Heat Watch Report

Treasure Valley, Idaho, USA

CAPA STRATEGIES
Climate | Adaptation | Planning | Analytics

The CAPA Heat Watch program, equipment, and all related procedures referenced herein are developed through a decade of research and testing with support from several universities and national agencies. These include, Portland State University, the National Science Foundation, and the U.S. Forest Service (USDA).

Data collection and project implementation were facilitated by the Treasure Valley Canopy Network and its partner organizations: City of Boise, City of Eagle, City of Meridian, City of Nampa, Davey Resource Group, Ecosystem Sciences Foundation, Idaho Smart Growth, North End Neighborhood Association, Southwest Idaho Resource Conservation and Development, The Keystone Concept, The Nature Conservancy Idaho

This report was prepared by CAPA Strategies, LLC
Summer 2019

Contents of this Report

Purpose and Aims

Greetings Treasure Valley!

Capa Strategies, in partnership with Treasure Valley Canopy Network collaborated with over a dozen local volunteers to collect thousands of temperature and humidity data points in the morning, afternoon, and evening of a long, hot campaign day on August 14, 2019. Thanks to these efforts, analysts at CAPA Strategies were able to combine the data with satellite imagery to produce the urban heat maps shared in this report. We are excited for the opportunities this data present to urban forest managers and community planners interested in improving health and livability in Treasure Valley communities.

The purpose and aims of this Heat Watch campaign are fourfold:

1. Recognize that communities face an **unprecedented challenge of building a resilient community in the face of a changing climate.** In order to build resilient communities, leaders and planners are challenged to build functional landscapes and infrastructure that can sustain a livable environment in the face of increasing intensity, duration, and frequency of climate-induced extreme weather events.

2. Understand the **distributional effects** of temperature and humidity (heat index) while providing an immediate and compelling opportunity to engage key community decision-makers (including leadership, planning professionals, the healthcare sector, etc.).

3. Bridge the innovations in **sensor technology** and **spatial analytics** with community engagement efforts.

4. Engage communities in advancing local actions that pro-actively develop resilient communities by strategically investing in functional landscapes in areas of greatest need.

By conducting these campaigns throughout the day, the results provide an immediate means for participants and others to understand **how urban heat varies** across neighborhoods and how local landscape features affect temperatures.

Methodology

The CAPA Heat Watch campaign engaged Treasure Valley volunteers in a field campaign that bridges citizen science with collective action.

CAPA Heat Watch provides an accessible and simple process together with remote support for community groups to collect vast amounts of primary temperature data in any metropolitan region. The results of the "campaigns" describe the distribution of heat, which are then used to identify potential actions for improving the health and well-being of local communities, infrastructure, and regional ecosystems. Our approach provides local volunteers with the data to engage community leadership in advancing effective solutions to address the impacts of urban heat islands.

1. Under the guidance and training of CAPA Strategies, local organizers create polygons of the area of organizers create polygons of the develop driving routes ("traverses") within each polygon.

2. Local organizers facilitate a 1-day urban heat campaign with the assistance of dozens of volunteers who traverse within defined polygons in the urban area of interest.

3. Traverses are conducted by mounting sensor equipment on the car, and driving the designated routes at 6 a.m., 3 p.m., and 7 p.m. on a hot, clear day. These sensors track GPS location, temperature, and humidity at one second intervals throughout each one-hour traverse. After completion, sensors are shipped back to the CAPA team for analysis.

4. The data are retrieved from each sensor and analysed using a machine learning algorithm that also incorporates local data and satellite imagery. The resulting maps show heat distribution for the entire city.

How to Use These Maps

The following sections include an overview of the results, which include a series of maps, overload on satellite imagery, that describe: (1) a combination of all the traverse data points, colored by temperature, for the morning, afternoon, and evening; and (2) a 'heat index' map that incorporates temperature and humidity to describes the area of interest, also in the morning, afternoon and evening ('Area Wide').

Warmer areas are depicted by red coloring, while relatively cooler areas are shown in blue. Details of the analytical process can be found in Shandas et al., 2019.

Note that the Heat Index map scale is classified by "natural breaks" in order to more explicitly depict warmer locations across each map. The temperature scales are different between the traverse and area-side maps because area wide includes the Heat Index.

We invite you to find on the map your home, place of work, or favorite park and compare the temperatures throughout the day. **How does your own experience with heat in these areas align with the map?** What about the landscape (e.g. shade trees, concrete buildings, river-side walkway, etc.) do you think might be influencing the temperatures in this area?

Nampa Traverses (Morning, Afternoon, Evening)

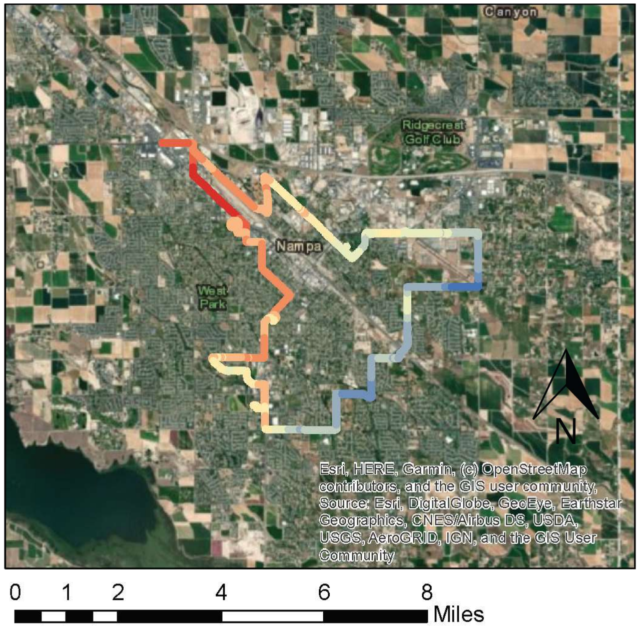


Figure 1a: Nampa 6-7AM Traverse Temperature (°F)

- 52.5 - 53.8
- 53.9 - 55.0
- 55.1 - 55.9
- 56.0 - 56.7
- 56.8 - 57.7
- 57.8 - 58.6
- 58.7 - 59.5
- 59.6 - 60.8
- 60.9 - 61.9
- 62.0 - 62.8

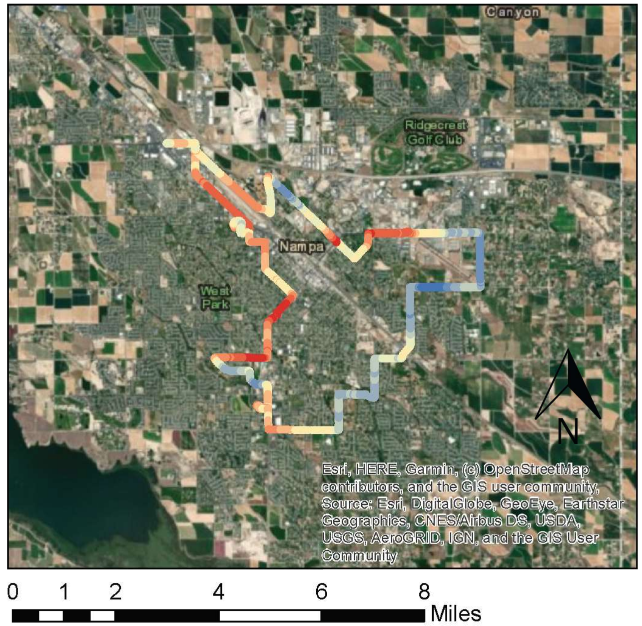


Figure 1b: Nampa 3-4PM Traverse Temperature (°F)

- 88.3 - 89.1
- 89.2 - 89.6
- 89.7 - 90.0
- 90.1 - 90.3
- 90.4 - 90.7
- 90.8 - 91.0
- 91.1 - 91.6
- 91.7 - 92.1
- 92.2 - 92.8
- 92.9 - 93.7

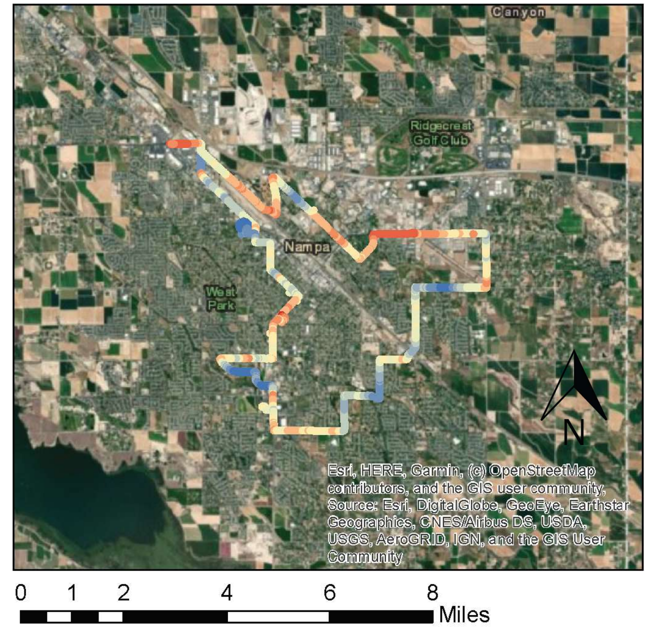


Figure 1c: Nampa 7-8PM Traverse Temperature (°F)

- 88.2 - 88.9
- 89.0 - 89.6
- 89.7 - 90.1
- 90.2 - 90.5
- 90.6 - 91.0
- 91.1 - 91.6
- 91.7 - 91.9
- 92.0 - 92.5
- 92.6 - 93.0
- 93.1 - 94.1

Nampa Area-Wide (Morning, Afternoon, Evening)

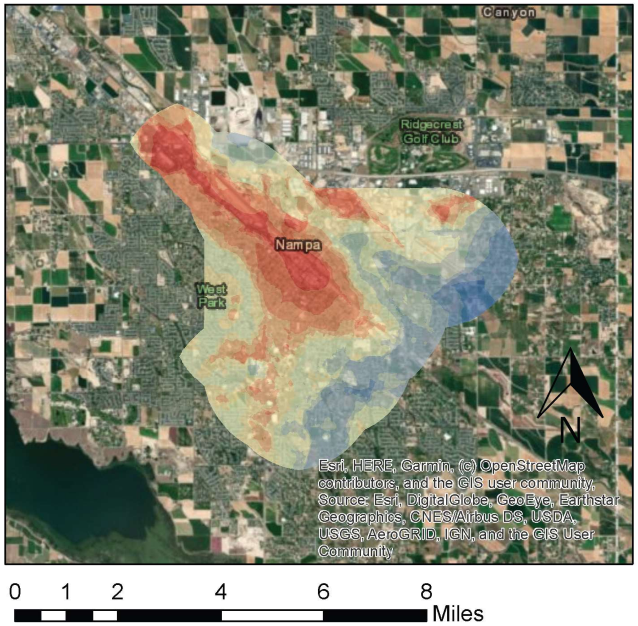


Figure 2a: Nampa 6-7AM Area-Wide Temperature (°F)

- 52.5 - 53.7
- 53.8 - 55.0
- 55.1 - 56.2
- 56.3 - 57.1
- 57.2 - 57.9
- 58.0 - 58.6
- 58.7 - 59.2
- 59.3 - 59.9
- 60.0 - 61.0
- 61.1 - 62.7

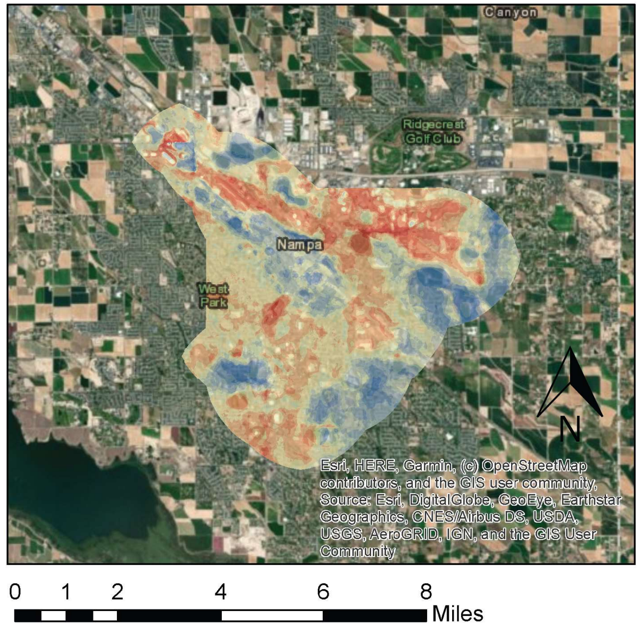


Figure 2b: Nampa 3-4PM Area-Wide Temperature (°F)

- 88.7 - 89.6
- 89.7 - 90.0
- 90.1 - 90.3
- 90.4 - 90.5
- 90.6 - 90.7
- 90.8 - 90.9
- 91.0 - 91.2
- 91.3 - 91.4
- 91.5 - 91.8
- 91.9 - 93.1

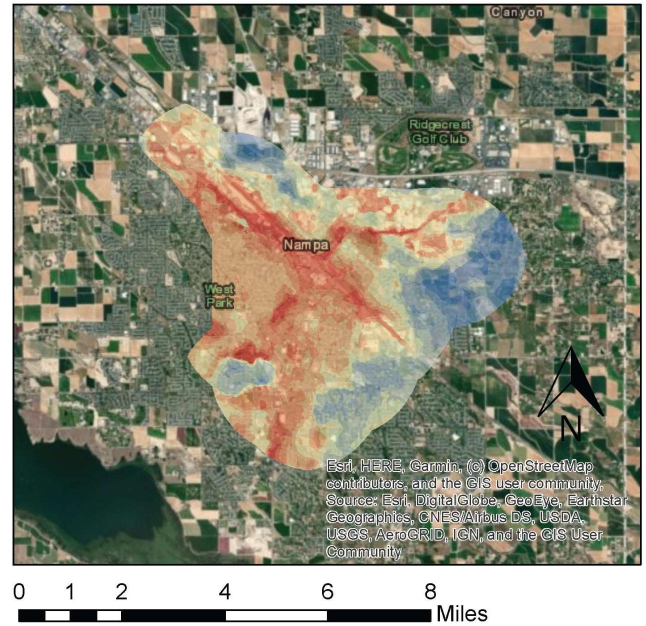


Figure 2c: Nampa 7-8PM Area-Wide Temperature (°F)

- 88.2 - 89.4
- 89.5 - 89.9
- 90.0 - 90.3
- 90.4 - 90.7
- 90.8 - 91.1
- 91.2 - 91.5
- 91.6 - 91.8
- 91.9 - 92.1
- 92.2 - 92.5
- 92.6 - 93.8

Boise Morning Traverses (6-7AM)

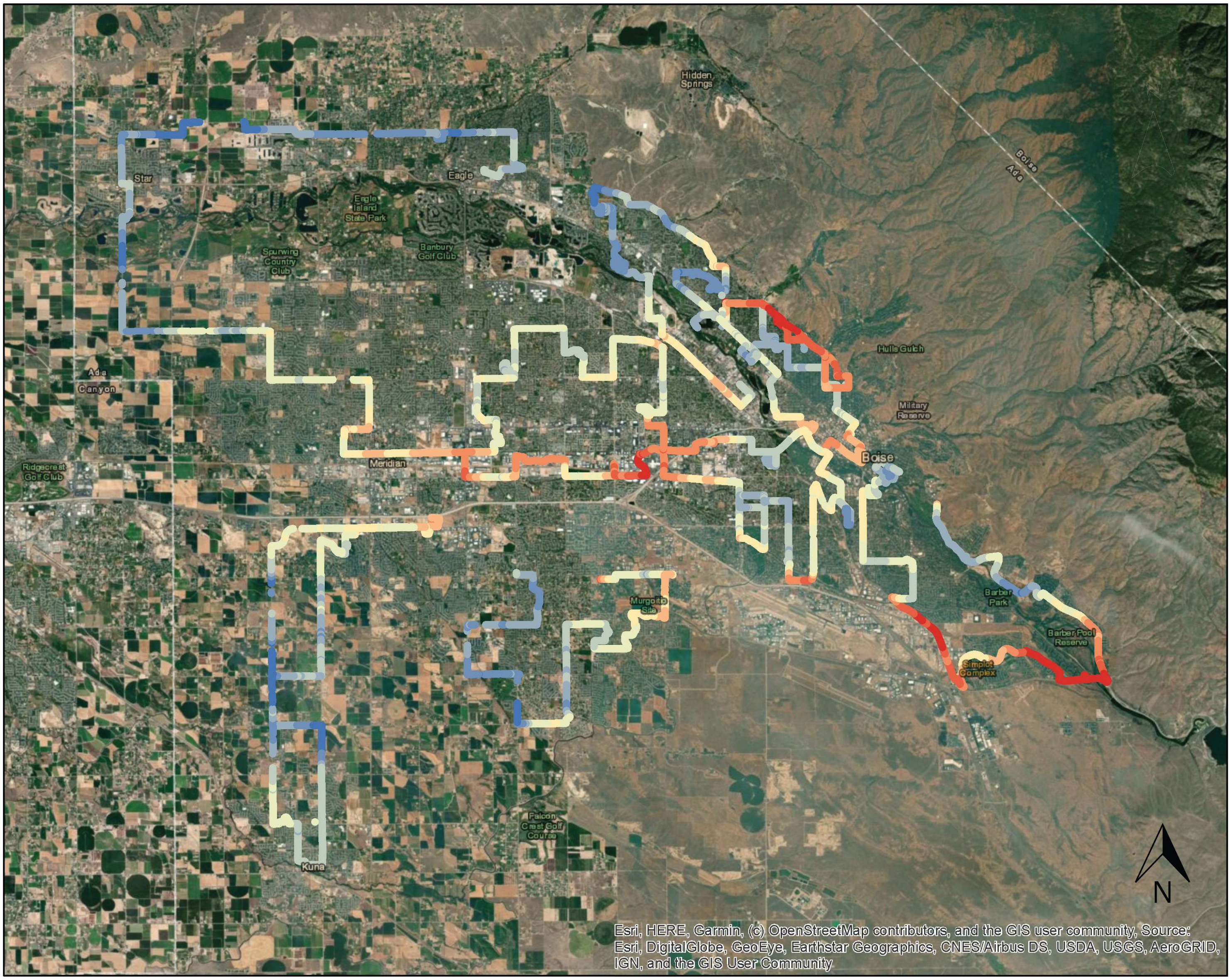


Figure 3: Boise 6-7AM Traverse Temperature (°F)

- 52.2 - 53.8
- 53.9 - 55.0
- 55.1 - 56.1
- 56.2 - 57.4
- 57.5 - 58.6
- 58.7 - 59.9
- 60.0 - 61.3
- 61.4 - 62.8
- 62.9 - 63.9
- 64.0 - 67.3

Boise Morning Area-Wide (6-7AM)

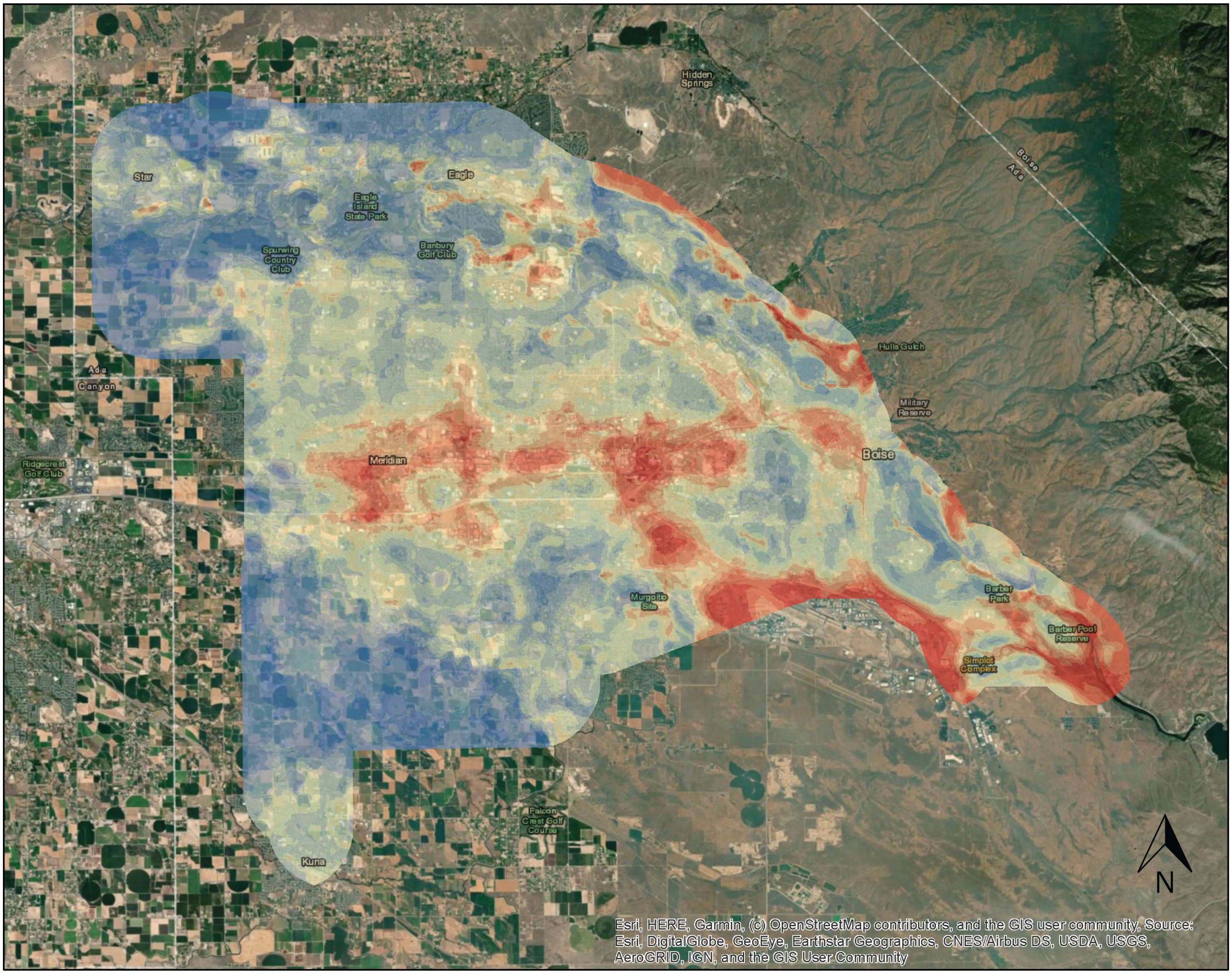


Figure 4: Boise 6-7AM Area-Wide Temperature (°F)

0 1 2 4 6 8 Miles

- 51.0 - 54.2
- 54.3 - 55.3
- 55.4 - 56.4
- 56.5 - 57.3
- 57.4 - 58.2
- 58.3 - 59.2
- 59.3 - 60.4
- 60.5 - 61.7
- 61.8 - 63.1
- 63.2 - 66.7

Boise Afternoon Traverses (3-4PM)

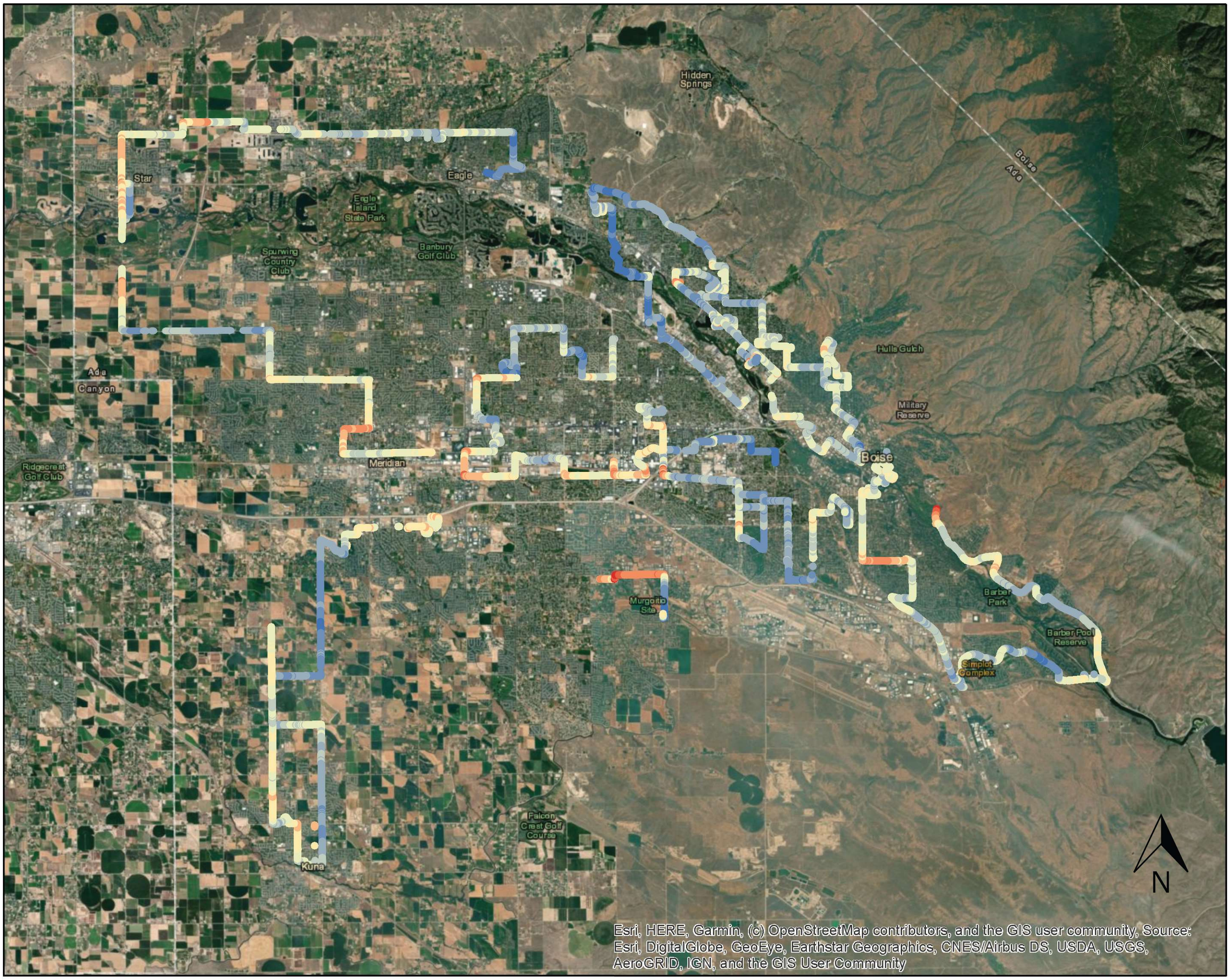


Figure 5: Boise 3-4PM Traverse Temperatures (°F)

0 1 2 4 6 8 Miles

- 87.4 - 88.5
- 88.6 - 89.4
- 89.5 - 90.1
- 90.2 - 90.7
- 90.8 - 91.4
- 91.5 - 92.1
- 92.2 - 93.0
- 93.1 - 94.1
- 94.2 - 95.4
- 95.5 - 96.6

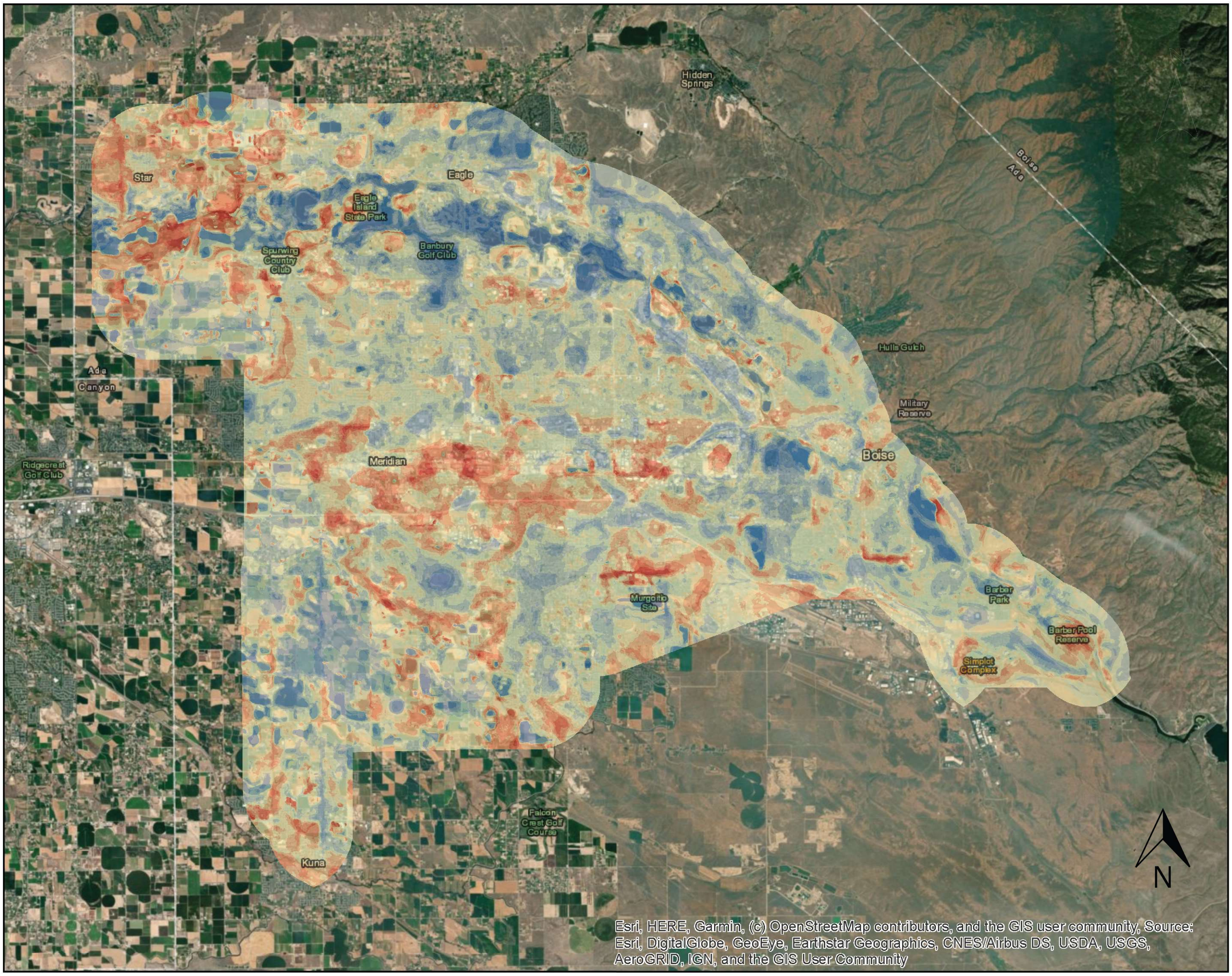


Figure 6: Boise 3-4PM Area-Wide Temperature (°F)

0 1 2 4 6 8 Miles

- 85.6 - 88.5
- 88.6 - 89.4
- 89.5 - 90.0
- 90.1 - 90.4
- 90.5 - 90.7
- 90.8 - 91.1
- 91.2 - 91.4
- 91.5 - 91.9
- 92.0 - 92.5
- 92.6 - 98.0

Boise Evening Traverse Points (7 - 8 pm)

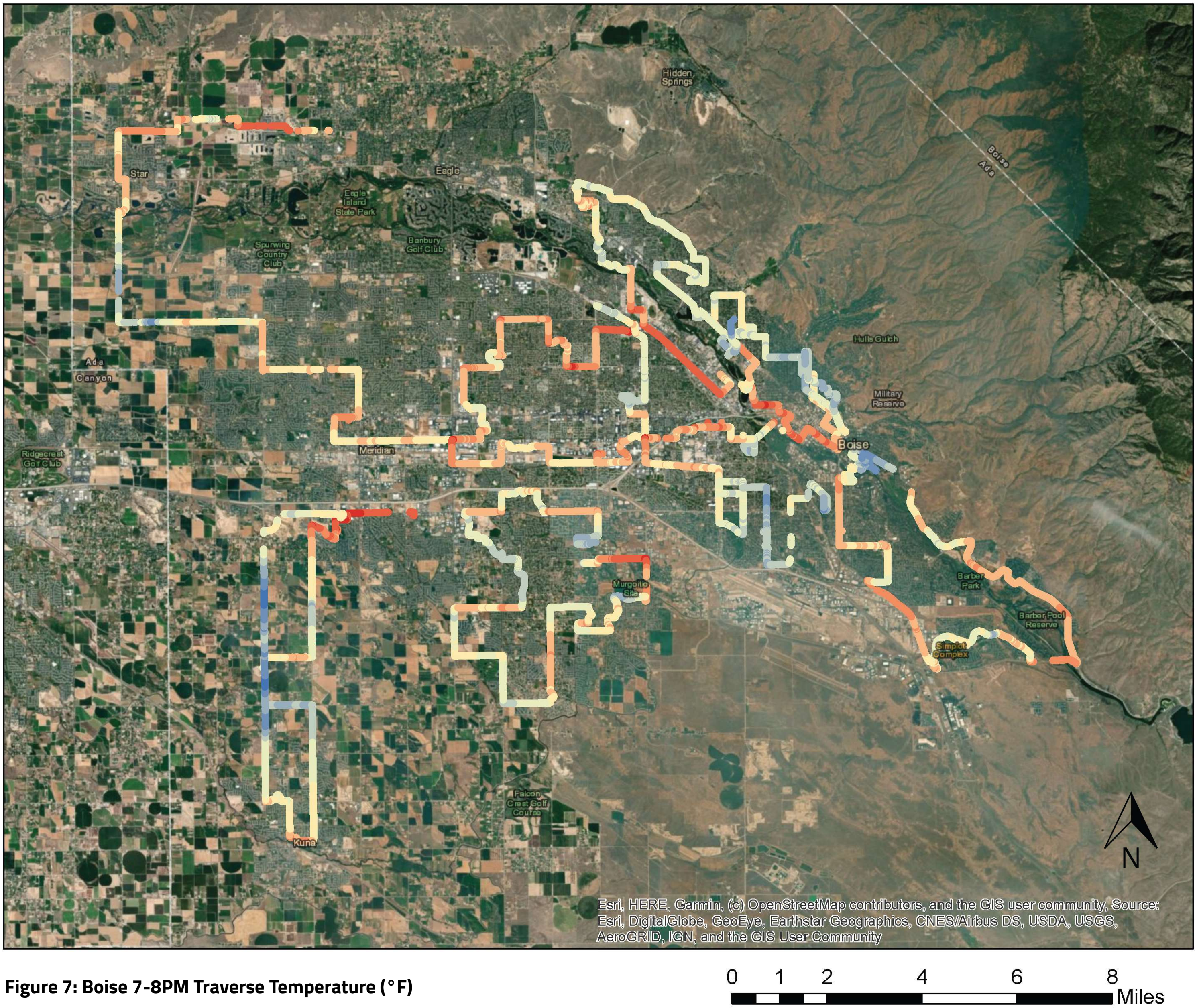


Figure 7: Boise 7-8PM Traverse Temperature (°F)

- 82.9 - 84.7
- 84.8 - 86.5
- 86.6 - 87.8
- 87.9 - 88.7
- 88.8 - 89.8
- 89.9 - 90.7
- 90.8 - 91.8
- 91.9 - 92.8
- 92.9 - 94.3
- 94.4 - 96.1

Boise Evening Area-Wide (7 - 8 pm)

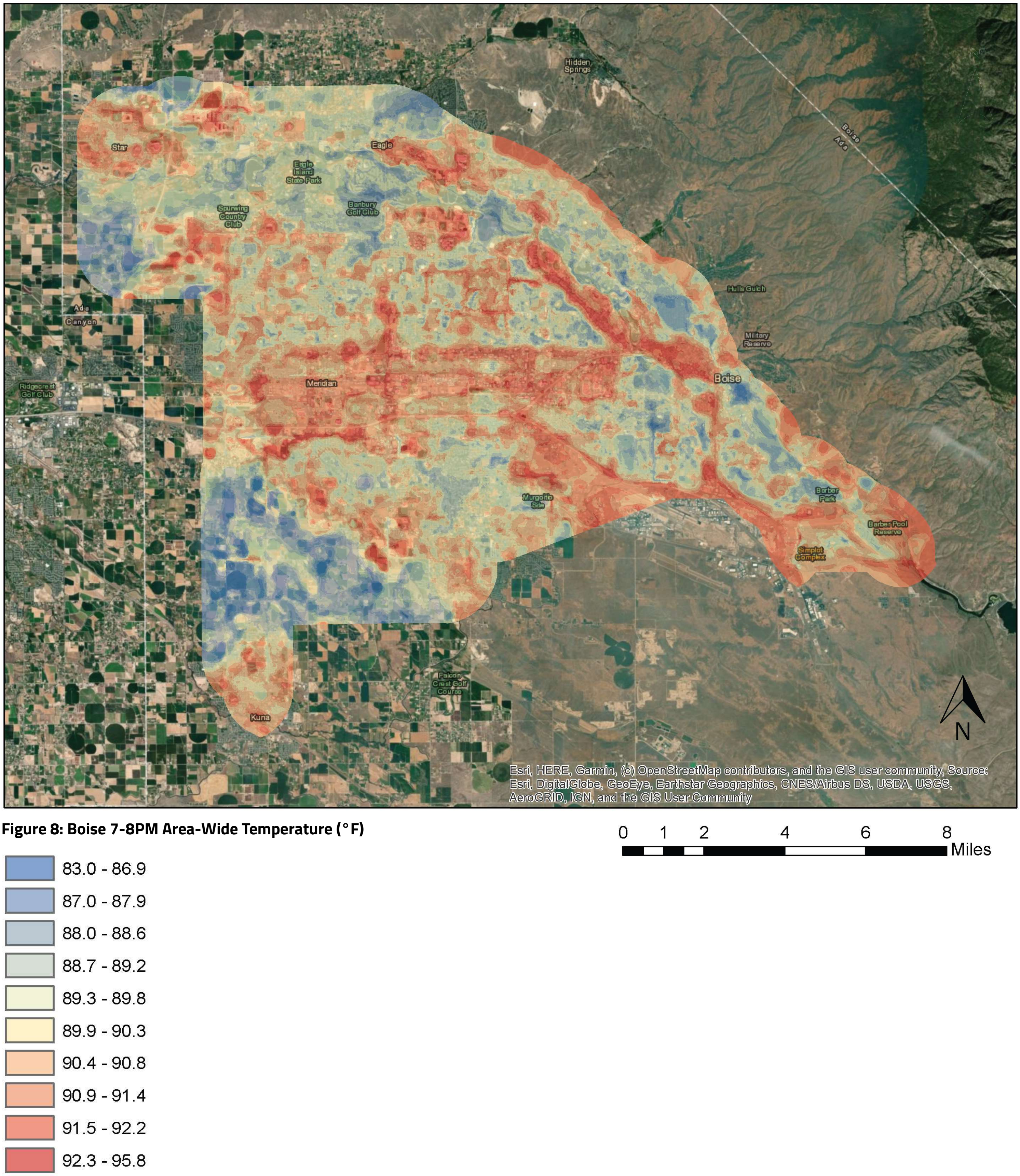


Figure 8: Boise 7-8PM Area-Wide Temperature (°F)

Summary of Findings

Temperature Statistics

Traverse	Nampa			Boise		
	MIN	MAX	MEAN	MIN	MAX	MEAN
6 - 7 am	52.5 F	62.7 F	58.0 F	51.0 F	66.7 F	57.5 F
3 - 4 pm	88.7 F	93.1 F	90.7 F	85.6 F	98.0 F	90.6 F
7 - 8 pm	88.2 F	93.8 F	91.2 F	83.0 F	95.8 F	90.1 F

Number of Data Points Used

Traverse	Nampa	Boise
6 - 7 am	2,767	22,828
3 - 4 pm	2,686	19,382
7 - 8 pm	2,252	22,090

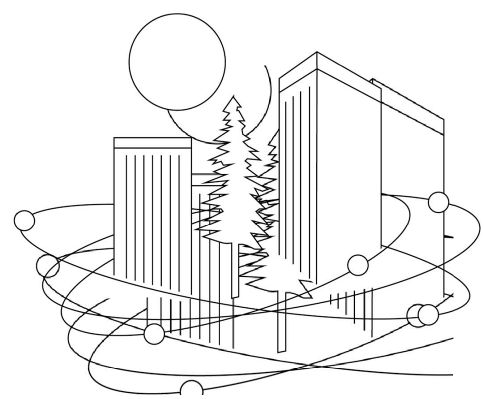
Accuracy Assessment* - Adjusted R Square

Traverse	Nampa	Boise
6 - 7 am	0.99	0.97
3 - 4 pm	0.86	0.96
7 - 8 pm	0.94	0.97

On August 14, 2019, volunteers traversed five study areas across Nampa and Boise. The maximum temperature measured during the traverses was 98 degrees Fahrenheit, with a highest concurrent temperature differential of 12.4 degrees.

*To assess the strength of our predictive temperature models, we used a 70:30 "holdout cross-validation method," which consists of predicting 30% of the data with the remaining 70%, selected randomly. An 'Adjusted R-Squared value of 1.0 is perfect predictability, and 0 is total lack of prediction. Additional information on this technique can be found at the following reference: *Voelkel, J., and V Shandas, 2017. Towards Systematic Prediction of Urban Heat Islands: Grounding measurements, assessing modeling techniques. Climate 5(2): 41*.

Please note that since raw files were used to create a predictive model for these maps, the extent of each map will extend beyond the areas where the data were collected. As such, we suggest interpreting the Heat Index values that extend beyond the traversed areas with caution.

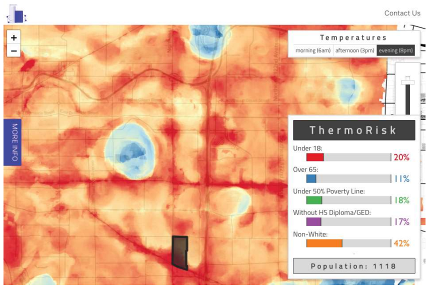


What's Next?

The TV Canopy Network will utilize this data to inform planning decisions across the valley, including: new development; in-fill development; municipal planning codes and local community health planning. Examples of this work include: using the data to inform community hospital and municipal partner Health Impact Assessments (HIA); future tree planting in neighborhoods of greatest need for shade and reduced heat impacts (using census and demographic data); planting along transportation corridors and in large parking lots to reduce heat impacts and improve air quality. In addition, the Network will incorporate the regional heat into our Map The Canopy page (http://www.tvcanopy.net/map-the-canopy), and in publications and social media outreach to increase the public's understanding of the benefit of our community trees.

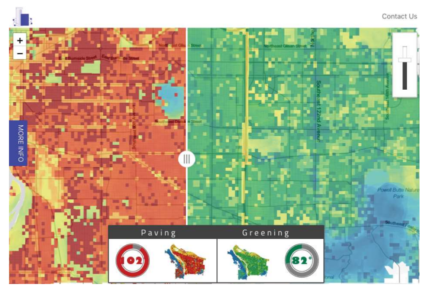
CAPA Insights

To further explore how your community's heat distribution affects local populations and infrastructure, CAPA Strategies has created a suite of tools that help to organize these variables in user-friendly interfaces.



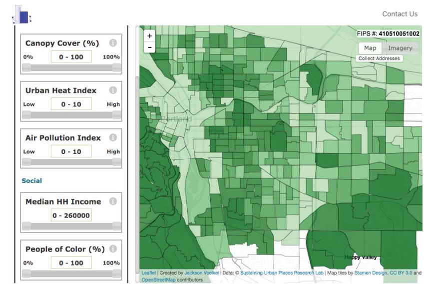
Social Vulnerability

Use Heat Watch data and publicly available demographic information to explore the intersection of urban heat and social vulnerability to better understand the needs of local communities facing the most acute impacts of a warming planet.



Scenarios of Changing the Built Environment

Using computer models and municipal infrastructure data, this tool shows the effect on heat of changing the built environment. We explore scenarios of increased paving versus greening on heat at the scale of a city-block up to an entire city.



Branch Out

This tool serves as a planting map to identify areas where expanding tree canopy will have direct benefit to social and environmental conditions. By using publicly available data along with socio-demographics, land use, and other datasets, each neighborhood is described in terms of the potential plantable locations.

Moving beyond data acquisition and decision support tools, CAPA offers resources and services to build and implement climate preparedness strategies. At CAPA we aim to make climate planning as accessible as possible by offering multiple scales of resources to fit your needs and capacity. Explore openly available tools, request place-specific analyses, or engage our team in facilitating outreach and planning processes. More information available at capastrategies.com/growing-capacity.

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