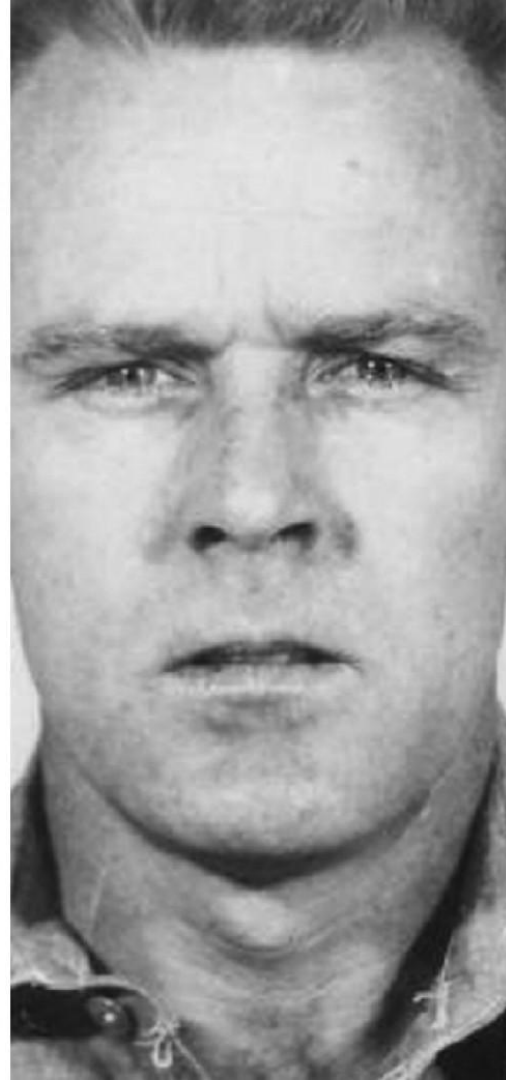


Space-time Mapping

New ways of exploring
and explaining data



Andy Eschbacher
@MrEPhysics
Map Scientist
CartoDB



Visualizing Escape Scenarios

From the
[Washington Post](#)

Angel Island, police search location

Paddle found here



Probable escape location

Escape from Alcatraz

Alcatraz

Golden Gate Bridge

Time of escape

● 20:00

● 21:00

● 22:00

● 23:00

● 00:00

● 01:00

● 02:00

03:00

● 04:00

Map by siggyf

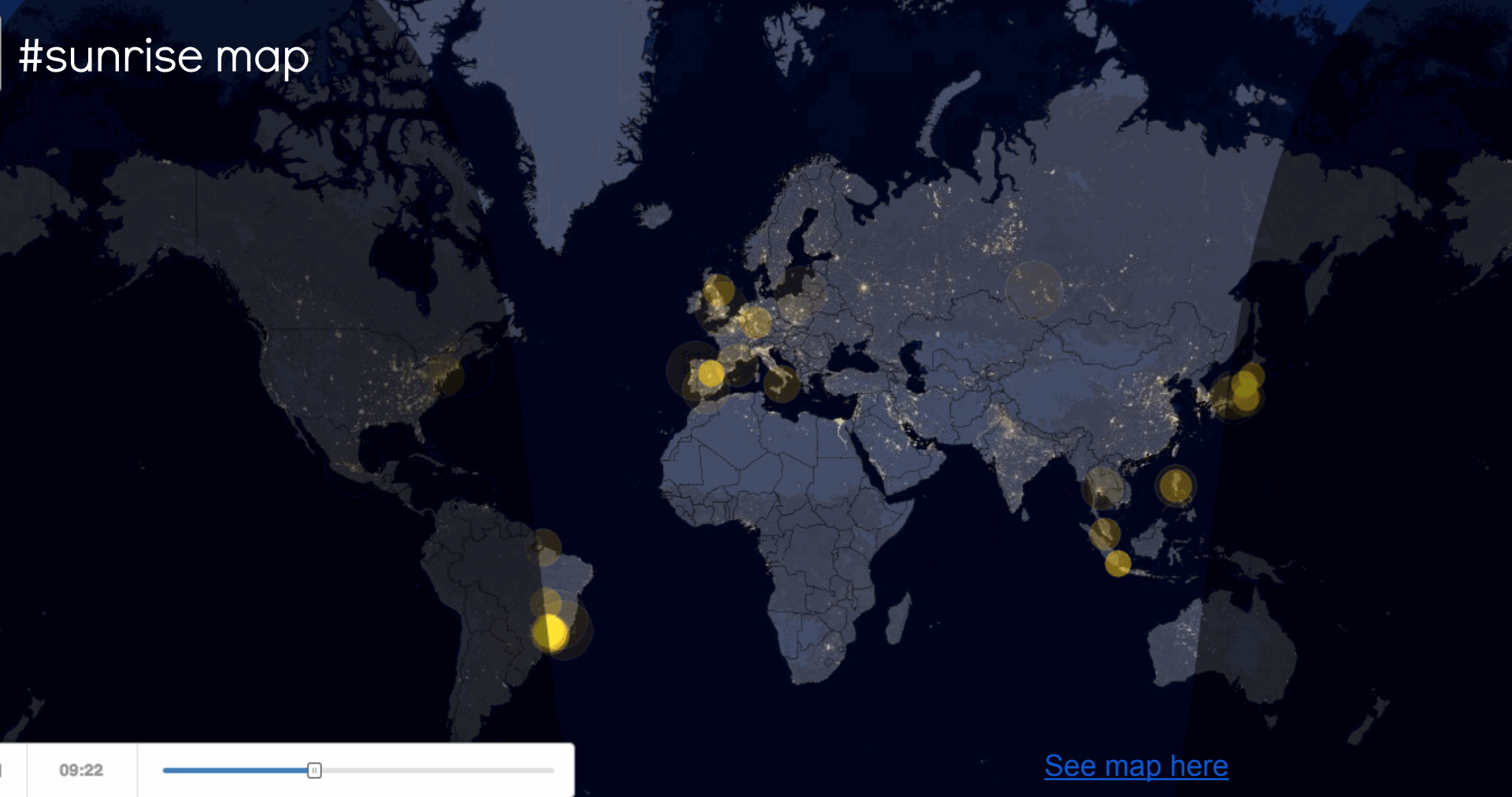
14:40

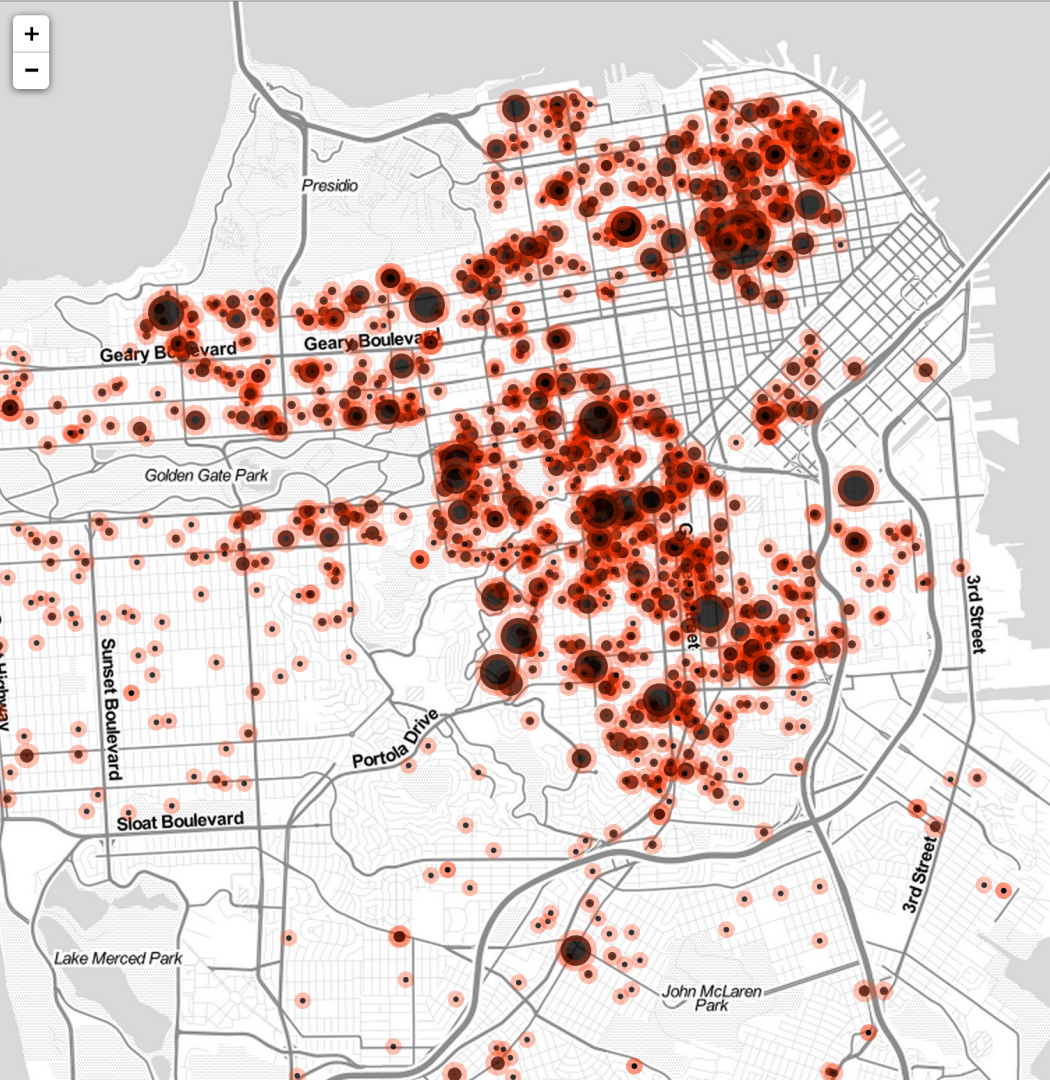


POWERED BY
CARTODB

© Mapbox © OpenStreetMap Improve this map, CartoDB attribution

#sunrise map





THE ELLIS ACT

3299

SAN FRANCISCO FAMILIES FORCED
OUT OF THEIR HOMES,
1/1/1997 - 7/27/2010



The Ellis Act is a state law which says that landlords have the right to evict tenants in order to "go out of business". All units in the building must be cleared of all tenants- no one can be singled out. Most often it is used to convert to condos or group-owned tenancy-in-common flats. Once a building becomes a condo it is exempt from Rent Control, regardless of the age of the building, and even if a unit owner subsequently rents to a long-term tenant.

There is no limit to the number of times a building owner can "go out of business".

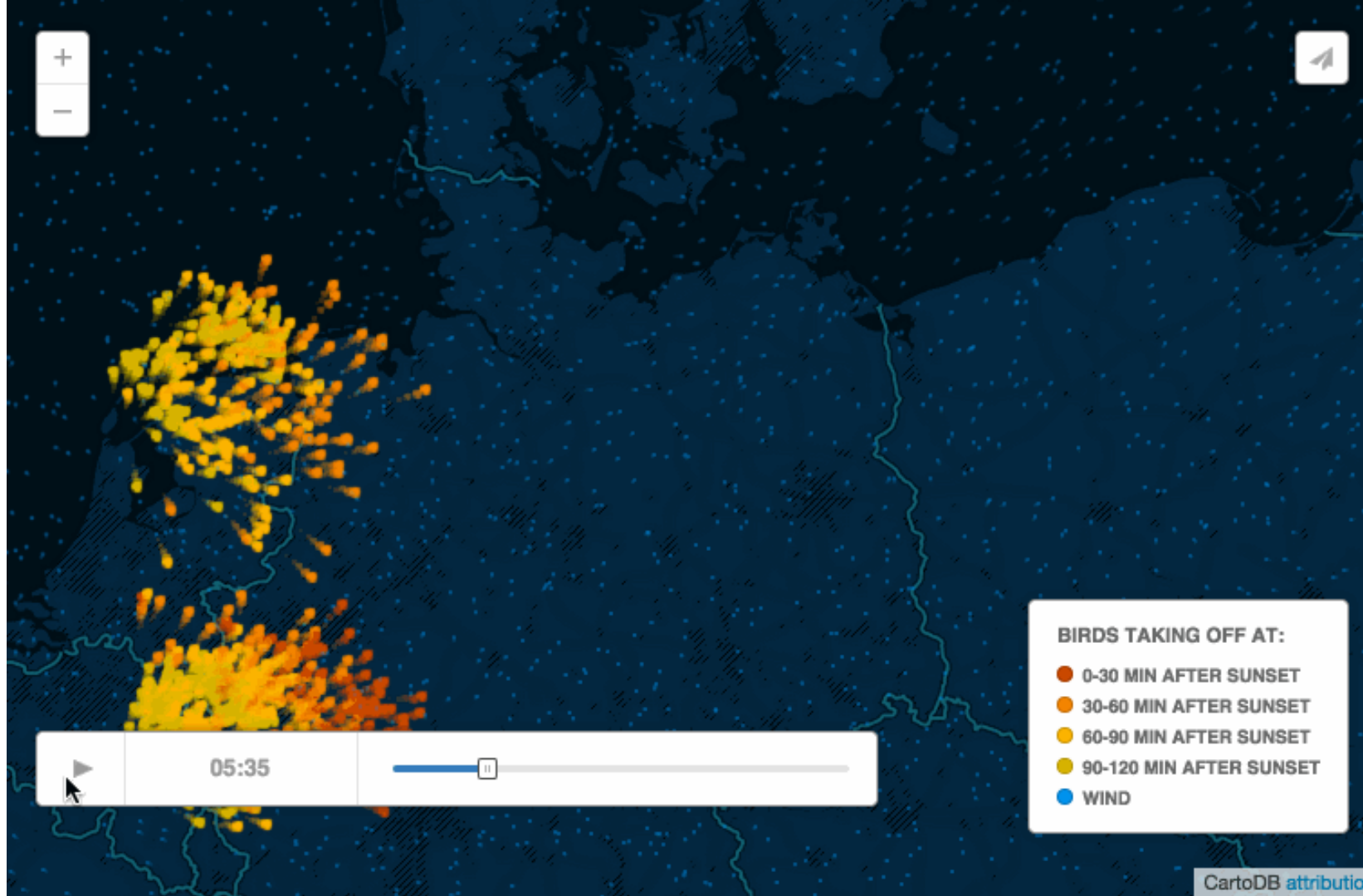
Rent Board data shows some owners buying and Ellis-ing multiple buildings over time. If these buyers do not want to be landlords, why are they buying buildings full of rental units? These Ellis-ed buildings - now "out of business"- are also showing up for rent as illegal vacation rentals on sites like AirBNB and VRBO.

With landlords looking for ways to avoid renting to long-term tenants, the housing crisis in San Francisco will only be exacerbated. See our [chart of no-fault evictions here](#).

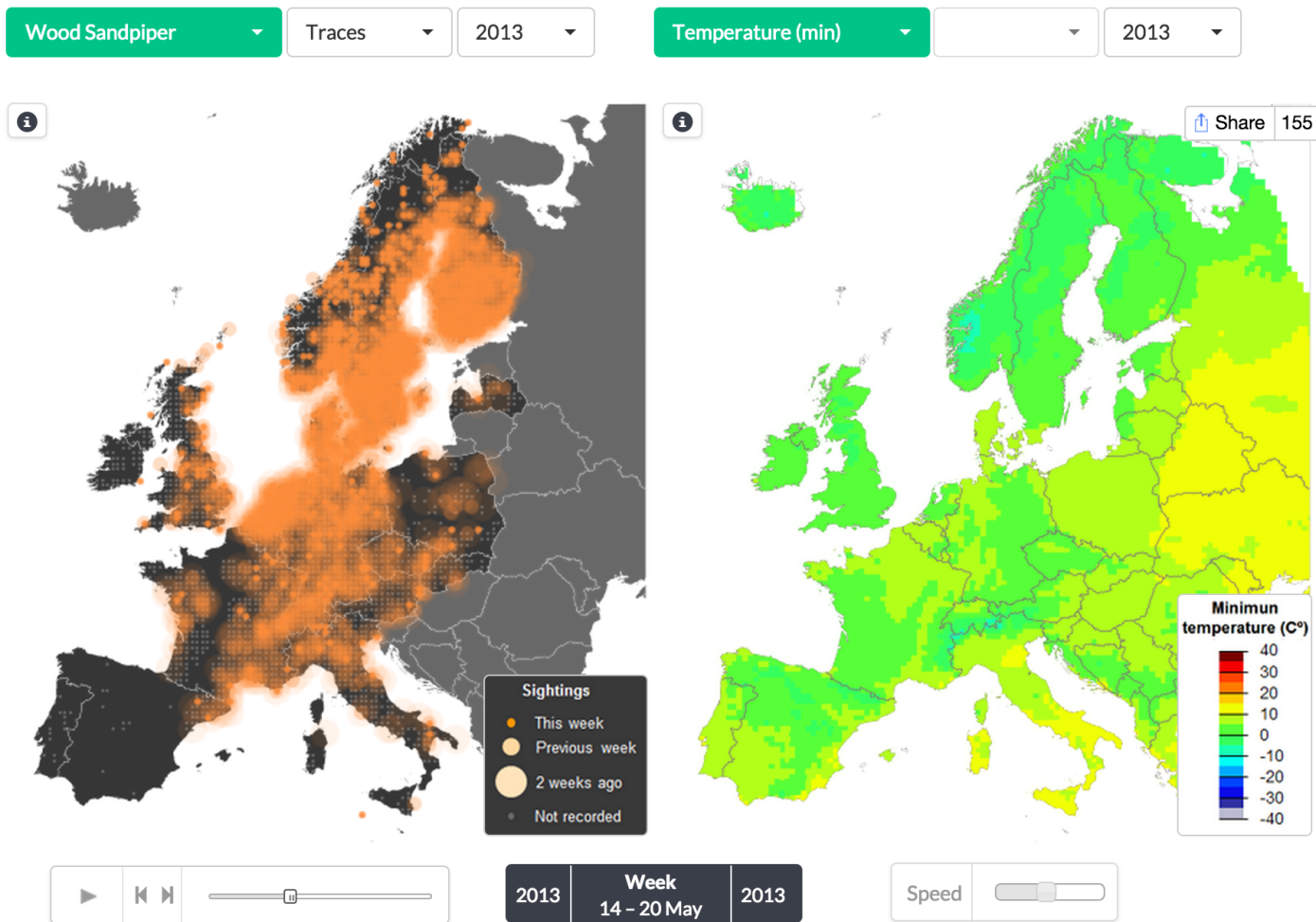
If you have been evicted, please fill out [our survey](#) to add your story to a comprehensive map in the making. [Leaflet](#)

Map by [Anti-Eviction Mapping Project](#)

Bird Migration Mapping



Bird Migration Mapping



GLOBAL
FOREST
WATCH
BETA

- FOREST CHANGE
- FOREST COVER
- FOREST USE
- CONSERVATION
- PEOPLE
- STORIES
- COUNTRY LAYERS

FOREST CHANGE

- Tree cover gain
- Tree cover loss

Displaying loss with > 30 % canopy density.

Tree cover loss is not always deforestation.

FOREST COVER

- Mangroves
- Tree cover

Displaying tree cover with > 30 % canopy density.

PEOPLE

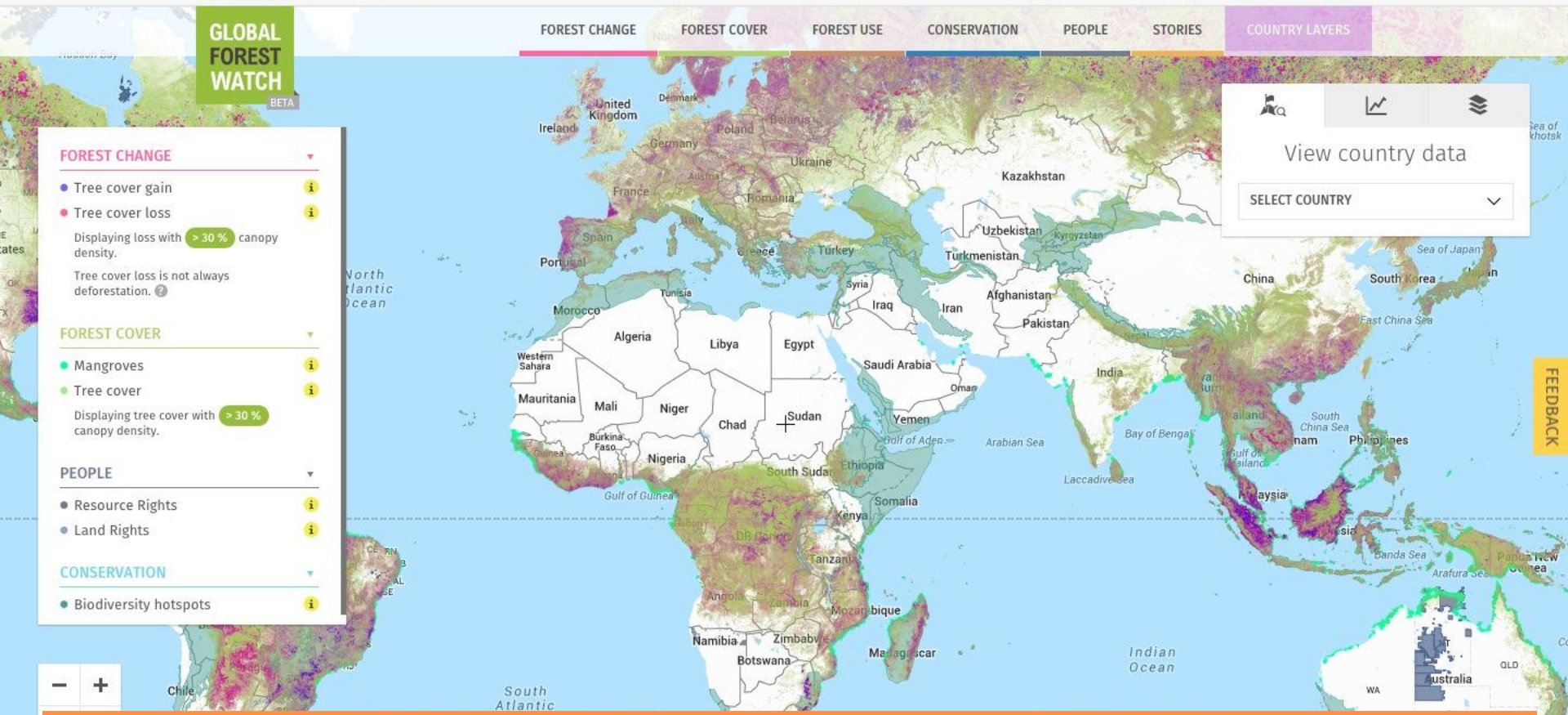
- Resource Rights
- Land Rights

CONSERVATION

- Biodiversity hotspots

View country data

SELECT COUNTRY



global forest watch, <http://www.globalforestwatch.org/>

Animated Web Maps are hard

... traditional data downloads lead to big bottlenecks

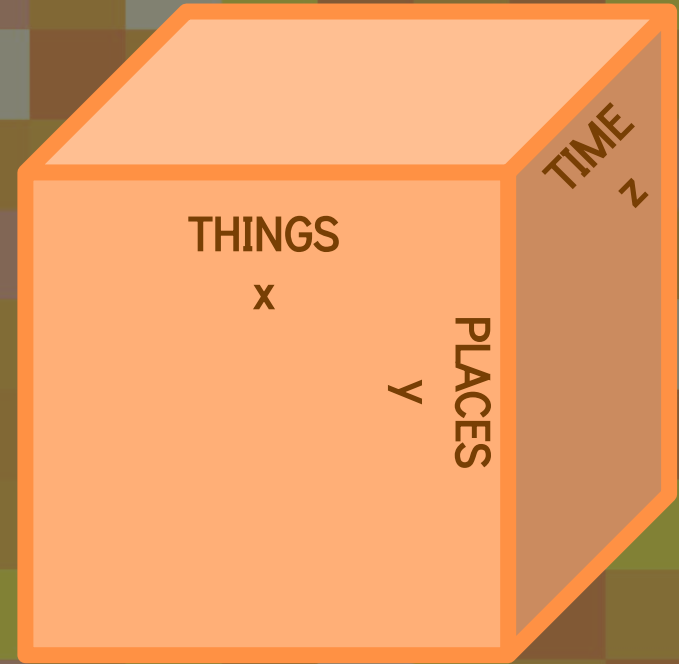
What's the minimal data dicing we can do?

Torque DataCube

flux capacitor for maps

slices of data on the client

~~tiling data~~, data^3



PRO

Fast

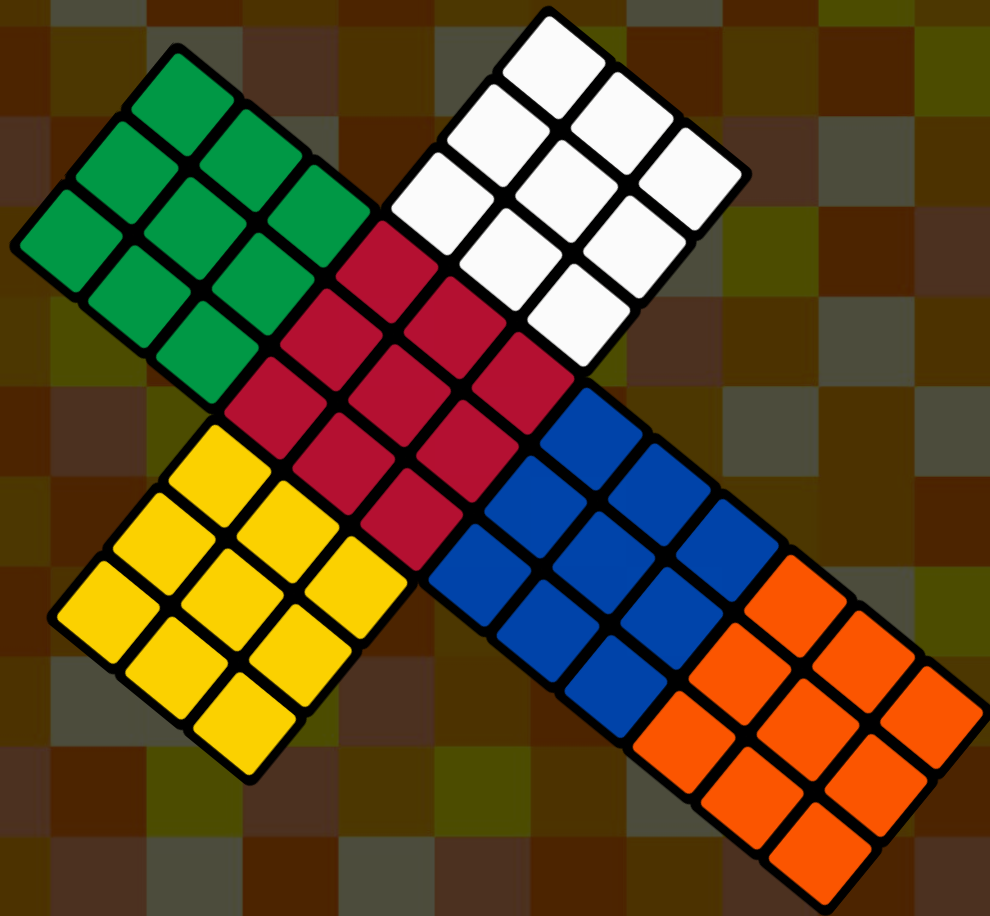
Light

Cached

CON

Slow for a lot of data

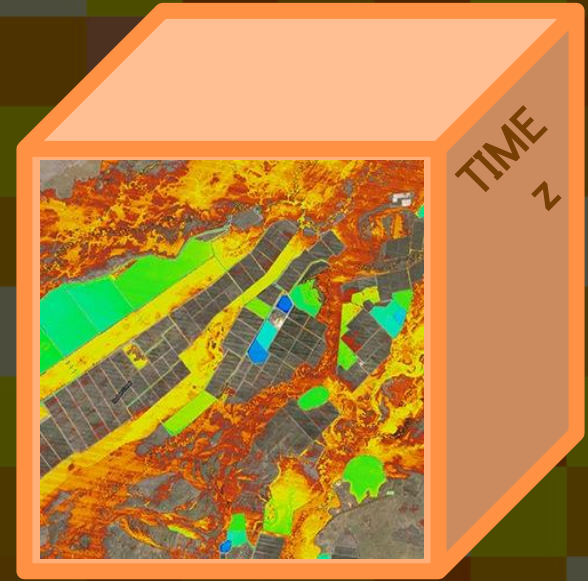
Lossy



Torque Timing

$$\text{floor}(\frac{\{\text{column_conv}\} - \{\text{start}\}}{\{\text{step}\}})$$

aka

$$(\text{curr_time} - \text{min_time}) / \text{number_steps}$$


Torque Encoding

delta encoding

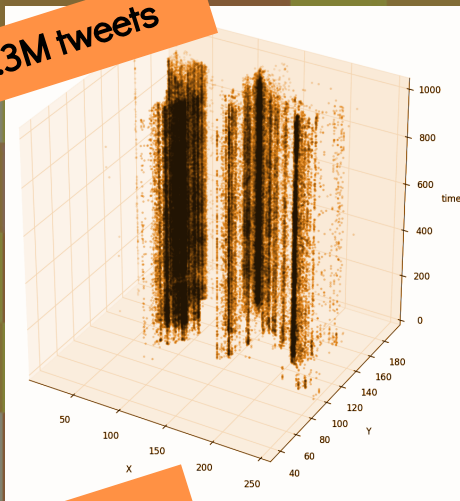
gzip compression

```
1 {  
2   x_uint8: [...],  
3   y_uint8: [...],  
4   vals_uint8: [...],  
5   dates_uint16 : [...],  
6 }
```

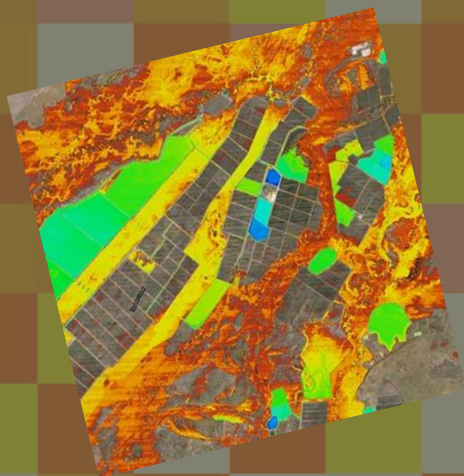
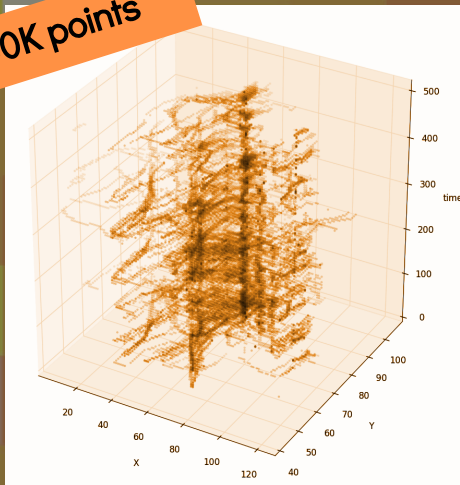
binning by step

```
1 {  
2   0: {  
3     x_uint8: [...],  
4     y_uint8: [...],  
5     vals_uint8: [...],  
6   },  
7   1: {...}  
8 }
```

1.3M tweets



800K points



```

1 WITH par AS (" +
2   "WITH innerpar AS (" +
3     "SELECT " +
4     "1.0/({xyz_resolution})*{resolution} as resinv, " +
5     "ST_MakeEnvelope({b_xmin}, {b_ymin}, {b_xmax}, {b_ymax}, {srid}) as b_ext, " +
6     "ST_MakeEnvelope({xmin}, {ymin}, {xmax}, {ymax}, {srid}) as ext" +
7   ") " +
8   "SELECT " +
9     "({xyz_resolution})*{resolution} as res, " +
10    "innerpar.resinv as resinv, " +
11    "innerpar.b_ext as b_ext, " +
12    "st_xmin(innerpar.ext) as xmin, " +
13    "st_ymin(innerpar.ext) as ymin, " +
14    "round((st_xmax(innerpar.ext) - st_xmin(innerpar.ext))*innerpar.resinv) - 1 as maxx, " +
15    "round((st_ymax(innerpar.ext) - st_ymin(innerpar.ext))*innerpar.resinv) - 1 as maxy " +
16    "FROM innerpar" +
17  ") " +
18  "SELECT xx x_uint8, " +
19    "yy y_uint8, " +
20    "array_agg(c) vals_uint8, " +
21    "array_agg(d) dates_uint16 " +
22  "FROM ( " +
23  "select " +
24    "GREATEST(0 - {b_size}, LEAST(p.maxx + {b_size}, round((st_x(i.{gcol}) - p.xmin)*resinv))) as xx, " +
25    "GREATEST(0 - {b_size}, LEAST(p.maxy + {b_size}, round((st_y(i.{gcol}) - p.ymin)*resinv))) as yy " +
26    ", {countby} c " +
27    ", floor(({column_conv} - {start})/{step}) d " +
28    "FROM ({_sql}) i, par p " +
29    "WHERE i.{gcol} && p.b_ext " +
30    stepFilter(attrs) +

```

Windshaft, Torque Renderer.js: <https://github.com/CartoDB/Windshaft/>

```

8  "SELECT " +
9  "({xyz_resolution})*{resolution} as res, " +
10 "innerpar.resinv as resinv, " +
11 "innerpar.b_ext as b_ext, " +
12 "st_xmin(innerpar.ext) as xmin, " +
13 "st_ymin(innerpar.ext) as ymin, " +
14 "round((st_xmax(innerpar.ext) - st_xmin(innerpar.ext))*innerpar.resinv) - 1 as maxx,
15 "round((st_ymax(innerpar.ext) - st_ymin(innerpar.ext))*innerpar.resinv) - 1 as maxy
16 "FROM innerpar" +
17 ") " +
18 "SELECT xx x_uint8, " +
19 "yy y_uint8, " +
20 "array_agg(c) vals_uint8, " +
21 "array_agg(d) dates_uint16 " +
22 "FROM ( " +
23 "select " +
24 "GREATEST(0 - {b_size}, LEAST(p.maxx + {b_size}, round((st_x(i.{gcol}) - p.xmin)*resinv))
25 "GREATEST(0 - {b_size}, LEAST(p.maxy + {b_size}, round((st_y(i.{gcol}) - p.ymin)*resinv))
26 "{countby} c " +
27 ", floor(({column_conv} - {start})/{step}) d " +
28 "FROM ({_sql}) i, par p " +
29 "WHERE i.{gcol} && p.b_ext " +
30 stepFilter(attrs) +
31 "GROUP BY xx, yy, d " +
32 ") cte, par " +
33 "GROUP BY x_uint8, y_uint8,

```

Aggregation happens here




```

1 WITH par AS (" +
2     "WITH innerpar AS (" +
3         "SELECT " +
4             "1.0/(({xyz_resolution})*{resolution})" +
5             "ST_MakeEnvelope({b_xmin}, {b_ymin}, {" +
6             "ST_MakeEnvelope({xmin}, {ymin}, {xmax}
7         ") " +
8         "SELECT " +
9             "({xyz_resolution})*{resolution} as res, " +
10            "innerpar.resinv as resinv, " +
11            "innerpar.b_ext as b_ext, " +
12            "st_xmin(innerpar.ext) as xmin, " +
13            "st_ymin(innerpar.ext) as ymin, " +
14            "round((st_xmax(innerpar.ext) - st_xmin(in
15            "round((st_ymax(innerpar.ext) - st_ymin(in
16        "FROM innerpar" +
17    ") " +
18    "SELECT xx x_uint8, " +
19        "yy y_uint8, " +
20        "array_agg(c) vals_uint8, " +
21        "array_agg(d) dates_uint16 " +
22    "FROM ( " +
23    "select " +
24        "GREATEST(0 - {b_size}, LEAST(p.maxx + {b_size}
25        "GREATEST(0 - {b_size}, LEAST(p.maxy + {b_size}
26        ", {countby} c " +
27        ", floor(({column_conv} - {start})/{step}) d "
28    "FROM ({_sql}) i, par p " +
29    "WHERE i.{gcol} && p.b_ext " +
30    stepFilter(attrs) +
31    "GROUP BY xx, yy, d " +
32    ") cte, par " +
33    "GROUP BY x_uint8, y_uint8;

```

```
/** torque visualization */
```

```
Map {
```

```

-torque-frame-count:696;
-torque-animation-duration:60;
-torque-time-attribute:"date_col";
-torque-aggregation-function:"count(cartodb_
-torque-resolution:16;
-torque-data-aggregation:linear;
}

```

```
#hail_copy{
```

```

marker-fill-opacity: 1;
marker-type: rectangle;
marker-width: 8;
marker-fill: #FFCC00;
}

```

```
#hail_copy[value<90]{
```

```
marker-fill-opacity: 0.9;
```

```
}
```

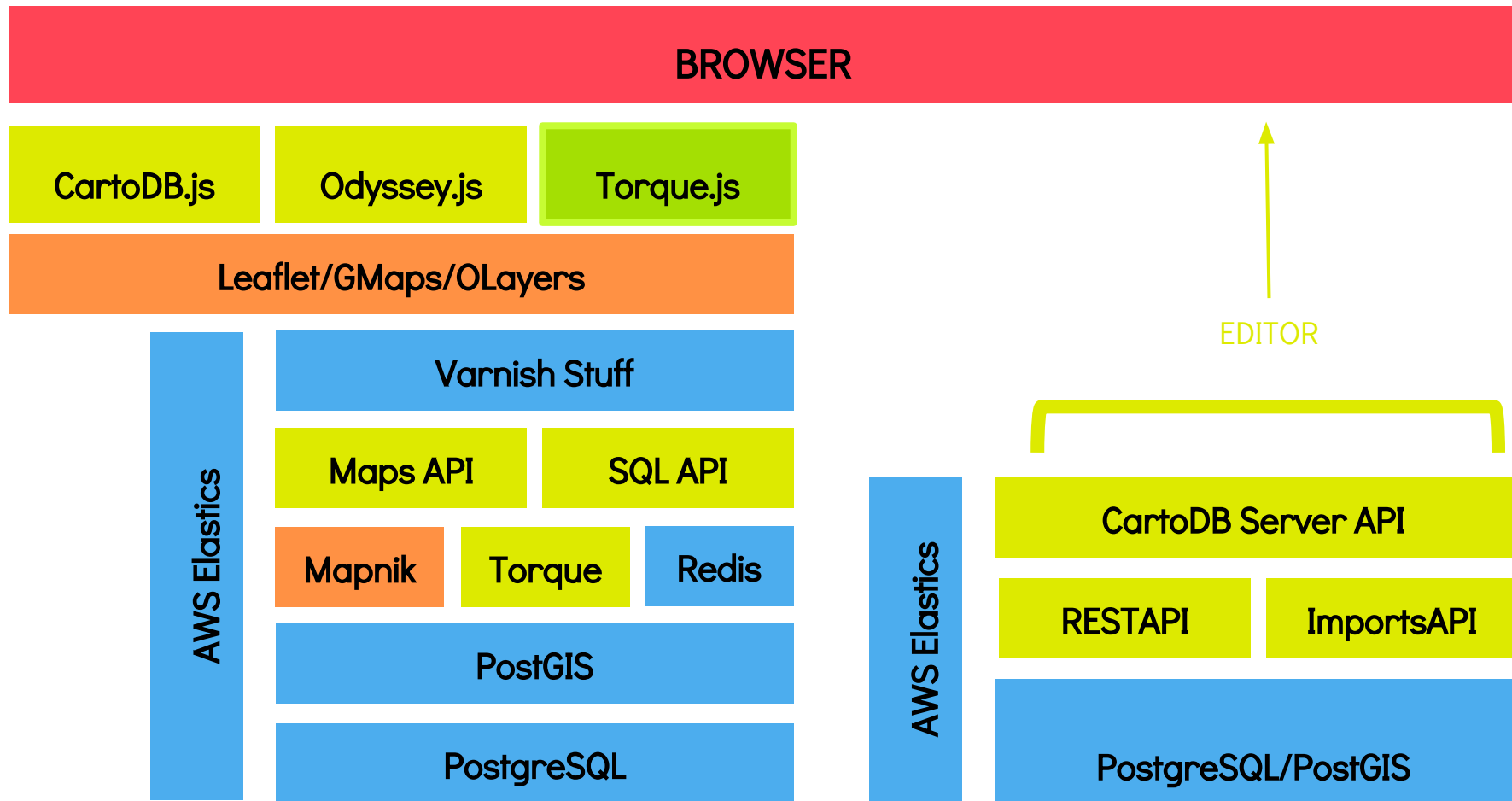
```
#hail_copy[value<45]{
```

```
marker-fill-opacity: 0.8;
```

```
}
```

```
#hail_copy[value<23]{
```

```
marker-fill-opacity: 0.7;
```



Experiments with Torque's renderer

See [Torque's render code](#)



This repository Search

Pull requests Issues Gist



CartoDB / **torque**

Unwatch

69

★ Unstar

245

Fork

86

Branch: master

torque / lib / torque / **renderer** / +



uses capitals for constants like a normal human being



fdansv authored on May 5

latest commit 9c17d7a1bc



..



[cartocss_render.js](#)

uses capitals for constants like a normal human being

4 months ago



[index.js](#)

Export renderers

9 months ago



[point.js](#)

uses capitals for constants like a normal human being

4 months ago



[rectangle.js](#)

Renderer.renderTile now accepts an optional {Function} callback param...

7 months ago



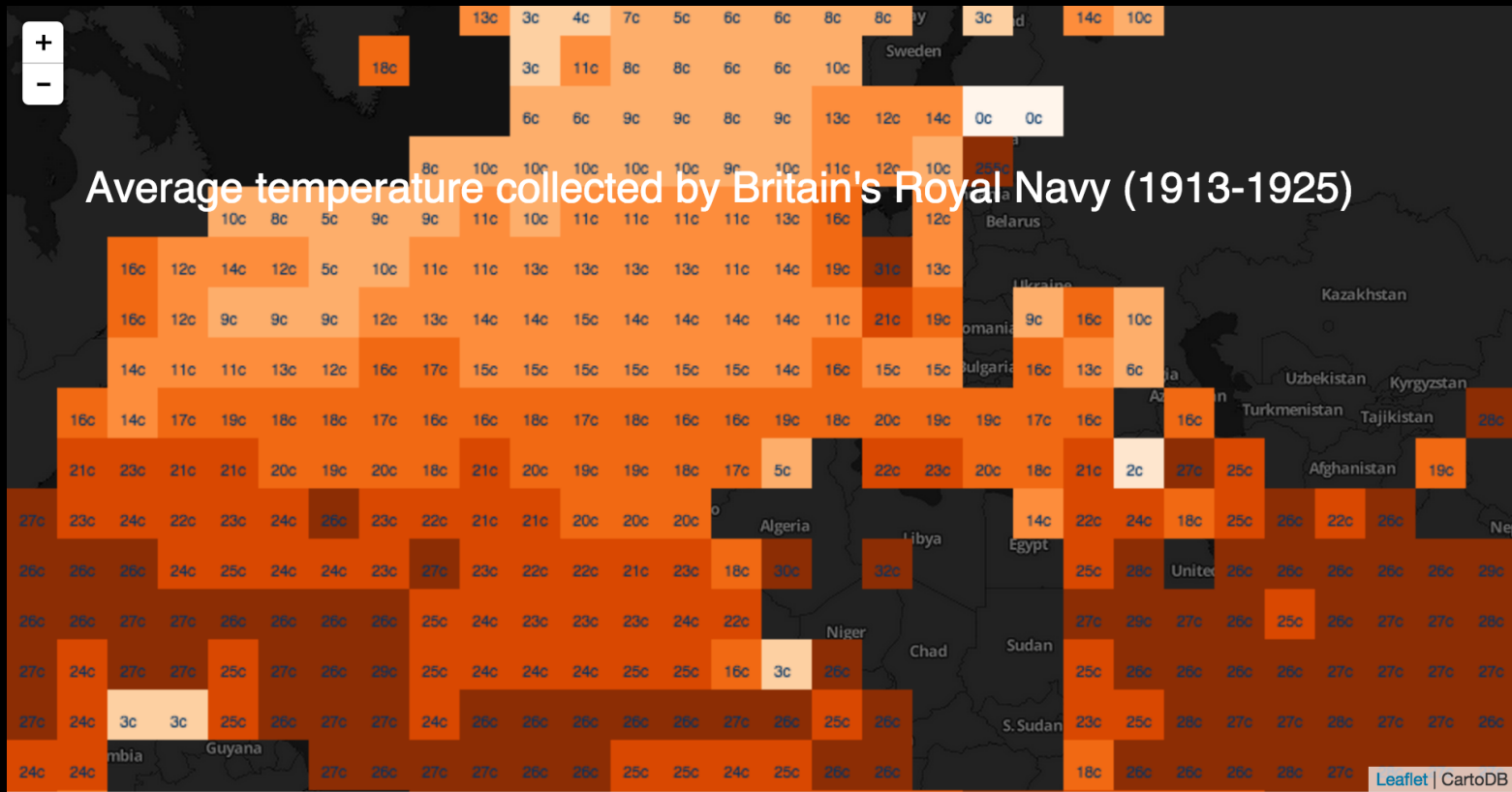
[torque_filters.js](#)

Make torque_filters accept options param to add canvasClass

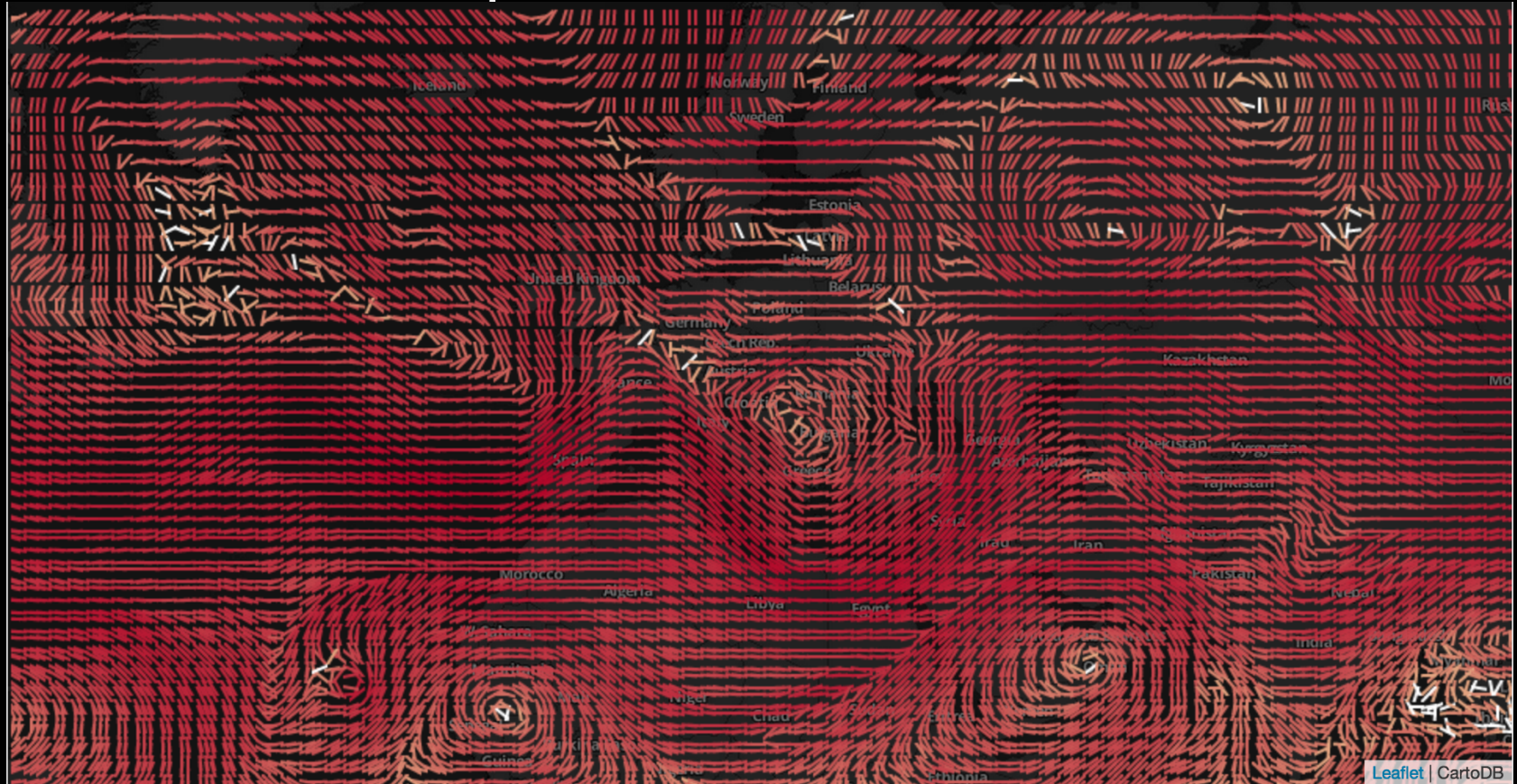
7 months ago



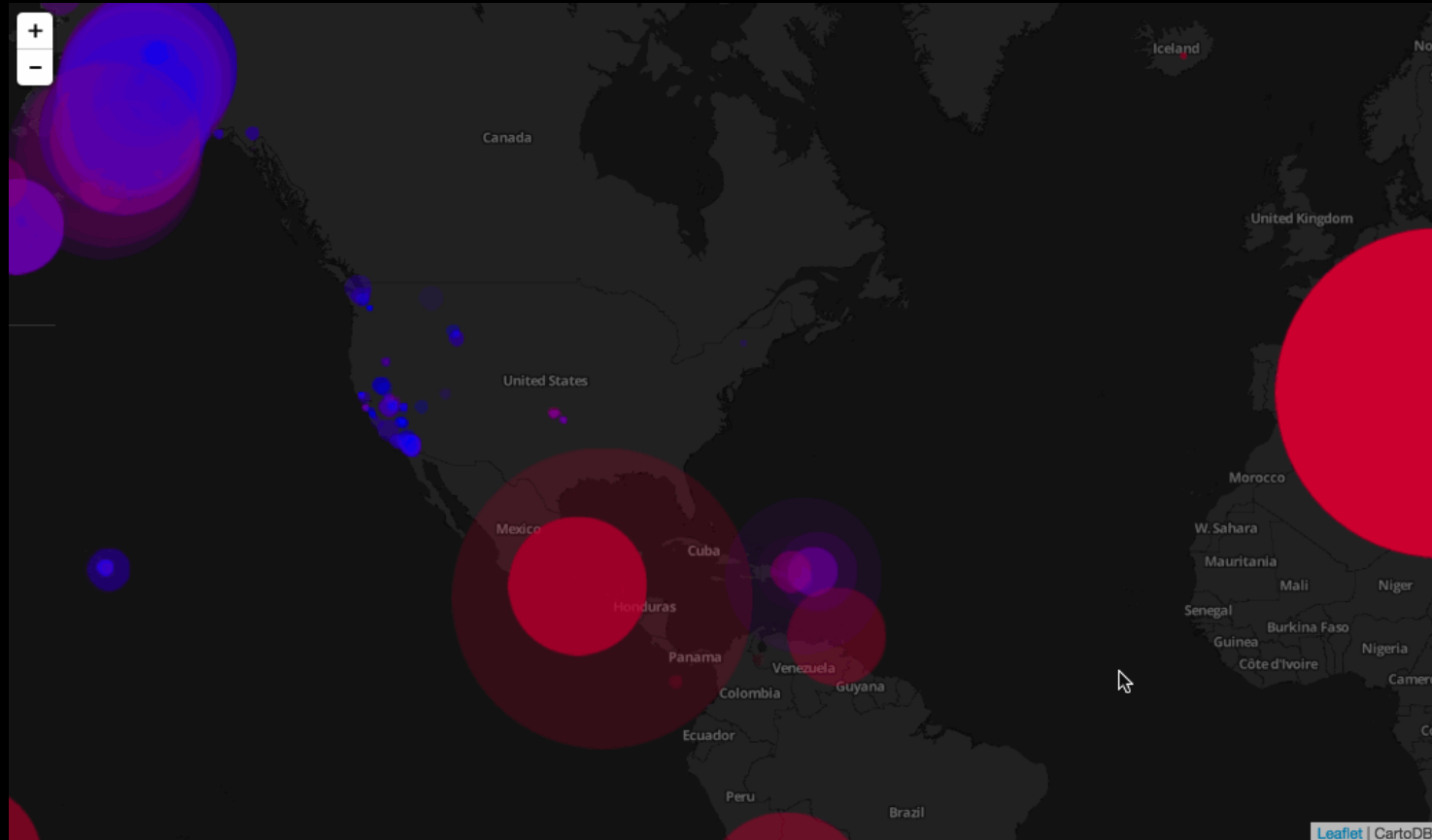
Torque with Labels



Torque with Vectors



Multivariate Torque



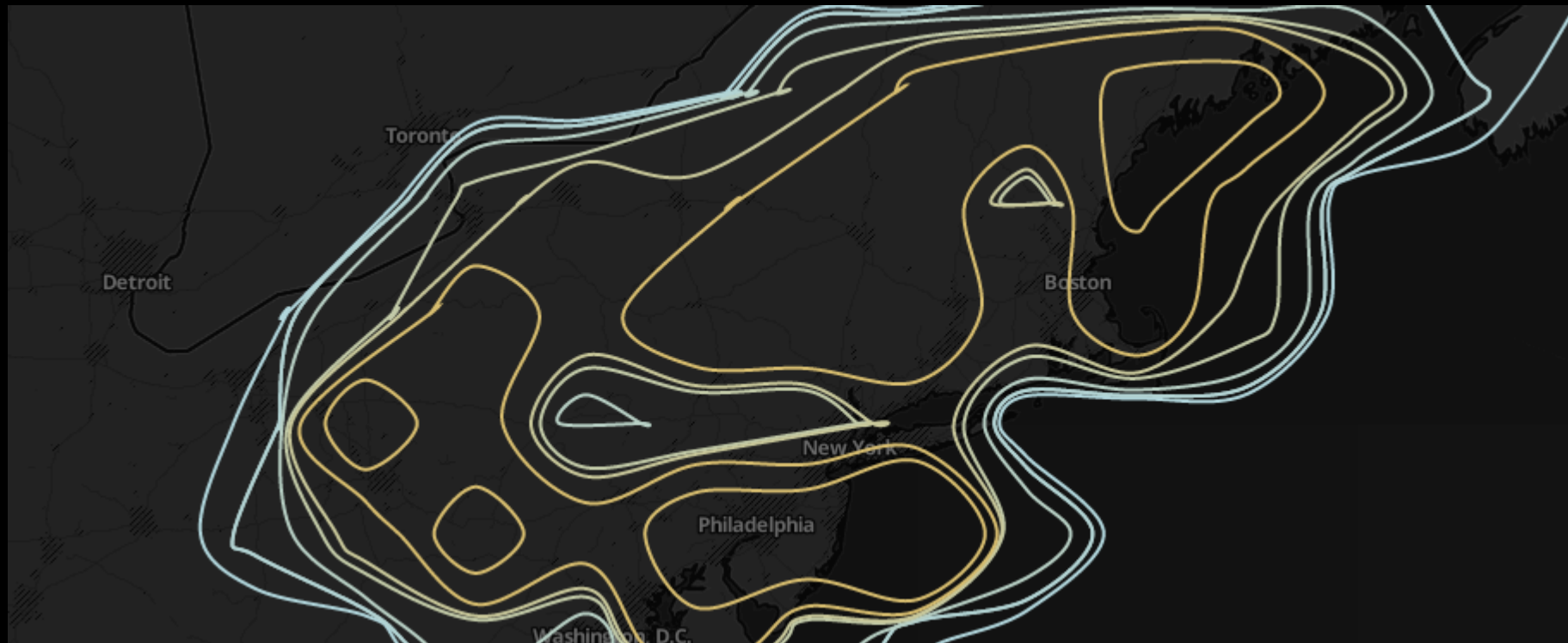
Leaflet | CartoDB

Map by Stuart Lynn

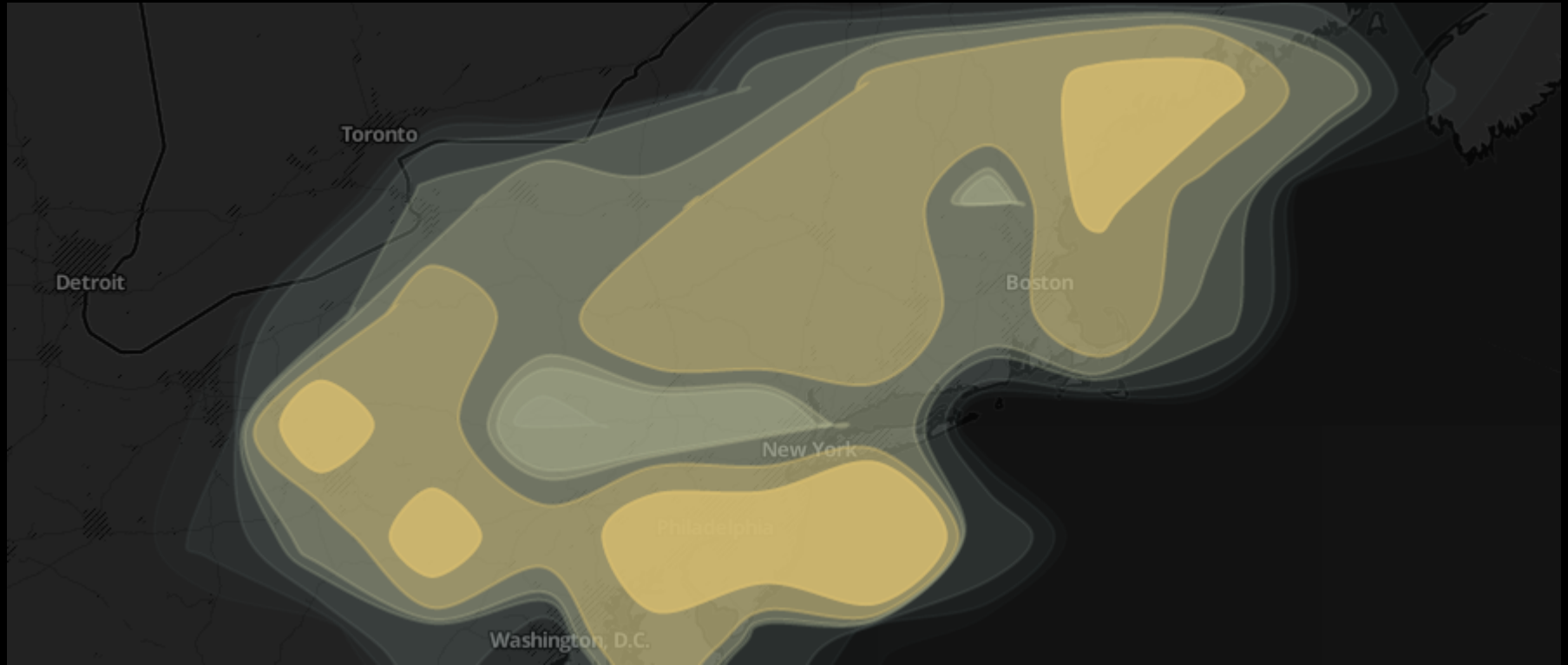
Isoline Tests



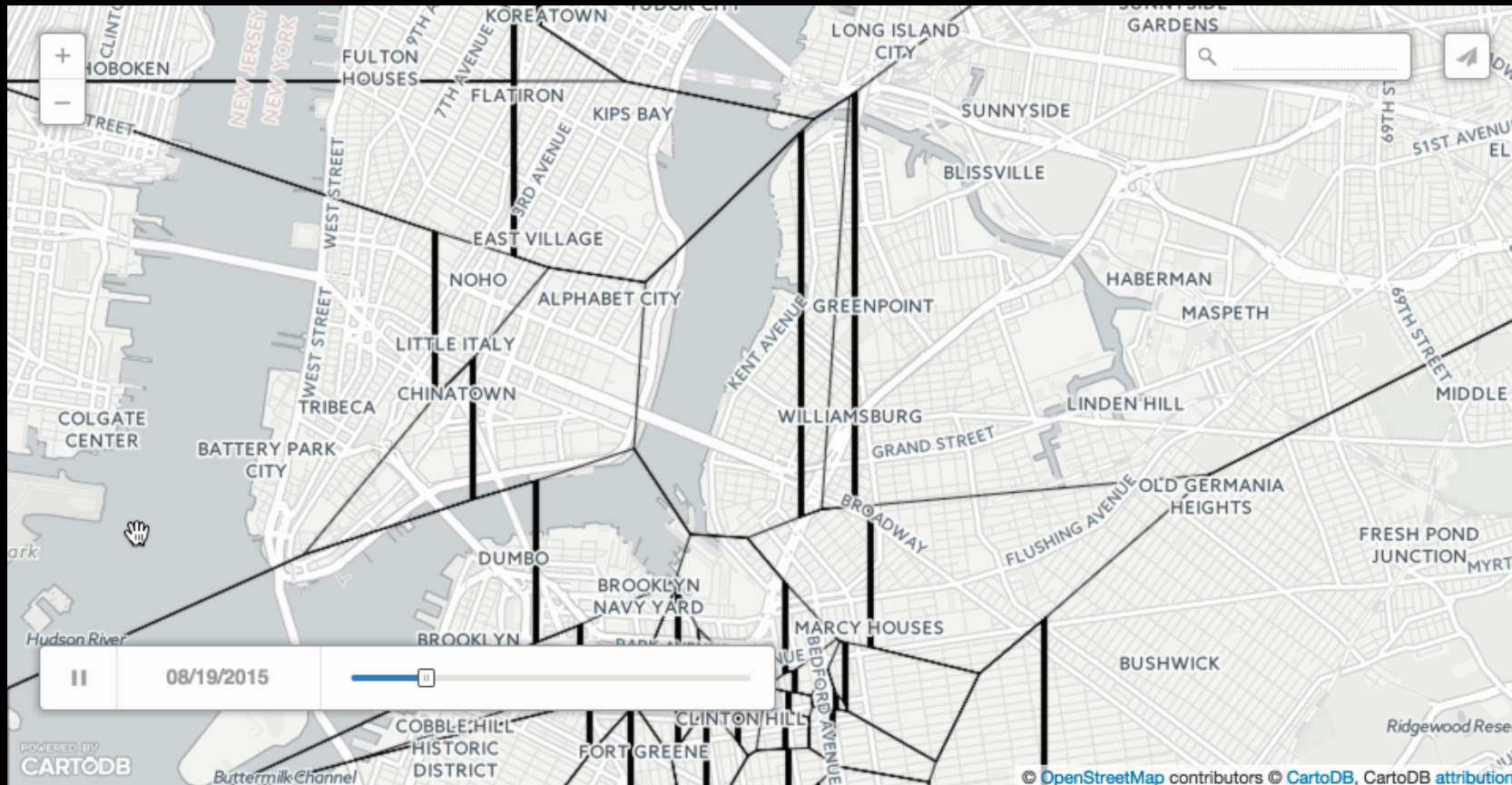
Isoline Tests



Isoband Tests



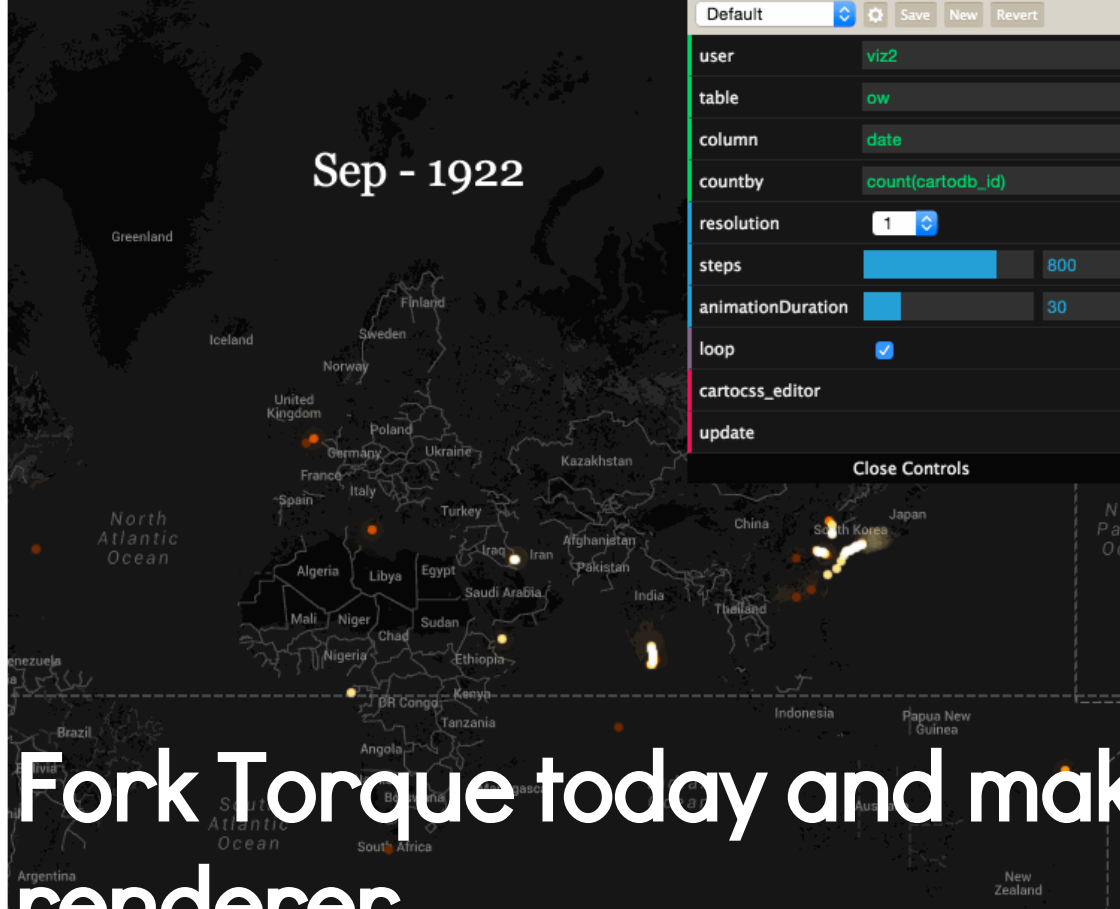
Torque with D3



```

#layer {
  marker-width: 3;
  marker-fill: #FEE391;
  [value > 2] { marker-fill: #FEC44F; }
  [value > 3] { marker-fill: #FE9929; }
  [value > 4] { marker-fill: #EC7014; }
  [value > 5] { marker-fill: #CC4C02; }
  [value > 6] { marker-fill: #993404; }
  [value > 7] { marker-fill: #662506; }
  [frame-offset = 1] {
    marker-width: 8;
    marker-fill-opacity: 0.05;
  }
  [frame-offset = 2] {
    marker-width: 20;
    marker-fill-opacity: 0.02;
  }
}

```



Fork Torque today and make a renderer

<https://github.com/CartoDB/torque>

Thank you to Javi Santana,
Stuart Lynn, Francisco Dans,
and Aurelia Moser for
helping with materials for this
talk.

View my slides at <http://bit.ly/cdb-torque>