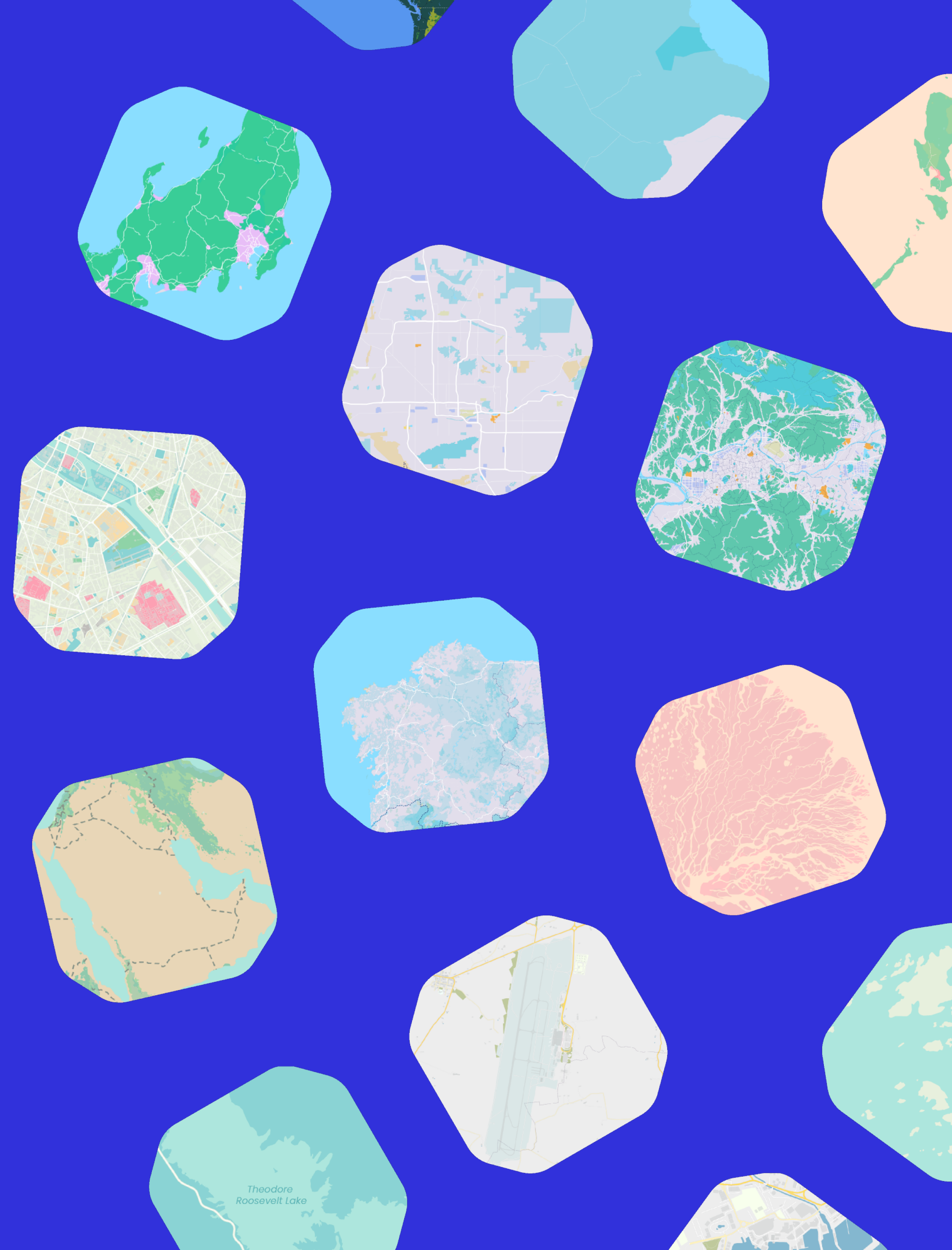


PROTOMAPS

Unlocking Interactive Maps For Newsrooms

NICAR 2025

@bdon | March 7, 2025



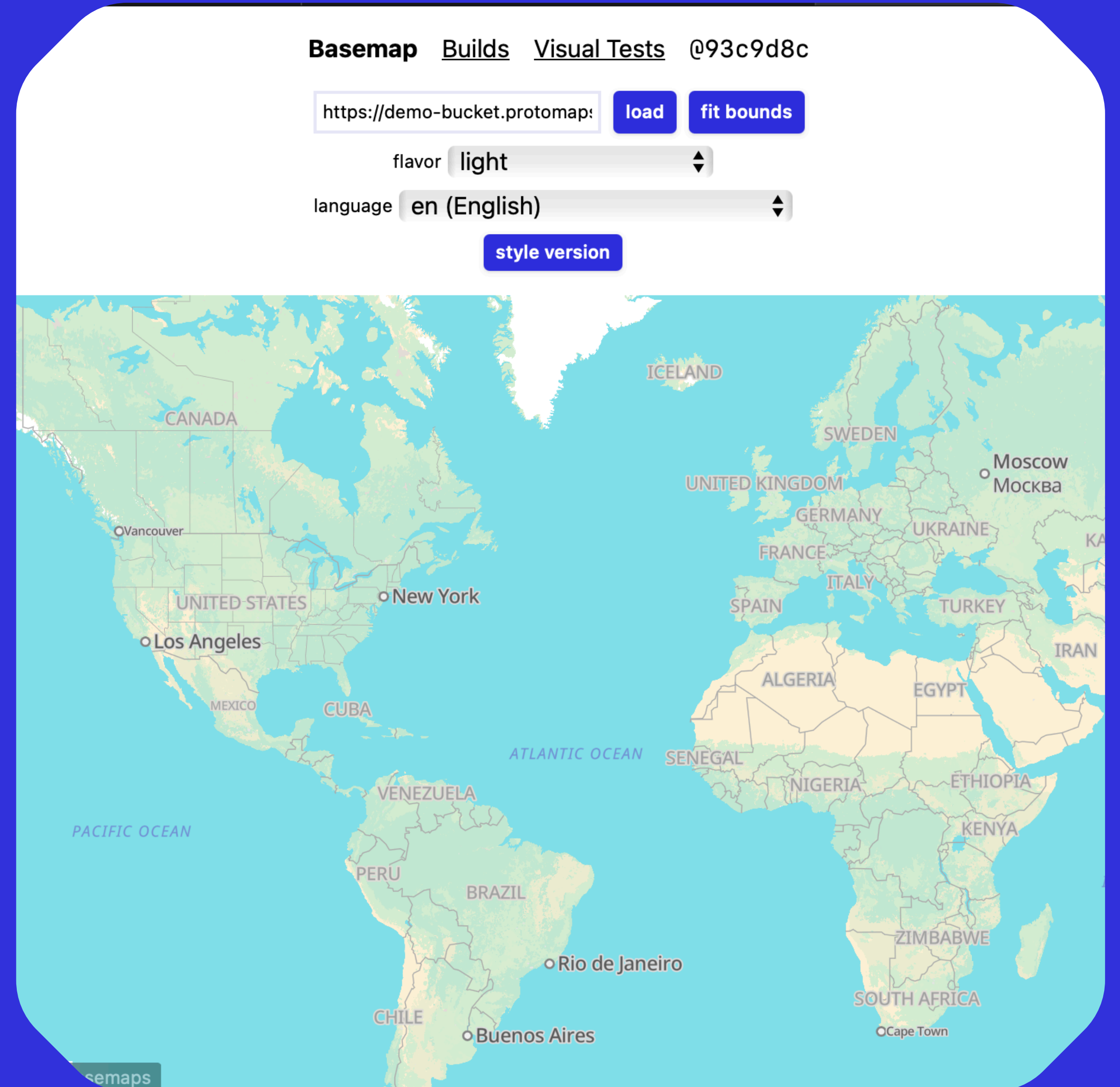
Tell your neighbors about the last map you used and why

(2 minutes)

What is Protomaps

In one slide

- A solution for **publishing interactive web maps under your own control.**
- **Why?** Cost, flexibility, longevity.
- Based on **OpenStreetMap.**
- Available at the low, low price of **\$0.**



About me

Find me on Bluesky! @bdon.org

- Open source developer building **cartographic tools**
- Started the Protomaps project in 2019
- Created company to sustain the project, supported by development contracts and grants



Target Audience

Who is this for?

- You are a developer who **is familiar with:**
 - JavaScript and visualization libraries (Leaflet, D3, MapLibre...)
 - **S3** or other static storage
 - **HTTP APIs**, JSON, CORS
- **But** you might not be familiar, or willing, to:
 - Administer databases
 - Maintain Linux servers
 - Dig into what/how to “use OpenStreetMap”

Non-target Audience

Who is this not for?

- Complete investment in ESRI or print ecosystem
- Zero code, collaboration, transactional/live data - check out **Felt**
- Organizations with large amounts of money to solve small problems

Maps as a primitive on the web

Build vs. Buy

How does your org approach these?

- **HTML**
- **CSS**
- **JSON**
- Markdown files
- **MP3 audio**
- WordPress site
- CMS
- Database
- Search Engine
- **Video**
- **Maps**

Build vs. Buy

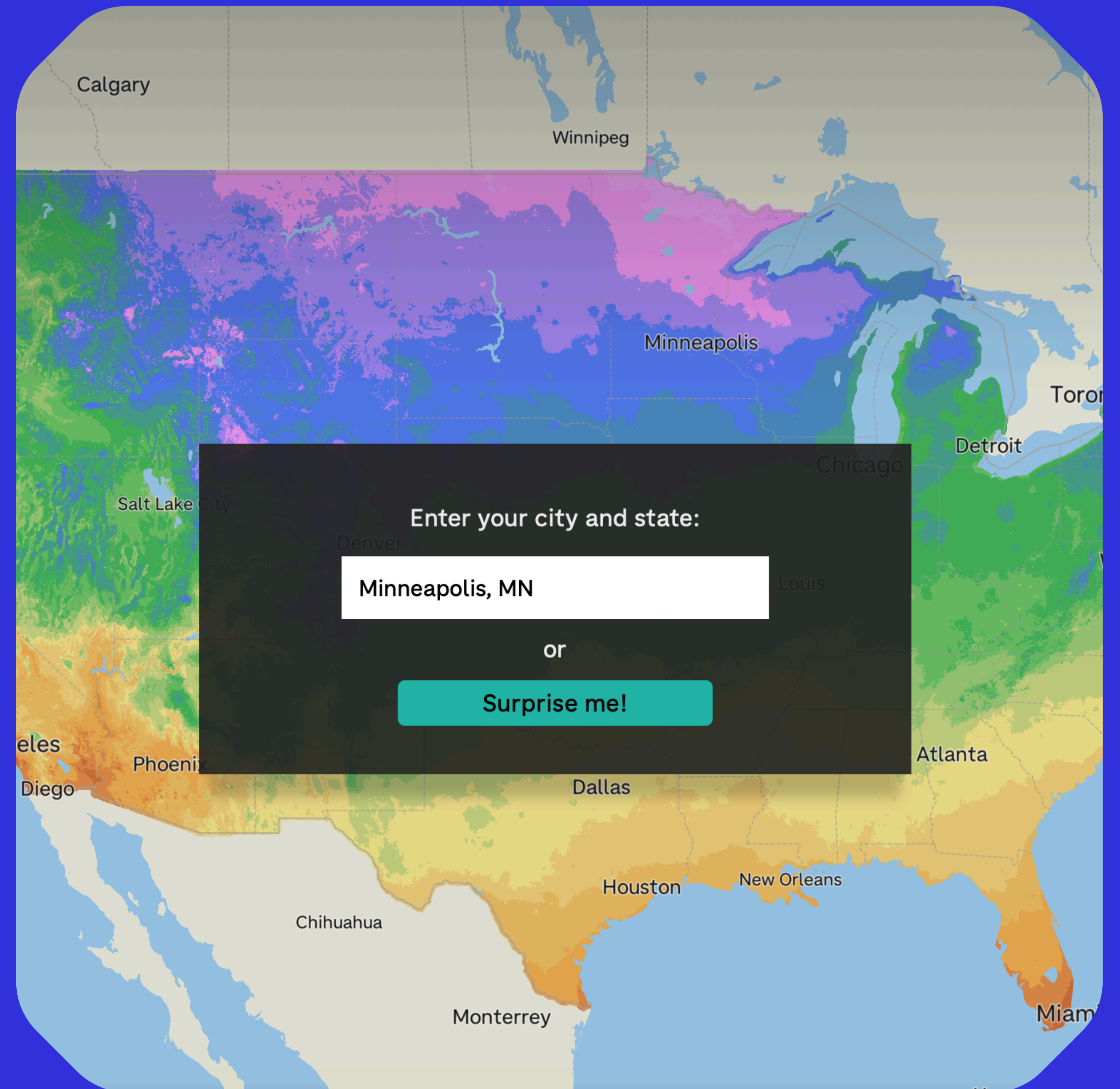
How does your org approach these?

- HTML
- CSS
- JSON
- Video
- **Maps**
- WordPress site
- CMS
- Database
- Search Engine

Example

NPR

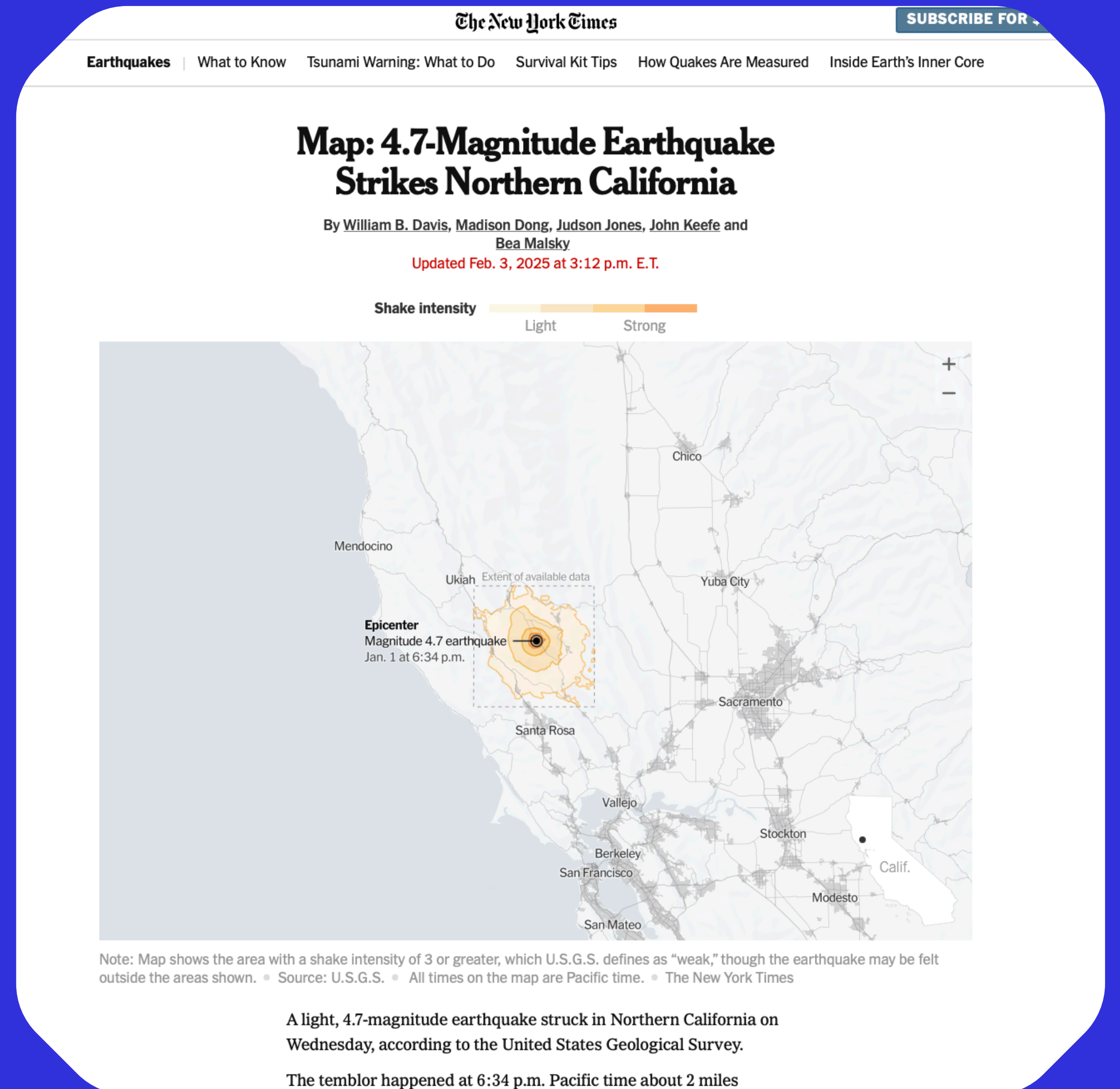
- Scrollytelling experience
- Serve .pmtiles directly to browser via CloudFront
- Protomaps basemap



Example

The New York Times

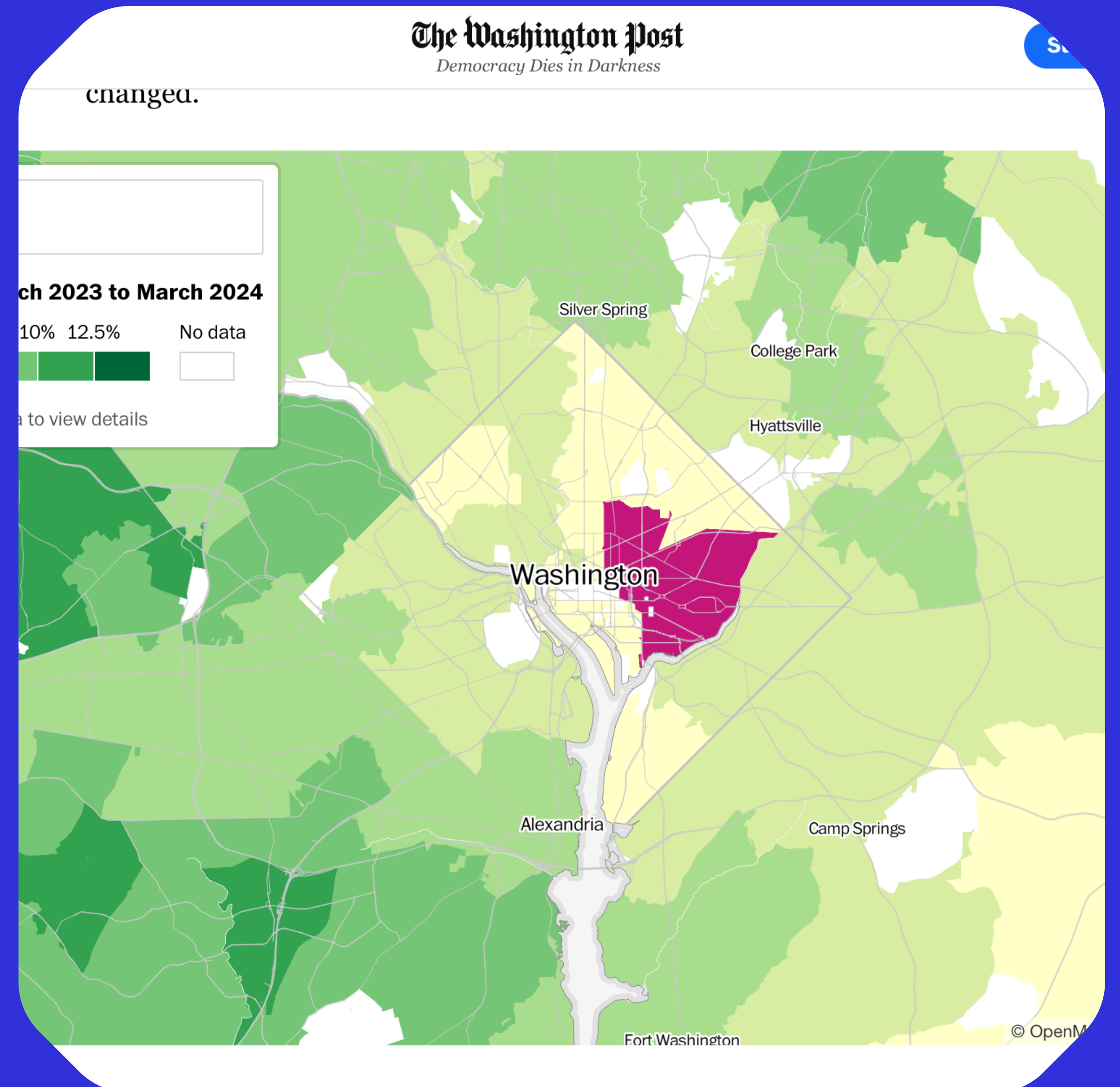
- USGS data
- Interactivity
- Custom base tileset served as .pmtiles



Example

The Washington Post

- Hover interactivity
- Uses a different open source base tileset (OpenMapTiles) with AWS CloudFront



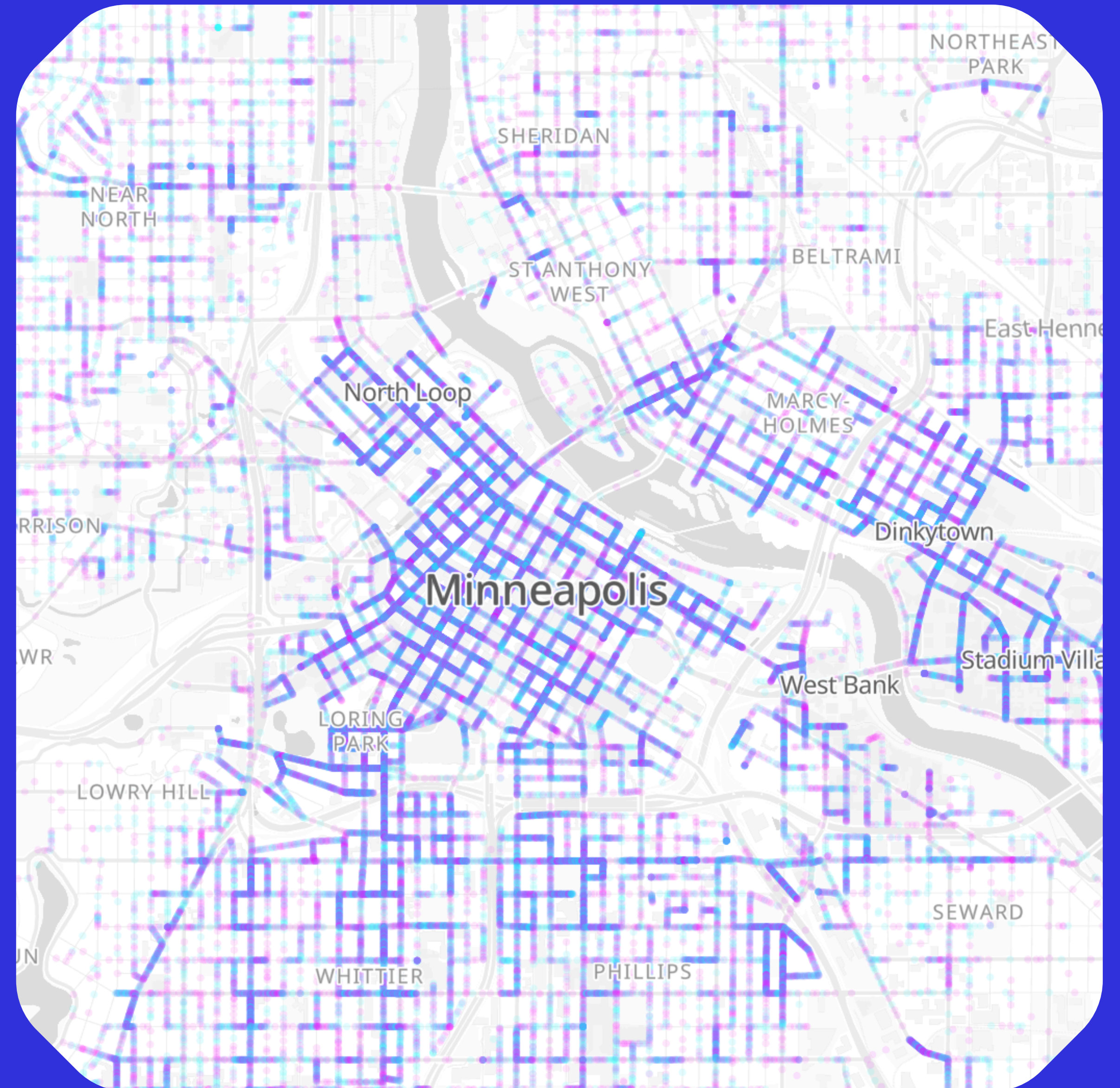
Map stories are like hamburgers

- **UI:** Top Bun
- **Overlay data:** Patty
- **Basemap:** Bottom Bun



What we're building

- <https://github.com/bdon/NICAR25-InteractiveMaps>
- Interactive
- Customizable
- 100% static page you can serve anywhere



[github.com/bdon/](https://github.com/bdon/NICAR25-InteractiveMaps)
NICAR25-InteractiveMaps

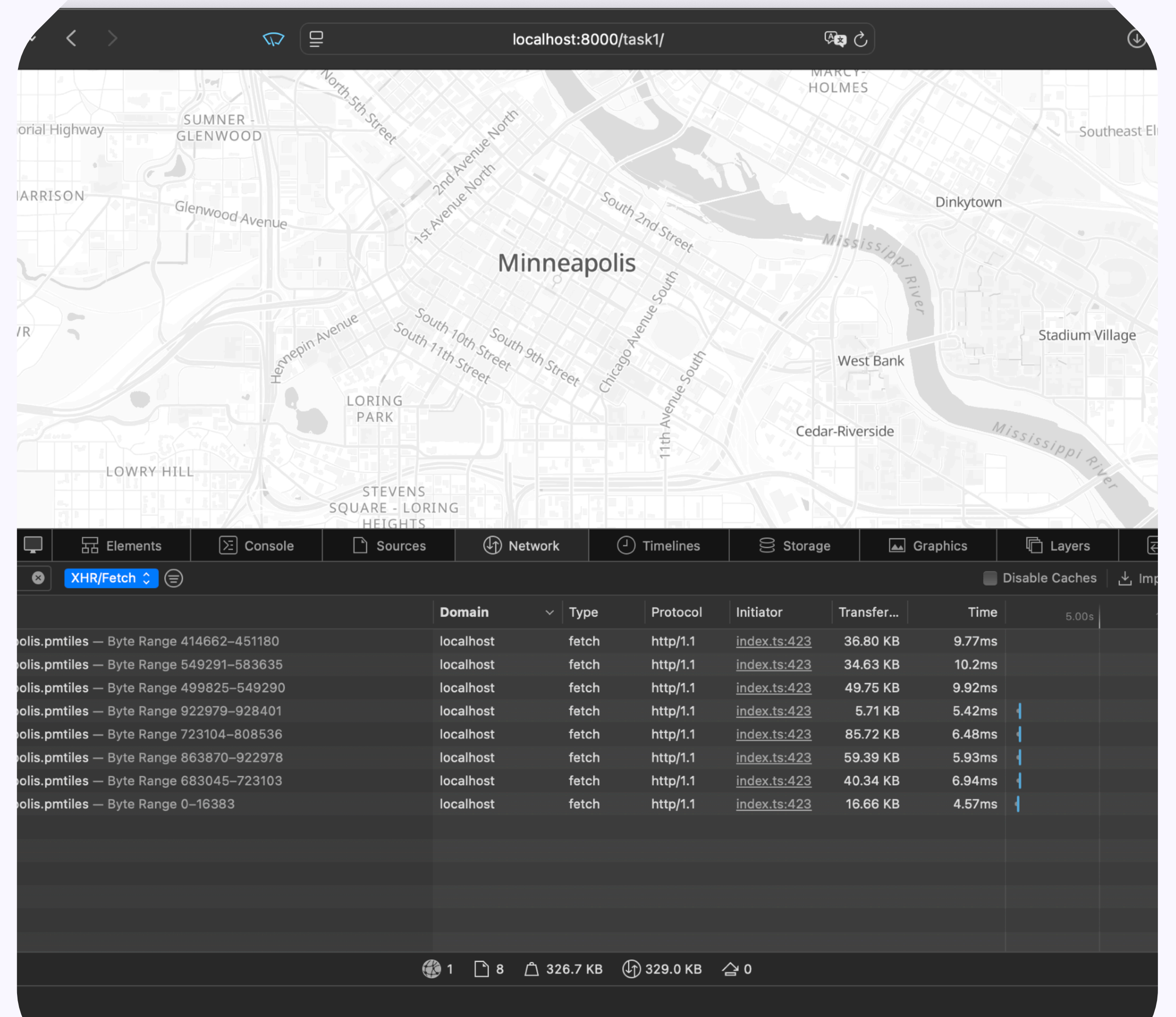
Task 1: Bottom Bun

Display a background basemap



Developer Console

- Open your developer console.
- bit.ly/nicar25-protomaps and click the link to GitHub pages on the right, then "Task 1"
- Pan and zoom around the map.
- What do you see?
- Compare it to another map site: play.placemark.io



python3 -m RangeHTTPServer

Explain?

- HTTP server needs to support **range requests**
- Almost every HTTP server supports this, exception is the one in the Python default library 🤔
- Run this from the project root: `python3 -m RangeHTTPServer`
- Go to <http://localhost:8000>

Customize

index.html:

Customize the **Flavor** and the **Language**

Flavor: light, dark, white, black, grayscale

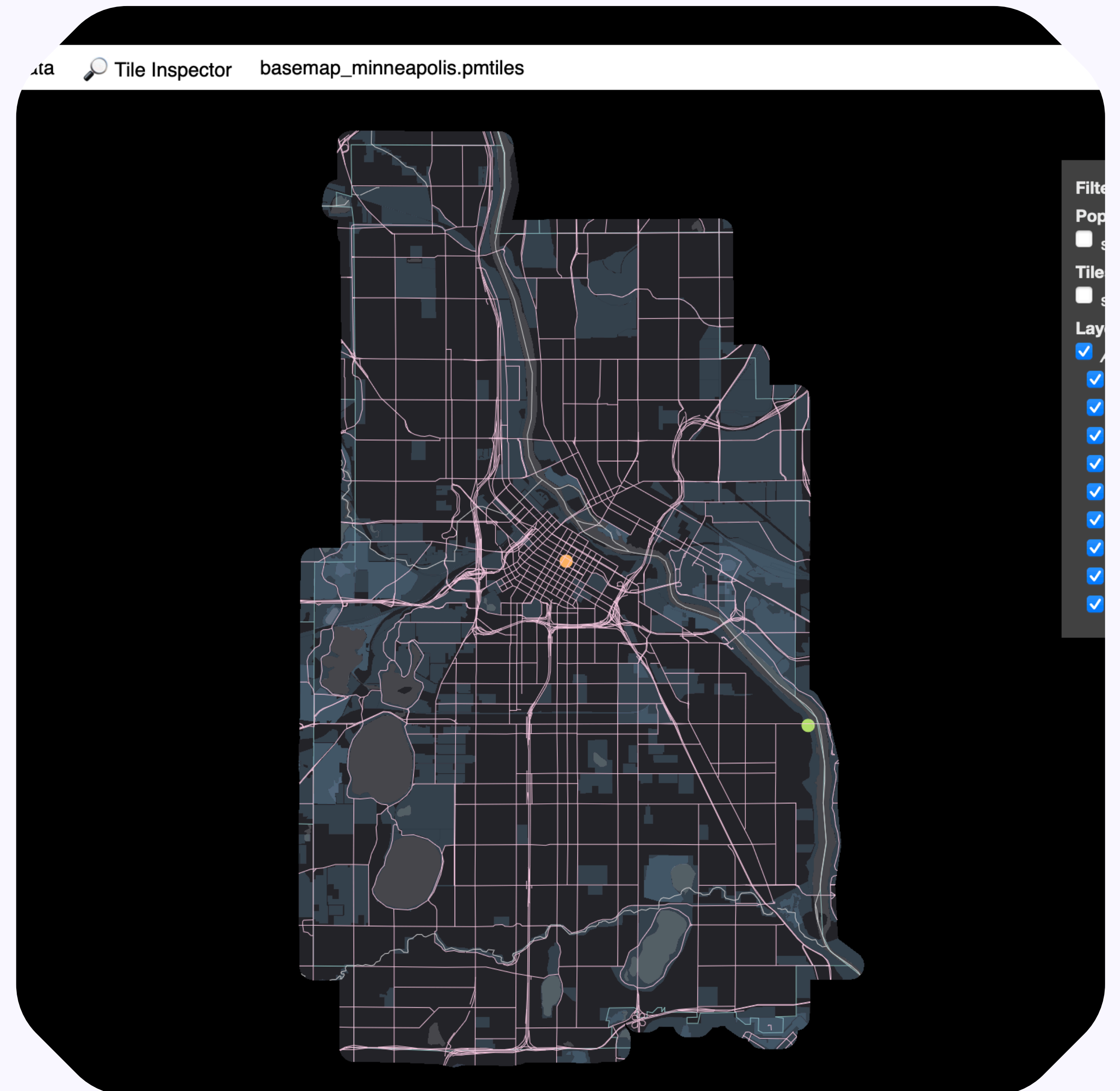
Lang: es, ja, ko, ru ...

```
basemaps.layers("basemap",  
basemaps.namedFlavor("white"),  
{lang: "en"})
```

pmtiles.io

Tasks

- Drag **basemap_minneapolis.pmtiles**
- Inspect the **JSON metadata**
- What is the **osmosisreplicationtime** contained in the metadata?



pmtiles cli

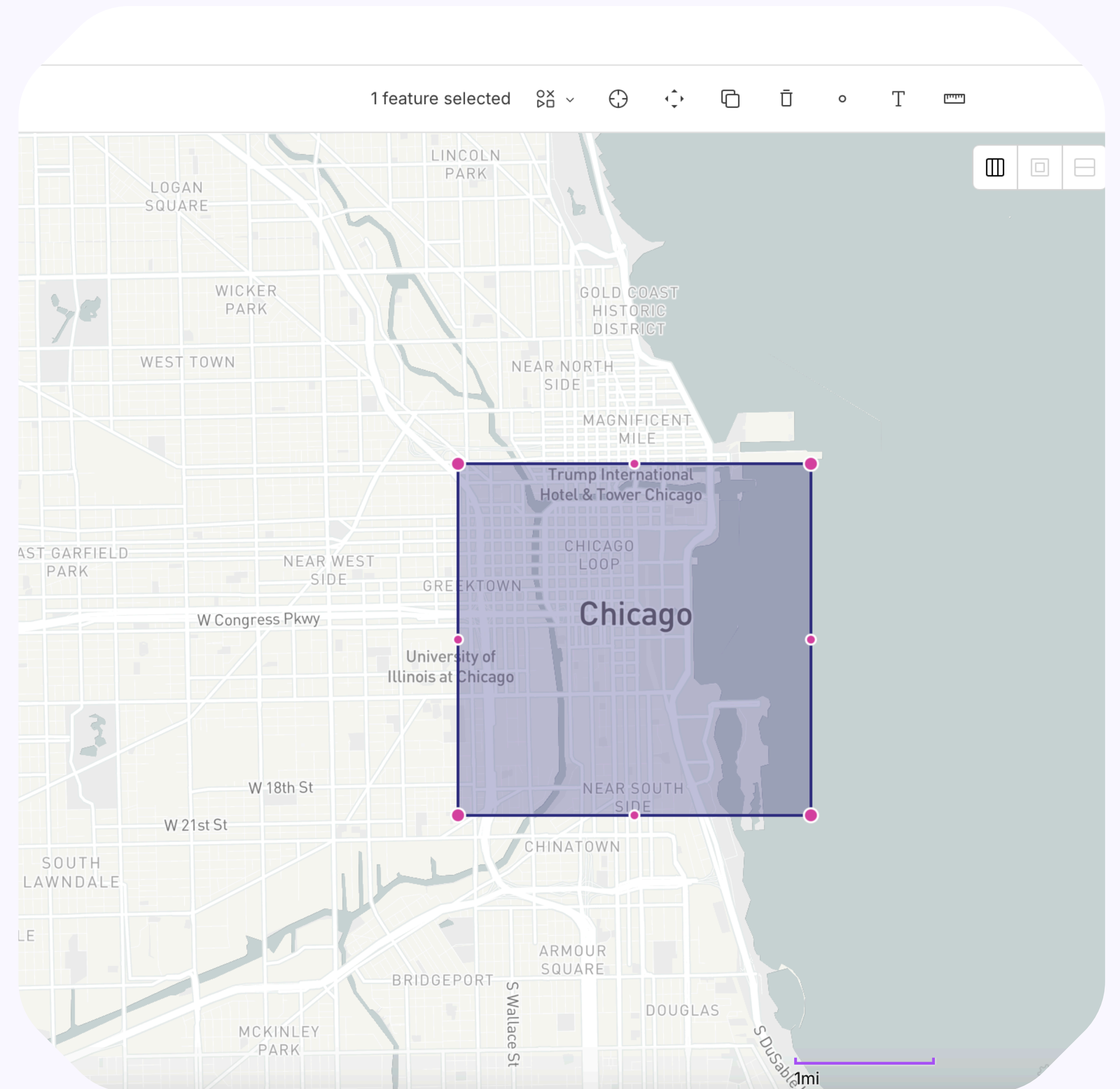
Tasks

- `programs/x86/pmtiles show tiles/basemap_minneapolis.pmtiles`
- `programs/arm64/pmtiles show tiles/basemap_minneapolis.pmtiles`

Where did the map come from?

Choose your own area

- Use play.placemark.io to **export a BBOX**
- MINX,MINY,MAXX,MAXY



```
pmtiles extract https://build.protomaps.com/  
20250306.pmtiles  
--bbox=-83.1379,42.2801,-82.9600,42.3751
```


Experimentation time

Basemap task 1

Hamburger Patty: Data Preparation

Minneapolis Open Data



The City of Minneapolis seeks to provide increased access to public spatial geographic information systems (GIS) and non-spatial data that is regularly requested by private citizens and businesses. These data sets are shared free of charge and with minimal licensing. We intend to continually build this content collection as data becomes available.

Find Data

Explore Data Categories



Motorized Foot Scooter and eBike Trips 2023



Minneapolis GIS
MapIT Minneapolis

[View Table](#)[Download](#)[More ▾](#)

Summary

This dataset includes all scooter and electrical bike trips for April - December within Minneapolis for the program in 2023. We have removed data when trips were over 7 hours and less than 0 miles or greater than 24 miles.

Field Descriptions

TripID: a unique identifier for each trip created by the City of Minneapolis

TripDuration: trip time in seconds

TripDistance: trip distance in meters

StartTime: time the trip started, rounded to the nearest half hour

[Read More ▾](#)

Attributes

Details



Dataset
Table



April 26, 2024
Info Updated



April 26, 2024
Data Updated



April 16, 2024
Published Date



Records: 796,385
[View data table](#)



Public
Anyone can see this content

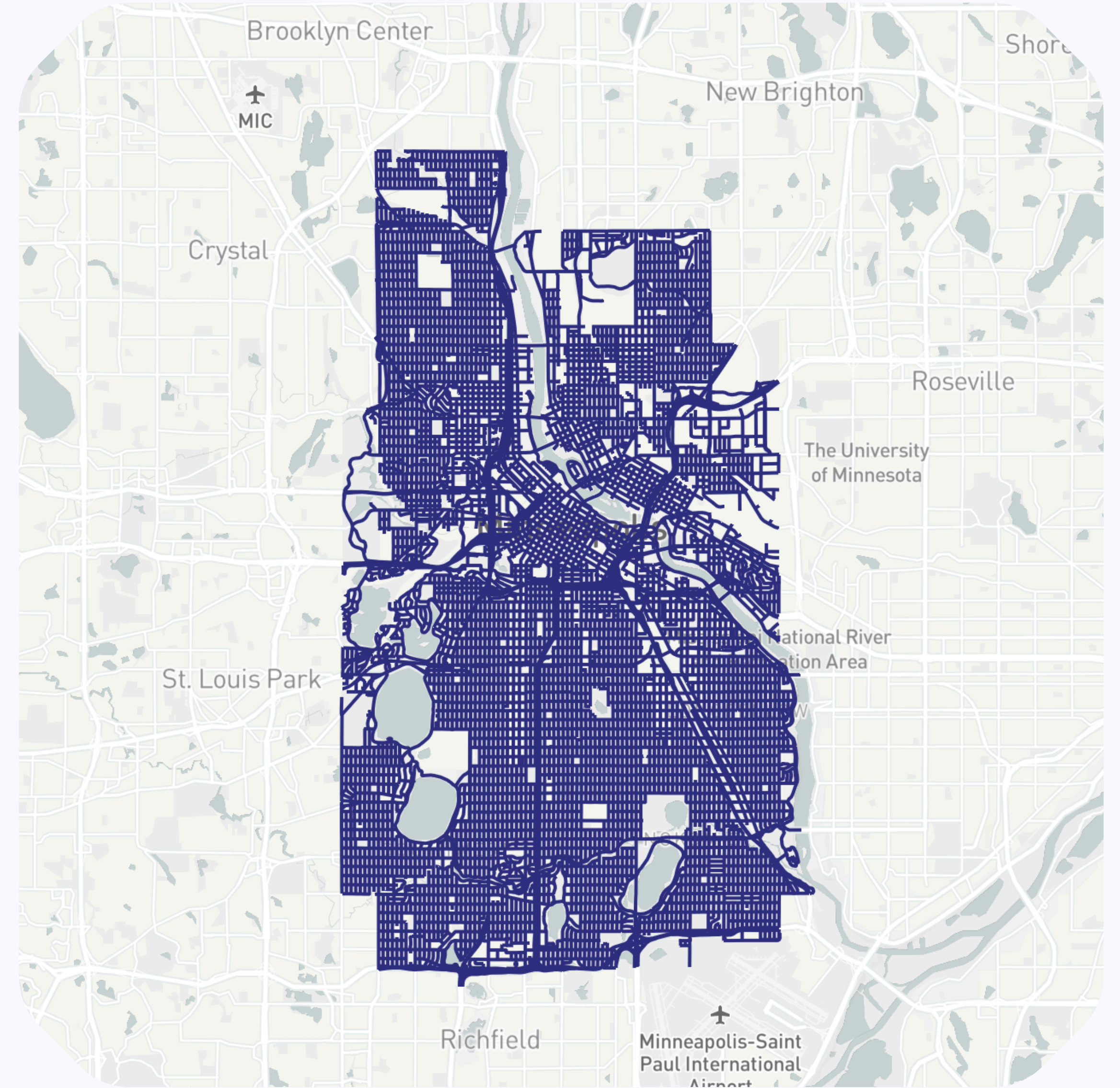


No License Provided
Request permission to use

[Learn about charts](#)

Motorized_Foot_Scooter_and_eBike_Trips_2023_-2732496373249609372

Distance	StartTime	EndTime	StartCenterlineID	StartCenterlineType
12	4/13/2023 7:00:00 PM	4/13/2023 7:00:00 PM	19101.00	street
1355	4/13/2023 7:00:00 PM	4/13/2023 7:30:00 PM	16644.00	street
175	4/13/2023 7:00:00 PM	4/13/2023 7:30:00 PM	AA6B3597-647A-479F-9B97-9F1AE767A620	trail
6890	4/13/2023 7:00:00 PM	4/13/2023 7:00:00 PM	21933.00	street
4783	4/13/2023 7:00:00 PM	4/13/2023 7:00:00 PM	BB5130FA-CCD3-4800-B7DF-06DBFA339616	trail
1611	4/13/2023 7:00:00 PM	4/13/2023 7:00:00 PM	16209.00	street
1504	4/13/2023 7:00:00 PM	4/13/2023 7:00:00 PM	F2382ED6-39A1-449C-83BB-4C8039BB6D3B	trail
5368	4/13/2023 7:00:00 PM	4/13/2023 7:30:00 PM	12610.00	street
209	4/13/2023 7:00:00 PM	4/13/2023 7:30:00 PM	16894.00	street
3938	4/13/2023 7:00:00 PM	4/13/2023 7:30:00 PM	12409.00	street
3905	4/13/2023 7:00:00 PM	4/13/2023 7:30:00 PM	16748.00	street
1840	4/13/2023 7:00:00 PM	4/13/2023 7:30:00 PM	19438.00	street
6489	4/13/2023 7:30:00 PM	4/13/2023 8:00:00 PM	16638.00	street
1413	4/13/2023 7:30:00 PM	4/13/2023 7:30:00 PM	19438.00	street
3159	4/13/2023 7:30:00 PM	4/13/2023 8:00:00 PM	16704.00	street
30	4/13/2023 7:30:00 PM	4/13/2023 7:30:00 PM	16813.00	street
213	4/13/2023 7:30:00 PM	4/13/2023 8:00:00 PM	17608.00	street
1460	4/13/2023 7:30:00 PM	4/13/2023 8:00:00 PM	16079.00	street
1005	4/13/2023 7:30:00 PM	4/13/2023 8:00:00 PM	15359.00	street
7	4/13/2023 7:30:00 PM	4/13/2023 8:00:00 PM	E33C3AB3-55C9-4874-A32D-586B8F07E889	trail
12077	4/13/2023 7:30:00 PM	4/13/2023 8:00:00 PM	B212AA70-1B78-44E1-ABBF-DE66258A87C0	trail
2174	4/13/2023 7:30:00 PM	4/13/2023 8:00:00 PM	B212AA70-1B78-44E1-ABBF-DE66258A87C0	trail
4732	4/13/2023 7:30:00 PM	4/13/2023 8:00:00 PM	17060674-6629-4E3A-B1DF-12D05E67E5D8	trail
1371	4/13/2023 7:30:00 PM	4/13/2023 7:30:00 PM	19436.00	street
2413	4/13/2023 7:30:00 PM	4/13/2023 7:30:00 PM	17105.00	street
775	4/13/2023 7:30:00 PM	4/13/2023 7:30:00 PM	15151.00	street



Data preparation

Minneapolis bike and scooter data

- CSV does not contain spatial data, only centerline ID of trip start/end
- Centerline IDs are available from GeoJSON file
- **create_geojson.py** program to join CSV to GeoJSON, placing at a random point on the centerline:

Maybe don't use tiles

Alternatives

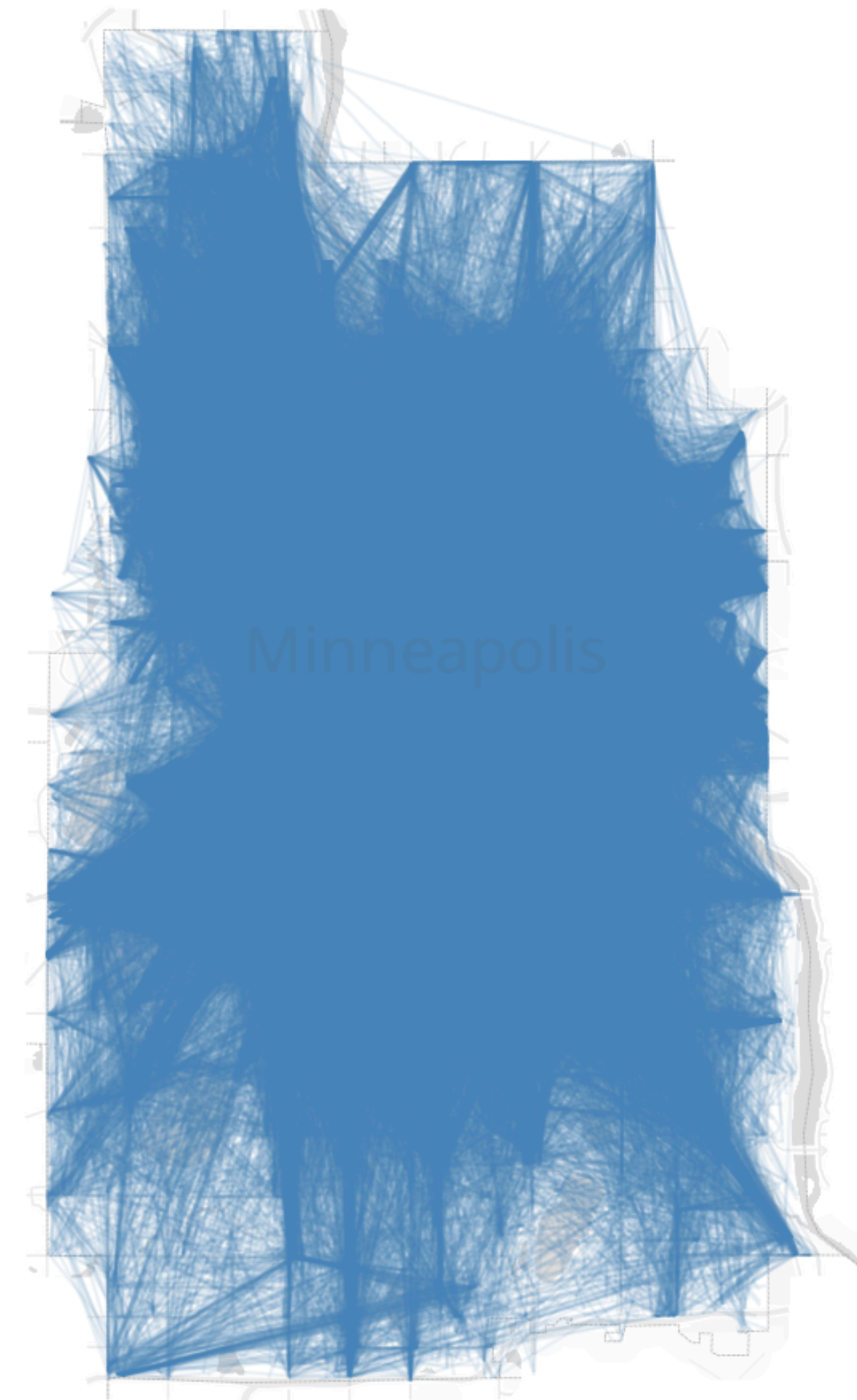
- Comment out `other_source` and `other_layer` in `task1/index.html`
- Try changing `minneapolis_skyway.geojson` to `MPLS_Centerline.geojson`. What happens?
- Use the web console to understand what's going on
- What about PostGIS? QGIS?



Loading results

GeoJSON

- `python3 create_geojson.py`
- output: `lines.geojson`, `points.geojson`
- Try loading `lines.geojson` in `task1/index.html`. How does it work?



Motivation for tiles

Creating vector tiles

- **Tiles** are a **lossy technique** for lightweight, interactive maps
- Create a **tile pyramid** via clipping and **generalization**
- Load our trips the same way we load our basemap
- You can store tiles as single files like 0/0/0.mvt, pmtiles is a convenient way to deal with them as a single file, even millions



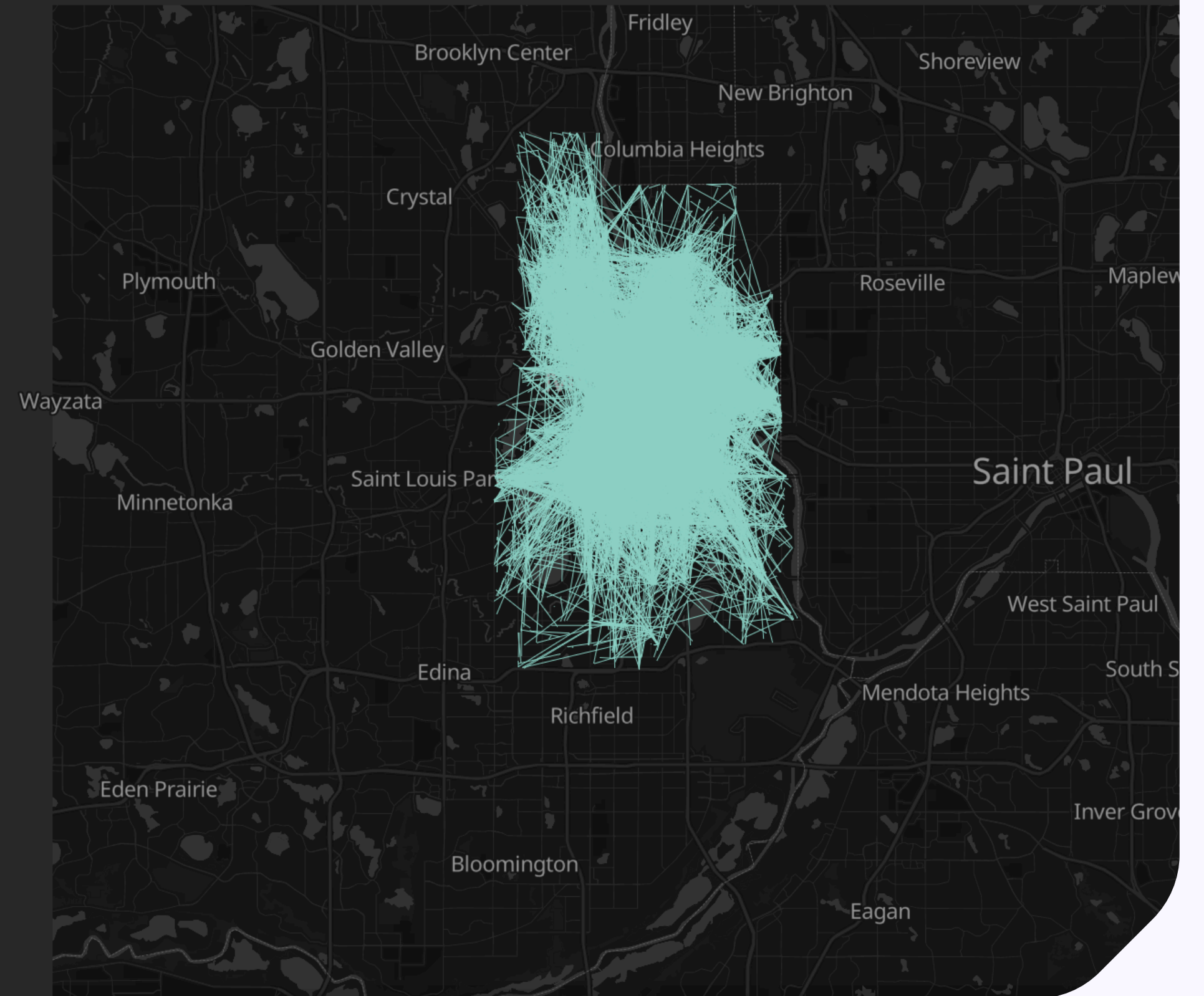
tippecanoe

Command line tile creation

```
tippecanoe points.geojson -o points.pmtiles --force --drop-fraction-as-needed
```

```
tippecanoe lines.geojson -o lines.pmtiles --force --drop-fraction-as-needed
```

View the output on pmtiles.io + experiment with the CLI



Experimentation time

Task 2: Load the pmtiles, check the console, change the colors

Task 3: Data Exploration

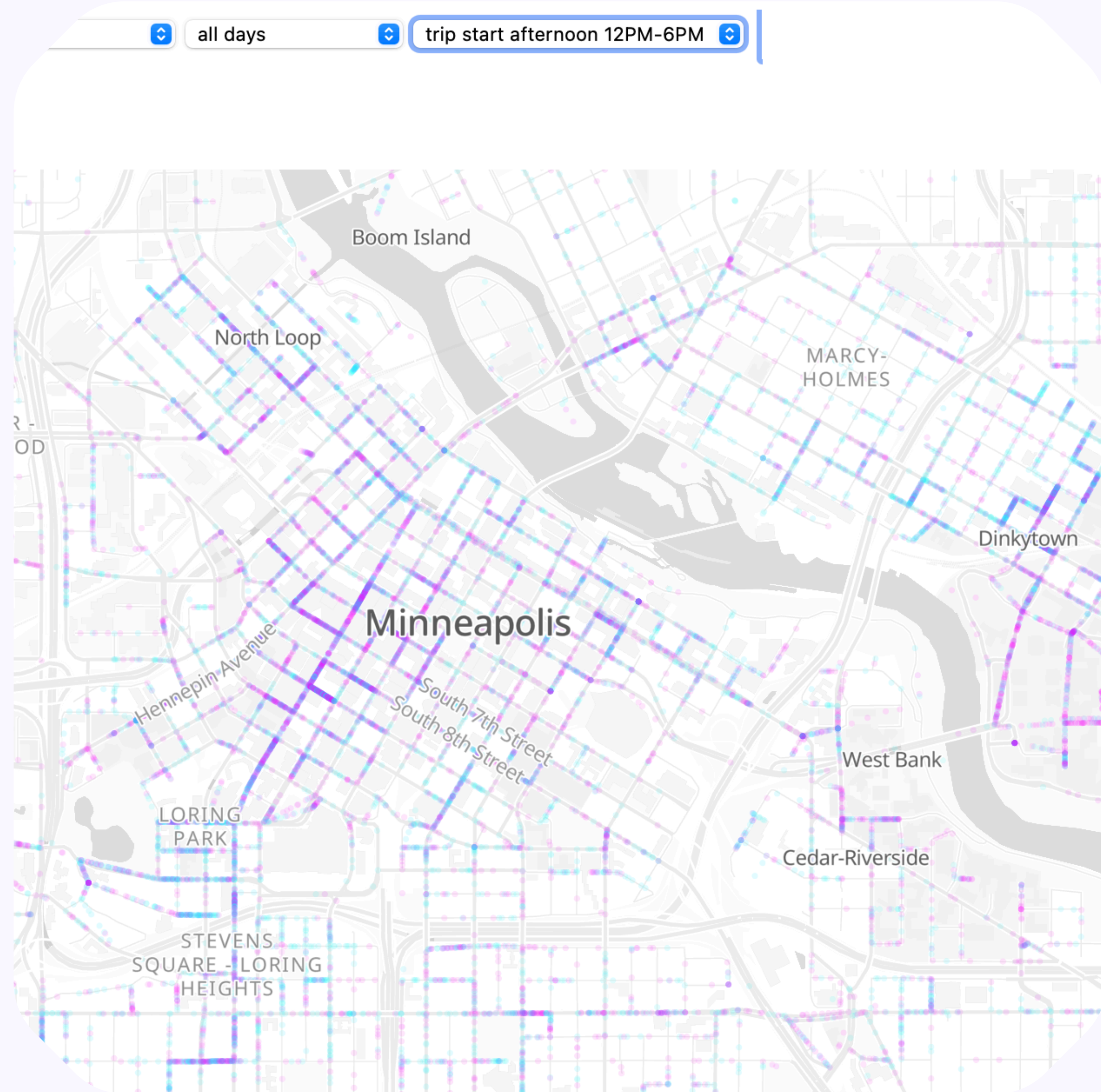
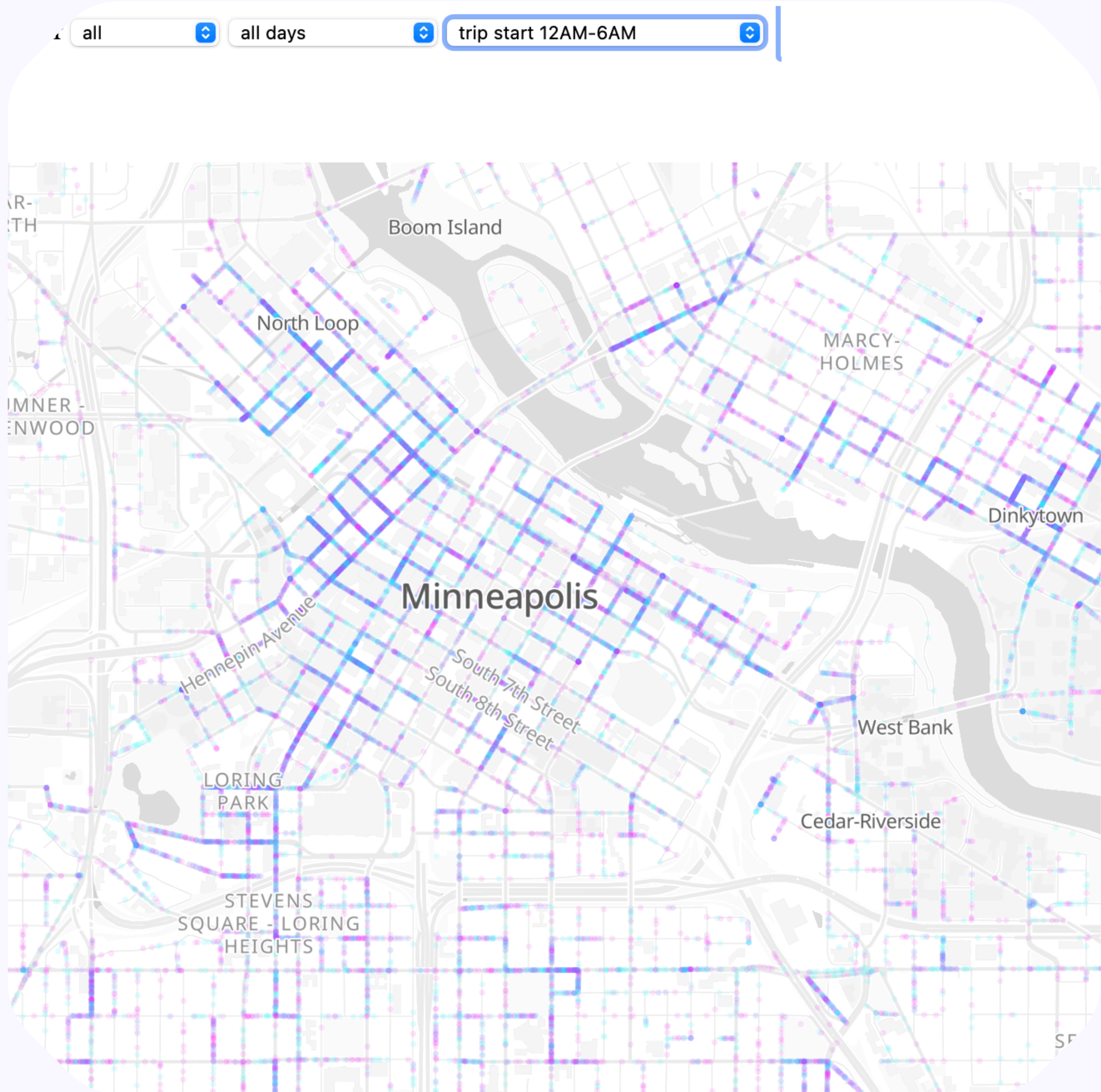
MapLibre is more than a static map

Dataset columns

Scooter and bicycle trips

- vehicleType
- StartTime
- EndTime

vehicleType	TripDuration	TripDistance	StartTime	EndTime
scooter	192	12	4/13/2023 7:00:00 PM	4/13/2023 7:00:00 PM
bicycle	1122	1355	4/13/2023 7:00:00 PM	4/13/2023 7:30:00 PM
scooter	321	175	4/13/2023 7:00:00 PM	4/13/2023 7:30:00 PM
scooter	1583	6890	4/13/2023 7:00:00 PM	4/13/2023 7:00:00 PM
scooter	1078	4783	4/13/2023 7:00:00 PM	4/13/2023 7:00:00 PM
scooter	381	1611	4/13/2023 7:00:00 PM	4/13/2023 7:00:00 PM
scooter	374	1504	4/13/2023 7:00:00 PM	4/13/2023 7:00:00 PM
scooter	1153	5368	4/13/2023 7:00:00 PM	4/13/2023 7:30:00 PM
scooter	399	209	4/13/2023 7:00:00 PM	4/13/2023 7:30:00 PM
scooter	1822	3938	4/13/2023 7:00:00 PM	4/13/2023 7:30:00 PM
scooter	1865	3905	4/13/2023 7:00:00 PM	4/13/2023 7:30:00 PM
scooter	453	1840	4/13/2023 7:00:00 PM	4/13/2023 7:30:00 PM
bicycle	1462	6489	4/13/2023 7:30:00 PM	4/13/2023 8:00:00 PM
scooter	372	1413	4/13/2023 7:30:00 PM	4/13/2023 7:30:00 PM



Expressions

The value for any `layout` property, `paint` property, or `filter` property may be specified as an *expression*. An expression defines a formula for computing the value of the property using the *operators* described below. The set of expression operators provided by MapLibre includes:

- Mathematical operators for performing arithmetic and other operations on numeric values
- Logical operators for manipulating boolean values and making conditional decisions
- String operators for manipulating strings
- Data operators, providing access to the properties of source features
- Camera operators, providing access to the parameters defining the current map view

Expressions are represented as JSON arrays. The first element of an expression array is a string naming the expression operator, e.g. `"*"` or `"case"`. Elements that follow (if any) are the *arguments* to the expression. Each argument is either a literal value (a string, number, boolean, or `null`), or another expression array.

```
[expression_name, argument_0, argument_1, ...]
```



- Data expressions
- Camera expressions
- Composition
- Type system
- Variable binding
 - let
 - var
- Types
 - literal
 - array
 - typeof
 - string
 - number
 - boolean
 - object
 - collator
 - format
 - image
 - number-format


```
},
},
layers: [
  ...basemaps.layers("basemap", basemaps.namedFlavor("white")),
  {
    id: "points",
    type: "circle",
    source: "points",
    "source-layer": "points",
    filter: ["==", ["get", "point"], "end"],
    paint: {
      "circle-color": ["case", ["==", ["get", "point"], "start"],
      "circle-opacity": 0.1,
      "circle-radius": ["step", ["zoom"], 2, 16, 10]
    }
  },
  ...basemaps.layers("basemap", basemaps.namedFlavor("white"), {
  })
]
},
```

Experimentation time

Task 3: changing the data shown dynamically

How do we host?

Discussion topic

- GitHub Pages is an option!
- The same way you host other static content (S3)
- Content delivery network preferred!
- **Q&A:** How does your org do this?

Homework: Extra Credit

Presidential precinct data for the 2020 general election

An Extremely Detailed Map of the 2020 Election

BY ALICE PARK, CHARLIE SMART, RUMSEY TAYLOR AND MILES WATKINS

🔍 Search an address, ZIP code or city

This map has detailed data from **2,523** of **3,143** counties in **47** states, representing **89%** of all votes cast. It was last updated on March 30.

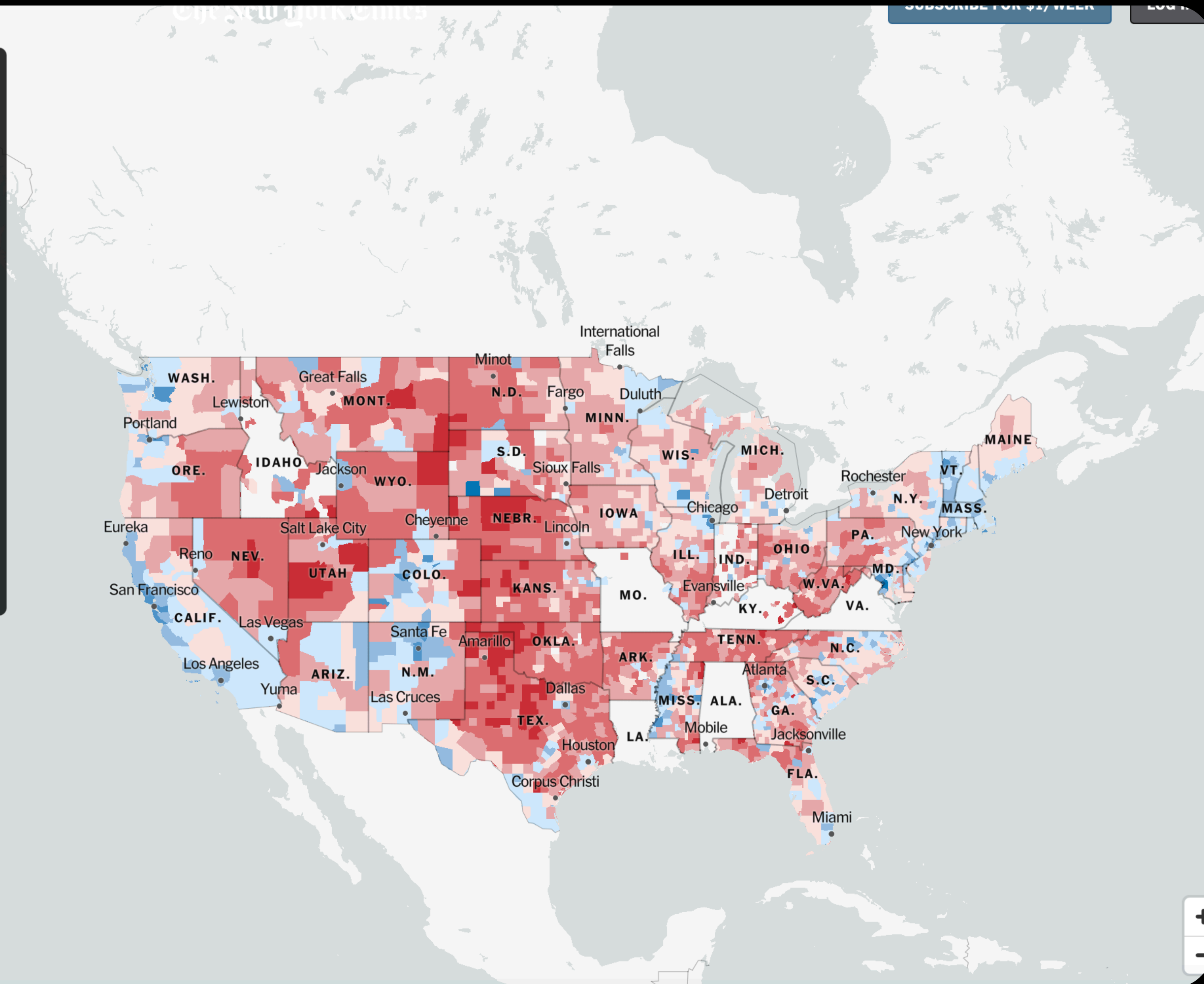


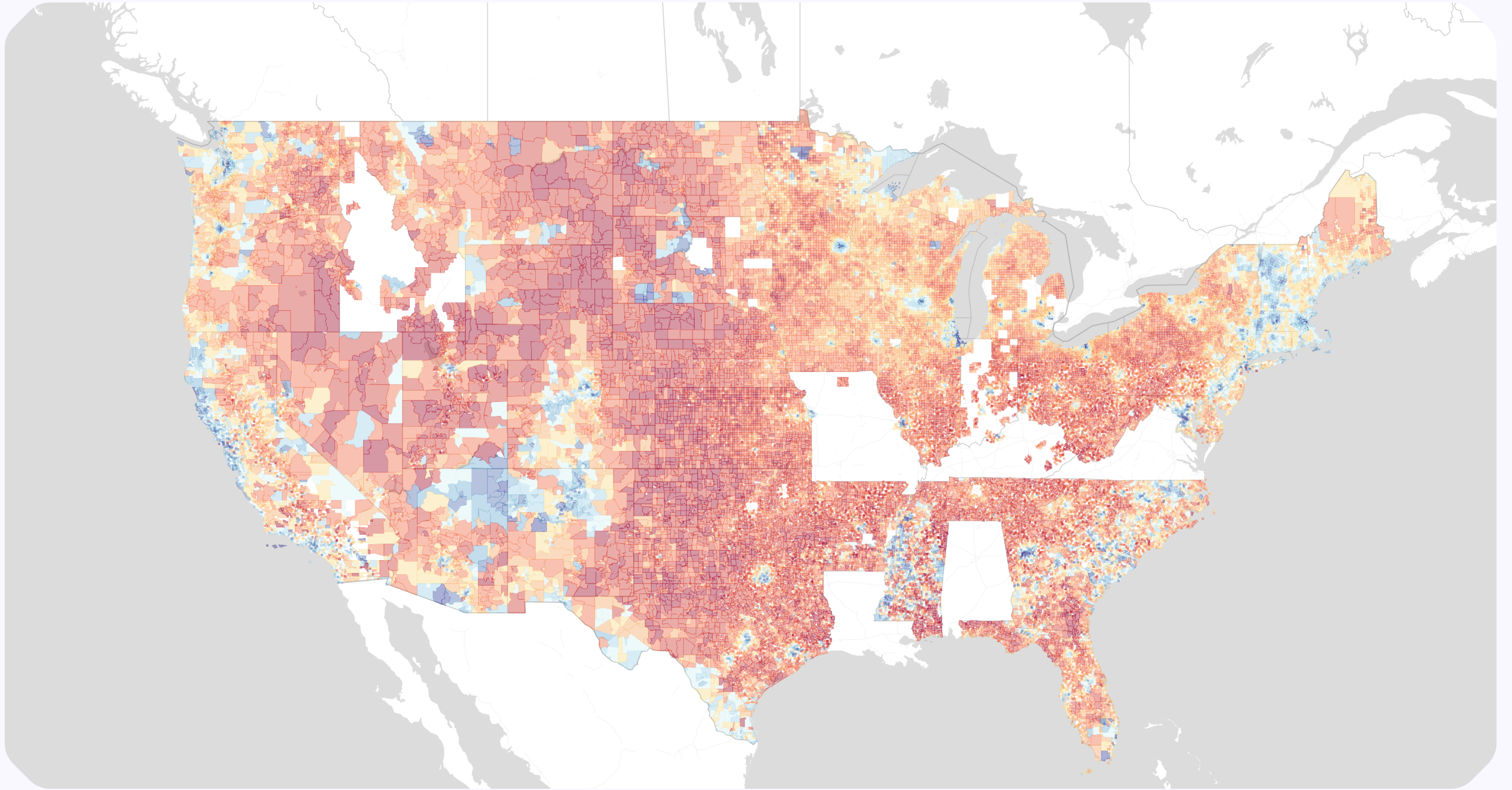
2020 results

Change from 2016

2016 PRECINCT MAP • ABOUT THE DATA

LEADER MARGIN, IN PCT. PTS.





2025 Roadmap

What's next for Protomaps

- Improved **cartographic generalization and completeness**
- More **example Flavors** and easier customization
- Use **standard web fonts**



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