Mapping our World

Exploring Geospatial Technologies for Understanding Environmental Change

Laura Egan Krauser, M.S., GISP
UofL Center for GIS

KRC KELI

Our Journey Together

- Introductions
- Understanding Geospatial Technologies
- Real-World Examples
- Q&A

About Me

- GIS Research Coordinator, UofL Center for GIS (ULCGIS)
- 10 Years in GIS/Mapping
- Teach courses in GIS and geospatial technology
- Lead and support research projects
- Provide technical support to campus GIS users

ULCGIS Program Overview

DJ Biddle, GISP
Director

Laura Krauser, GISP
GIS Research Coordinator

Andrea Gaughan, Ph.D.
Prof: Remote Sensing, Modeling

Forrest Stevens, Ph.D.
Asst. Prof: Programming, Remote Sensing, Modeling

Wei Song, Ph.D.
Assoc. Prof: Transportation, Logisitics

Haifeng (Charlie) Zhang, Ph.D.
Prof: Demographic Analysis, Crime Analysis

Christopher A. Day, Ph.D.
Prof: Water Resources GIS, Spatial Hydrology

Jason Naylor, Ph.D.
Asst. Prof: Extreme Weather Events, Climate Change

Audience Poll: Type in the Chat

When you hear 'mapping our world,'
what's the first thing that comes to mind?

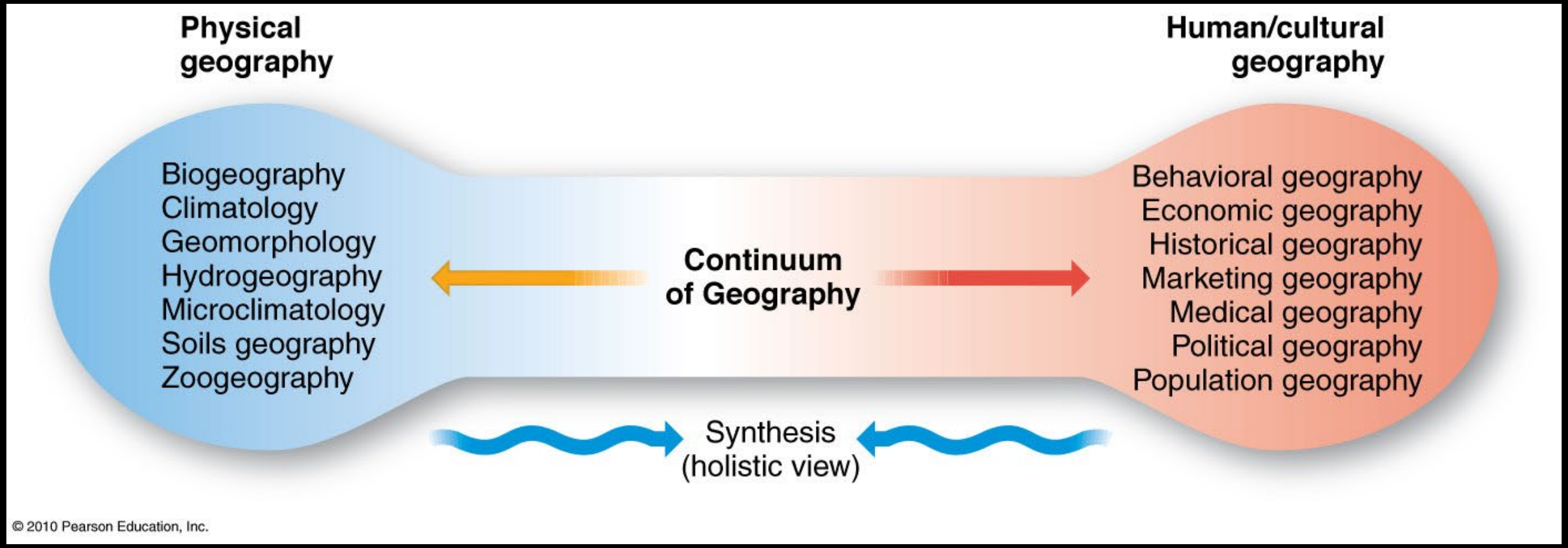
Understanding Geospatial Technologies

What is Geography?

Geography is the study of places and the relationships between people and their environments. Geographers explore both the physical properties of Earth's surface and the human societies spread across it. They also examine how human culture interacts with the natural environment, and the way that locations and places can have an impact on people. Geography seeks to understand where things are found, why they are there, and how they develop and change over time.

- *National Geographic Society*

Geography is unique!

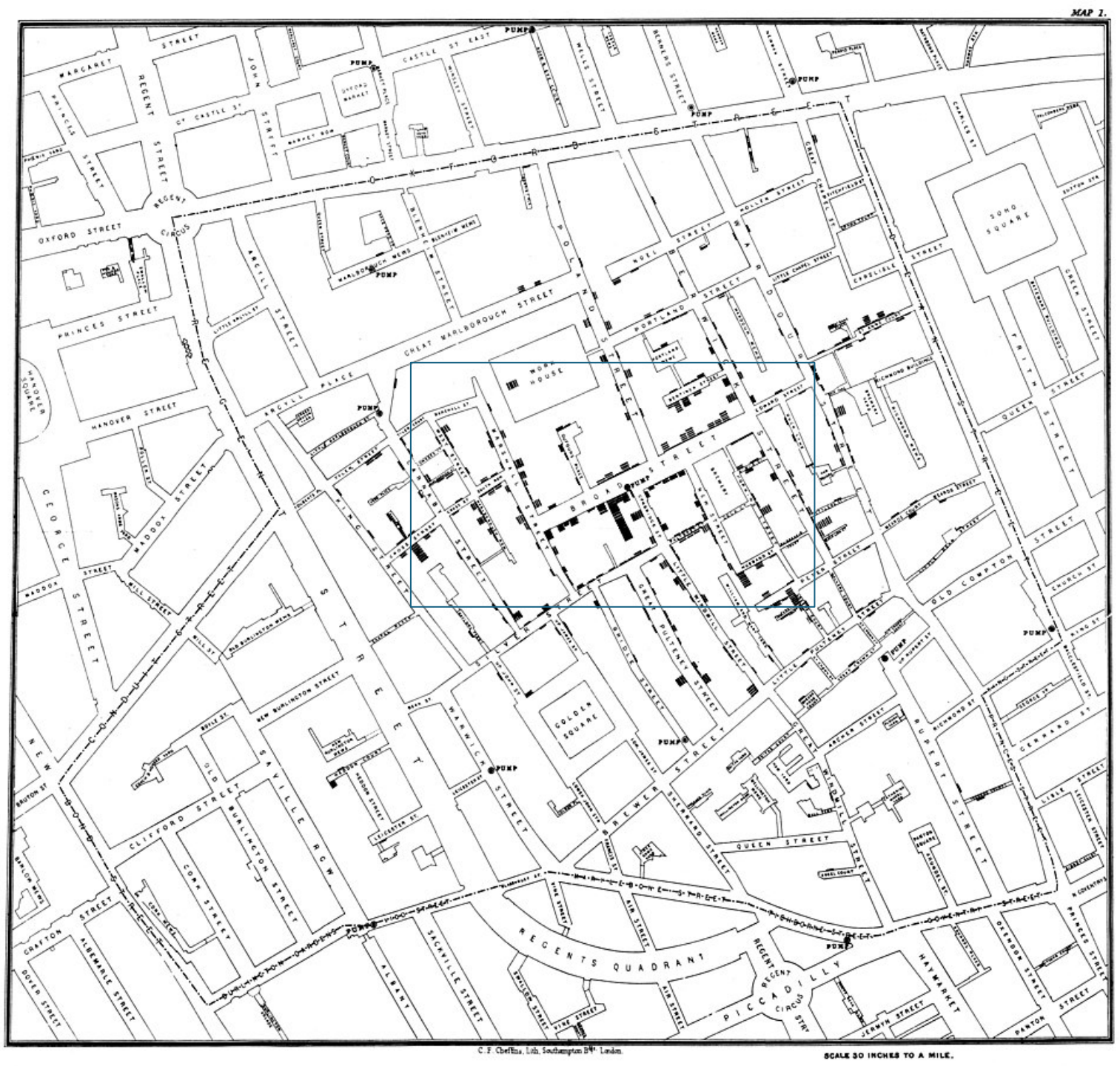


What is Geospatial Science?

- Geospatial science is the study of phenomena based on their location and spatial relationships.
- It integrates tools and methods to observe, analyze, and model spatial patterns across Earth's surface.

- Core disciplines include: **geography, cartography, GIS, remote sensing, geodesy, and spatial statistics.**


CHOLERA "TRAMPLES THE VICTOR & THE VANQUISH'D BOTH."


MAP 1.
BROAD STREET
PUMP
WORK HOUSE
GOLDEN SQUARE
SOHO SQUARE
REGENTS QUADRANT
PICCADILLY
REGENT CIRCUS
OXFORD STREET
REGENT STREET
GREAT MARLBOROUGH STREET
ARGYLL PLACE
HANOVER STREET
GEORGE STREET
MADDOX STREET
NEW BURLINGTON STREET
SAVILLE ROW
CLIFFORD STREET
OLD BURLINGTON STREET
CORK STREET
WARWICK STREET
GREAT PULTENEY STREET
BERWICK STREET
POLAND STREET
NOEL STREET
PORTLAND STREET
CHARLES ST
GREEK STREET
FRITH STREET
QUEEN STREET
OLD COMPTON STREET
RUPERT STREET
ARCHER STREET
HAYMARKET
JERMYN STREET
PANTON STREET
ALBANY
SACKVILLE STREET
ALBEMARLE STREET
GRAFTON STREET
DOVER STREET
C. F. Cheffins, Lith. Southampton Bldgs. London.
SCALE 30 INCHES TO A MILE.

WORK HOUSE

MARSHALL ST.

BENTINCK STREET

EDWARD STREET

DUFOURS PLACE

BROAD STREET

PUMP

MARSHALL STREET

WEST STREET

SOUTH ROW

CROSS ST

CAMBRIDGE ST

NEW STREET

BREWERY

TOPKINS

DUCK LANE

STREET

HUSBAND ST

LITTLE

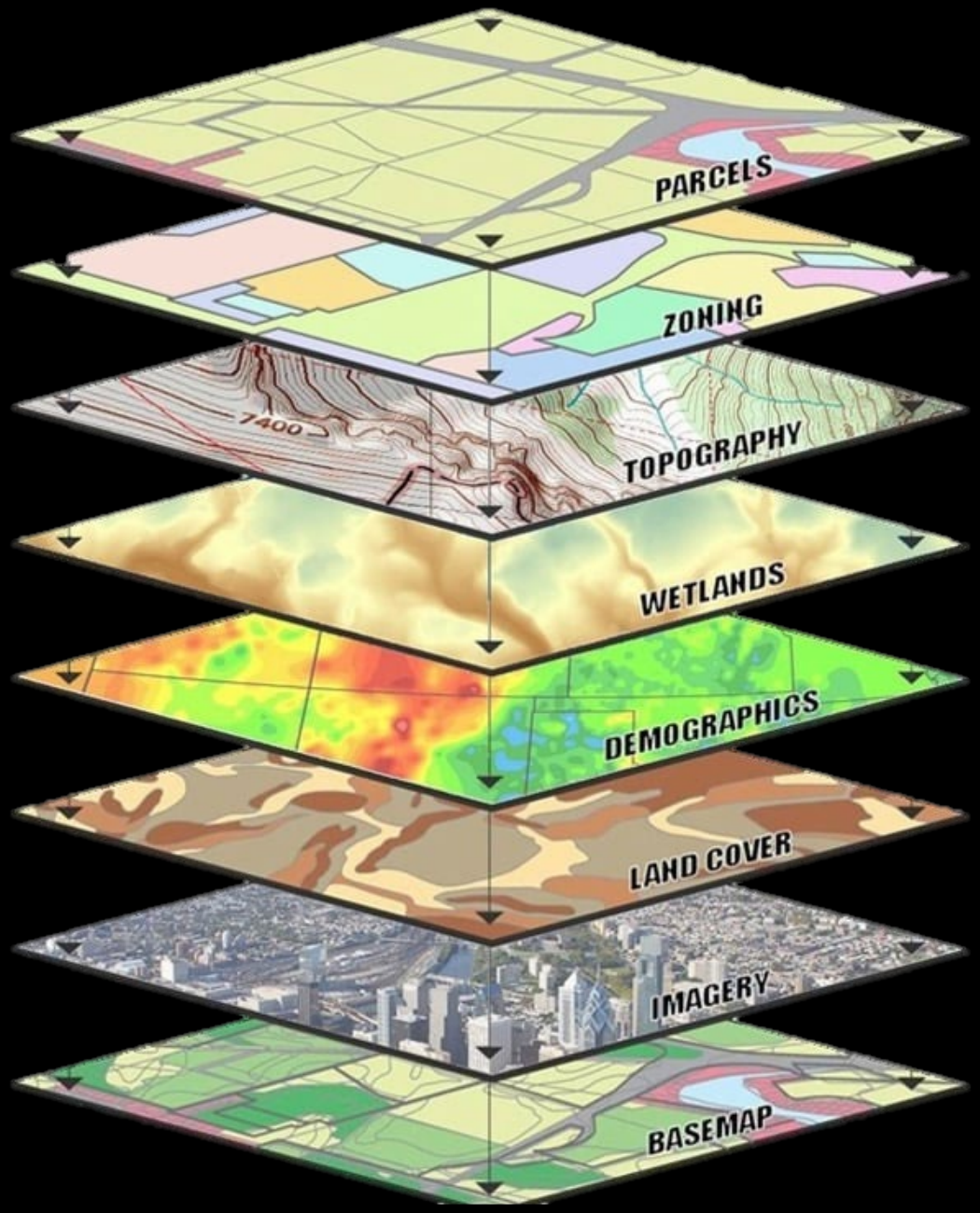
PETER

What is Geospatial Technology?

GPS/ GNSS	Global navigation satellite system and location services What is precisely where?
Geographic Information System (GIS)	Modeling out world through layers of data Where things are and related attributes
Remote Sensing	Earth observation and earth monitoring

GIS

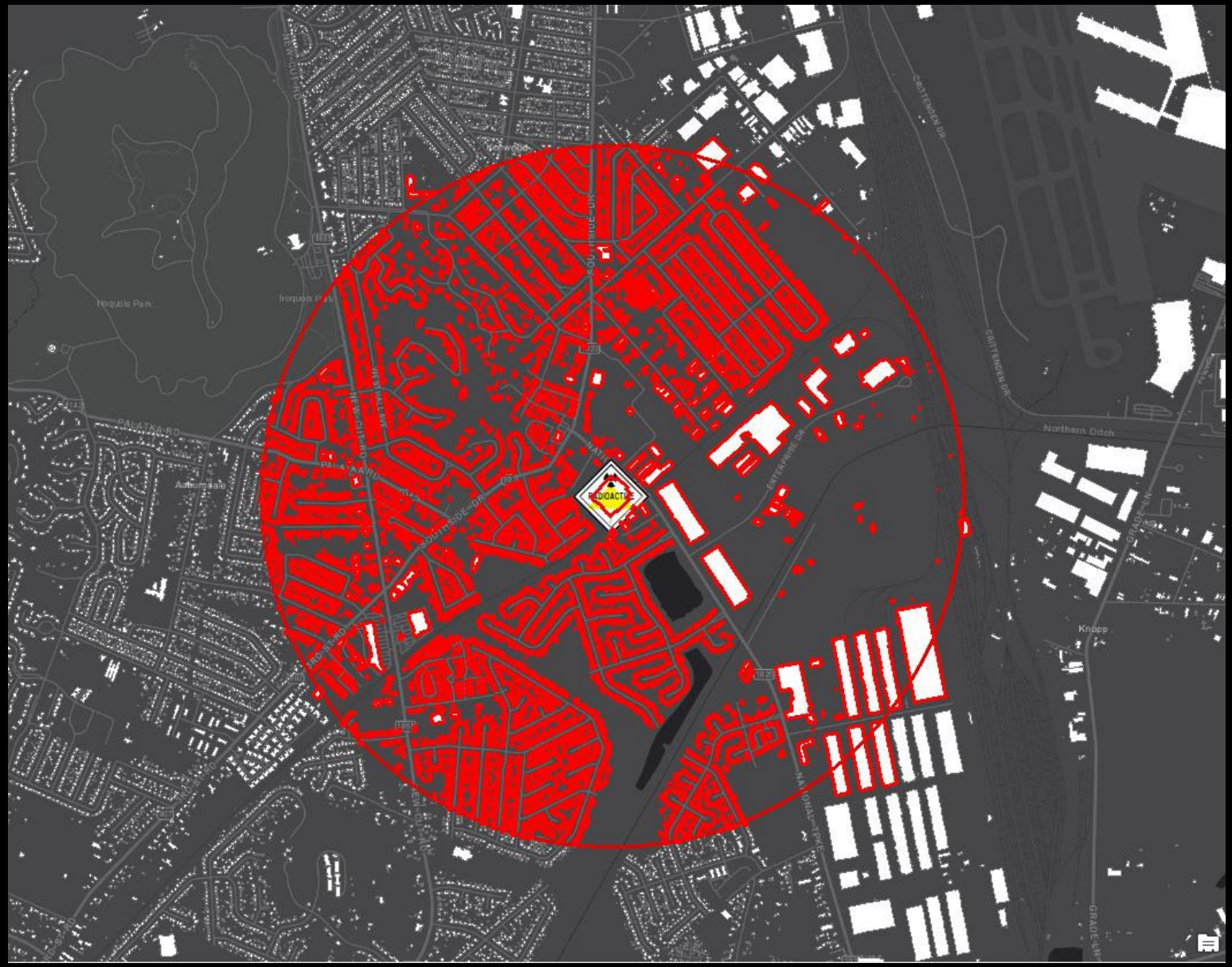
- A GIS is a digital system for capturing, storing, analyzing, and visualizing spatial (location-based) data.
- Combines maps + data + analysis to reveal patterns, trends, and relationships.

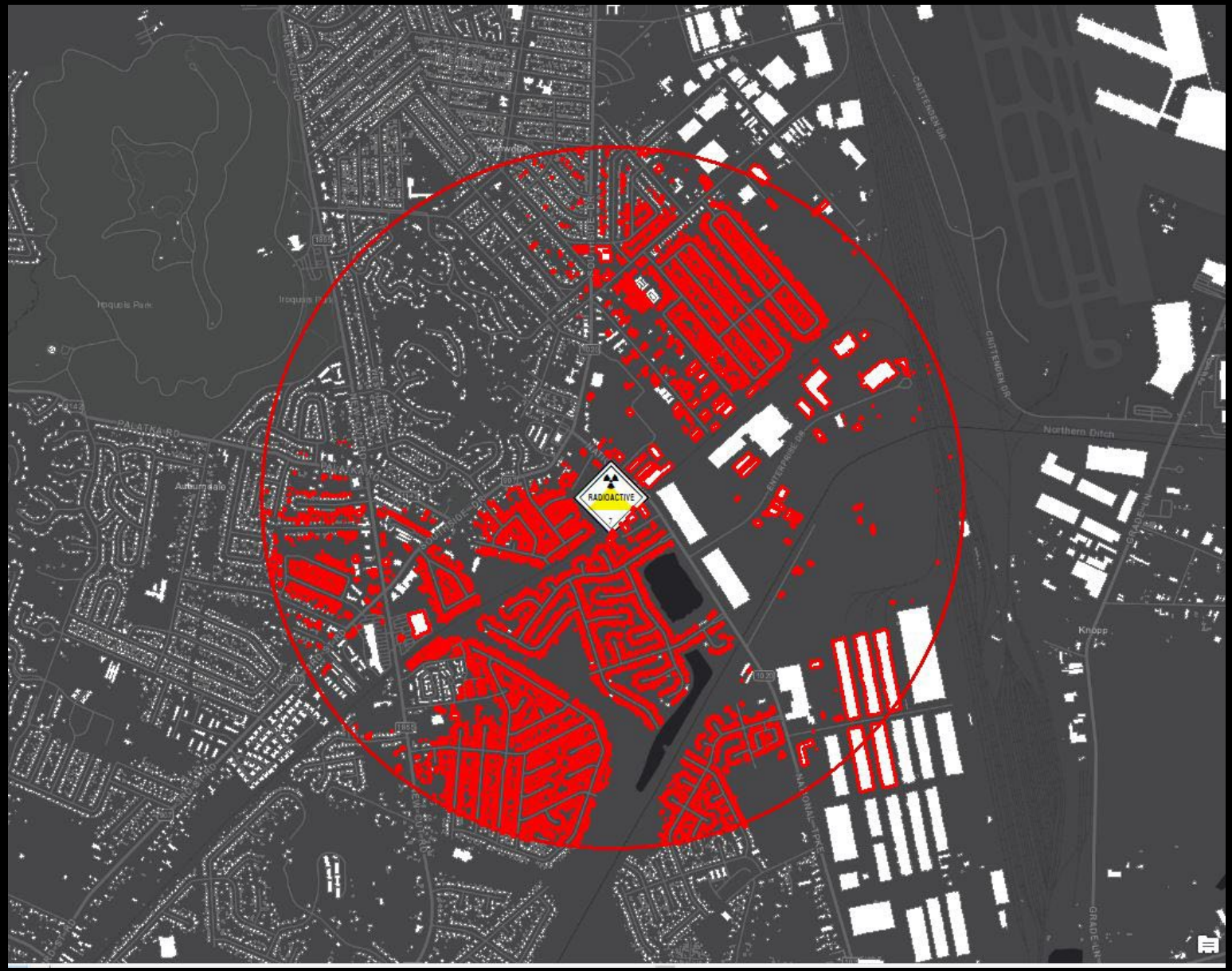


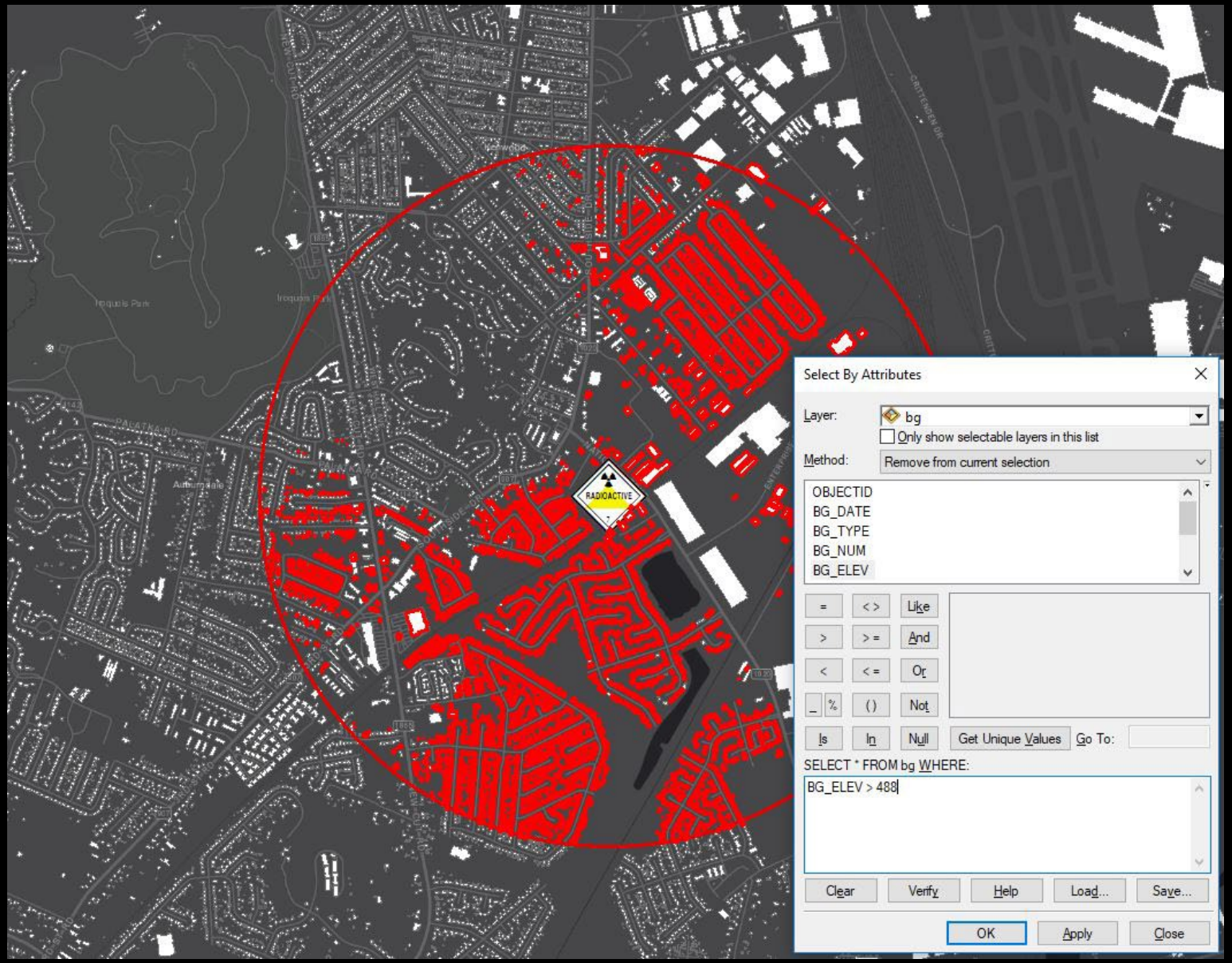
Querying Data

- A dangerous chemical spills from a local factory, threatening the surrounding neighborhoods!
- The chemical spill will affect all residents within one mile of the factory
- But! Because the chemical flows downhill, houses that are on higher ground are safe!
- Who do we need to evacuate?


RADIOACTIVE
Iroquois Park
Iroquois Park
Auburndale
Northern Biten
Knopp


Iroquois Park
Iroquois Park
Northern Ditch
Knopp
RADIOACTIVE


RADIOACTIVE
Iroquois Park
Northern Ditch
Knopp


RADIOACTIVE
Select By Attributes
Layer:
bg
Only show selectable layers in this list
Method:
Remove from current selection
OBJECTID
BG_DATE
BG_TYPE
BG_NUM
BG_ELEV
=
< >
Like
>
> =
And
<
< =
Or
_
%
( )
Not
Is
In
Null
Get Unique Values
Go To:
SELECT * FROM bg WHERE:
BG_ELEV > 488
Clear
Verify
Help
Load...
Save...
OK
Apply
Close

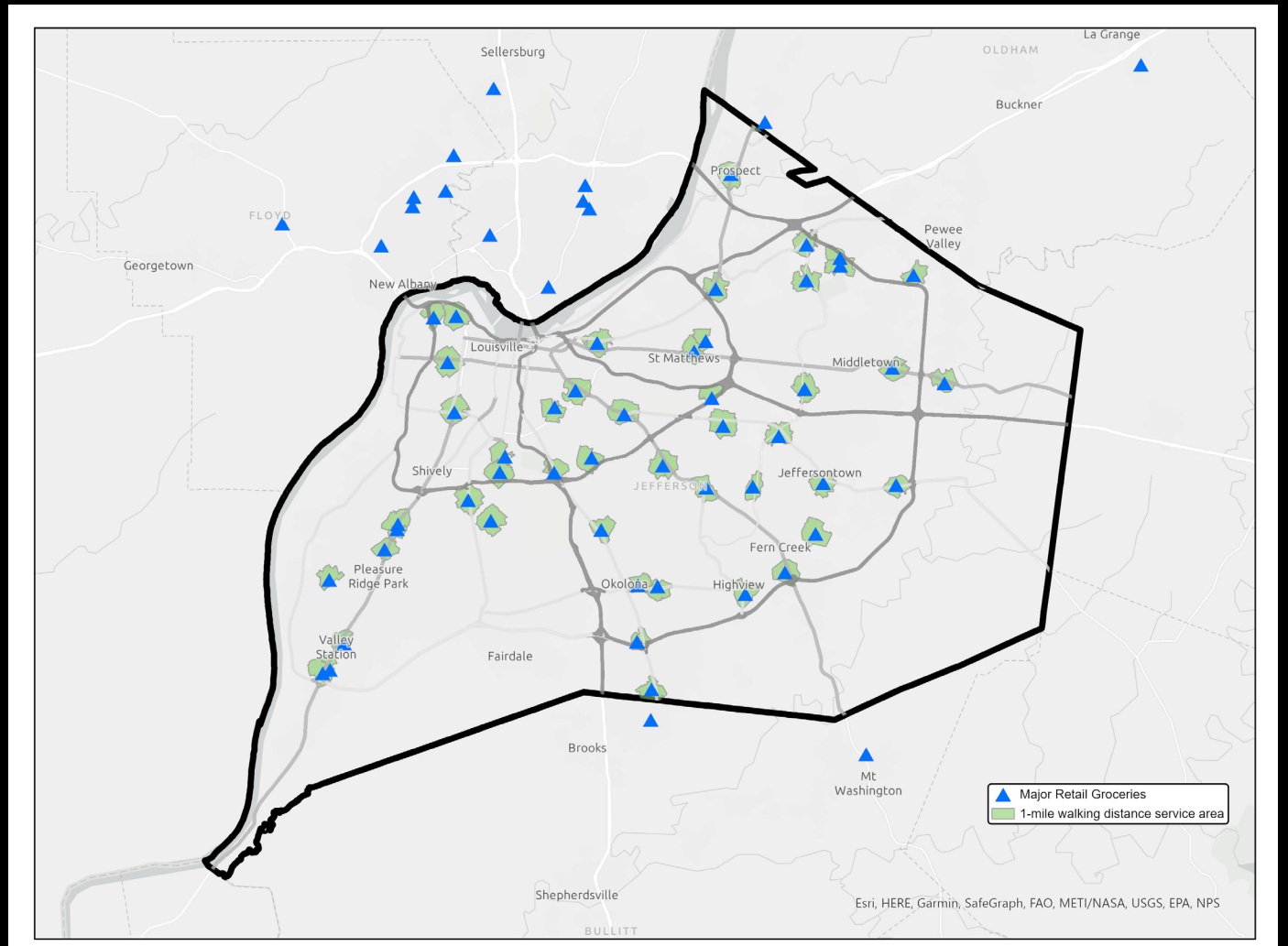
Table

Parcel

CUR_FIRSTNAME	CUR_NAME2	CUR_
JOY LESLIE		115 S ARBOR
GHAEB KARIM		6412 SOUTHSI
MARTIN J	GERSTLE KAREN	207 SENECA T
ANDREA		6522 ESTELE A
HUMANE SOCIETY ANIMAL		241 STEEDLY
CHARLES & KIMBERLY		457 BLEEMEL
BOBBY J & GWENDOLYN		113 S ARBOR
T M T PROPERTIES LLC		11600 TRANQ
THAI	NGUYEN TUYET	7925 TOLLS LI
INVESTMENTS LLC		12016 HUDSO
AVENUE REALTY LLC		258 EILER AVE
MAYELIN AVILA		6501 SOUTHSI
LLC		9302 FELSMER
CHARLES & KIMBERLY		457 BLEEMEL
MARK & TERRI L		11600 TRANQ
KEVIN & HONG CHI Q		209 REVOLUTI
GARBAWI MUSTAFA		236 STEEDLY
PROPERTIES LLC		PO BOX 328
STEEDLEY DRIVE LAND TR		PO BOX 95
THANG P	AU KIM P	1110 GLENLAH
KENT ANDREW		1306 MOUNT H
PROPERTIES LLC		1518 PETUNIA
HAI TAN	NGUYEN TAI TAN	244 STEEDLY
INVESTMENTS LLC		1504 CROSSTI
NANCY G		6509 SOUTHSI
PROPERTIES LLC		PO BOX 328
ROBERTO T & MONER MART		6500 SOUTHSI
JOHN R & SHERRY S		9014 ROYAL C
MARIA SALAZAR	PEREZ ALBERT GINARTE	305 E SOUTHS
STEVE & NANCY		14401 BROOK
LAREDO SANCHEZ	MALDONADO YAQUELIN ALMAR	303 E SOUTHS
JAMES R & CONNIE SUE		6500 EVANGE
DAZNIE DE LA ROSA		6525 EVANGE
REALTY LLC		149 E WOODL
INVESTMENTS III LLC		4716 TAYLOR
VICTOR		6502 SOUTHSI
PROPERTIES LLC		PO BOX 328
CHARLES L & PAT L		6504 EVANGE
ALVIS L	PARSONS IVA	307 E SOUTHS
LISA G		4814 ROCKAW
MARY J		111 CAMBRIDG
<Null>	<Null>	<Null>
WAYNE HARDY SPECIAL NE	HARDY RUTH S	301 E SOUTHS
LOUIS B & AUBREY K		109 CAMBRIDG

1 (2074 out of 289403 Selected)

Other “where” questions…



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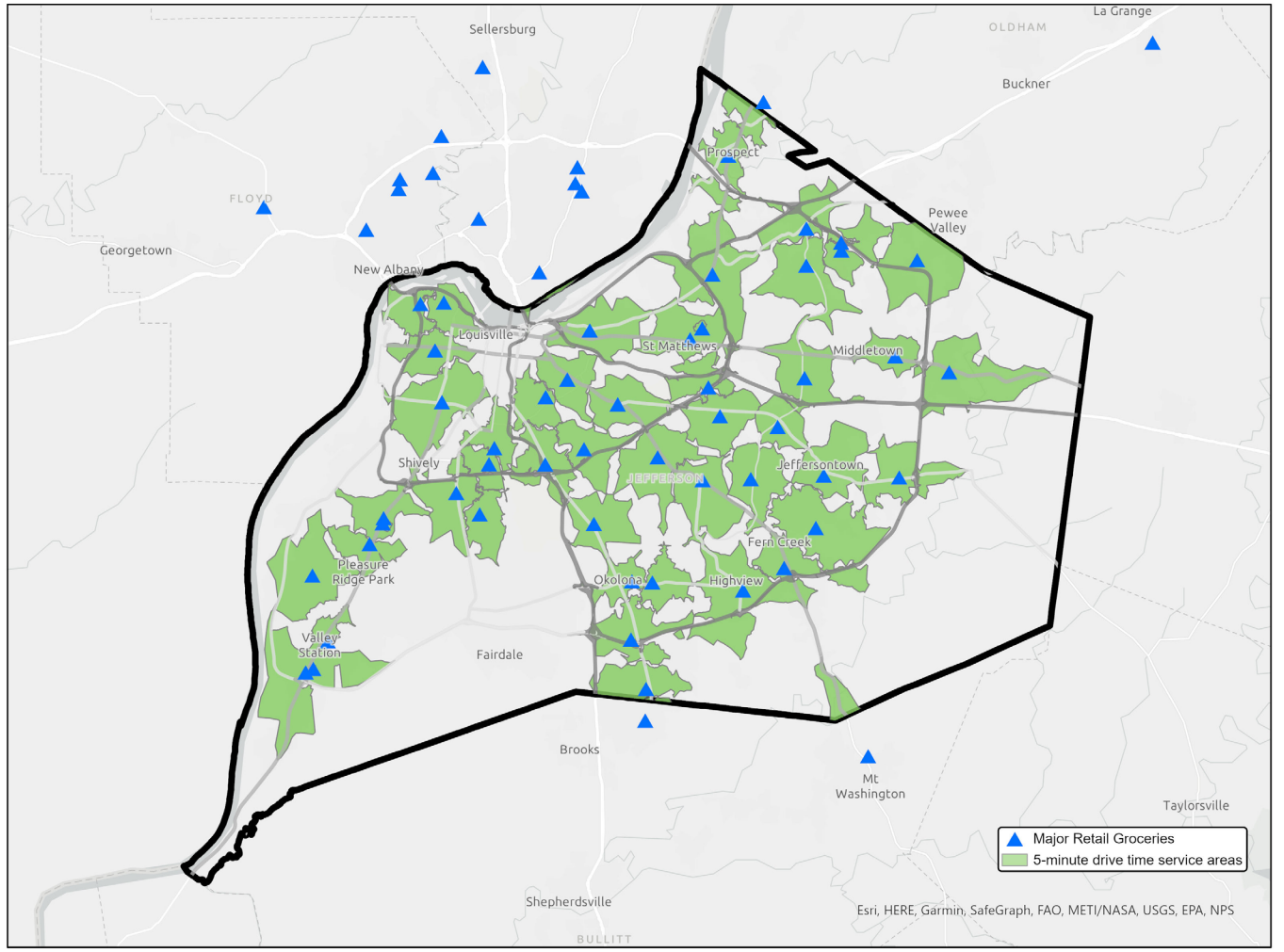
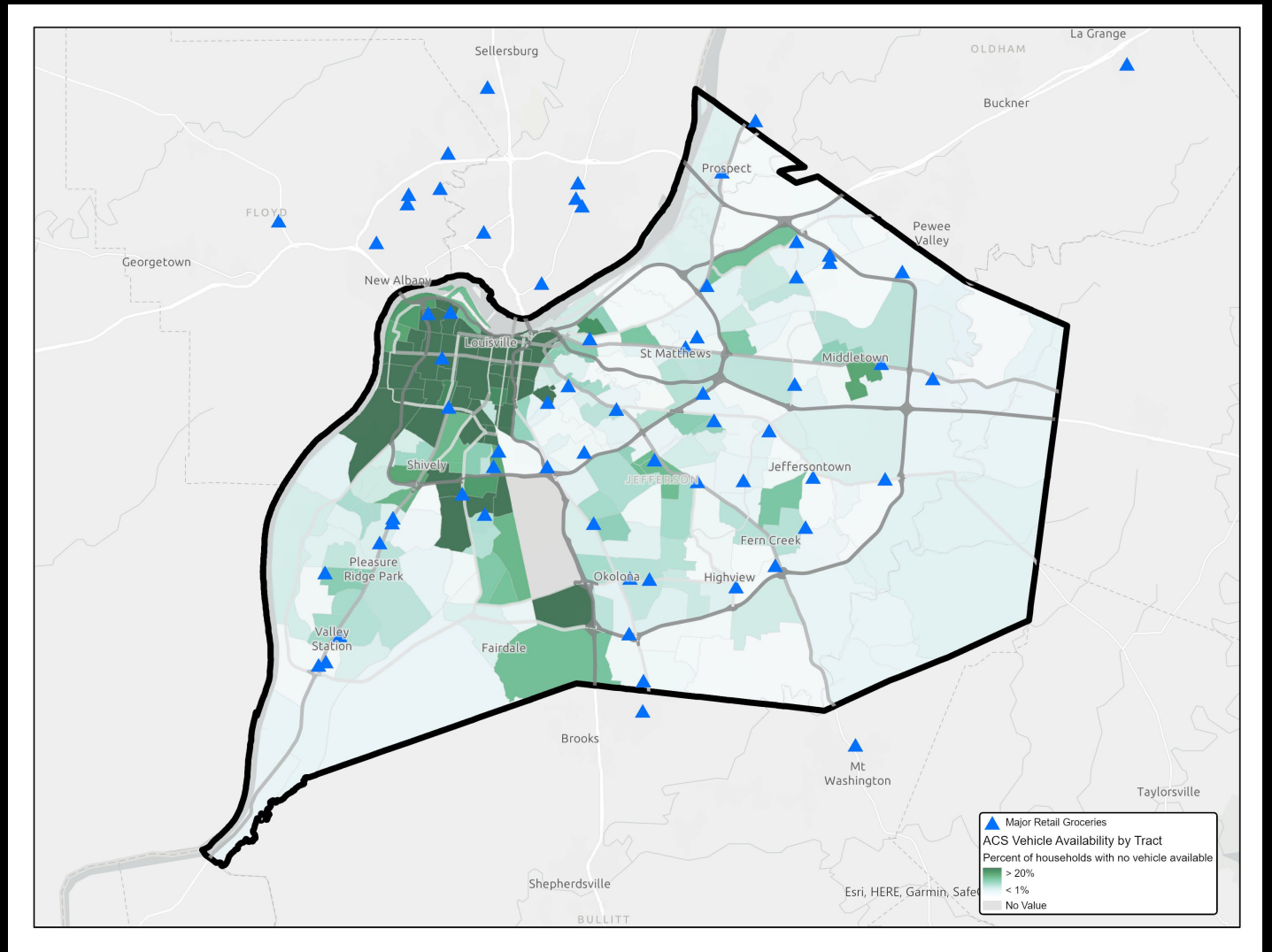


Other “where” questions…



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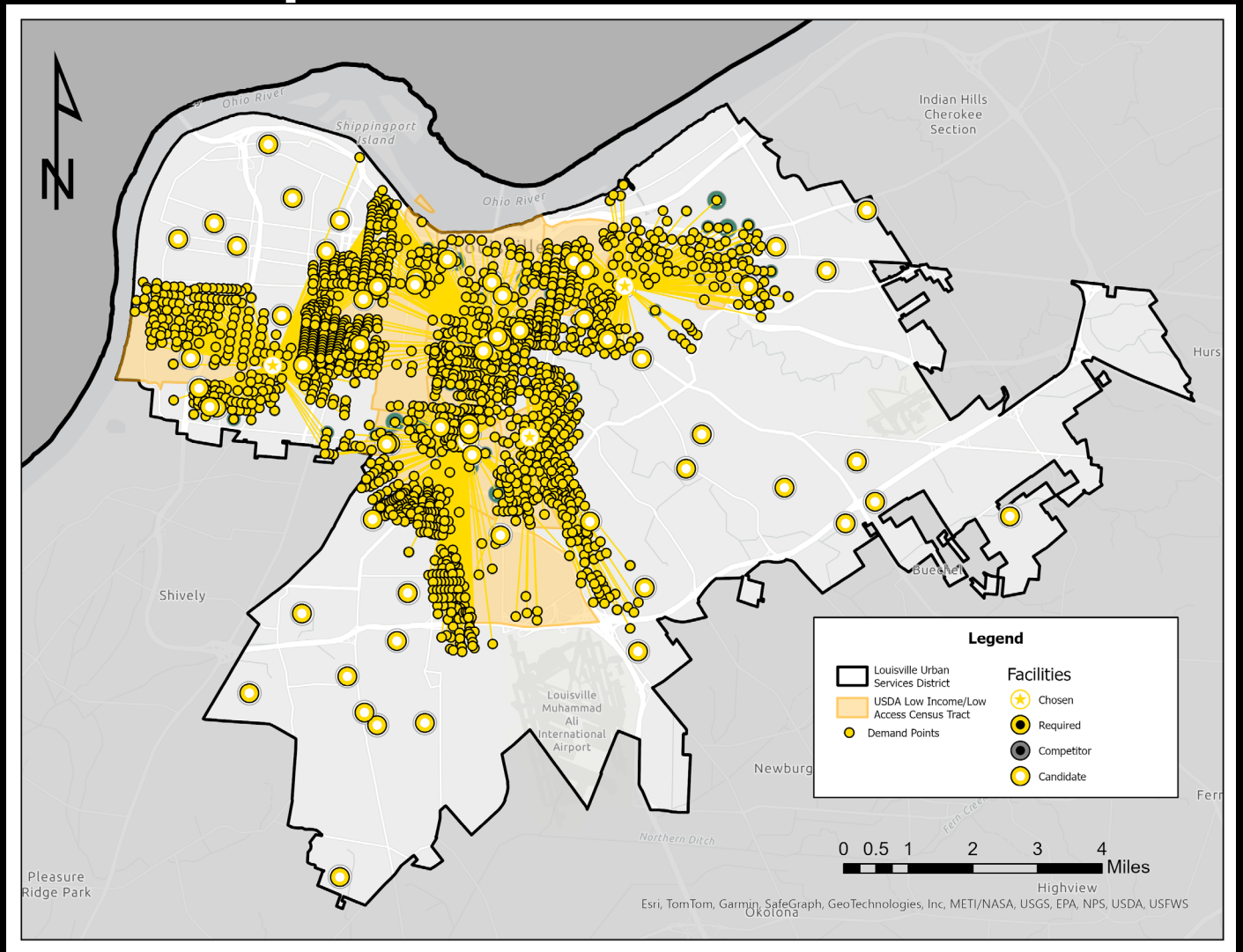


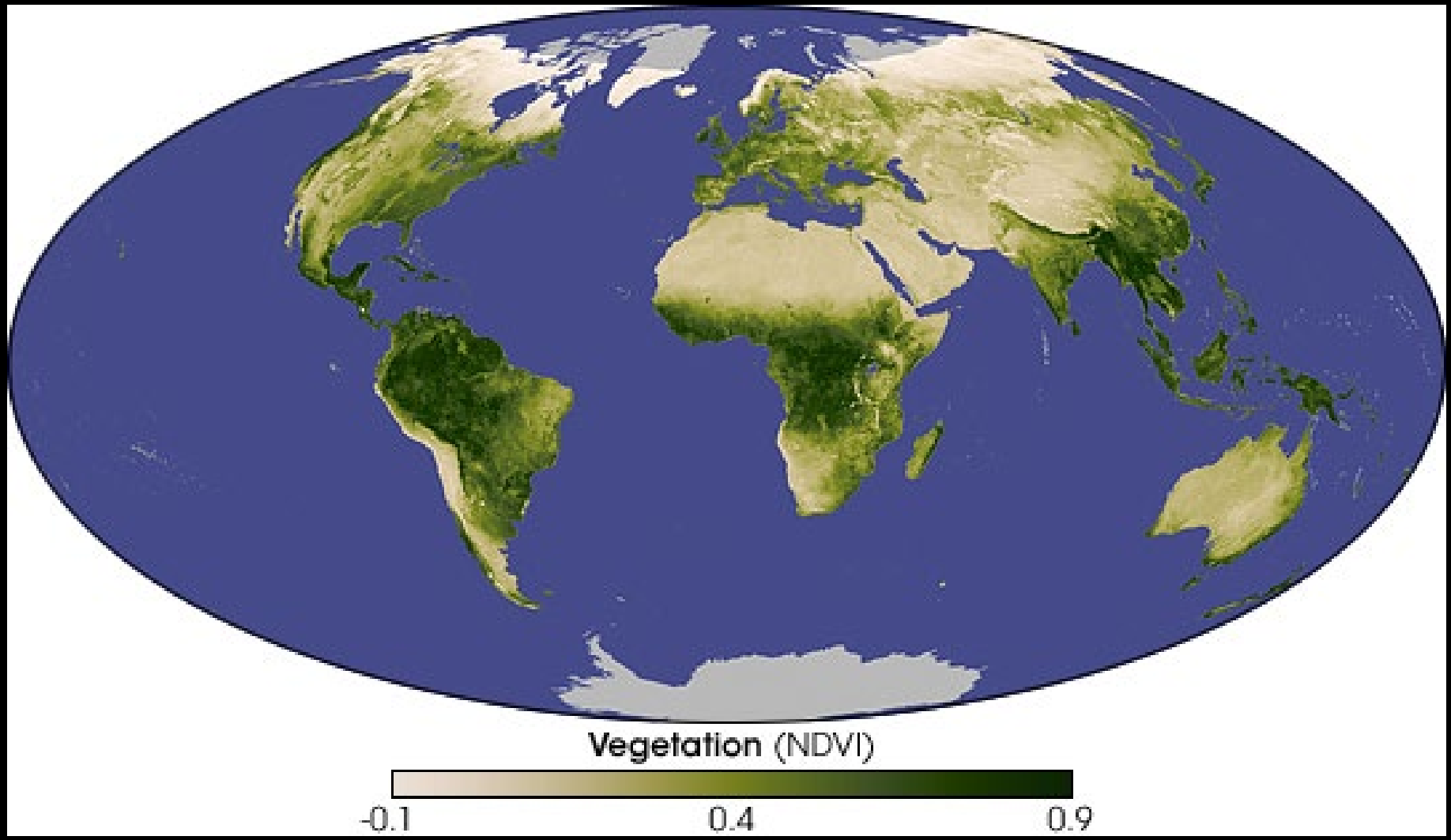
Remote Sensing

- Remote sensing uses satellite or aerial sensors to detect and monitor changes on Earth's surface.
- Provides consistent, large-scale data on land cover, vegetation, water, and more.


Google Earth Timelapse
Hefei, China
2000

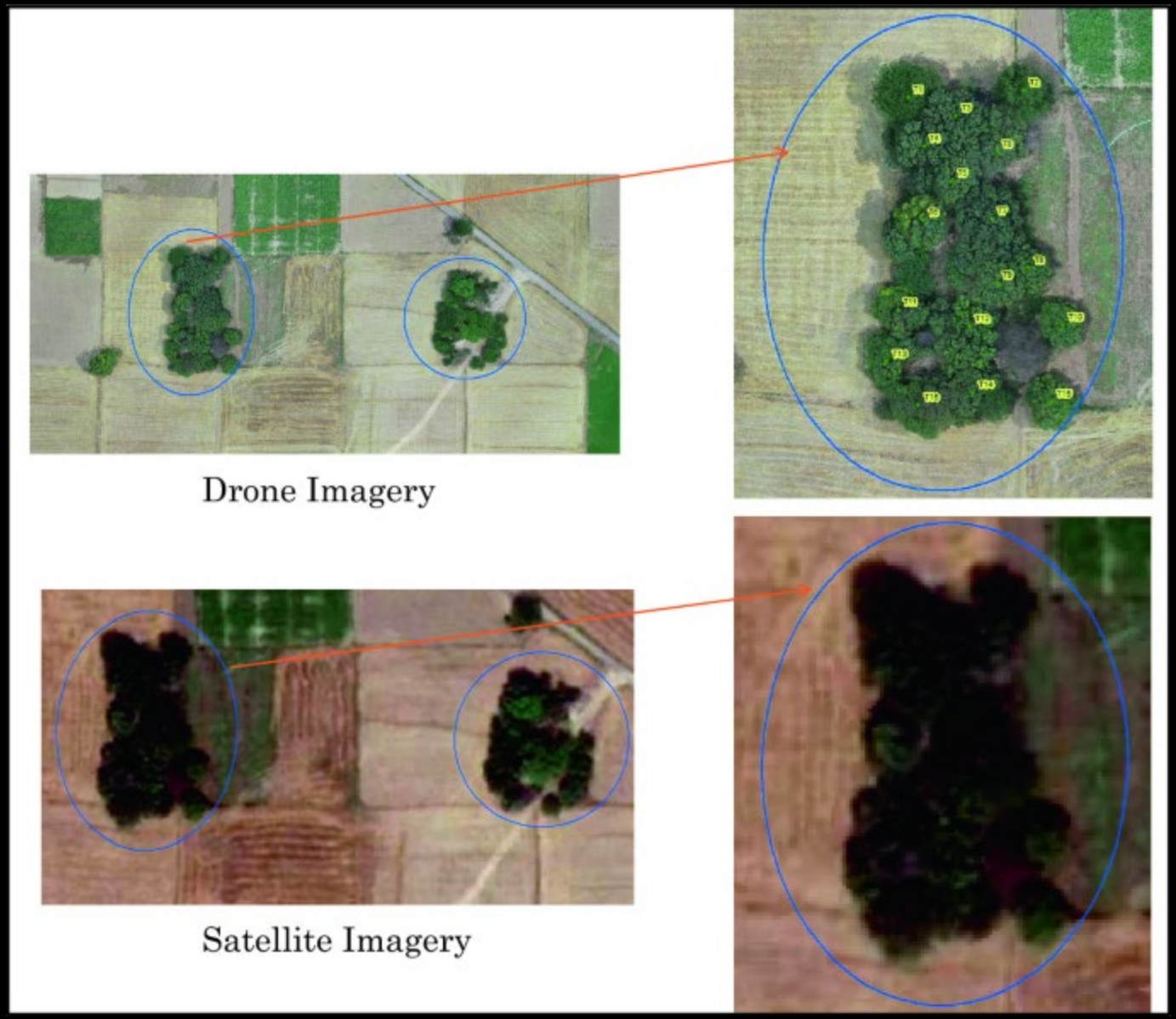

Google Earth Timelapse
Whitesville, West Virginia
2009

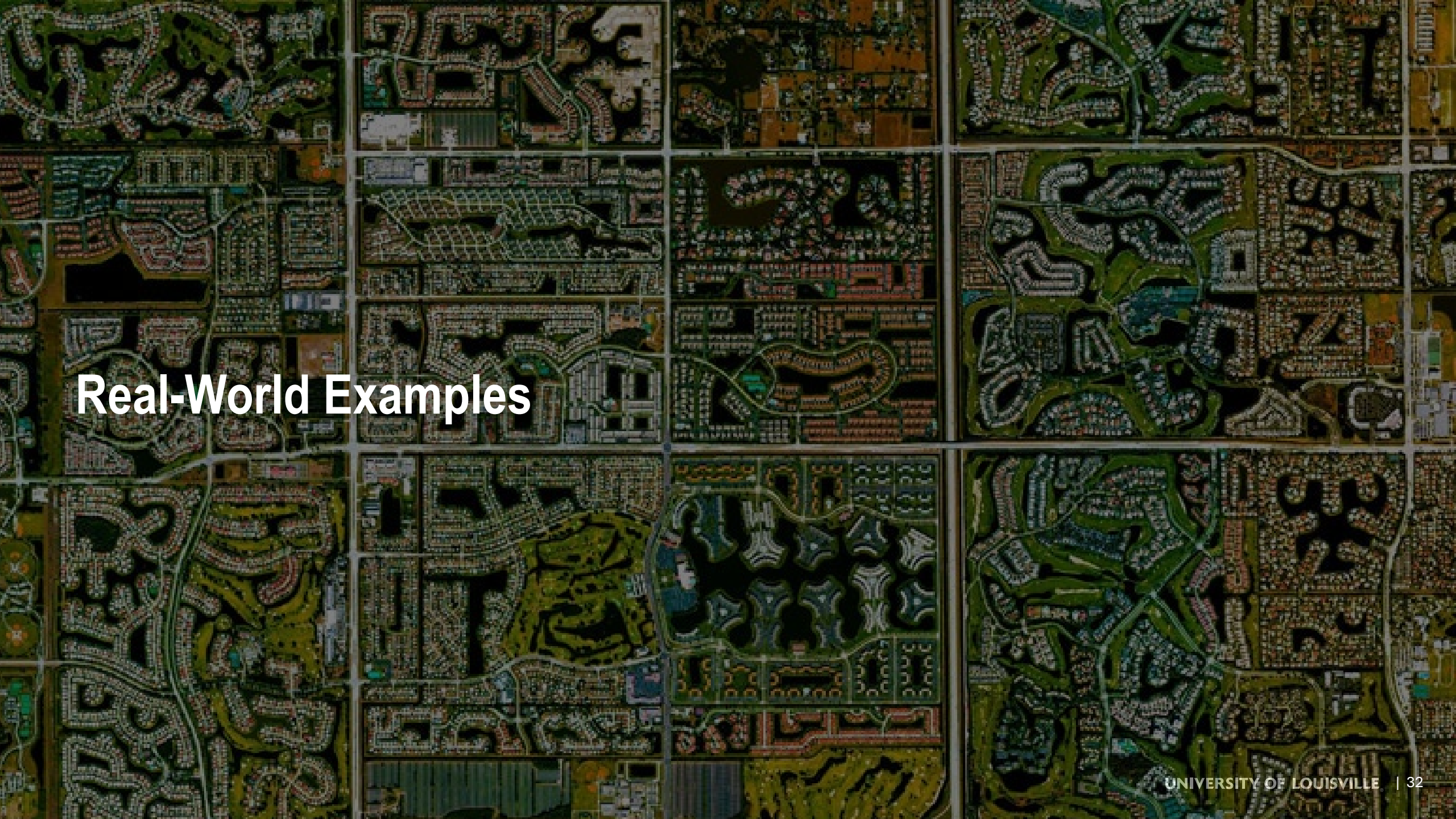
Remote Sensing


Vegetation (NDVI)
-0.1
0.4
0.9

Drones

- Detailed, on-demand views from low altitude.


Drone Imagery
Satellite Imagery



Real-World Examples

Social and Demographic Mapping

- Where are people and what are they like?
- How do environmental hazards disproportionately impact different social groups?

United States Census Bureau **My Community Explorer 4.4**

Feedback | → MCE Puerto Rico | About | Table | Data Sources

A mapping tool to help understand the potential impact of disasters to people, businesses, and the economy.

Step 1: Select State Set the Context

Step 2: Select County Generate a Profile

To set the Community Context (right panel):
'Select a State' in Step 1 or Draw a Region in the Map Using the select tool The right panel will update to reflect your chosen state or region.

To generate County Profile (tabs):
'Select a County' in Step 2. Census tract information is included in maps on County Profiles.

Responsive Legend

Census Datasets (states, counties, census tracts)

Community Resilience Estimates

Predominant Category of Social Vulnerability (SV) - Tracts (CRE 2022)

Predominant category

- Estimated population with 3+ components of SV
- Estimated population with 1-2 components of SV
- Estimated population with 0 components of SV
- No one group predominant or Population is 0

Reference Layer Legend

(Overlays from other data sources)

Active Hurricanes, Cyclones and Typhoons (Source: NOAA)

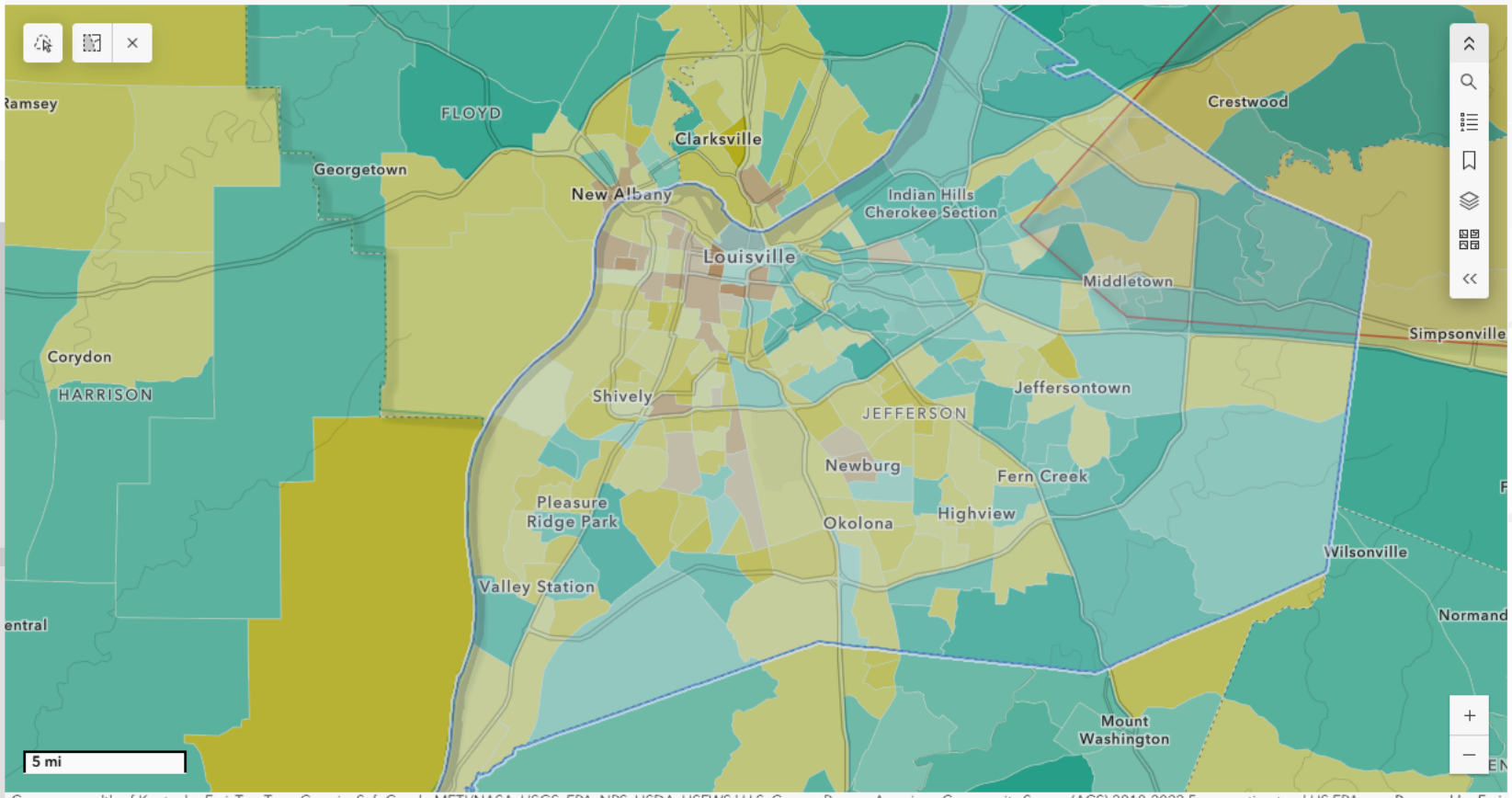
Forecast Position

Classify by Wind Speed

- Category 5
- Category 4

Interactive Map: Explore Census Bureau and Emergency Response Reference Datasets

Select Thematic & Reference Layers to view by clicking Layers icon in map then turning layers on & off | Expand the map by clicking in the upper right corner



Commonwealth of Kentucky, Esri, TomTom, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA, USFWS | U.S. Census Bureau American Community Survey (ACS) 2018-2022 5-year estimates, | US EPA, … Powered by Esri

American Community Survey 2018-2022, Community Resilience Estimates 2022, County Business Patterns 2022, & Nonemployer Statistics 2022

Community Context

USA Totals shown until state and/or region is selected

Selected Region Contains: 1 Counties

Jefferson County	Kentucky

Households 327.2K

Population 779.2K

Population with 3+ Components of Social Vulnerability
Community Resilience Estimates 2022

20.89%

Explore CRE

Household Characteristics
ACS 2018-2022 5-Year Estimates

Below Poverty: 43.3K or 13.2%

1+ Disability: 84.3K or 25.8%

Without Vehicle: 29.5K or 9.0%

With Broadband: 291.4K or 89.1%

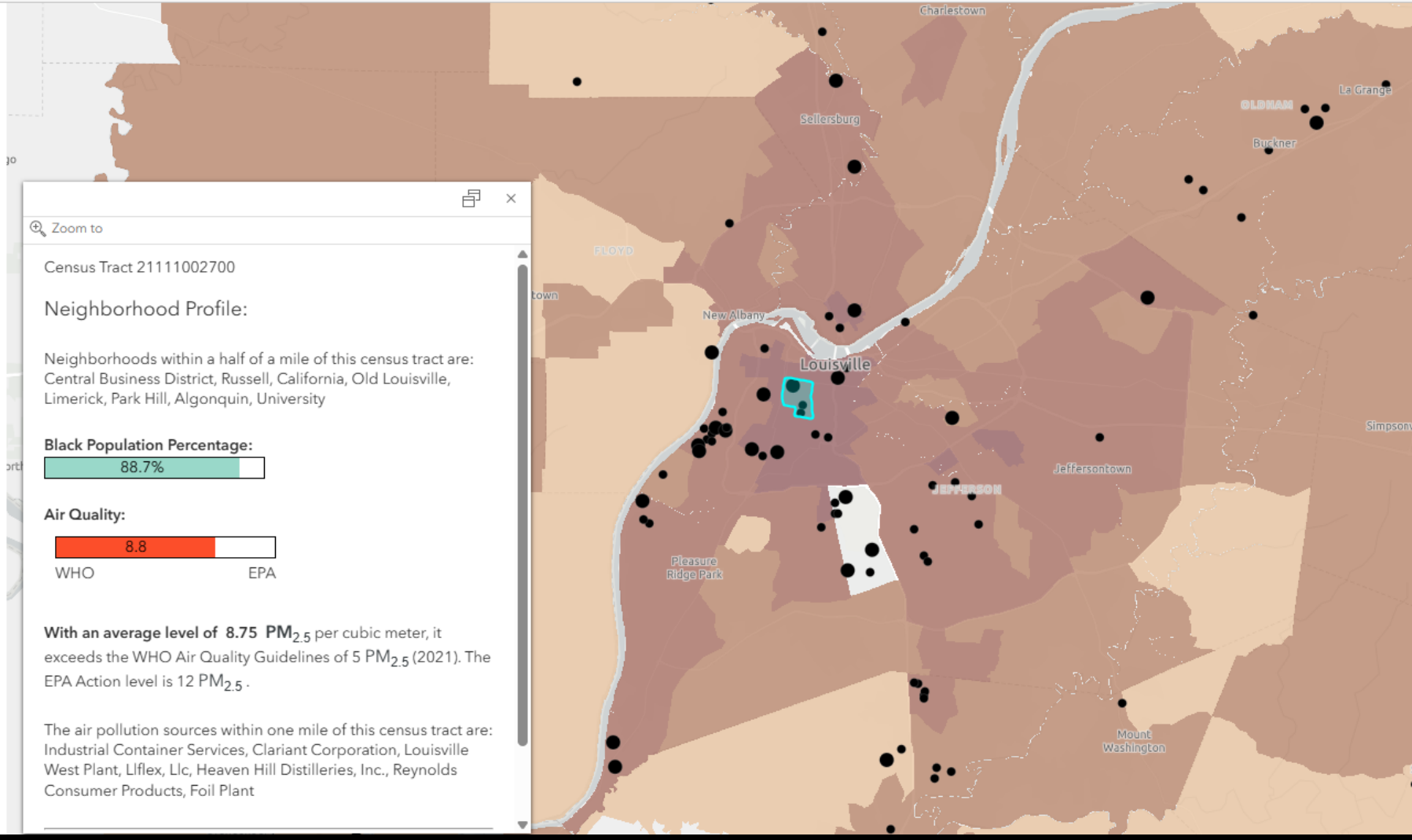
View DP02, DP04, B22010, B17017 data at data.census.gov for MoE & more | MOE Methodology for Aggregation

Exploring Air Quality and Racial Demographics in Louisville

The Map | Data Sources: | Demographics | Particulate Pollution | Emissions Sources | Neighborhoods | Credits

Welcome to our interactive web map exploring the relationship between air quality and racial demographics in Louisville.

This map provides data for each census tract in Louisville, providing average Particulate Matter 2.5 ($PM_{2.5}$) levels affecting different communities, focusing on the black population.



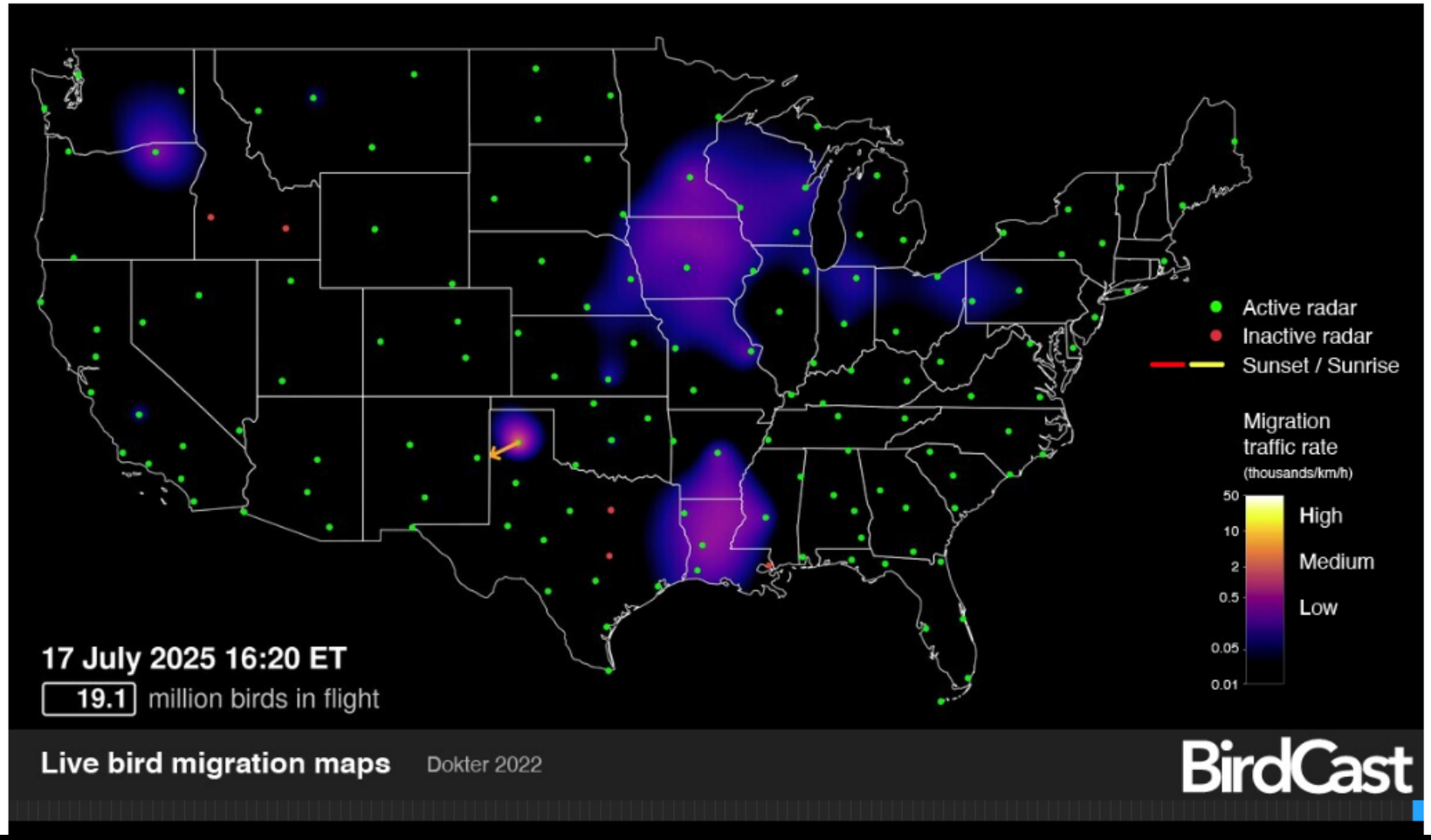
Physical and Environmental Mapping

- Species habitat mapping/modeling
- Land cover change analysis
- Natural hazards vulnerability
- Climate change monitoring

Live bird migration maps

Select a date:

2025/07/16



USGS science for a changing world

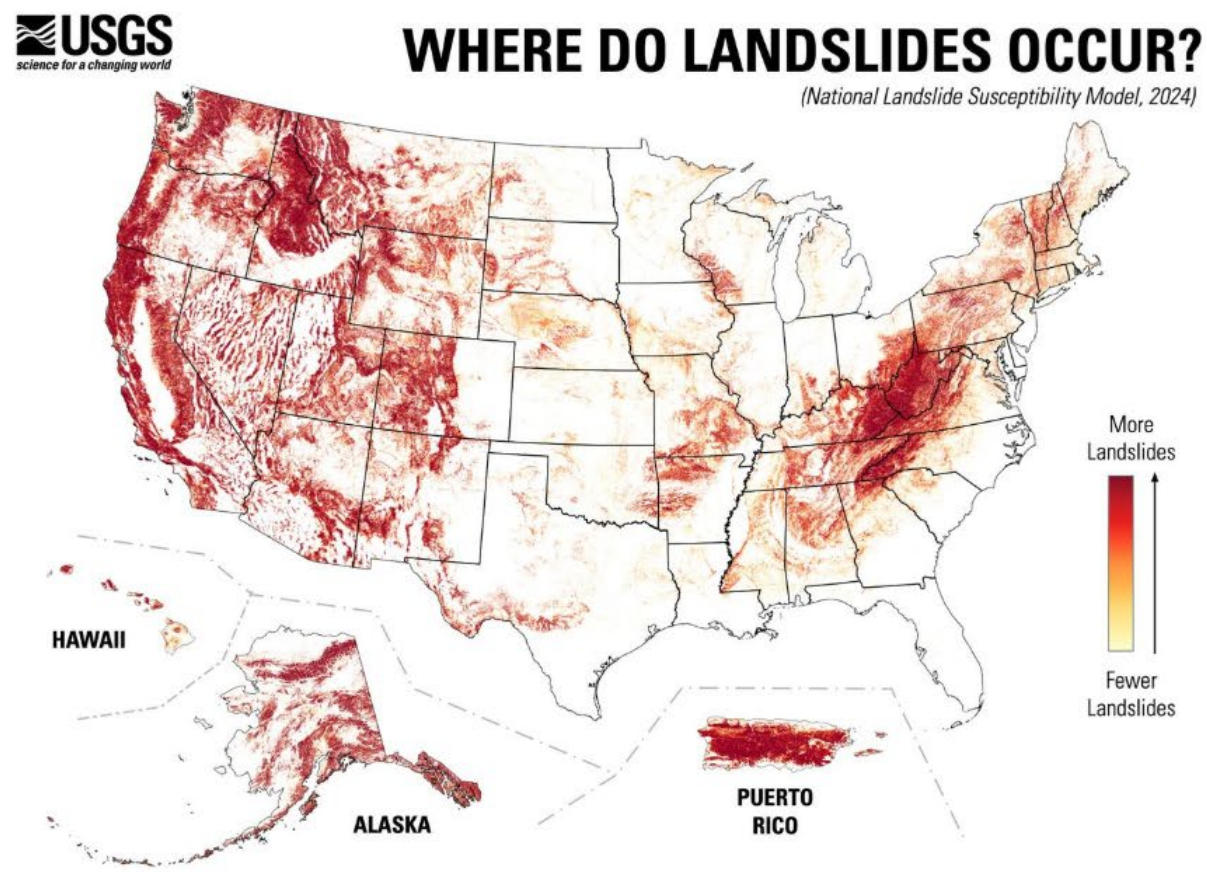
SCIENCE PRODUCTS NEWS CONNECT ABOUT

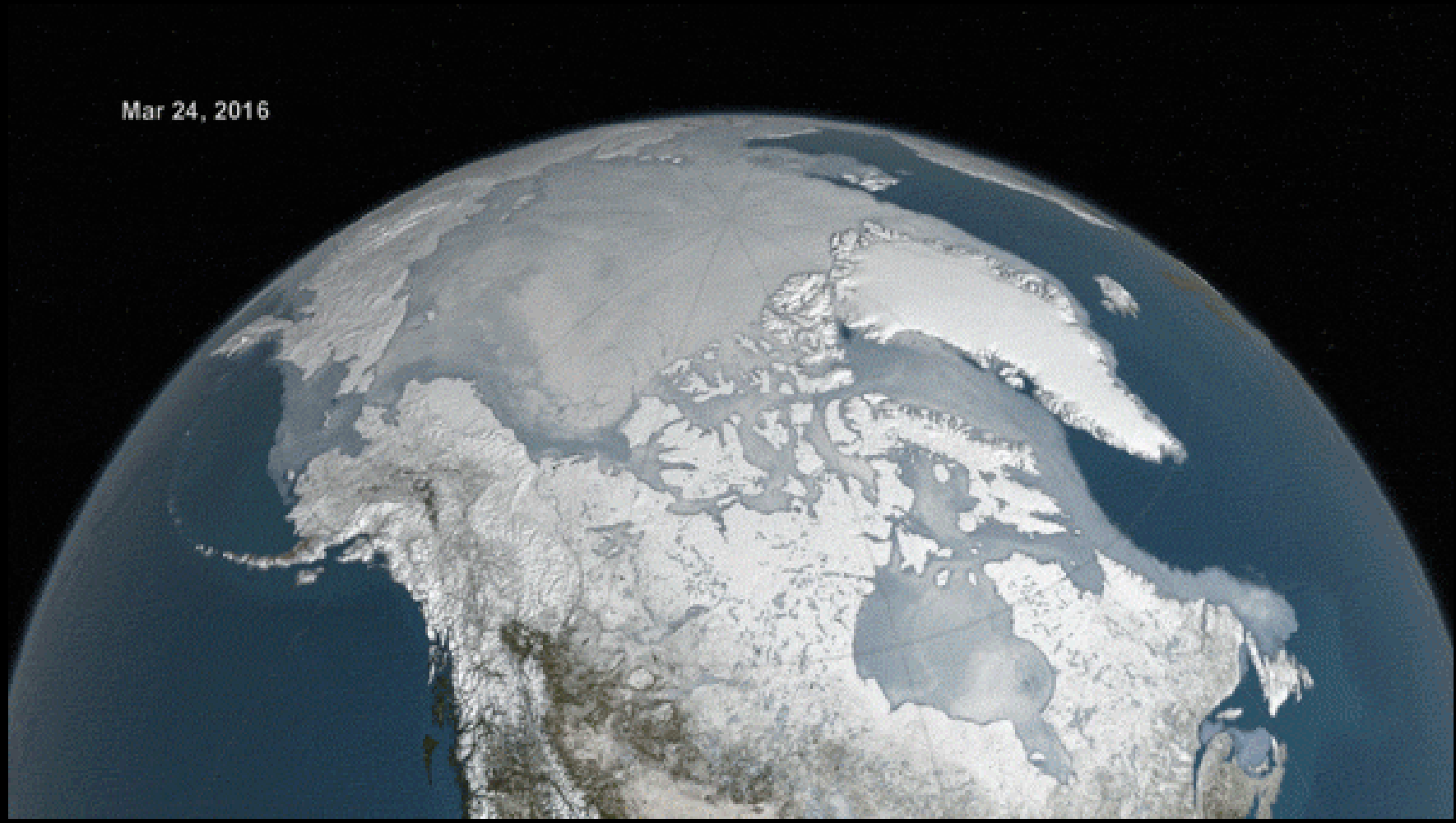
Latest Earthquakes

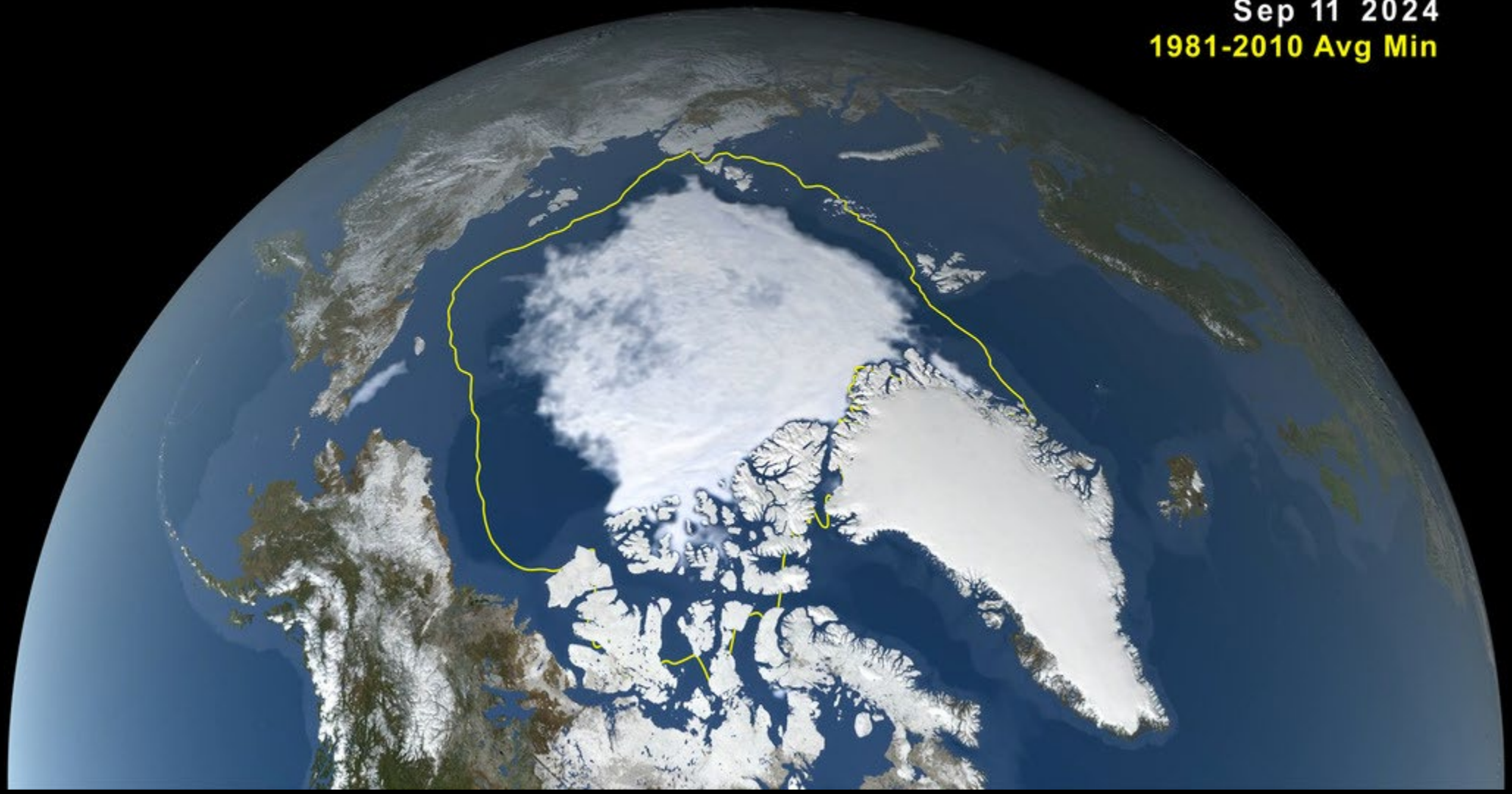
IMAGES | ILLUSTRATIONS

Where Do Landslides Occur?

By Communications and Publishing SEPTEMBER 10, 2024




Mar 24, 2016


Sep 11 2024
1981-2010 Avg Min

MRLC
Celebrating 20+ years of Partnership
Multi-Resolution Land Characteristics Consortium

Contents | Legend | Help

All | Explore Partner Datasets

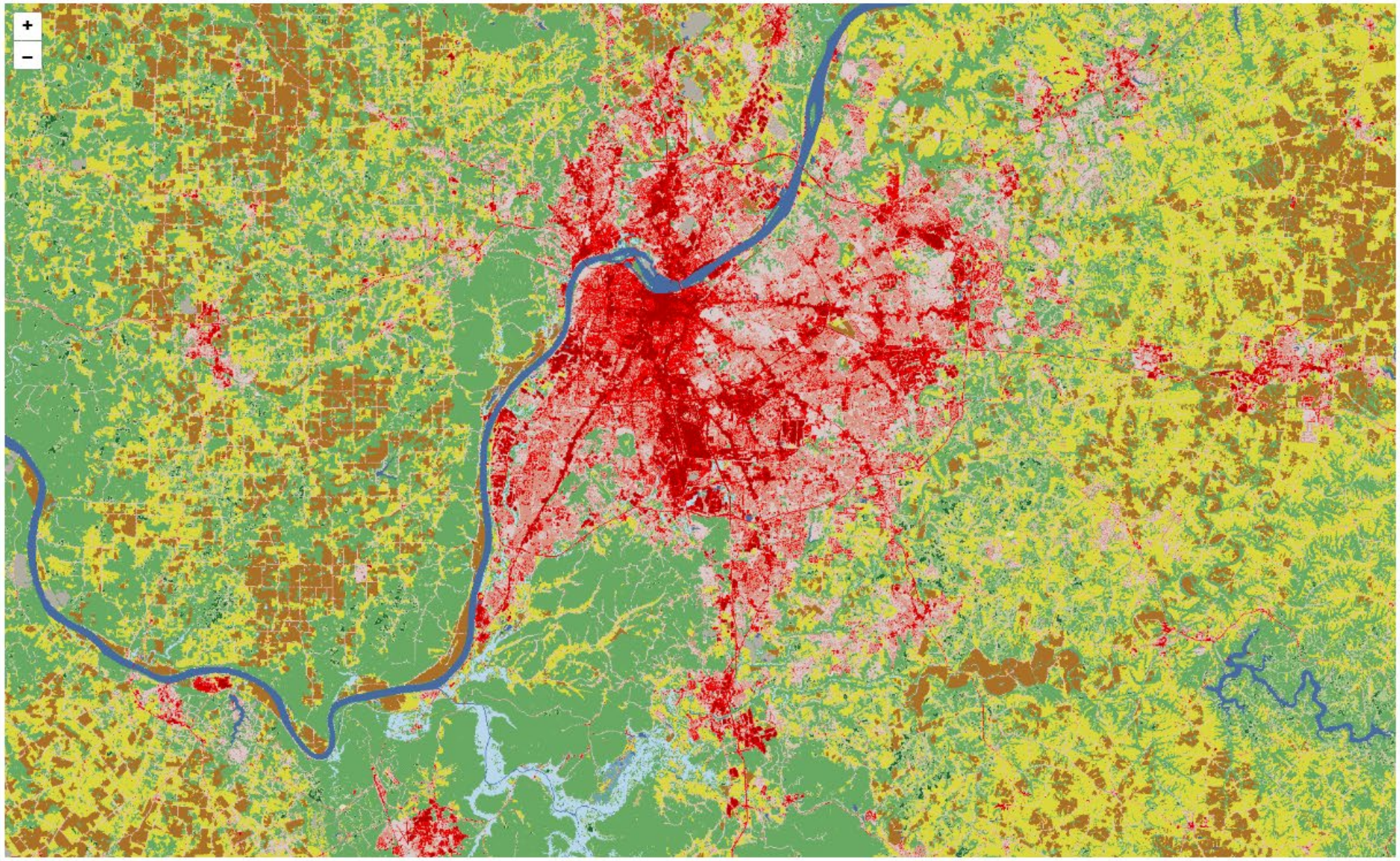
Dataset (Double click to open)

- Annual NLCD
  - Fractional Impervious Surface
  - Impervious Descriptor
  - Land Cover
  - Land Cover Change
  - Land Cover Confidence
  - Spectral Change Day of Year
  - Tree Canopy
- Annual NLCD Summary Products
- NLCD Tree Canopy
- Legacy NLCD

Layers

- Overlays
  - [x] Land Cover (2024)
  - [x] Legacy Land Cover 2016 AK Land Cover
- Boundaries
  - [ ] National Atlas States
  - [ ] US Counties
- Base Layers
  - [x] ESRI World Imagery

All Annual NLCD Land Cover (2024)



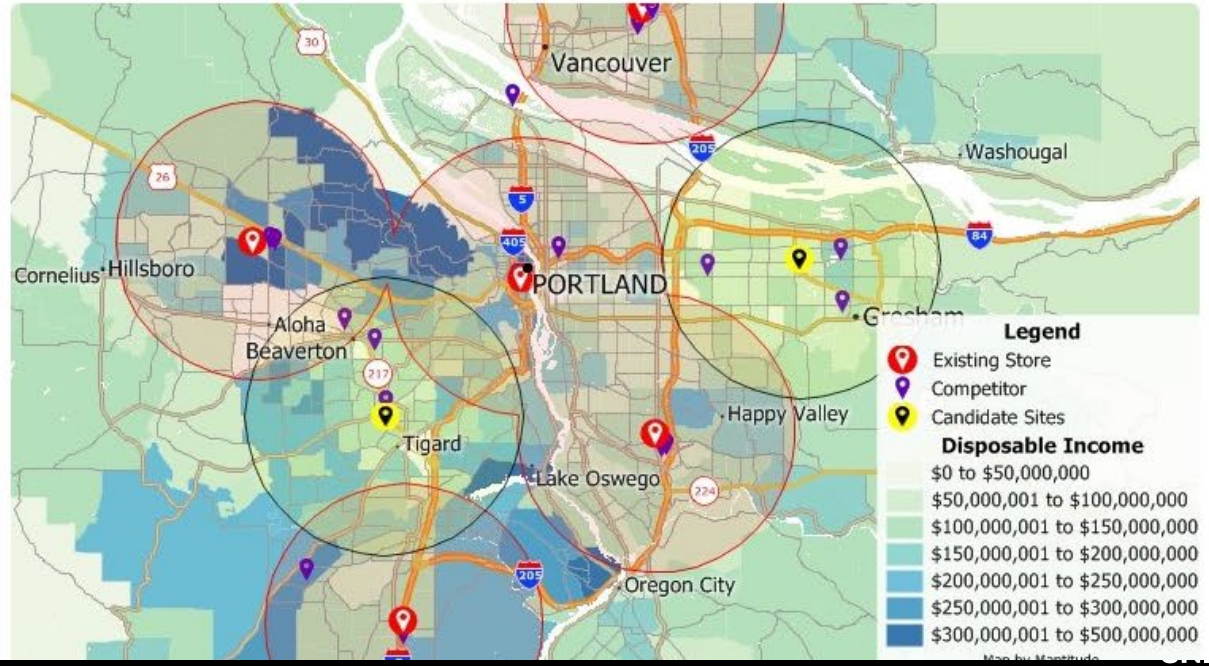
Logistics and Transportation

- How can we minimize transportation costs?
- What is the best route for the UPS truck?
- What percentage of the population is within a one hour drive of a trauma center?
- Do we need a new TARC route due to population growth?

GIS in Retail Site Selection Process

The retail site location process is not simply a matter of identifying available properties. It requires a series of analytical steps that GIS software is ideally suited to help answer:

- What amenities, attractions, and services are in the surrounding area
- What is the demographic profile of the market area in terms of education, employment, and buying power
- What competitive or complementary retail is in the immediate area
- Are there better locations available in the market area such as within a 15-minute drive time ring
- How accessible is the site from major roads and population centers



Journalism and Storytelling

- Story Maps convey place-based narratives about a topic or idea
- Mashups of maps, text, and multimedia in an interactive web applications
- Effective and engaging communication in a web browser
- https://storymaps.esri.com

Rising waters

Mapping the impact of
Brazil's historic flooding

Esri's StoryMaps team

May 17, 2024

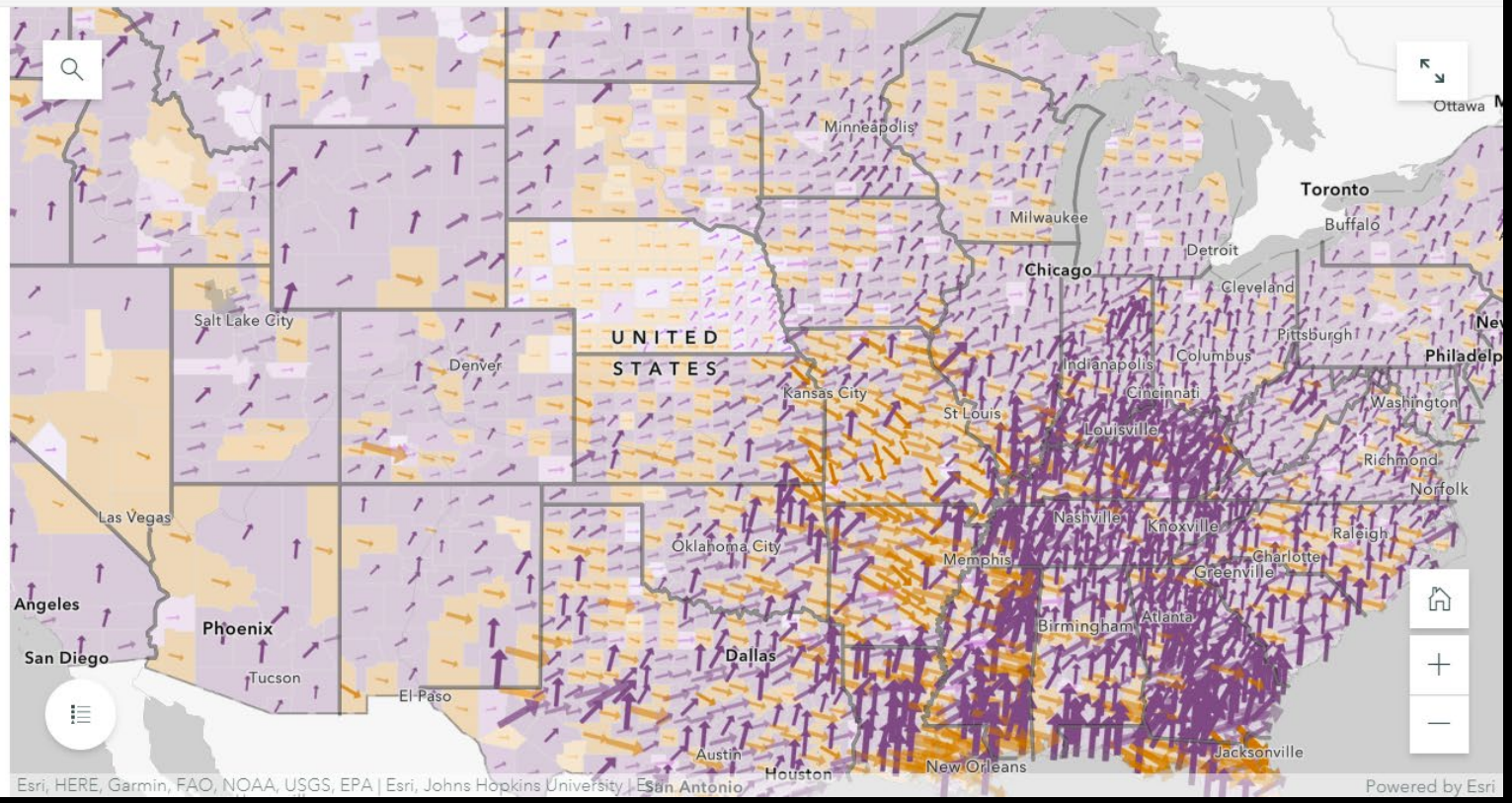
esri Which Way Are Things Going?

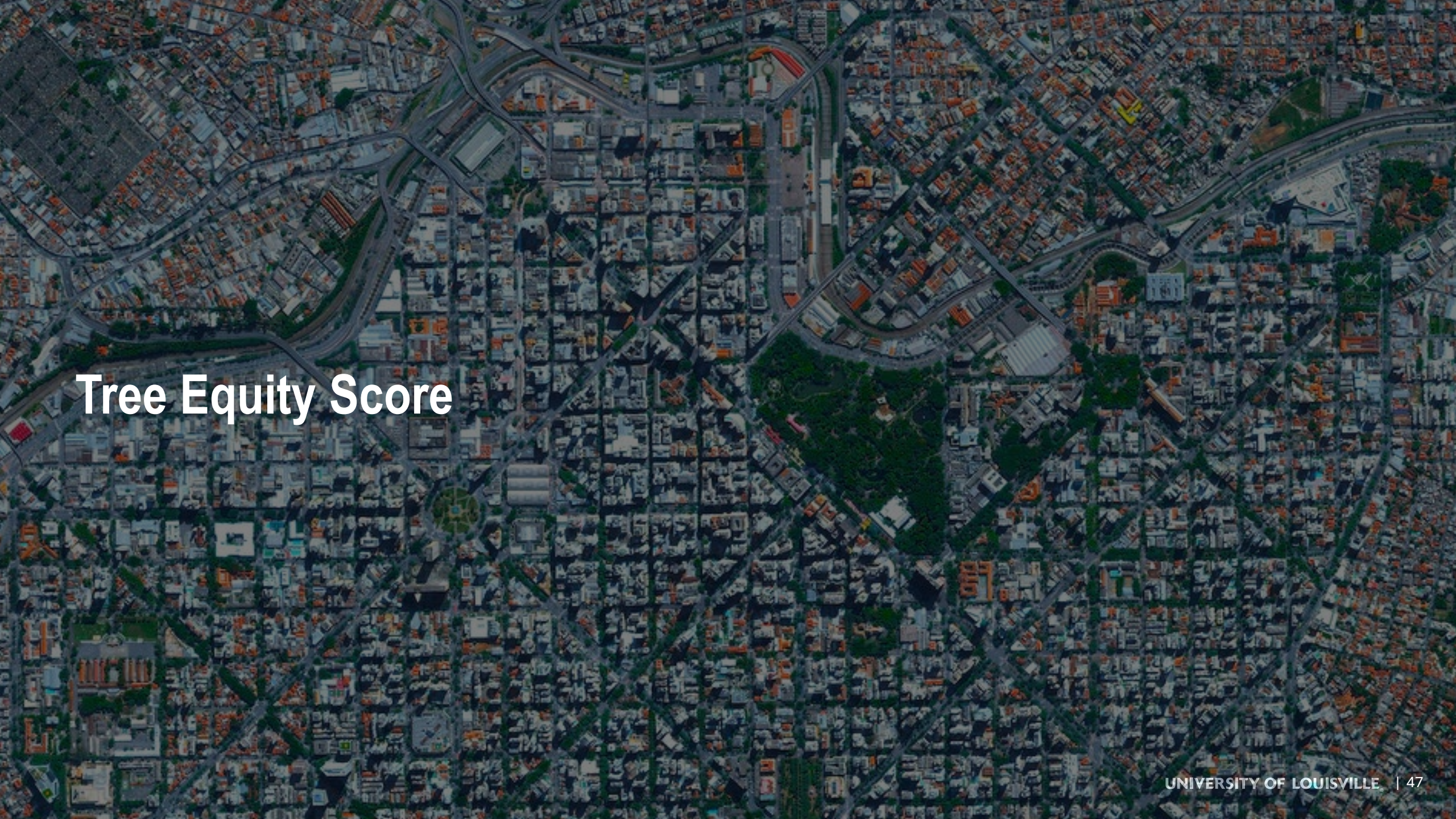
About This Map | Find Your State | Best and Worst Counties Lists | Credits

About This Map

To help policy makers, business leaders and the public understand COVID-19 trends, Charlie Frye, Chief Cartographer at Esri, analyzes the week to week changes in active cases. By shifting focus from the highly variable daily changes in active case counts to a weekly perspective, we can see weekly trends emerge. The maps below show data through August 22, 2021.

This arrow map builds on a simple question most people want to know: are things getting better, or worse, in my



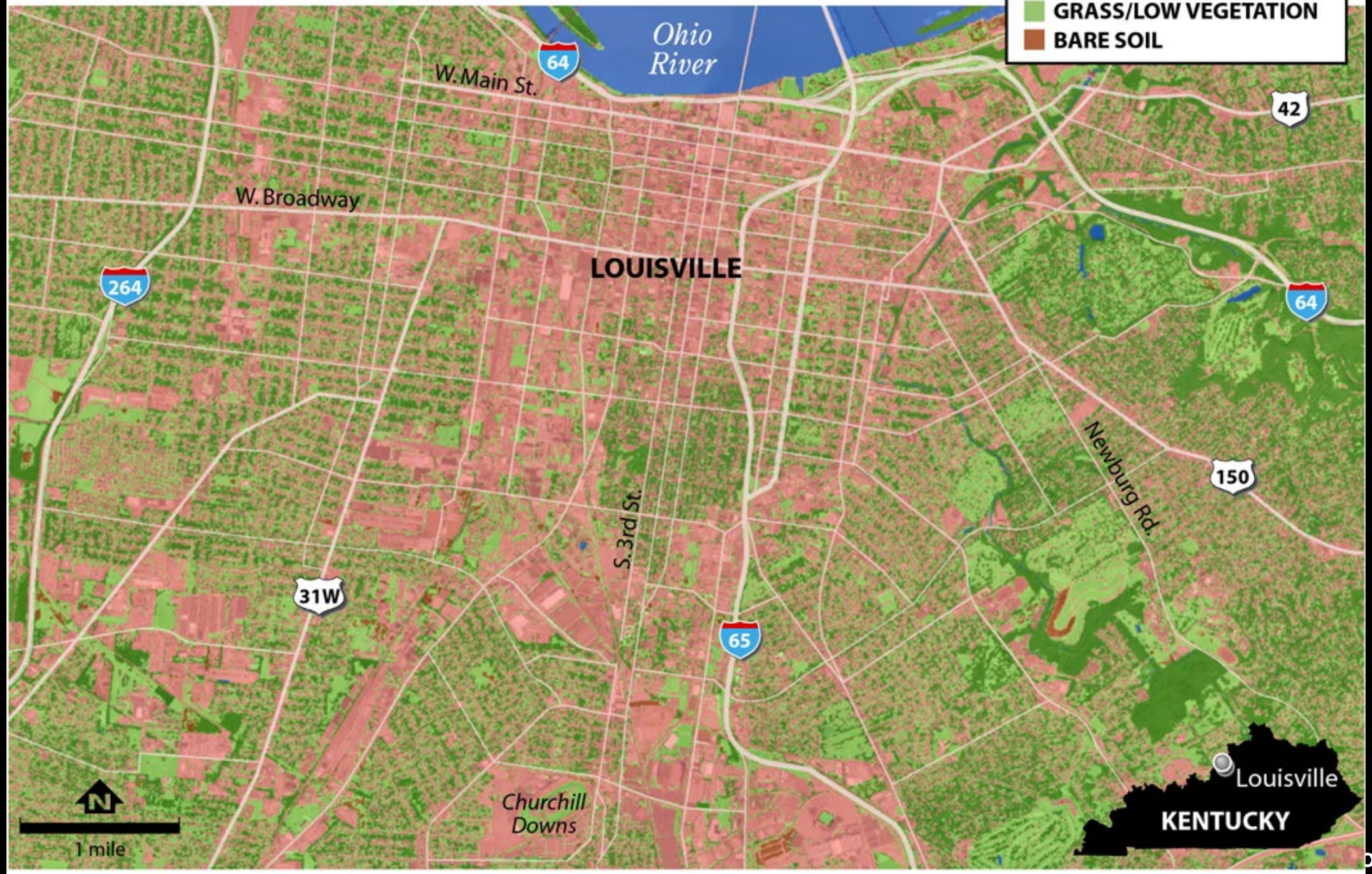


Tree Equity Score


TREE EQUITY SCORE
American Forests
National Map
Local Analyzers
About Tree Equity Score
We believe data belongs to everyone.
OUR GOAL IS THAT URBAN COMMUNITIES HAVE THE RESOURCES TO GET HEALTHY TREES TO THOSE WHO NEED THEM THE MOST.

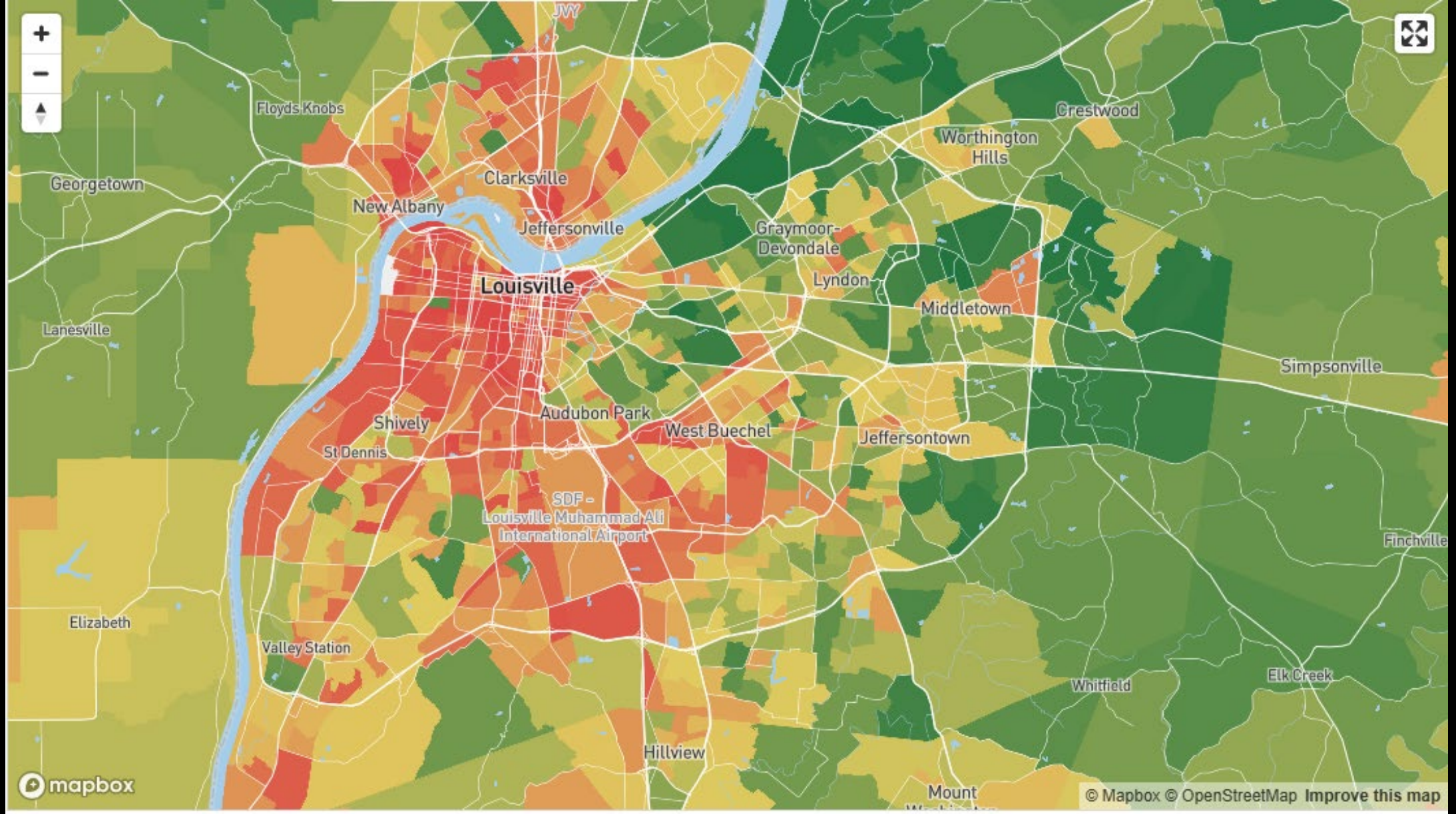
Louisville's Changing Tree Cover

Much of downtown Louisville is largely devoid of tree cover, leaving it vulnerable to the heat island effect as the sun heats up the buildings, streets and parking lots.



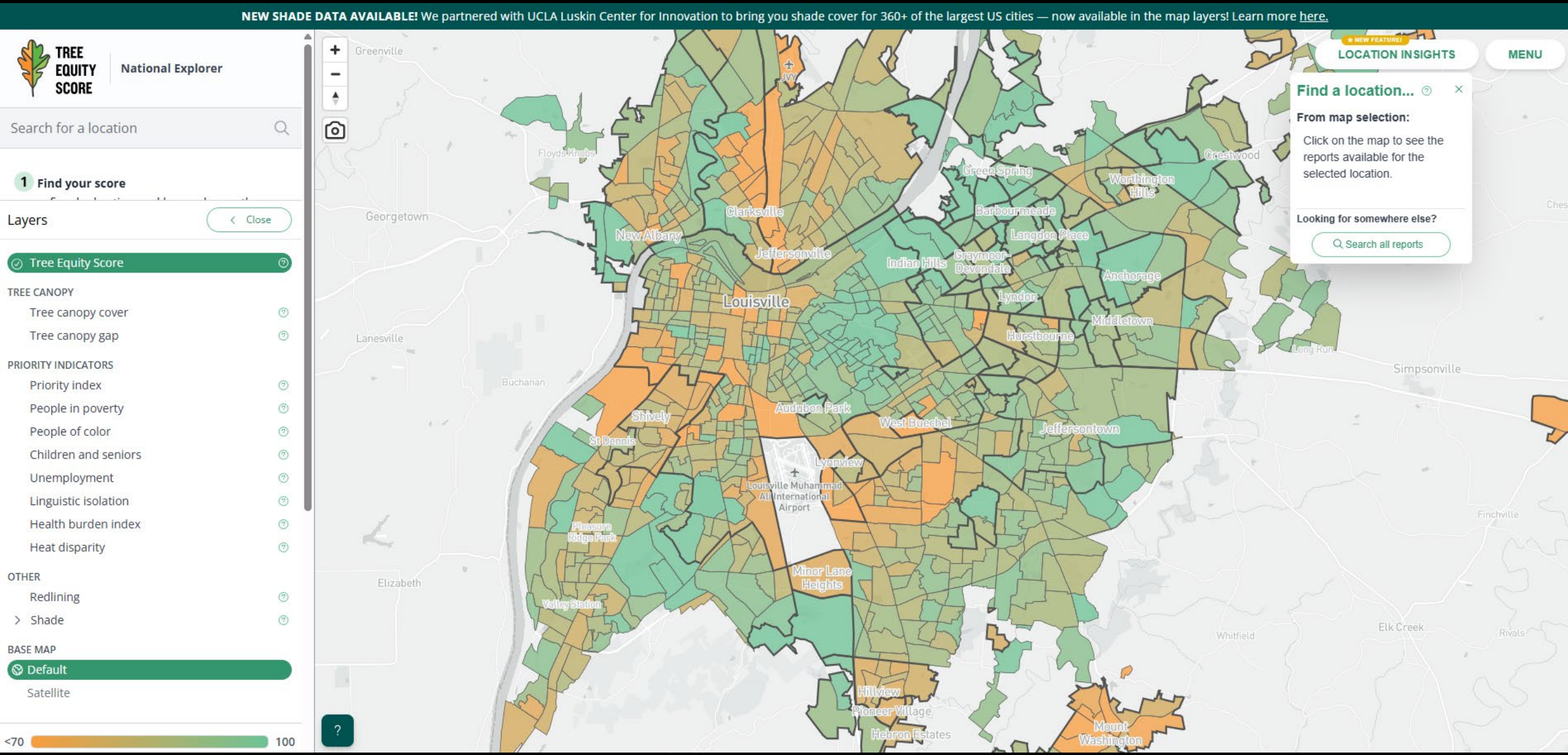
SOURCE: cartotronics.com

PAUL HORN / InsideClimate News



Household Income Key

High	Average	Low


NEW SHADE DATA AVAILABLE! We partnered with UCLA Luskin Center for Innovation to bring you shade cover for 360+ of the largest US cities — now available in the map layers! Learn more here.
TREE EQUITY SCORE
National Explorer
Search for a location
1 Find your score
Layers
Close
Tree Equity Score
TREE CANOPY
Tree canopy cover
Tree canopy gap
PRIORITY INDICATORS
Priority index
People in poverty
People of color
Children and seniors
Unemployment
Linguistic isolation
Health burden index
Heat disparity
OTHER
Redlining
Shade
BASE MAP
Default
Satellite
<70
100
NEW FEATURE!
LOCATION INSIGHTS
MENU
Find a location...
From map selection:
Click on the map to see the reports available for the selected location.
Looking for somewhere else?
Search all reports
Greenville
Floyds Knobs
Georgetown
New Albany
Clarksville
Jeffersonville
Louisville
Lanesville
Buchanan
Elizabeth
Crestwood
Worthington Hills
Green Spring
Barbourmeade
Langdon Place
Indian Hills
Graymoor-Devondale
Anchorage
Lyndon
Middletown
Hurstbourne
Long Run
Simpsonville
Audubon Park
Shively
St Dennis
West Buechel
Jeffersontown
Lynnview
Louisville Muhammad Ali International Airport
Pleasure Ridge Park
Minor Lane Heights
Valley Station
Hillview
Pioneer Village
Hebron Estates
Mount Washington
Whitfield
Elk Creek
Rivals
Finchville


TREE EQUITY SCORE
National Explorer
Search for a location
Census Block Group 211110003002
Population 836
Louisville, KY
KY Congressional District 3
71
Tree Equity Score
Ranked 240th of 251 block groups in Louisville
Priority HIGH
Current Canopy Cover 23%
Canopy Cover Goal: 50%
Score indicators
Priority index
People of color 69%
Children and seniors 31%
Unemployment 26%
Linguistic isolation 0%
People in poverty 60%
Health burden index 60
Heat disparity +11.6°F
NEW FEATURE!
LOCATION INSIGHTS
MENU
Find a location...
From map selection:
Louisville, KY
Jefferson County, KY
KY Congressional District 3
State of Kentucky
Looking for somewhere else?
Search all reports
Louisville
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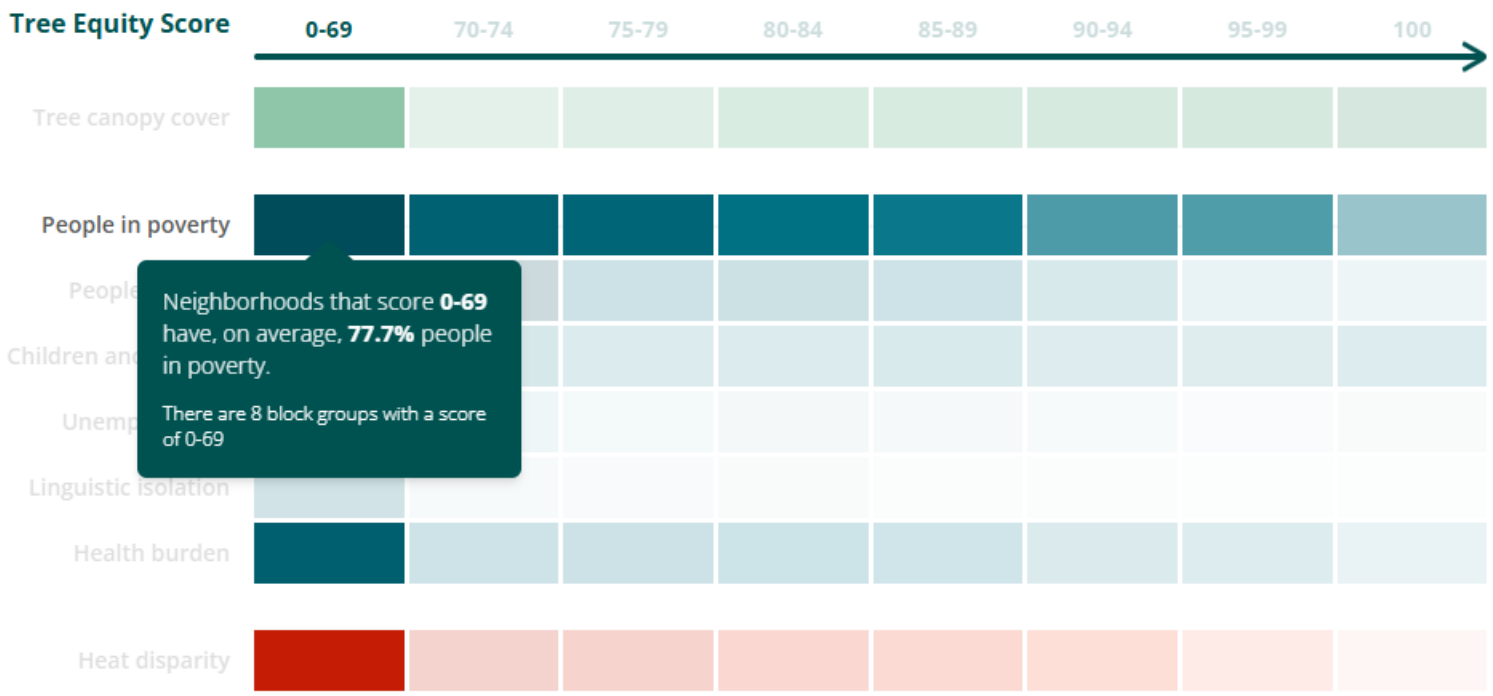

LOUISVILLE, KY

Tree Equity Score Breakdown

Hover to explore the characteristics of neighborhoods with similar Tree Equity Scores.

HOW TO READ IT

Neighborhoods are grouped from lowest to highest Tree Equity Scores, left to right. Darker colors represent higher values. Hover to gather data. Move vertically to get data for a single score range. Move horizontally to compare data across scores.

Infinite Uses for GIS and Geospatial Tools

There are literally thousands of ways to use GIS to answer questions, create new knowledge, and help people understand their world a little better!

Questions? Comments?

Thank you!

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