

Street View for Whom?

An Initial Examination of Google Street View's Urban Coverage and Socioeconomic Indicators in the US

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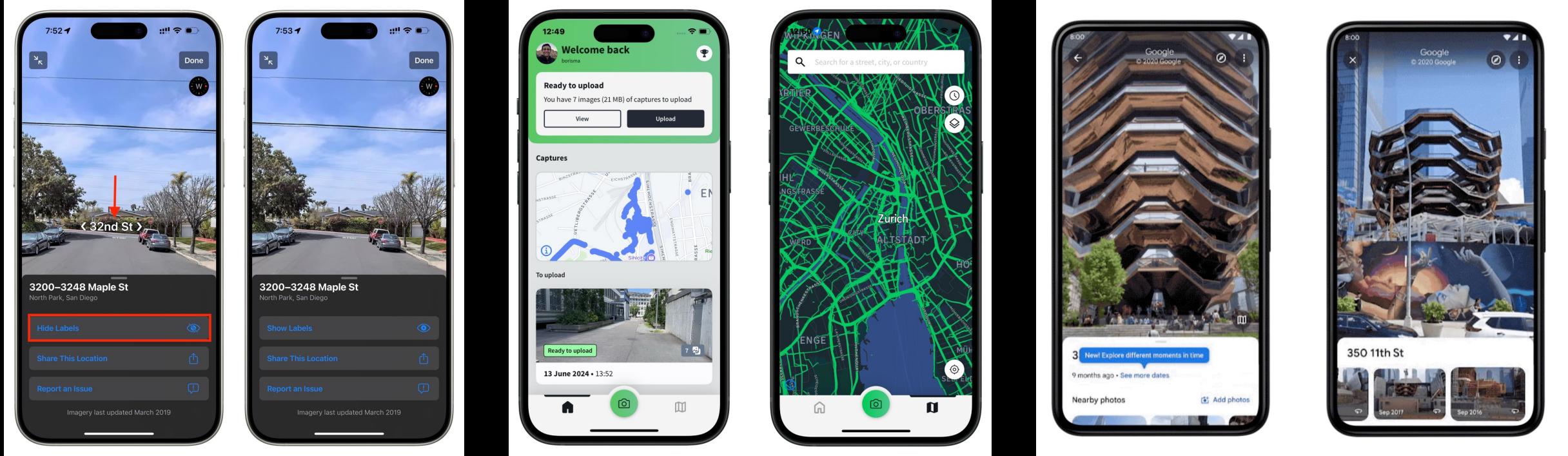
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OF COMPUTER SCIENCE & ENGINEERING

UNIVERSITY of
WASHINGTON

A black and white photograph of a city street scene. The foreground features a large, light-colored building with multiple stories and decorative architectural details. A prominent sign on the building reads "S NEWSAGENCY". In front of the building, there's a car parked on the left and another on the right. A large, solid white arrow points upwards from the bottom center of the image towards the middle ground.

**STREET-LEVEL IMAGERY HAS BECOME FUNDIMENTAL
TO URBAN INFORMATICS, SUPPORTING DIVERSE
RESEARCH ACROSS VARIOUS FIELDS.**

MAJOR PROVIDERS



Apple Lookaround

Mapillary (Meta)

Google Street View

Also have...

BaiduMaps, KartaView, Grabmaps, etc.



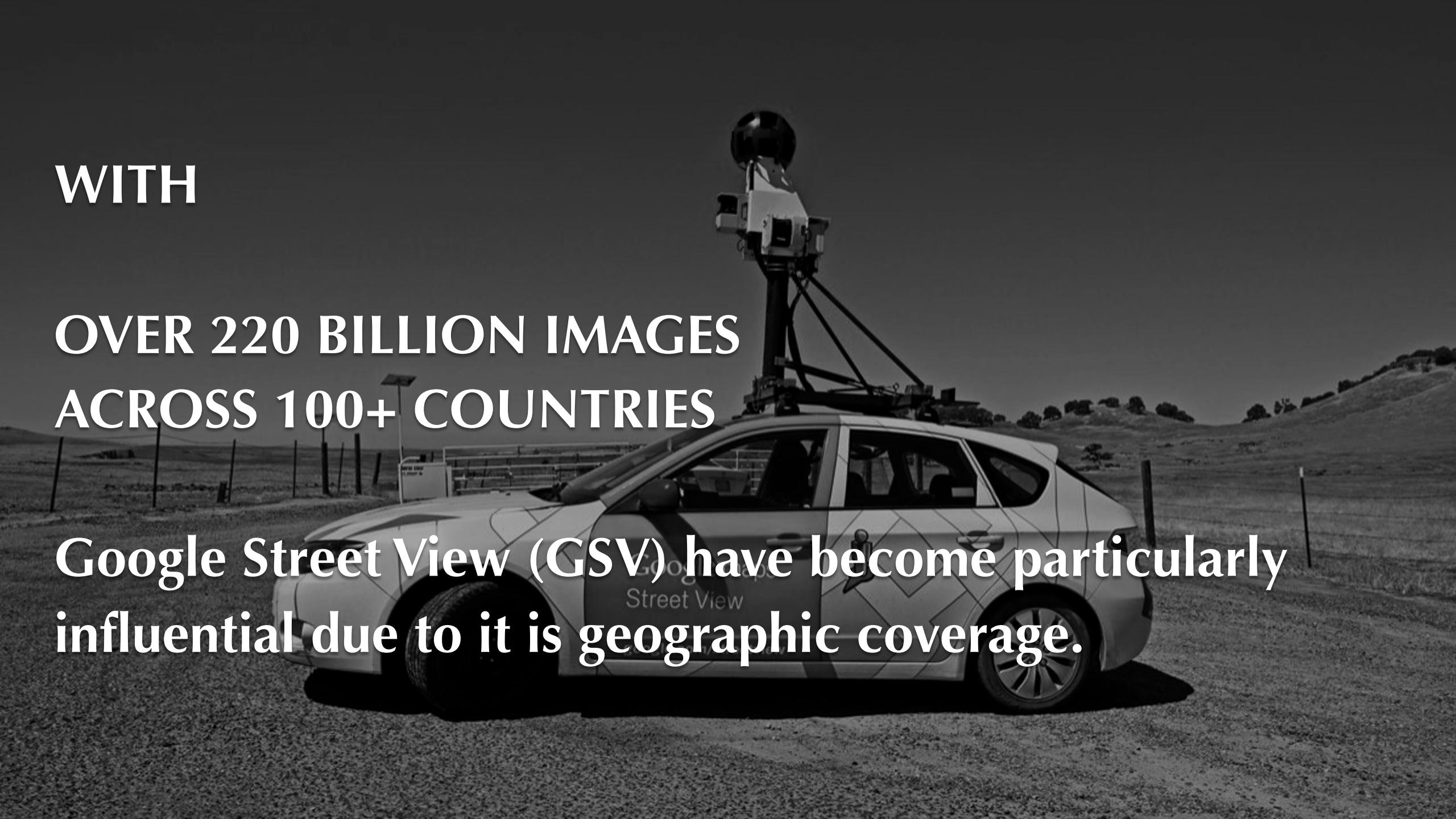
KartaView

GrabMaps

WITH

OVER 220 BILLION IMAGES
ACROSS 100+ COUNTRIES

Google Street View (GSV) have become particularly influential due to its geographic coverage.





Contents lists available at ScienceDirect

Cities

journal homepage: www.elsevier.com/locate/cities

Assessing the equity and evolution of urban visual perceptual quality with time series street view imagery

Zeyu Wang^a, Koichi Ito^a, Filip Biljecki^{a,b,*}

^a Depa
^b Depa

ART

Keywo
Reside
Public
Enviro
Spatia
Street
Visual



Contents lists available at ScienceDirect

Landscape and Urban Planning

journal homepage: www.elsevier.com/locate/landurbplan

Research Paper

Measuring human perceptions of a large-scale urban region using machine learning

Fan Zhang^{a,b,c}, Bolei Zhou^d, Liu Liu^e, Yu Liu^a, Helene H. Fung^f, Hui Lin^{b,g,*}, Carlo Ratti^c

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^b Institute of I
^c Sensable Ci
^d Computer Sc
^e China Acad
^f Department o
^g College of G

ARTICLE

Keywords:
Urban perce
Place semant
Street-level i
Deep learnin
Built environ



Contents lists available at ScienceDirect

Computers, Environment and Urban Systems

journal homepage: www.elsevier.com/locate/ceus

ARTICLE

Physical urban change and its socio-environmental impact: Insights from street view imagery

Yingjie Liu^{a,1}, Zeyu Wang^{b,1}, Siyi Ren^c, Runying Chen^c, Yixiang Shen^d, Filip Biljecki^{e,f,*}

^a Department of Architect
^b Department of Urban I
^c The Paul G. Allen Scho
^d Department of Electric
^e Department of Architect
^f Department of Real Est

ARTICLE IN

Keywords:
Urban renewal
Gentrification
Change detection
Deep learning

Tohme: Detecting Curb Ramps in Google Street View Using Crowdsourcing, Computer Vision, and Machine Learning

Kotaro Hara^{1,2}, Jin Sun, Robert Moore^{1,2}, David Jacobs, Jon E. Froehlich^{1,2}

¹ Makeability Lab | ² Human Computer Interaction Lab (HCIL)
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GSV has been leveraged by researchers to sensing urban environment, performing research audits at scale.



Using deep learning and Google Street View to estimate the demographic makeup of neighborhoods across the United States

Timnit Gebru^{a,1}, Jonathan Krause^a, Yilun Wang^a, Duyun Chen^a, Jia Deng^b, Erez Lieberman Aiden^{c,d,e}, and Li Fei-Fei^a

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Edited by Kenneth

The United States American Community Survey study that captures population, occupation, and industry data. Although demographic data can exceed several million records, machine vision has become an increasingly important tool for analyzing regions based on street scene images. In this paper, we present a novel method for estimating income levels in particular neighborhoods, which enables all automobiles to estimate income levels based on zip code and population size. People and power are concentrated during a period of pickup in the next few years, it is likely that automated systems will outperform models based on traditional methods alone.

Improve the urban visual interface to support urban infrastructure as a foundation for the role of deep learning in socioeconomic status and economic goals.

Advantages of the proposed approach include rapid detection of curb ramps, preservation of privacy, and reduced costs. Researchers have found that the urban density of a city is correlated with the number of curb ramps estimated by the model.

Author Keywords

Neural networks, computer vision, accessibility, sidewalks, curb ramps, Google Streetview

PNAS

RESEARCH ARTICLE

SOCIAL SCIENCES
SUSTAINABILITY SCIENCE

OPEN ACCESS



Urban visual intelligence: Uncovering hidden city profiles with street view images

Zhuangyuan Fan^a ID, Fan Zhang^{b,1} ID, Becky P. Y. Loo^{a,c} ID, and Carlo Ratti^d

Edited by Richard Shearmur, McGraw-Hill Education Member Susan Hanson

Paper Session 4: Finding your Way (to this session)

ASSETS '19, October 28–30, 2019, Pittsburgh, PA, USA

Deep Learning for Automatically Detecting Sidewalk Accessibility Problems Using Streetscape Imagery

Galen Weld¹, Esther Jang¹, Anthony Li², Aileen Zeng¹, Kurtis Heimerl¹, and Jon E. Froehlich¹

¹Paul G. Allen School of Computer Science and Engineering, University of Washington, Seattle, USA

²Department of Computer Science, University of Maryland, College Park, USA

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and infrequent.¹ Moreover, the resulting data is in disparate formats, is not typically open (*i.e.*, published online), and is not intended for end-user tools [23, 50]. To expand who can collect sidewalk data and to improve data granularity and freshness, researchers have introduced smartphone-based tools [15, 46, 52] as well as instrumented wheelchairs [35, 39, 51, 57], both of which capture sidewalk information *in situ* as it's experienced. However, these tools have been limited by low adoption, small geographic coverage, and high user burden (*e.g.*, requiring users to take out their phones, load an app, take a picture, annotate it, and upload it) [20, 23].

To partially address these challenges, researchers have begun developing automated methods for sidewalk assessment using machine learning and online imagery (*e.g.*, satellite photos [10, 8], panoramic streetscape imagery [31, 32, 33]). While still early, these complementary approaches promise to dramatically decrease manual labor and cost. However, they have been limited by the inability to automatically handle images and the choice of machine learning models, both of which negatively impact performance. In this paper, we attempt to address both of these issues.

We present the first examination of deep learning methods to automatically assess sidewalk accessibility in terms of curb

COMMENT | 13 August 2023

Putting Africa on the map

A lack of street view imagery in many countries mean valuable data isn't available to researchers.

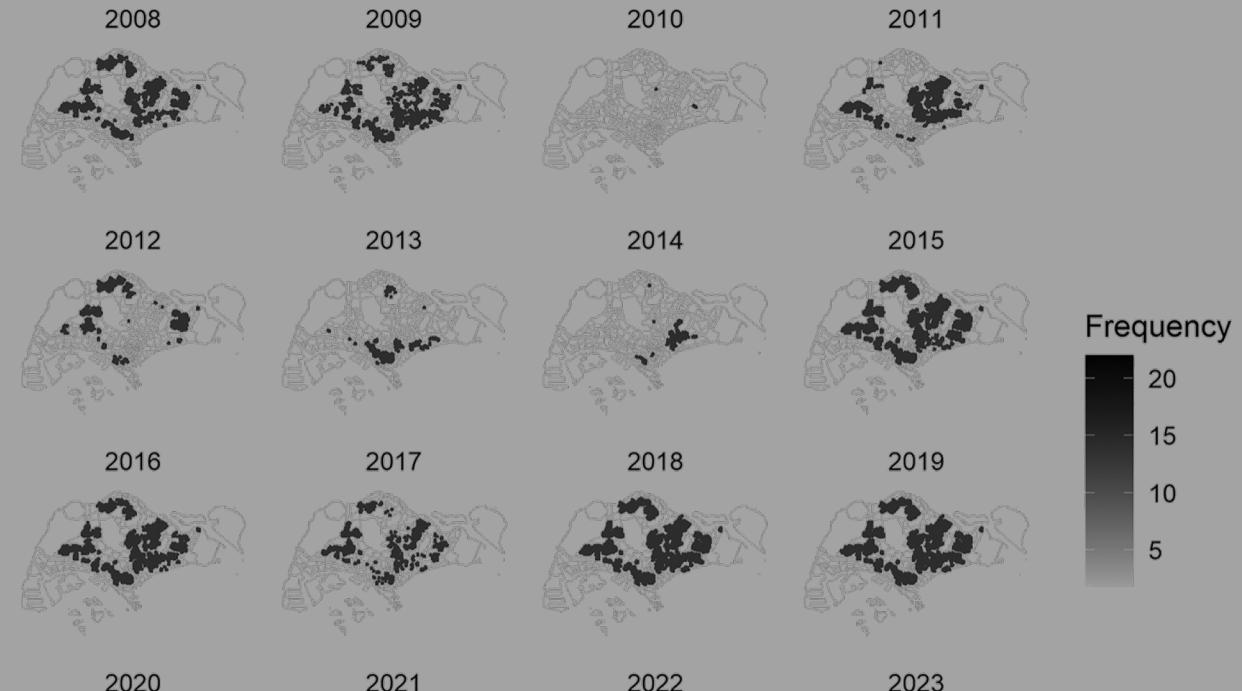
By [Mette Bendixen](#), [Tawanda Kanhema](#) & [Lars L. Iversen](#)



a

Despite GSV's widespread adoption and practical utility, disparities in how frequently or recently these images are updated across neighborhoods and cities remain largely unexamined.

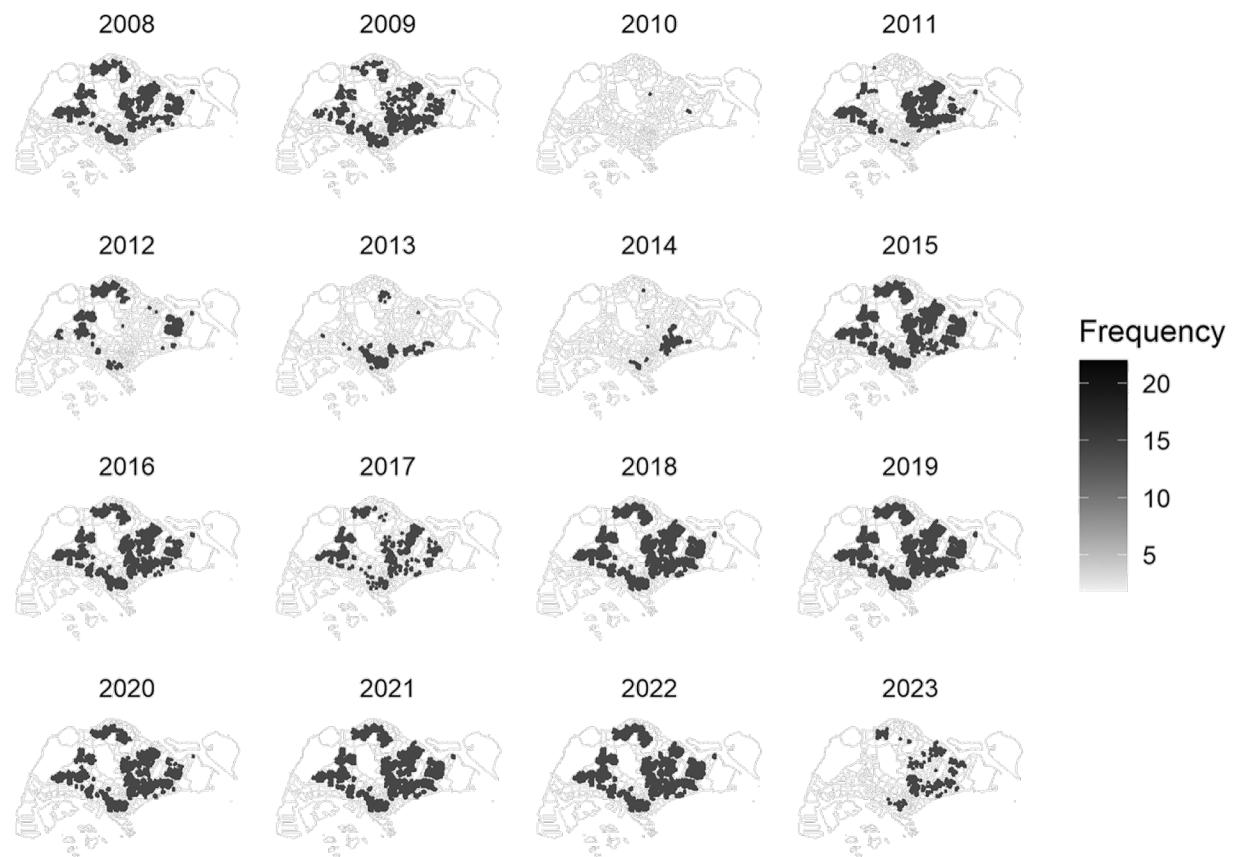
The spatio-temporal distribution of images retrieved from Google Street View in Singapore



Source: Wang, Z., Ito, K., & Biljecki, F. (2024). Assessing the equity and evolution of urban visual perceptual quality with time series street view imagery. *Cities*, 145, 104704.

The spatio-temporal distribution of images retrieved from Google Street View in Singapore

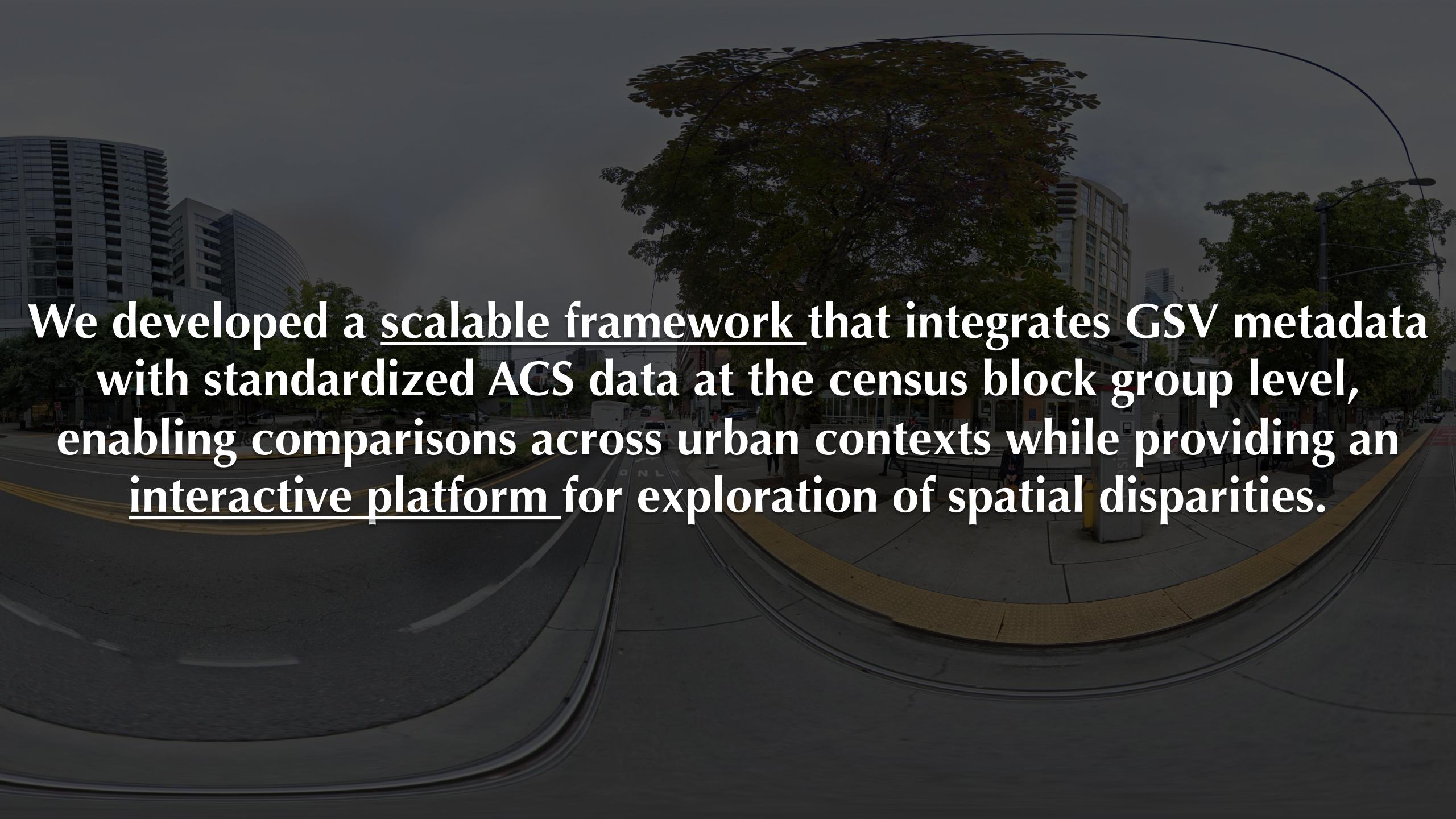
Such disparities may reflect deeper inequalities in the digital representation of urban spaces, potentially biasing downstream analyses and influencing policy decisions.



Source: Wang, Z., Ito, K., & Biljecki, F. (2024). Assessing the equity and evolution of urban visual perceptual quality with time series street view imagery. *Cities*, 145, 104704.

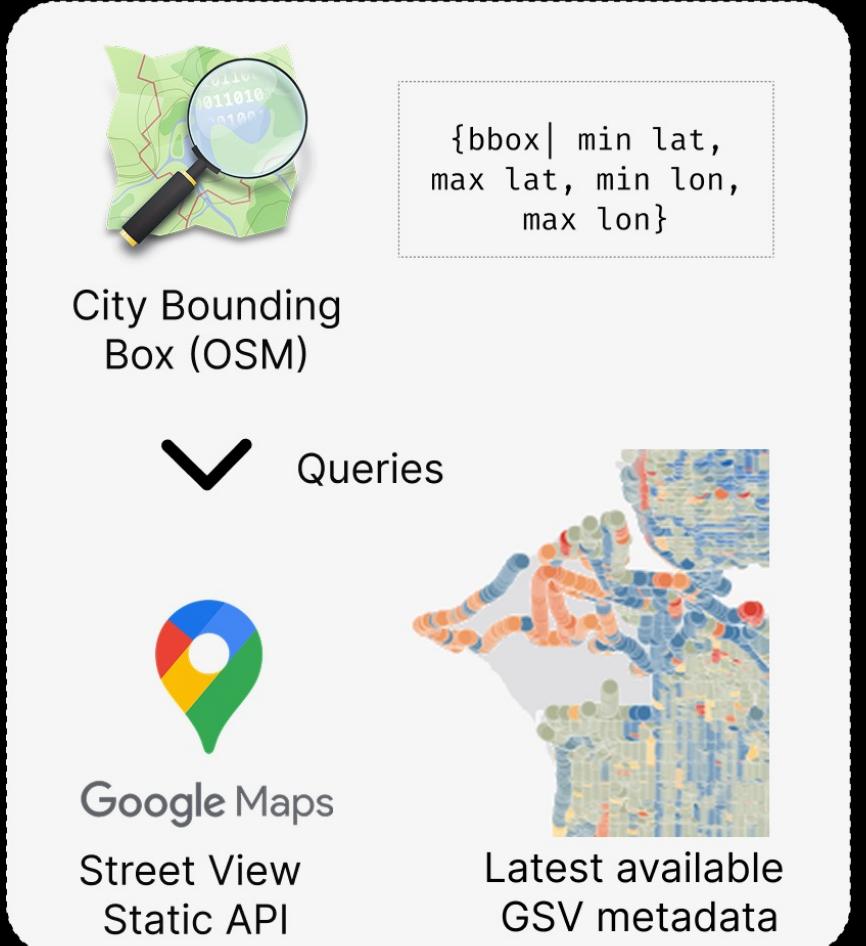
Gaps

- Lack scalable and reproducible frameworks for integrating standardized demographic data with SVI metadata.
- Most analyses are limited to specific cities or regions, preventing broader geographic comparisons.
- Lacks accessible, interactive tools for transparent exploration of spatial representation patterns.

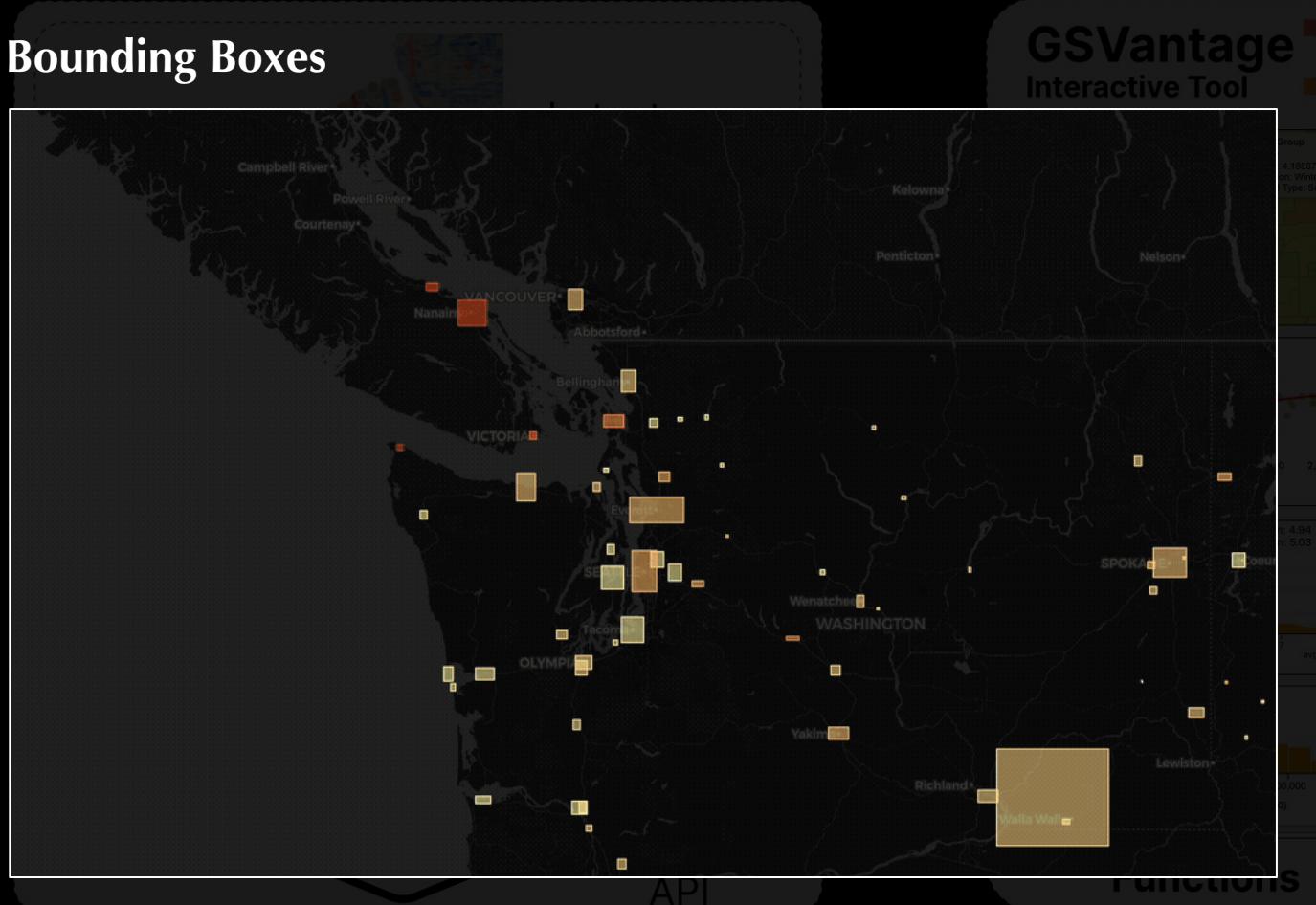


We developed a scalable framework that integrates GSV metadata with standardized ACS data at the census block group level, enabling comparisons across urban contexts while providing an interactive platform for exploration of spatial disparities.

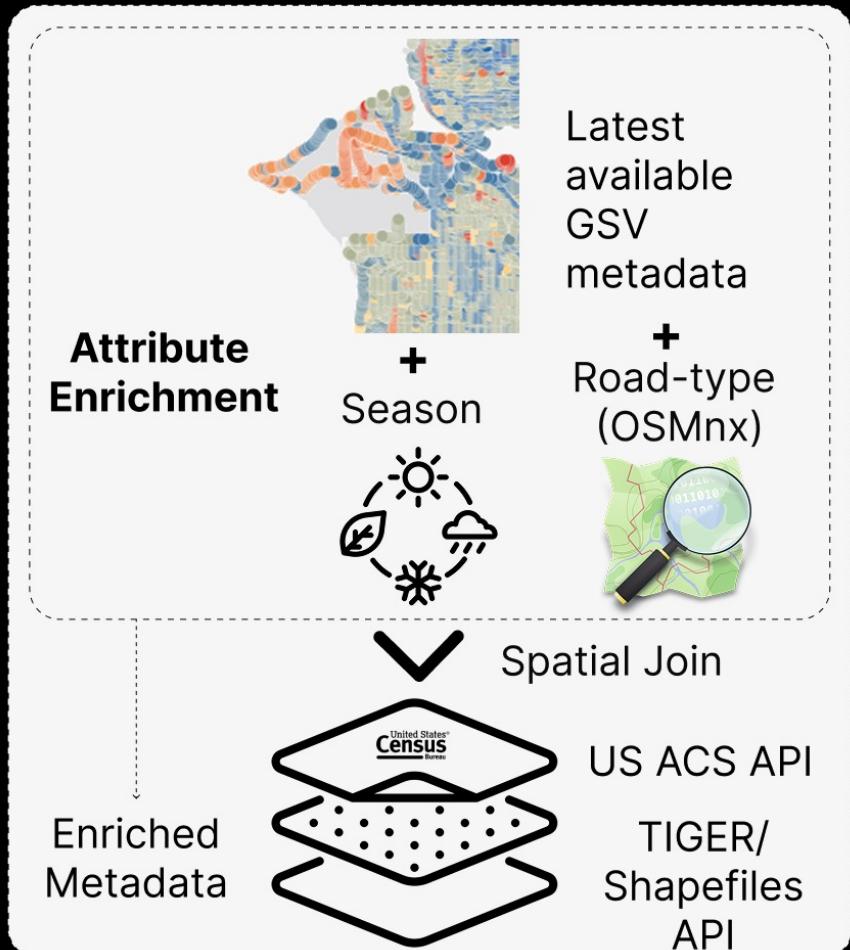
Pipeline



GSVTracker &
Downloader



Pipeline



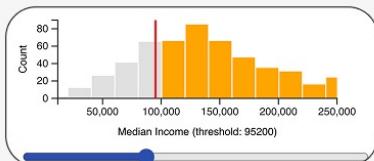
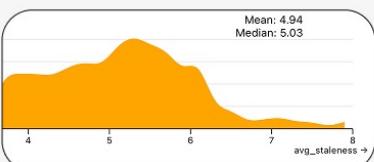
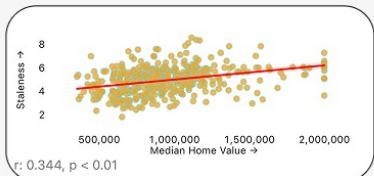
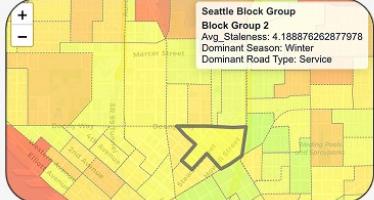
Enrichment & Integration



Pipeline

GSVantage

Interactive Tool



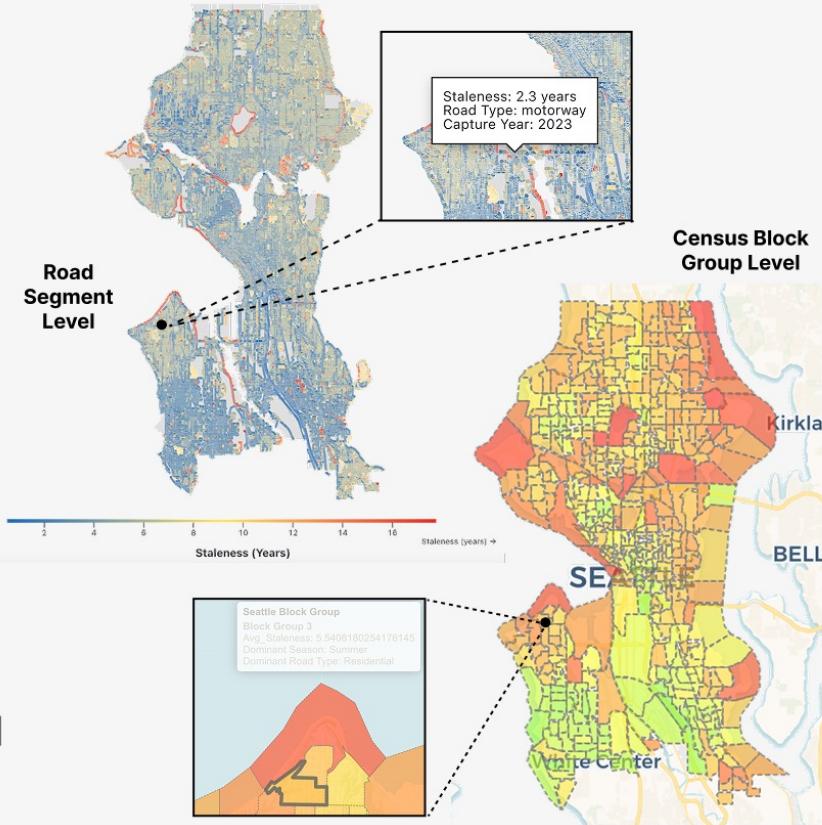
Functions

Interactive Mapping

Correlation Analysis

Staleness Distribution

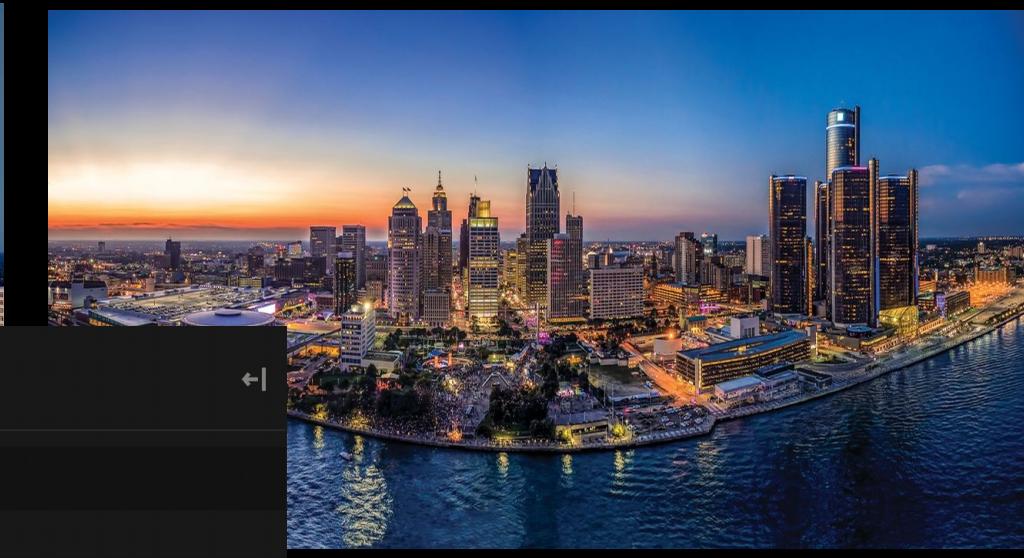
Neighborhood Filtering



Spatial Distribution of Image Staleness: Seattle Case

Correlation Analysis &
Visual Analytics Dashboard

Demo



Home

[Atlanta](#)

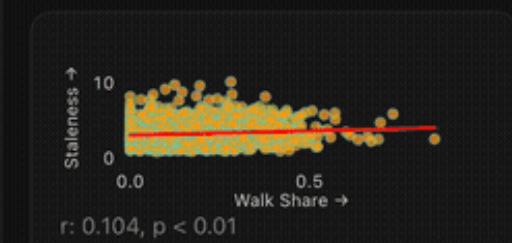
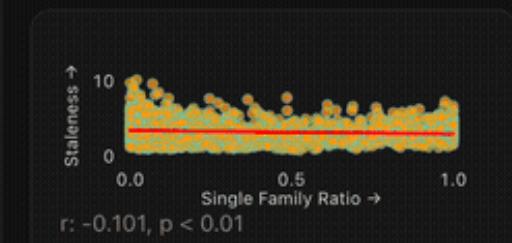
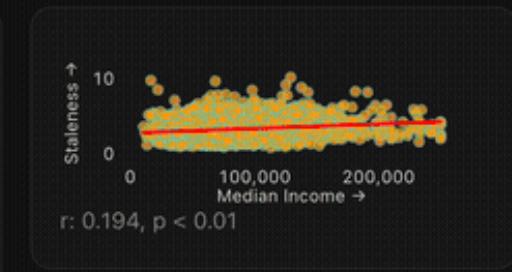
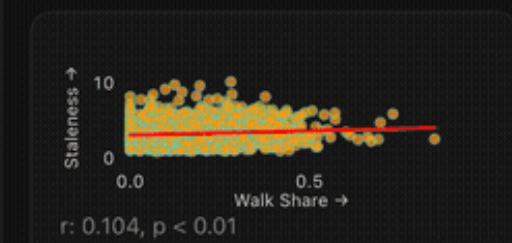
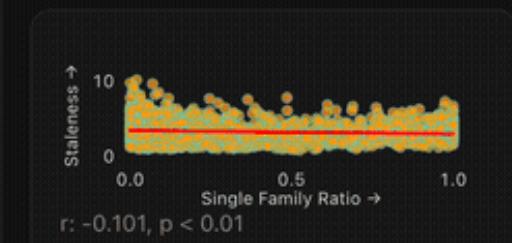
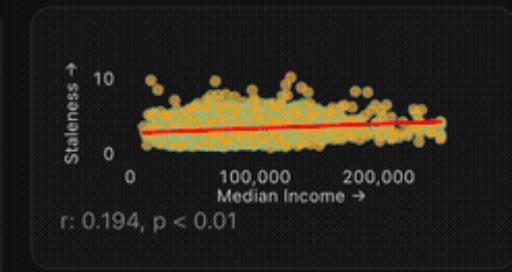
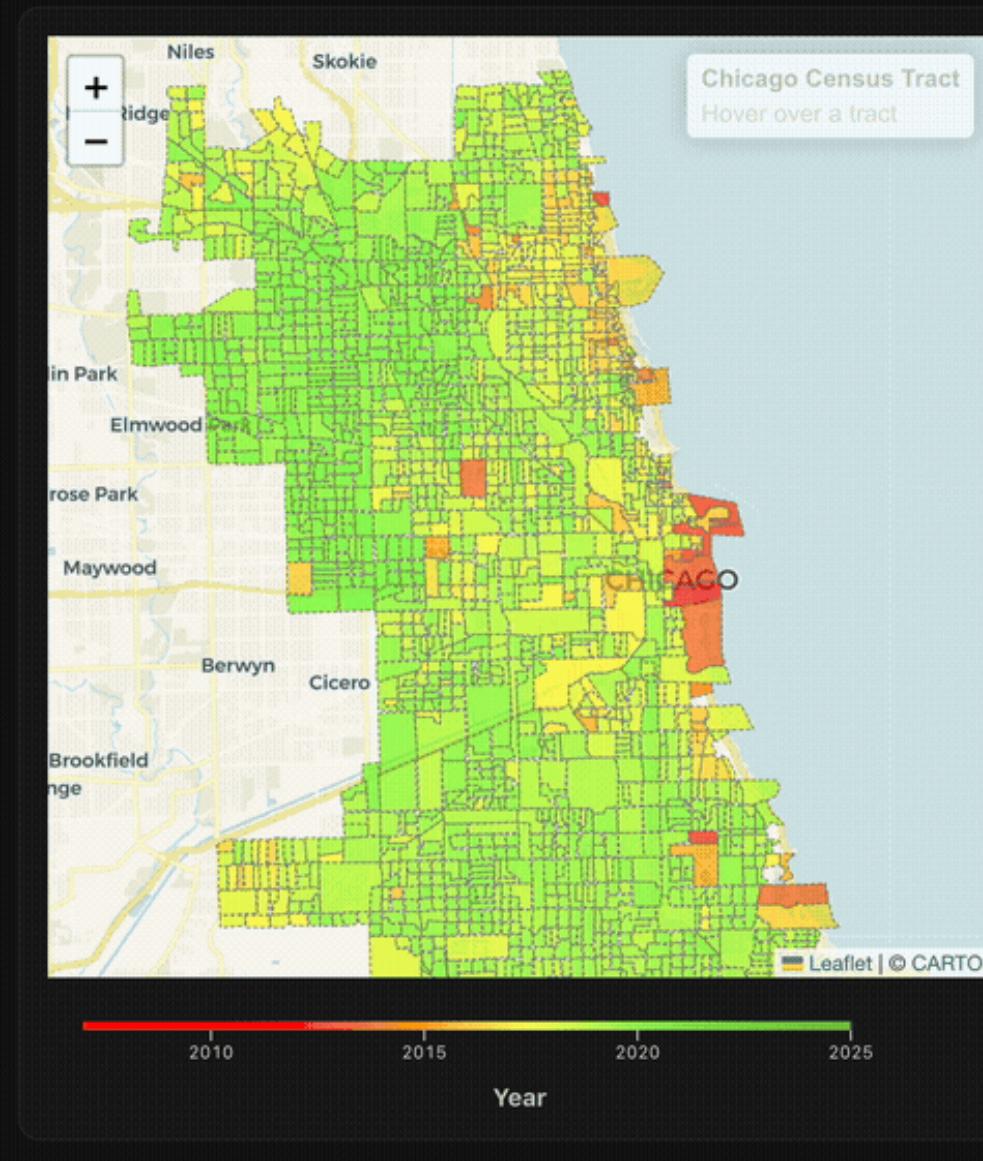
Chicago

Detroit

Seattle

Demo

Chicago

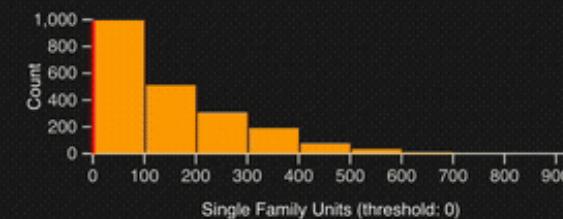
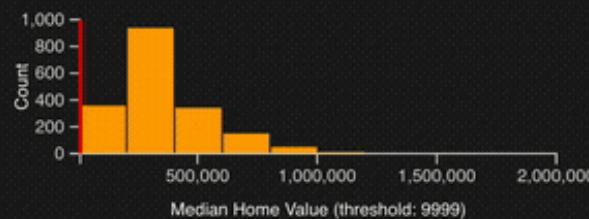
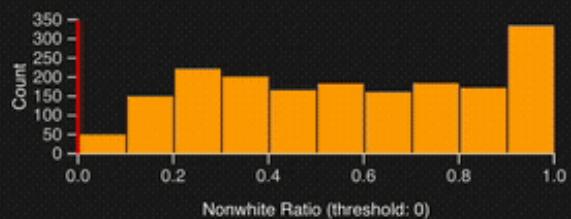
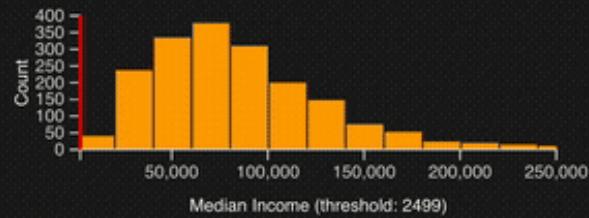
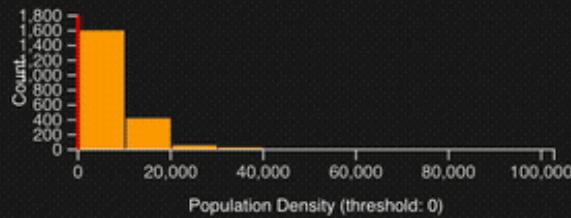


Demo

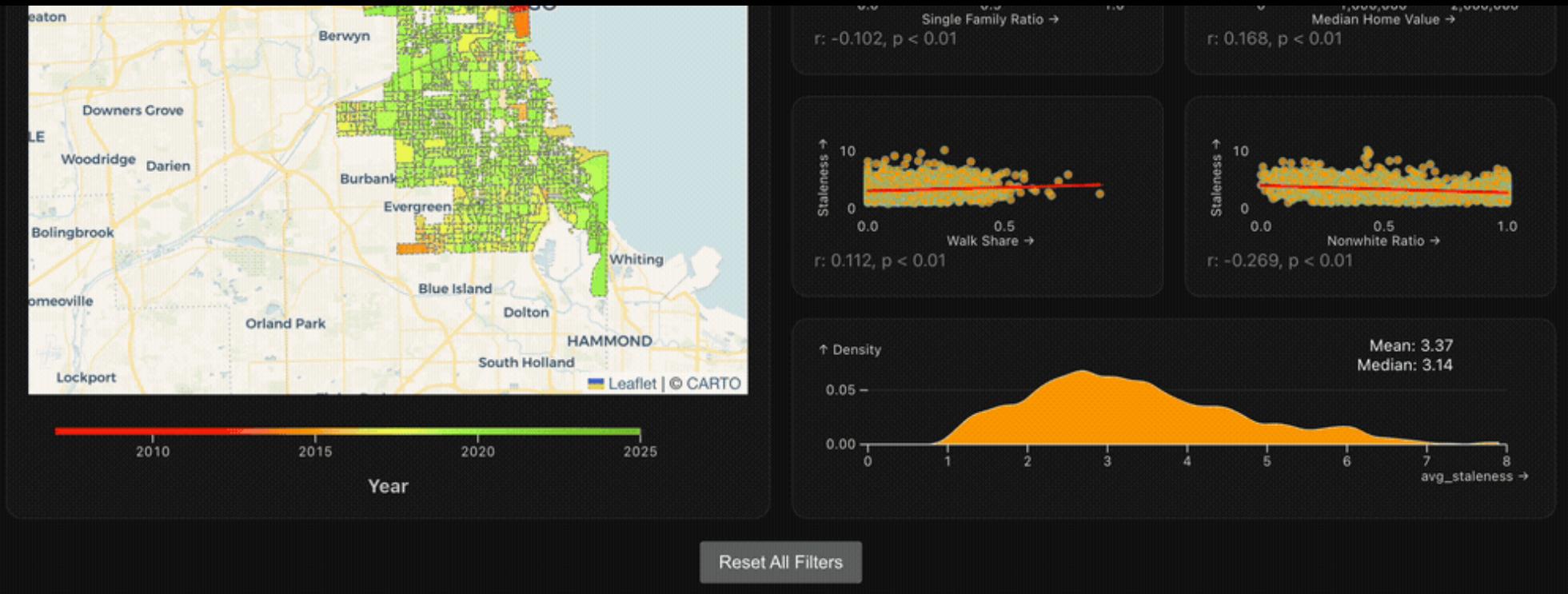
Select your targeted neighbourhood

Use the filters below to explore how Google Street View image freshness varies by neighborhood characteristics.

Example: I want to see the distribution of image staleness in high-income neighbourhood.



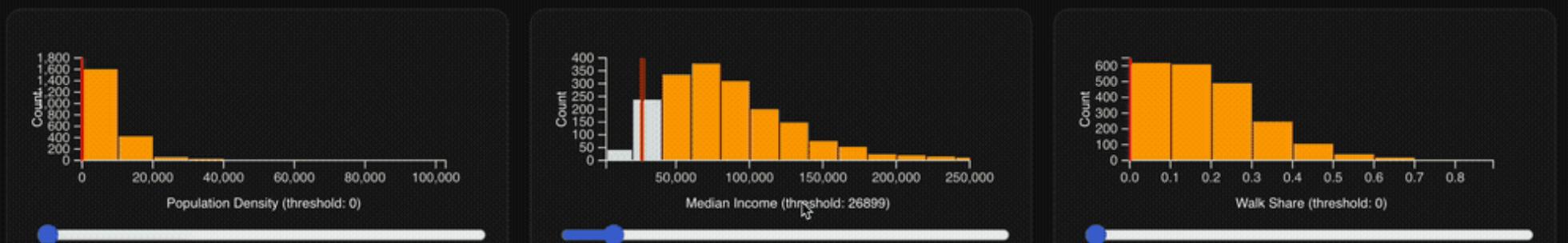
Demo



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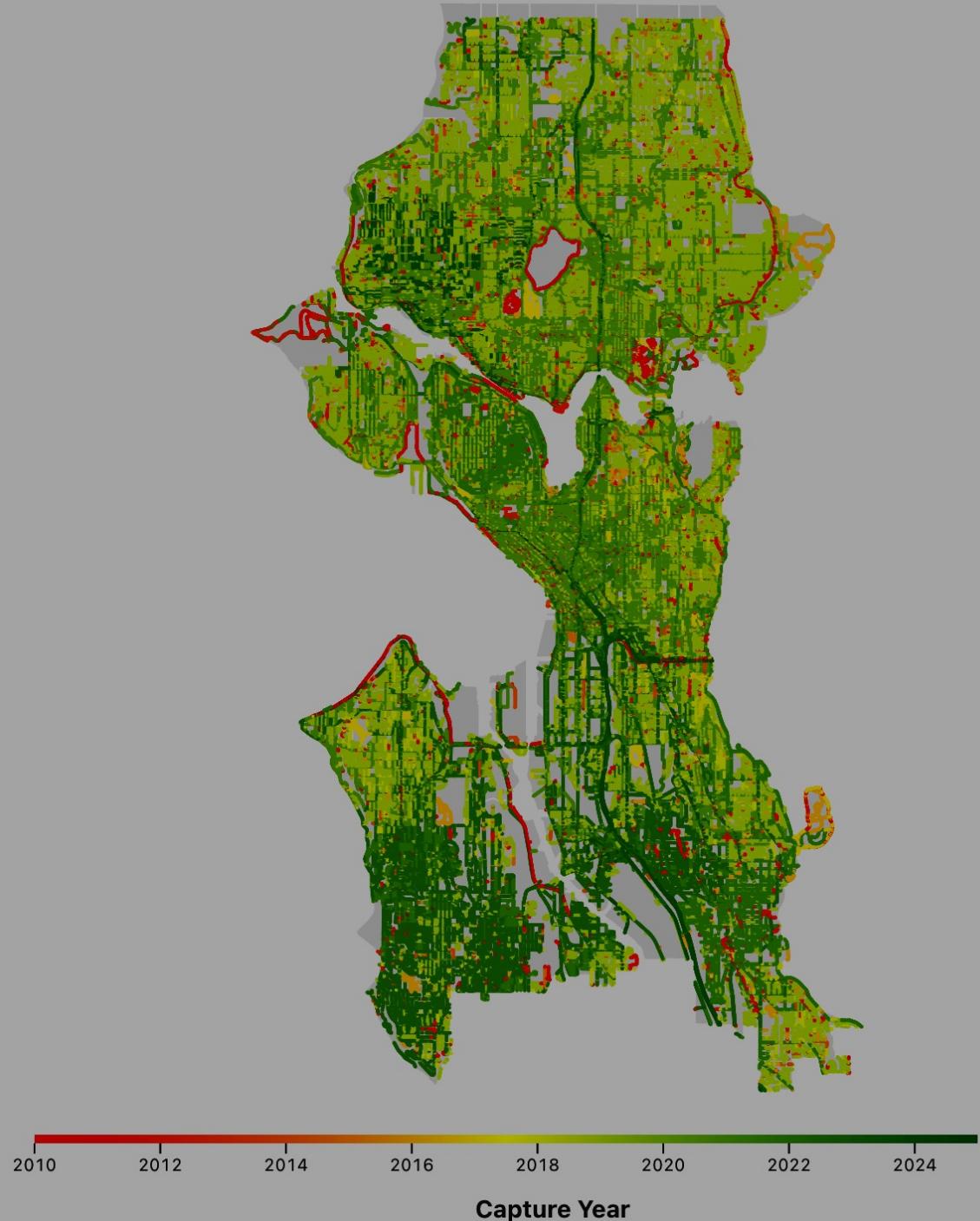


Initial Results

We observed a generally consistent “Digital Redlining” pattern in Google’s SVI update frequency.

Neighborhoods that are higher-income, higher-value, pre-dominantly single-family, or suburban tend to exhibit higher image staleness;

while denser, pedestrian-oriented, and higher-minority communities receive more regular updates.

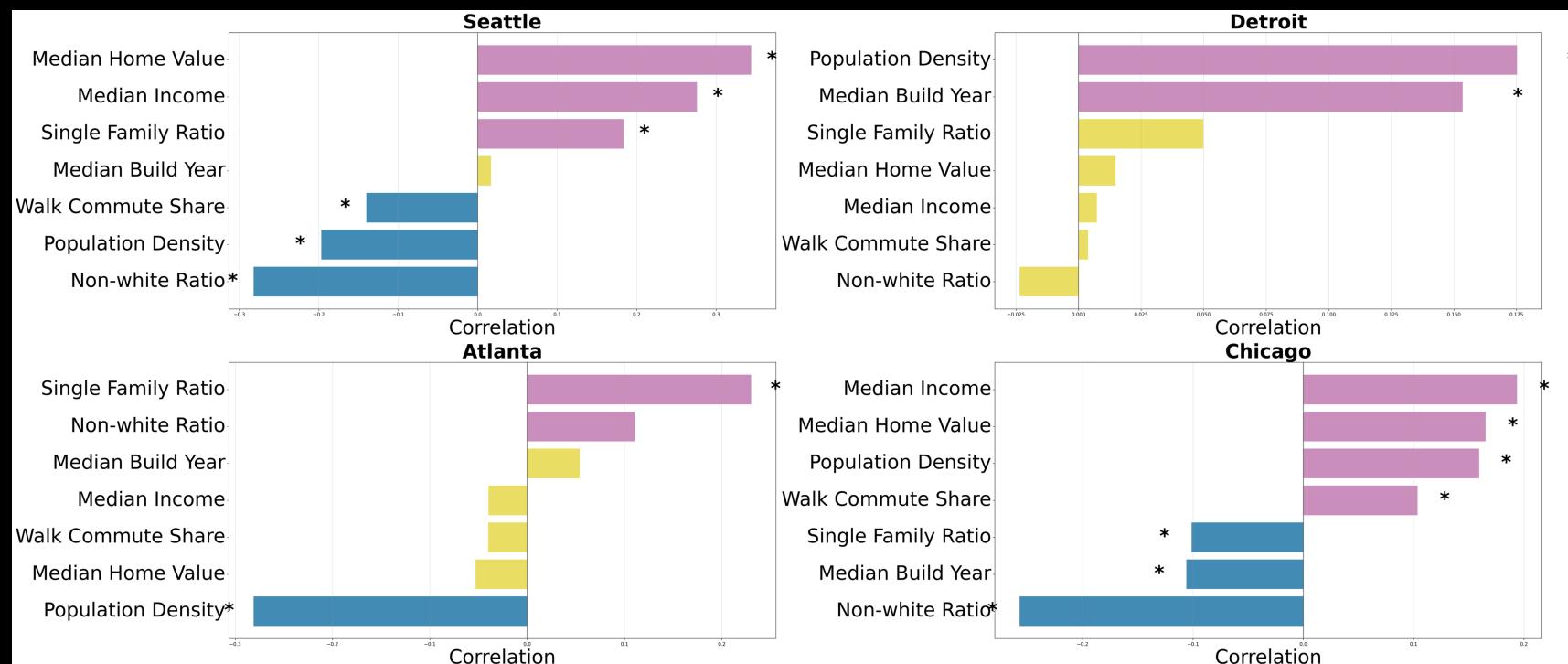


Initial Results: Are GSV updates spatially equitable?

Sufficient observations (N) | $N_{\text{Atlanta}} = 425$, $N_{\text{Chicago}} = 2142$, $N_{\text{Detroit}} = 622$, $N_{\text{Seattle}} = 537$

Consistent trends (Seattle, Chicago, Atlanta):

- ↑ Median Income / Home Value / Single-Family Ratio → **Older imagery**
- ↑ Population Density / Walk Commute Share / Non-white Ratio → **Fresher imagery**
- **Walk Commute Share** = most consistent predictor ($r \approx -0.2$ to -0.3)
- Detroit = weaker / mixed results



Contributions

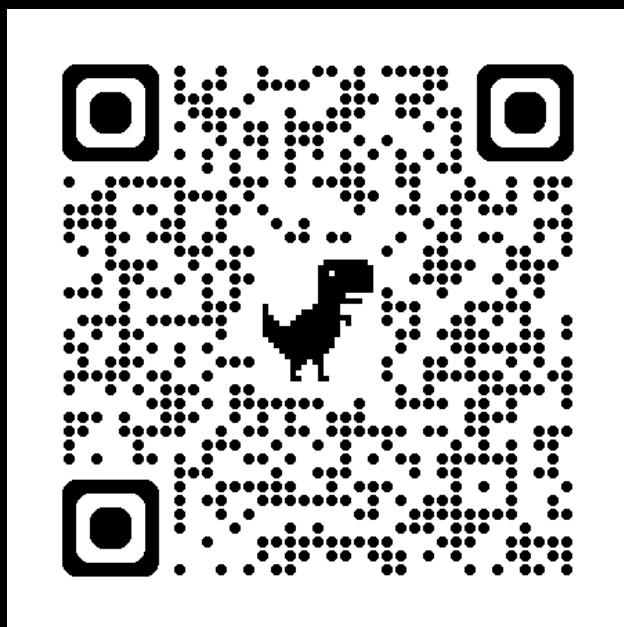
- Empirical evidence of spatial inequalities in widely used street-level imagery.
- An open-source extensible framework for integrating imagery, metadata with social economic data across diverse contexts.
- An interactive visualization tool that promotes transparency and supports audits of digital equity.

Limitations

- Spatial dependencies need further modeling.
- There may be selection bias in the choice of cities; including more cities would improve generalizability.
- Correlation ≠ causation.

Thank you

Project Repo

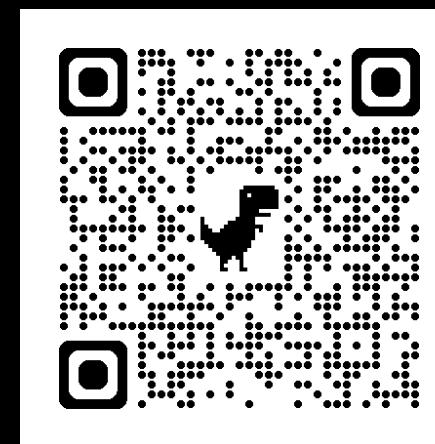


github.com/makeabilitylab/GSVantage

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LinkedIn



Google Scholar



Makeability Lab

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