

Lab: Environmental Justice of Canopy and Heat

Following the prior analysis, discerning geographers may wonder why some racial and ethnic groups have high “access” to open space but conversely low proportion of area of open space. Further, you may wonder about the *quality* of the open space, or whether there are *private* forms of open space in some areas of the city (e.g. large gardens, country clubs, etc.). Thinking specifically about open space in the context of urban vegetation, heat islands, and deadly hazardous heat waves / heat domes, we ask three further questions about majority race/ethnic group regions in Chicago. We want to know about the spatial distribution of **healthy vegetation**, **surface temperature**, and **cooling centers** for heat wave relief.

PURPOSE

- Analyze an urban (environmental) justice issue by combining socio-economic data with data on the built or natural environment.
- Develop and practice GIS workflows with spatial queries, spatial joins, and gridded environmental data.

OUTCOMES

- The outcome should be a single data layer of race/ethnic groups in Chicago with the following variables calculated:
 - Percentage of area covered by healthy vegetation
 - Average surface temperature
 - Cooling centers per 100,000 people

DATA

From the previous labs, identify the data layer containing Chicago census **tracts** from 2020, filtered to contain population ≥ 20 and rent > 0 , projected to EPSG:6454 NAD83 NAD83(2011) / Illinois East, and classified by majority race or ethnic group.

chicago_1940.gpkg Geopackage

- **Title:** Boundary of Chicago, Illinois in 1940.
- **Responsible Party:** University of Chicago
- **Spatial Coverage:** Chicago, Illinois
- **Coordinate Reference System:** EPSG:6454 NAD83 NAD83(2011) / Illinois East
- **Spatial Representation Type:** Polygon
- **Spatial Resolution:** Municipal boundary
- **Temporal Coverage:** Boundary as of 1940
- **Lineage:** Drawn in book by Henry Hughes Presler and digitized by Wesley Akin Hotchkiss at the University of Chicago. Downloaded from ArcGIS Hub as a shapefile and then projected into EPSG:6454 and transformed to geopackage format. Digitized by University of Chicago Library (call number G4104.C6E1 1948.H6)
- **Distribution:** ArcGIS Hub https://hub.arcgis.com/datasets/ef650d58f775438b84a5ba0f07a154be_0
- **Constraints:** Public access, but no license

vegetation.tif

- **Title:** Healthy vegetation in Chicago, Illinois
- **Responsible Party:** Ola Zalecki
- **Spatial Coverage:** Cook County, Illinois
- **Coordinate Reference System:** EPSG:6454 NAD83 NAD83(2011) / Illinois East
- **Spatial Representation Type:** Raster grid
- **Spatial Resolution:** 5 meters
- **Temporal Coverage:** Aerial photography acquired on 09/05/2021, 09/08/2021, 09/28/2021

- **Lineage:** After the USDA collected NAIP imagery, Google Earth Engine was used to acquire, merge, and clip the imagery, calculate NDVI, and classify NDVI over 0.075 as green vegetation.
- **Distribution:** The original data is developed and distributed by the National Agriculture Imagery Program (NAIP) of the United States Department of Agriculture (USDA), but was more conveniently accessed through Google Earth Engine. GeoTIFF file format.
- **Constraints:** Public Domain data free for use and redistribution.
- **Variables:**
 - **Band 1: integer (normative):** the values in each cell have the following meaning:
 - 0: absence of healthy vegetation (normalized difference vegetation index ≤ 0.075)
 - 1: presence of healthy vegetation (normalized difference vegetation index > 0.075)
 - 2: "no data" value for areas outside of the study extent

1st2020.tif

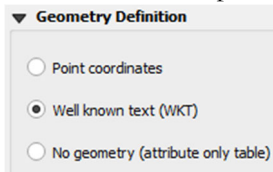
- **Title:** Surface temperature in Chicago, Illinois
- **Responsible Party:** Ola Zalecki
- **Spatial Coverage:** Chicago, Illinois
- **Coordinate Reference System:** EPSG:6454 NAD83 NAD83(2011) / Illinois East
- **Spatial Representation Type:** Raster grid
- **Spatial Resolution:** 30 meters
- **Temporal Coverage:** July 3 and July 12, 2022, at about 10:30 am local time.
- **Lineage:** Thermal infrared band raster image in TIFF format from Landsat 09 imagery, corrected to convert sensor data into temperature in Celsius. The average temperature between the two dates was taken. Processing prior to download was completed in Google Earth Engine. Script can be found here: <https://code.earthengine.google.com/381fab4282972cbbcdec6ec902cb434c>
- **Distribution:** Landsat 09 data is controlled and available at USGS and via GoogleEarthEngine. GeoTIFF file format.
- **Constraints:** Public domain
- **Variables:**
 - **Band 1: LST: decimal number:** Land Surface Temperature measured in Celsius degrees

Cooling_Centers_20241116.csv comma-separated values text file

- **Title:** Cooling Centers in Chicago, Illinois
- **Responsible Party:** City of Chicago
- **Spatial Coverage:** Chicago, Illinois
- **Coordinate Reference System:** EPSG:4326 (WGS 1984 Geographic Coordinate System)
- **Spatial Representation Type:** text
- **Spatial Resolution:** street addresses / parcel lots
- **Temporal Coverage:** Summer 2024
- **Lineage:** Downloaded from City of Chicago and provided as-is
- **Distribution:** The City of Chicago ("City") voluntarily provides the data on this website as a service to the public. <https://data.cityofchicago.org/Health-Human-Services/Cooling-Centers/msrk-w9ih>
- **Constraints:** Public domain
- **Variables:**
 - **Site type: text:** Type of cooling center from this domain of possible values: {Chicago Community College, Community Service Center, Library, Park District Facility, Park District Spray Features, Police District, Regional Senior Center, Satellite Senior Center}
 - **Location: text:** WKT (well-known text) format of a geographic point, e.g. the first data value in this column looks like this: POINT (-87.723772026 41.757456)

METHODS

- Complete the Central Falls tutorial videos on Spatial Queries and Joins
- Read the instructions in full.
- Develop a workflow, taking into account the following methods and hints:
 - Final results should only consider census tracts that fall completely within a 400 meter buffer of the City of Chicago as of 1940.
 - The tool you have previously used to load a table of text data with latitude and longitude coordinates also has another option for loading geometry data, shown selected below:



- Check the workflow accuracy with an instructor.
- Implement the workflow, saving results to the appropriate **derived** folder and checking results along the way.

CHECK RESULTS

There are **769** tracts completely inside 400 m of Chicago's 1940 boundary having populations of 20 or greater and non-zero rent.

FINAL RESULTS

Please check these final results with an instructor.

Majority Group	Tracts (N)	Population	Cooling Centers	Cooling Centers Per 100,000 People	Vegetation	Average Surface Temperature
Asian	6	20,888	2	9.6	15.3%	43.0
Black	263	717,416	116	16.2	31.2%	41.8
Latinx	172	687,848	61	8.9	19.3%	43.9
Mixed	109	419,454	38	9.1	23.2%	42.5
White	219	811,180	62	7.6	26.5%	42.0

AM I DONE?

- Check your results for the cooling centers, area with vegetation, and average surface temperature
- Back up work to W:\ drive