Geographic Data Science - Lecture VIII

Points

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Today

- The *point* of points
- Point patterns
- Visualization of point patterns
- Identifying clusters of points

The *point* of points

Points like polygons

Points *can* represent “**fixed**” **entities**

In this case, points are **qualitatively** similar to **polygons/lines**

The **goal** here is, taking location fixed, to model other aspects of the data

Points like polygons

Examples:

- Cities (in most cases)
- Buildings
- Polygons represented as their centroid
- …

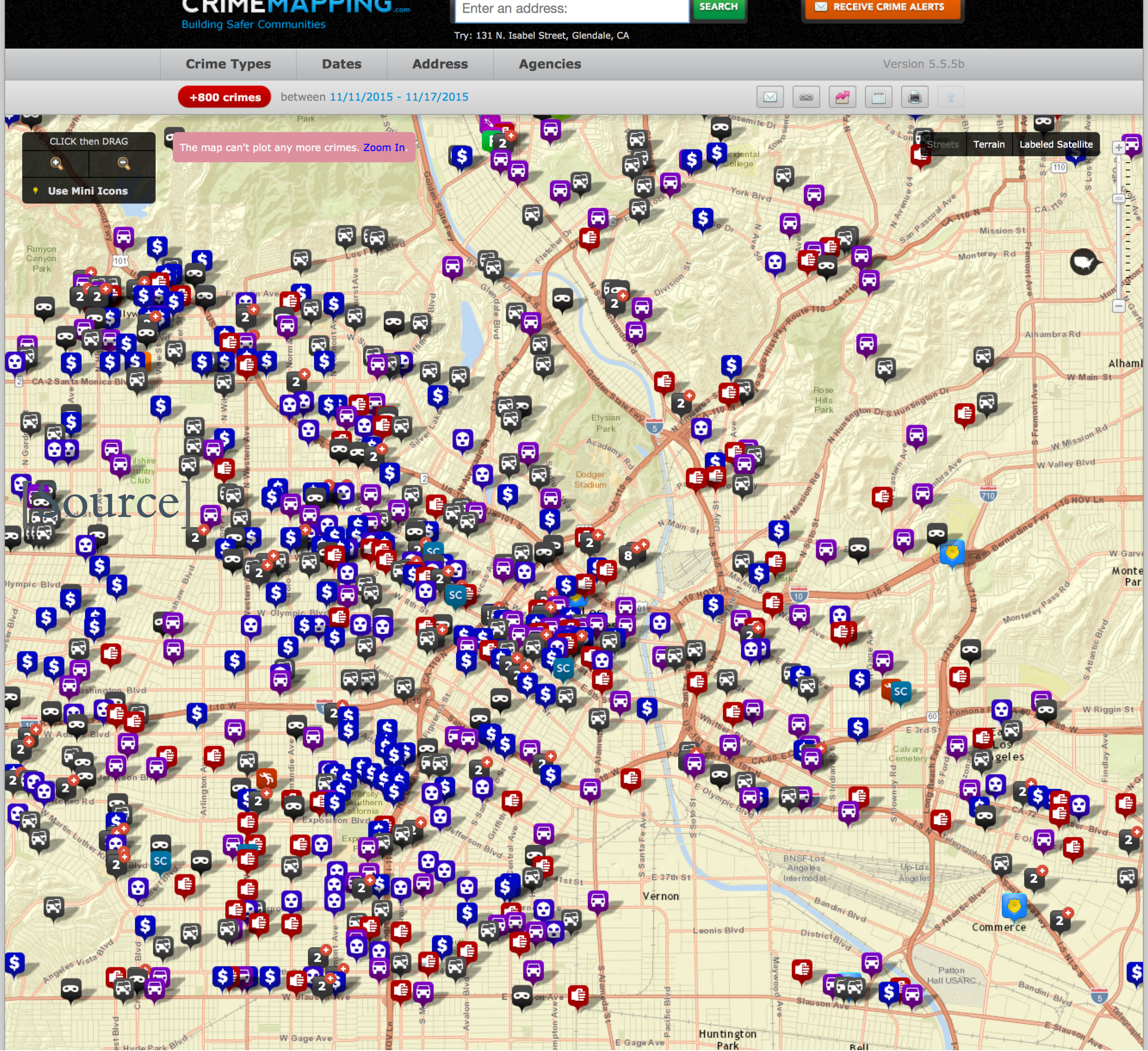
When points are not polygons

Point data are not only a different geometry than polygons or lines…

… Points can also represent a fundamentally different way to approach spatial analysis

Points unlike polygons

A few examples…

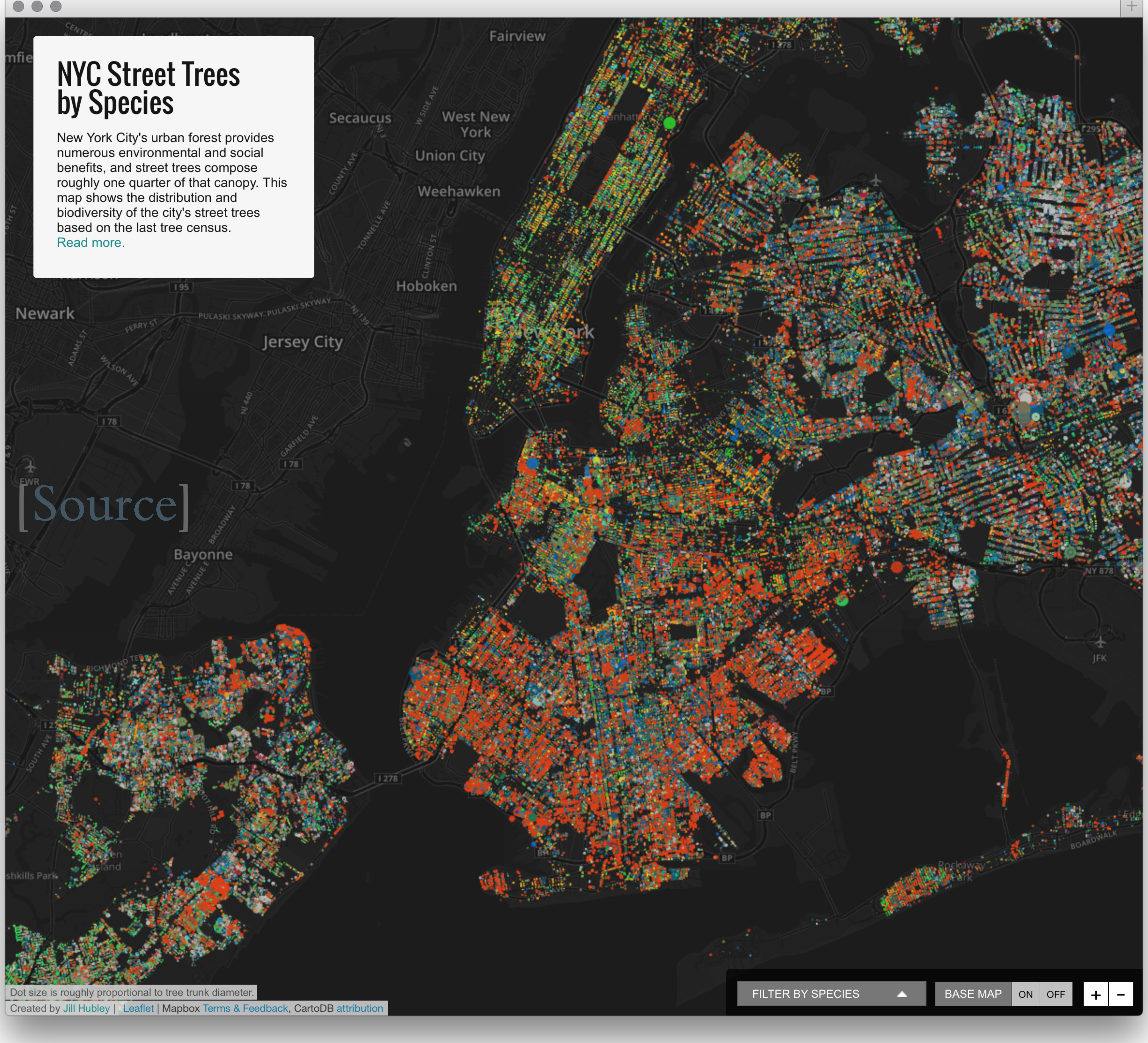


Try: 131 N. Isabel Street, Glendale, CA

+800 crimes between 11/11/2015 - 11/17/2015

The map can't plot any more crimes. Zoom In

Source]



NYC Street Trees by Species

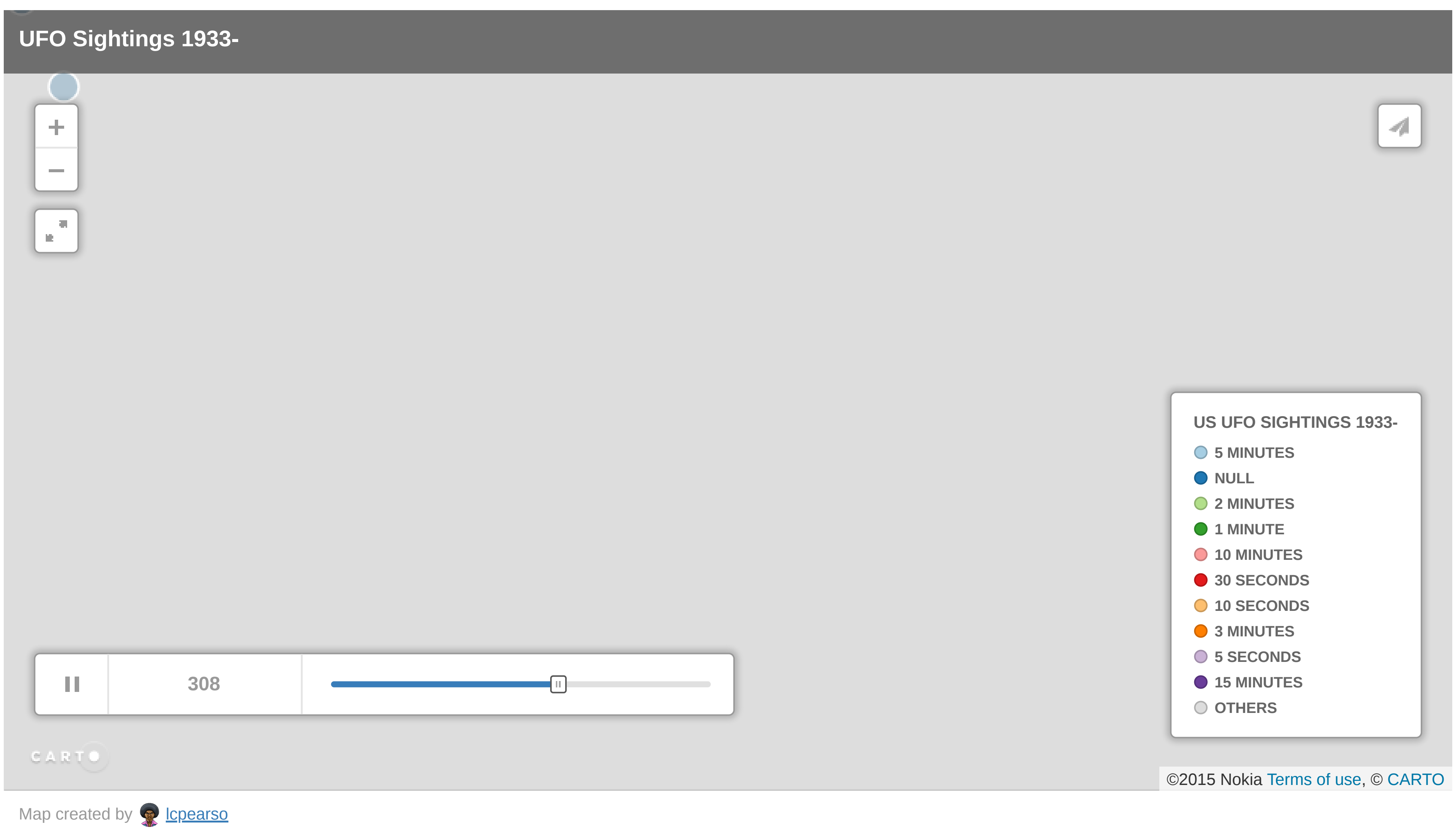
New York City's urban forest provides numerous environmental and social benefits, and street trees compose roughly one quarter of that canopy. This map shows the distribution and biodiversity of the city's street trees based on the last tree census.
Read more.

[Source]

Dot size is roughly proportional to tree trunk diameter.

Created by Jill Hubley | Leaflet | Mapbox Terms & Feedback, CartoDB attribution

UFO Sightings (1933-)



UFO Sightings 1933-

US UFO SIGHTINGS 1933-

- ● 5 MINUTES
- ● NULL
- ● 2 MINUTES
- ● 1 MINUTE
- ● 10 MINUTES
- ● 30 SECONDS
- ● 10 SECONDS
- ● 3 MINUTES
- ● 5 SECONDS
- ● 15 MINUTES
- ● OTHERS

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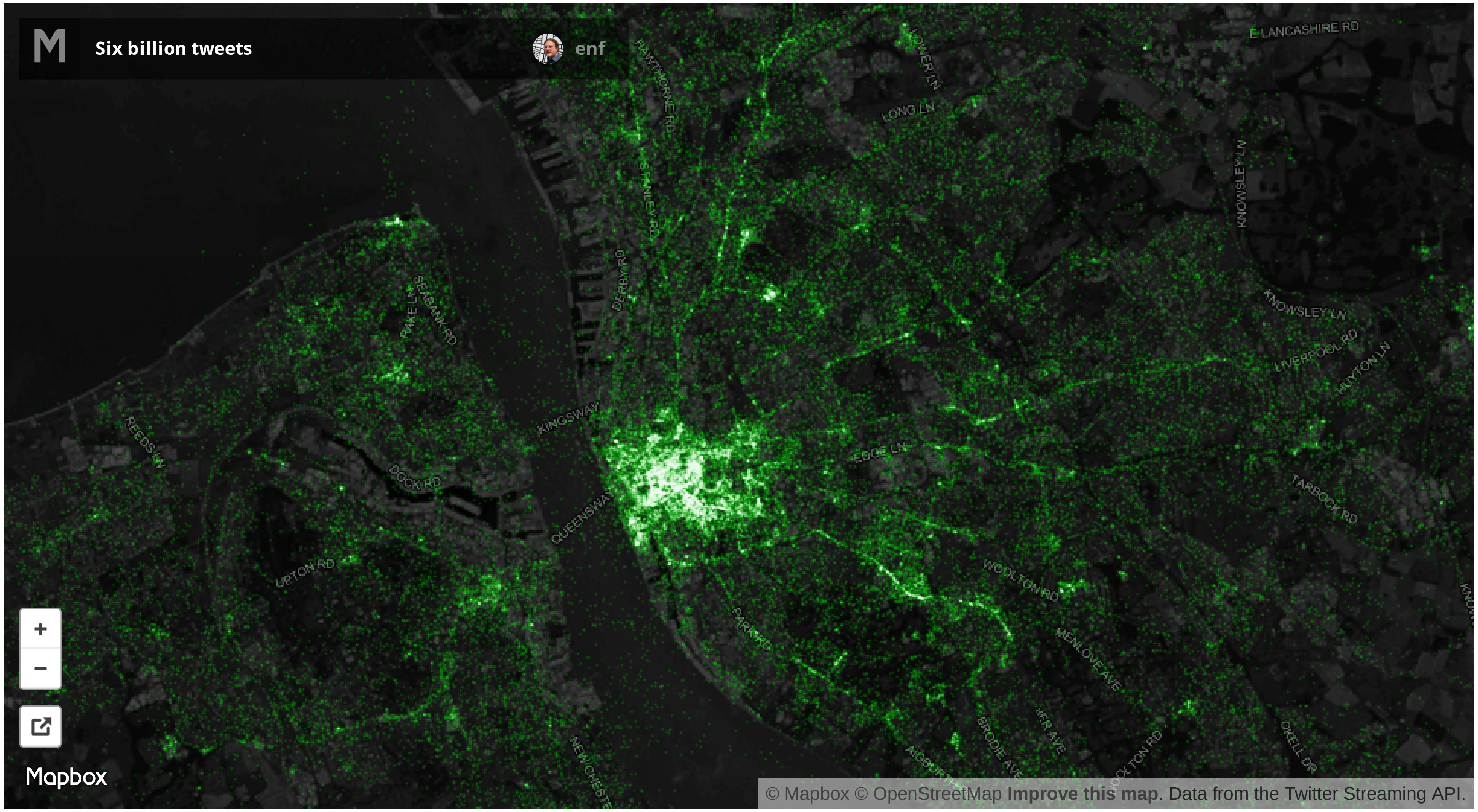
Map created by lcpearso

Geo-tagged tweets



© Mapbox © OpenStreetMap **Improve this map**. Data from the Twitter Streaming API.

Point patterns

Point patterns

Distribution of **points over** a portion of **space**

Assumption is a point can happen anywhere on that space, but only happens in specific locations

- **Unmarked**: locations only
- **Marked**: values attached to each point

Point Pattern Analysis

Describe, characterize, and explain point patterns, focusing on their **generating process**

- Visual exploration
- *Clustering* properties and *clusters*
- Statistical modeling of the underlying processes

Visualization of PPs

Visualization of PPs

Two routes (today):

- *Aggregate* ↔ “Histogram”
- *Smooth* ↔ KDE

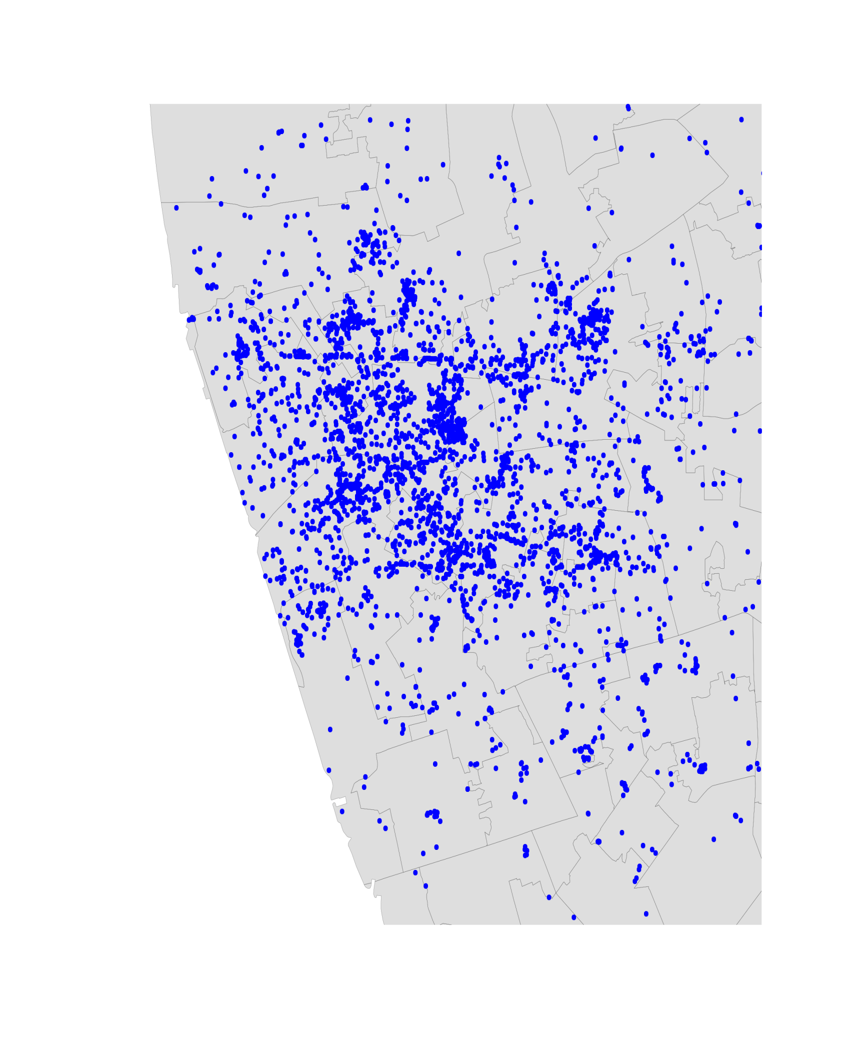
Aggregation

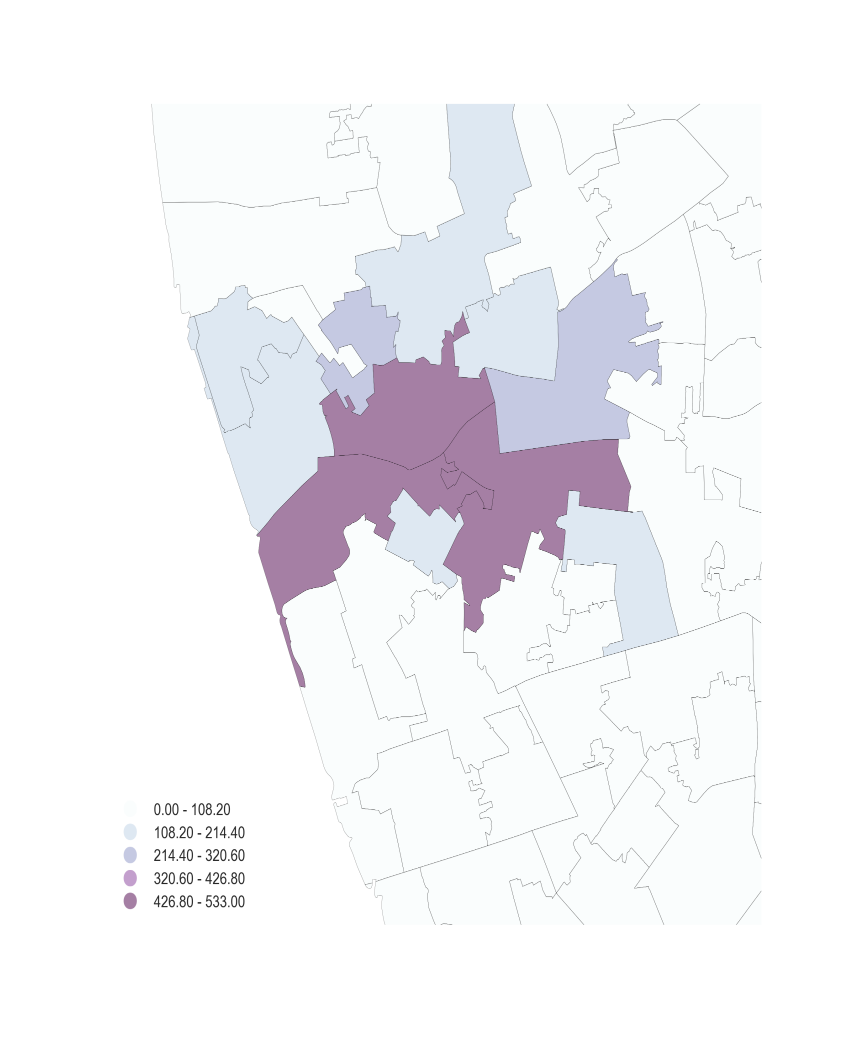
Points meet polygons

Use **polygon** boundaries and **count** points per area

[Insert your skills for **choropleth mapping** here!!!]

But, the polygons need to *"make sense"* (their delineation needs to relate to the point generating process)




0.00 - 108.20
108.20 - 214.40
214.40 - 320.60
320.60 - 426.80
426.80 - 533.00

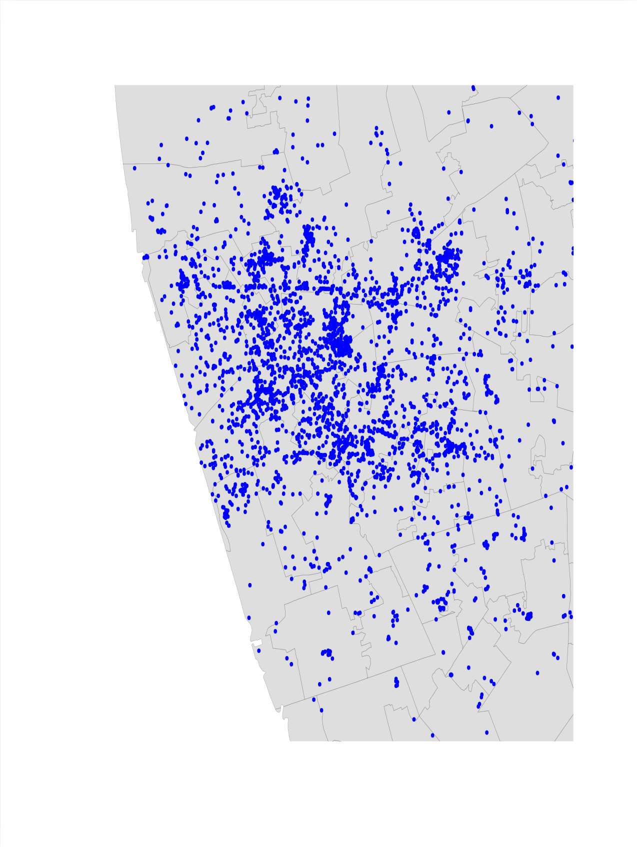
Hex-binning

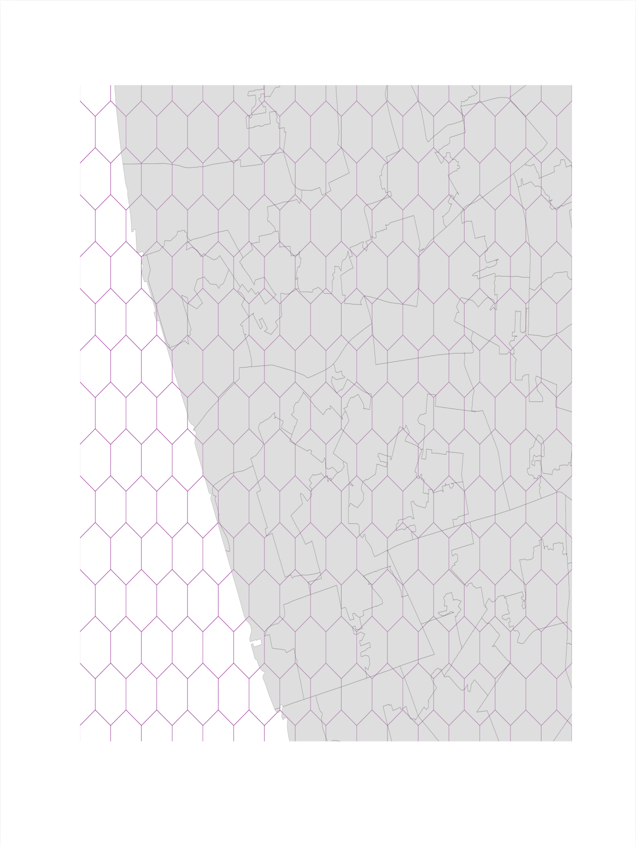
If **no** polygon boundary seems like a **good candidate** for aggregation…

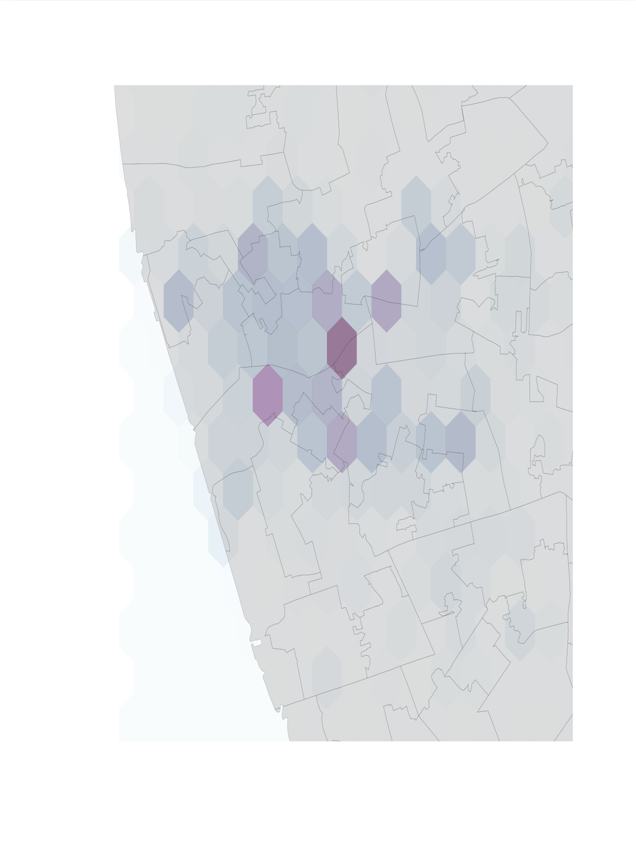
…draw a **hexagonal** (or squared) **tesselation**!!!

Hexagons…

- Are **regular**
- **Exhaust** the space (Unlike circles)
- Have **many sides** (minimize boundary problems)







But…

(Arbitrary) aggregation may induce **MAUP** (see Lecture 4)

+

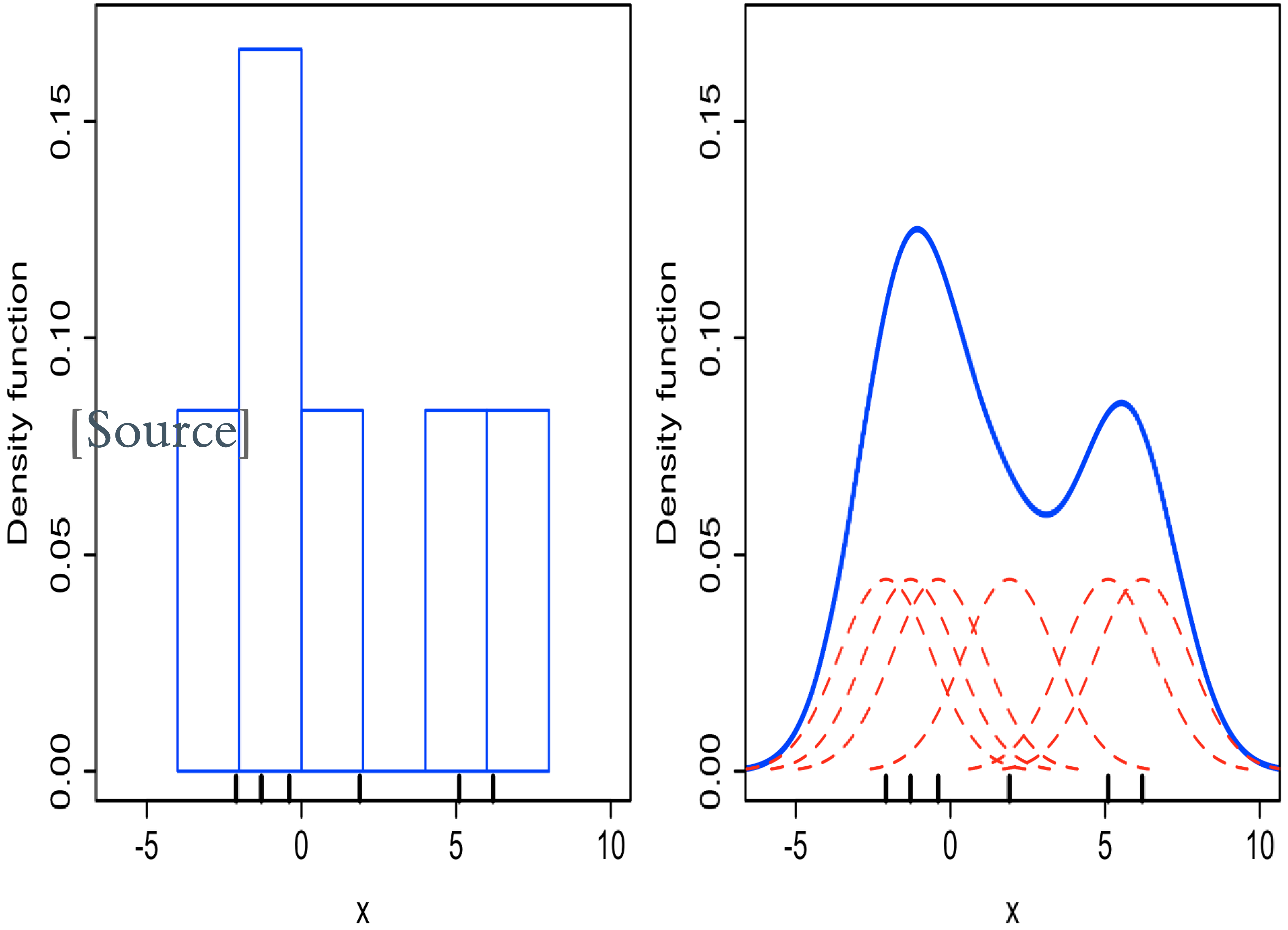
Points usually represent events that affect only **part** of the population and hence are best considered as **rates** (see Lecture 4)

Kernel Density Estimation

Kernel Density Estimation

*Estimate the (**continuous**) observed **distribution** of a variable*

- Probability of finding an observation at a given point
- “Continuous histogram”
- Solves (much of) the MAUP problem, but not the underlying population issue

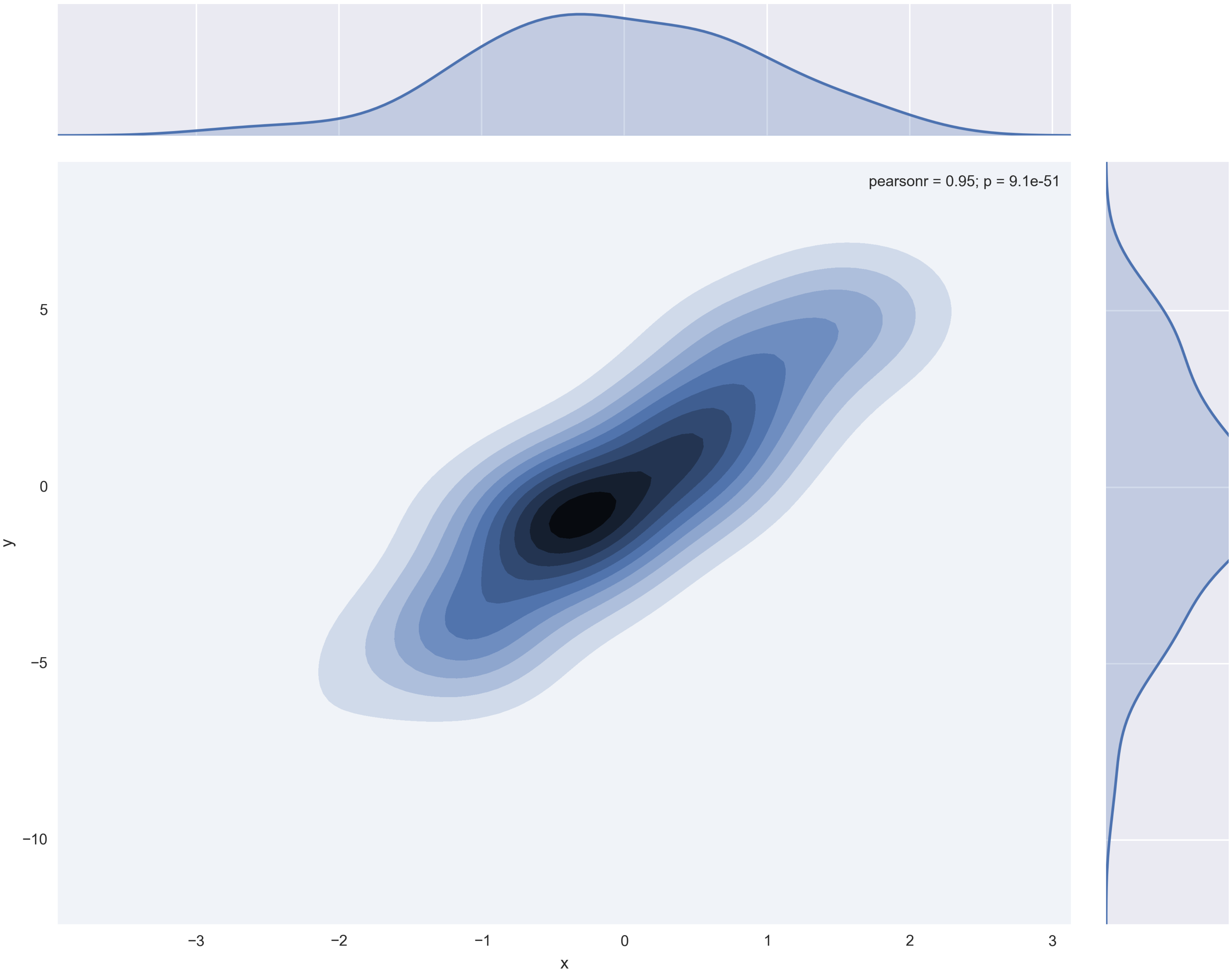

Density function
0.00
0.05
0.10
0.15
-5
0
5
10
x
Density function
0.00
0.05
0.10
0.15
-5
0
5
10
x

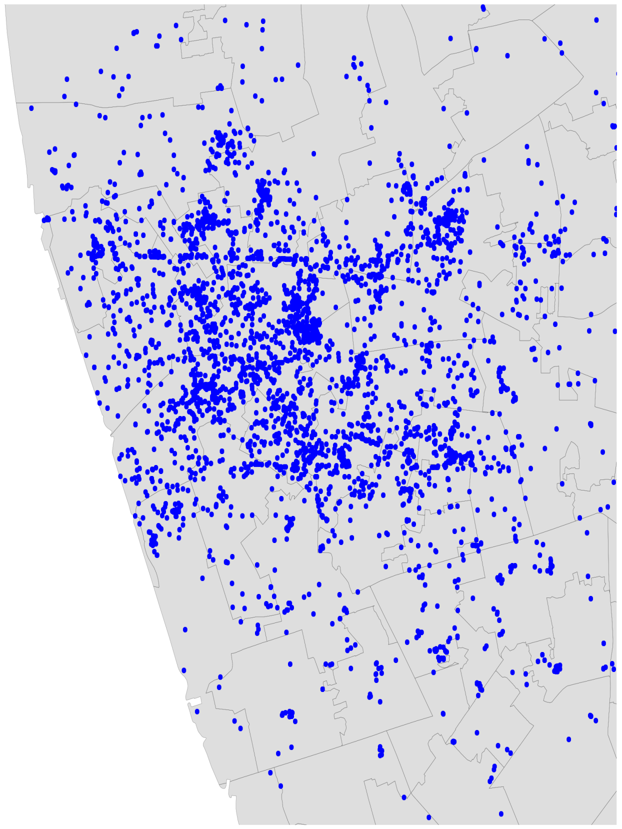
[Source]

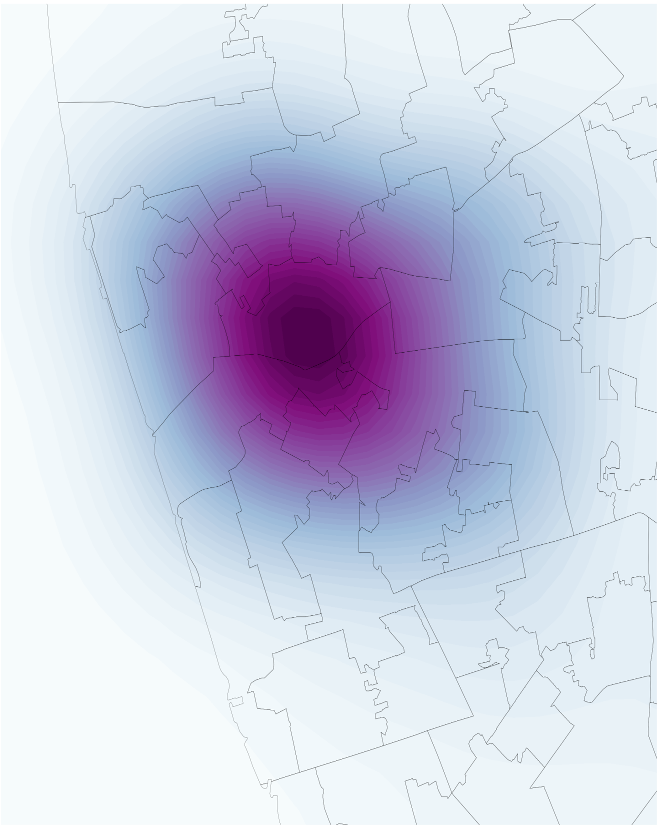
Bivariate (spatial) KDE

Probability of finding observations at a given point in space

- **Bivariate** version: distribution of **pairs of values**
- In **space**: values are coordinates (XY), locations
- Continuous “version” of a choropleth


pearsonr = 0.95; p = 9.1e-51
5
0
−5
−10
y
−3
−2
−1
0
1
2
3
x





Finding clusters of PPs

Concentrations/agglomerations of points over space, significantly more so than in the rest of the space considered

Huge literature spanning **spatial analysis**, **statistics** and **computer science**. Today, we’ll look at…

Density

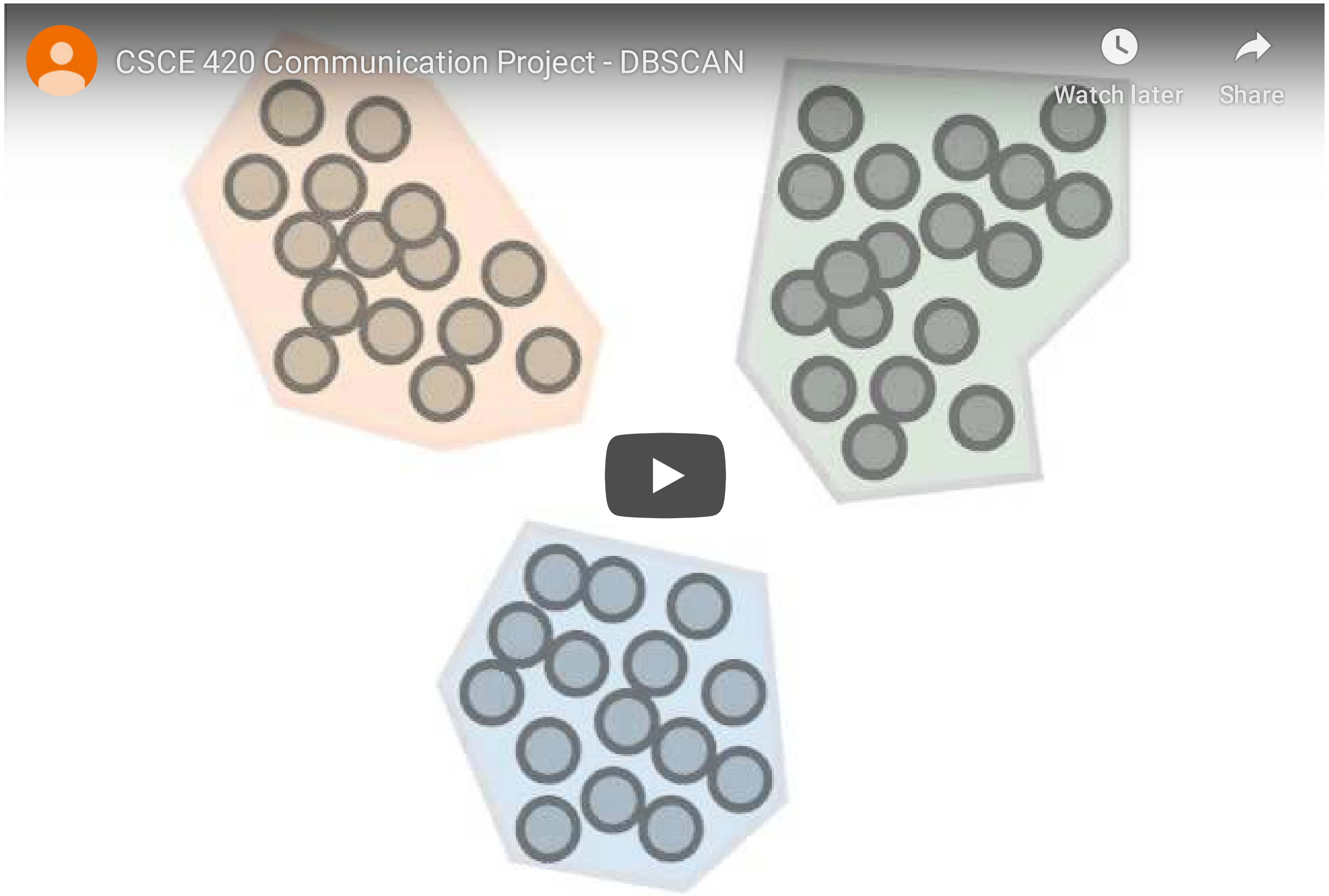
Based

Spatial

Clustering of

Applications with

Noise



CSCE 420 Communication Project - DBSCAN
Watch later
Share

DBSCAN

(Additional) **Pros:**

- Not necessarily spatial
- Very fast to run so → scales relatively well → applicable to large datasets

(Additional) **Cons:**

- Not based on any probabilistic model (no inference)
- Hard to learn about the underlying process

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