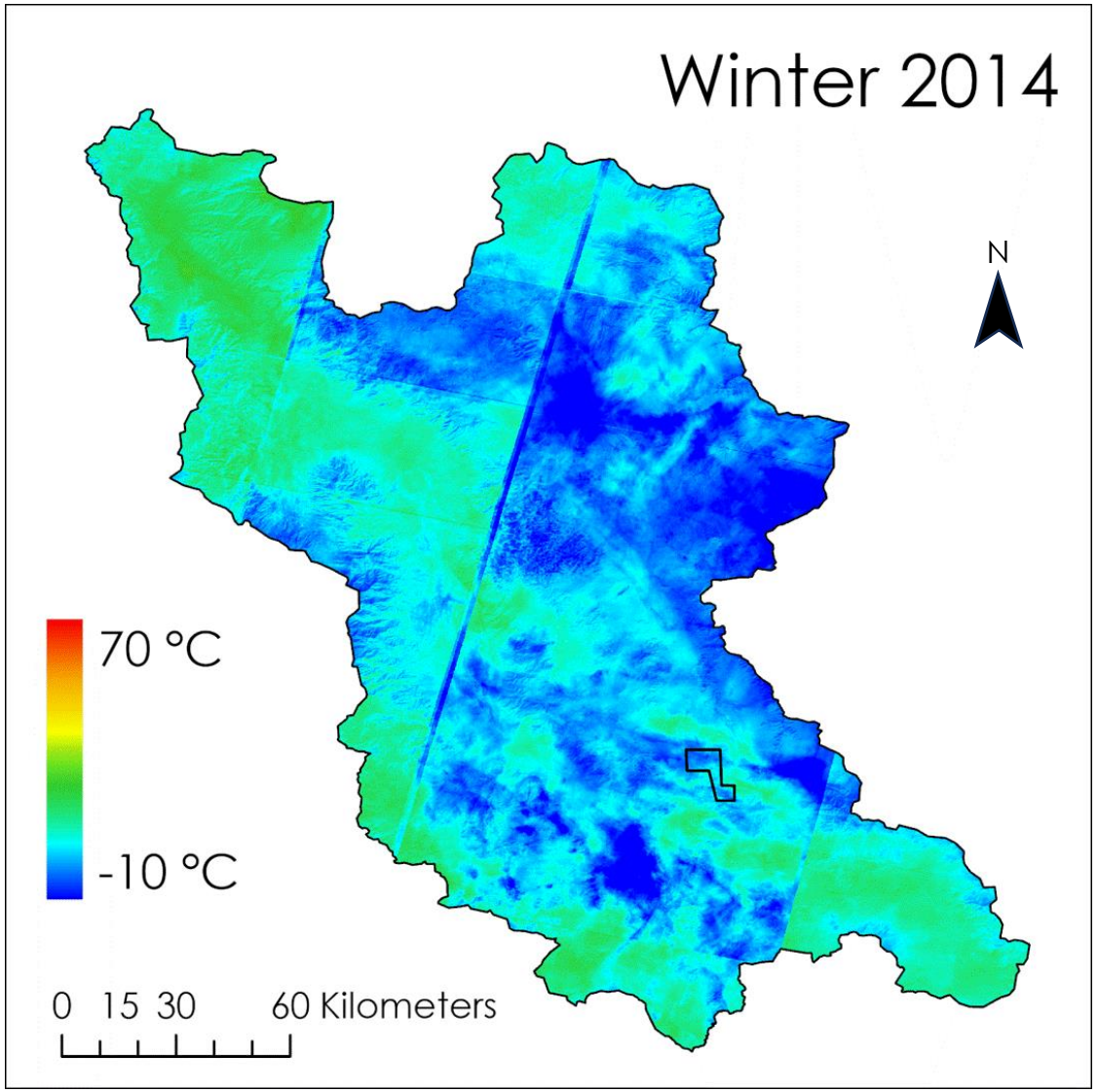
ECOSTRESS – 2024 Hot Spot Analysis

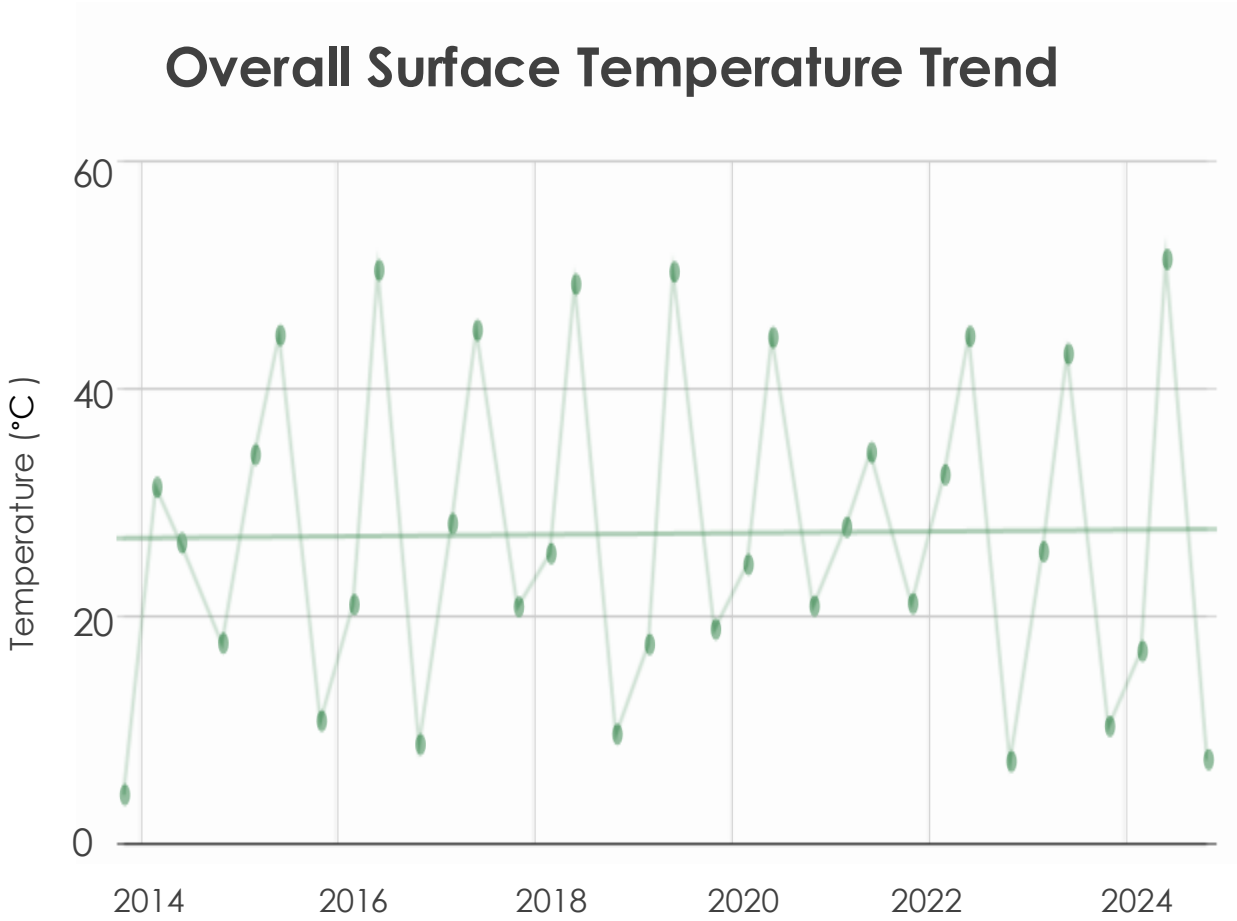
Apparent hot and cold trends throughout the vole area of interest.



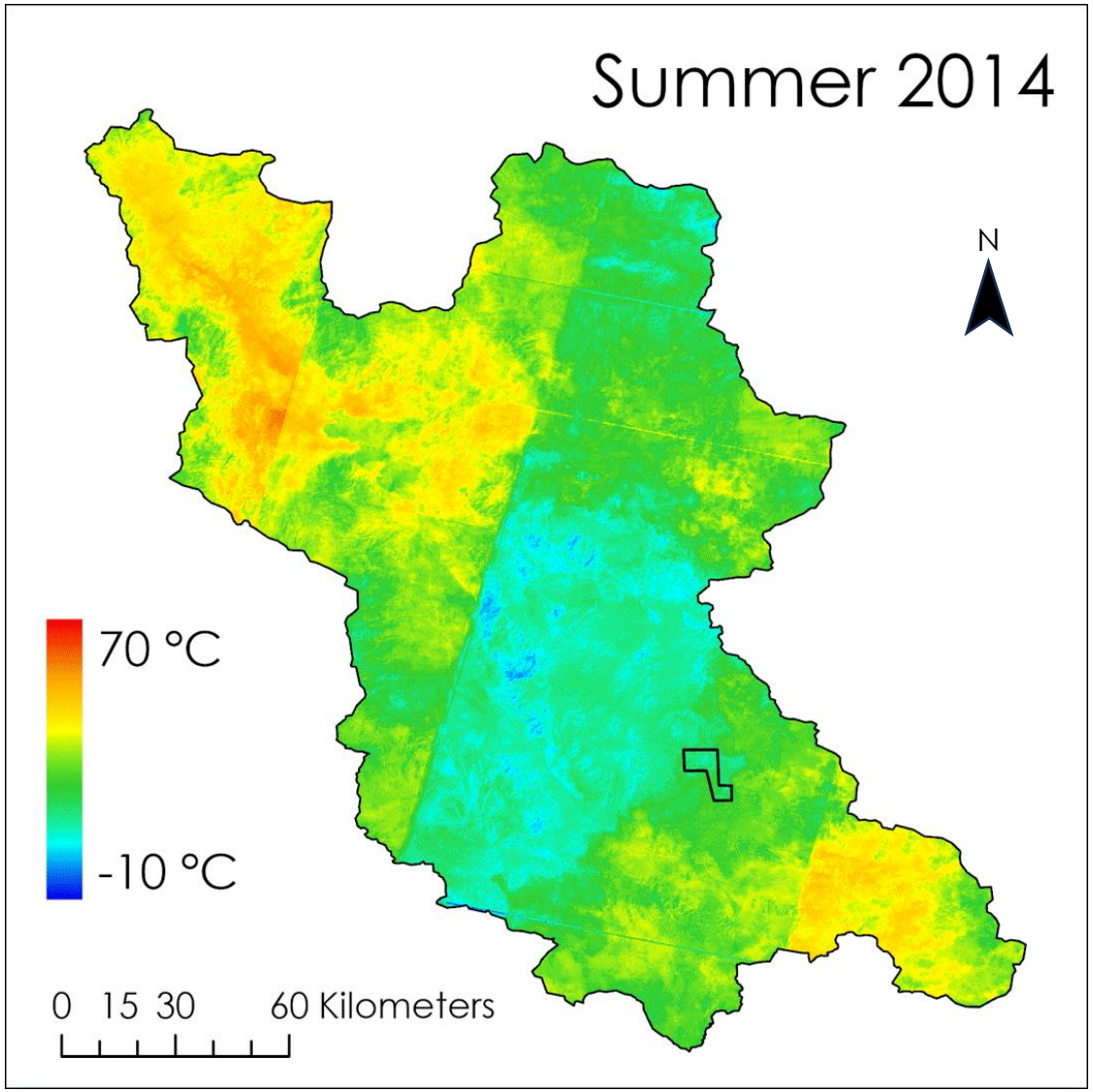
Land following the river and known bulrush areas are persistently cold throughout 2024.

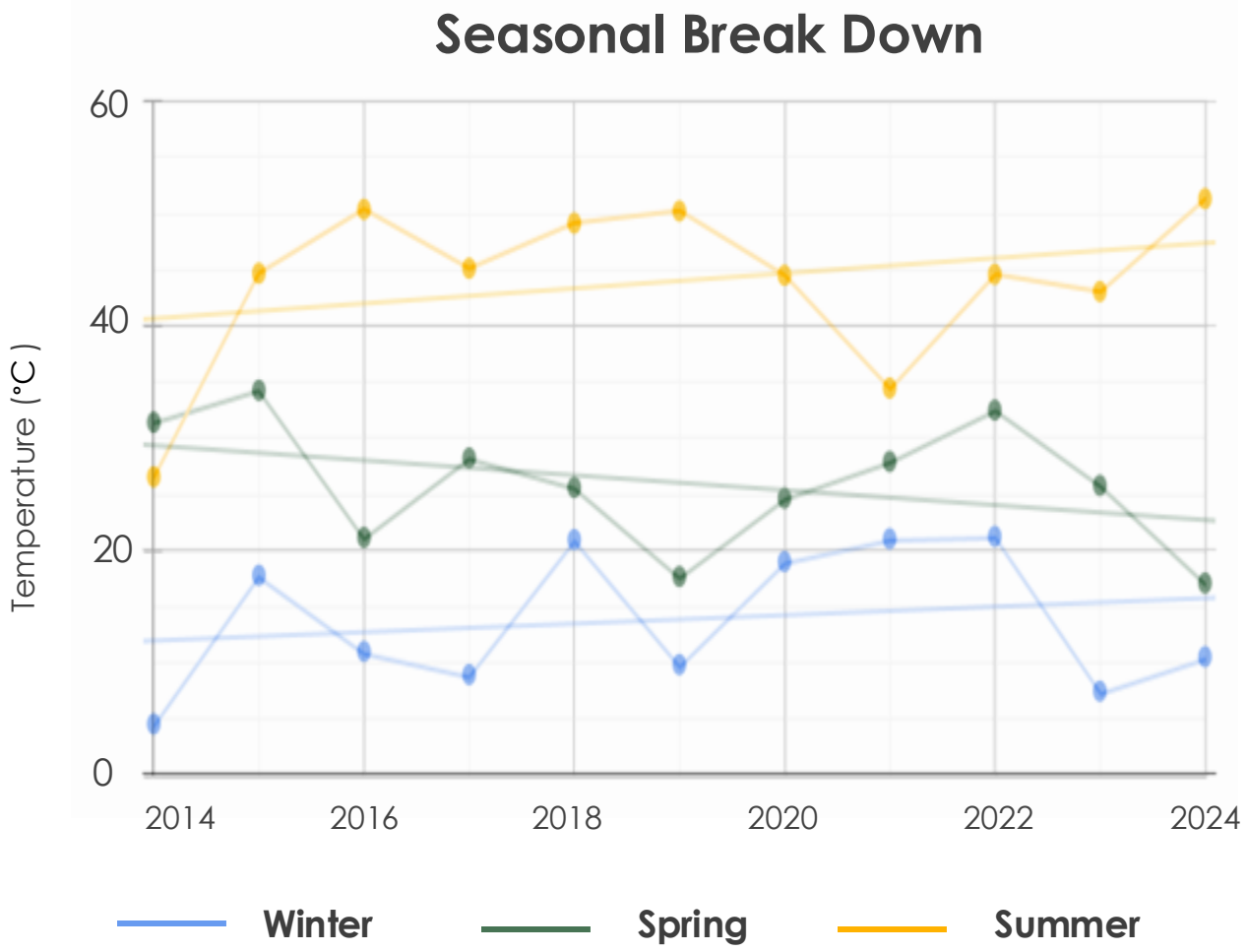
Land Surface Temperature Seasonal Time Series



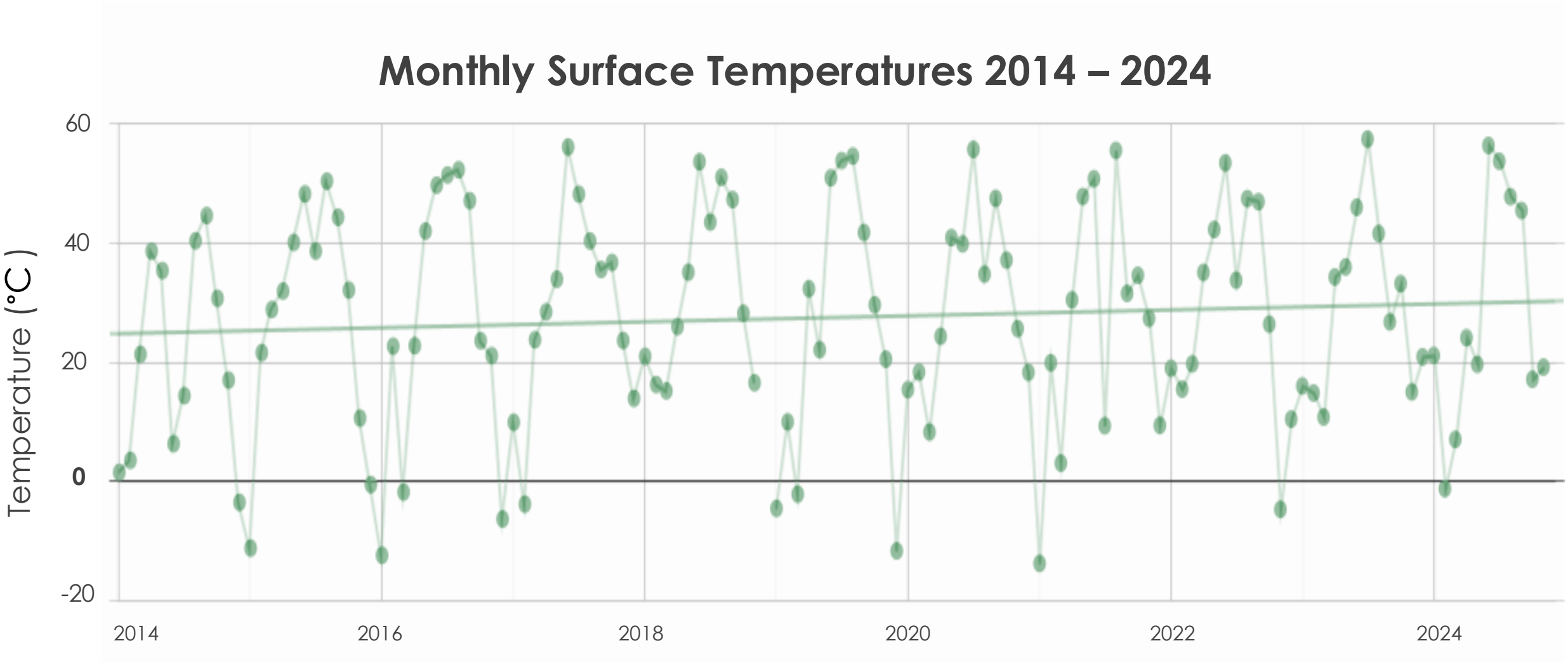


Land Surface Temperature Seasonal Time Series



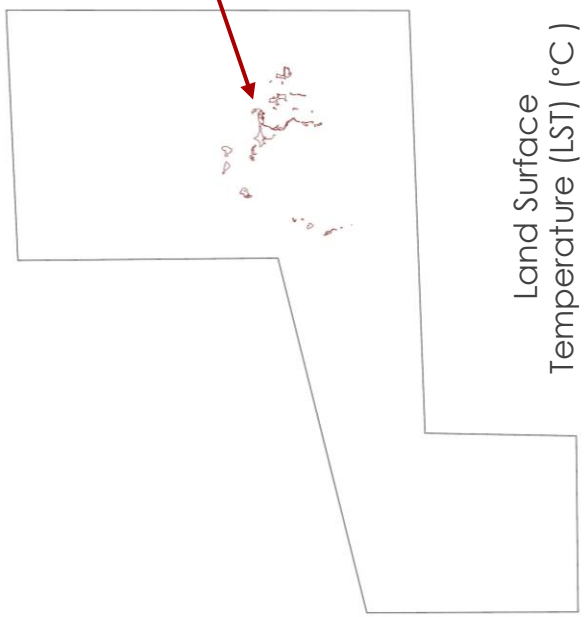


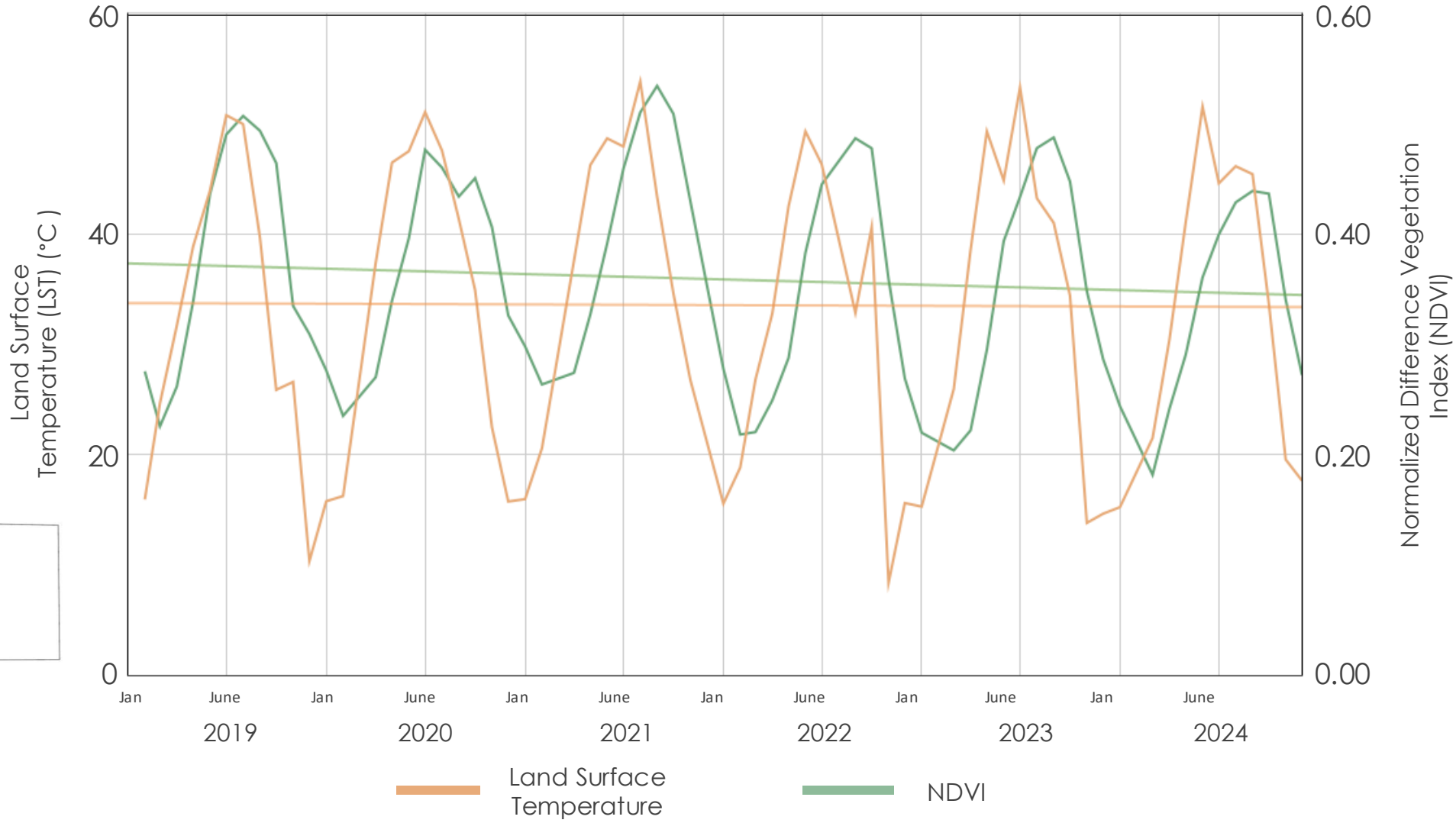
Land Surface Temperature Monthly Time Series



Sentinel-2 NDVI vs Landsat 8 LST Time Series

*This analysis was done for bulrush areas mapped in 2015.





Errors and Uncertainties

SAR Sensors and Imagery

PALSAR-2:

- Limited temporal resolution
- Varied effects of terrain and slope
- Spatial resolution too coarse to detect standing water in this area

Sentinel-1

- Bulrush and plant type shapefiles that were used to sample points were created in 2015–2016
- Lack of speckle filtering

Thermal Sensors and Imagery

ECOSTRESS

- LST does not represent soil temperature
- Variable revisit time based on the sensor's location aboard the ISS affected data
- Data only available 2018 to present

Landsat-8 TIRS:

- Consistent revisit time did not capture the hottest time of day
- Landsat cannot produce accurate images when it's cloudy

Overall Conclusions

- **ALOS-2 PALSAR-2 did not feasibly detect** standing water extent due to limited temporal resolution and coarse spatial resolution.
- **Sentinel-1 feasibly detected inundated vegetation** through thresholding and can be used to inform bulrush restoration efforts.
- **Sharpened ECOSTRESS data detected persistent hot and cold areas** in the study area throughout 2024.
- **Basin has been warming** with an increase from 2014 to 2024.
- Bulrush greenness (NDVI) peaks soon after the hottest month of the year.


Image Credit: Austin Roy

Acknowledgements

NASA Develop Program

Caroline Baumann (NASA DEVELOP – JPL Lead)

Spring 2025 Amargosa Basin Ecological Conservation Project

Gabrielle Shen, Simon Ng, Peter Blatchford, Alondra Gallegos (Analytical Mechanics Associates)

Science Advisors

Vicky Espinoza (NASA JPL, California Institute of Technology)

Brandi Downs (NASA JPL, California Institute of Technology)

Matthew Bonnema (NASA JPL, California Institute of Technology)

Benjamin Holt (NASA JPL, California Institute of Technology)

Project Partners

Austin Roy (California Department of Fish and Wildlife)
Cameron Mayer (Friends of the Amargosa Basin)
Christina Manville (U.S. Fish and Wildlife Service, Southern Nevada Fish and Wildlife Office)
Mandy Campbell (Timbisha Shoshone Tribe)