

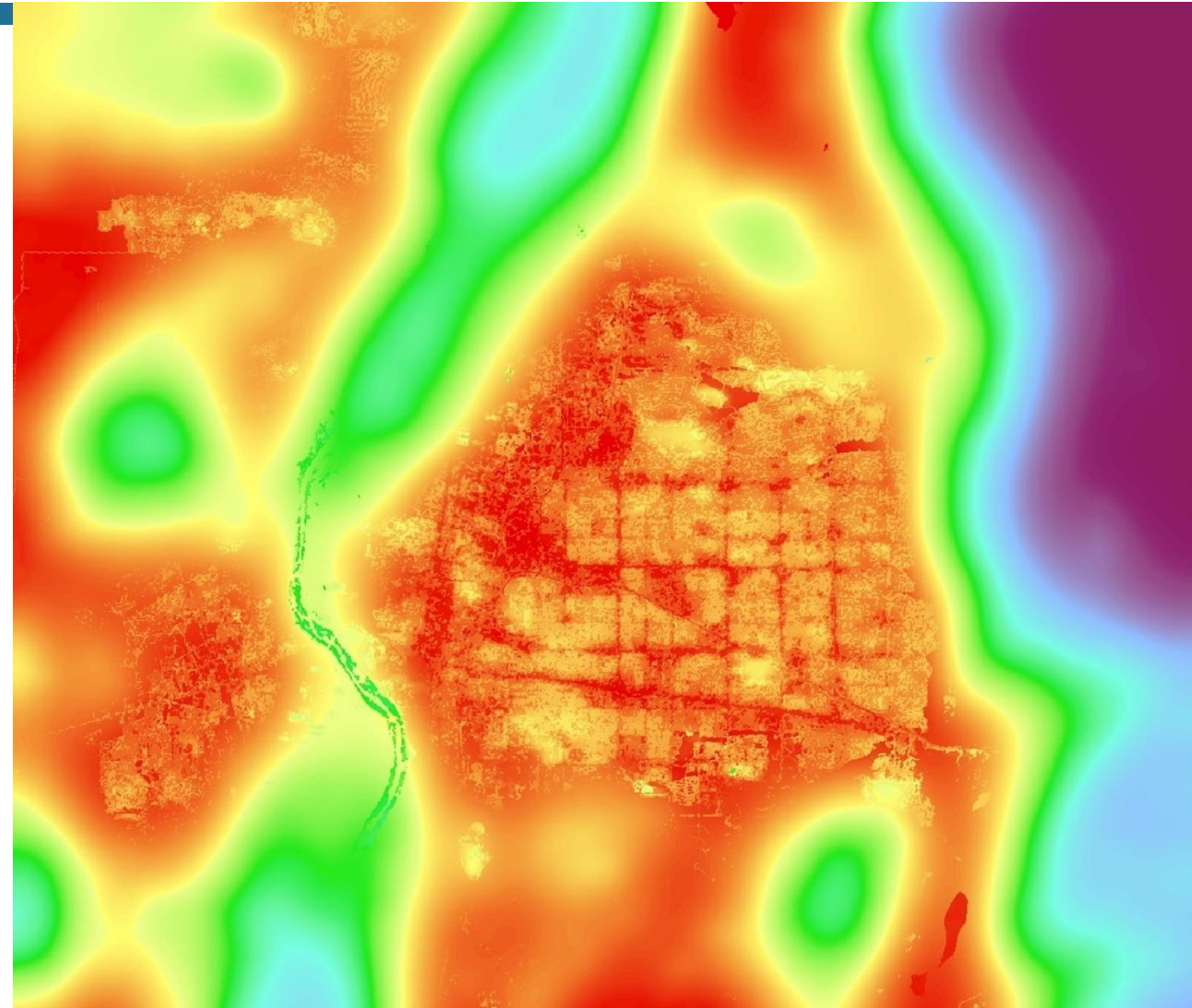


Albuquerque

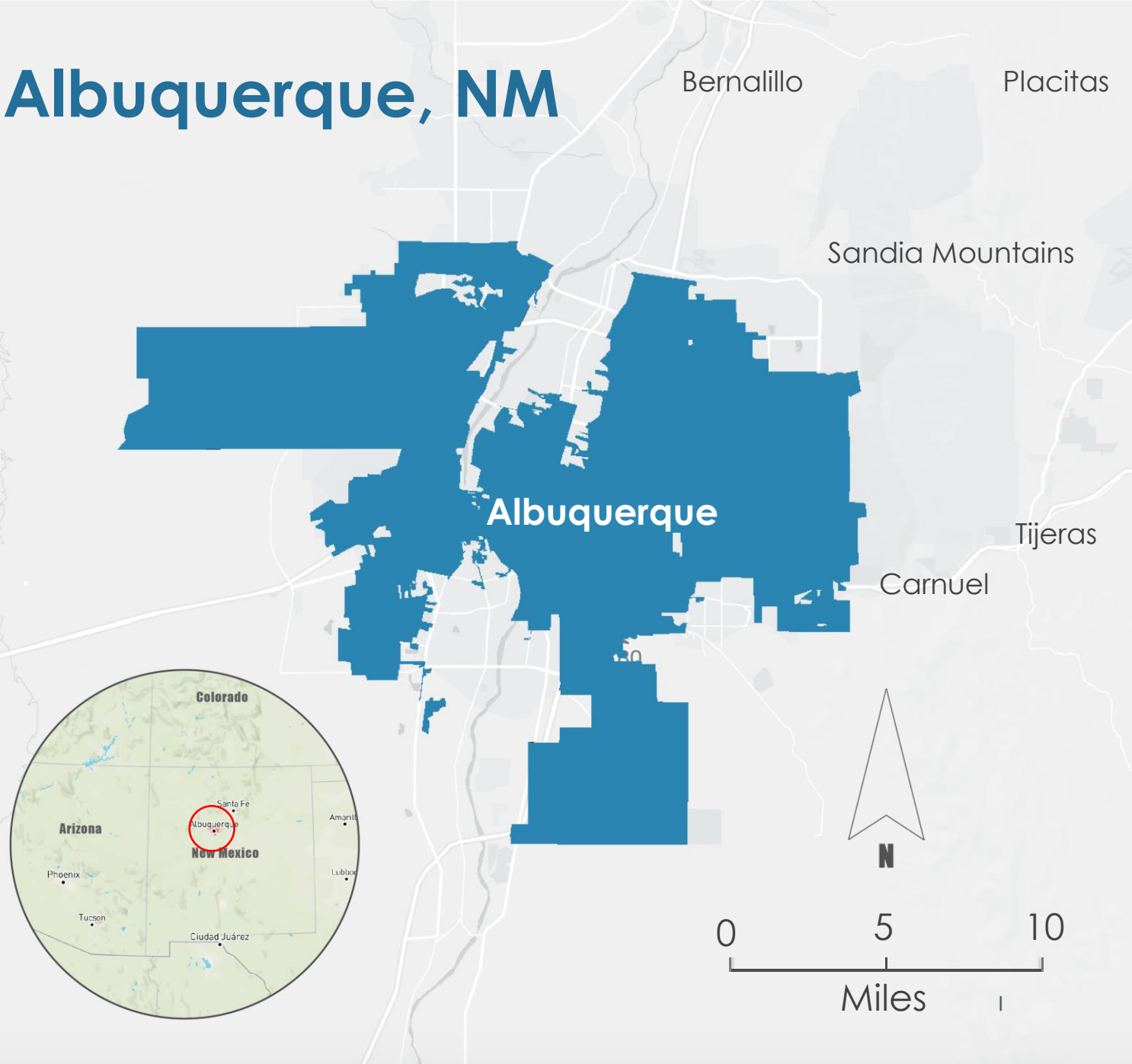
Urban Development

Enhancing Urban Cooling Interventions by Modeling
Urban Forestry through NASA Earth Observations in
Albuquerque, New Mexico

Max Stewart (Team Lead)
Christina Dennis
Ritisha Ghosh
Richard Kirschner
Steven Nystrom



Albuquerque, NM



Study Area & Period

Study Area

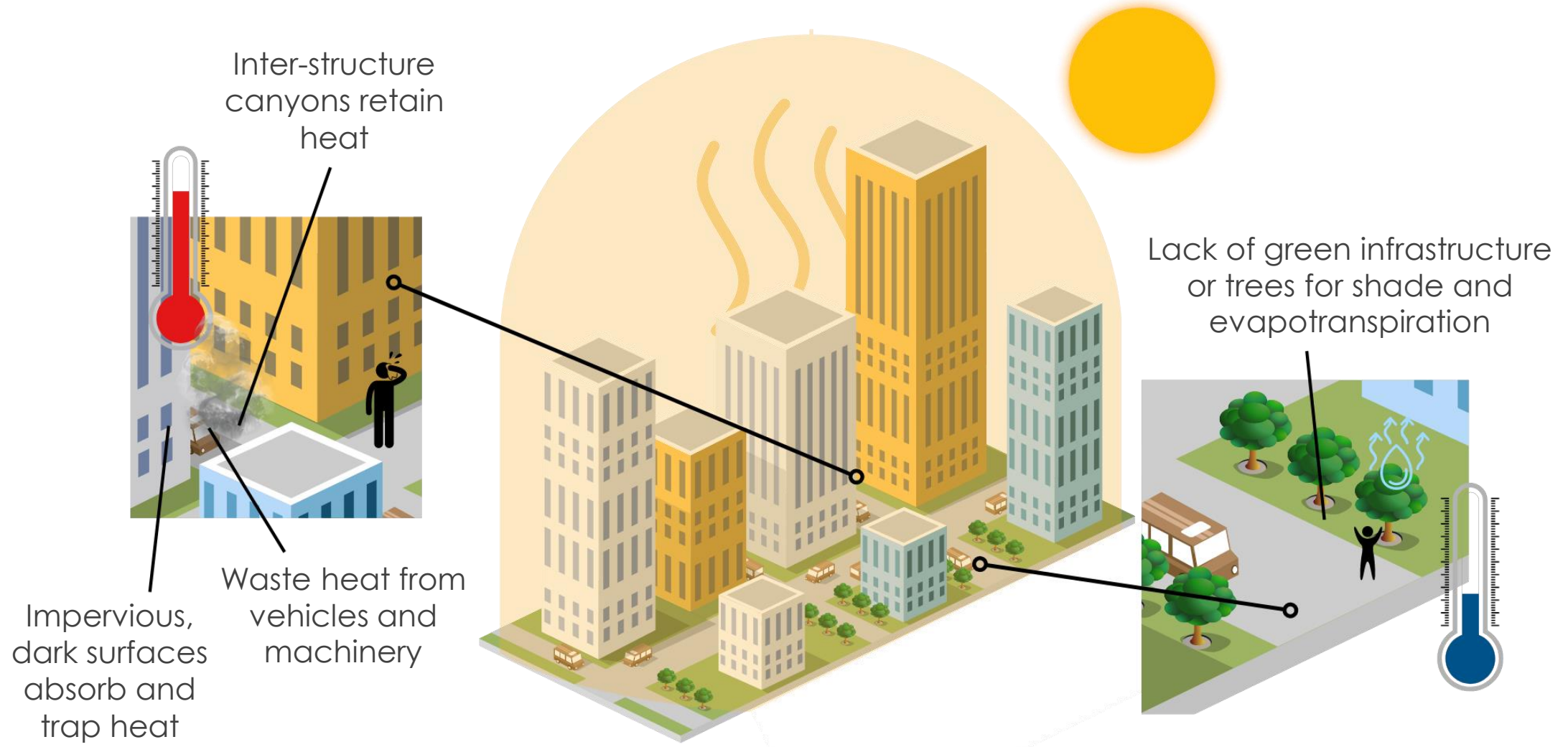
- ▶ Albuquerque, New Mexico
- ▶ Population: 564,559
- ▶ Climate: Subtropical Steppe Climate (BSk)
- ▶ Average Summer Temperatures: 61° F – 93° F

Study Period

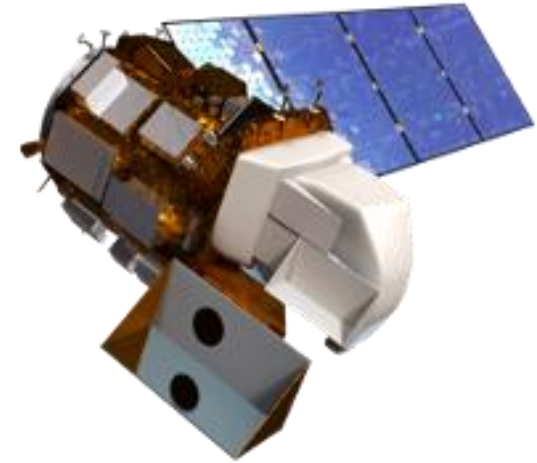
- ▶ 2018 – 2021
- ▶ June 1 – August 31st



Background: Urban Heat Islands & Mitigation



NASA Satellites & Sensors



ISS

▶ **ECOSTRESS**

- ▶ 70 m resolution, temporal revisitation 1-7 days

**Landsat
8**

▶ **TIRS**

- ▶ 100m resolution (LST product gridded at 30m), temporal revisitation 16 days



Image Credit: NASA/GSFC/Landsat

Methodology



ISS ECOSTRESS



Data Acquisition

Land Processes
Distributed Active
Archive Center
Catalogue



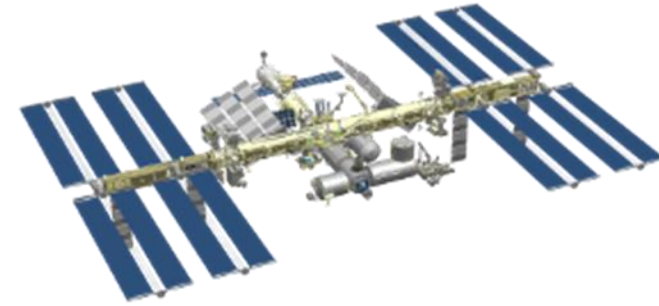
Processing

Composite raster
image created in
ArcGIS Pro to map
evapotranspiration.



Analysis

Evapotranspiration
data utilized as input
in the InVEST Urban
Cooling Model.



Landsat 8: TIRS



Data Acquisition

Google Earth
Engine: Landsat 8
Level 2 Tier 2
Catalogue



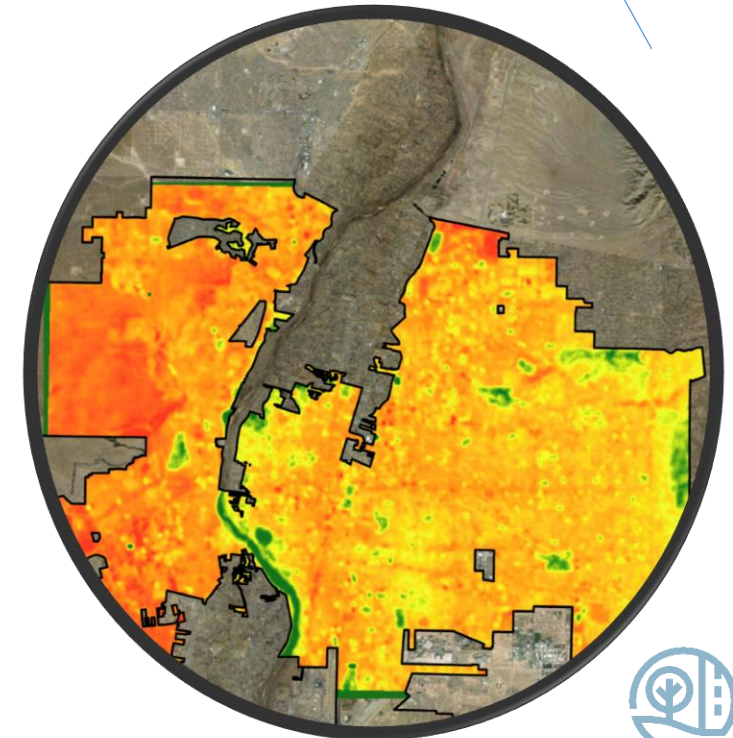
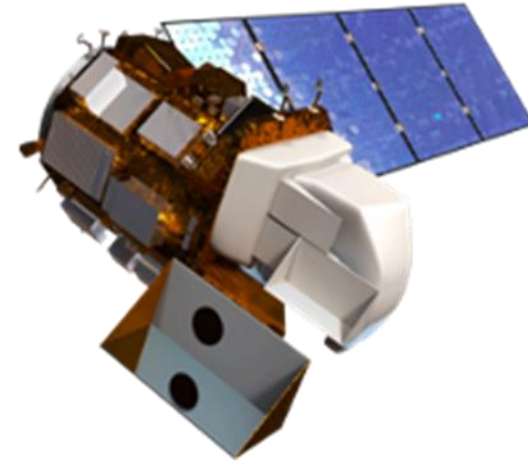
Processing

Values were
converted from K to
°F and averaged
over the study
period.

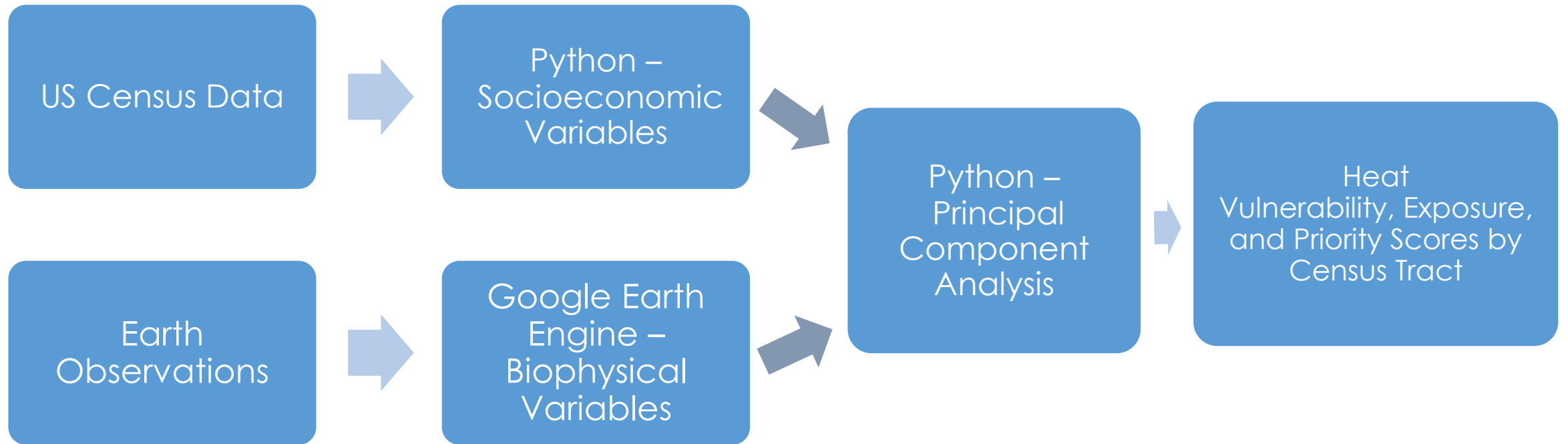


Analysis

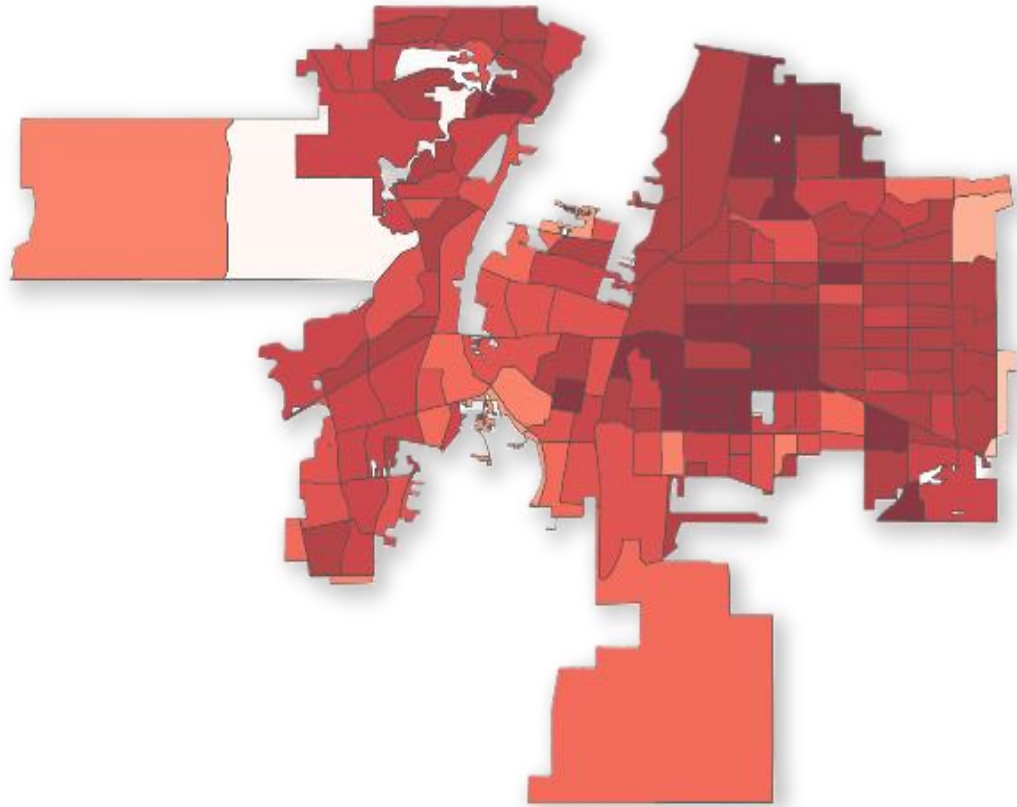
Averaged land
surface temperatures
were added as inputs
to the InVEST model.



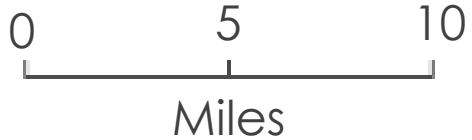
Urban Heat Exposure Assessment Tool (UHEAT 2.0)



Heat Priority: Summer 2020



True color image

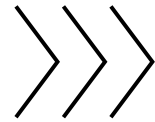
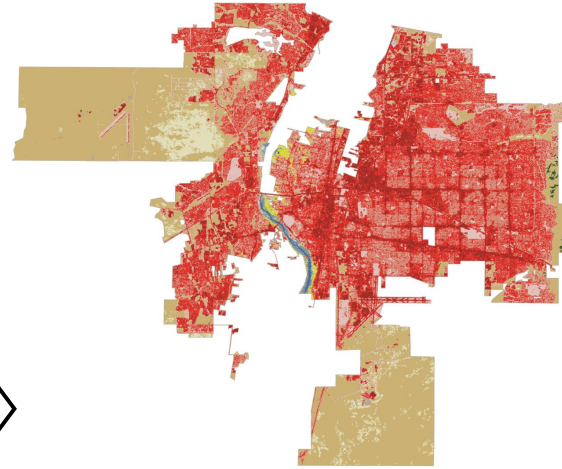


InVEST Urban Cooling Model

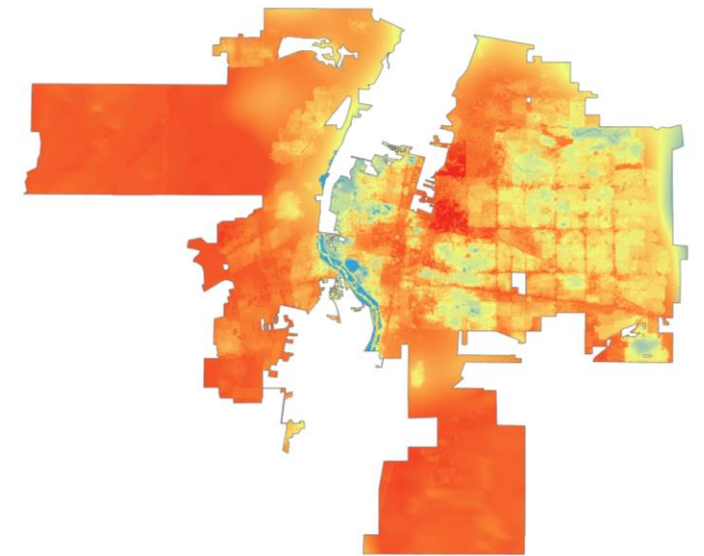
Albedo



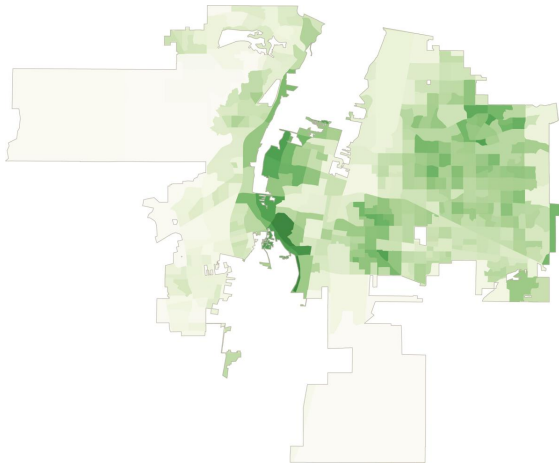
Land Cover



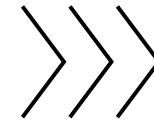
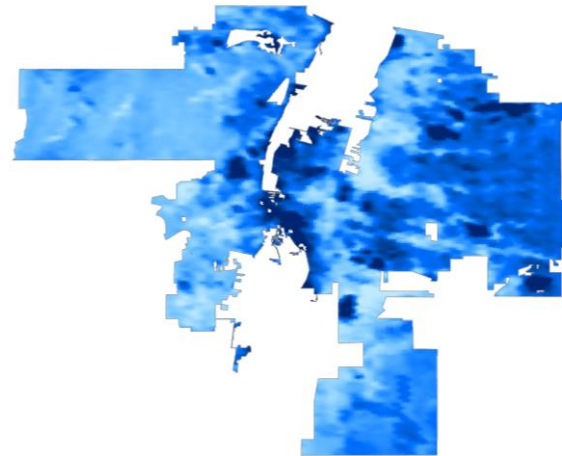
Heat Mitigation Index



Shade

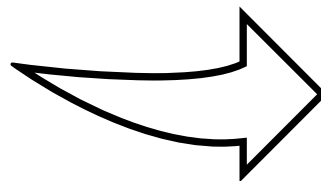


Evapotranspiration



InVEST Hack

Land cover averages over the whole city

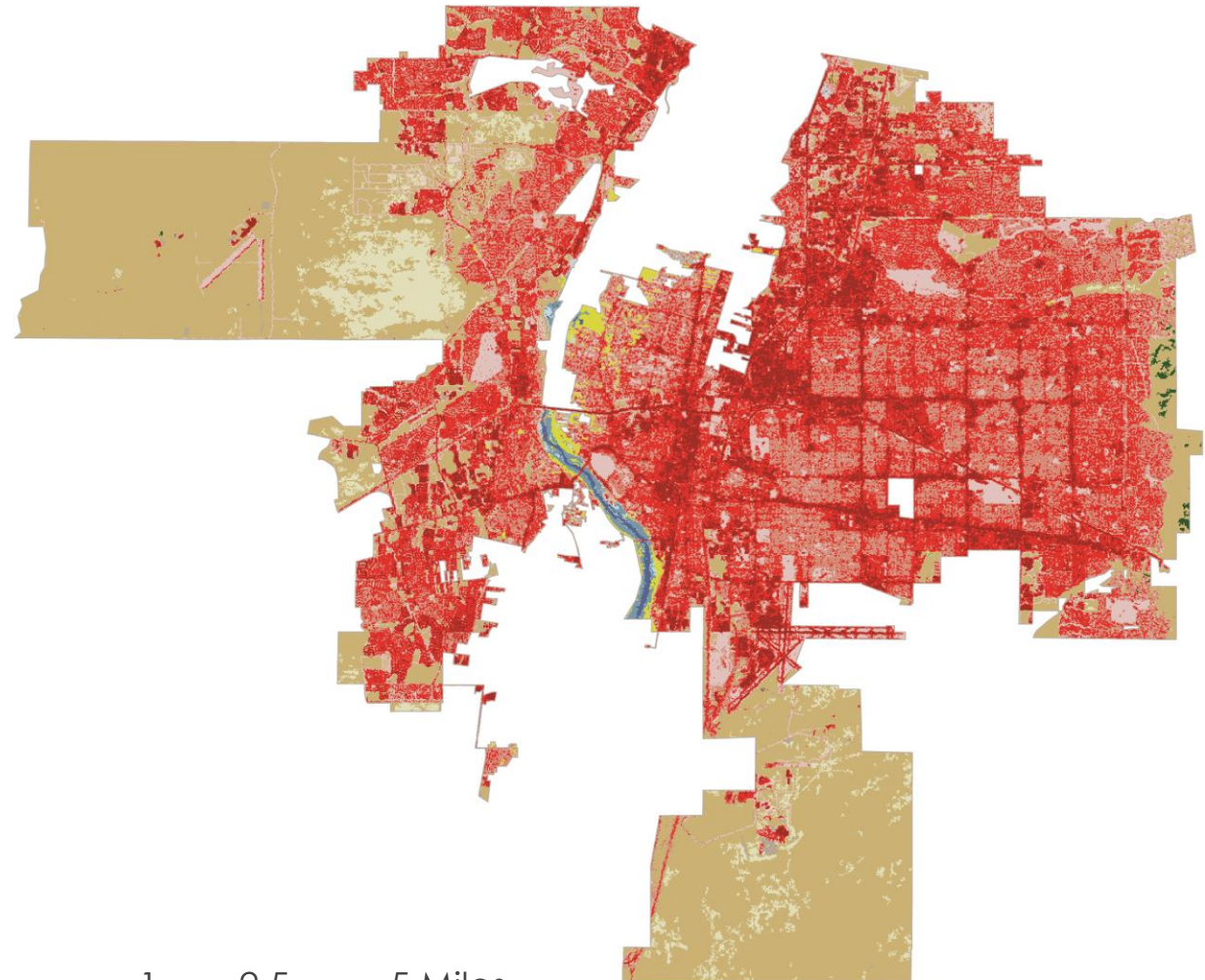


Land cover averages by census block group

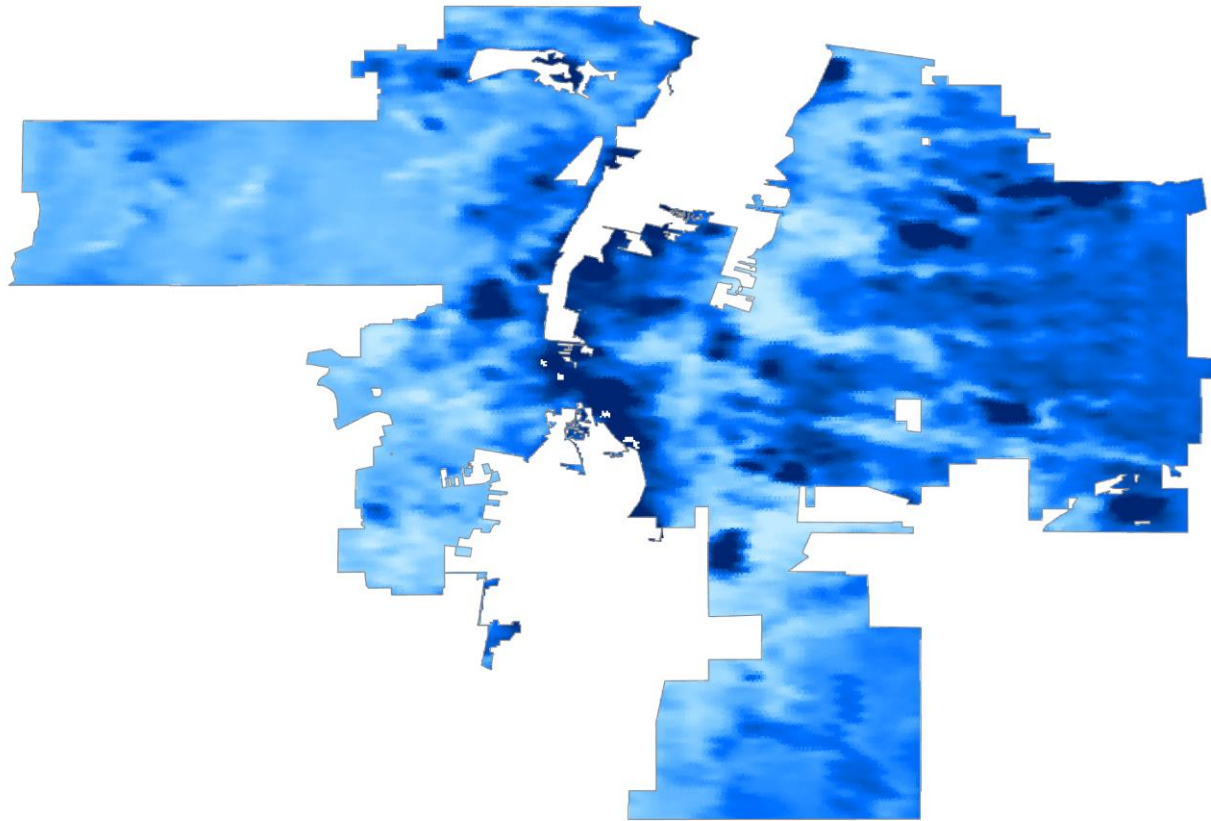


Land Cover

- Open Water
- Developed, Open Space
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Barren Land (Rock/Sand/Clay)
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Shrub/Scrub
- Grassland/Herbaceous
- Pasture/Hay
- Cultivated Crops
- Woody Wetlands
- Emergent Herbaceous Wetlands



Evapotranspiration



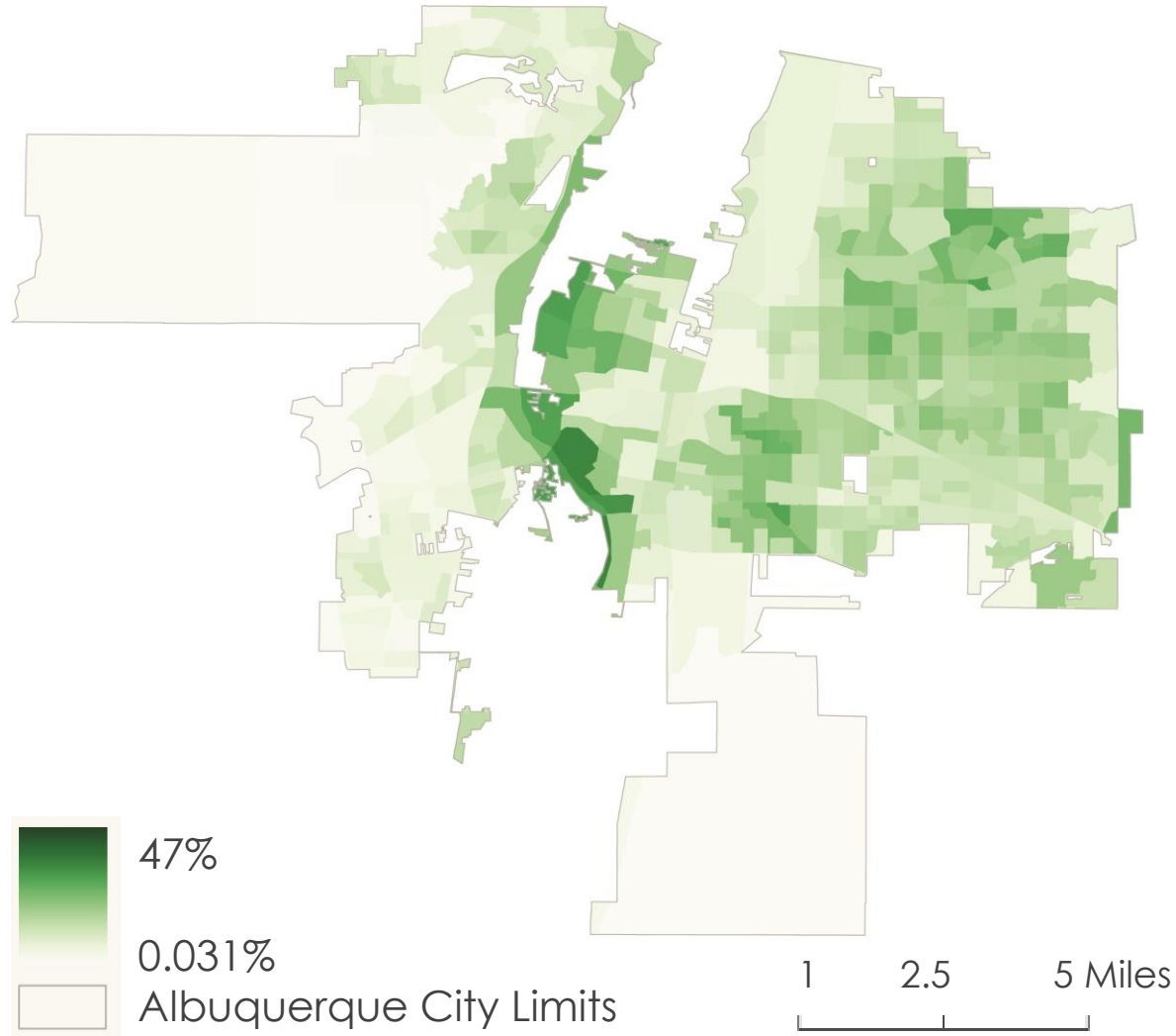
- ▶ ECOSTRESS Instantaneous Values
- ▶ Composite Image from 2019

8.7 mm/day

1 2.5 5 Miles



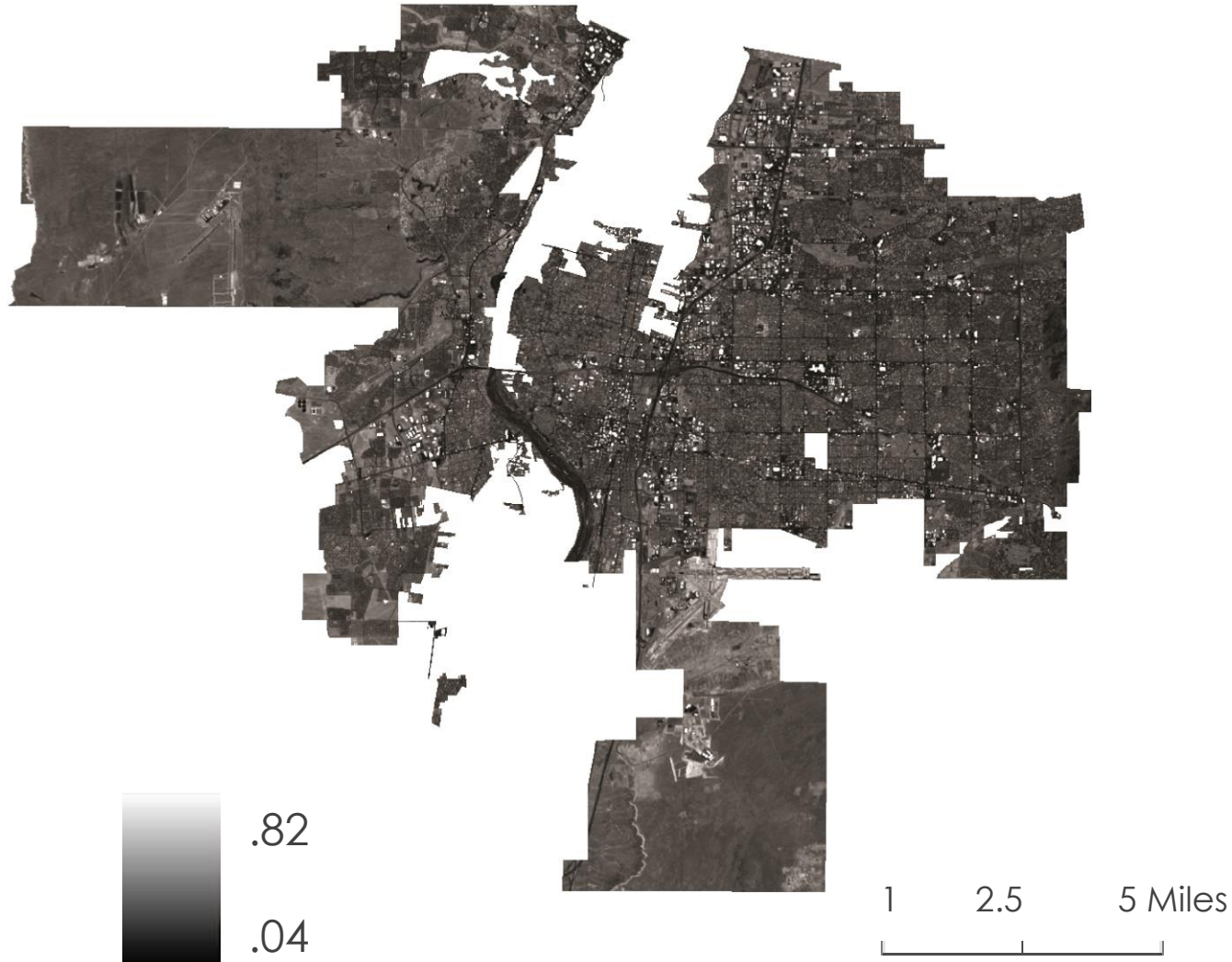
Biophysical Table: Current Tree Canopy Cover



- ▶ The Nature Conservancy of New Mexico NAIP 2020 Tree Canopy Cover
- ▶ 30m resolution
- ▶ Input for 'shade' variable in biophysical table



Biophysical Table: Albedo

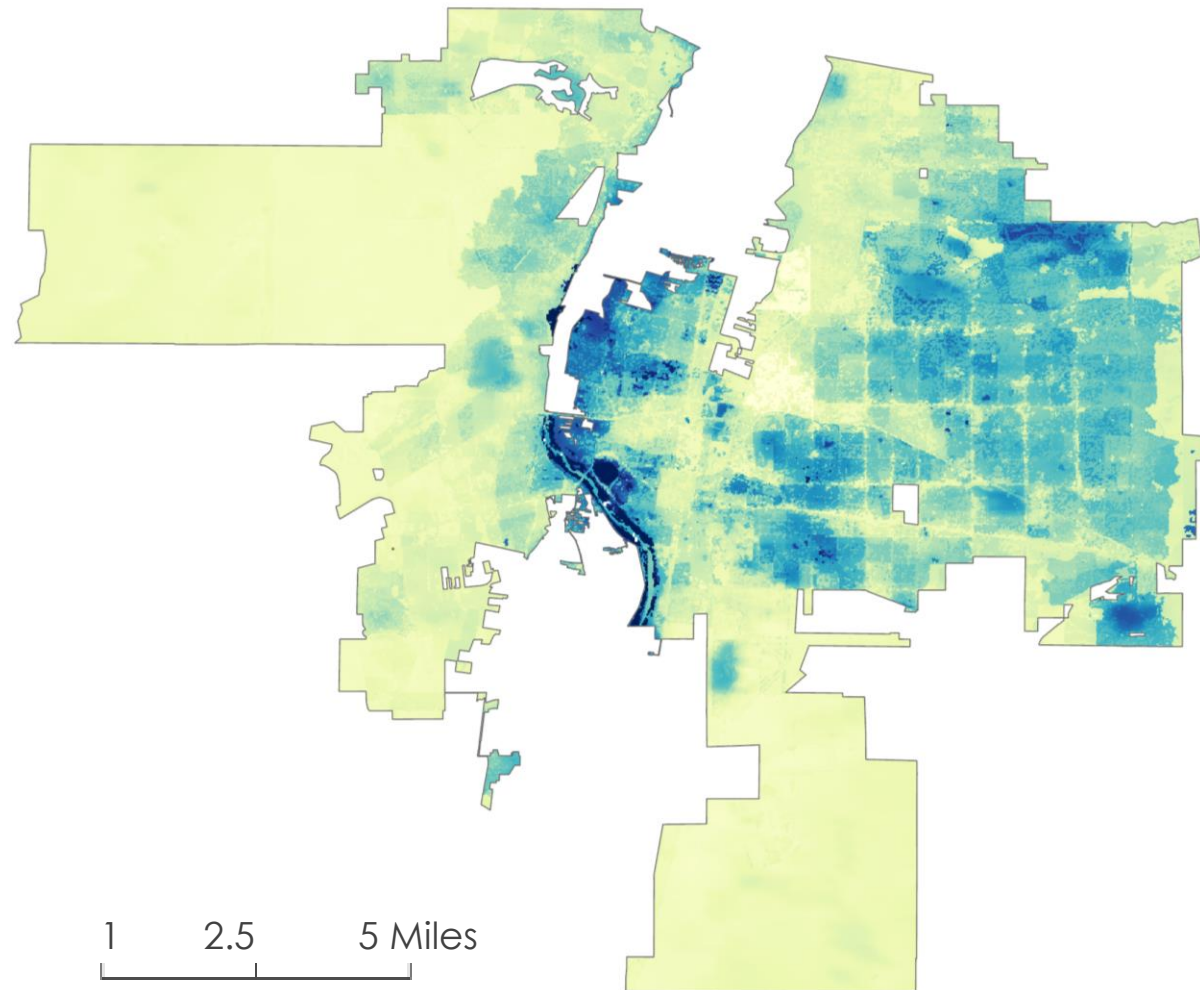
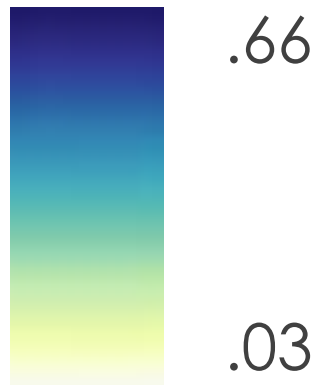


- ▶ Philadelphia Health & Air Quality, Spring 2020 code
- ▶ Landsat 8 surface reflectance
- ▶ Input for 'albedo' variable in biophysical table



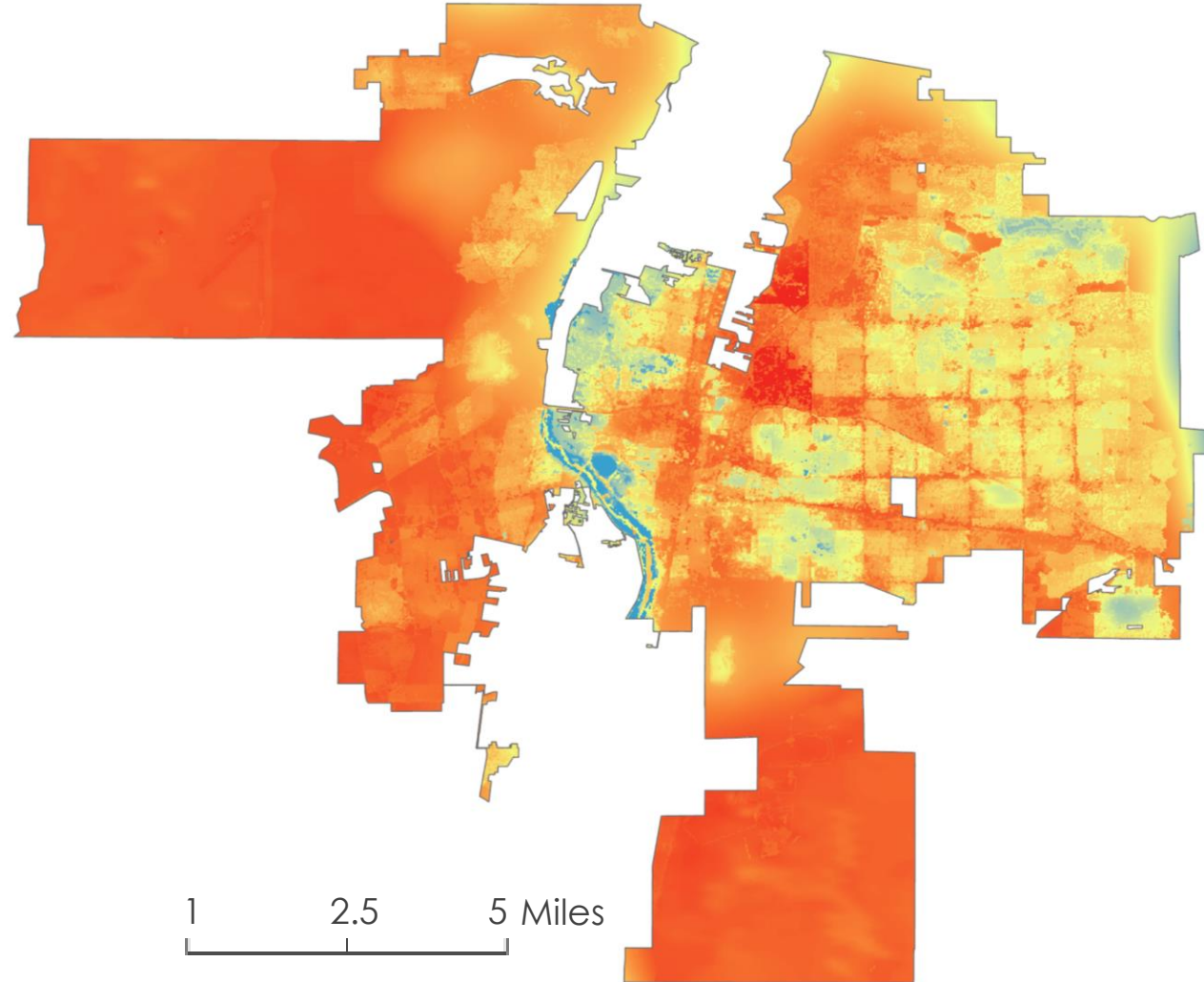
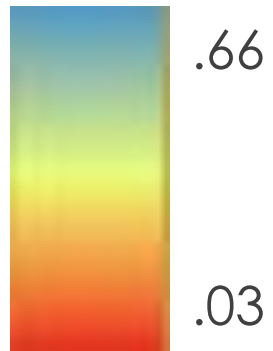
InVEST Outputs

Current Cooling Capacity Index



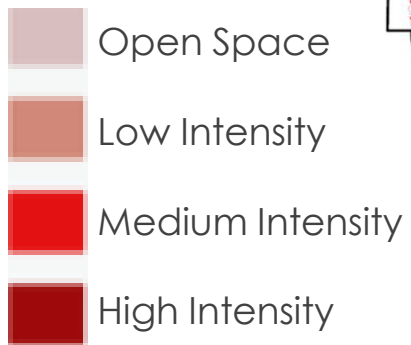
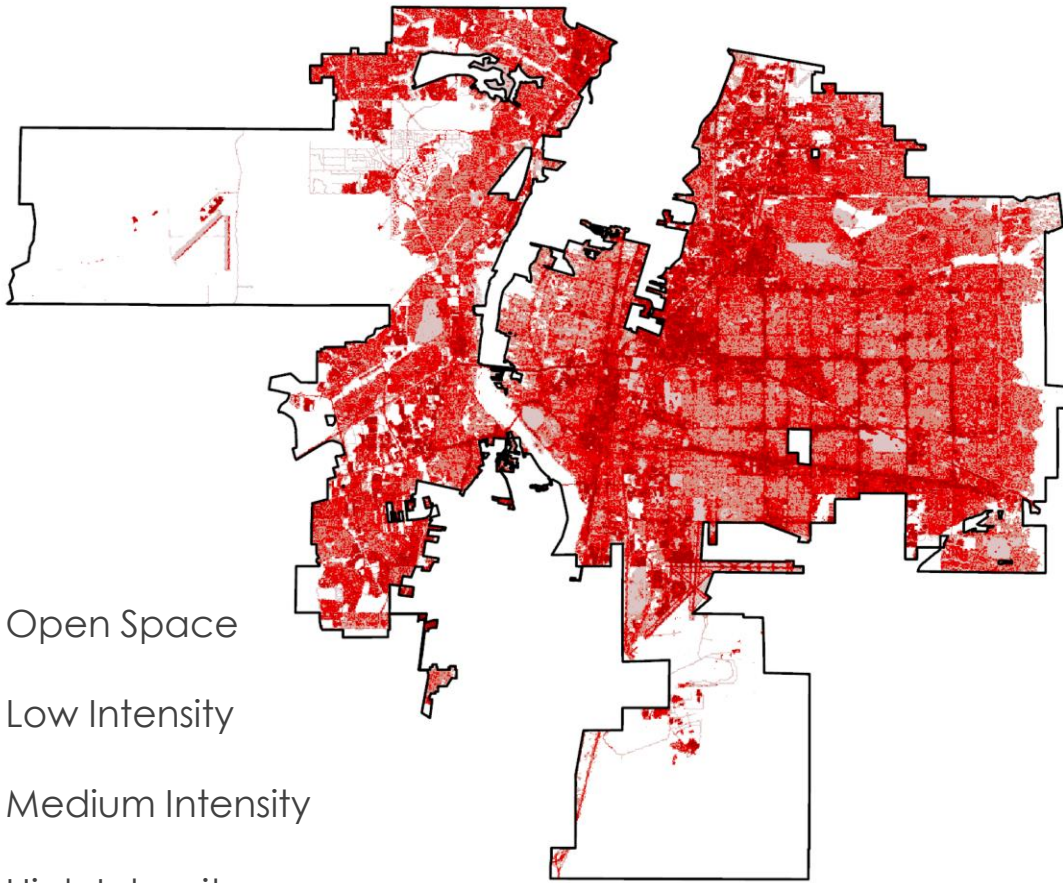
InVEST Outputs

Heat Mitigation Index

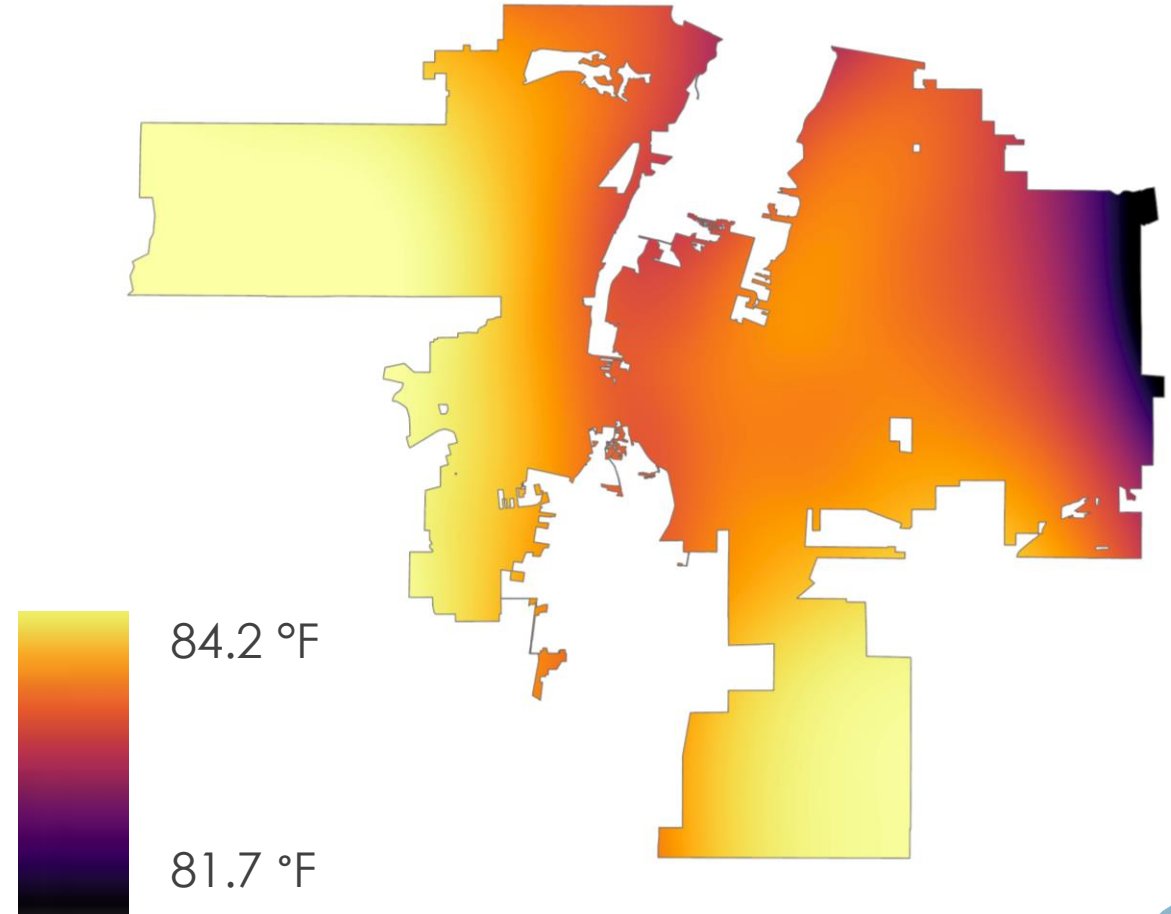


InVEST Outputs

'Developed' Land



Estimated Air Temperature



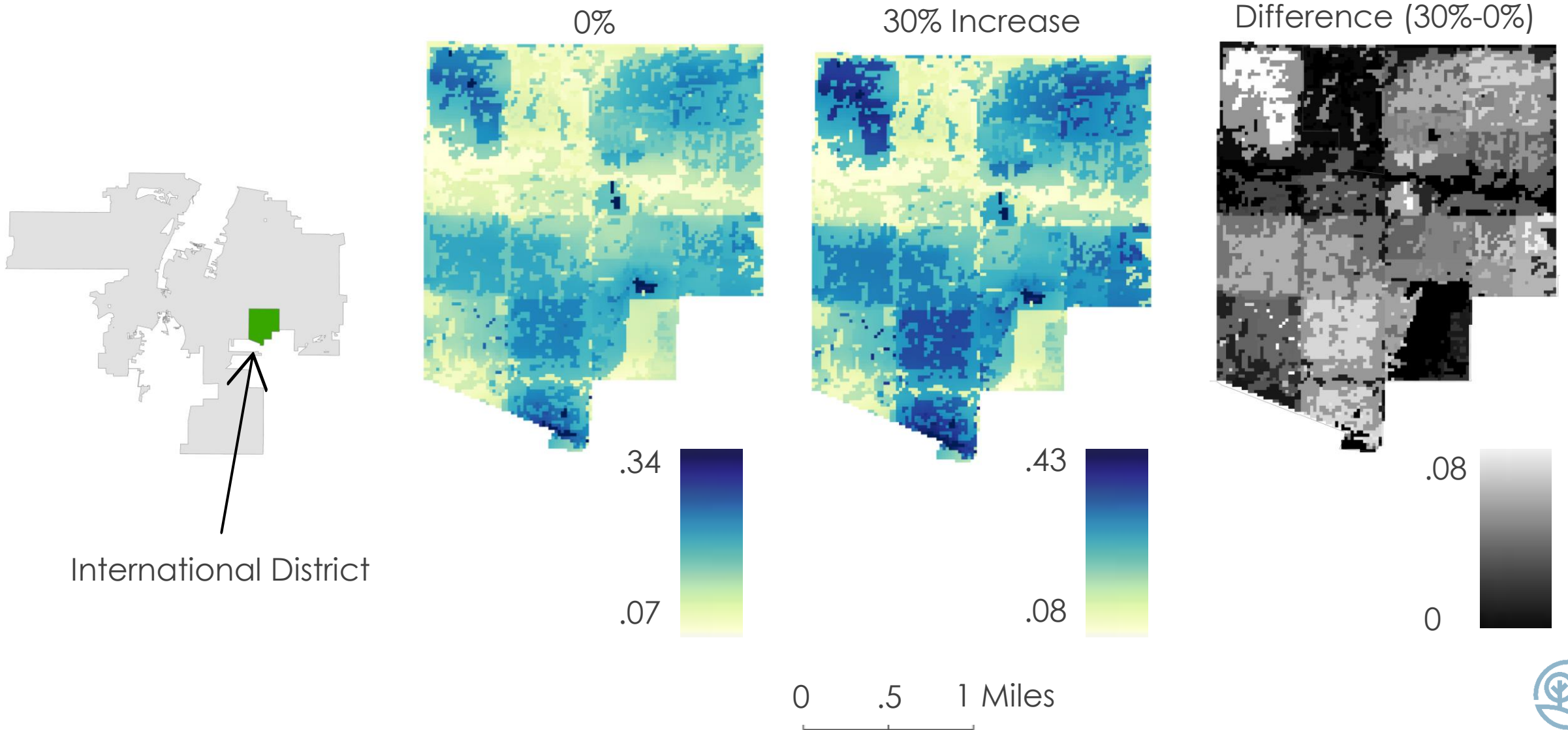
84.2 °F

81.7 °F

1 2.5 5 Miles



Example Usage: Cooling Capacity





Priority Cooling Region



Multiple Canopy Adaptation Models



Potential Cooling / Human Thermal Comfort

ENVI-met



ENVI-Met: Simulation Locations



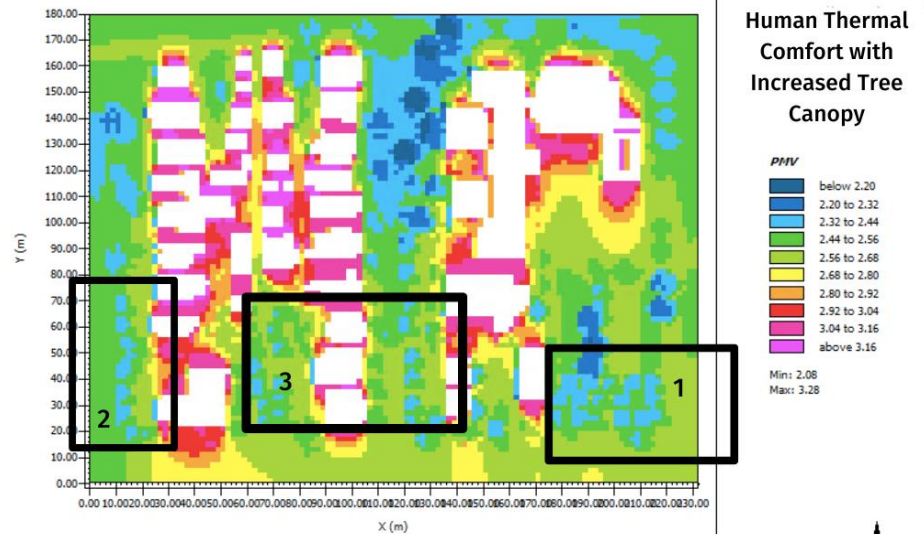
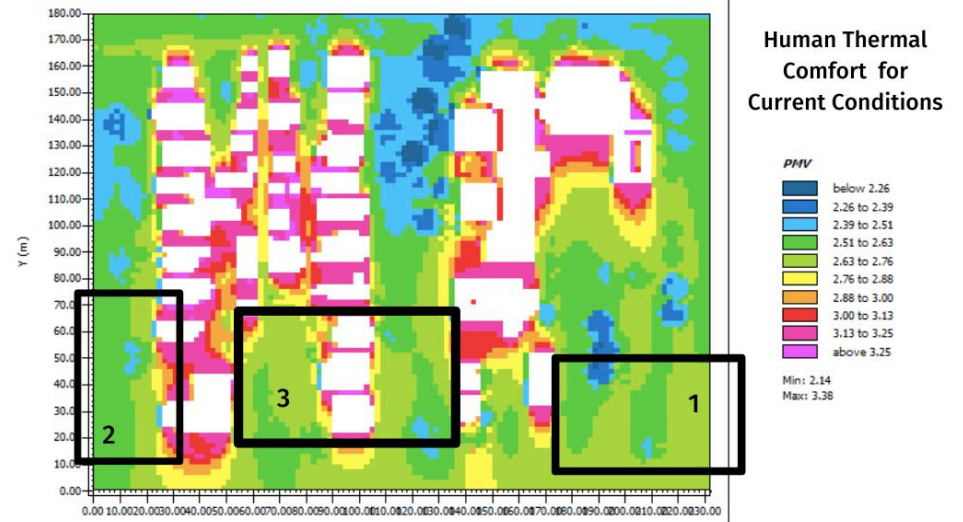
True color image of South Broadway Neighborhood



Neighborhood as modeled in ENVI-met



ENVI-Met: Thermal Comfort



Errors and Uncertainties



Coarse Spatial Resolution



Time Constraints



LST vs. Experienced Temperature



Estimated Socioeconomic Data

Future Work

Increased Urban Tree Canopy

- ▶ Additional Tree Planting Initiatives
- ▶ Ecosystem Services
- ▶ Public health implications + access to greenspace

Vulnerability in Albuquerque

- ▶ Definition of Vulnerability
- ▶ Intersectionality of Vulnerabilities
- ▶ Environmental Justice
- ▶ Collaboration with Community Organizers and University Engagement

ACKNOWLEDGEMENTS

Advisors, Mentors, & Fellows

- ▶ Dr. David Hondula (Arizona State University, City of Phoenix Office of Heat Response and Mitigation)
- ▶ Dr. Kenton Ross (NASA Langley Research Center)
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- ▶ Michelle Gricius (GIS Manager, City of Albuquerque Planning Department)
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Additional Support

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