



# Visualizing commuting patterns using LODES data

by Thea Evans

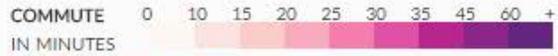
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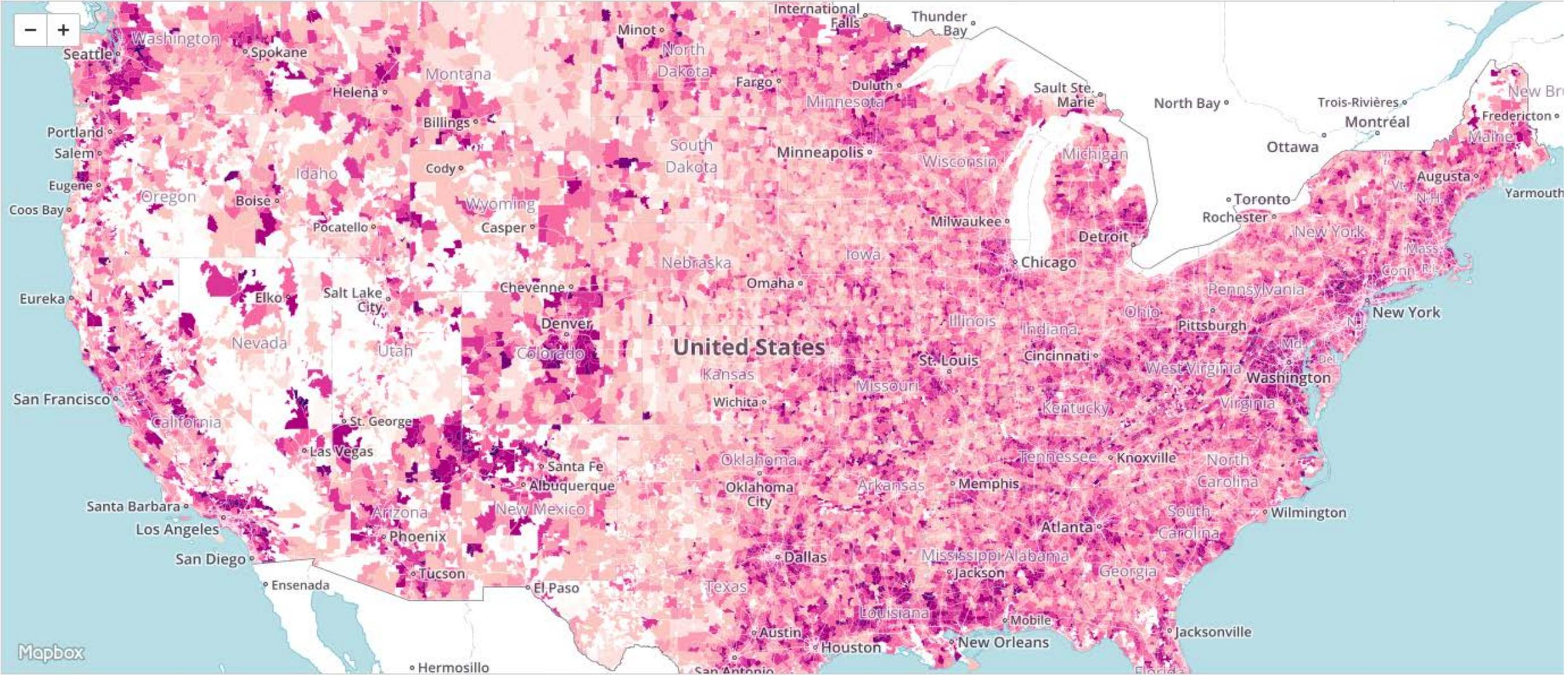
# WNYC Average Commute Times

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The average travel time to work in the United States is 25.4 minutes, according to the U.S. Census Bureau. Move around the map or enter your town or zip code to find commute times for your area.

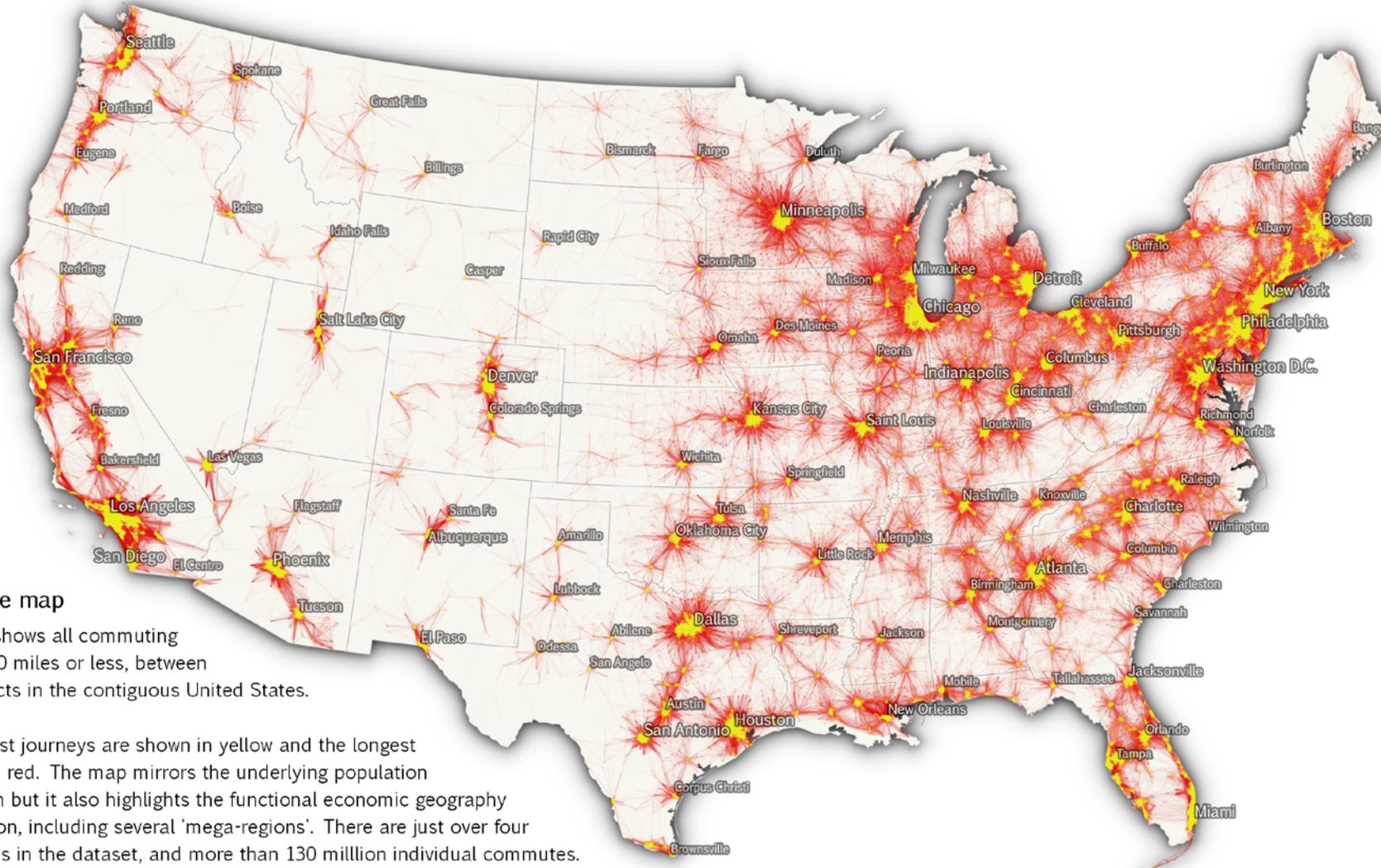


[ZOOM IN](#)



# The American Commute

A functional economic geography of the United States



## About the map

This map shows all commuting links of 100 miles or less, between census tracts in the contiguous United States.

The shortest journeys are shown in yellow and the longest journeys in red. The map mirrors the underlying population distribution but it also highlights the functional economic geography of the nation, including several 'mega-regions'. There are just over four million lines in the dataset, and more than 130 million individual commutes.

Data Source: American Community Survey 2006-2010

500 miles

Map created by Alasdair Rae

# LEHD Origin-Destination Employment Statistics (LODES)

- Part of the Longitudinal Employer-Household Dynamics data products from the U.S. Census Bureau
- Unemployment Insurance earnings data and Quarterly Census of Employment and Wages data from States are combined with administrative data, census data, and survey data
- Data limitations
  - Only includes data for employees covered by unemployment insurance. Does not include self-employed individuals
  - Workplace location reported by the employer may not be the physical location to which the employee commutes (e.g. telecommuters)
  - There are known issues with employers underreporting multiple worksite locations
  - Design Comparison of LODES and ACS Commuting Data Products: <https://ideas.repec.org/p/cen/wpaper/14-38.html>
- Three groups of data files are available for most states from 2002-2014
  - Origin-Destination (OD) data
  - Residence Area Characteristic (RAC) data
  - Workplace Area Characteristic (WAC) data
- The current version of LODES was enumerated by 2010 census blocks
- <https://lehd.ces.census.gov/data/#lodes>

# OD file structure

- **[ST]\_od\_[PART]\_[TYPE]\_[YEAR].csv.gz**
- [ST] = lowercase, 2-letter postal code for a chosen state
- [PART] = Part of the state file, can have a value of either “main” or “aux”. Complimentary parts of the state file, the main part includes jobs with both workplace and residence in the state and the aux part includes jobs with the workplace in the state and the residence outside of the state.
- [TYPE] = Job Type, can have a value of “JT00” for All Jobs, “JT01” for Primary Jobs, “JT02” for All Private Jobs, “JT03” for Private Primary Jobs, “JT04” for All Federal Jobs, or “JT05” for Federal Primary Jobs.
- [YEAR] = Year of job data. Can have the value of 2002-2014 for most states.

# Mapping Indiana commutes

- Commuters within Indiana
  - in\_od\_main\_JT00\_2014.csv.gz
- Residents of other states that commute to Indiana
  - in\_od\_aux\_JT00\_2014.csv.gz
- Indiana residents that commute to other states
  - il\_od\_aux\_JT00\_2014.csv.gz
  - ky\_od\_aux\_JT00\_2014.csv.gz
  - mi\_od\_aux\_JT00\_2014.csv.gz
  - oh\_od\_aux\_JT00\_2014.csv.gz

# Record-level structure

2C		1.70010001e+14											
	w_geocode	h_geocode	s000	sa01	sa02	sa03	se01	se02	se03	si01	si02	si03	createdate
1	170010001001001	291119701003153	1	0	1	0	0	1	0	0	0	1	20160219
2	170010001001001	291219602002067	1	0	0	0	0	0	0	0	0	1	20160219
3	170010001001001	291279601003153	1	0	0	0	0	0	0	0	0	0	20160219
4	170010001001001	291279601003153	1	0	0	0	0	0	0	0	0	1	20160219
5	170010001001001	291279601003153	1	0	0	0	0	0	0	0	0	0	20160219
7	170010001001001	292054501001187	1	0	0	1	0	0	1	0	0	1	20160219
8	170010001001001	292214601004063	1	0	1	0	0	1	0	0	0	1	20160219
9	170010001001004	190570003001008	1	0	0	1	1	0	0	1	0	0	20160219
10	170010001001004	190570006001008	1	0	1	0	0	0	1	1	0	0	20160219
11	170010001001004	200450008021024	1	0	1	0	0	0	1	1	0	0	20160219
12	170010001001004	202090449003004	1	0	1	0	0	0	1	1	0	0	20160219
13	170010001001004	290270705002011	1	0	0	1	0	0	1	1	0	0	20160219
14	170010001001004	290718003001034	1	0	0	1	0	0	1	1	0	0	20160219
15	170010001001004	291039601003187	1	1	0	0	0	0	1	1	0	0	20160219
16	170010001001004	291119701001067	2	0	1	1	0	0	2	2	0	0	20160219
17	170010001001004	291119701002026	1	0	1	0	0	1	0	1	0	0	20160219
18	170010001001004	291119701003059	1	0	1	0	0	0	1	1	0	0	20160219
19	170010001001004	291119702002077	1	0	1	0	0	0	1	1	0	0	20160219

State code

County code

Tract code

Block code

Number of jobs by age range

Number of jobs by earnings range

Number of jobs by industry sector

Total number of jobs

# Transform data using statistical software

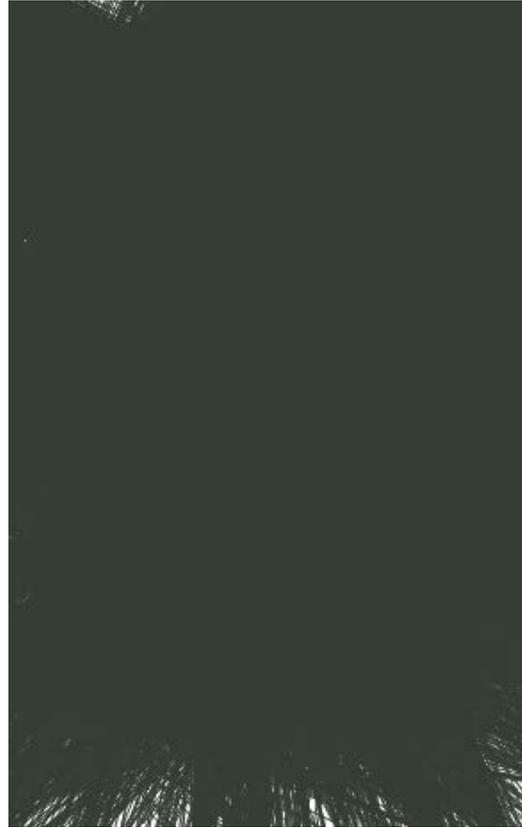
- Append files together
- Drop non-Indiana records
- Drop records of residents from non-neighboring states that work in Indiana. We are not considering these to be daily commuters.
- Aggregate the work and home census block codes into census tract geo-ids. Ensure that the total jobs variable is aggregated accordingly.
- Join lat/long values from tract centroids to the LODES data
- Generate a Well Known Text (WKT) LineString field that QGIS will use to create each commuting line
  - `gen geom = "LINESTRING (" + w_longdeg + "." + w_longdec + " " + w_latdeg + "." + w_latdec + ", " + h_longdeg + "." + h_longdec + " " + h_latdeg + "." + h_latdec + ")"`

w_lat	w_long	h_lat	h_long	geom
38.04386	-87.64426	36.98796	-89.16368	LINESTRING (-87.644256 38.043860, -89.163680 36.987960)
38.35257	-87.5812	36.98796	-89.16368	LINESTRING (-87.581200 38.352564, -89.163680 36.987960)

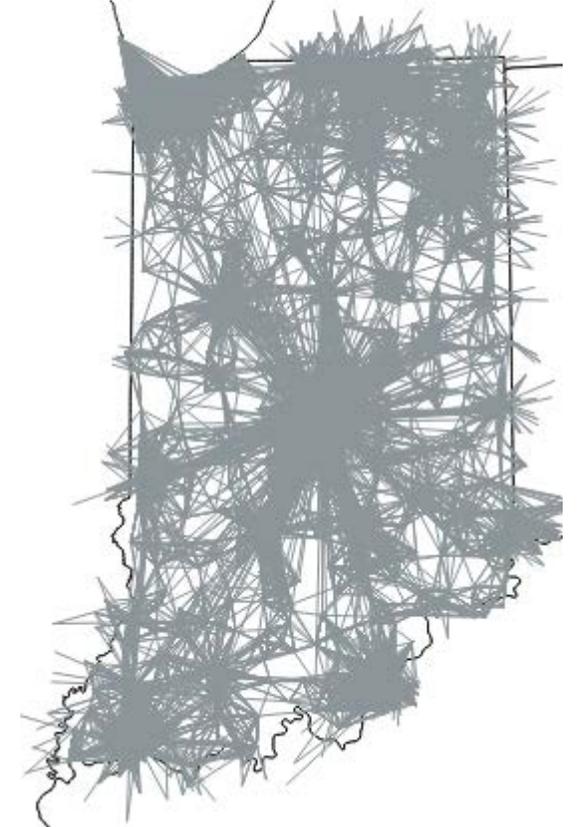
# Determining frequency of map lines

- Mapping each individual commute ( $n=3,061,054$ ) is too many lines for the map to render quickly or for the viewer to interpret
- Experiment with visualizing the lines to represent higher numbers of commuters
  - 10, 20, 50, etc.
  - For Indiana, 20 commuters per line yields a good result (about 69,000 lines)

One line per commuter

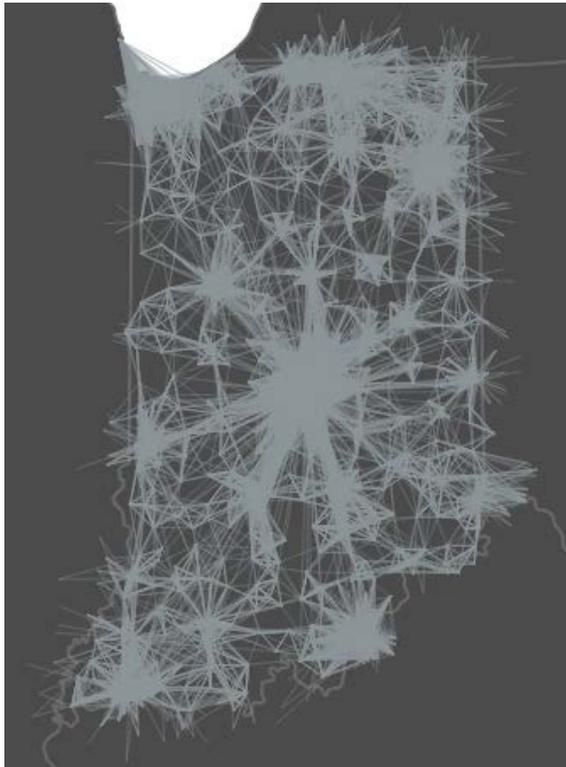


One line per 20 commuters

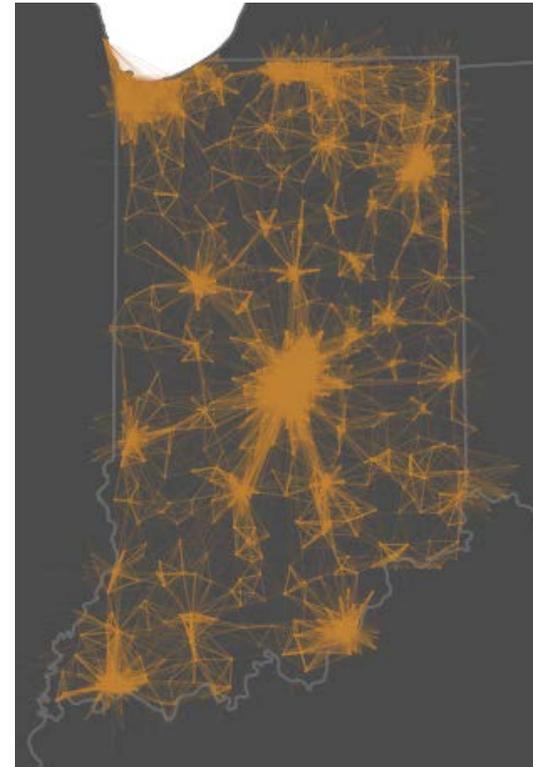


# Symbolizing the lines in QGIS

**Change the line width to 0.1 and  
darken the background**

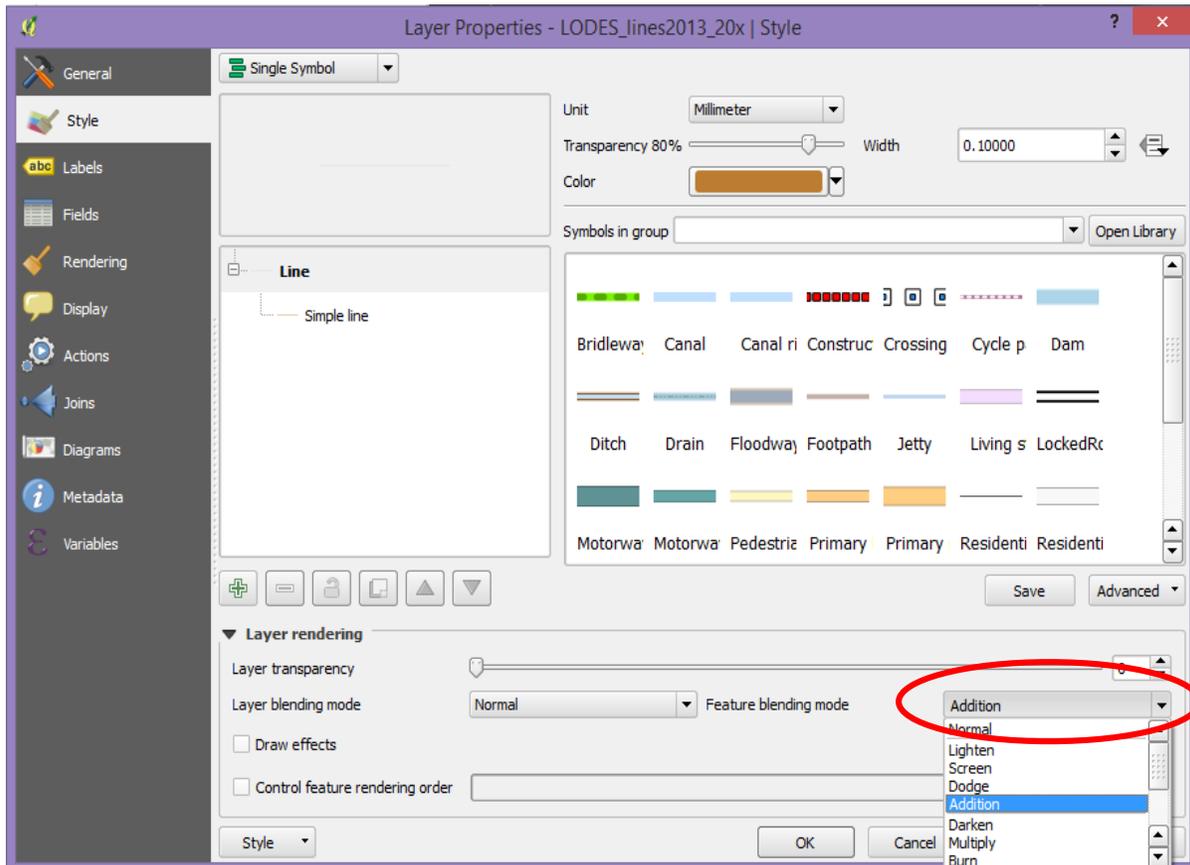


**Change the line color and add  
feature transparency**



# Add a glow effect

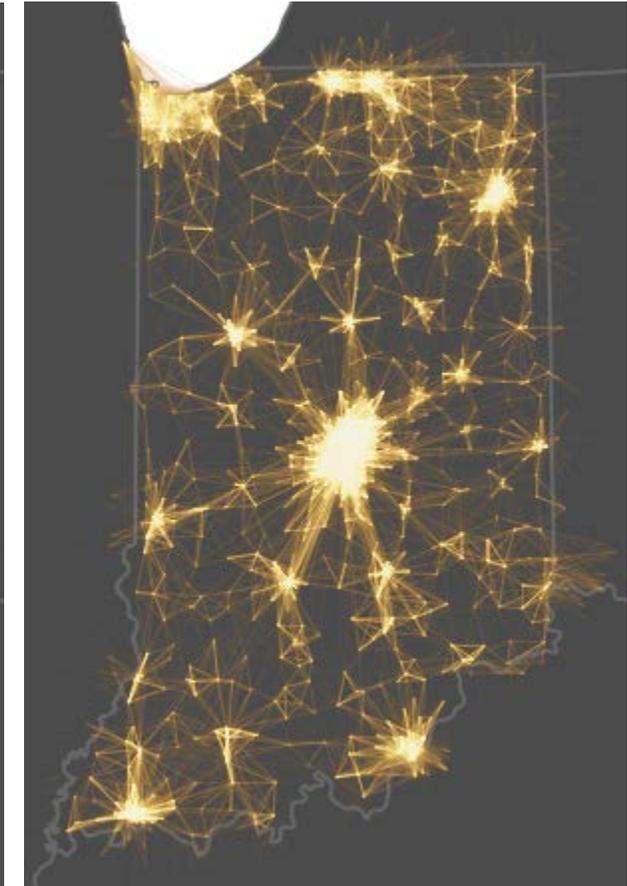
## Adjust the feature blending mode



## Addition mode



## Screen mode



# Adjust the line color to show non-Indiana residents

Layer Properties - LODES\_lines2014\_20x | Style

General

Style

Column: 123 homestate

Symbol: Change... Color ramp: [source] Edit Invert

Symbol	Value	Legend
—	17	17
—	18	18
—	21	21
—	26	26
—	39	39

Classify Add Delete Delete all Advanced

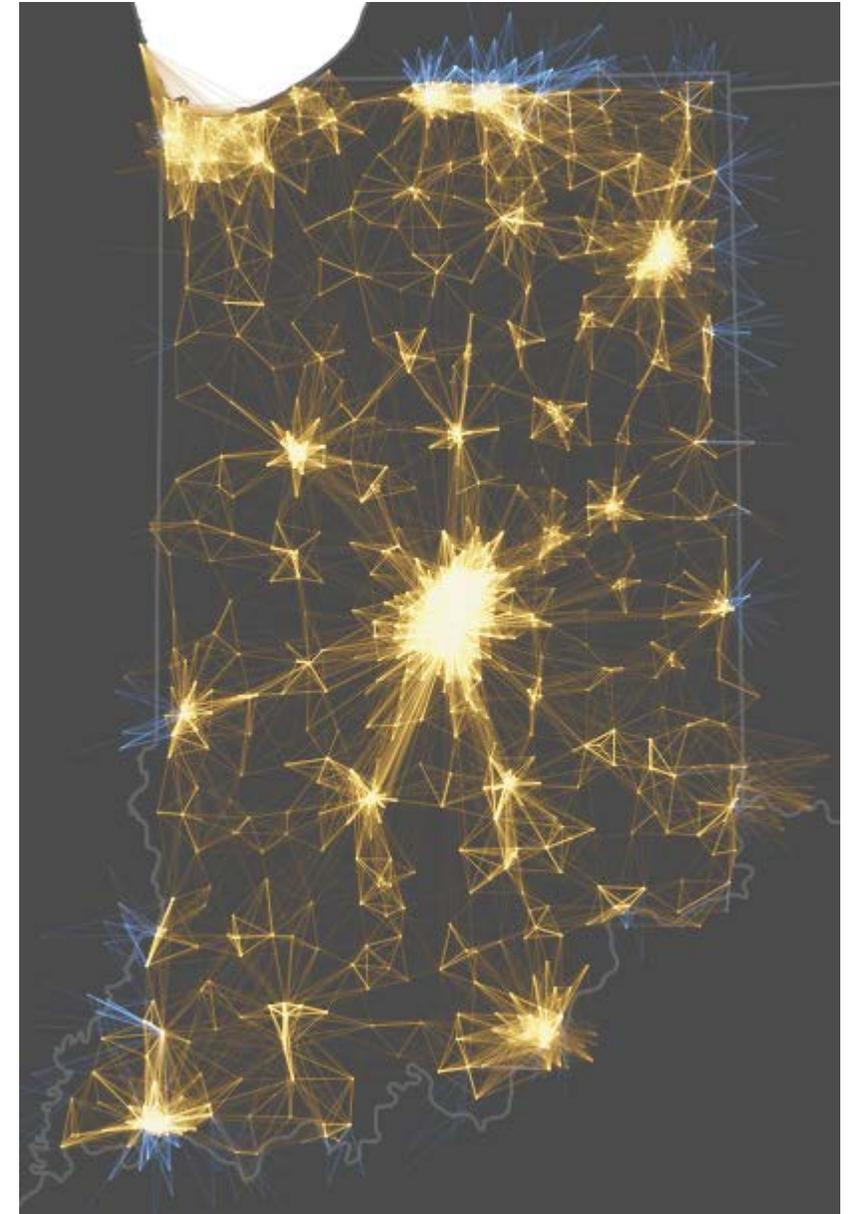
Layer rendering

Layer transparency: 0

Layer blending mode: Normal Feature blending mode: Screen

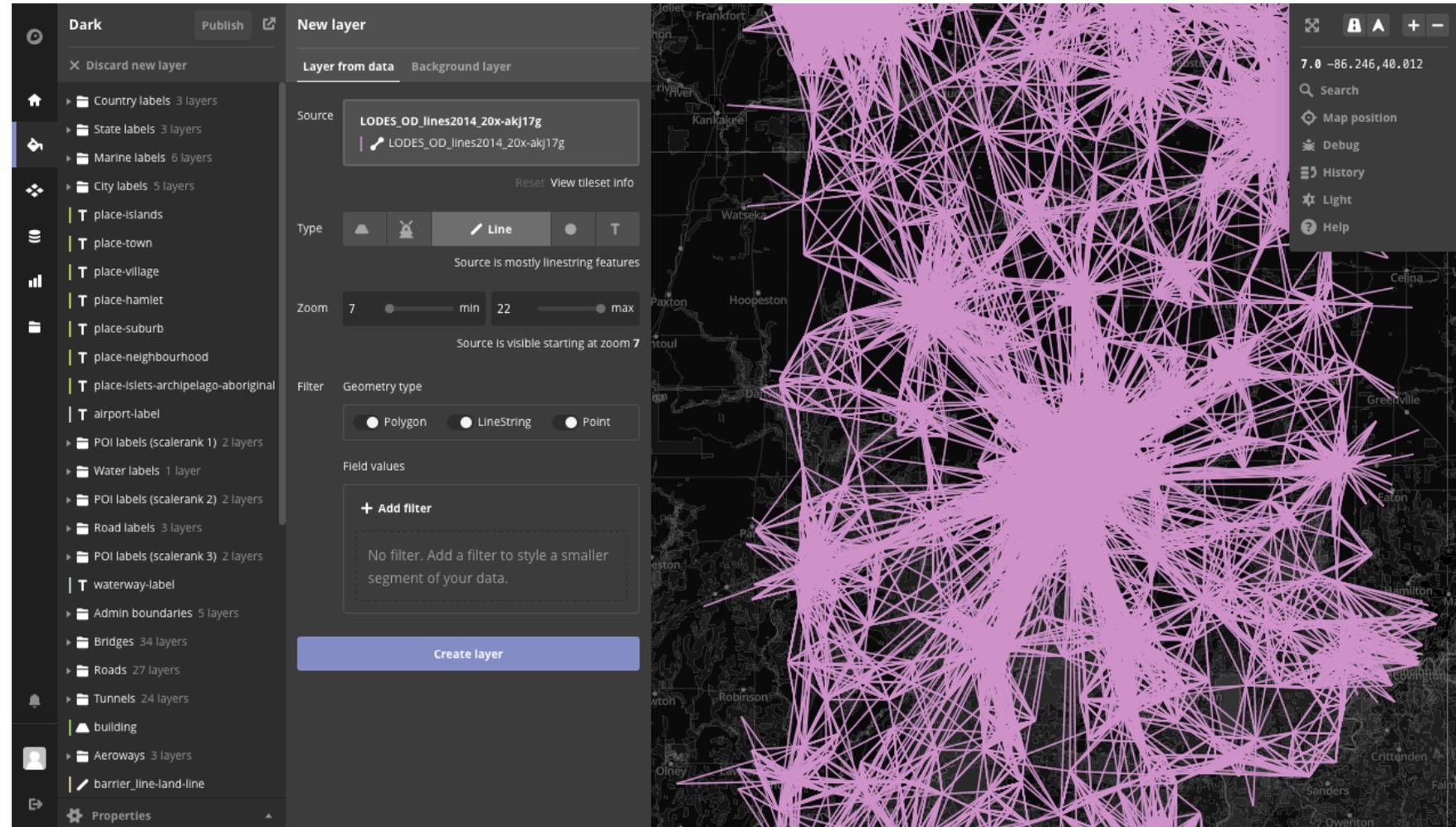
Draw effects Control feature rendering order

Style OK Cancel Apply Help



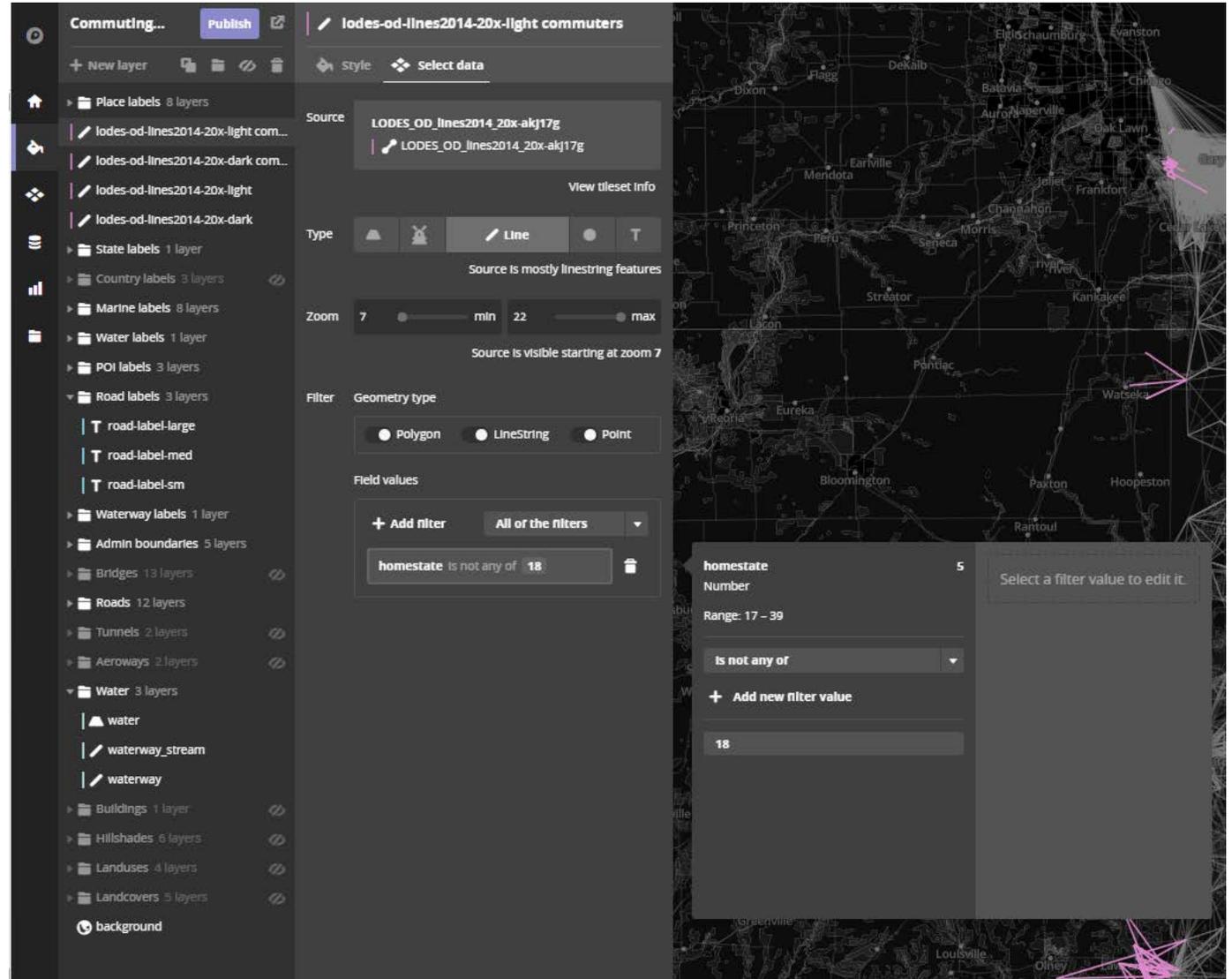
# From QGIS to Mapbox

- Save the lines as a shapefile in QGIS
- Create a new vector tileset in Mapbox studio by importing the zipped shapefile
- Add the tileset to a default or custom style to create a layer



# Create the line glow effect in Mapbox

- Add 4 lines layers to a style
- Filter two layers to display only non-Indiana residents (homestate is not any of 18)
  - Style the top layer to be light blue, 0.36 opacity, 0.8 px wide, and a blur of 0 px
  - Style the next layer to be dark blue, 0.27 opacity, 2.5 px wide, and a blur of 0.5 px
- Filter the other two layers to display only Indiana residents (homestate is 18)
  - Style the top layer to be light yellow, 0.36 opacity, 0.8 px wide, and a blur of 0 px
  - Style the next layer to be dark orange, 0.27 opacity, 2.5 px wide, and a blur of 0.5 px



# Mapbox result

