Heat and Health Data Explorer: User Guide and Technical Documentation

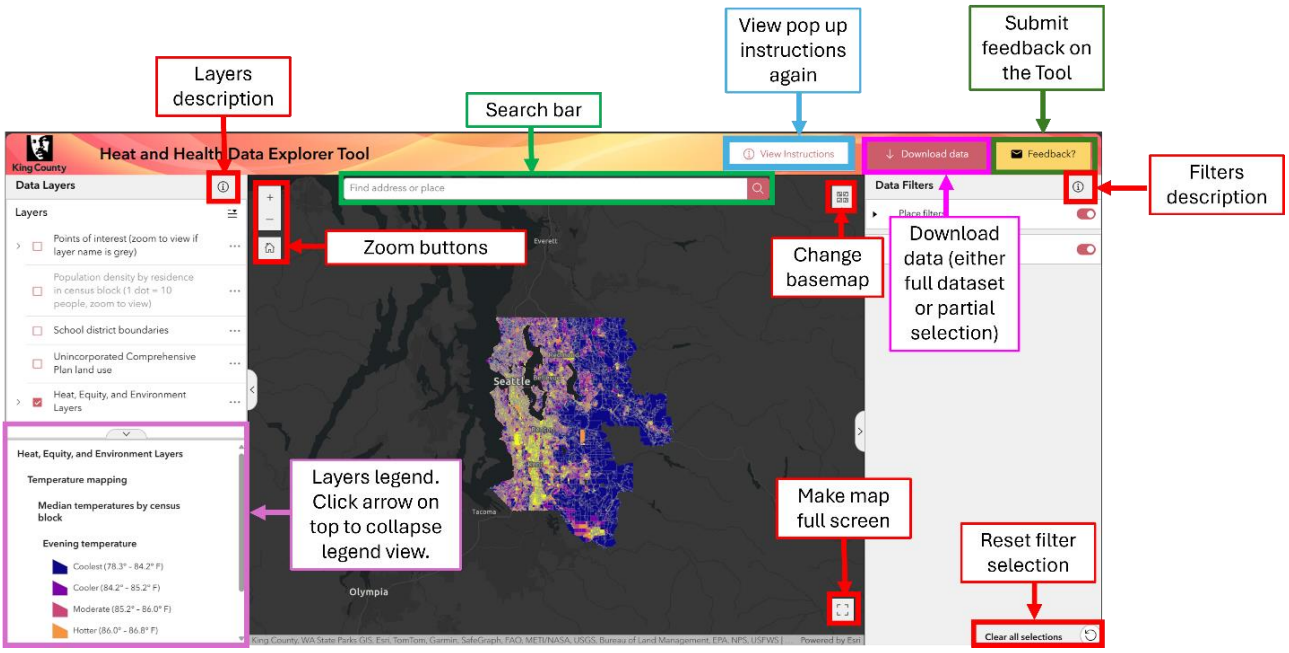
Introduction

Welcome to the King County Heat and Health Data Explorer! This tool is designed to help you visualize heat islands in King County (mapped by census block), understand what factors contribute to heat exposure and risk, and better plan for extreme heat before it happens. Using the tool, you can explore local data to identify areas most vulnerable to extreme heat, assess contributing factors, and support evidence-based decision-making for heat mitigation strategies and community planning. While this tool can be an invaluable resource for strategic planning and policy development, please note that **it is not intended for emergency response or real-time decision-making** during heat events.

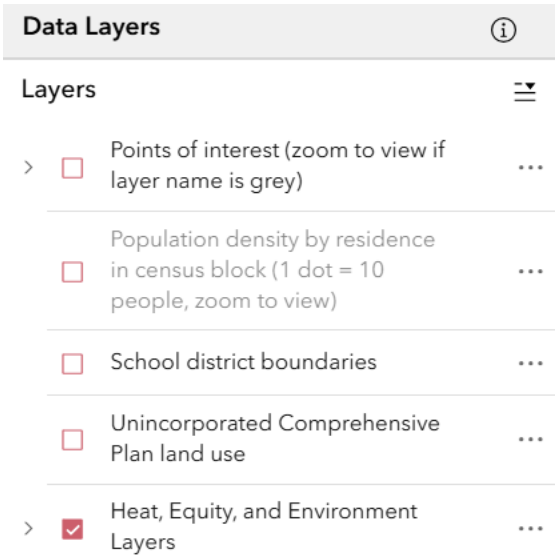
This document contains...

1. Tool Layout

The tool uses data layers and filters to visualize and analyze the content. Here is a diagram of all features in the tool:



Data layers, on the left side of the screen, allow you to view geographic data. Each layer represents a specific dataset displayed on the map. You can hover over the "i" information icon in the header to learn more about how to use layers. Layers can be turned on or off in a group or individually. Layers are color-coded for easy interpretation. Refer to the legend on the right-hand side of the map to see which layer is active and what the colors represent. Layer titles that are greyed out means you need to zoom in order to activate them.



Heat, Equity, and Environment (HEE) layers can only be viewed one at a time, but other layers can be seen concurrently. See the section below for a list of a description of all layers in the tool.

Data layers in the tool:

Layer Name	Description	Data Source(s)
Points of interest (zoom to view if layer name is grey)	This layer includes facilities and other areas of interest that are relevant during heat events including transit stops with shelters, schools, libraries, medical facilities, swimming beaches, and parks and recreation. All of these can be overlaid on top of a HEE layer.	King County GIS Common Interest Points layer King County Metro transit stops King County Water and Land Resources Division Swimming Beaches layer
Population density by residence in census block (1 dot = 10 people, zoom to view)	This layer shows how densely populated the census block is based on where people live. One dot is equal to ten people. The dots are randomly distributed across census block, and this can be overlaid on top of a HEE	2020 US Census

	layer.	
School district boundaries	This layer shows the geographic boundaries of King County school districts and can be overlaid on top of a HEE layer.	King County Elections school districts layer
Unincorporated Comprehensive Plan land use	This layer shows how different areas in unincorporated King County are classified for use. See the legend for a full breakdown of the land use types. This can be overlaid on top of a HEE layer.	

Heat, Equity, and Environment Layers

Filter Name	**Description**	**Data Source**
Census blocks with no residents	This layer shows census blocks with no residences. People may still be in these census blocks for work, recreational purposes, or other reasons. This layer is active by default.	DI confirming with Fred.
Environment layers		
Impervious surface coverage	This layer shows paved surfaces in King County.	King County GIS, 2021
Tree canopy coverage	This layer shows tree canopy coverage in King County, and it is measured using LiDAR data.	King County GIS, 2021
Multi-family housing concentration	This layer shows where the concentration of multi-family housing units is the highest by calculating a ratio of multi-family units to single family units.	ACHS Housing Units in Structures via Esri Living Atlas
Equity		
Land Conservation Initiative opportunity area within census block	This layer shares "opportunity areas" for open space land acquisition from King County's Land Conservation Initiative (LCI). An opportunity area is defined as "locations where households lack open space access	King County (compiled from various data sources)

	and simultaneously fall in the bottom third of census tracts for household income and top third of ZIP codes for hospitalization rates due to asthma, diabetes, and heart disease."	
Justice40 area	Justice40 is a data layer created by the federal government to prioritize disadvantaged communities for environmental justice investment. This layer can help identify communities at higher risk to extreme heat due to factors included in the disadvantage index. Though the Justice40 map was taken down in 2025, more information can be found in an archive here.	Esri Living Atlas Justice40 layer
FEMA Community Disaster Resilience Zone (CDRZ)	The CDRZ layer, created by the Federal Emergency Management Agency, identifies areas with highest hazard risk. The ranking is based on cumulative impacts of estimated losses resulting from natural hazards to buildings, people, and agriculture; social vulnerability to the hazards; and current community resilience.	Esri Living Atlas CDRZ layer
Overall CDC/ATSDR Social Vulnerability Index rank	The Social Vulnerability Index layer, created by the federal Centers for Disease Control and Prevention (CDC) and Agency for Toxic Substances and Disease Registry (ATSDR), identifies communities experiencing social vulnerability based on factors such as socioeconomic status, household characteristics, housing type, and more. Specific variables in the index can be found here. This layer can help identify communities at higher risk to extreme heat due to factors included in the vulnerability index.	Esri Living Atlas SVI 2020
Temperature mapping: Median temperatures by census block		

Morning temperature	This layer shows morning surface temperatures (summarized by median value) split into five rankings of coolest to hottest (termed "quintiles") per 2020 census block. The temperature data is based on the 2020 King County heat mapping study.	King County See "Download Data" button to access this data.
Afternoon temperature	This layer shows afternoon surface temperatures (summarized by median value) split into five rankings of coolest to hottest (termed "quintiles") per 2020 census block. The temperature data is based on the 2020 King County heat mapping study.	King County See "Download Data" button to access this data.
Evening temperature	This layer shows evening surface temperatures (summarized by median value) split into five rankings of coolest to hottest (termed "quintiles") per 2020 census block. The temperature data is based on the 2020 King County heat mapping study. **This is the default map view** as it shows how areas retain heat over time (demonstrating the heat island effect).	King County See "Download Data" button to access this data.
Temperature mapping: Original July 2020 temperature modeling		
Morning temperature model	This layer is the original 6 – 7 AM surface temperature map created from a 2020 King County heat mapping study.	Urban Heat Mapping – Morning Temperature | Climate Change GIS Open Data
Afternoon temperature model	This layer is the original 3 – 4 PM surface temperature map created from a 2020 King County heat mapping study.	Urban Heat Mapping – Afternoon Heat Index | Climate Change GIS Open Data
Evening temperature model	This layer is the original 7 – 8 PM surface temperature map created from a 2020 King County heat mapping study.	Urban Heat Mapping – Evening Temperature | Climate Change GIS Open Data

Data filters, on the right side of the screen, allow you to narrow down the data displayed on the map based on specific criteria. For example, you can filter by temperature thresholds to see areas experiencing the highest heat or you can filter by population groups (e.g., adults over 65) to focus on specific at-risk communities.

When looking at the data filters, note that **1 corresponds to least heat exposure/vulnerability** while **5 corresponds to most heat exposure/vulnerability**. For Tree Canopy Coverage, this means 1 corresponds to a high level of tree canopy coverage (more shade = cooler) while 5 corresponds to a low level of tree canopy coverage (less shade = hotter). You can also utilize the search bar to look up specific locations. See the section below for a list of a description of all layers in the tool.

Data filters in the tool:

Place Filters

Filter Name	Description	Data Source
Jurisdiction name	This filter focuses the map on a specific city or unincorporated area.	King County GIS City_area and paa_area layers
Morning temperature	This filter allows you to sort areas by morning surface temperature. Note: The King County Executive Climate Office (ECO) defines heat island as the hottest 40% of temperatures (both *4: Hotter* and *5: Hottest*).	King County heat map study summarized by median value in 2020 Census blocks
Afternoon temperature	This filter allows you to sort areas by afternoon surface temperature. Note: King County ECO defines heat island as the hottest 40% of temperatures (both *4: Hotter* and *5: Hottest*).	King County heat map study summarized by median value in 2020 Census blocks
Evening temperature	This filter allows you to sort areas by evening surface temperature. Note: King County ECO defines heat island as the hottest 40% of temperatures (both *4: Hotter* and *5: Hottest*).	King County heat map study summarized by median value in 2020 Census blocks
Tree canopy coverage	This filter allows you to sort areas by ranking of tree canopy coverage in selected census blocks.	King County GIS, 2021
Impervious Surface Coverage	This filter allows you sort areas by ranking of impervious surface	King County GIS, 2019

	coverage in selected census blocks.	
Concentration of multi-family homes	This filter allows you to sort areas by ranking of multi-family housing concentration in selected census blocks.	ACHS Housing Units in Structures via Esri Living Atlas
King County Council District	This filter focuses the map on a specific King County Council District (choose from one to nine).	King County GIS
School Districts	This filter focuses the map on a specific King County school district.	King County GIS
Land Conservation Initiative (LCI) Opportunity Area	This filter focuses the map based on whether the area is classified as a LCI Opportunity Area. See the layers list for more information on LCI Opportunity Areas.	King County (compiled from various data sources)
Justice40 Area	This filter focuses the map based on whether the area is classified as a Justice40 area. See the layers list for more information on Justice40 areas.	Esri Living Atlas Justice40 layer
FEMA Community Disaster Resilience Zone (CDRZ) Census Area	This filter focuses the map based on whether the area is classified as a FEMA CDRZ. See the layers list for more information on FEMA CDRZs.	Esri Living Atlas CDRZ layer

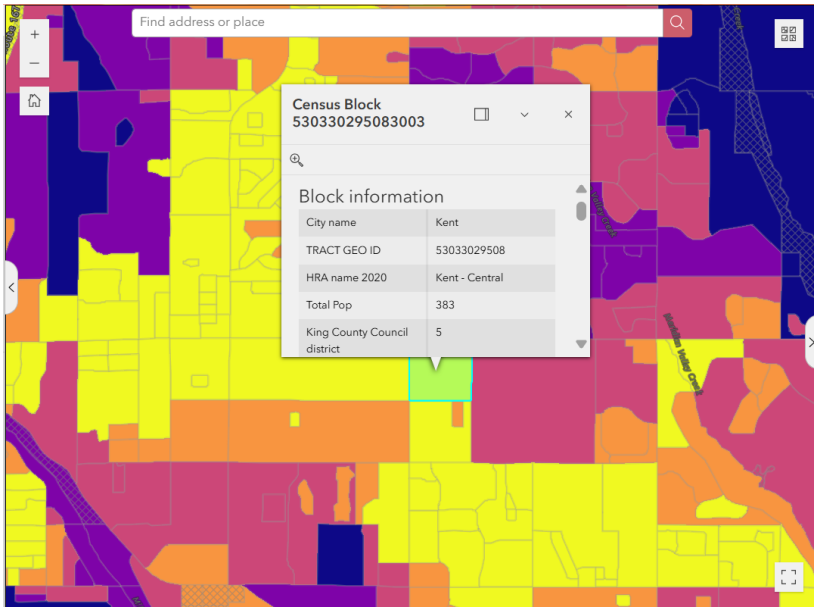
People Filters

Filter Name	**Description**	**Data Source**
Adults 65+ living alone	This filter allows you to sort areas by ranking of adults 65 and above living alone.	Esri Living Atlas - ACS Context for Senior Well Being (2017-2021)
Population under 18	This filter allows you to sort areas by ranking of percentage of population under 18.	ACS Population Variables via Esri Living Atlas
People with a disability	This filter allows you to sort areas by ranking of people with a disability. This ranking includes disabilities related to cognition, perception, and mobility.	Esri Living Atlas - ACS Disability by Type (2017-2021)

Adults with diabetes	This filter allows you to sort areas by ranking of adults with diabetes.	Washington State Department of Health GIS
Life expectancy	This filter allows you to sort areas by ranking of life expectancy.	Washington State Department of Health GIS
Limited English proficiency	This filter allows you to sort areas by ranking of limited English proficiency. As a note, *5: Highest* refers to the **lowest** amount of English proficiency per census block.	Esri Living Atlas – ACS English Ability and Linguistic Isolation (2017-2021)
Population under 200% of the federal poverty level	This filter allows you to sort areas by ranking of the population under 200% of the federal poverty level. The definition of federal poverty level can be found here.	Esri Living Atlas – ACS Poverty Status Variables (2017-2021)
Households with severe housing cost burden	This filter allows you to sort areas by ranking of households with severe housing cost burden which is defined as households that spend 50% or more of their household income on housing.	ACS Housing Cost Variables via Esri Living Atlas
Overall CDC/ATSDR social vulnerability rank	This filter focuses the map on areas classified as socially vulnerable based on CDC's Social Vulnerability Index. The index is made up of four categories containing variables that contribute to social vulnerability. Specific variables in the index can be found here.	2020, CDC/ATSDR SVI: Data and Documentation Download | Place and Health | ATSDR
CDC/ATSDR socioeconomic status vulnerability rank	This filter focuses the map on areas classified as socially vulnerable based on the socioeconomic variables in CDC's Social Vulnerability Index. Specific variables in the index can be found here.	2020, CDC/ATSDR SVI: Data and Documentation Download | Place and Health | ATSDR
CDC/ATSDR household characteristics vulnerability rank	This filter focuses the map on areas classified as socially vulnerable based on the household-focused variables in CDC's Social Vulnerability Index.	2020, CDC/ATSDR SVI: Data and Documentation Download | Place and

	Specific variables in the index can be found here.	Health | ATSDR
CDC/ATSDR racial & ethnic minority status vulnerability rank	This filter focuses the map on areas classified as socially vulnerable based on the racial and ethnic-focused variables in CDC's Social Vulnerability Index. Specific variables in the index can be found here.	2020, CDC/ATSDR SVI: Data and Documentation Download | Place and Health | ATSDR
CDC/ATSDR housing type & transportation vulnerability rank	This filter focuses the map on areas classified as socially vulnerable based on the housing and transportation-focused variables in CDC's Social Vulnerability Index. Specific variables in the index can be found here.	2020, CDC/ATSDR SVI: Data and Documentation Download | Place and Health | ATSDR

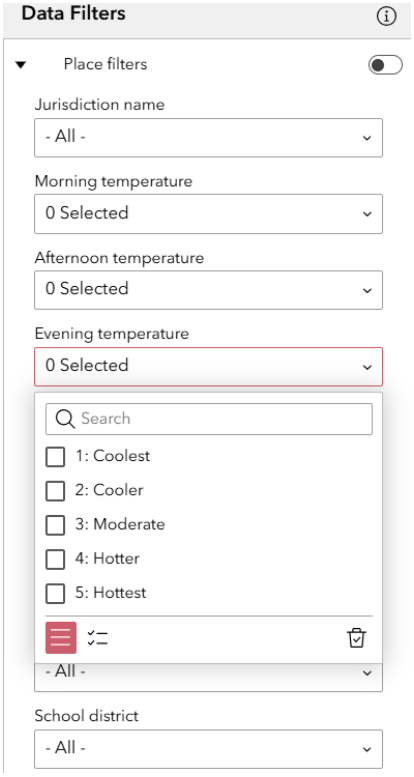
Together, layers and filters allow you to customize your analysis to suit your specific needs. Please note that it sometimes takes time for the layers and filters to load. Additionally, you can use the search bar at the top to enter a specific address. When using the tool, you can click on any census block to view a summary of these data layers per each block. This can be useful if you are trying to learn more about the specific area a facility is in.



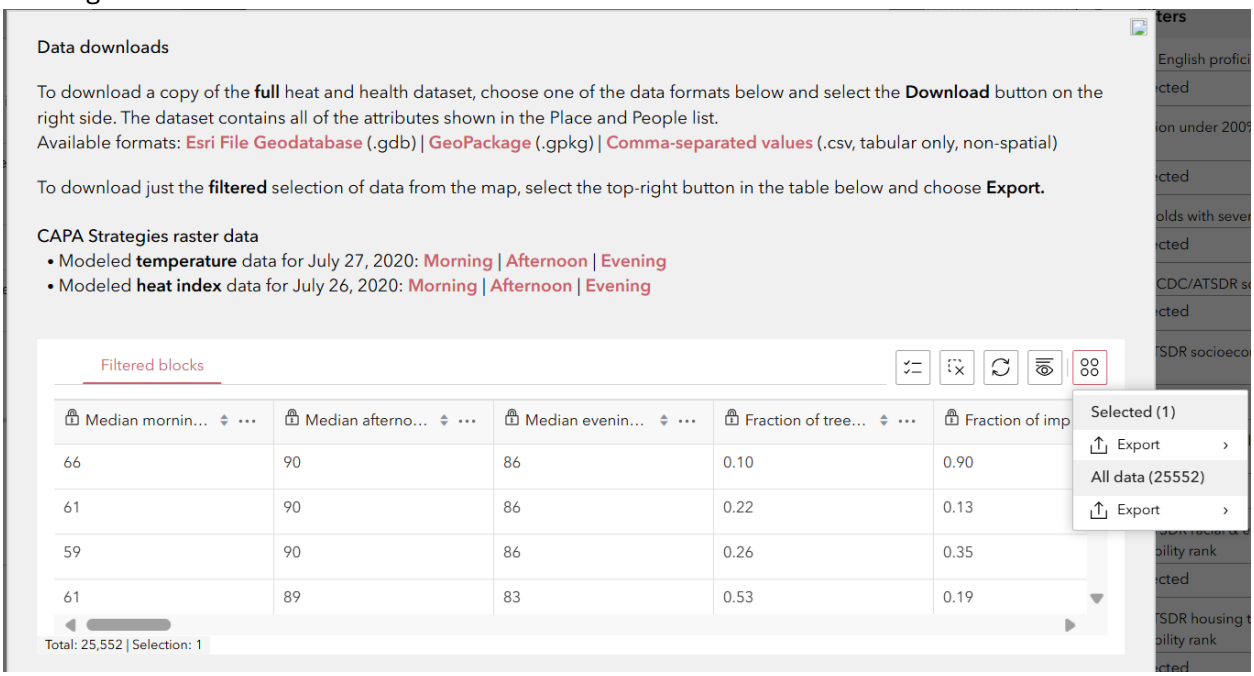
2. Step-by-step Guide

Click here to go back to top of document.

1. Once you enter the Heat and Health Data Explorer Tool , you will be greeted with a pop-up containing helpful tips to navigate the tool. Once you close out of the pop-up, you will see a heat map of median evening temperatures by census block. This is the default heat map. If you would like to see the instructions again, click on the "View Instructions" button in the header.
2. On the left side, click the layers on and off to select the base information you want to see. If any layers appear grey, you need to zoom in until they are visible. You can also search for locations that are of interest to you in the search bar. Click the "i" button to view more information about the layers. Any layers in the Health, Equity, and Environment sections can only be viewed *one at a time*.
3. Once the base layers are selected, go to the right side of the tool and choose filters that align with your objectives to further narrow down the map. Click the "i" button to view more information about filters. All filters on a scale from 1 – 5 are split into quintile bins. For example, *5: Hottest* in the Evening temperature filter means the hottest 20% of King County and *1: Coolest* means the coolest 20%. **Note:** The King County Executive Climate Office uses the the hottest 40% of the county (which is the area included in the *4: Hotter* and *5: Hottest* temperature filters) in their heat island analysis.



4. Combine multiple filters to refine your analysis further. Multiple filters can be active at the same time. For example, you can identify older adults at higher heat risk by choosing *4: Hotter* and *5: Hottest* in Evening Temperatures and *4: High* and *5: Highest* in Adults 65+ living alone. If desired, reset the filter selection by clicking the "Clear all selections" arrow at the bottom right of the screen.
5. To see a summary of all filter attributes for a specific location on the map, click the area on the map for a census block summary.
6. If you would like to export data from your selection or if you would like to download the full dataset, click the "Download Data" button in the top right of the screen. If you are seeking to download a specific selection of data, ensure all of your chosen filters are active before clicking the Download Data button.



7. If you would like to leave feedback for the tool development team, click the "Feedback" button in the top right. Feedback can include suggestions on additional data layers to include in the tool, reports on tool features that are not working, and ideas for improving the user interface of the tool.

Best Practices and Limitations

Best Practices:

- For general analysis of heat islands, the King County Executive Climate Office (ECO) uses the evening heat map as the default as it shows how areas retain heat over time, demonstrating the urban heat island effect. ECO also defines a heat island as the hottest 40% of the county (which is the area included in the *4: Hotter* and *5: Hottest* temperature filters). However, choose the time-of-day temperature that is most relevant for your

analysis. For example, analysis about heat exposure in daycares would choose the afternoon heat map.
- Use the tool alongside other resources, such as local datasets or information about health outcomes, for a more comprehensive analysis.
- Consult local government staff and/or community groups to better understand mapping results and plan interventions.

Limitations:

- The tool is not a real-time emergency response system. Do not use it to guide immediate actions during extreme heat events.
- Some data layers may have slight delays in updates; always cross-reference with the latest public health data for critical decisions.

For any further questions, contact Daaniya Iyaz, King County Climate Preparedness Project Manager, at daiyaz@kingcounty.gov.

3. Technical Documentation

Click here to go back to top of document.

The sources of all data included in the tool are in the Tool Layout section above.

To learn how the King County GIS team created the median temperature quintile maps, read below.

Data Inputs

- **2020 Census blocks**: King County GIS copy of the US Census Block data from 2020, in WA State Plane North (EPSG 2926)
- **CAPA Strategies, Modeled temperature data for July 27, 2020:** The original input is a raster of modeled temperature values for the evening of 2020-07-27. The raster has a 10 meter cell size (10m x 10m) and is in the WGS 1984 UTM Zone 10N projected coordinate system.

Software: ArcGIS Pro 3, DuckDB, R, Python (numpy, pandas, matplotlib)

Process

1. Use the **Zonal Statistics as Table** tool with the census blocks as zones. This tool will take all of the temperature values within a census block and provide summary statistics such as count, min, max, range, mean, standard deviation, and median.
2. This provides the **median temperature** for each census block. Median was used because there are sufficient numbers of values in a given census block and it will avoid the influence of any high or low outlier values.
3. Quintile ranks were derived from the table of census blocks with associated median temperatures. This used the algorithm provided by numpy in numpy.percentile, with percentiles set at 20, 40, 60, 80, and 100 percent.
4. **Note:** this percentile ranking is using the **census blocks**, *not land area*, for the ranking. This was chosen because the census blocks are roughly sized by population of residents and thus better captures the quintiles of residents rather. For example, if there are 10,000 census blocks then there are 2,000 census blocks marked as the hottest quintile, and so on. This was chosen instead of finding the 200 hottest square miles out of 1000 square miles because the population distribution would be skewed.