

<https://archive.curbed.com/2017/2/6/14489320/highways-worst-united-states>

How do urban highways impact social connections?





<https://archive.curbed.com/2017/2/6/14489320/highways-worst-united-states>

**What does urban sociology say
about urban highways?**



Streets and their sidewalks-the main public places of a city-are its most vital organs.

— *Jane Jacobs* —

AZ QUOTES

Hypothesis:

Urban highways are barriers to social ties

PNAS

RESEARCH ARTICLE

SOCIAL SCIENCES

Urban highways are barriers to social ties

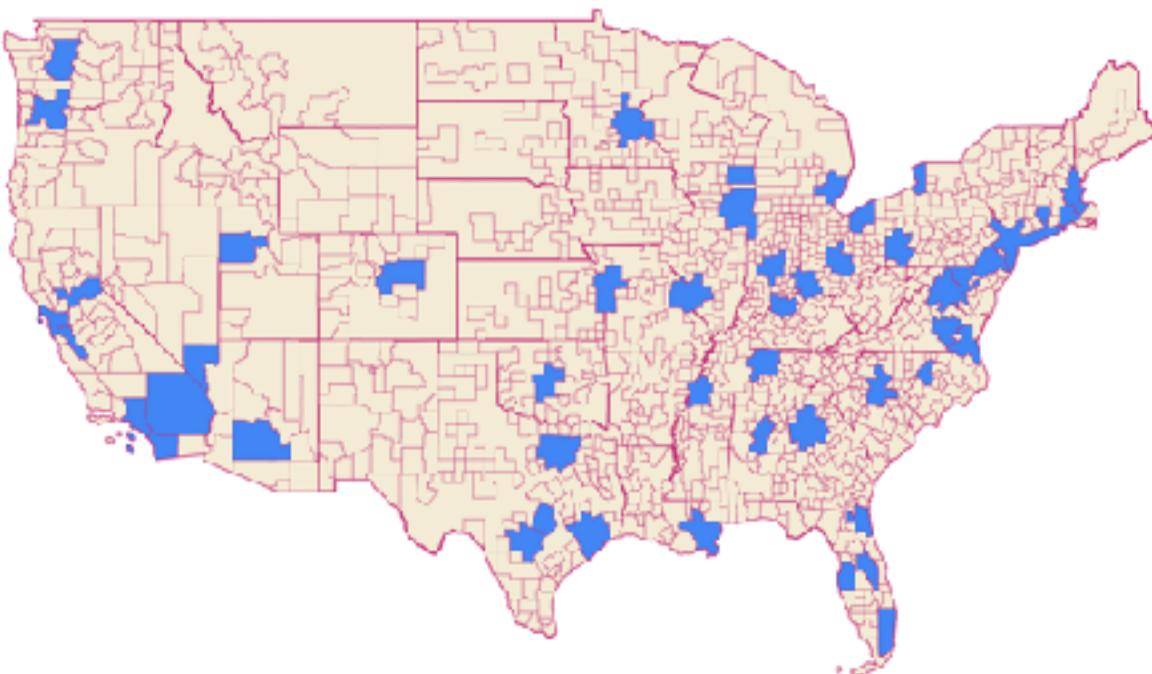
Luca Maria Aiello^{a,b,1} , Anastassia Vybornova^a , Sándor Juhász^{c,d,e} , Michael Szell^{a,b,c,f} , and Eszter Bokányi^g

Affiliations are included on p. 9.

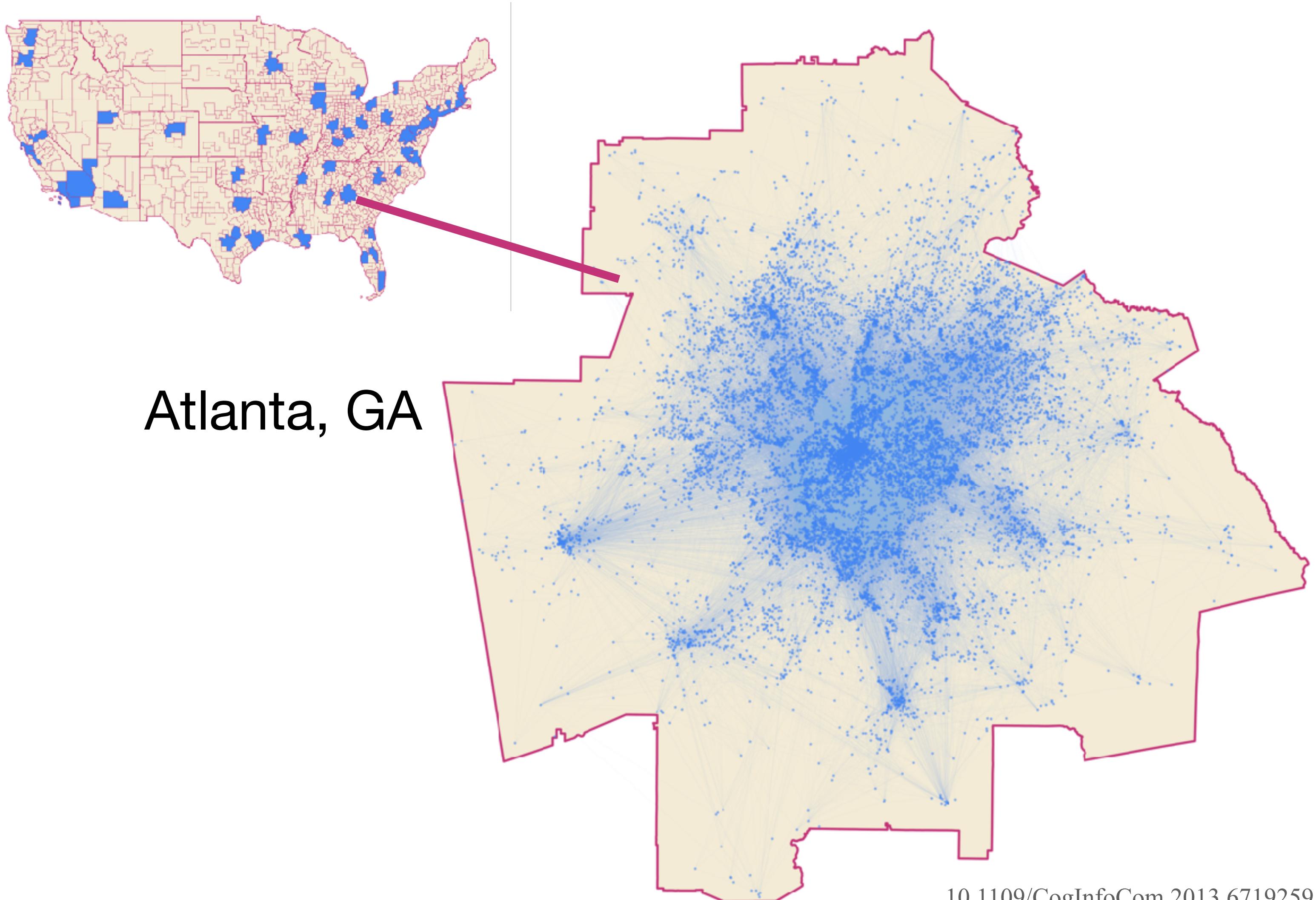
Edited by Susan Hanson, Clark University, Worcester, MA; received May 7, 2024; accepted January 23, 2025

<https://www.pnas.org/doi/10.1073/pnas.2408937122>

What kind of (social network) data could we use to test this hypothesis?



Social network

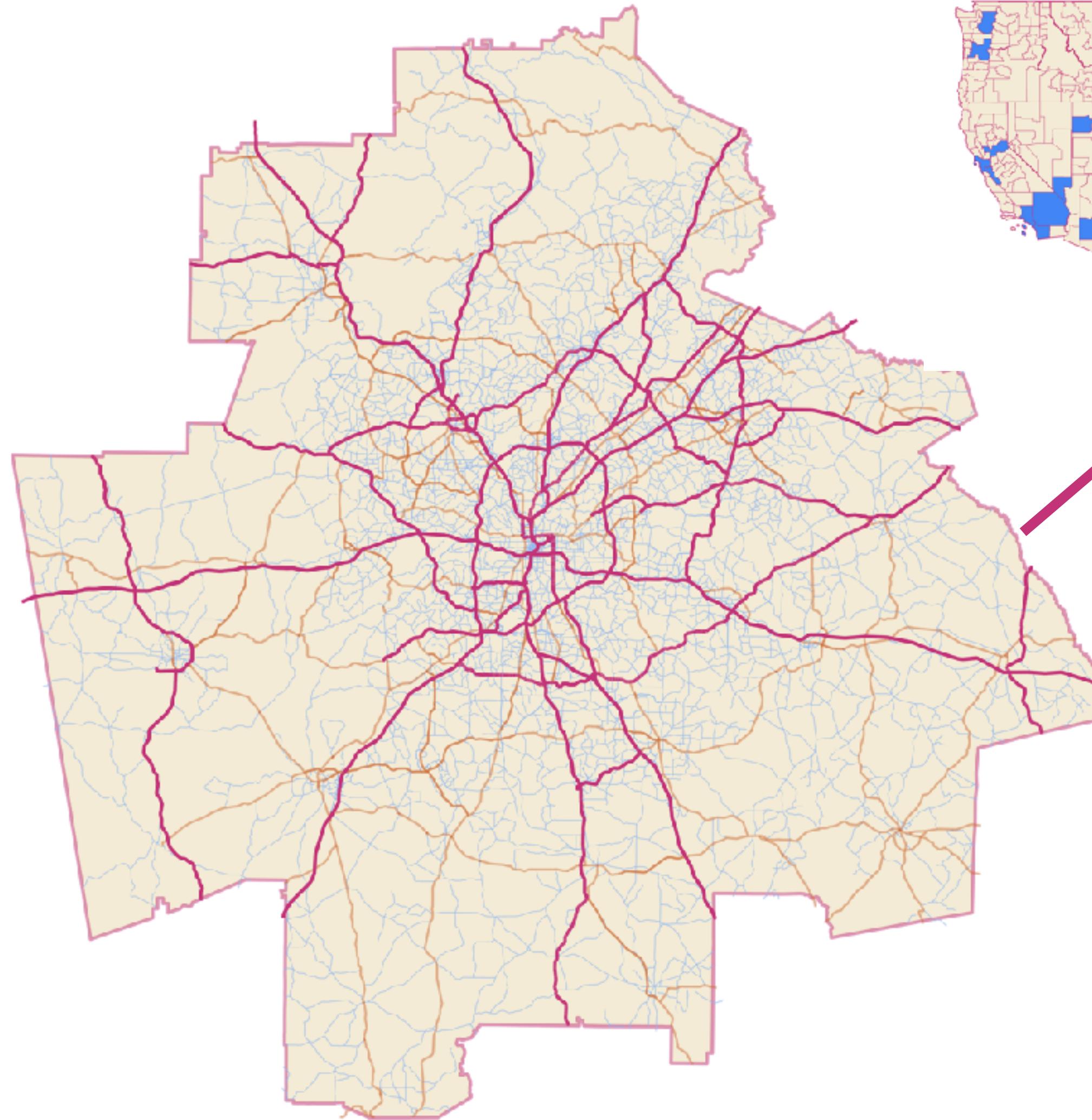


Atlanta, GA

10.1109/CogInfoCom.2013.6719259

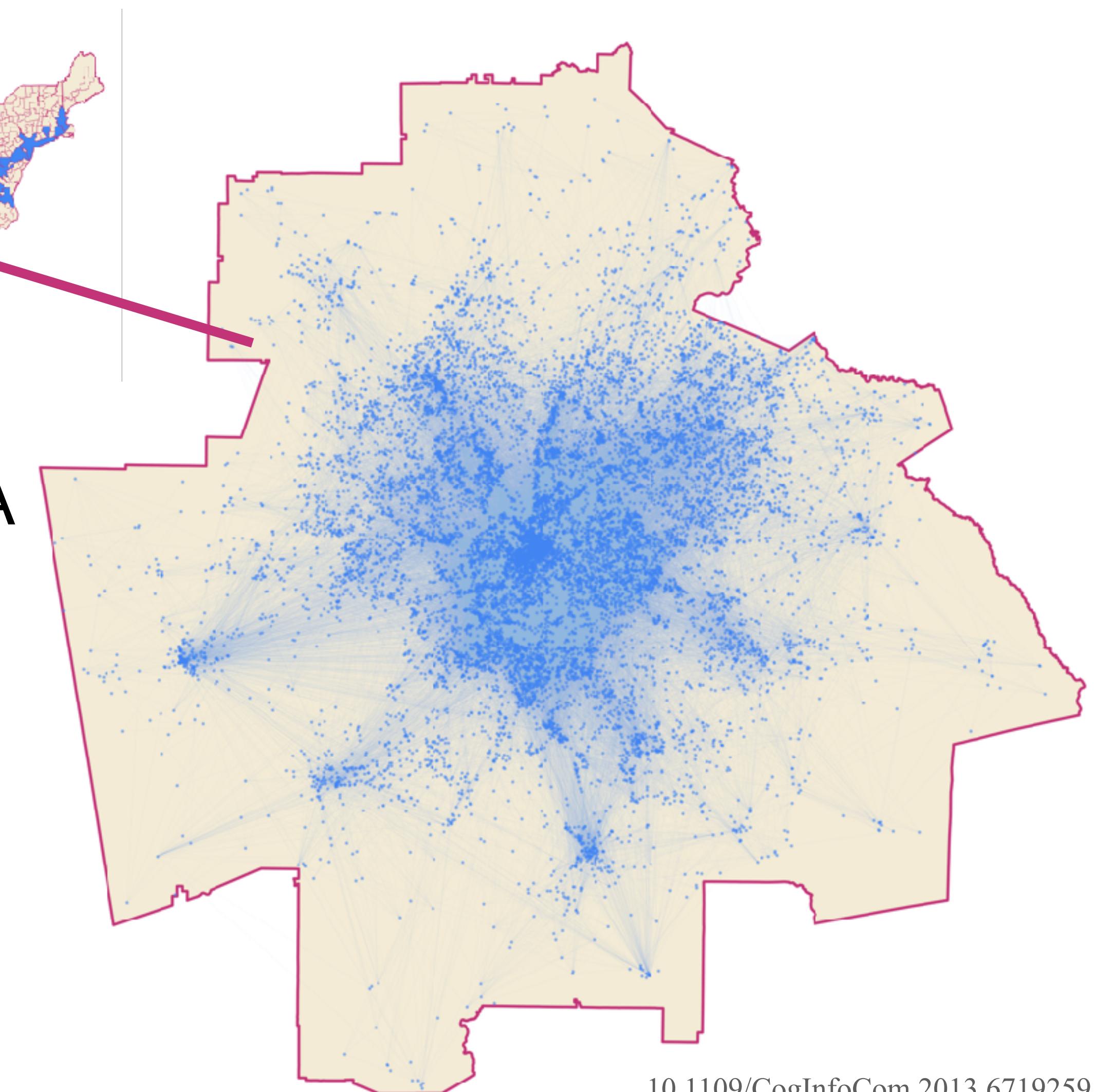
Twitter

Spatial network



OpenStreetMap

Social network



Twitter

10.1109/CogInfoCom.2013.6719259

Let's use the Twitter network
as our social network.

Let's use the Twitter network
as our social network.

What should we compare our
social network to?

We need to compare the “real”
network to a **null model** network.

What properties should this null model network have?

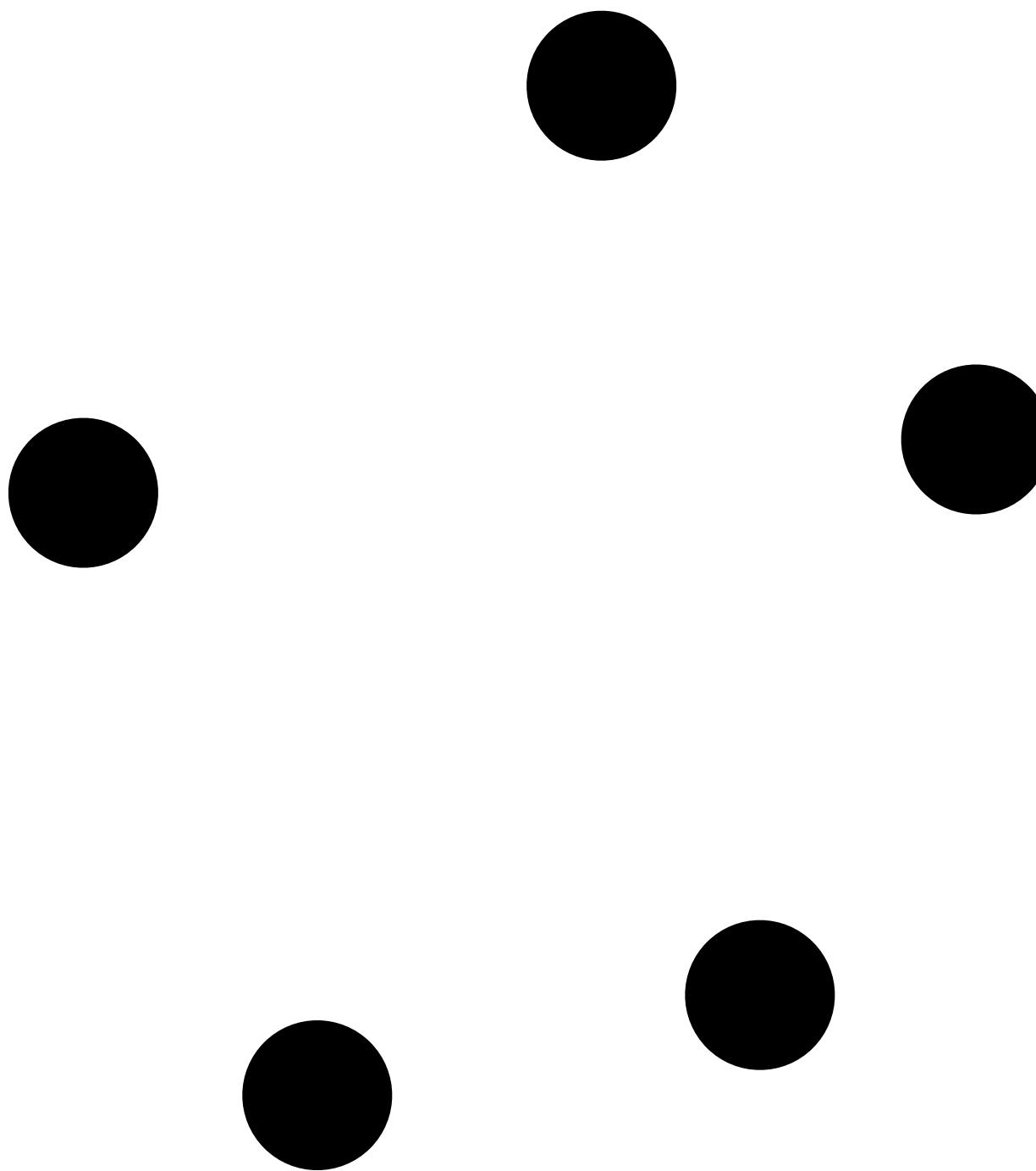
What properties should this null model network have?

Node number Node location Edge number Edge location Degree distribution

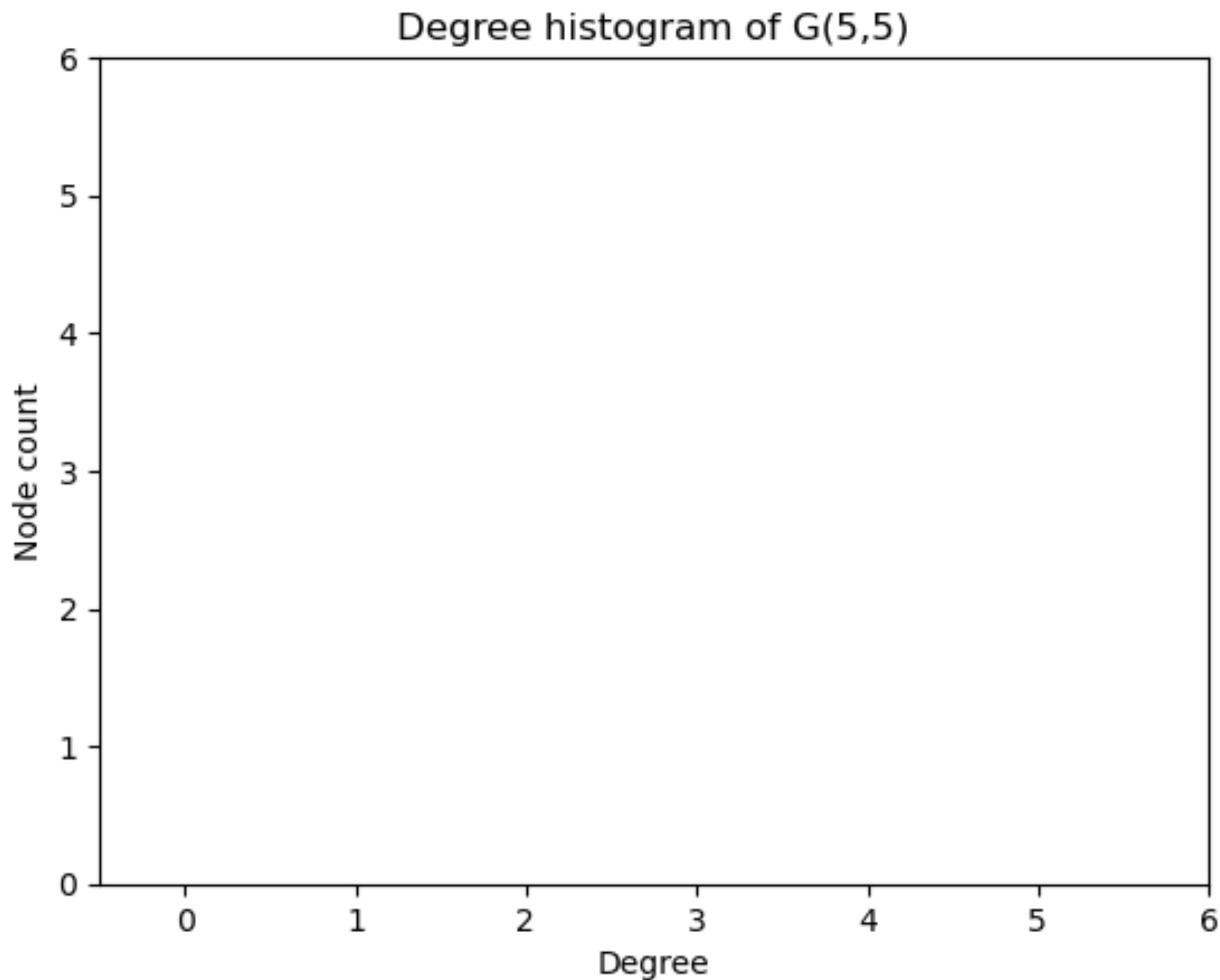
What properties should this null model network have?

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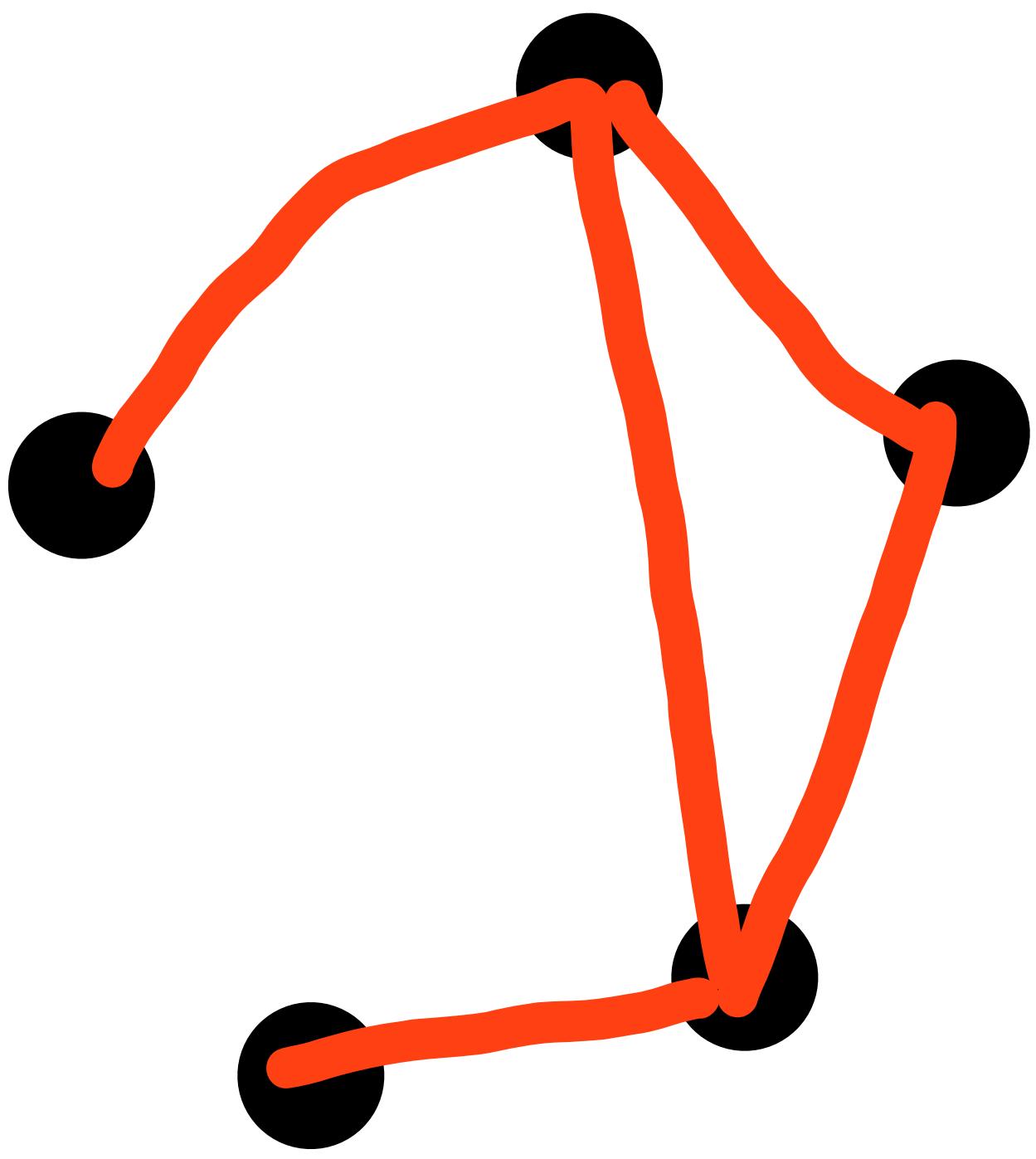
1. Random network: Draw a total of 5 edges between (any of the) 5 nodes below.



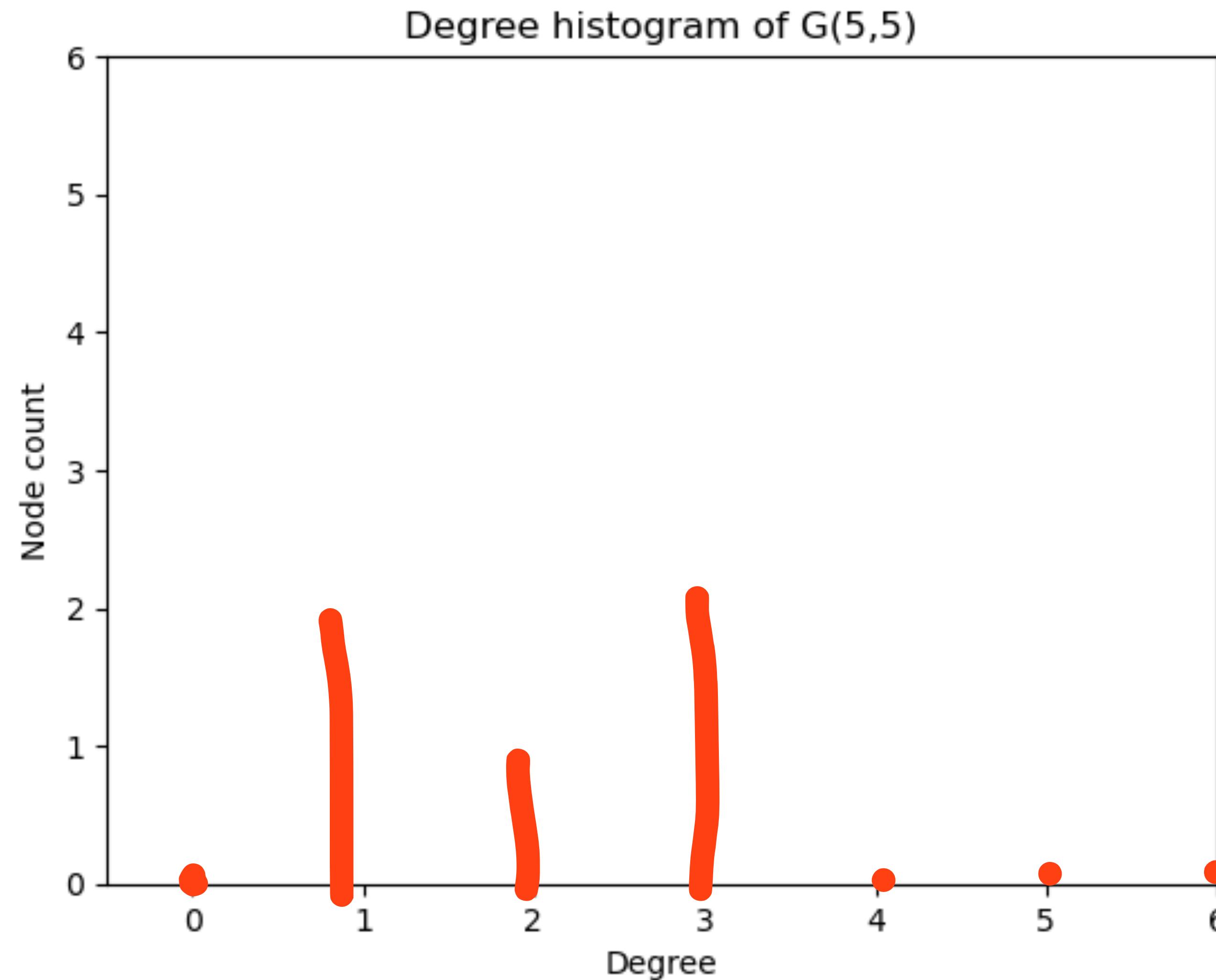
2. Degree histogram: Draw the degree histogram of the random network you've created.



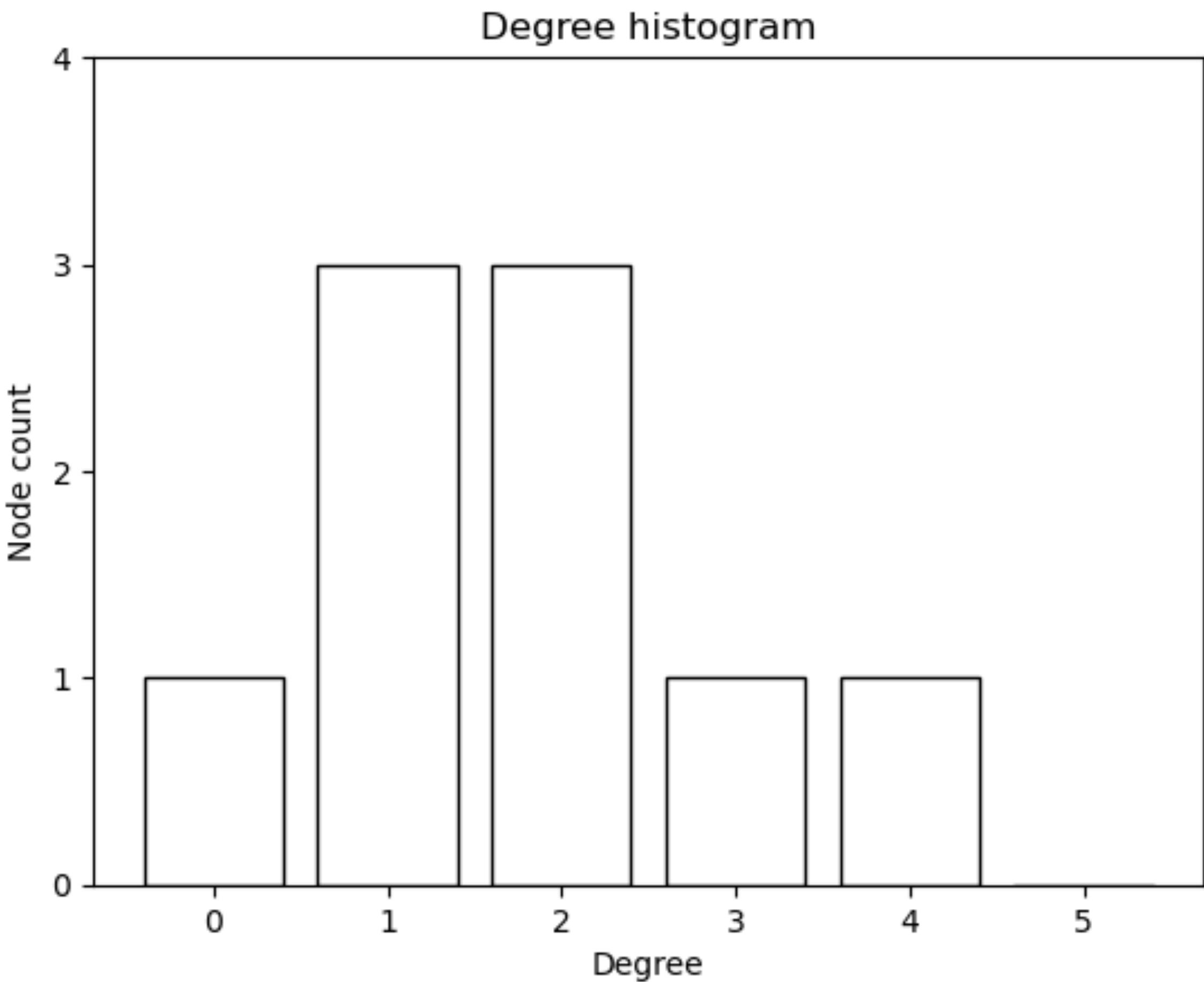
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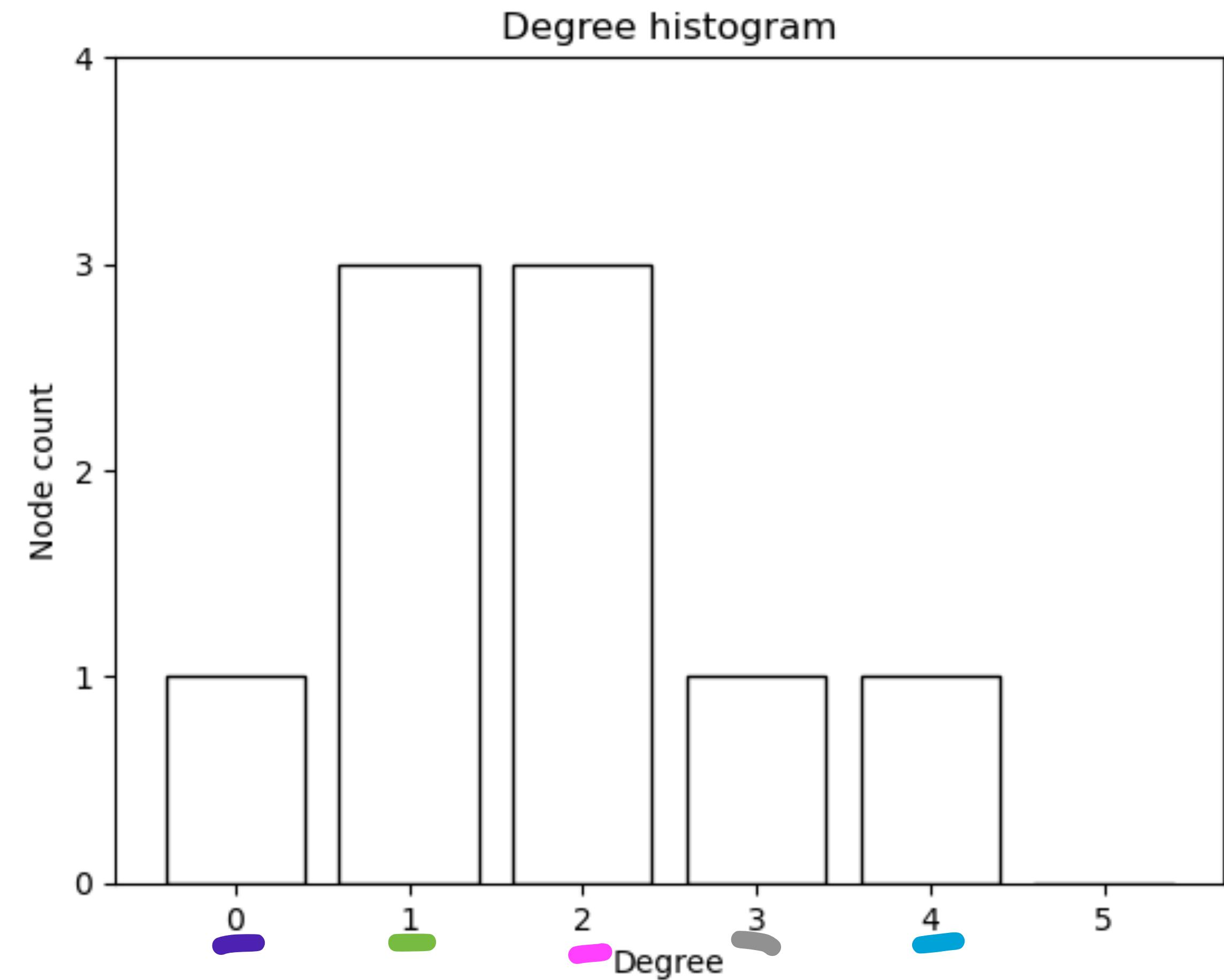
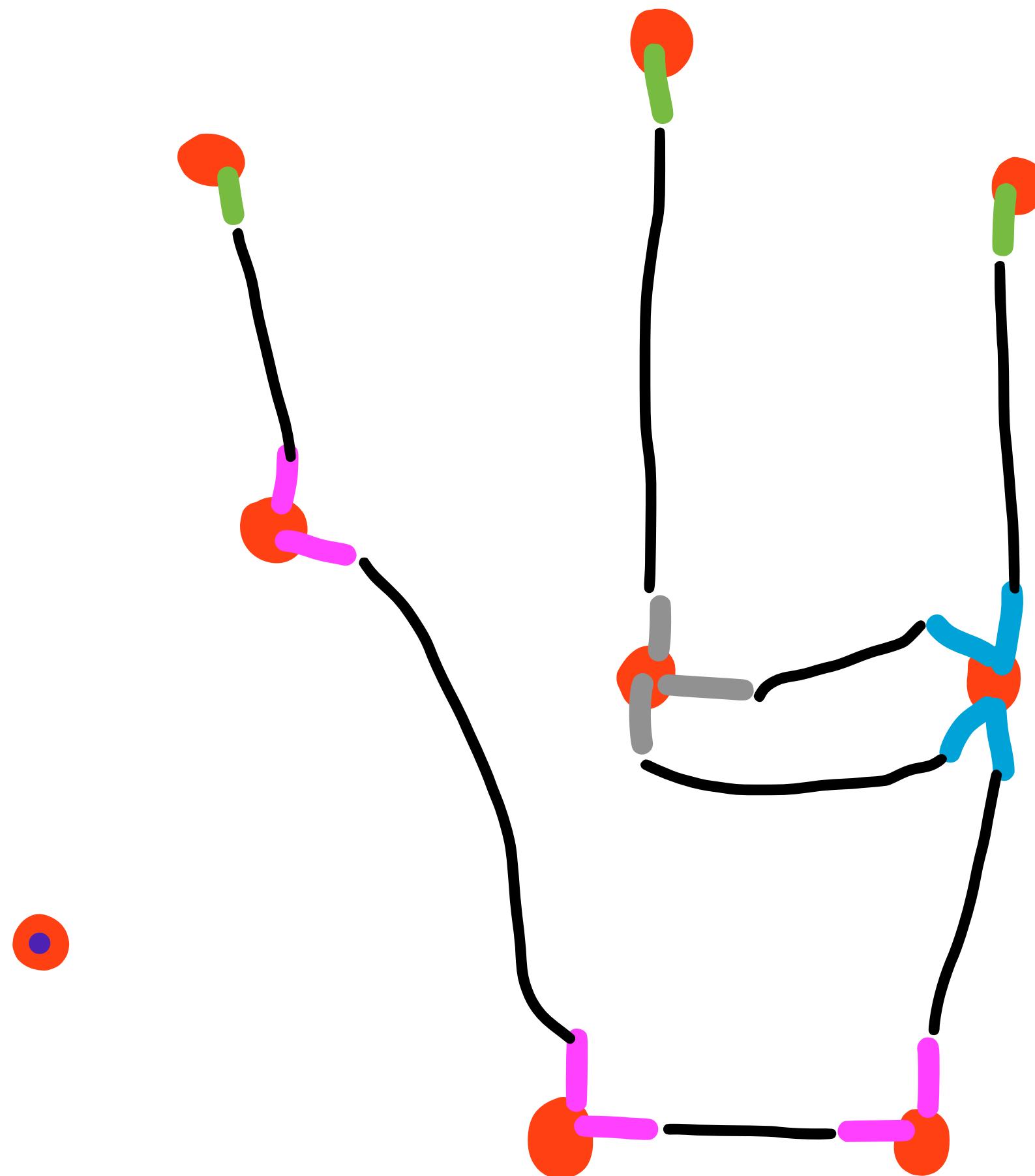
2. Degree histogram: Draw the degree histogram of the random network you've created.



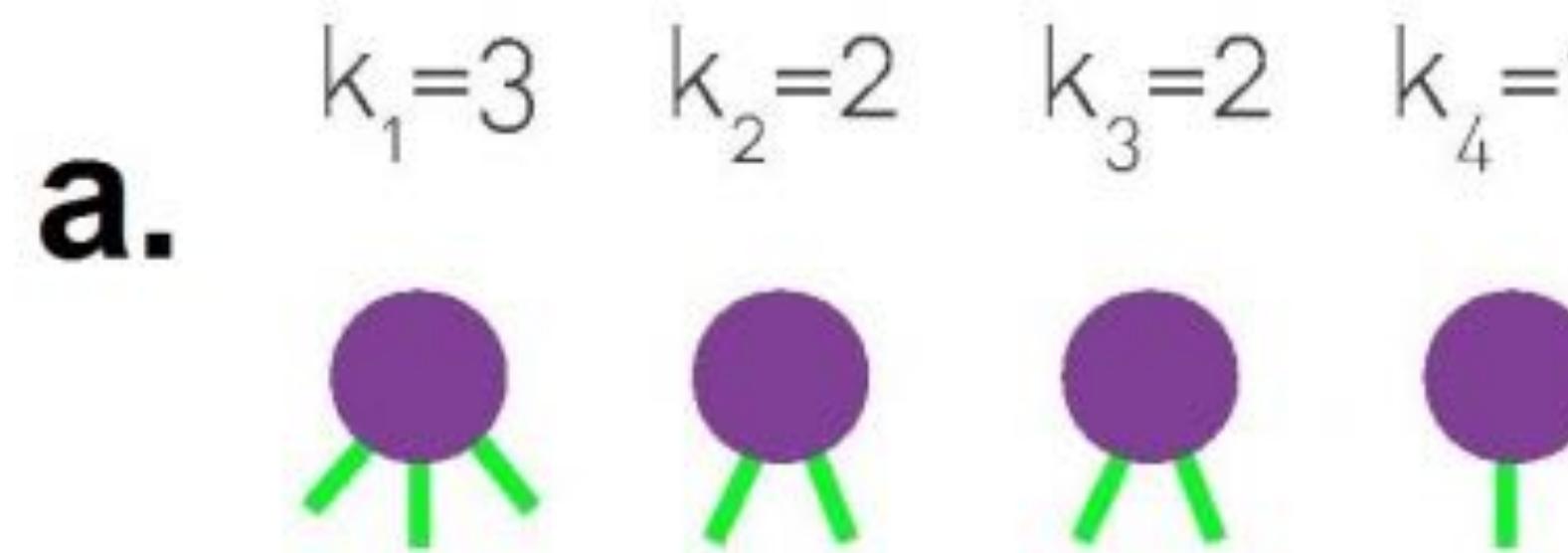
3. Draw a network that is described by the degree histogram on the right.



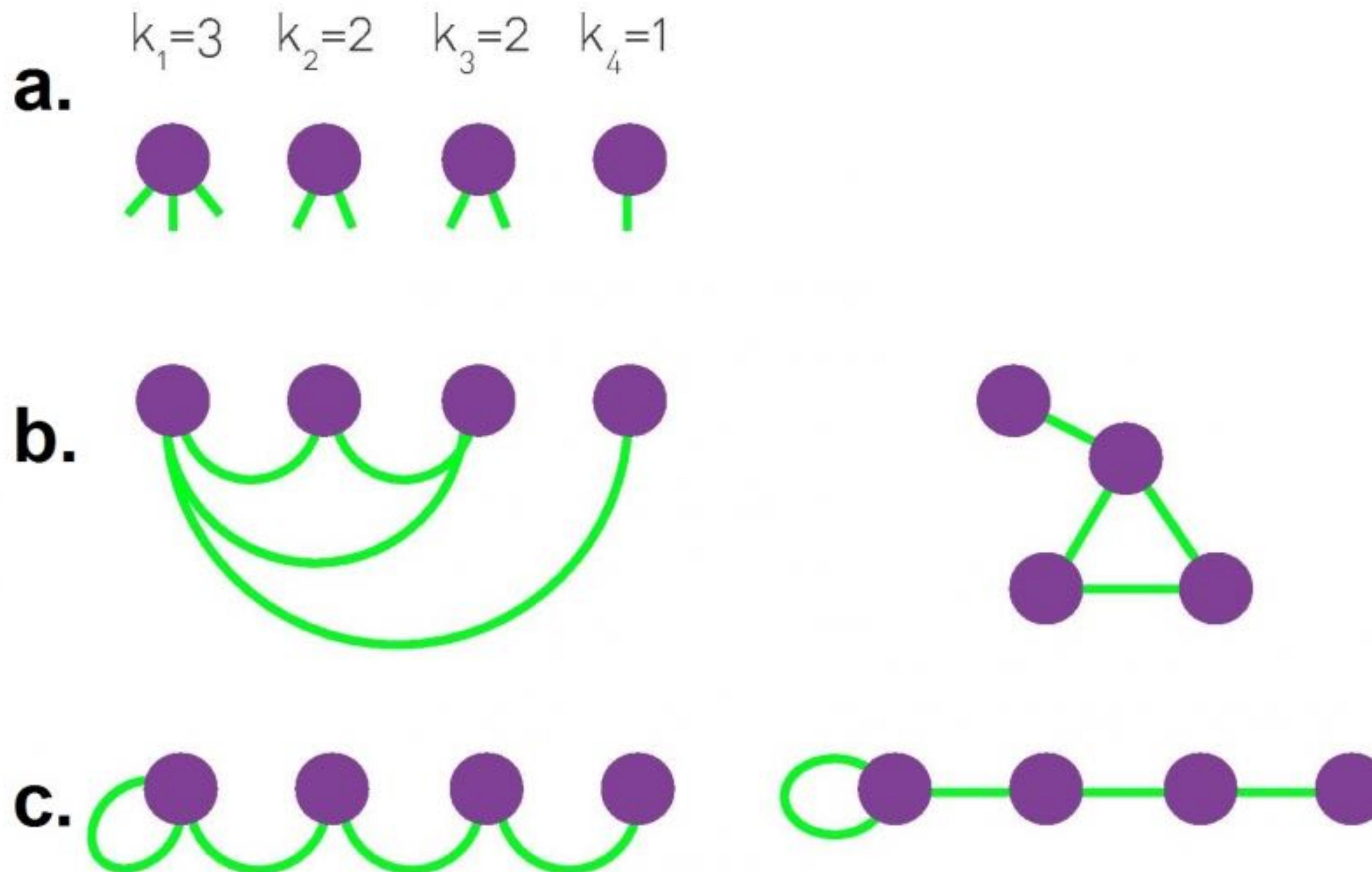
3. Draw a network that is described by the degree histogram on the right.



Configuration model

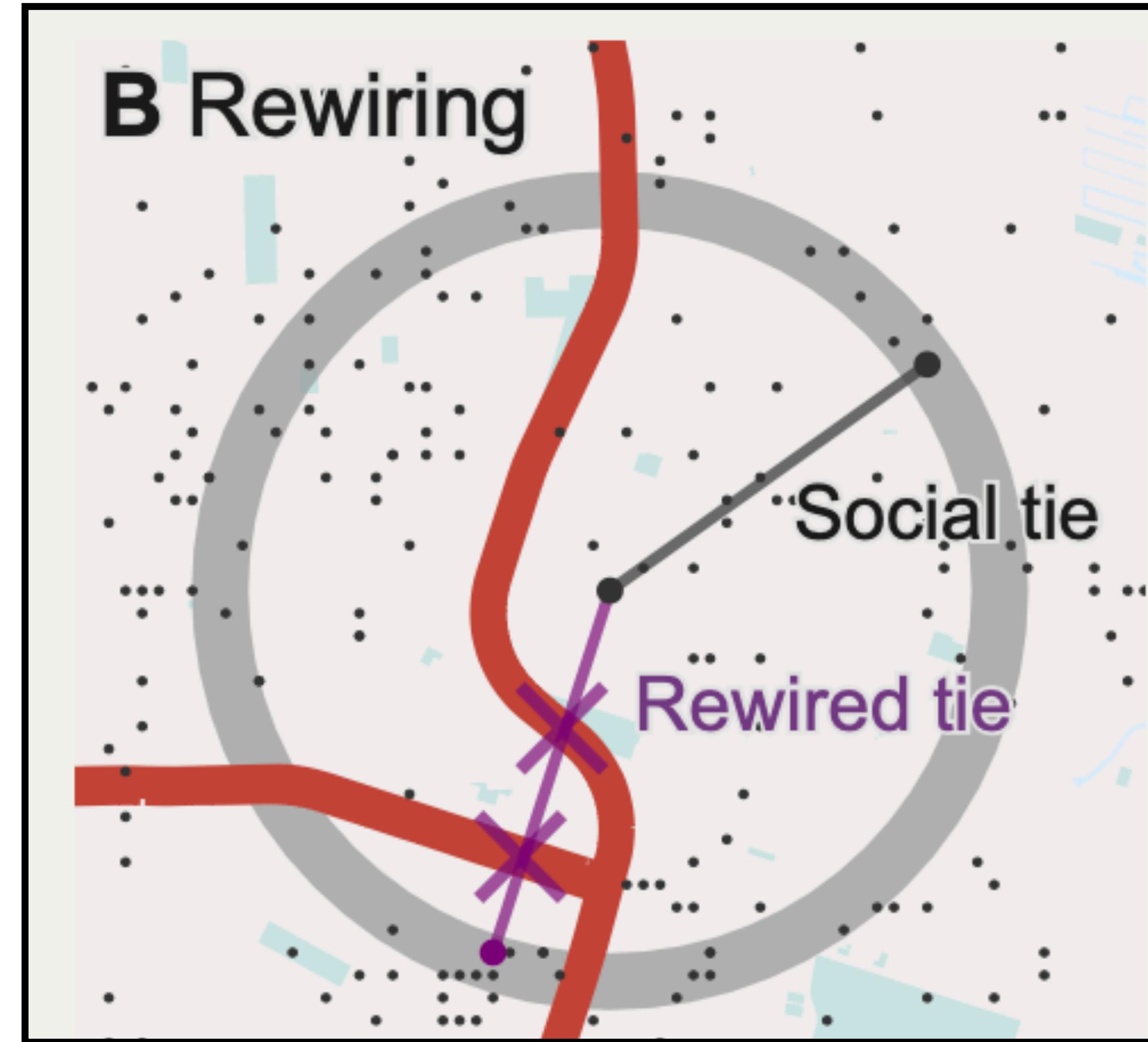


Configuration model



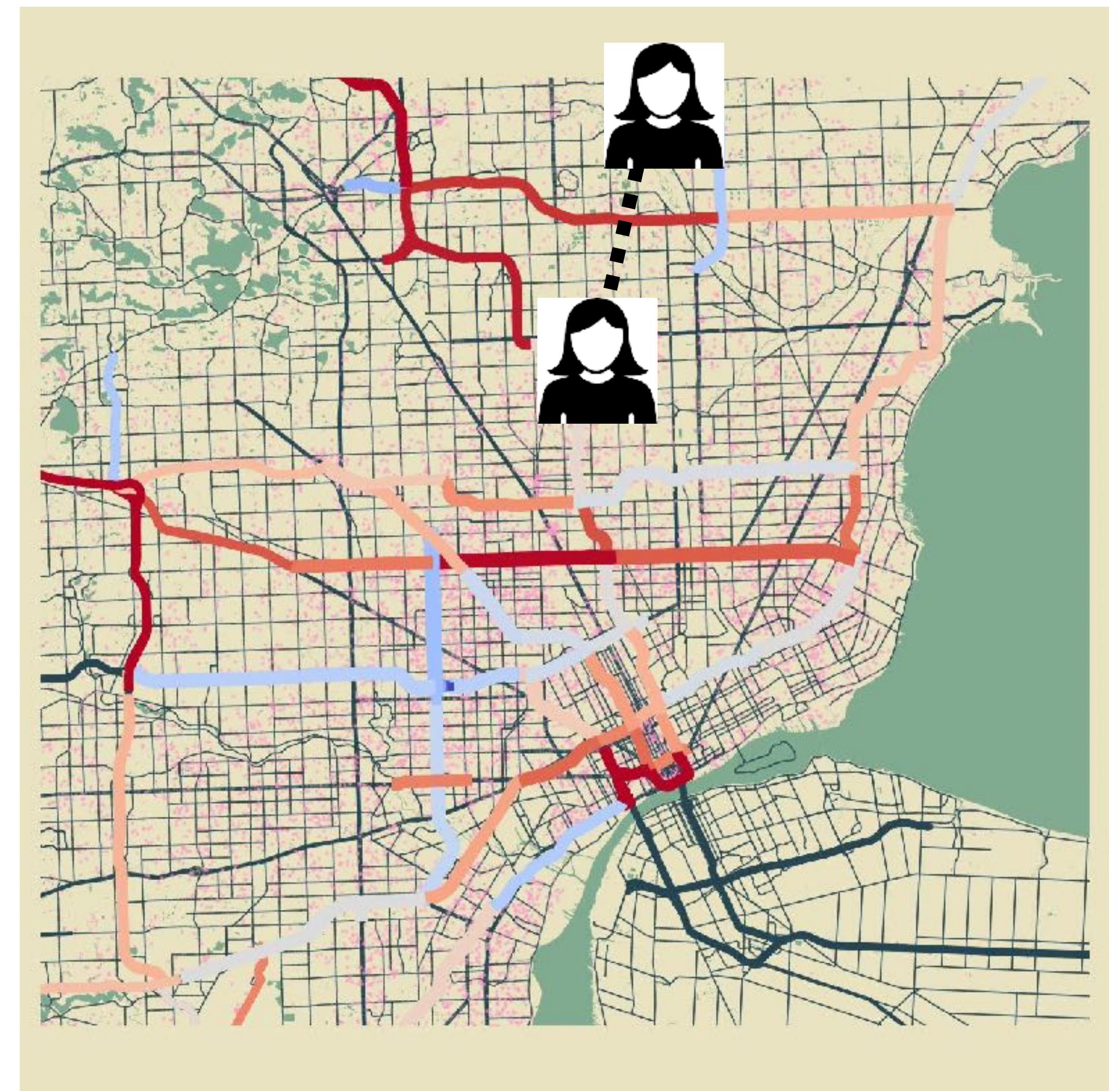
Configuration model

+ geographical distance constraint



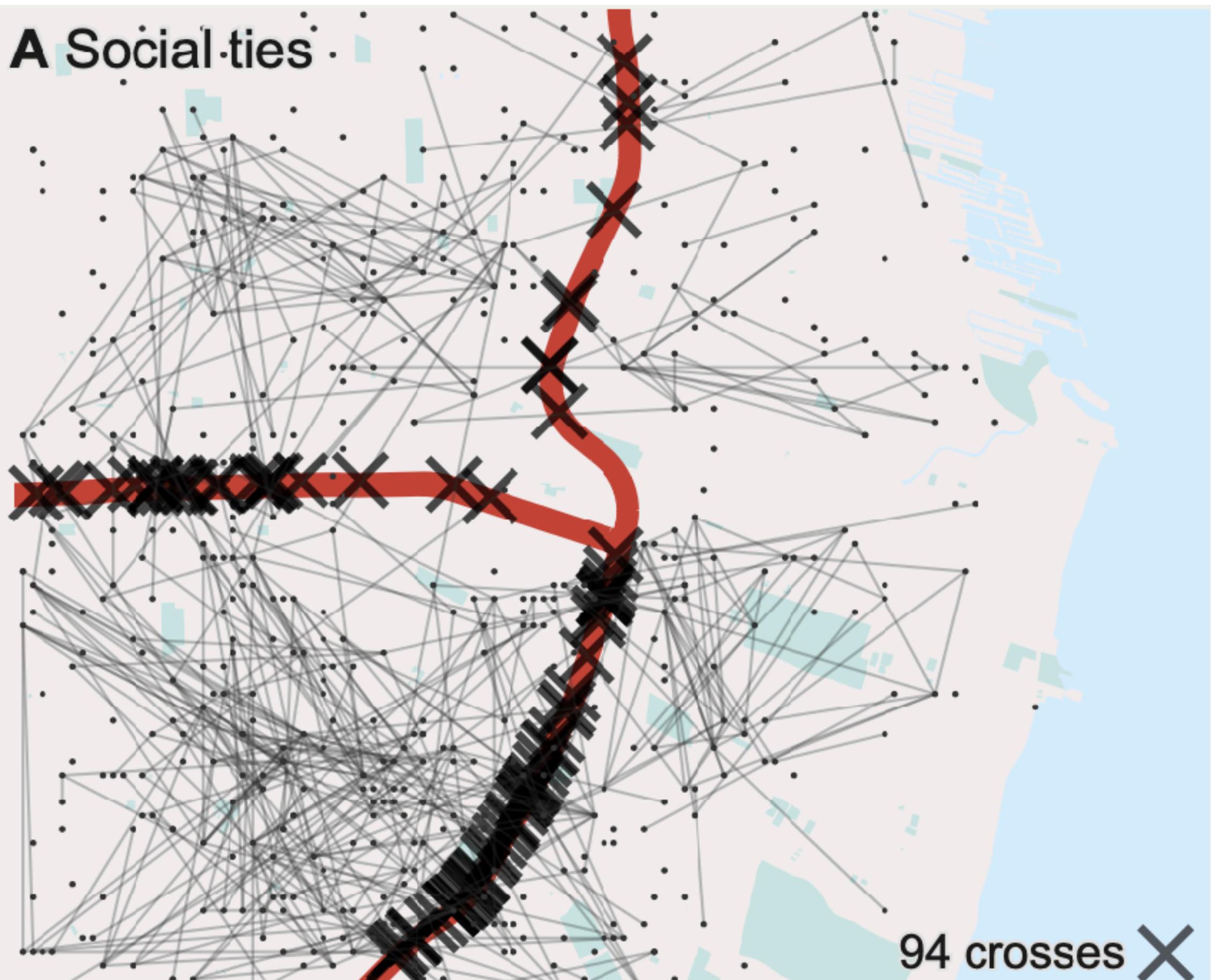


<https://www.theguardian.com/cities/2018/feb/21/roads-nowhere-infrastructure-american-inequality>

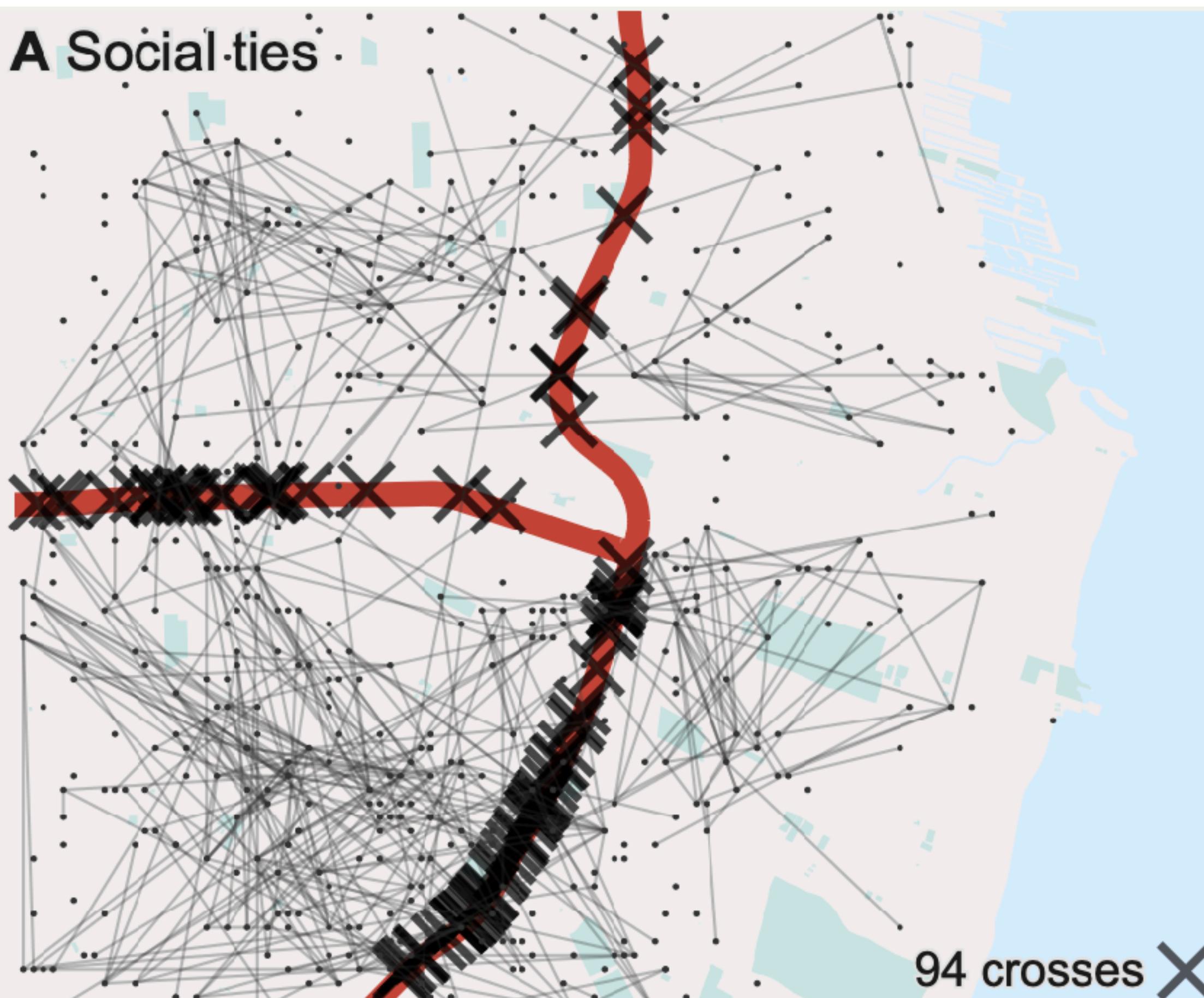


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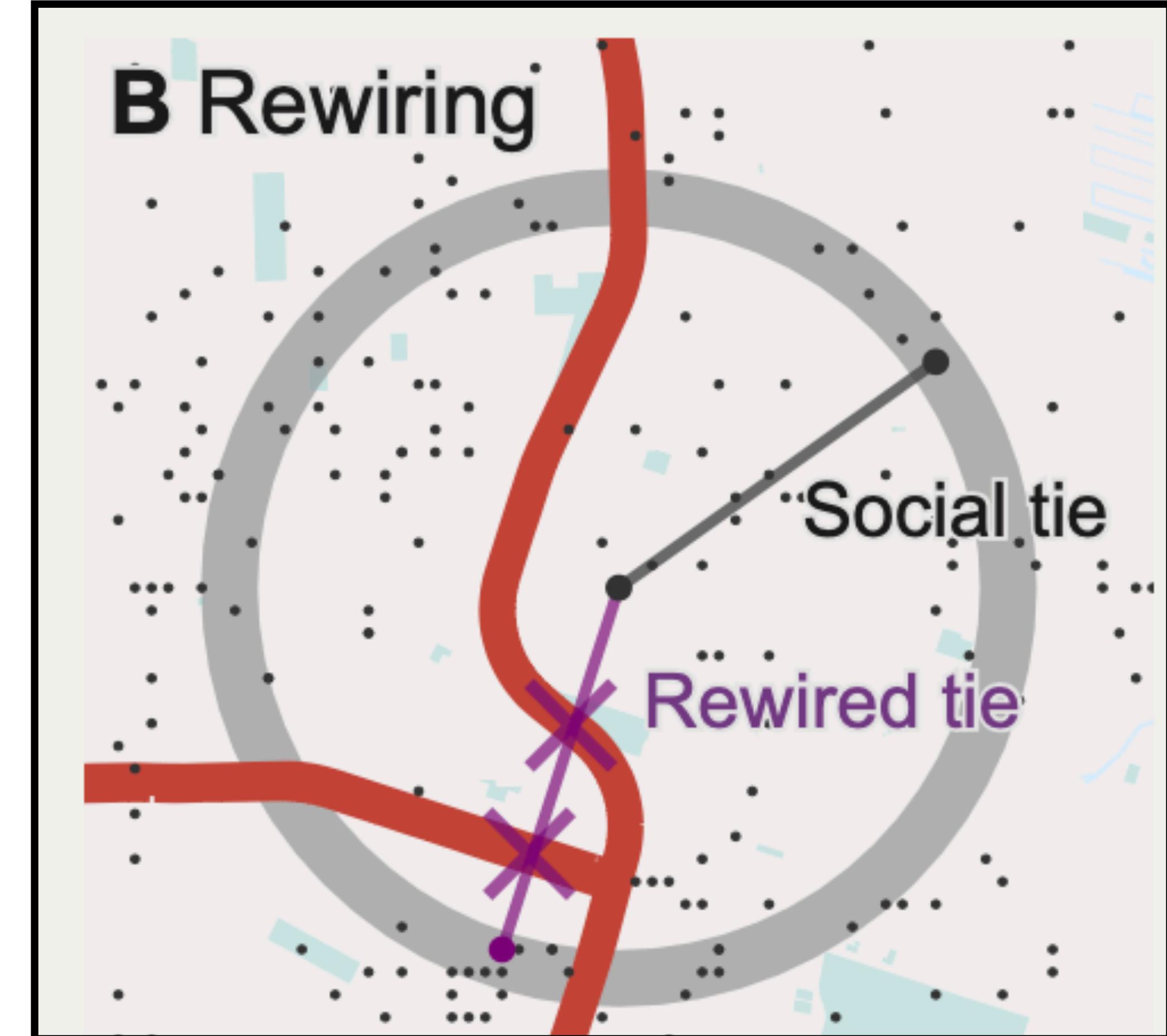
A Social ties



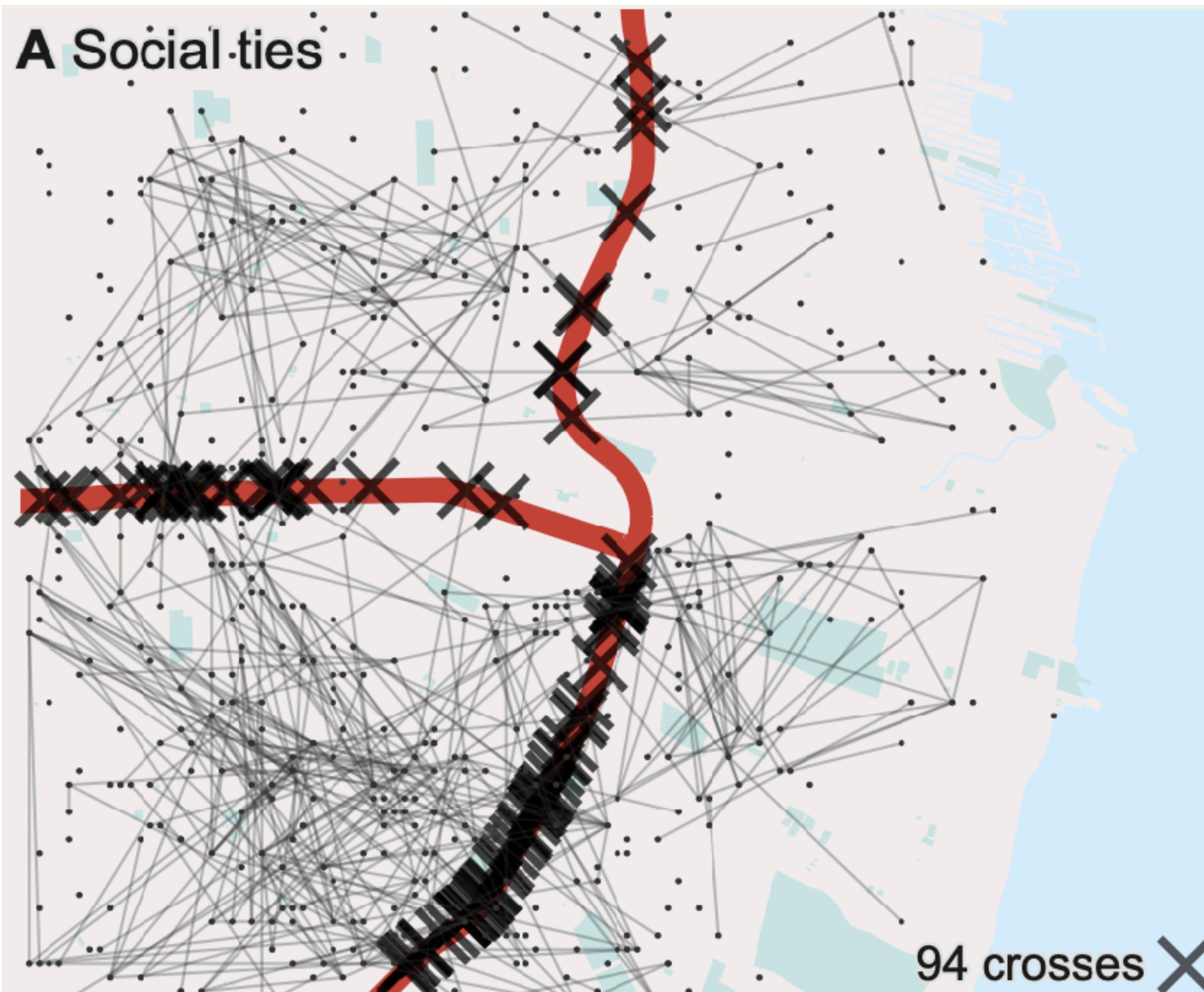
A Social ties



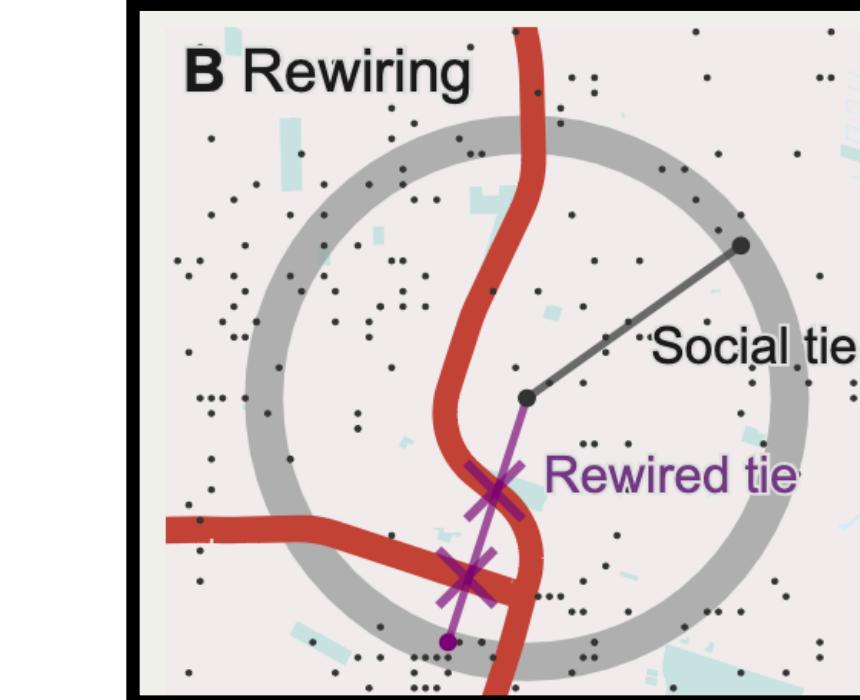
B Rewiring



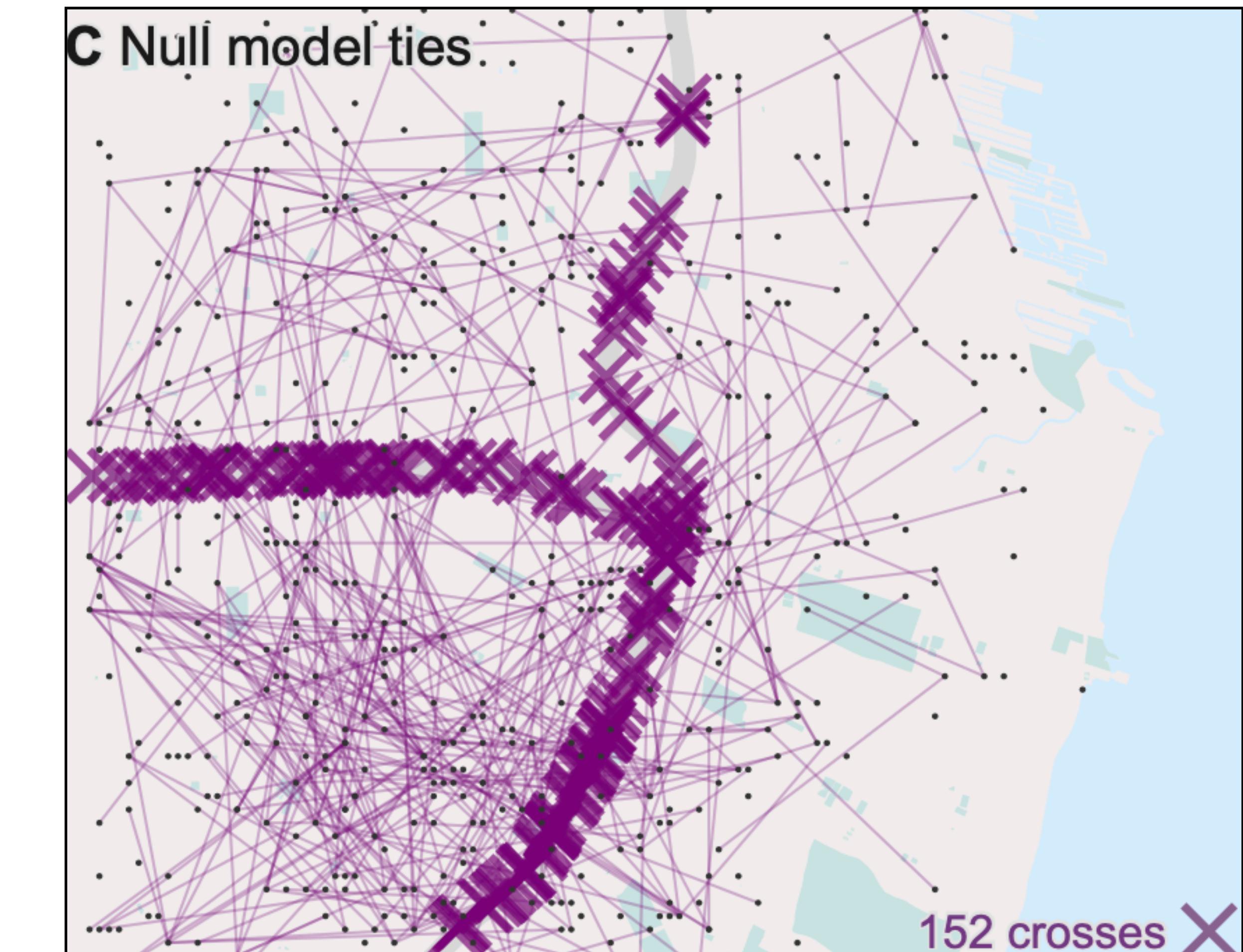
A Social ties



B Rewiring



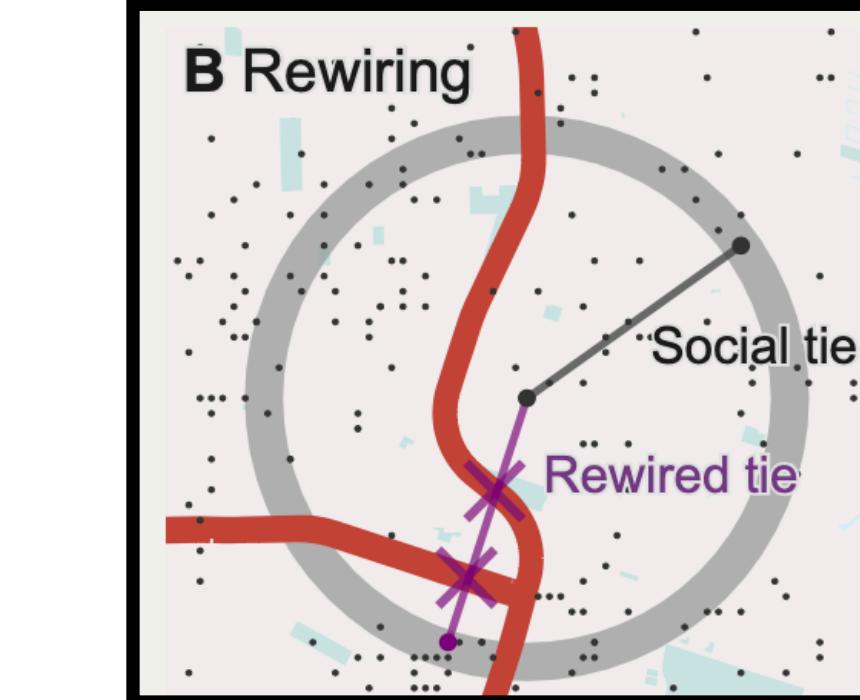
C Null model ties



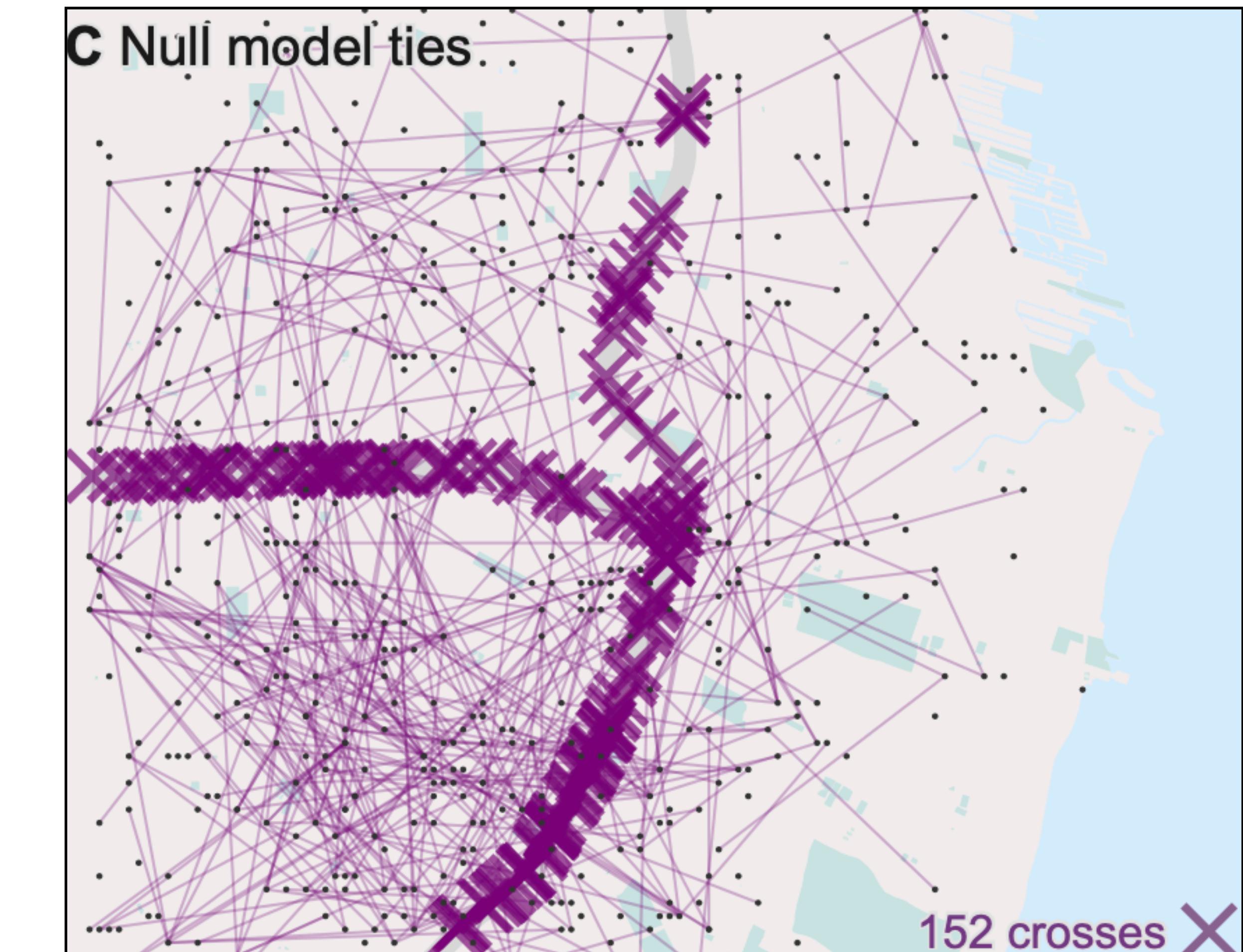
A Social ties



B Rewiring



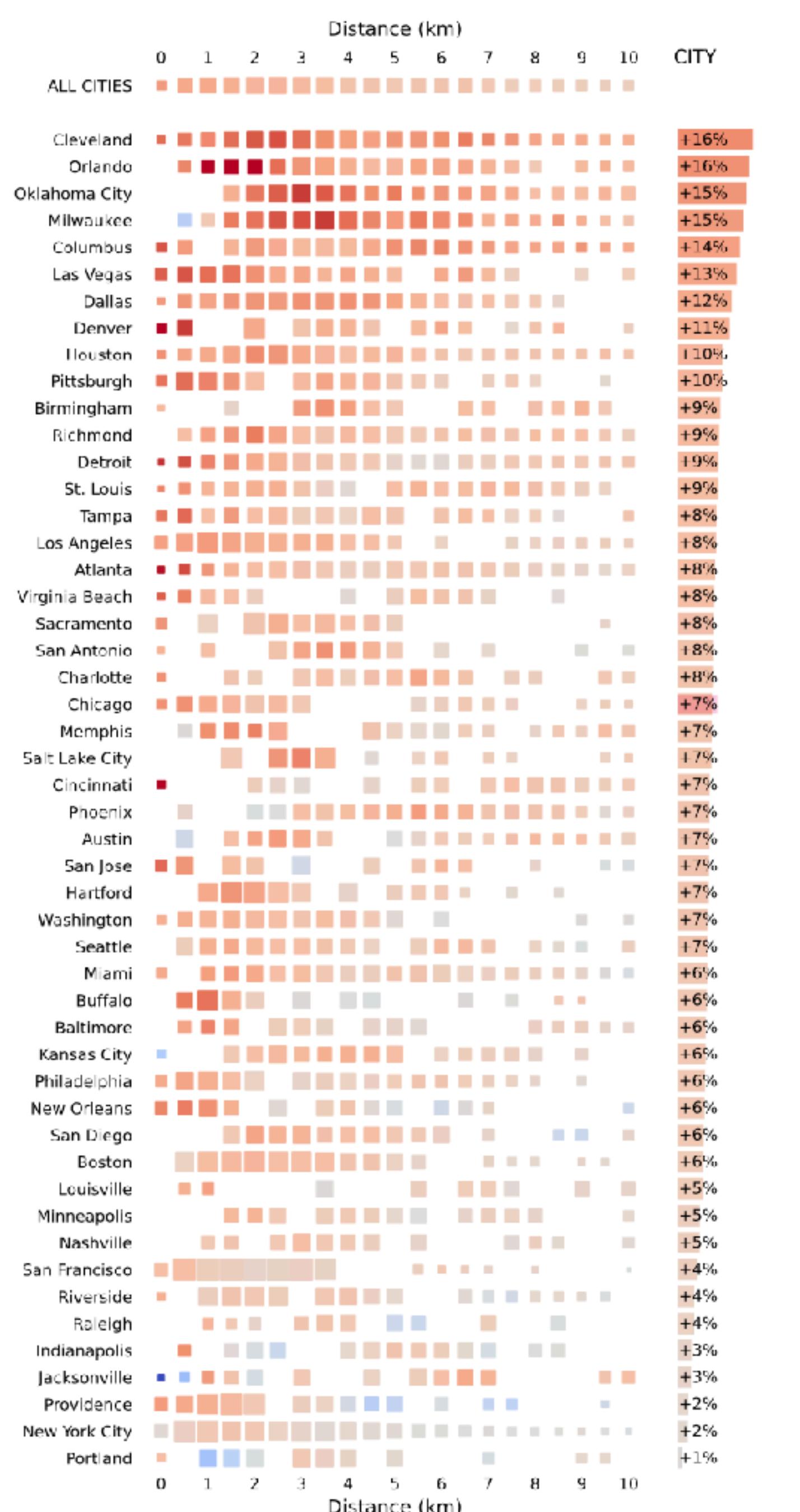
C Null model ties

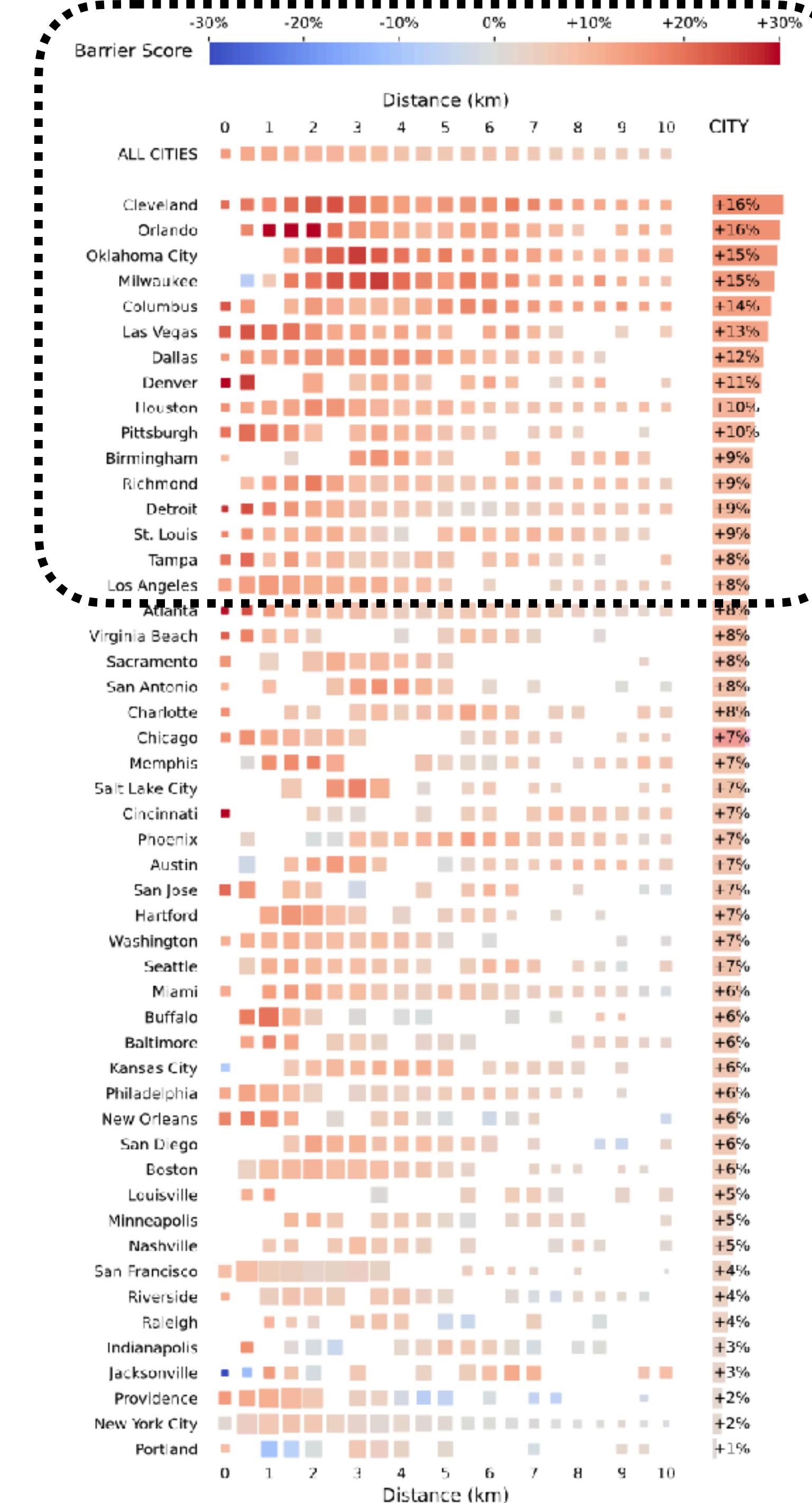


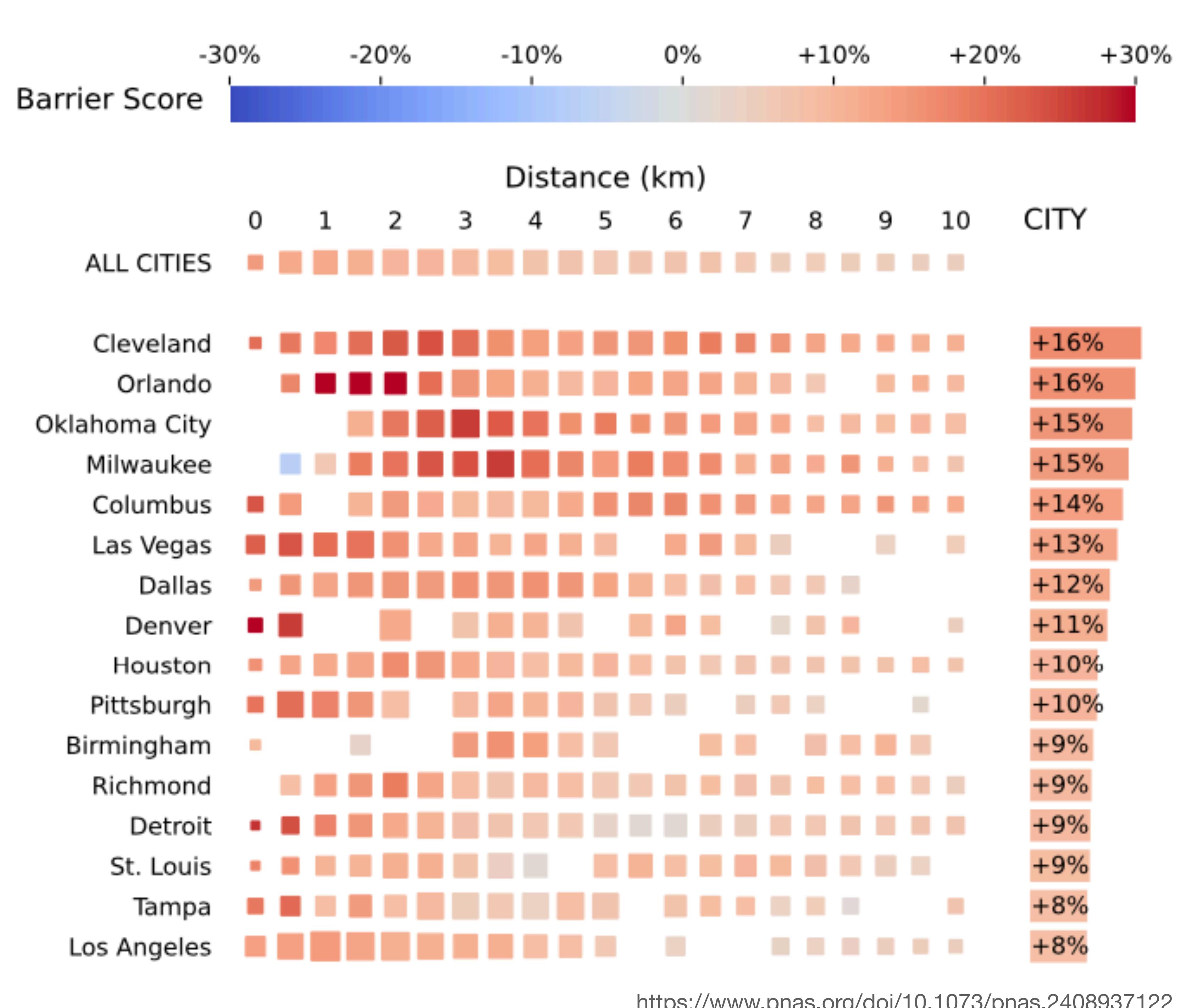
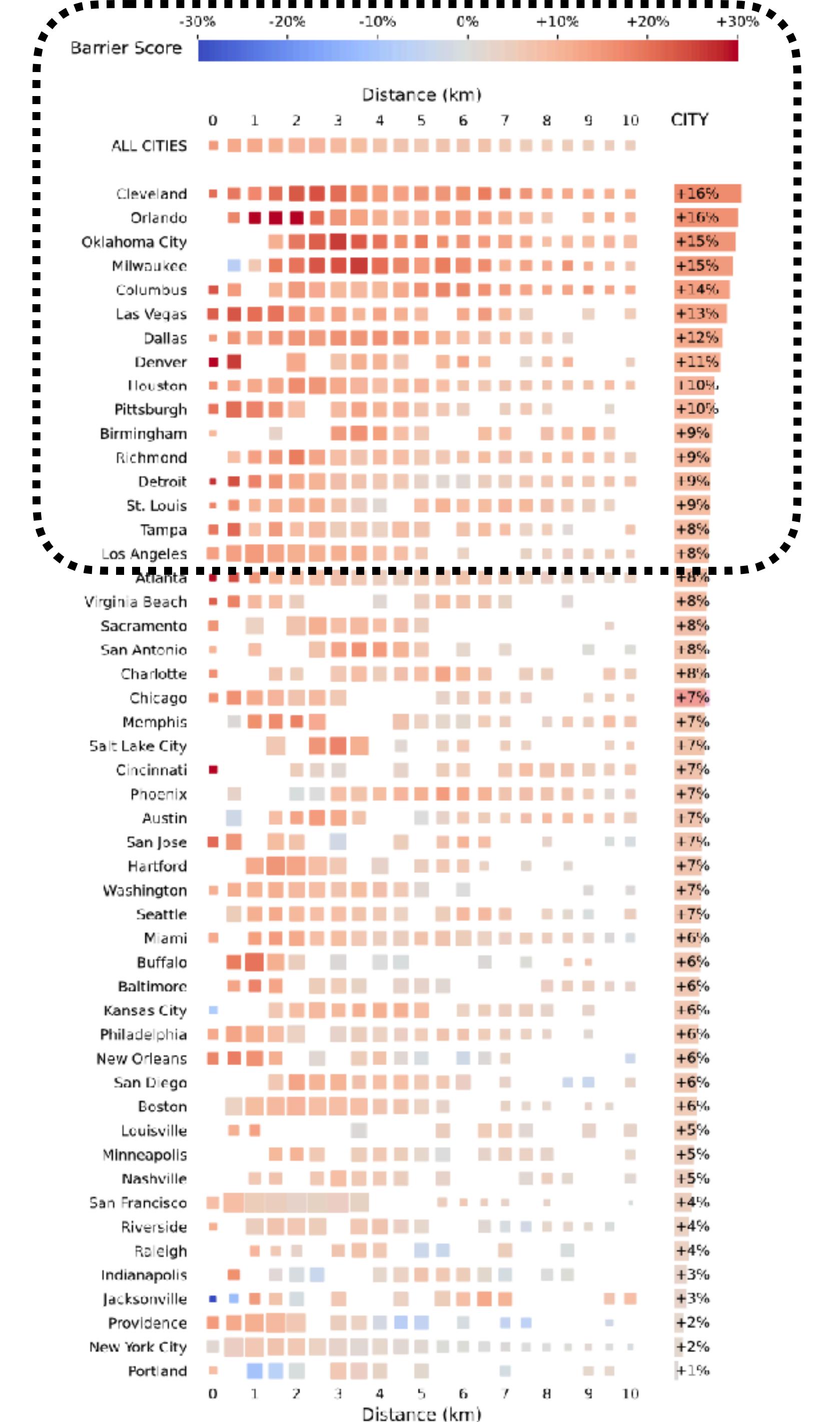
D Barrier Score

$$B_i = \frac{152 - 94}{94}$$

= +62%





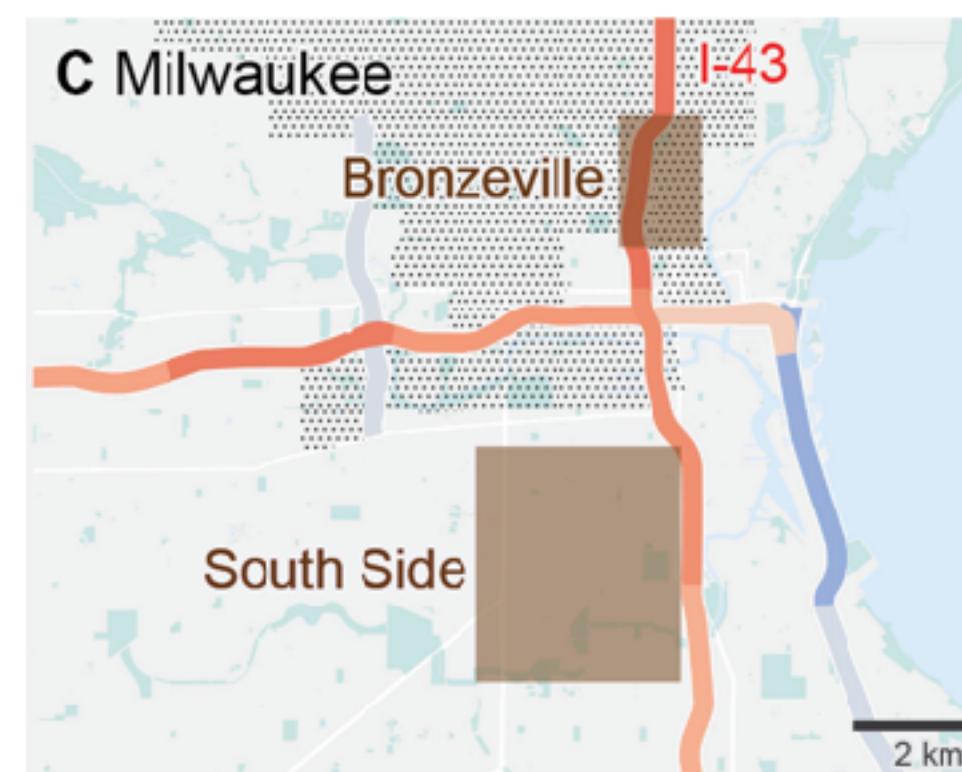
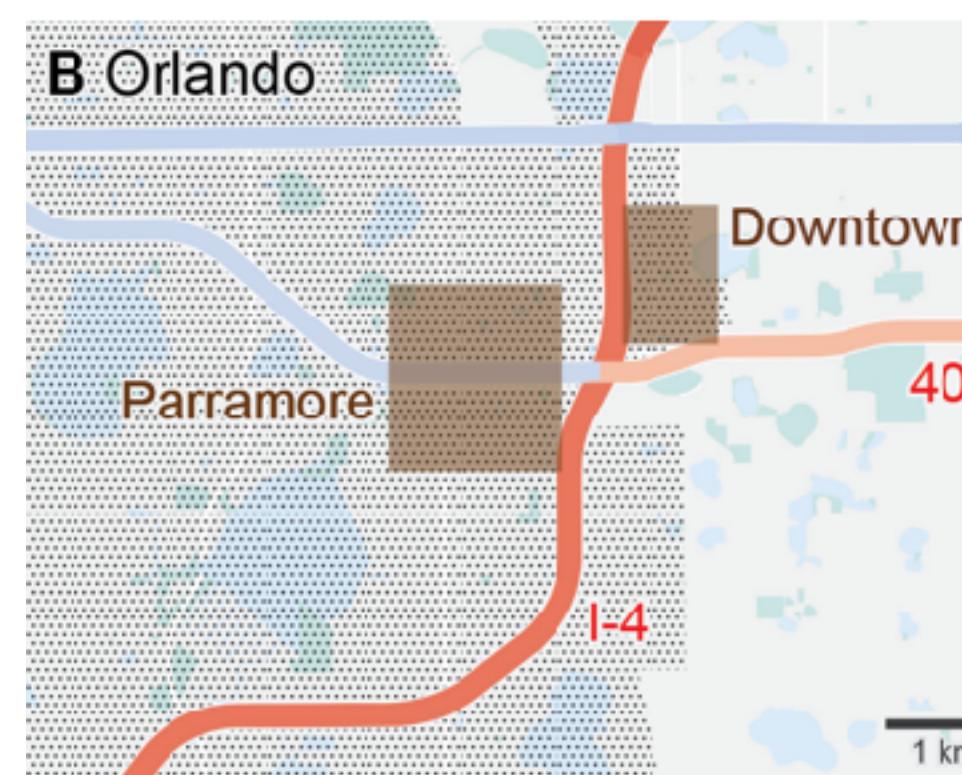


James Baldwin (1963) on urban renewal

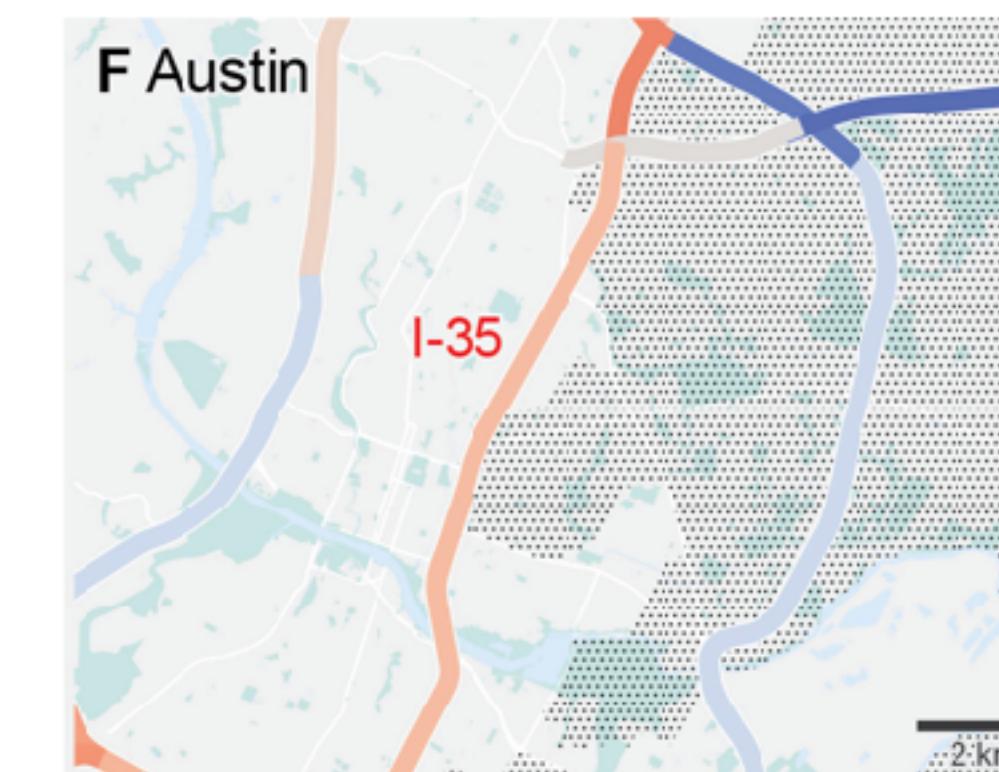
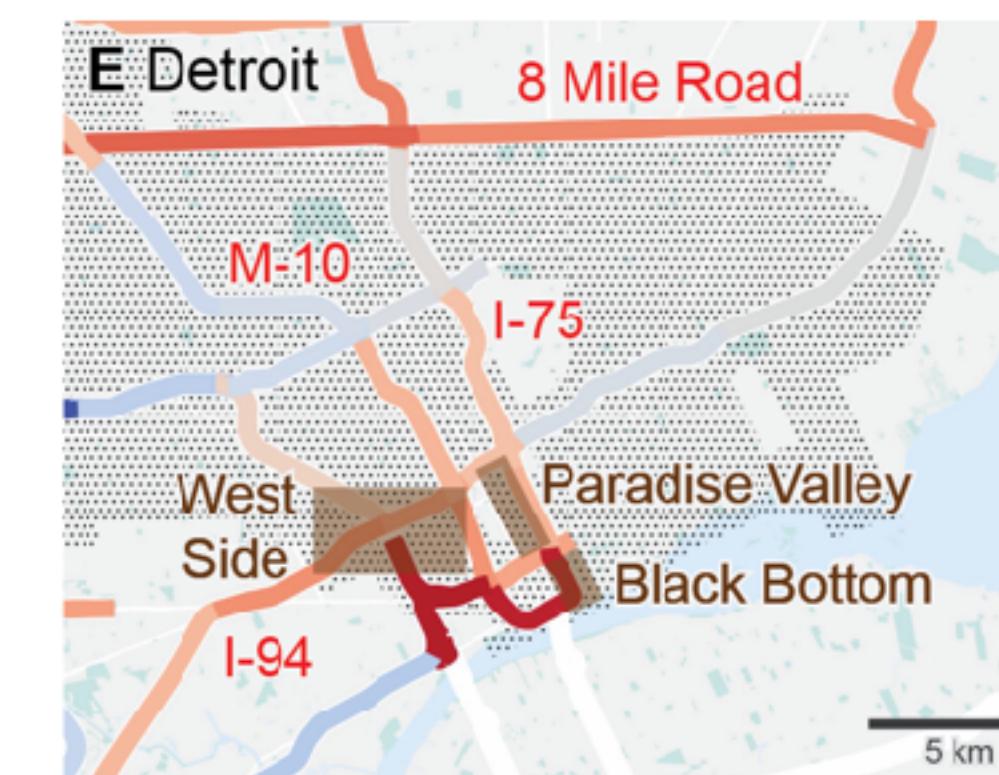
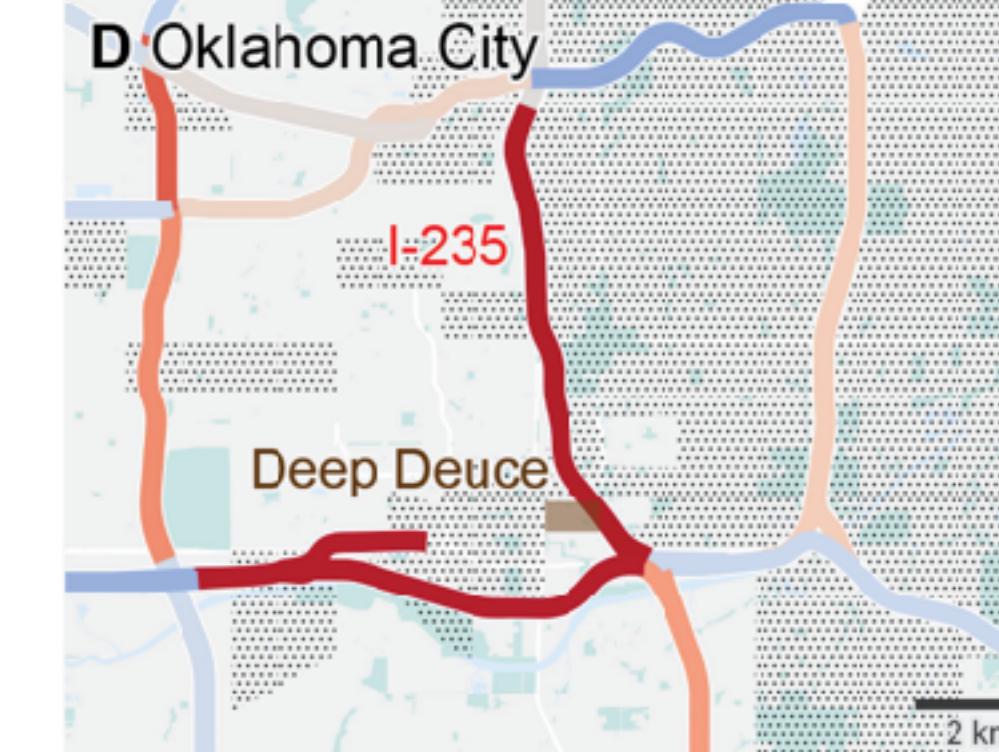


<https://www.youtube.com/watch?v=T8Abhj17kYU>

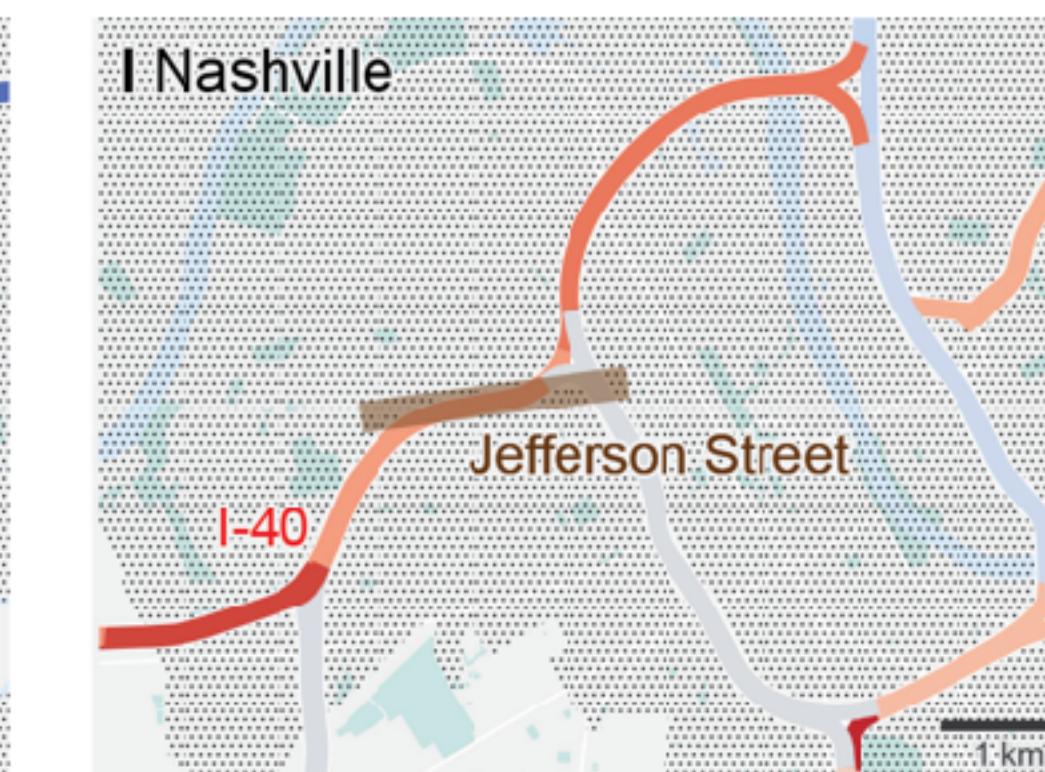
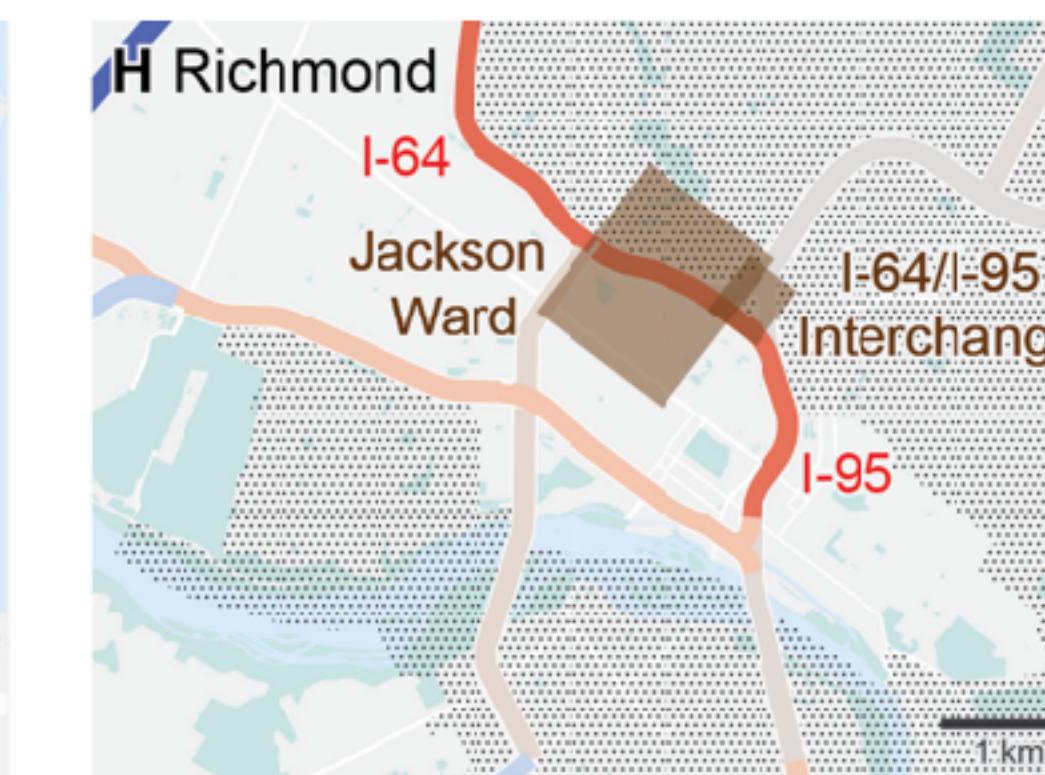
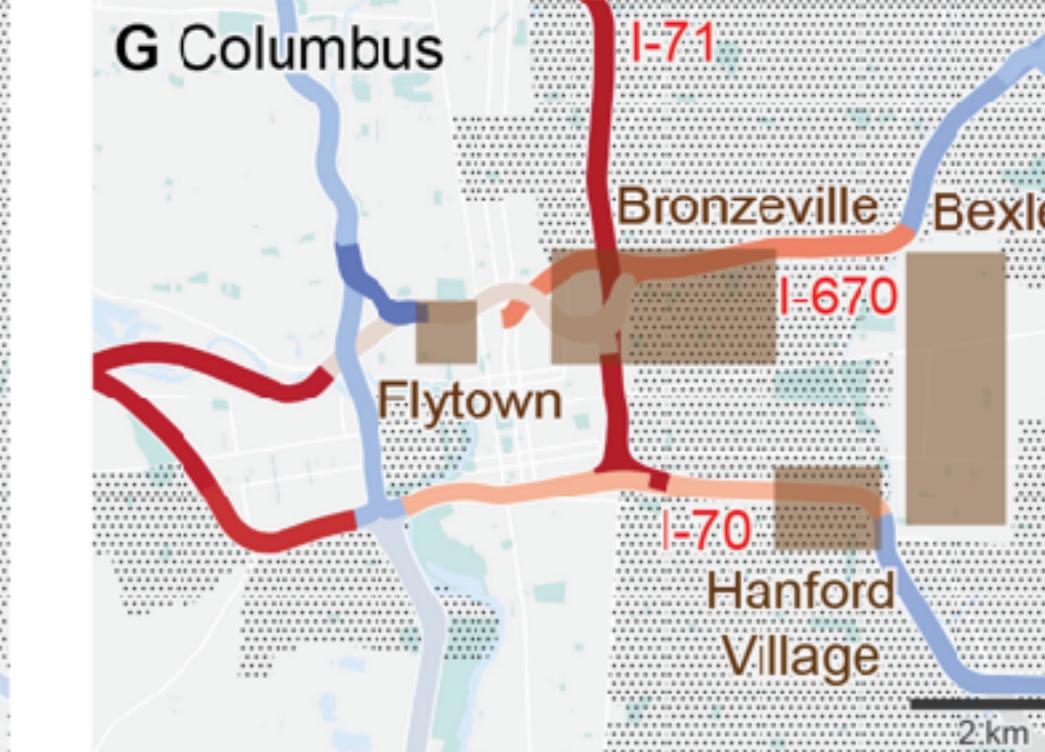
Top 3 Barrier Scores



Interracial Barriers



Intraracial Barriers

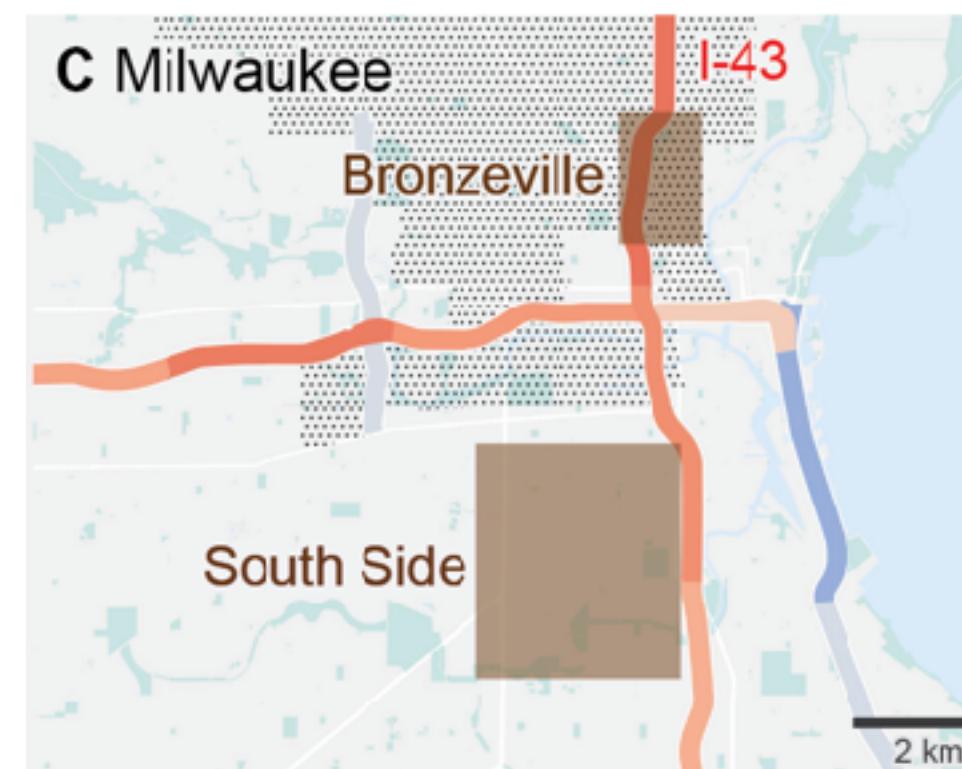
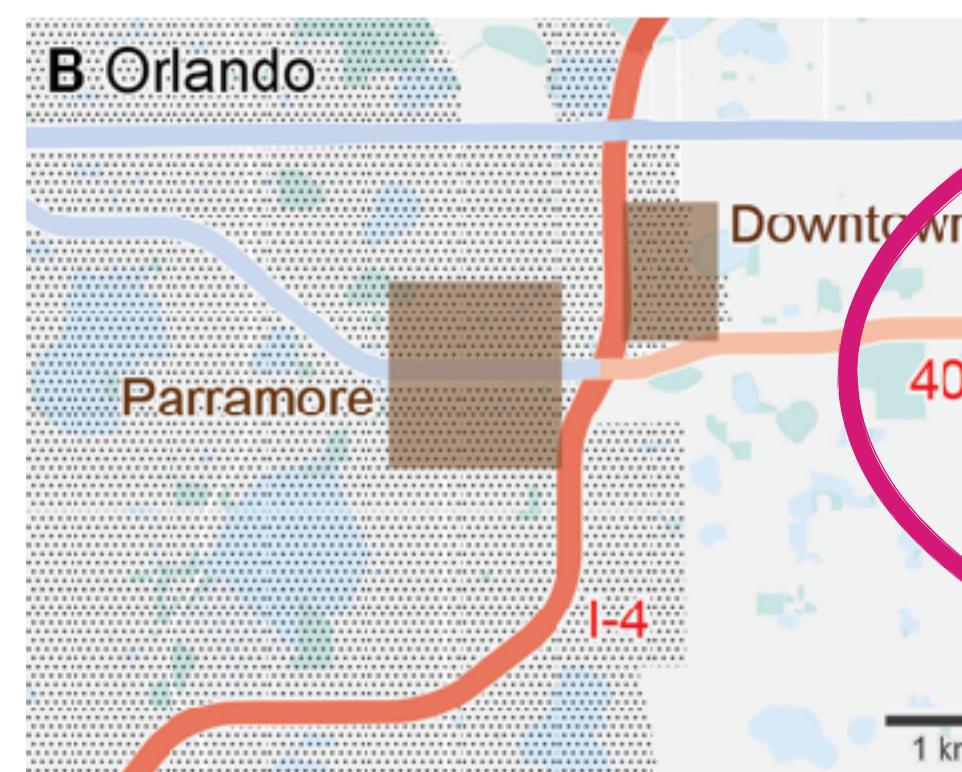


Area of interest

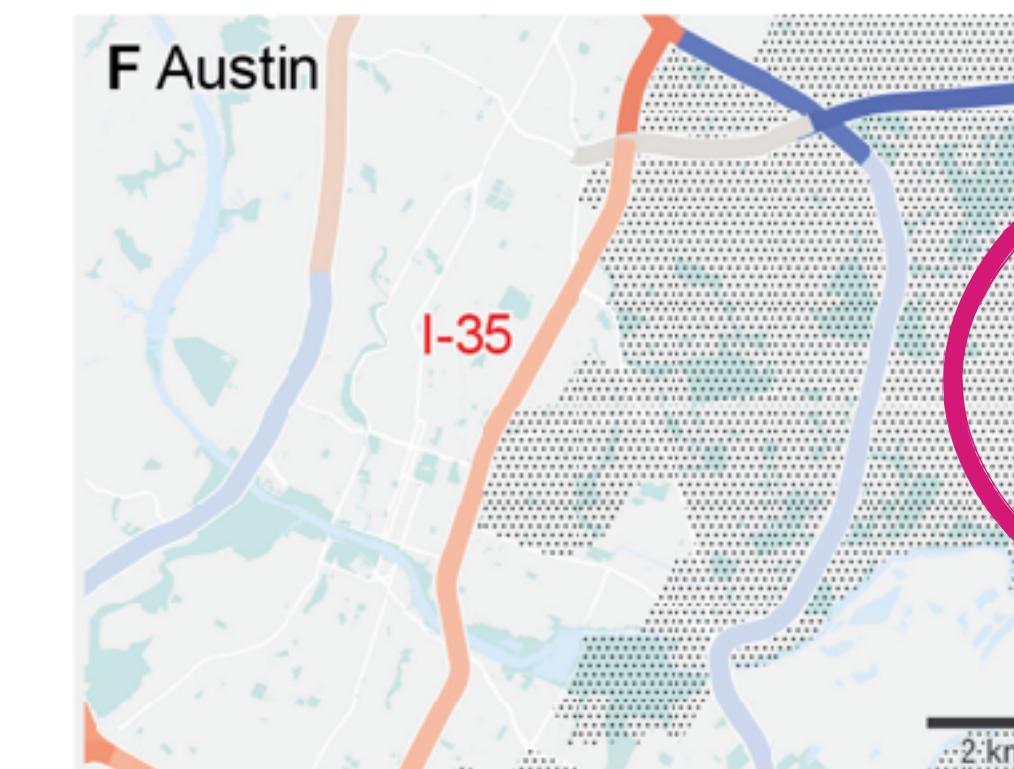
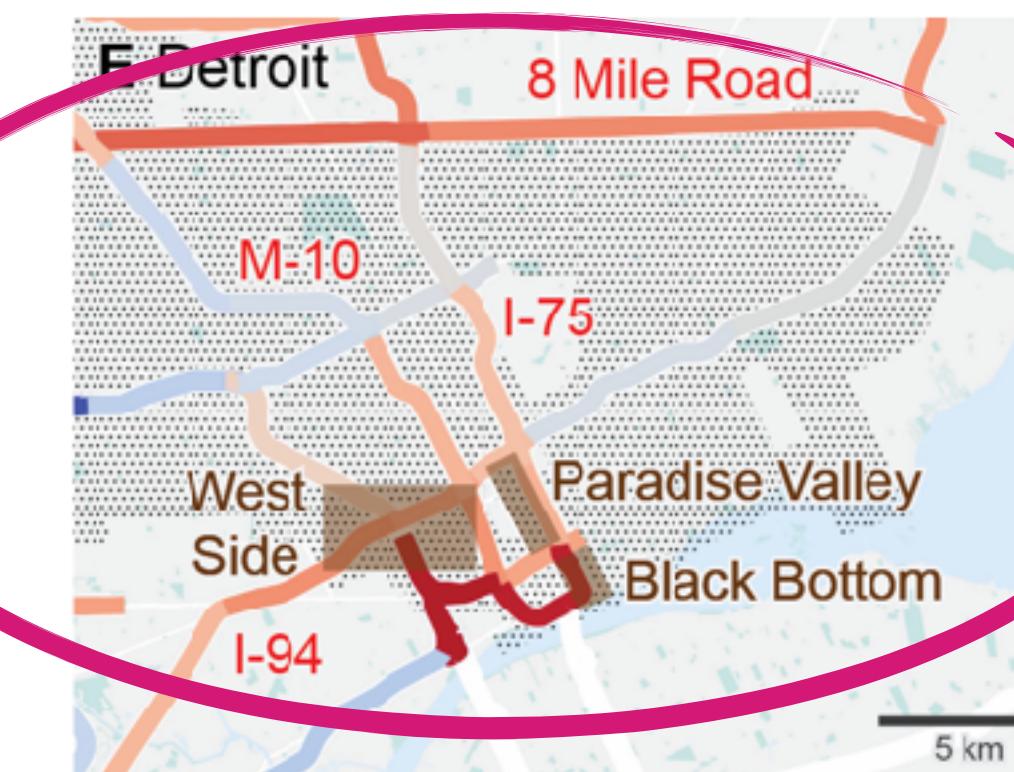
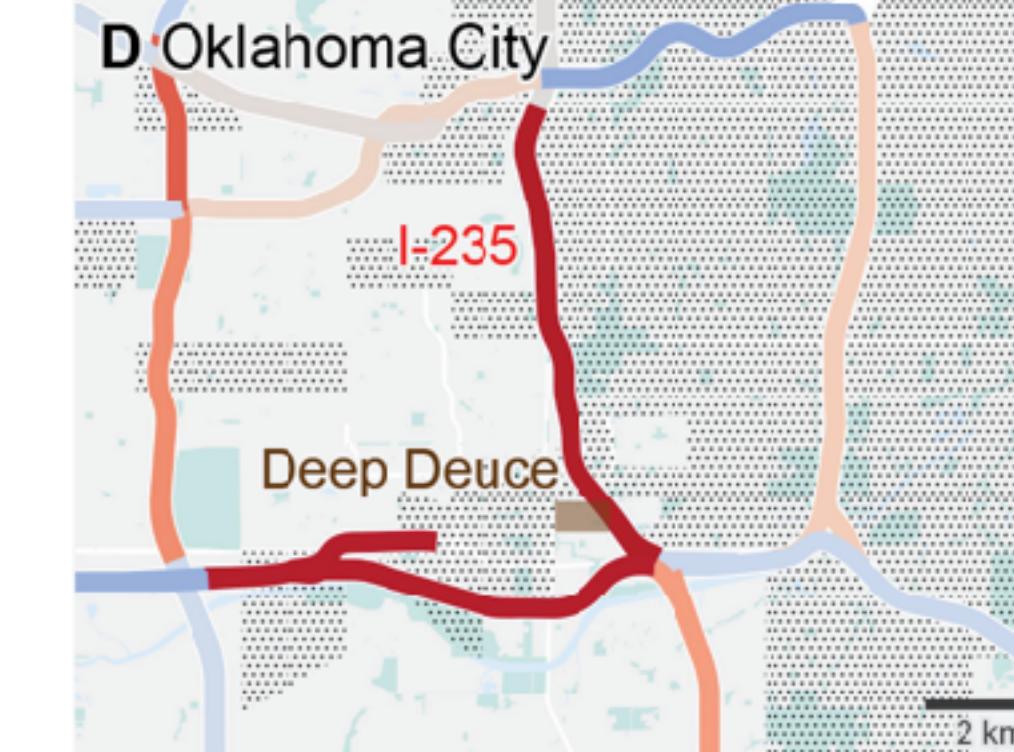
Black, upper quartile

Barrier Score: -30% -15% 0% +15% +30% No data

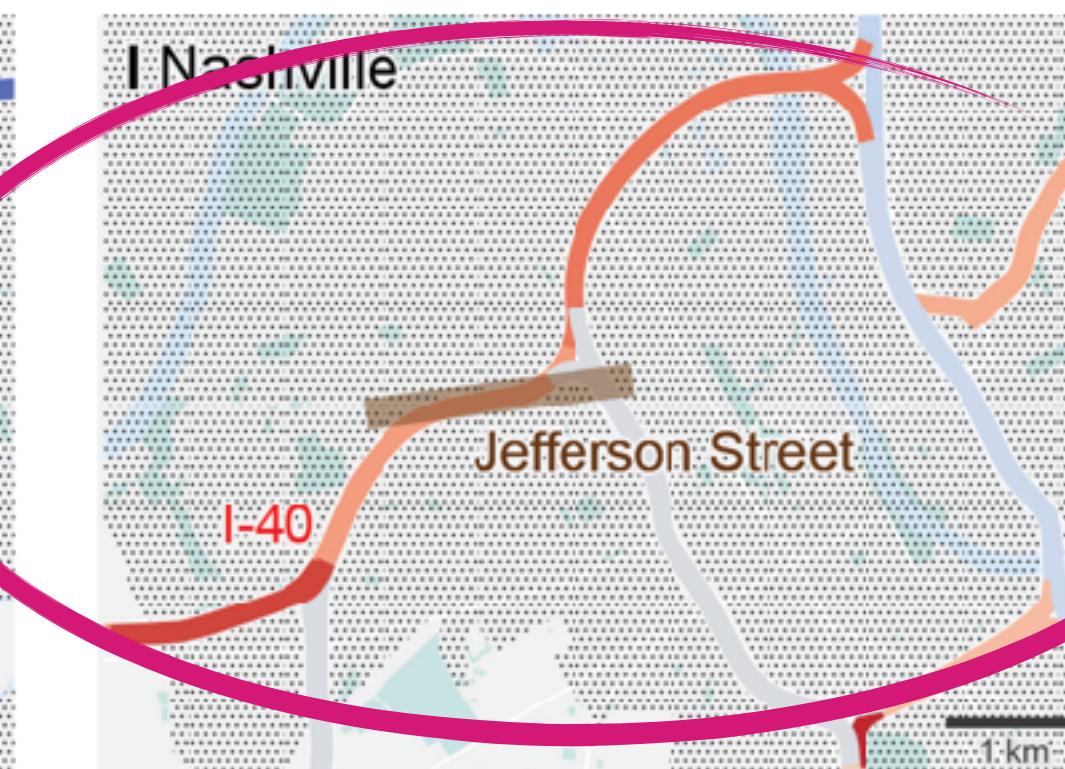
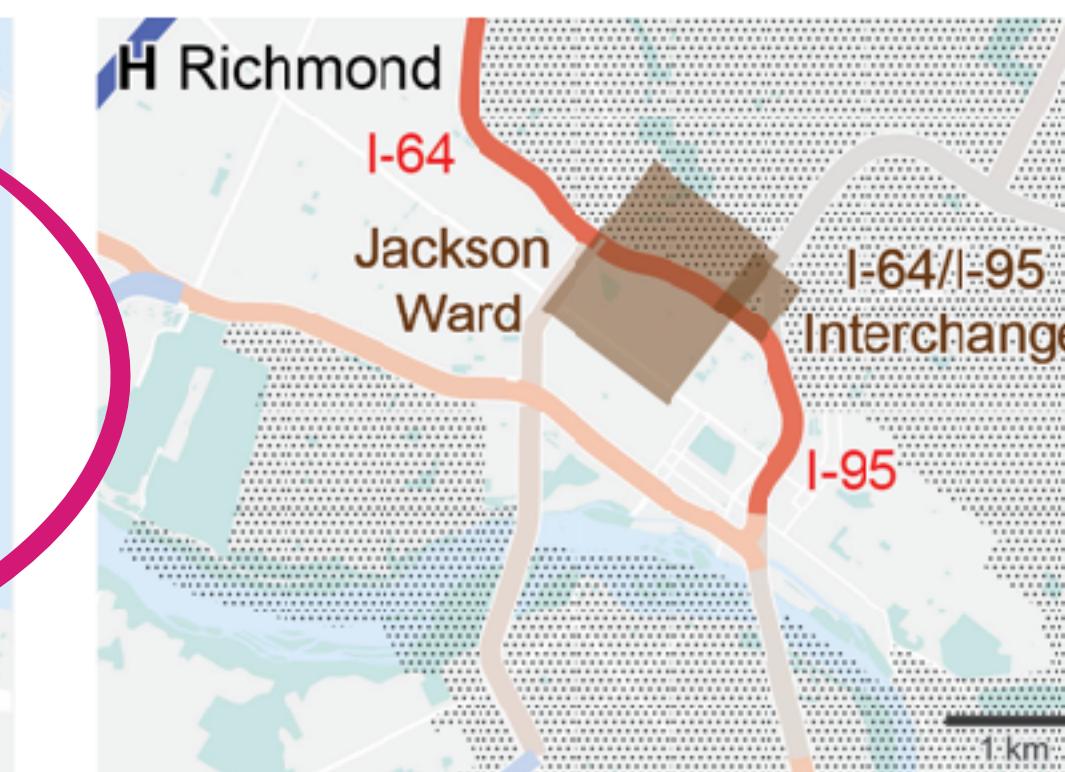
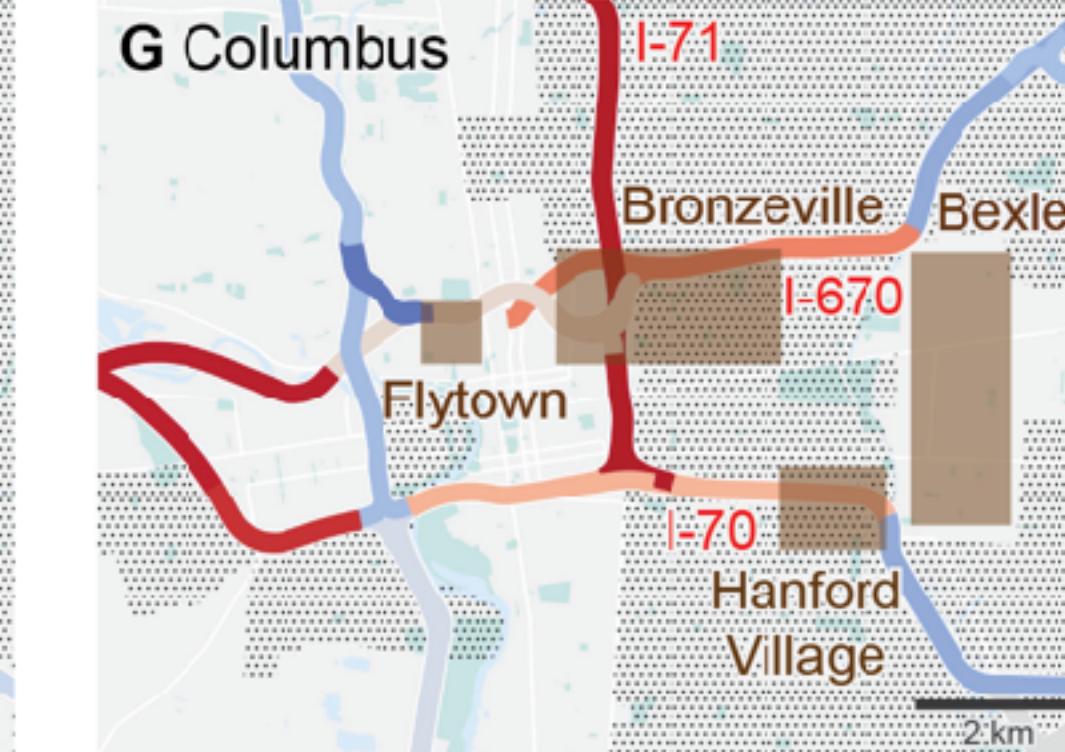
Top 3 Barrier Scores



Interracial Barriers



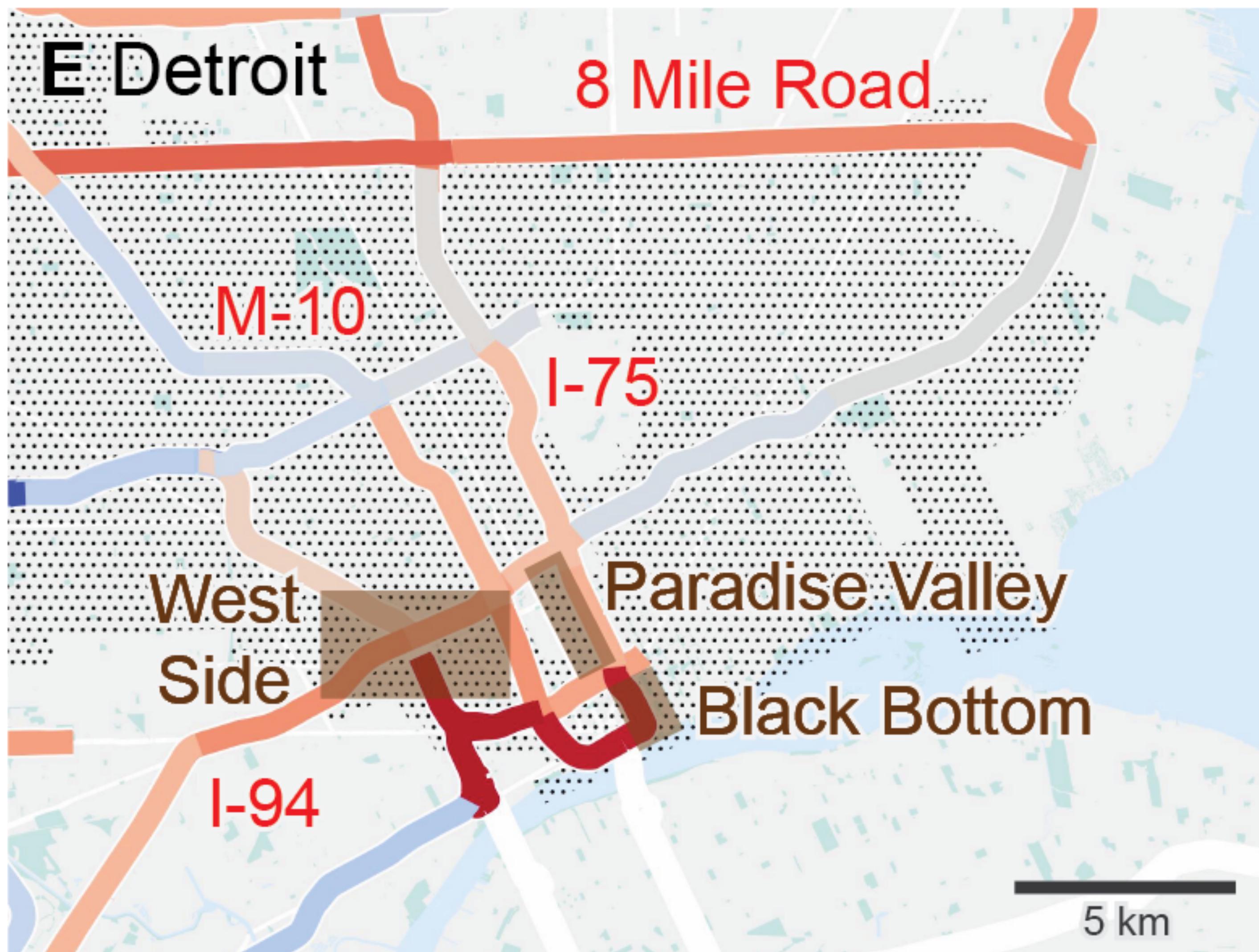
Intraracial Barriers



Area of interest

Black, upper quartile

Barrier Score: -30% -15% 0% +15% +30% No data



Area of interest

Black, upper quartile

Barrier Score:

-30%

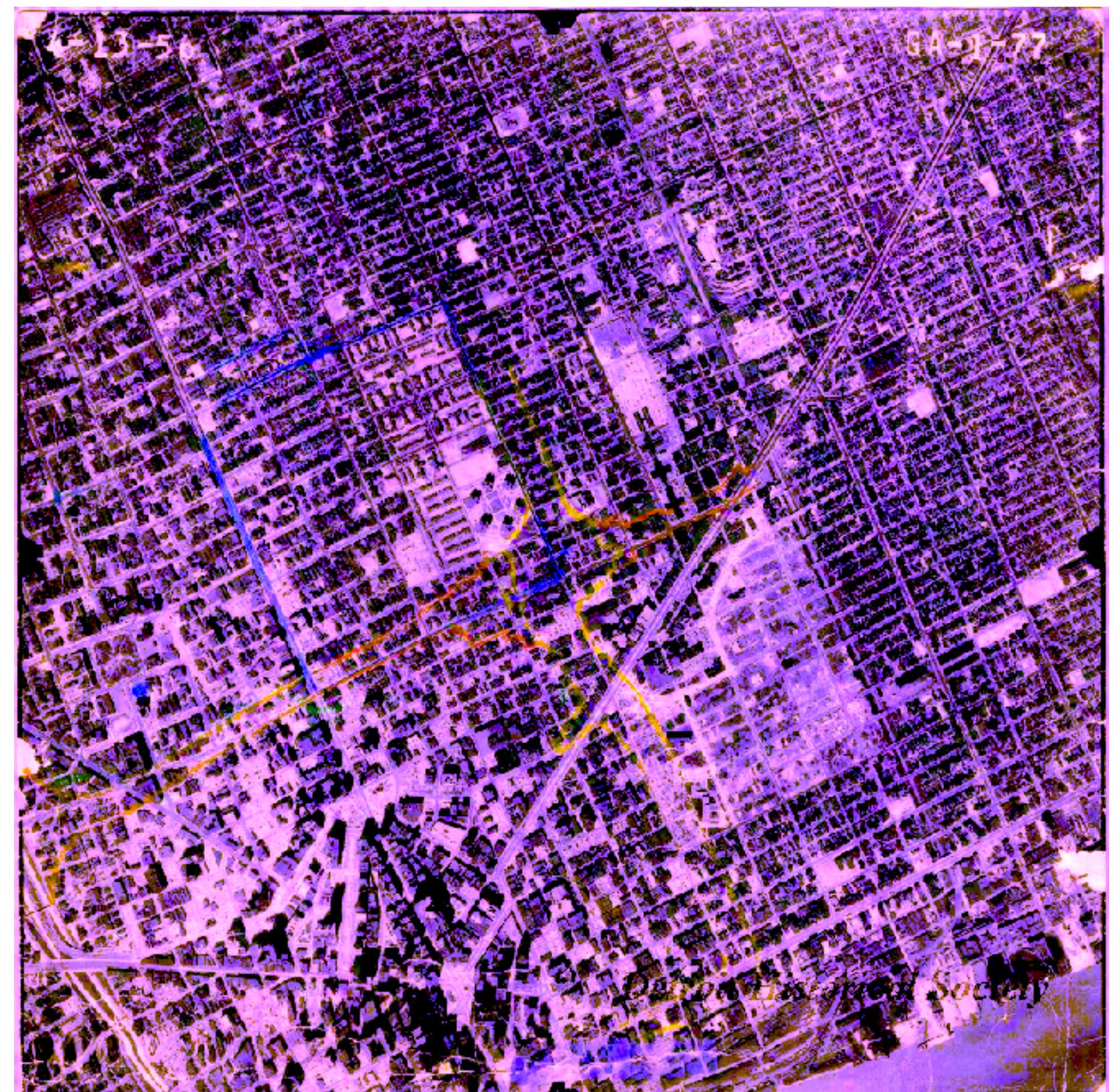
-15%

0%

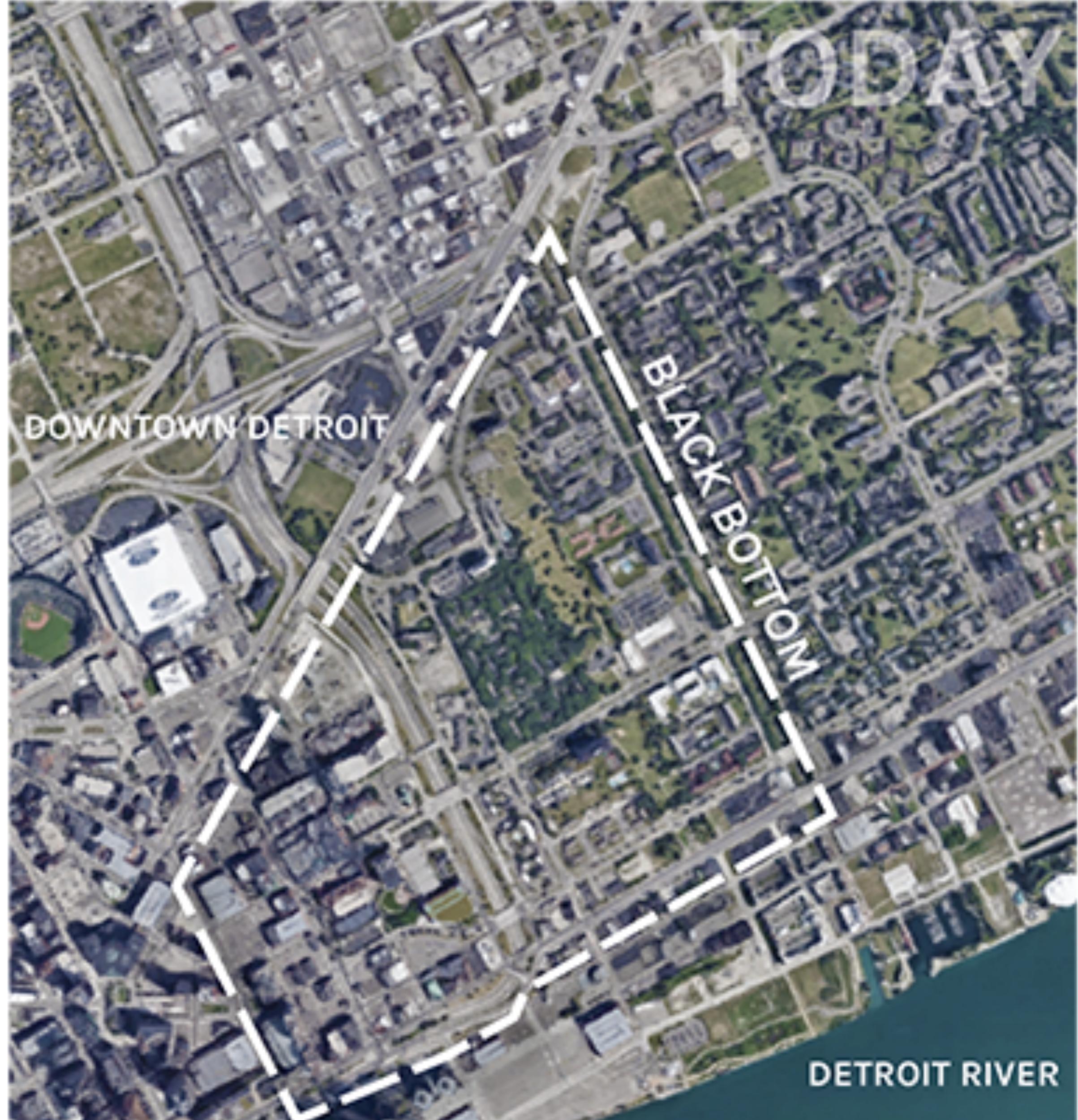
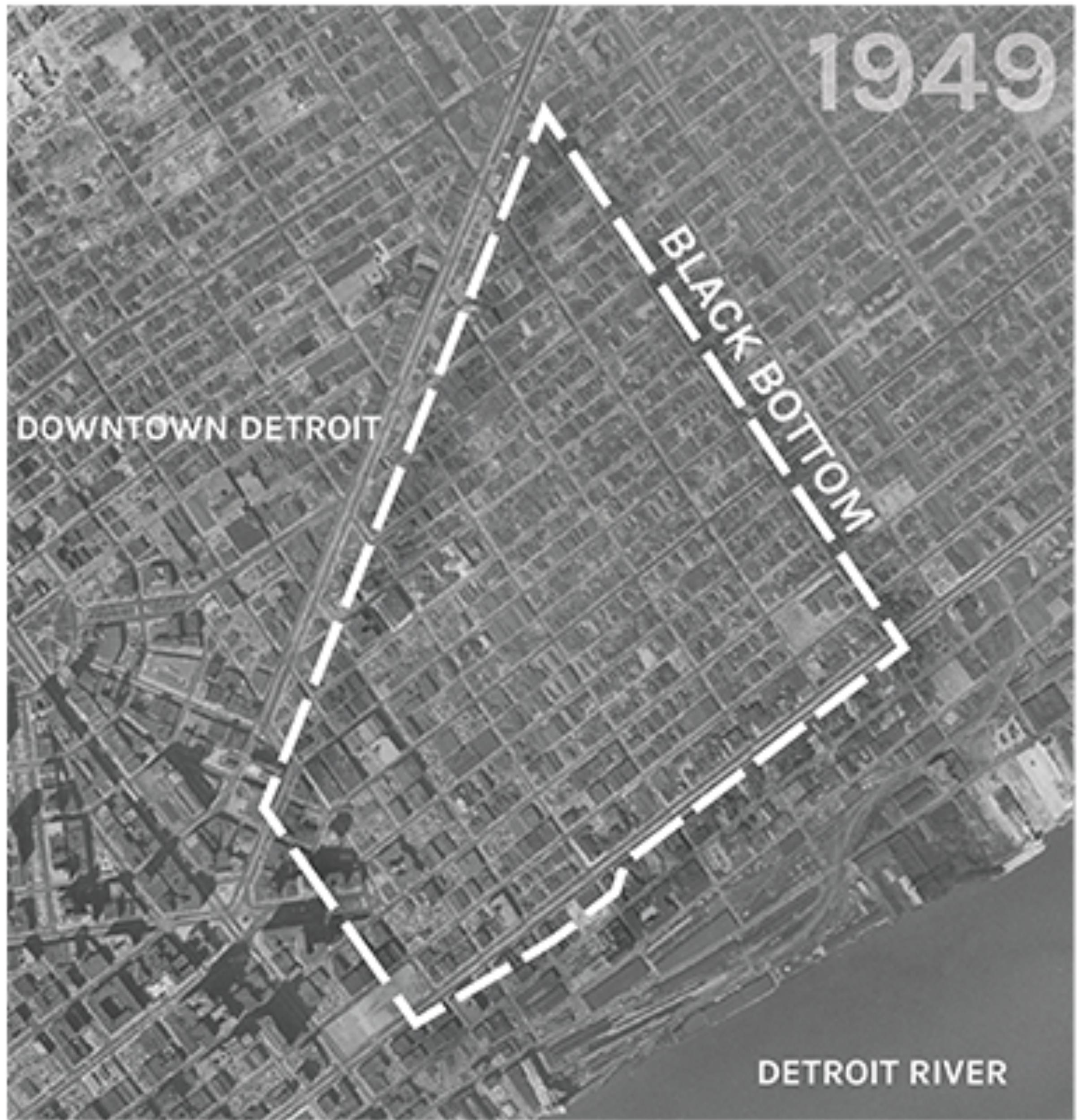
+15%

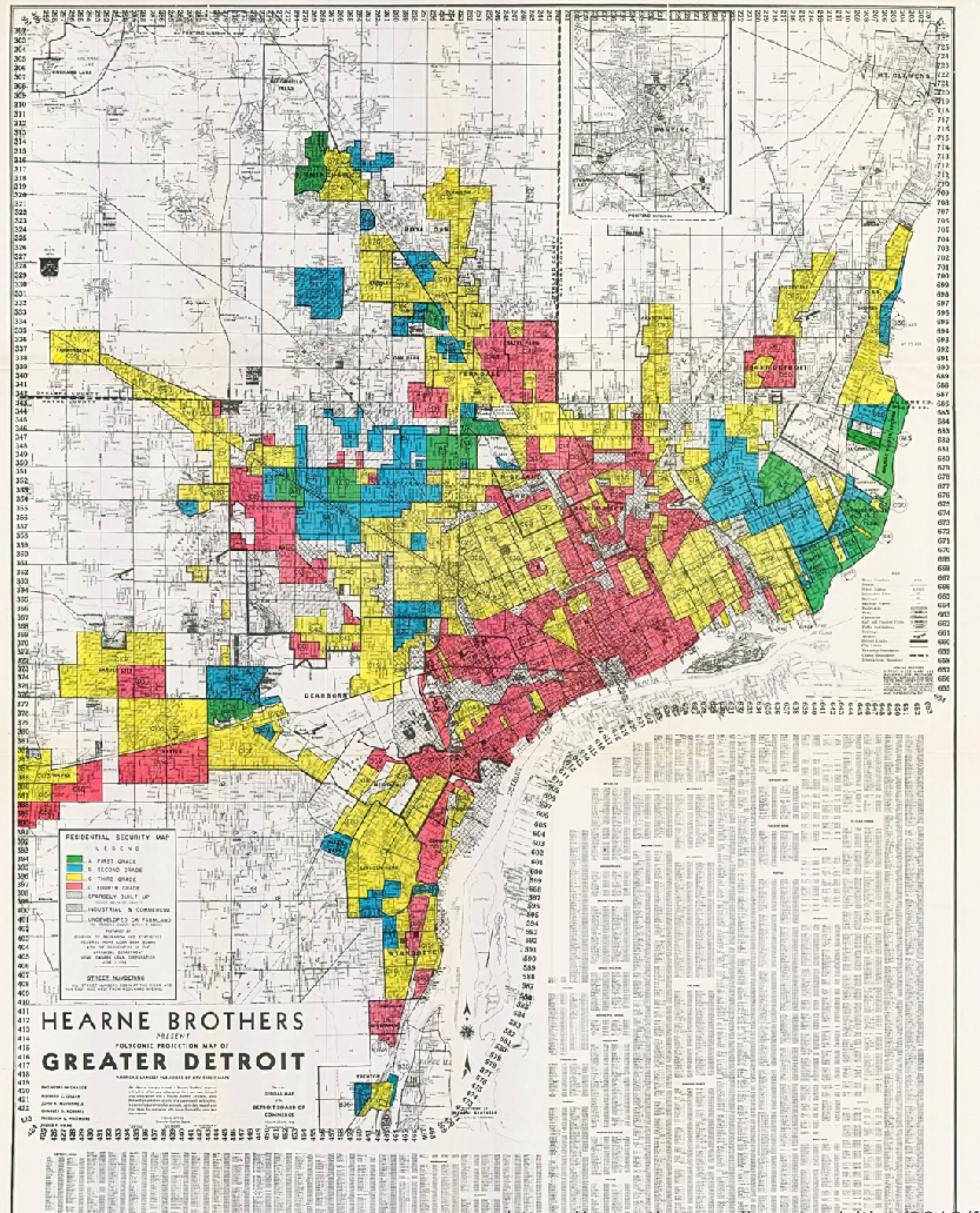
+30%

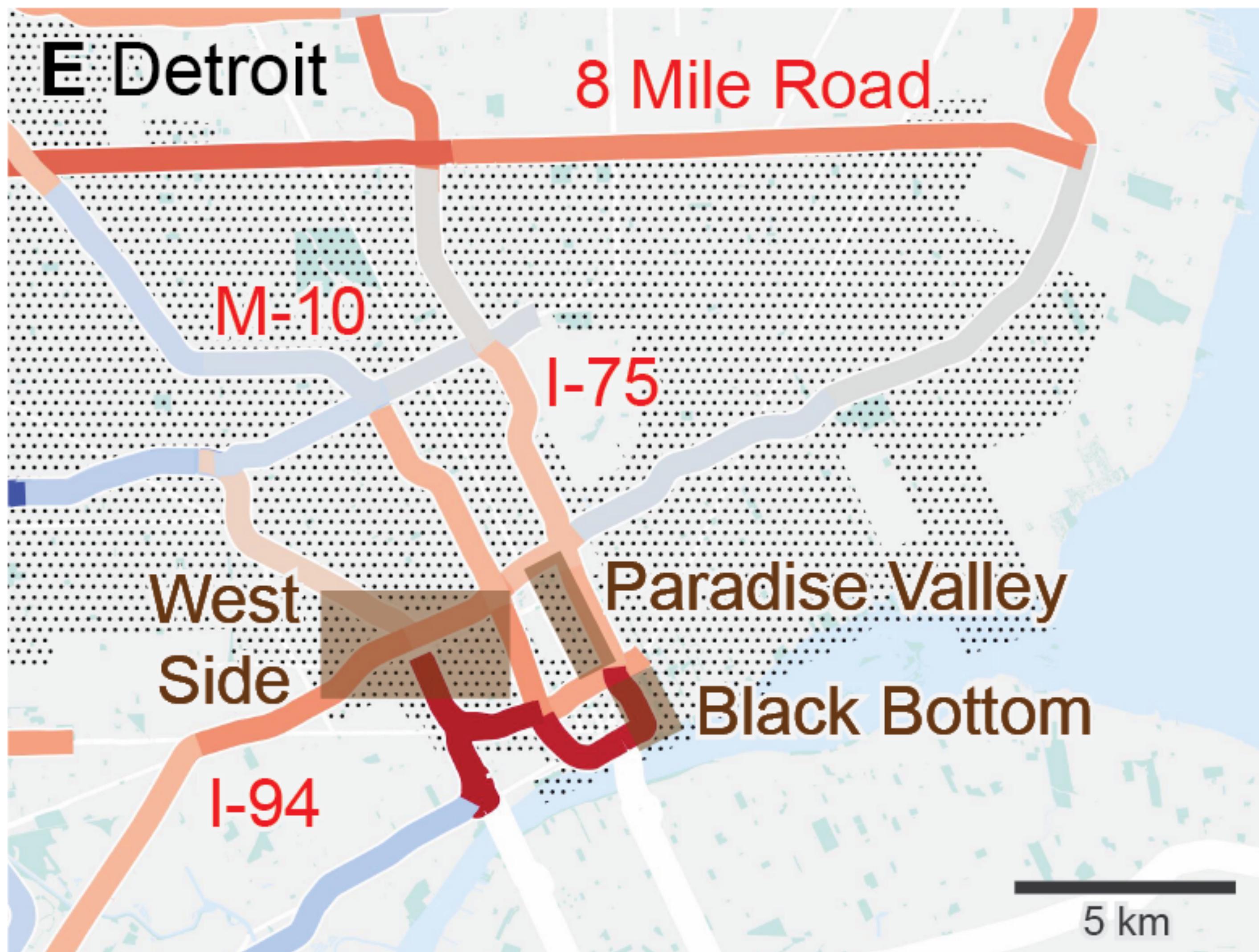
No data



Detroit 1956







Area of interest

Black, upper quartile

Barrier Score:

-30%

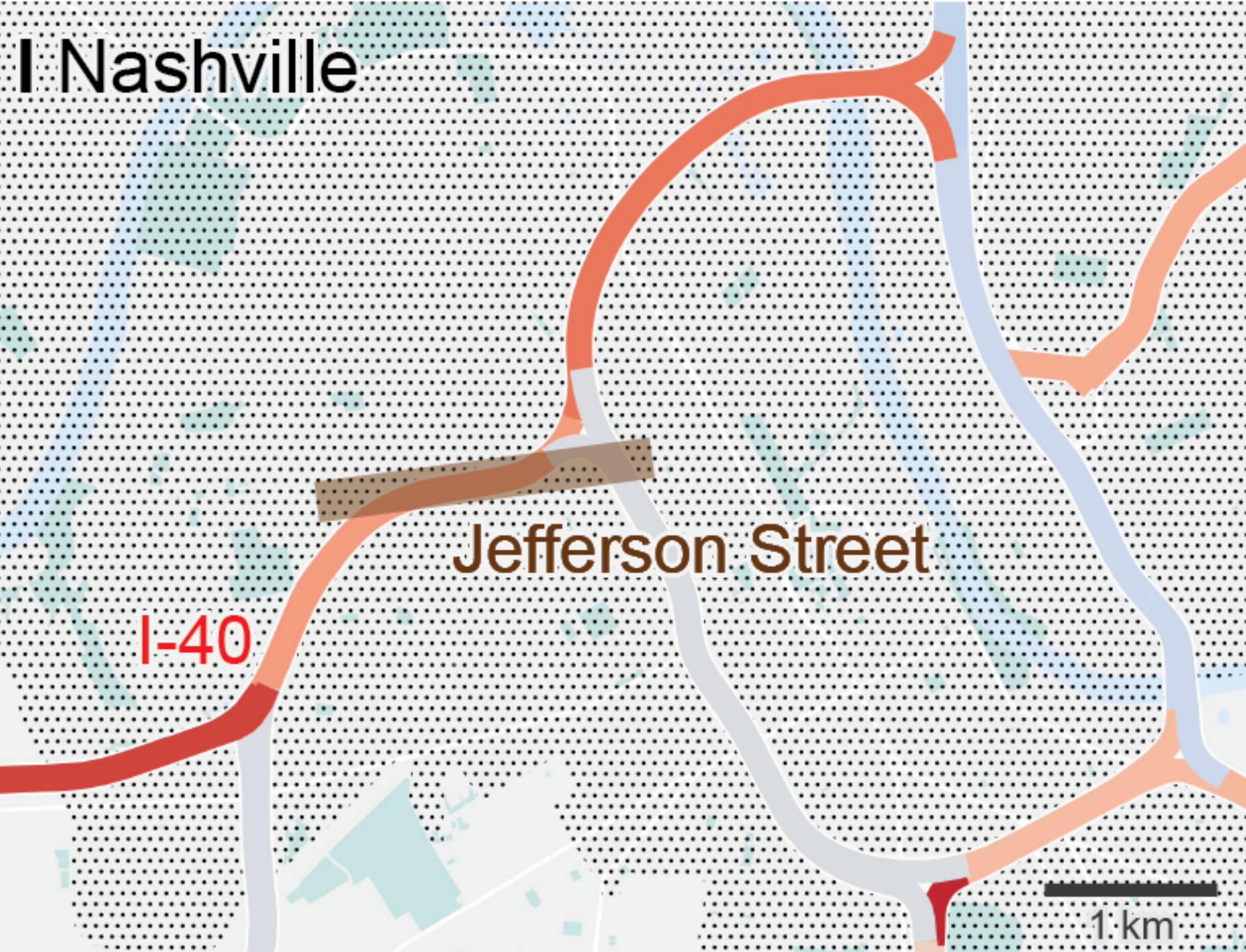
-15%

0%

+15%

+30%

No data



Area of interest

Black, upper quartile

Barrier Score:

-30%

-15%

0%

+15%

+30%

No data

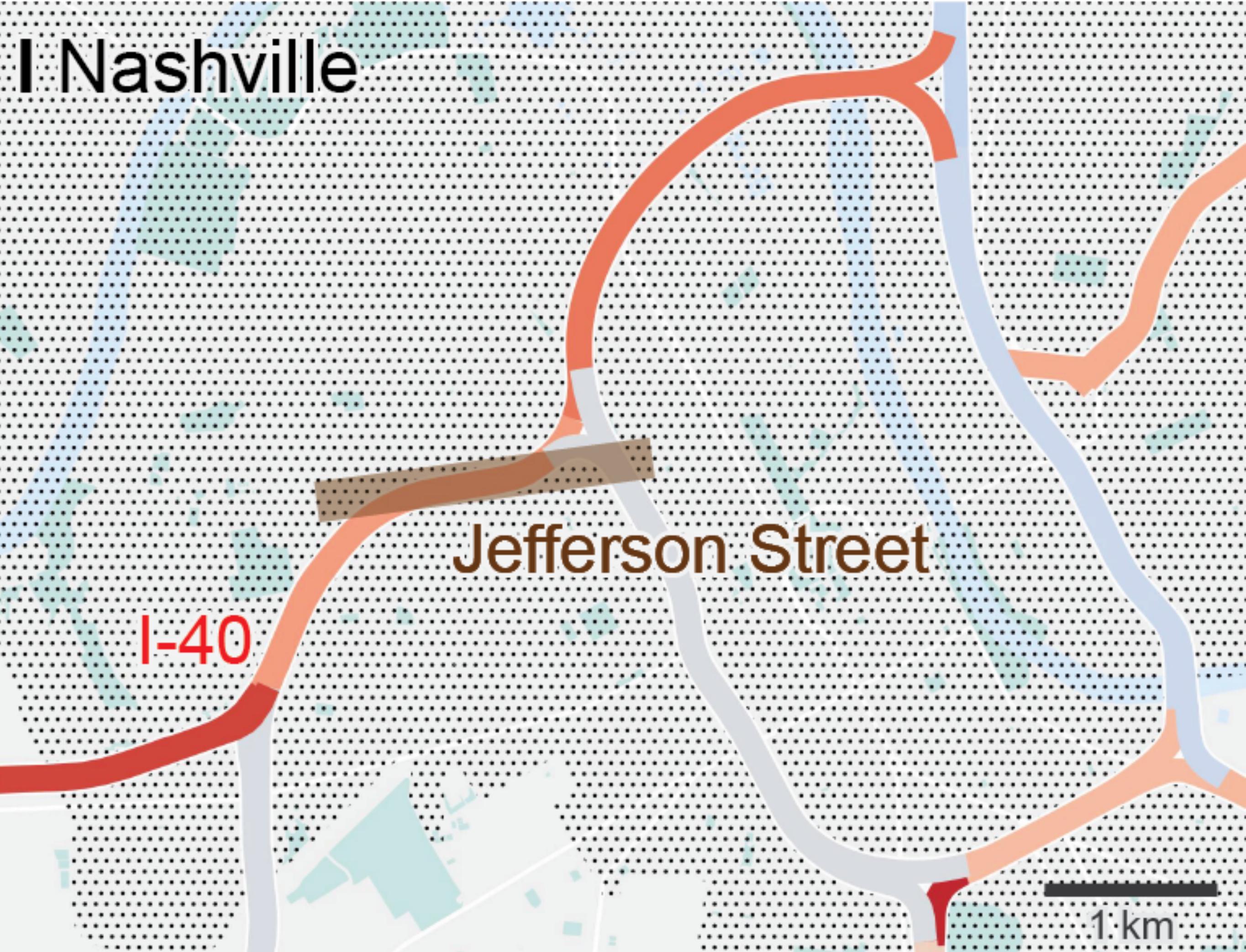


Nashville 1967

<https://eu.tennessean.com/story/news/politics/2021/06/14/nashville-interste-40-cap-project-black-neighborhoods-split-highway/7529846002/>

Nashville I-40 Steering Committee v. Ellington

<https://case-law.vlex.com/vid/nashville-i-40-steering-888302226>



Area of interest

Black, upper quartile

Barrier Score:

-30%

-15%

0%

+15%

+30%

No data

Reconnecting Communities Program

MARCH 13, 2024

FACT SHEET: President Biden Announces Over \$3 Billion to Reconnect Communities That Have Been Left Behind and Divided by Transportation Infrastructure



► [BRIEFING ROOM](#)

► [STATEMENTS AND RELEASES](#)

Portland (OR)

I-5 Rose Quarter Improvement Project



Breaking: House Moves to Rescind \$3.1B for Reconnecting Communities Divided by Highways

The House Transportation Committee wants to slash funding for one of America's most critical equity-focused grant programs — unless advocates speak out and get them to reverse course.

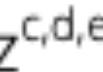


By Kea Wilson

4:13 PM GMT-4 on April 29, 2025

Note: America Walks is collecting signatures from organizations who oppose this proposal. [Sign on here](#). Private individuals who want to contact their representatives to urge them to preserve this funding can do so through with [this tool](#) from the National Campaign for Justice.

Urban highways are barriers to social ties

Luca Maria Aiello^{a,b,1} , Anastassia Vybornova^a , Sándor Juhász^{c,d,e} , Michael Szell^{a,b,c,f} , and Eszter Bokányi^g

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Degree distribution

Configuration model

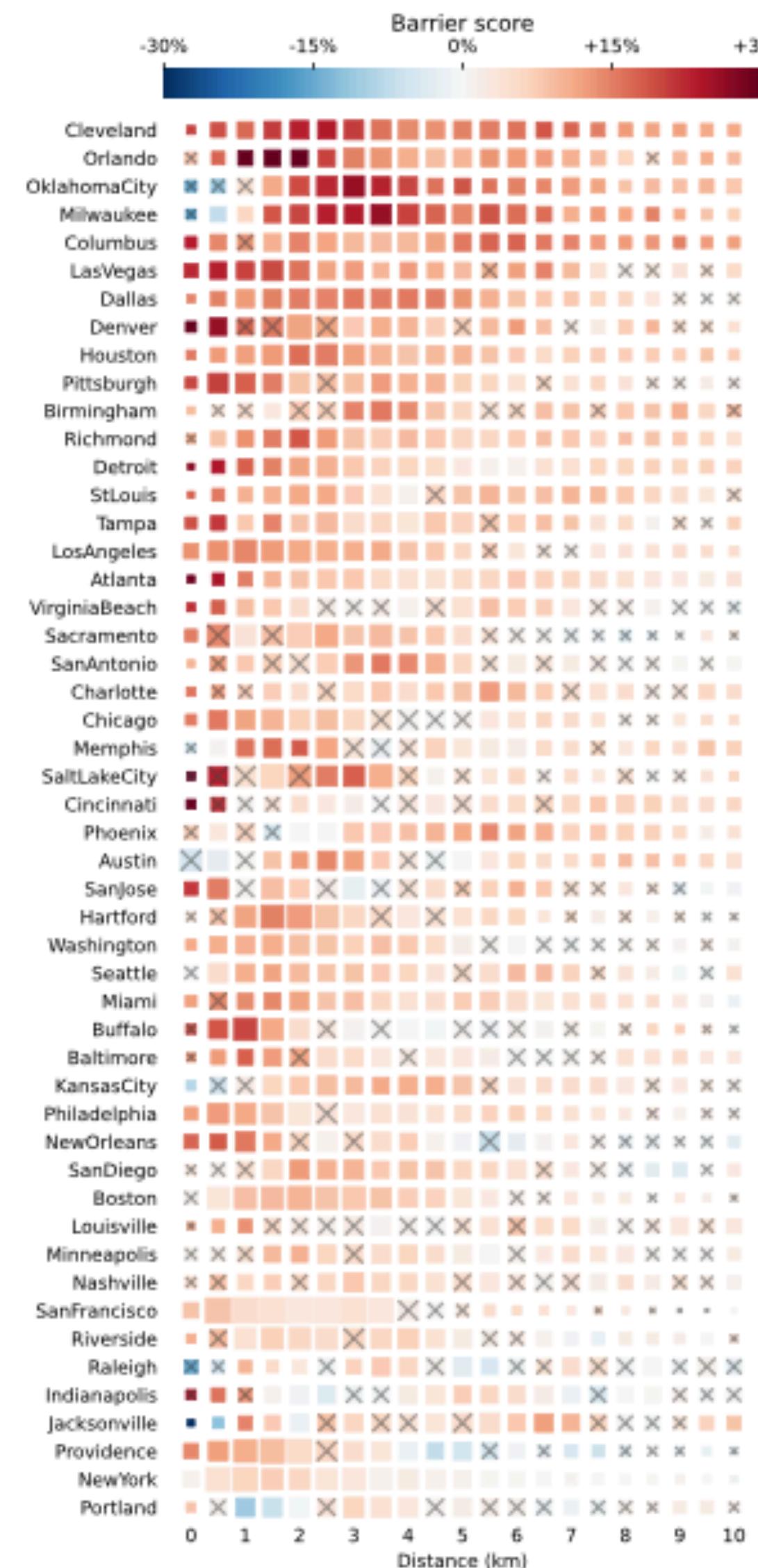


Fig. SI8. Statistical testing reveals most negative Barrier Scores are non-significant. Heatmap of all Barrier Scores $B(d)$ grouped into 0.5 km bins of social tie distance. Values marked with an 'x' are non-significant according to T-tests ($p > 0.01$).



Fig. SI10. Bridges explain negative Barrier Scores in Jacksonville. Highway Barrier Scores for the highways in central Jacksonville. Red represents positive scores, blue represents negative scores. The bridges connecting downtown to the south bank facilitate the connection between two densely populated areas, resulting in negative Barrier Scores. The Acosta Bridge and the Main Street Bridge highlighted in the map are those that contribute the most to the negative Barrier Scores $B(d)$ for values of d below 1.5 km.

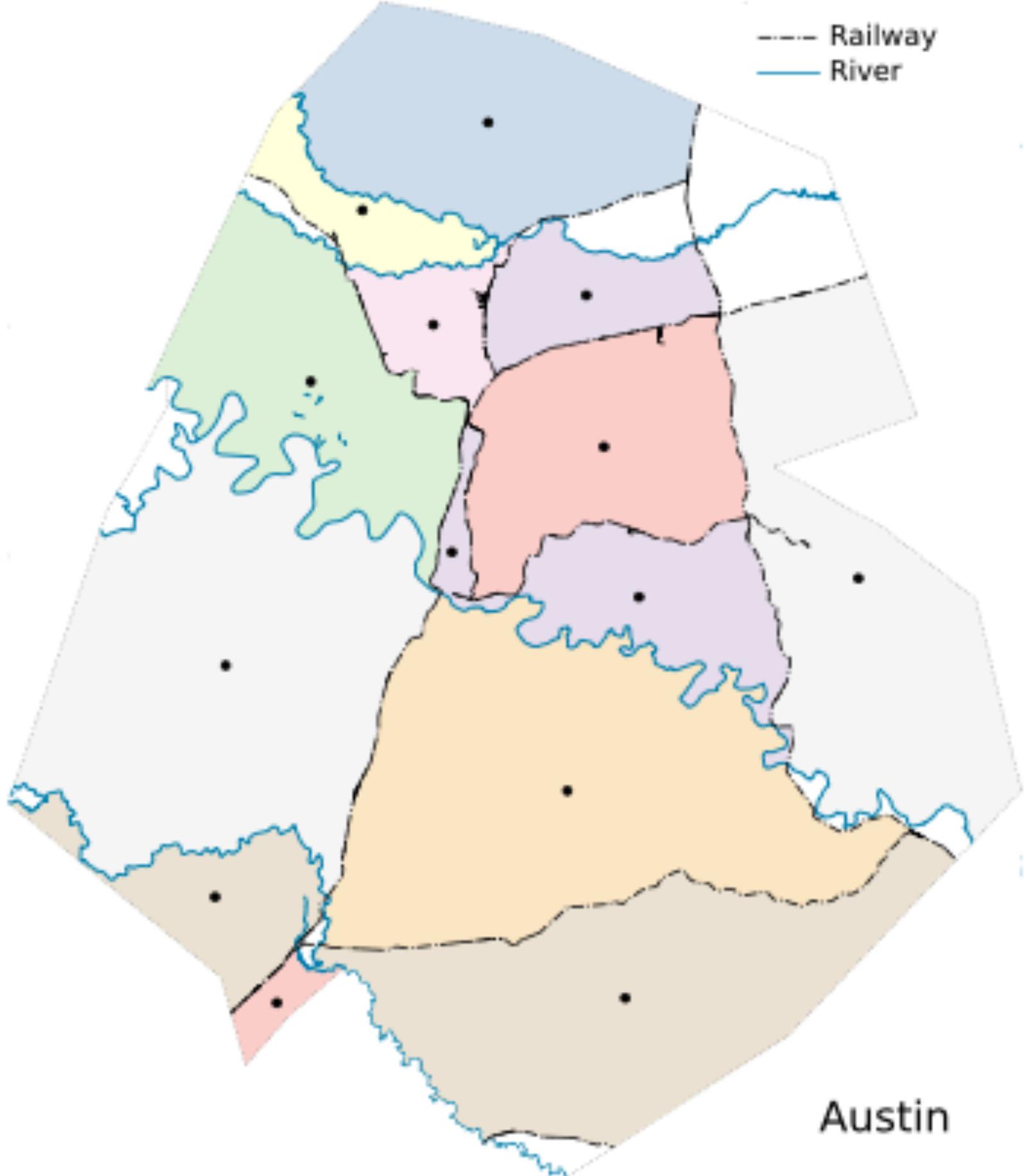


Fig. SI11. Polygonization of the metropolitan area of Austin based on railways and waterways. Each polygon is delimited by railways, waterways, or the metropolitan area boundaries. Polygons containing an insufficient number of users are discarded. The remaining ones (colored and marked with a dot) are retained, and the Barrier Score is recalculated by considering only social ties that are fully within the polygons. The purpose of the polygonization is to measure Barrier Scores in geographical areas that are not confounded by other major physical barriers.

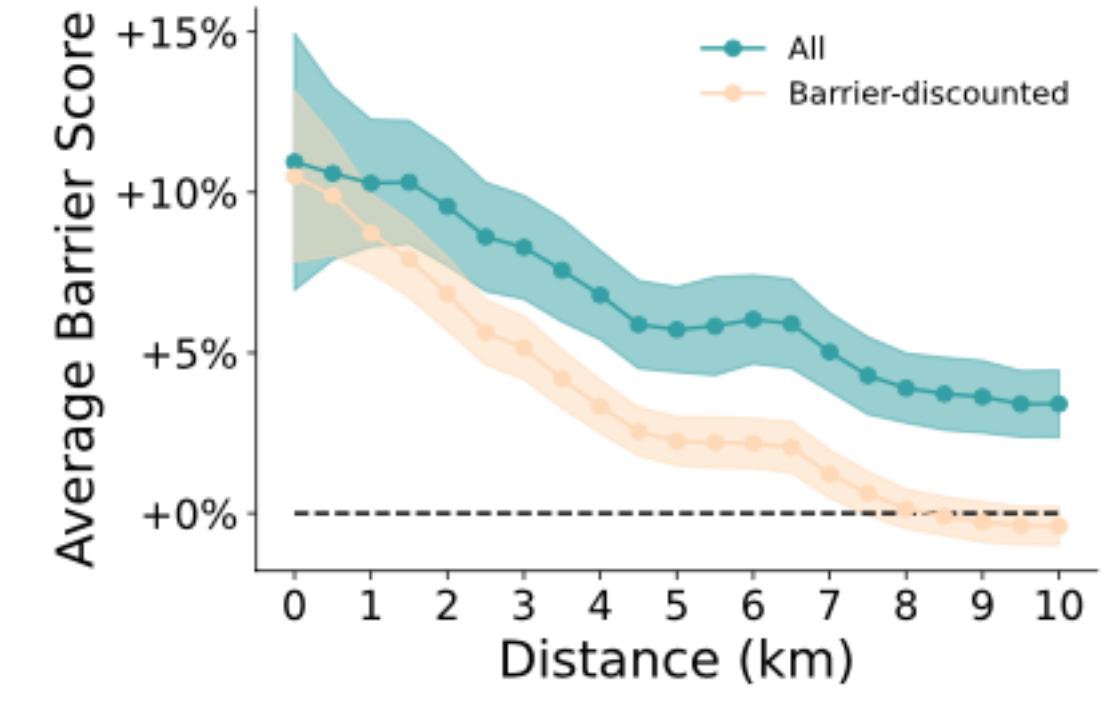
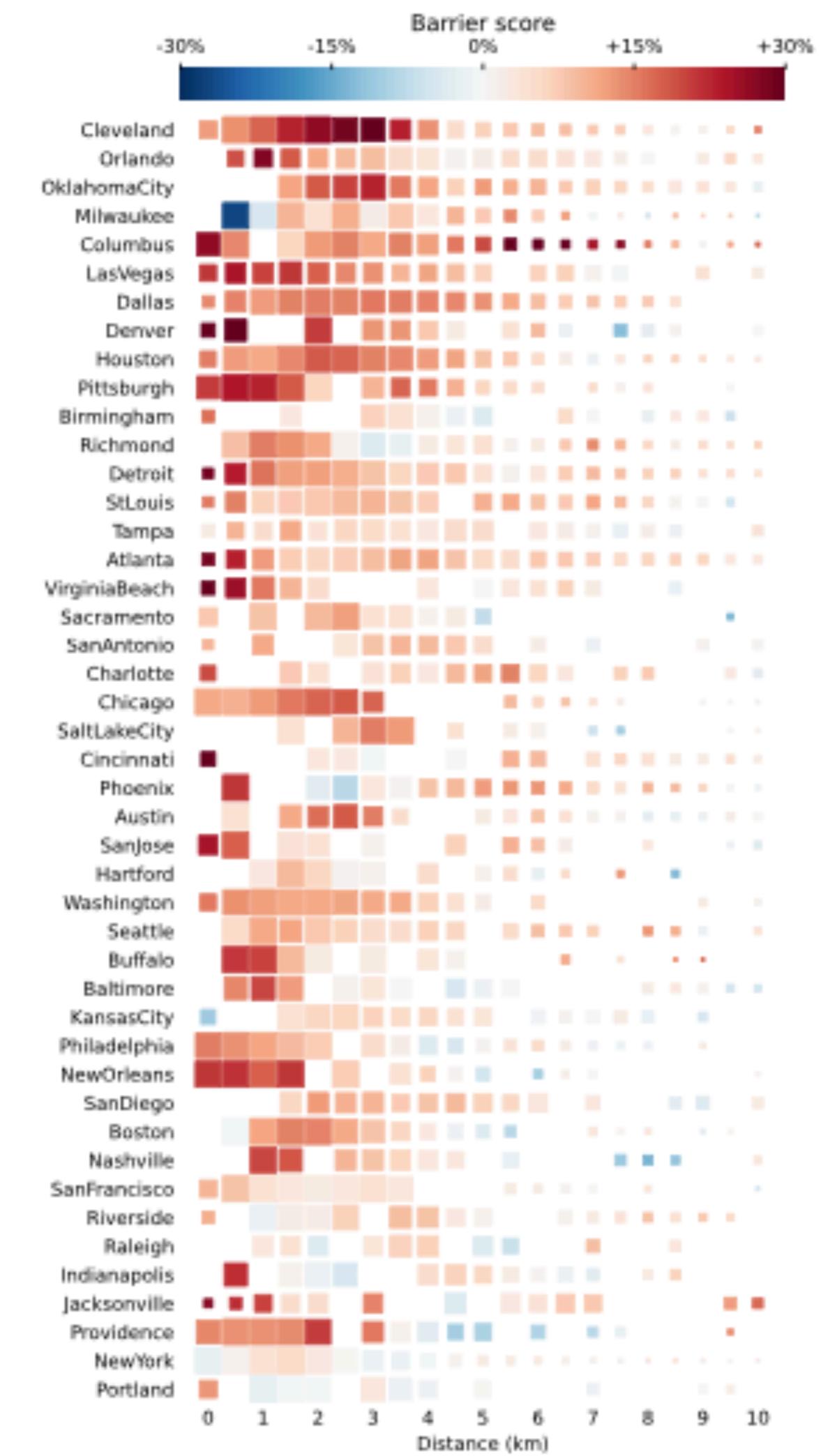


Fig. SI12. Barrier Scores in urban areas with no railways nor waterways. Heatmap of all Barrier Scores $B(d)$ grouped into 0.5 km bins of social tie distance. The estimated scores correspond to Barrier Score estimation that limits the analysis to social ties fully contained in areas that are not crossed by any railway or waterway. Non-significant values are not displayed.

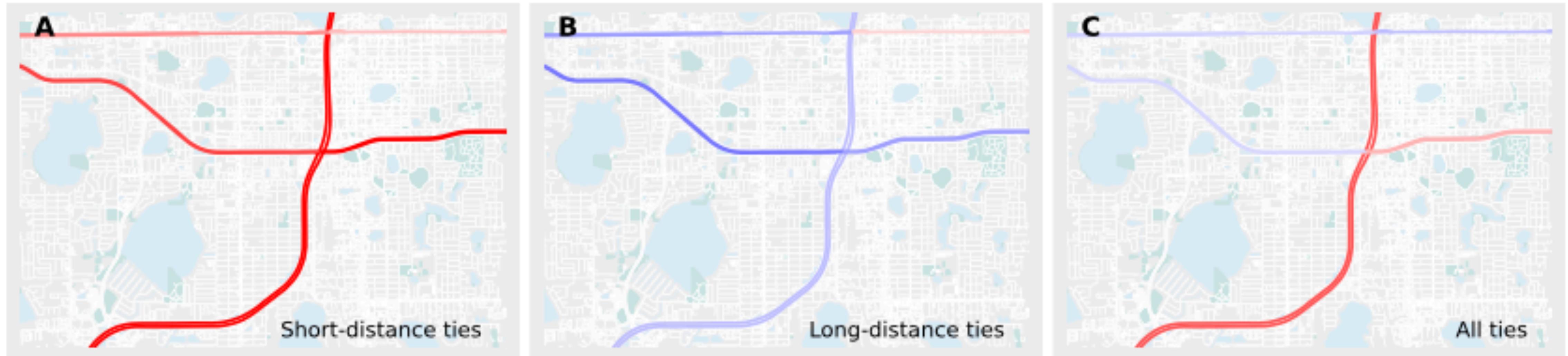


Fig. SI19. Aggregating over short and long distance ties can lead to mixed Highway Barrier Score signs. Highway Barrier Scores for the highways in central Orlando. Red represents positive scores, blue represents negative scores. The scores are calculated considering: **A.** only short-distance ties up to 5 km; **B.** and only long-distance ties between 15 km and 20 km; **C.** highway crosses from all ties.

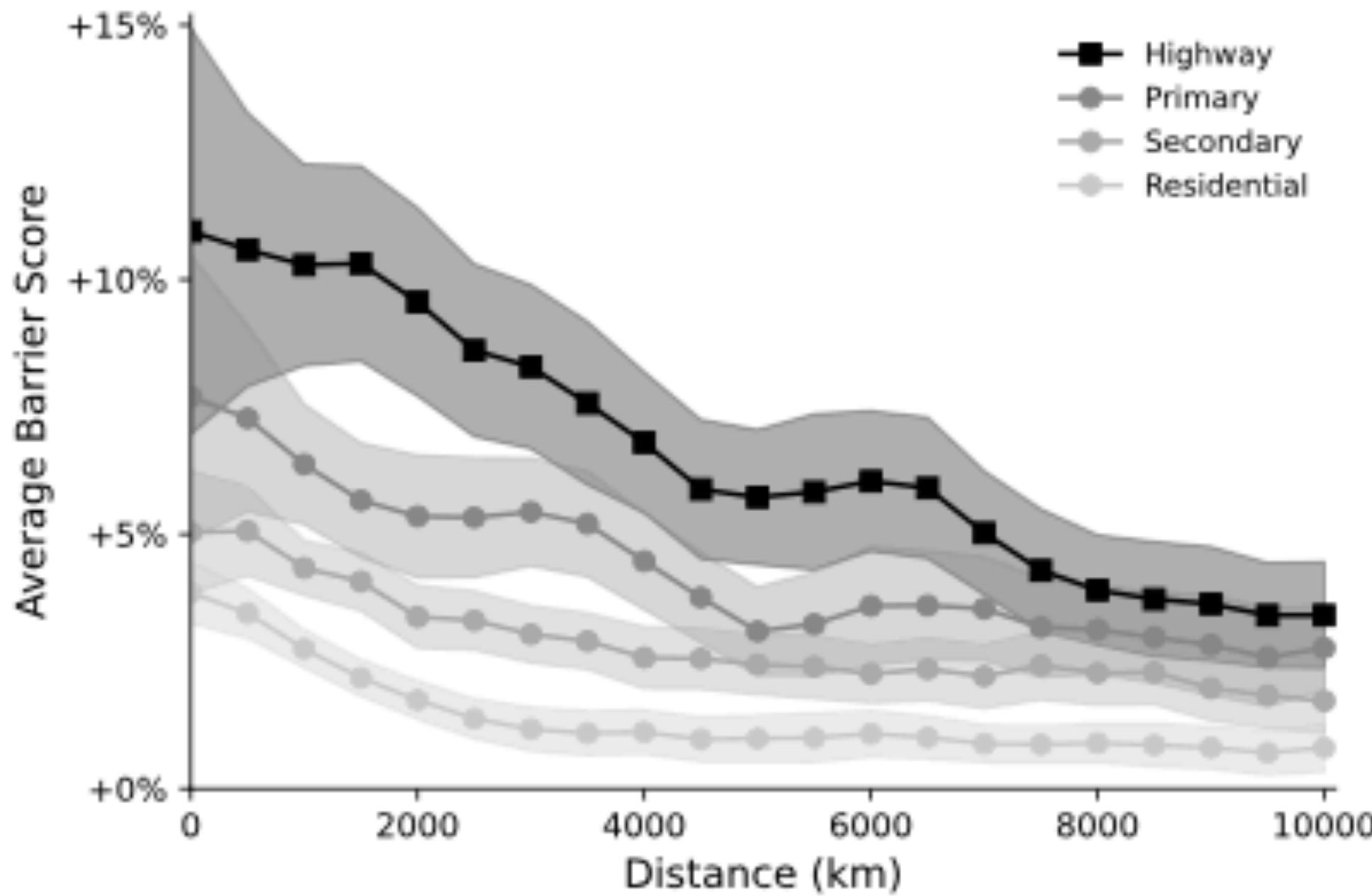


Fig. SI21. The Barrier Score decreases with social tie distance for highways, to a lesser extent for other street types. The distance-constrained Barrier Score $B(d)$ across multiple distances, averaged over all cities, and calculated for different types of roads. Across all distances, streets that are higher up in the road hierarchy have higher Barrier Scores.

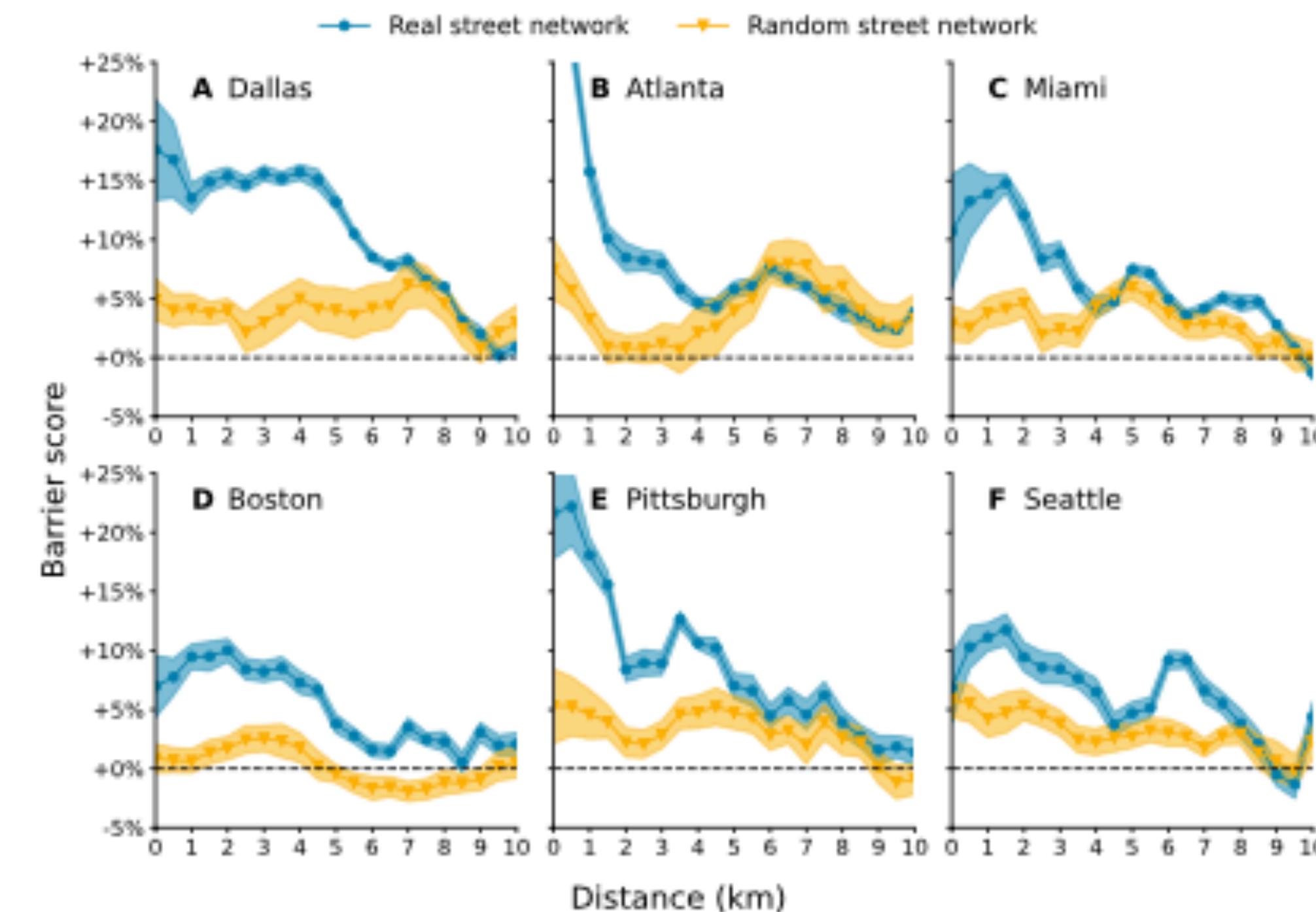


Fig. SI22. Random street layout. Barrier Score for social ties at distance d for a model that considers the real highway network compared to a model that uses a randomized version of the highway network. Cities on top panels **A-C** are selected among cities without major natural barriers within their built environment, whereas cities on the bottom panels **D-F** are built around major water bodies.

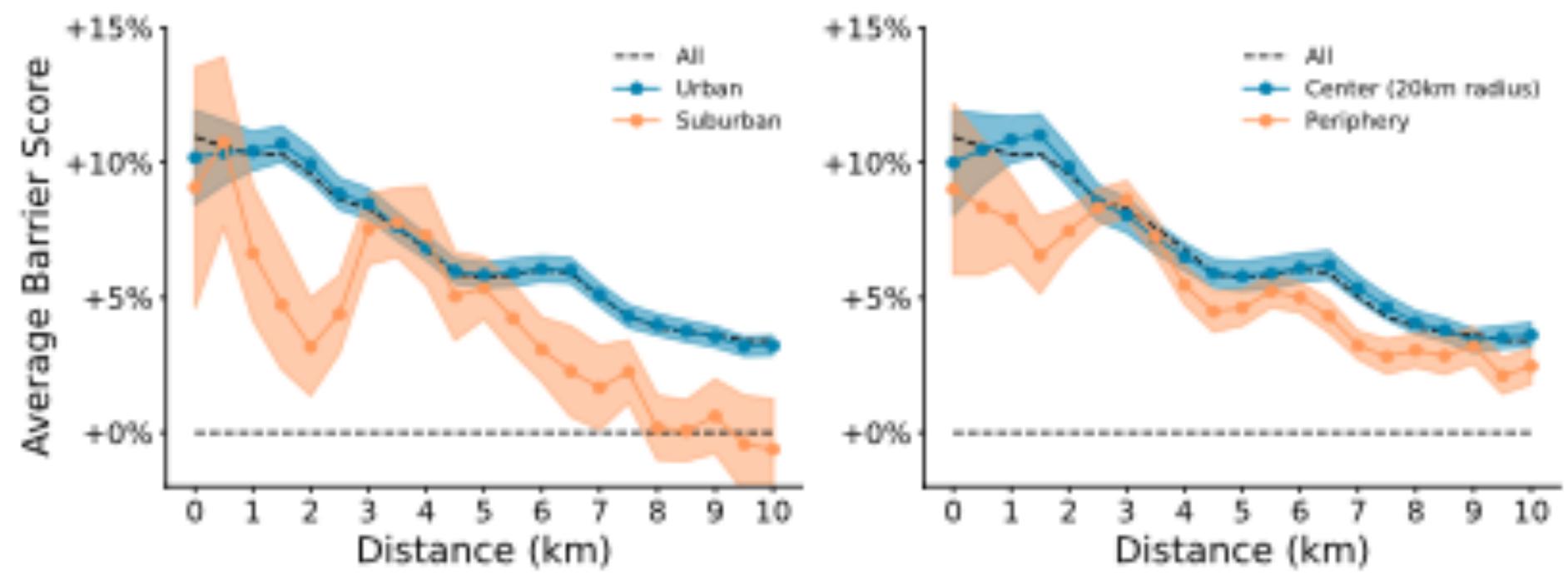


Fig. SI23. Barrier Scores are higher in urban areas. Barrier Scores versus distance calculated considering different subsets of users. **A.** Comparison between urban and suburban areas. Urban areas account for 80% of the population and for about 20% of the full metropolitan areas. **B.** Comparison between area around the city center (20 km radius) and area outside the center. The central radii contain about 55% of the population and account for 10% of the full metropolitan areas. Values are averaged over 20 randomized runs of the null model, and then macro-averaged over the 50 cities considered. 95% confidence intervals are shown. Both plots provide the values calculated on all users as reference.

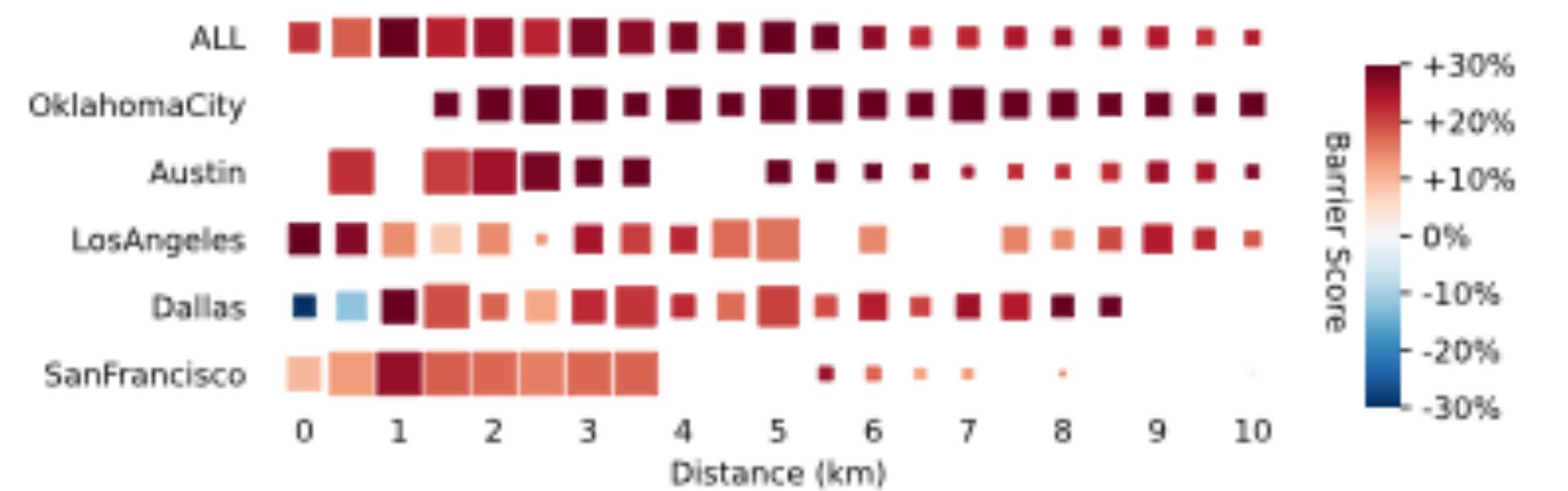


Fig. SI24. Barrier Score vs. distance in the Gowalla database. Heatmap of Barrier Scores $B(d)$ grouped into 0.5 km distance bands for the five cities most represented in the Gowalla dataset. Color denotes Barrier Score, areas of the squares denote relative number of links per distance band. The Barrier Scores are considerably higher than those observed on average in our Twitter dataset, across all distances.

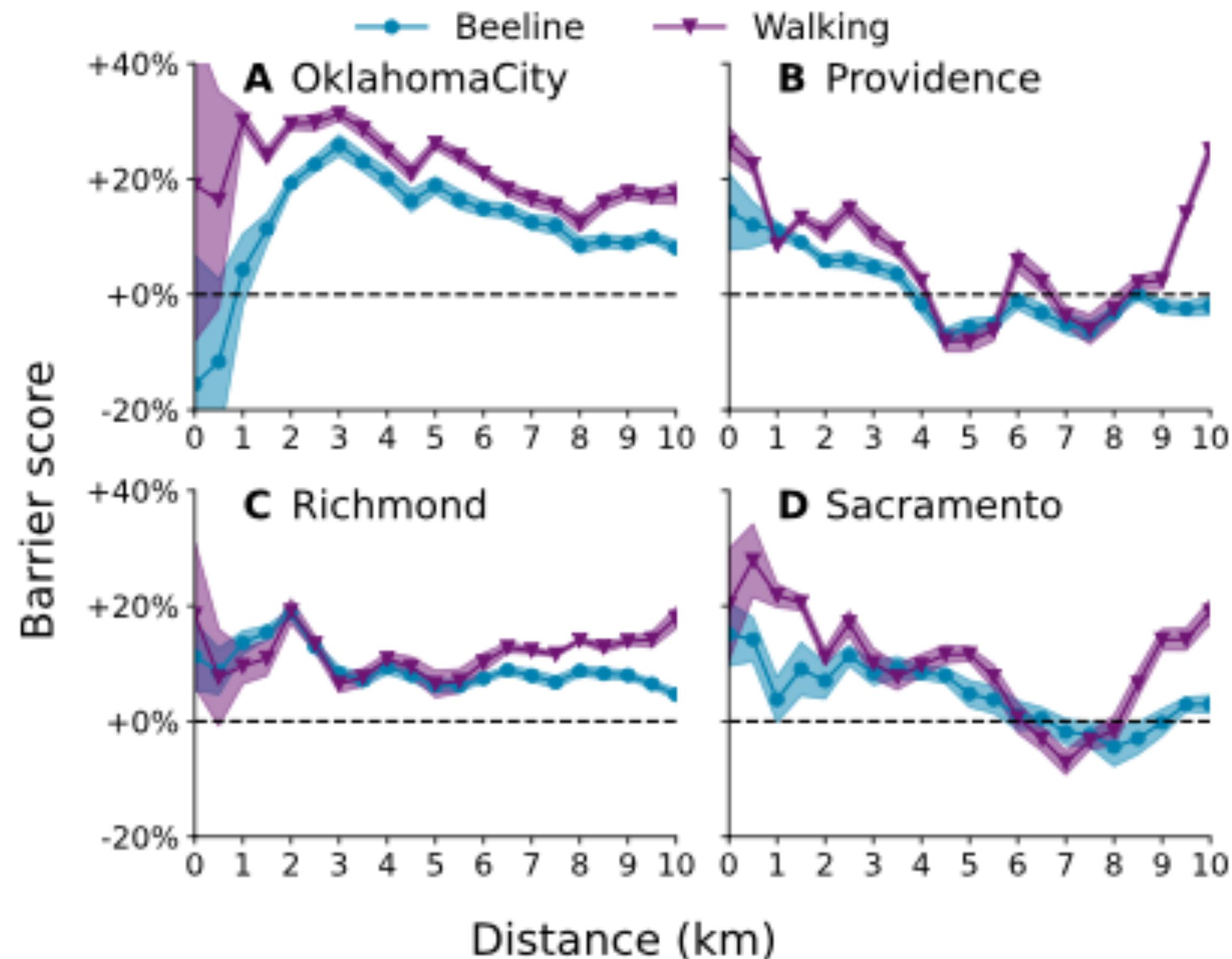


Fig. SI25. Calculating Barrier Scores for beeline versus walking distance in 4 cities shows robust distance patterns. Averages over 20 randomized runs of the null model are shown, together with 95% confidence intervals.