



Establishing an Urban Heat Exposure Severity Index for Infrastructure Prioritization in Tempe, Arizona, Using NASA Earth Observations and LiDAR

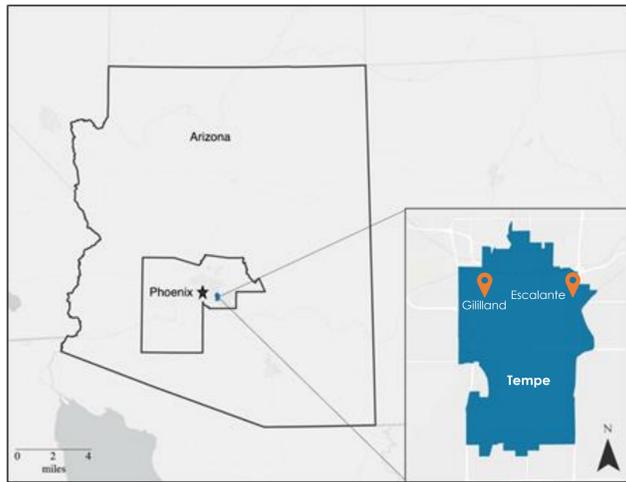


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Objectives

- ▶ Integrate the capabilities of NASA's Earth observations with *in situ* measurements and socioeconomic and health demographics to help address the pressing concern of urban heat.
- ▶ Provide the City of Tempe, Arizona, a sharable geodatabase that can be used to develop future urban heat mitigation initiatives.
- ▶ Identify areas with the highest heat vulnerability using a principal component analysis (PCA) of socioeconomic, health, and environmental indicators to target public health awareness outreach and cooling initiatives.

Study Area

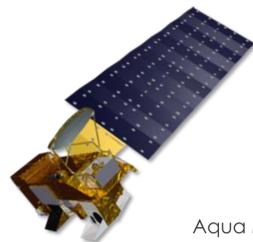


195,000 Residents
 Growing 3% Annually
 Area: 40 Square Miles
 Annual Averaged Temperature: 76.7 °F
 Annual Averaged Rainfall: 8 inches

Earth Observations



Landsat 8 OLI



Aqua MODIS

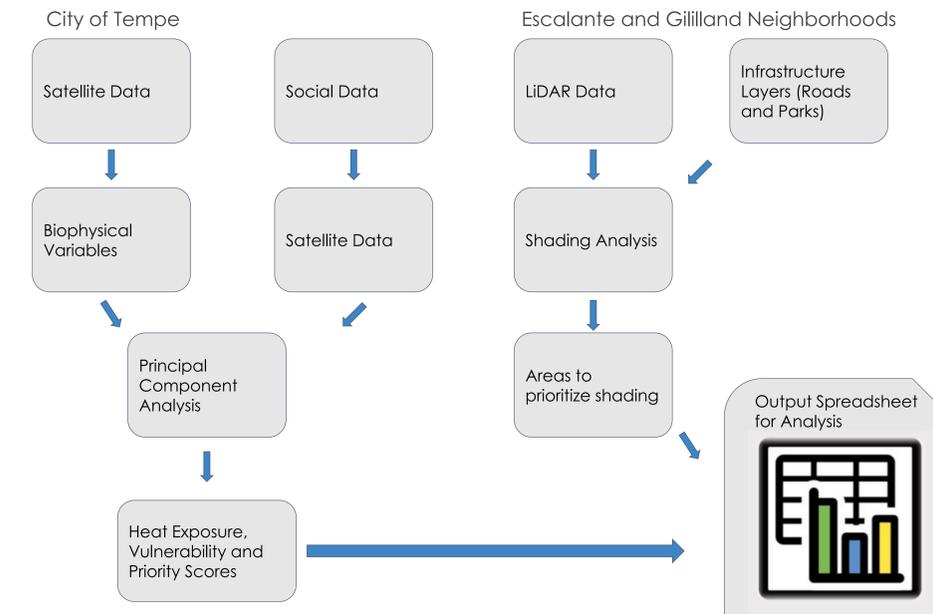
Project Partners

- ▶ City of Tempe
 - ▶ Dr. Braden Kay, Project Lead City of Tempe, Sustainability Director; Dr. Paul Coseo; HUE Initiative Project Advisor; Dr. Katja Brundiers, HUE Initiative Project Advisor
- ▶ Arizona State University School of Sustainability

Abstract

Located on the banks of the Salt River in the Sonoran Desert, Tempe, Arizona, features a semi-arid climate with summer daily maximum temperatures regularly exceeding 37.8°C. Tempe is also subject to the southwestern monsoon season from July-September and the humidity exacerbates the high temperatures. Furthermore, the rapid urbanization experienced in Tempe has resulted in an intensification of the urban heat island. The summer of 2020 shattered the previous record of days exceeding 43.4°C, leading to higher energy and water costs, lower comfort, and increased risk of heat stroke for residents. Recognizing the impacts of extreme heat, the City of Tempe partnered with the Healthy Urban Environments initiative and NASA DEVELOP to identify census tracts that experience a higher mean land surface temperature than the city average. The NASA DEVELOP team used remotely sensed land surface temperature (LST), normalized difference vegetation index (NDVI), normalized difference built-up index (NDBI), normalized difference water index (NDWI), and albedo data calculated from Aqua Moderate Resolution Imaging Spectroradiometer (MODIS) and Landsat 8 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) instruments from 2015 to 2020 to create heat hazard and exposure maps. LiDAR point cloud data, provided by the United States Geological Survey through Arizona State University's Map and Geospatial Hub, were used to derive 3D buildings, building footprints, and tree point data for a shading analysis of walking paths, roads, and buildings at the census tract level. *In situ* meteorological measurements including air temperature and humidity were used to compare the macro-scale temperature measurements. The team worked with the City of Tempe to develop a methodology to process available data and identify areas of highest concern for urban heat effects within the city. With these insights, Tempe, Arizona can better address these issues with data-driven information to make decisions regarding heat mitigation and adaptation efforts.

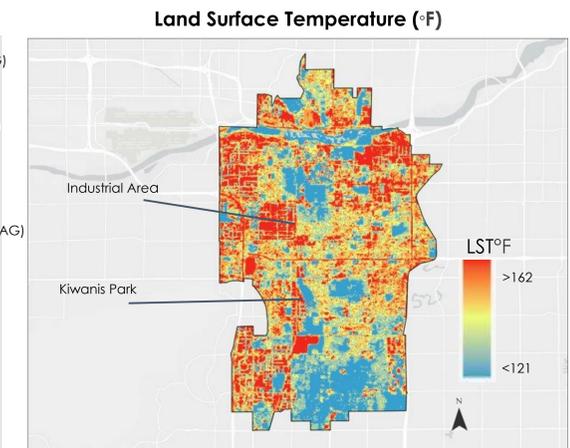
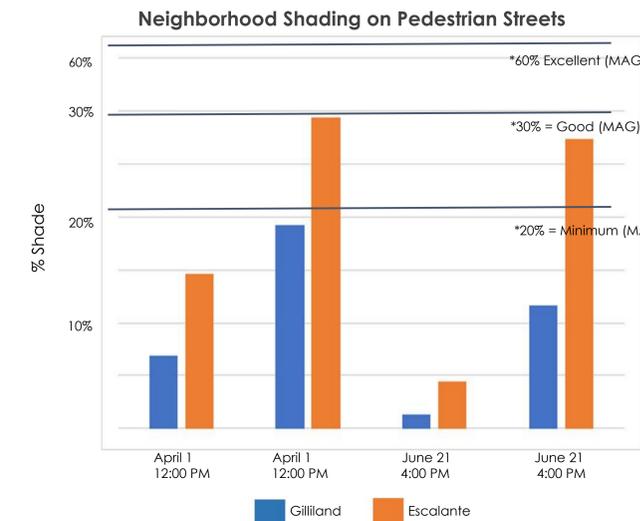
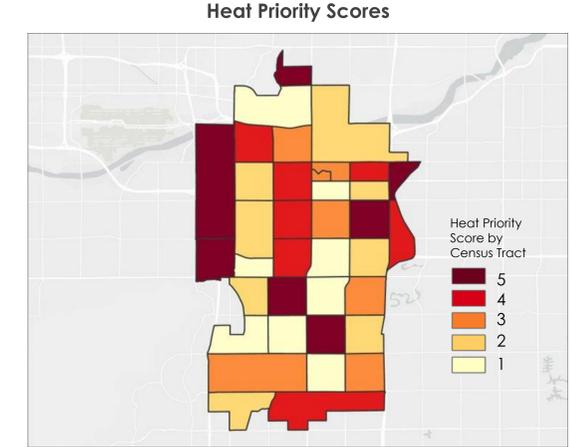
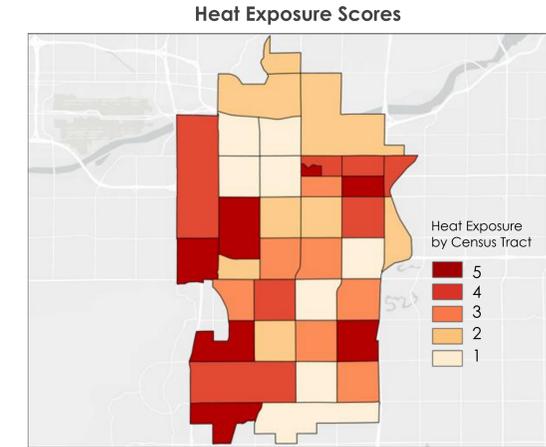
Methodology



Acknowledgements

- ▶ Ryan Hammock (NASA DEVELOP) and Dr. David Hondula (Arizona State University)
- ▶ Dr. Brandon Kay and the rest of the city staff and those involved in the HUE Initiative.
- ▶ Previous contributors: Hannah Bonestroo, Roger Alvarez, Elizabeth Swanson, and Taylor Quinn

Results



Conclusions

- ▶ The PCA analysis showed that NDBI, NDVI and LST explained the most variation for the biophysical variables, while % poverty, % population over 65, and % minority explained the most variation in terms of vulnerability.
- ▶ Based on the Heat Exposure Map, western Tempe and areas adjacent to the Kyrene Industrial Park scored the highest.
- ▶ Shading in the Gilliland and Escalante neighborhoods can be greatly improved upon for pedestrian comfort.

About DEVELOP
 #NASADEVELOP

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