Guidance on integrating socio-economic data into vulnerability assessments

Union of Concerned Scientists


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What is vulnerability?

- A term used to describe susceptibility to harm.
- The likelihood of a human or natural system or any of its components (e.g., people, plants, animals, and buildings) to be harmed due to exposure to a hazard (e.g., sea level rise, a hurricane, heat waves).

EXPOSURE

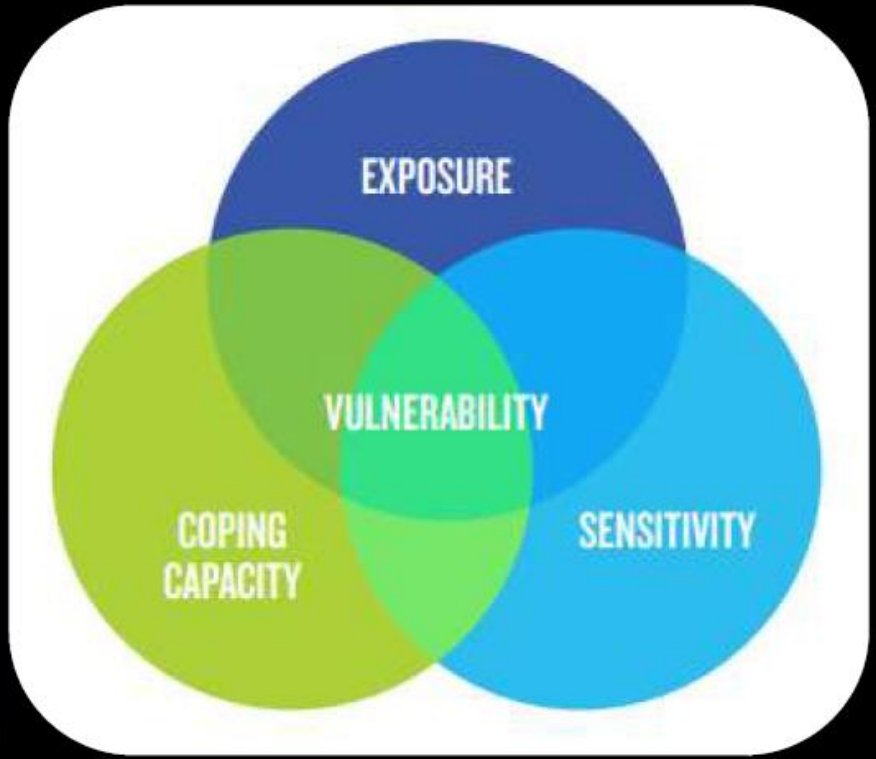
Exposure describes the nature and magnitude of an environmental stress event (e.g., extreme temperature, flood, drought) and is usually quantified in terms of the probability that the event will affect people or a system, the duration of the event, and its spatial magnitude.[11] Climate hazard events, like extreme precipitation, typically have an impact at a regional or larger scale; consequently, exposure is usually characterized regionally. Depending on hazard type and data sources, differences in the magnitude of exposure can often be quantified at fine spatial or temporal scales.

ADAPTIVE (OR COPING) CAPACITY

Populations make use of both formal and informal mechanisms—resources, assets, interpersonal relationships, and institutions—to cope with or adapt to climate hazards. *Adaptive capacity* captures these mechanisms' potential to avoid, minimize, or cope with the negative effects of climate exposure.[12] Adaptive capacity is more difficult to quantify than exposure and sensitivity due to the lack of publicly available data. Proper quantification of this element typically requires collection of data at the local level.

SENSITIVITY

Sensitivity describes the socioeconomic or demographic characteristics (e.g., race or ethnicity, income and poverty status, educational level, linguistic barriers, type of housing, built environment characteristics) that can make people susceptible to the negative effects of an exposure. It is often measured at the individual, household, or community scale. Census data on these characteristics at the national, state, county, block group, and tract levels in the United States make it relatively straightforward to characterize sensitivity to climate hazards.



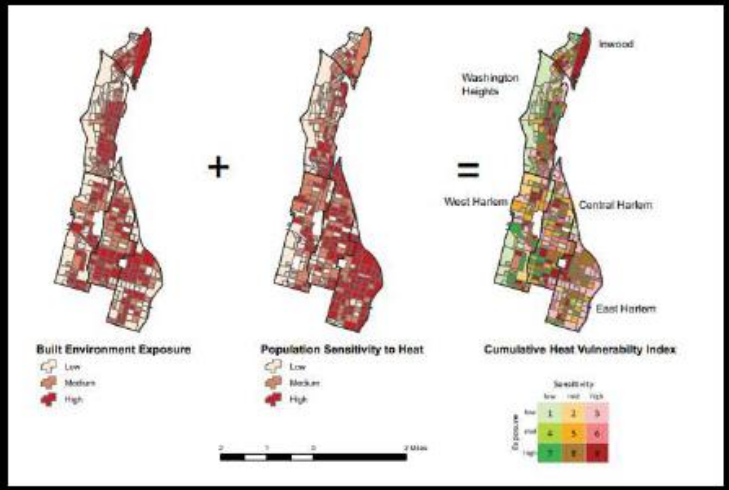
No, but really, what is it?

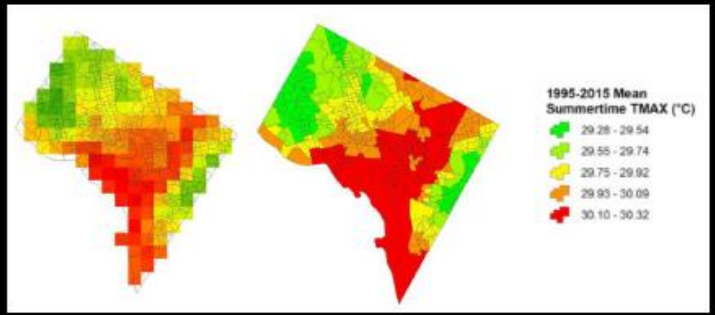
Climate vulnerability assessments

Vulnerability assessments are a helpful mechanism to identify the people and places most vulnerable to climate change at the local level.

Vulnerability assessments can help communities answer these key questions*:

1. What are the key exposures and sensitivities leading to vulnerability, and how effective are the applied coping strategies?
2. What are the key consequences of climate change impacts on the environment and human well-being?
3. What are the adaptation responses that could address the estimated impacts of climate change while helping build resilience in natural and human systems?
4. What are the types of interventions, capacities, and main steps needed to be undertaken to implement adaptations





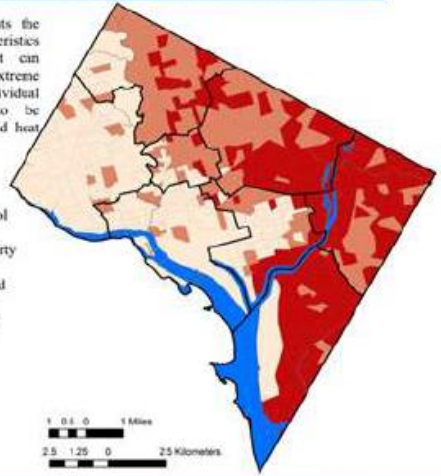
* United Nations Environment Programme, "Vulnerability and Climate Change Impact Assessments for Adaptation: VIA Module," November 2009, https://wedocs.unep.org/bitstream/handle/20.500.11822/11217/ClimateChange_Manual_Final.pdf?sequence=1&isAllowed=y.

Heat vulnerability assessment

[SENSITIVITY: WHO IS SUSCEPTIBLE TO HEAT?

This dimension represents the socio-economic characteristics of the population that can magnify vulnerability to extreme heat, and includes individual risk factors known to be associated with increased heat morbidity or mortality:

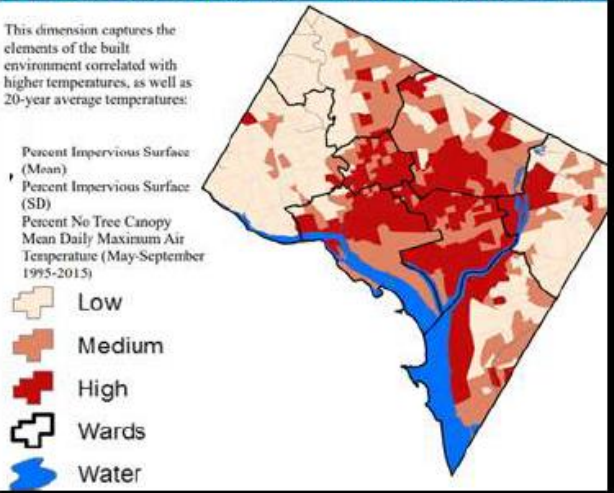
- Percent Not White
- Percent No High School Diploma
- Percent Living in Poverty
- Percent Elderly
- Percent Receiving Food Stamps
- Percent with Disability
- Percent with no AC

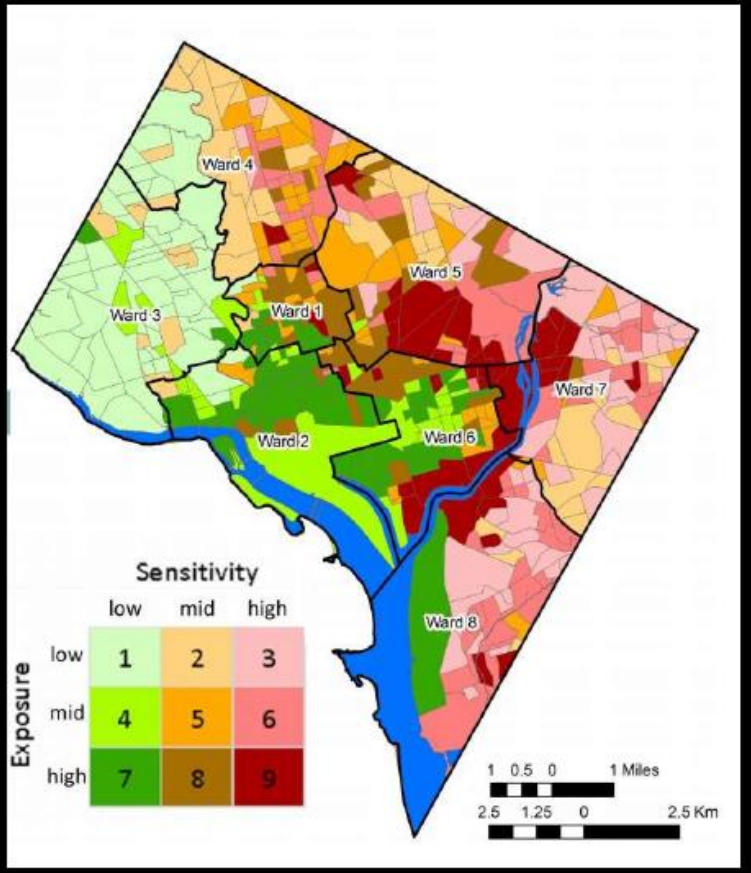


[EXPOSURE: WHERE ARE THE HEAT-PRONE AREAS

This dimension captures the elements of the built environment correlated with higher temperatures, as well as 20-year average temperatures:

- Percent Impervious Surface (Mean)
- Percent Impervious Surface (SD)
- Percent No Tree Canopy
- Mean Daily Maximum Air Temperature (May-September 1995-2015)





Filling in coping capacity

FIGURE 8: BARRIERS TO USING AC DURING HOT WEATHER IN NORTHERN MANHATTAN

Data from 2014-2015

- Don't like the noise of AC 4%
- Don't know 5%
- Don't like the feeling of AC; not my preference 6%
- Prefer not to answer 9%
- Don't have a home AC unit, or not provided by landlord 9%
- Can't afford to operate/cost of electricity 10%
- Can't afford to purchase, fix, or repair an AC unit 18%
- Nothing prevents me; I use it 40%

We asked Northern Manhattan residents what new measures they would like to see implemented during heat waves and very hot days. Here are some of their responses.

- More cooling centers, with longer hours
- Distribution of free water
- More public drinking fountains
- Distribution of free fans
- More public pools, with longer hours
- Planting of more trees
- Free air conditioners for those in need, with vouchers for electricity bills
- More parks or green areas
- More help for the elderly
- More readily available information in residential buildings, such as posters in common areas listing symptoms to watch for and numbers to call for help
- Incentives for landlords to make modifications to reduce heat vulnerability
- Fans for subway platforms


{ Thank You
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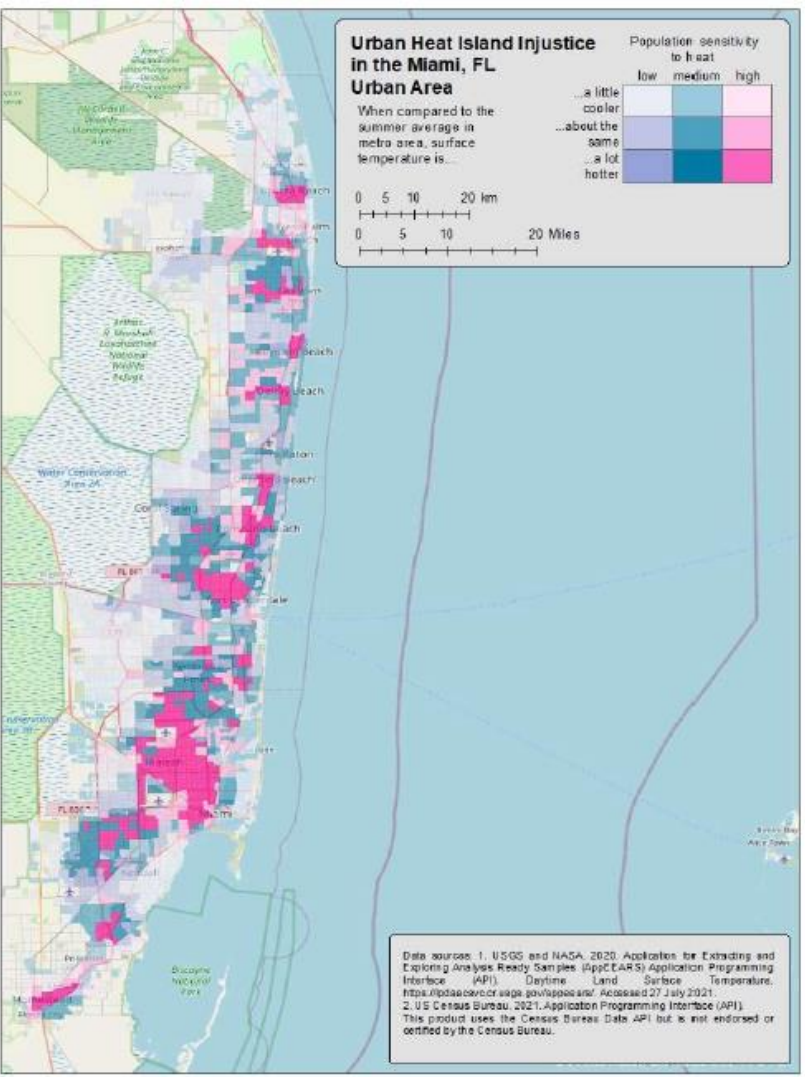
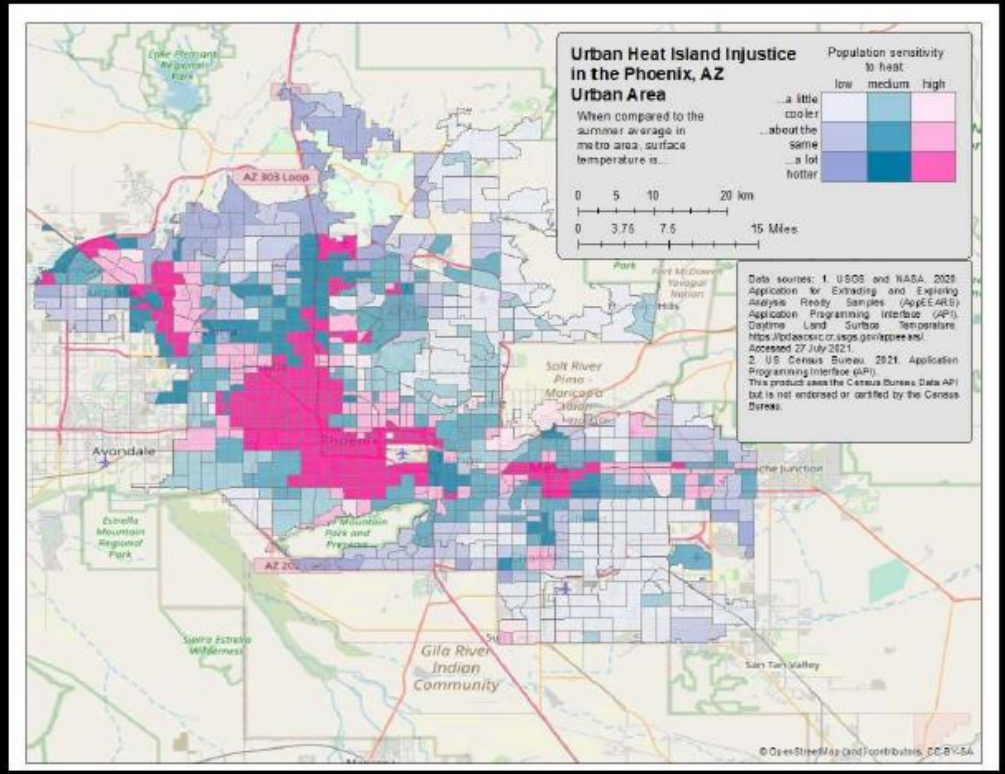
Resources

1. Guide to Community Climate Vulnerability Assessments - https://www.nrdc.org/sites/default/files/guide-community-climate-vulnerability-assessments-report.pdf
2. Mapping Extreme Heat Vulnerability and Health Outcomes to inform the District of Columbia's Climate Adaptation Plan: Progress Report. https://www.academia.edu/37170191/Mapping_Extreme_Heat_Vulnerability_and_Health_Outcomes_to_inform_the_District_of_Columbias_Climate_Adaptation_Plan_Progress_Report
3. Inequities of keeping cool in urban heat islands - https://blog.ucsusa.org/juan-declet-barreto/the-inequities-of-keeping-cool-in-urban-heat-islands/

TABLE A1: SOCIOECONOMIC AND BUILT ENVIRONMENT DESCRIPTOR VARIABLES USED IN HEAT VULNERABILITY MAPPING				
VARIABLE	**DESCRIPTION**	**SOURCE**	**TIME PERIOD**	**SPATIAL SCALE**
Sensitivity				
Percent White (not Hispanic)	Percentage of the population of the White race and not of Hispanic or Latino/Latina origin/ethnicity	U.S. 2010 Census	2010	Census Block Group
Percent Black/African American (not Hispanic)	Percentage of the population of the Black/African American race and not of Hispanic or Latino/Latina origin/ethnicity	U.S. 2010 Census	2010	Census Block Group
Percent Hispanic	Percentage of the population that is of Cuban, Mexican, Puerto Rican, South or Central American (except for Brazil) origin	U.S. 2010 Census	2010	Census Block Group
Percent Asian (not Hispanic)	Percentage of the population of the Asian race and not of Hispanic or Latino/Latina origin/ethnicity	U.S. 2010 Census	2010	Census Block Group
Percent 65 or Older	Percentage of the population that is 65 of years of age or older	U.S. 2010 Census	2010	Census Block Group
Percent Living Alone	Percentage of households that contain exactly one person	U.S. 2010 Census	2010	Census Block Group
Percent with Disability	Percentage of the population 16 to 64 years of age with at least one mental or physical disability	2010 ACS*	2006-2010	Census Block Group
Percent No High School Diploma	Percentage of the population over 25 years of age that has not obtained at least a High School Diploma or GED equivalent	2010 ACS*	2006-2010	Census Block Group
Percent in Poverty	Percentage of the households whose ratio of income to poverty level is less than one	2010 ACS*	2006-2010	Census Block Group
Exposure				
Percent Trees	Percentage of all pixels in Census Block Group that are classified as trees	MacFaden et al. (2012)	2010	3-ft^2 pixel aggregated to CBG
Percent Impervious	Percentage of all pixels in Census Block Group that are classified as roads, buildings, or other paved surfaces	MacFaden et al. (2012)	2010	3-ft^2 pixel aggregated to CBG
Land Surface Temperature				
Mean and Standard Deviation LST for May-September 2007-2011	Mean and standard deviation surface temperature (°C) at the time of diurnal satellite overpass	Landsat 2007-2011	summer months 2007-2011	30-m^2 pixel aggregated to CBG


Urban Heat Island Injustice in the Miami, FL Urban Area
When compared to the summer average in metro area, surface temperature is...
Population sensitivity to heat
low medium high
...a little cooler
...about the same
...a lot hotter
0 5 10 20 km
0 5 10 20 Miles
Data sources: 1. USGS and NASA. 2020. Application for Extracting and Exploring Analysis Ready Samples (AppEEARS) Application Programming Interface (API). Daytime Land Surface Temperature. https://lpdaacsvc.cr.usgs.gov/appeears/. Accessed 27 July 2021.
2. US Census Bureau. 2021. Application Programming Interface (API).
This product uses the Census Bureau Data API but is not endorsed or certified by the Census Bureau.


Urban Heat Island Injustice in the Phoenix, AZ Urban Area
When compared to the summer average in metro area, surface temperature is...
Population sensitivity to heat
low medium high
...a little cooler
...about the same
...a lot hotter
0 5 10 20 km
0 3.75 7.5 15 Miles
Data sources: 1. USGS and NASA. 2020. Application for Extracting and Exploring Analysis Ready Samples (AppEEARS) Application Programming Interface (API). Daytime Land Surface Temperature. https://lpdaacsvc.cr.usgs.gov/appeears/. Accessed 27 July 2021.
2. US Census Bureau. 2021. Application Programming Interface (API).
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Avondale
Phoenix
Gila River Indian Community
Salt River Pima-Maricopa Indian Community
AZ 303 Loop
AZ 202
Estrella Mountain Regional Park
Sierra Estrella Wilderness
Lake Pleasant Regional Park
Fort McDowell Yavapai Nation
San Tan Valley
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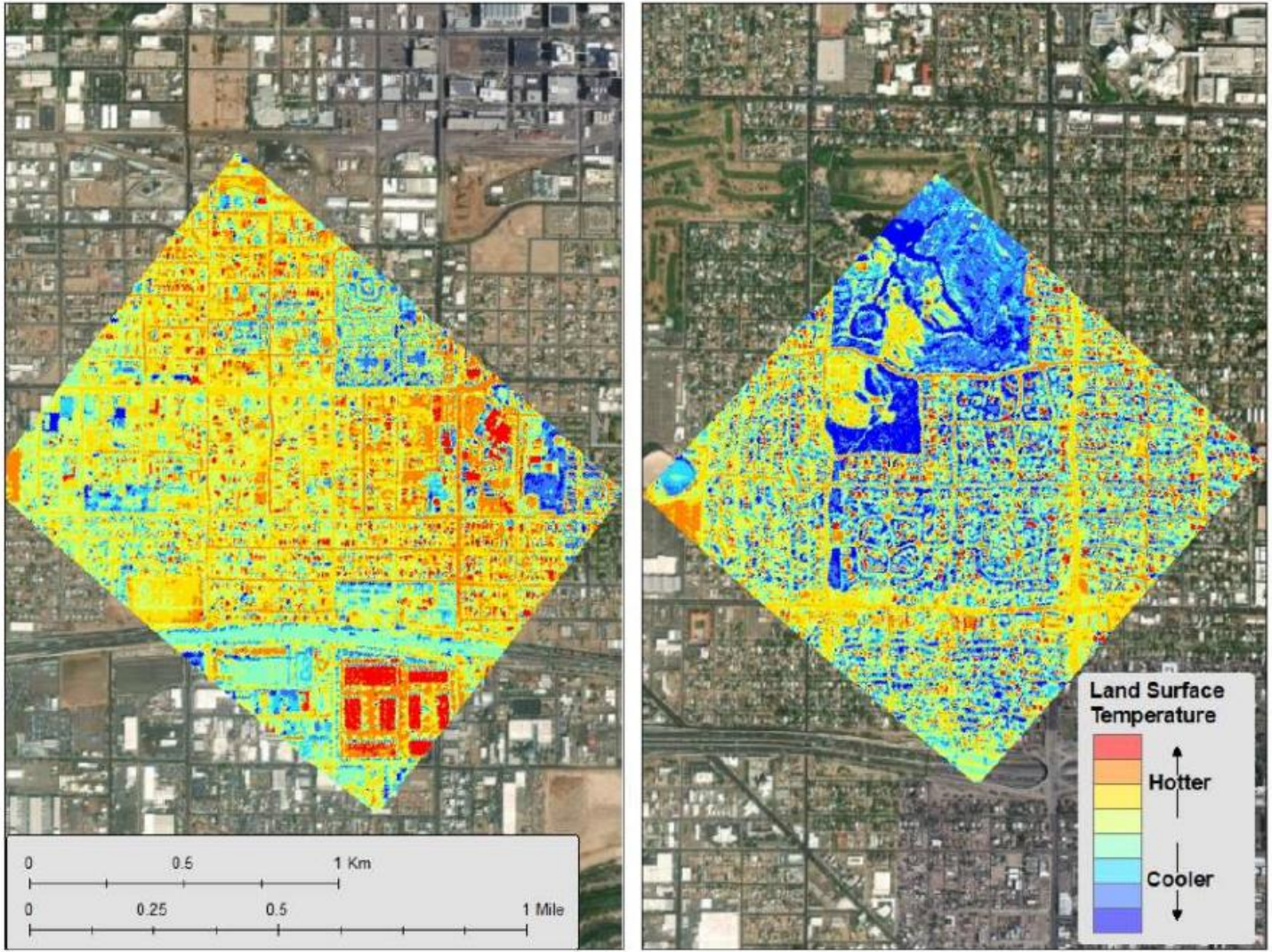
0
0.5
1 Km
0
0.25
0.5
1 Mile
Land Surface Temperature
Hotter
Cooler