

# WEB-MAPPING FOR PUBLIC HEALTH

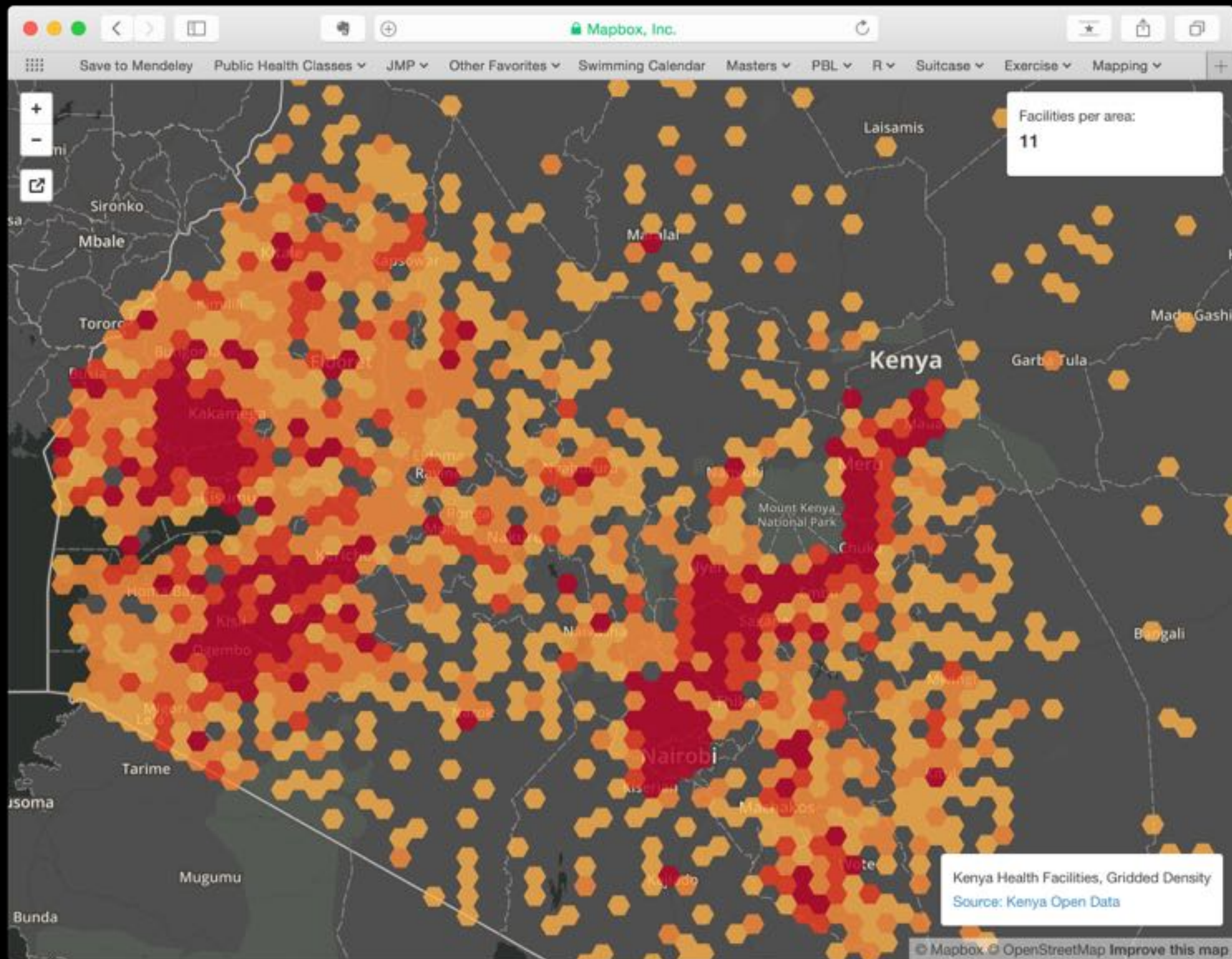
JOSH PEPPER | JRPEPPER@GMAIL.COM  
JOINT MEDICAL PROGRAM

Welcome! While we wait, please:

- Create an account at <https://cartodb.com/signup?plan=academy>
- Download file from: <http://tinyurl.com/publichealthmapping>



# Density of Health Facilities in Kenya



<https://www.mapbox.com/blog/open-source-to-map-health-data/>



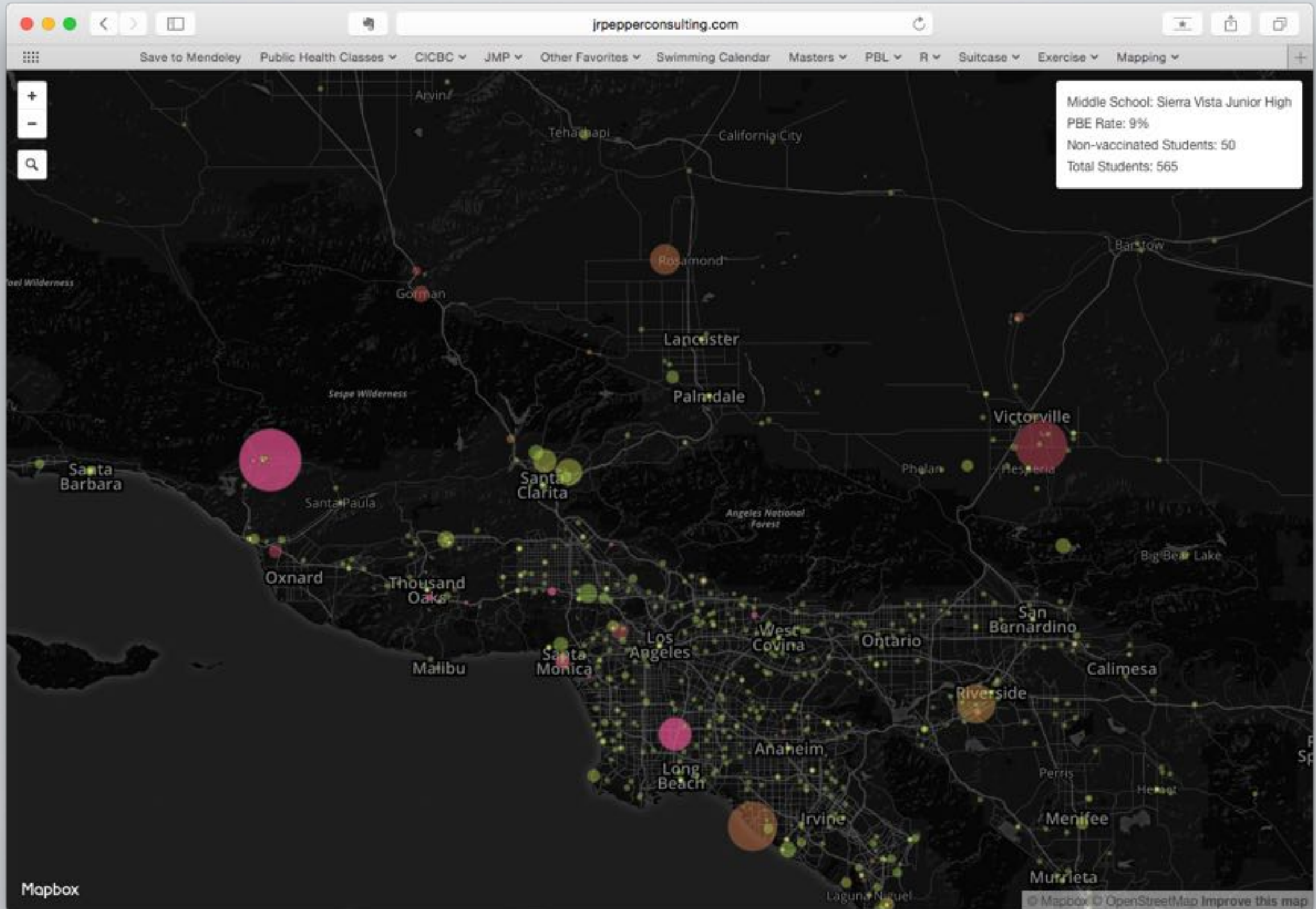
# Superfund Sites

The screenshot shows the TOXMAP web application interface. The browser address bar displays `toxmap.nlm.nih.gov`. The top navigation bar includes links for 'Save to Mendeley', 'Public Health Classes', 'JMP', 'Other Favorites', 'Swimming Calendar', 'Masters', 'PBL', 'R', 'Suitcase', 'Exercise', and 'Mapping'. The main navigation bar features icons for 'Home', 'Start Over', 'Zoom to Location', 'Search', 'US Census & Health Data', 'Bookmarks', 'Chemical Information', 'Print', and 'Help'. The left sidebar, titled 'Map Contents', includes a 'Hide' button and a 'Browse TOXMAP' section. Under 'Browse TOXMAP', there is a note: 'Click check boxes to turn ON / OFF map data. For other TRI years, use the Search Tool'. The 'TOXMAP Data' section contains several categories with checkboxes: 'All TRI Facilities (1988-2013)', 'TRI Facilities - 2013', 'Superfund National Priority List', 'NPRI (Canada Only) - 1994-2013', and 'Other'. The 'Other' category includes 'Nuclear plants (commercial)', 'Hospitals (zoom in)', '113th Congressional Districts', and 'EPA Coal Plants 2013'. The main map area shows a geographical view of California with various cities and Superfund sites marked with blue dots. A pop-up window titled 'Superfund Site Details' is open over the Concord Naval Weapons Station, displaying the following information: Site Name: CONCORD NAVAL WEAPONS STATION, Site ID: 0902778, EPA ID: CA7170024528, Status: Final, Address: PORT CHICAGO HWY CONCORD, CA 94520. The pop-up also includes 'more...' and 'close' links. The map includes a scale bar (0 to 40 km / 0 to 20 mi) and a 'Powered by esri' logo in the bottom right corner.

<http://toxmap.nlm.nih.gov/toxmap/flex/>



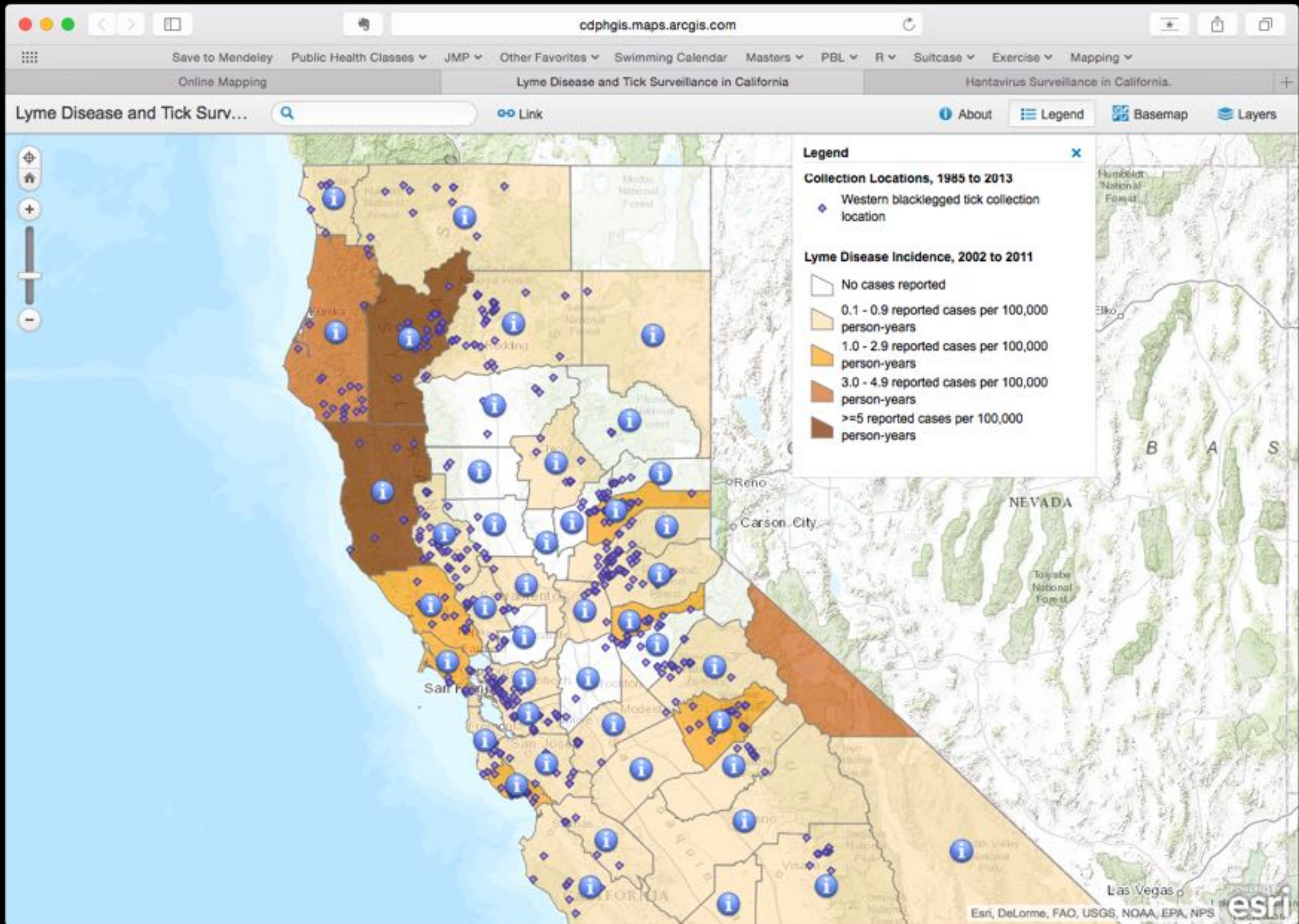
# Immunizations



<http://jrpepperconsulting.com/mapping/pbe/>

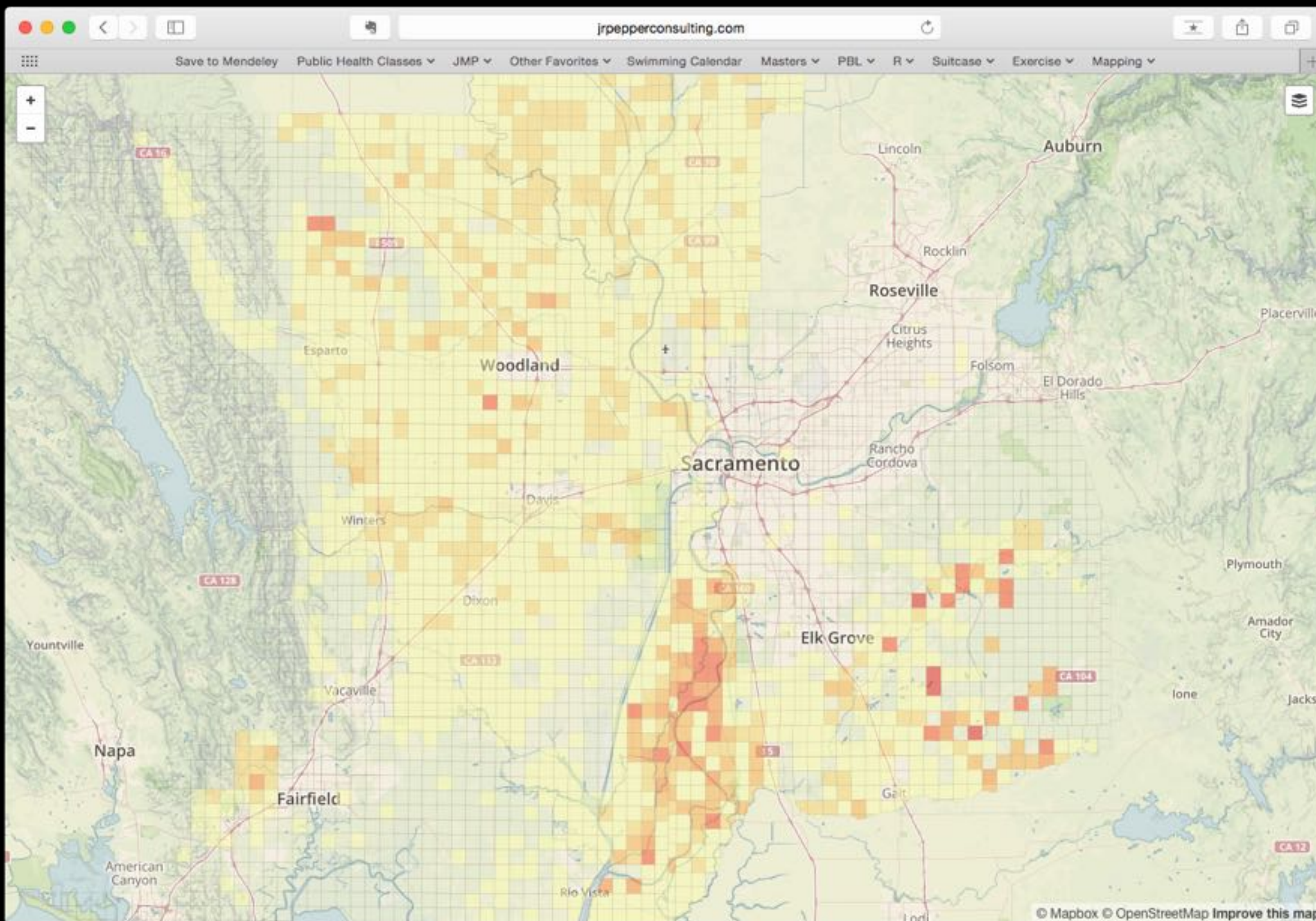


# Lyme Disease





# Pesticide Use



<http://jrpepperconsulting.com/mapping/woodland/>



# Asthma

cehtp.org

Save to Mondeley Public Health Classes JMP Other Favorites Swimming Calendar Masters PBL R Suitcase Exercise Mapping

## Asthma Hospitalization and Emergency Department Visits Query Results

This query system automatically generates a **table, map, and chart** using the criteria you have chosen. To see the data in your desired format, click on the corresponding tabs below. View the **Info** tab to learn about the data and how they can be used. View the **Sources** tab for information about the underlying data sources.

To **modify your query**, click on the yellow box to the right. Options for **other ways to visualize the data** are listed on the right side bar.

**Table** **Map** **Chart** **Info** **Sources**

**Hospitalizations due to asthma in California by County, All Races/Ethnicities, All Ages, Both Sexes, 2012** [Notes]

**Age Adj. Rate per 10,000**

- 16.8 +
- 12.6 - 16.8
- 8.4 - 12.6
- 4.2 - 8.4
- 0 - 4.2
- No Data

Labels: **On** | **Off**

DN - Del Norte SK - Siskiyou MD - Mendocino  
 HU - Humboldt TR - Trinity SH - Shasta LS - Lassen  
 TE - Tehama PM - Plumas  
 BU - Butte GL - Glenn CO - Colusa YU - Yuba  
 SU - Sutter NE - Nevada SF - San Francisco  
 PL - Placer SH - Shasta SI - Sierra SJ - San Joaquin  
 ED - El Dorado AP - Alpine TO - Tuolumne  
 CA - Calaveras SA - Santa Ana AM - Amador  
 CC - Contra Costa CC - Contra Costa SS - Stanislaus  
 AL - Alameda AL - Alameda ME - Merced MA - Madera  
 DN - Del Norte KN - Kern LA - Los Angeles  
 FR - Fresno LK - Lake LS - Lassen  
 HU - Humboldt MA - Madera MD - Mendocino  
 IN - Inyo ME - Merced

MN - Mono PM - Plumas SM - San Mateo  
 MO - Modoc RI - Riverside SN - Sonoma  
 MP - Mariposa SA - Sacramento SO - Solano  
 MR - Marin SB - Santa Barbara SRI - San Bernardino  
 MT - Monterey SC - Santa Clara SS - Stanislaus  
 NA - Napa SD - San Diego ST - San Benito  
 NE - Nevada SF - San Francisco SU - Sutter  
 OR - Orange SH - Shasta SJ - San Joaquin  
 PL - Placer SI - Sierra SK - Siskiyou  
 SL - San Luis Obispo SL - San Luis Obispo TU - Tulare  
 VE - Ventura YU - Yuba

1. [View time series of this indicator for San Bernardino](#)  
 2. [View all indicators for San Bernardino](#)

**Modify Your Query** **Print... Export...**

- To see more-detailed county-specific data, click on the county name in the Table tab
- Produce estimates for areas where data are sparse
- Request more Asthma information from CEHTP

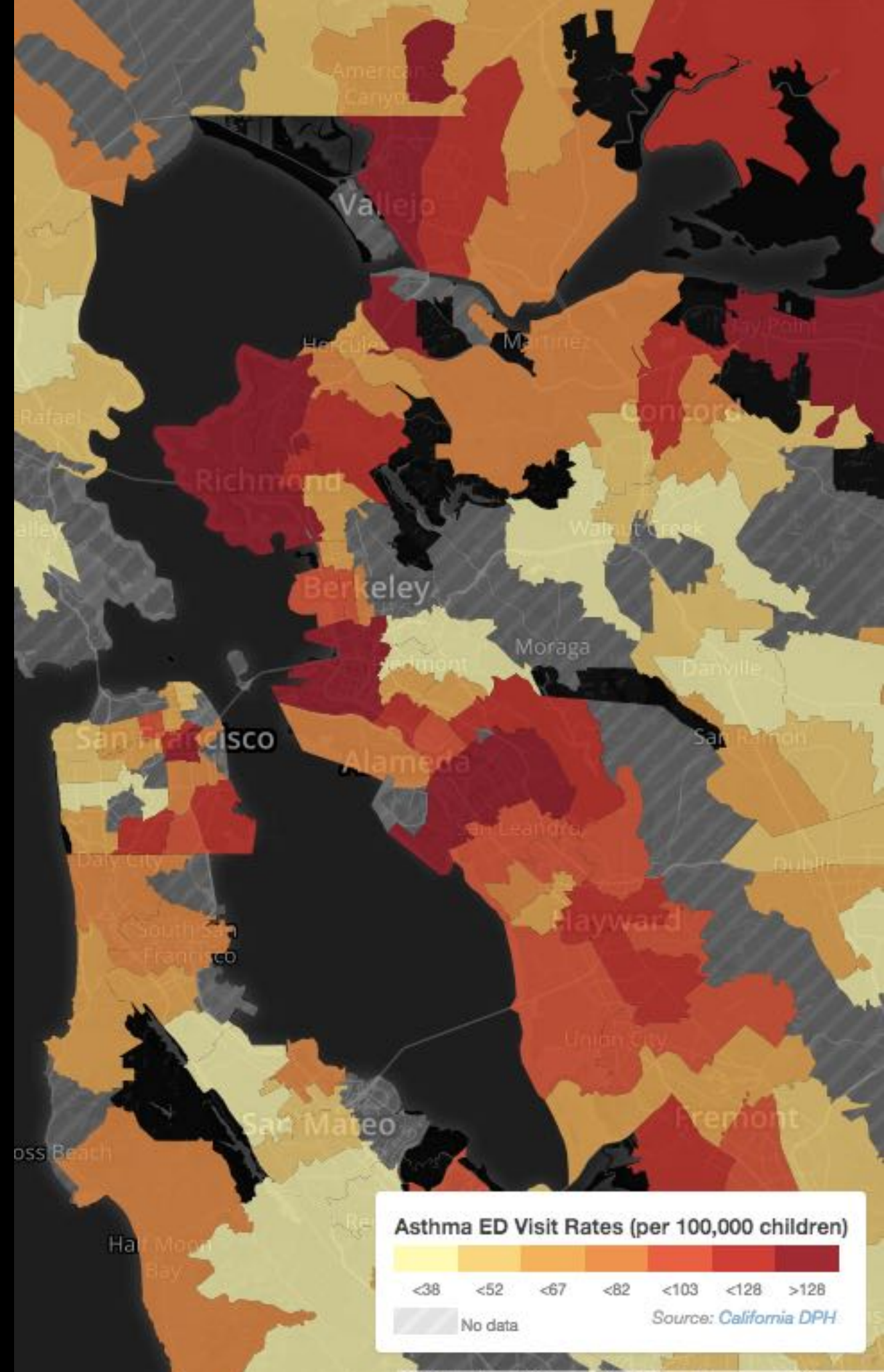
**NOTES ABOUT THE DATA**

- Asthma hospitalizations represent people with severe asthma who end up being hospitalized because of their asthma. Although there is no cure, asthma can be controlled with regular preventative healthcare, a clear asthma action plan, medication, and by avoiding known asthma triggers. [For more information...](#)
- Asthma symptoms and asthma attacks have been found to be associated with both indoor and outdoor environmental factors. [For more information...](#)
- Data Source: Patient Discharge Database from the California Office of Statewide Health Planning and Development, 2012.
- California statewide **Age Adj.** Rate per 10,000 of Hospitalizations due to asthma is 8.57 with a 95% confidence interval of 8.48 - 8.66.



# OVERVIEW

- Why maps matter in public health
- Different types of maps
- The landscape of free map-making software
- **Tutorial of map-making:** creating an online and printed map of asthma-related ED visits in California.
- Extra time for questions, and working with **your data**





1: 0,0	2864	202,22865	202,22866	202,22867	202,22868	202,22869	202,22870	202,22871
203: 202,0	2864	203,22865	203,22866	203,22867	203,22868	203,22869	203,22870	203,22871
204: 203,0	2864	204,22865	204,22866	204,22867	204,22868	204,22869	204,22870	204,22871
205: 204,0	2864	205,22865	205,22866	205,22867	205,22868	205,22869	205,22870	205,22871
206: 205,0	2864	206,22865	206,22866	206,22867	206,22868	206,22869	206,22870	206,22871
207: 206,0	2864	207,22865	207,22866	207,22867	207,22868	207,22869	207,22870	207,22871
208: 207,0	2864	208,22865	208,22866	208,22867	208,22868	208,22869	208,22870	208,22871
209: 208,0	2864	209,22865	209,22866	209,22867	209,22868	209,22869	209,22870	209,22871
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219: 218,0	2864	219,22865	219,22866	219,22867	219,22868	219,22869	219,22870	219,22871
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221: 220,0	2864	221,22865	221,22866	221,22867	221,22868	221,22869	221,22870	221,22871
222: 221,0	2864	222,22865	222,22866	222,22867	222,22868	222,22869	222,22870	222,22871
223: 222,0	2864	223,22865	223,22866	223,22867	223,22868	223,22869	223,22870	223,22871

**Public health**  
**involves lots**  
**of data**

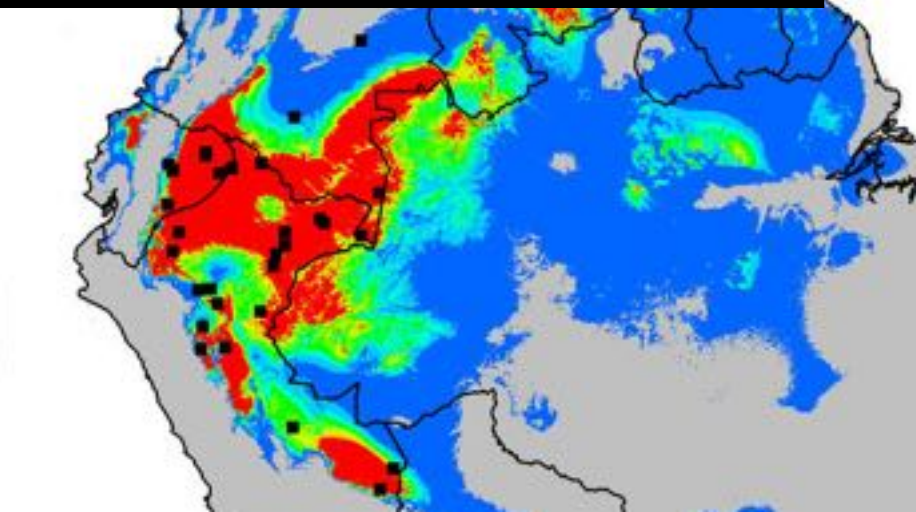
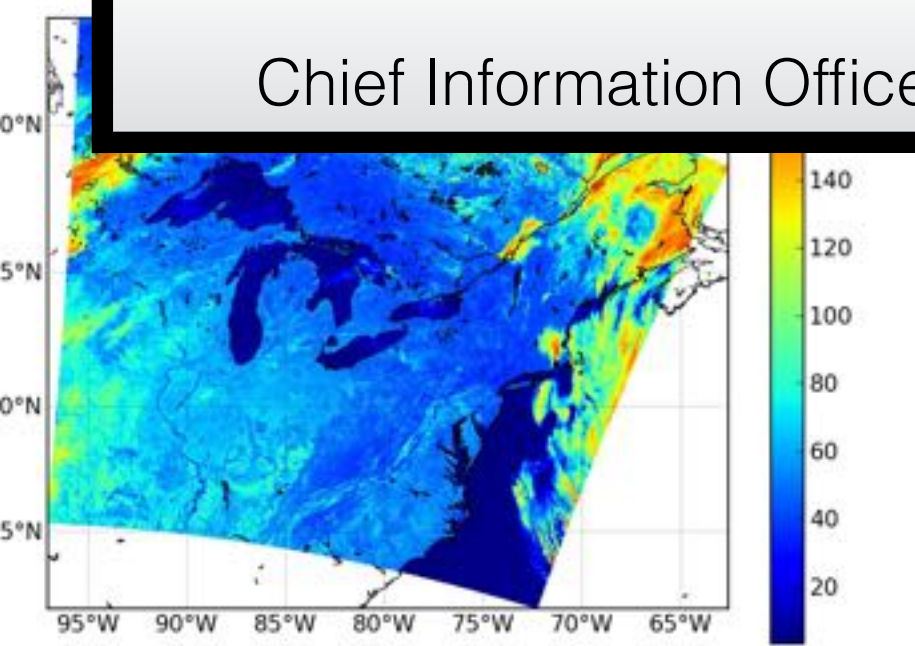




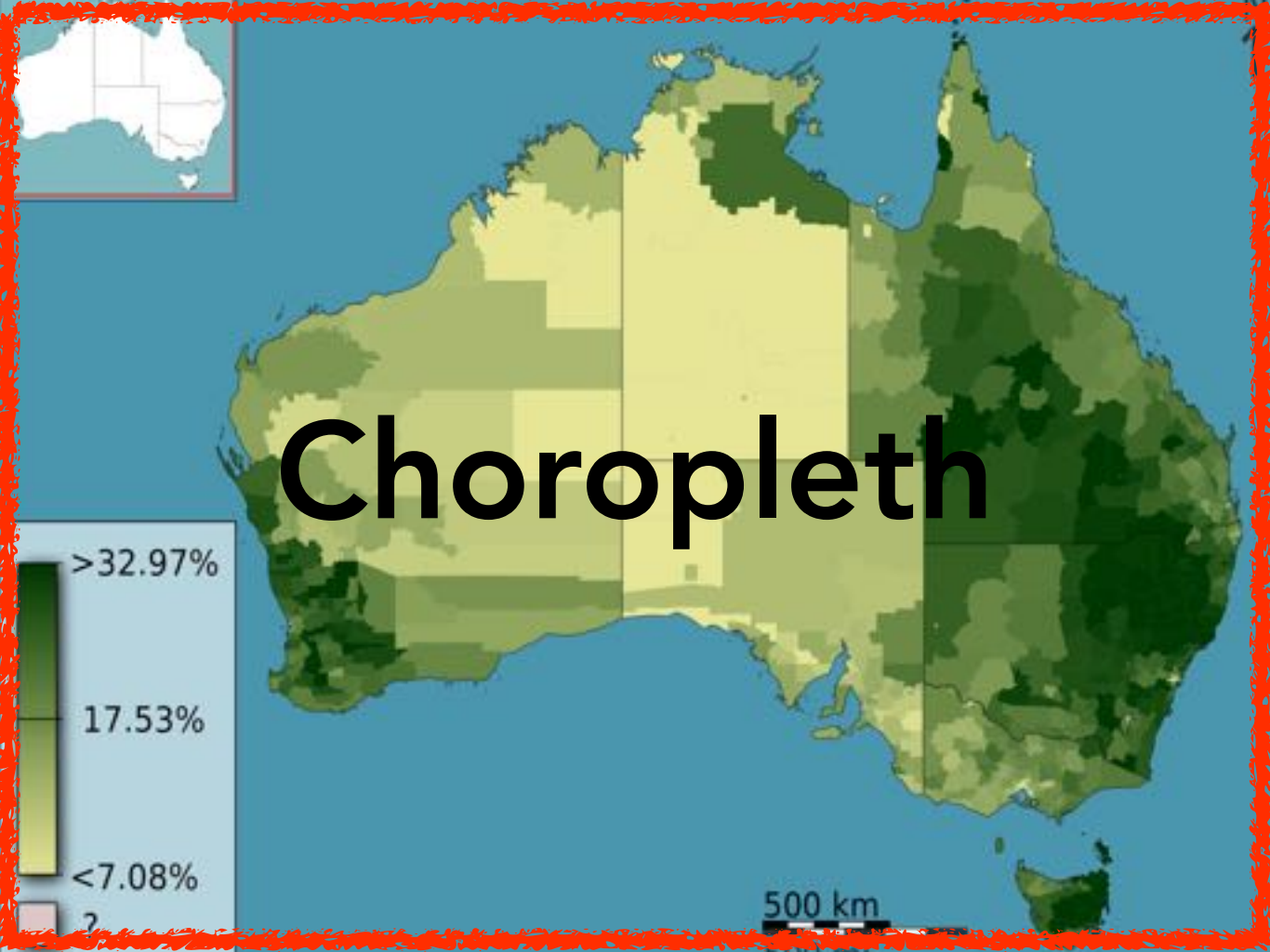
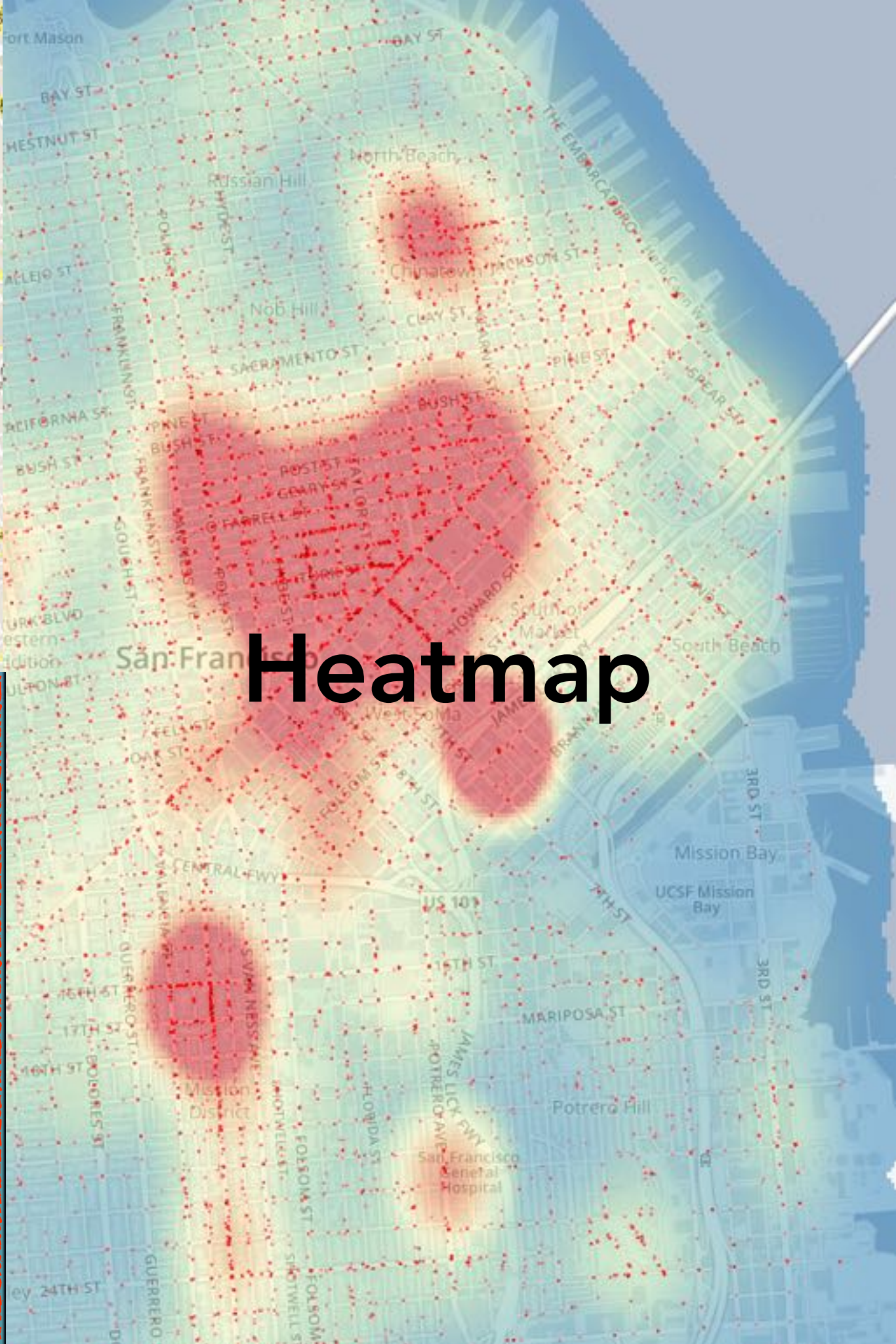
“When expressed in a map display, these seemingly sterile and often isolated statistical health data suddenly become immediately **useful, co-relational information systems** that health planners can use directly to modify programs that affect community and individual health care in such a way as to improve health outcomes.”



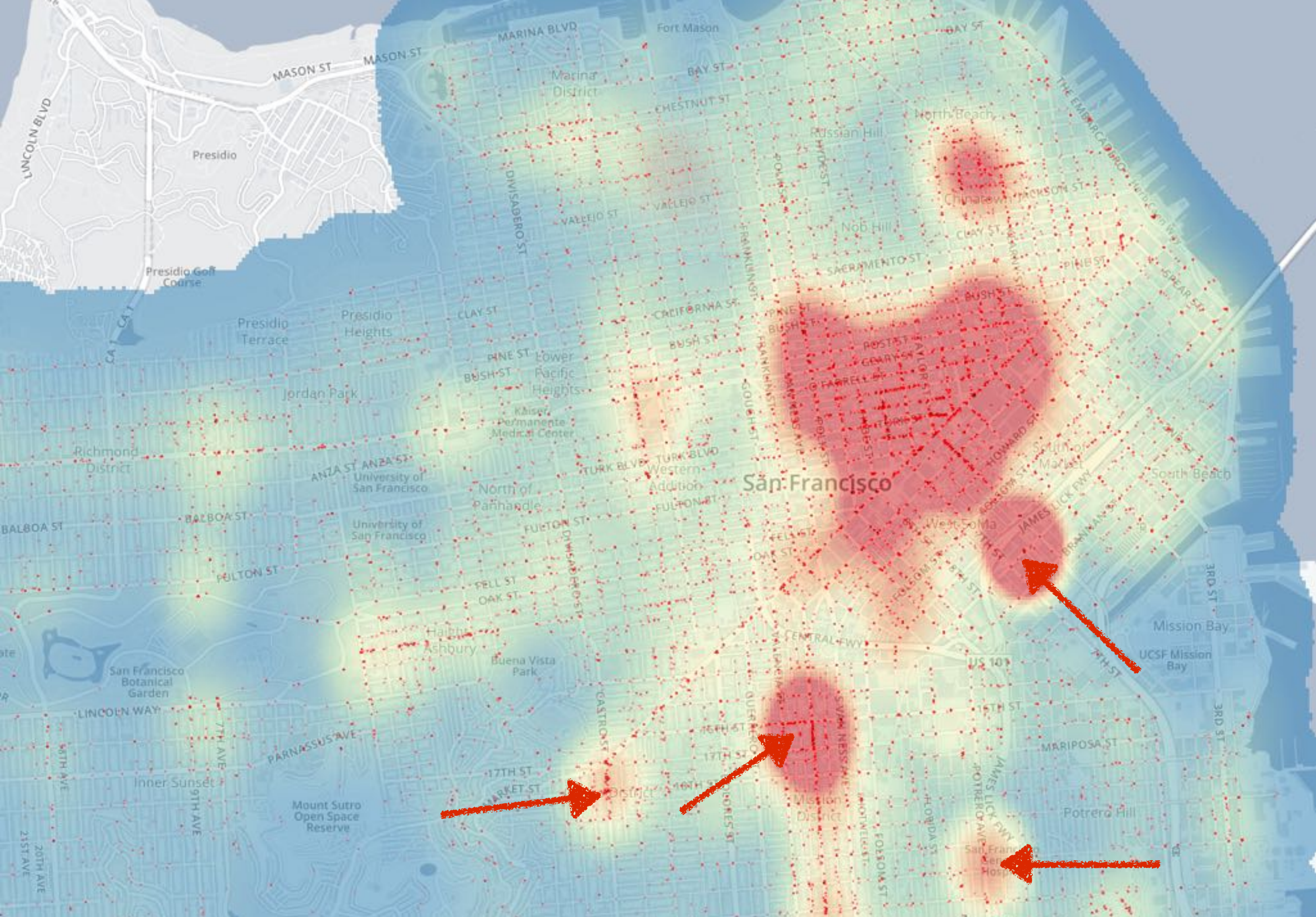
– Saleem Sayani  
Chief Information Officer, Maryland Department of Health and Mental Hygiene











<https://a.tiles.mapbox.com/v3/joshpepper.hhlolmb9.html>



# SOME FREE TOOLS FOR MAPPING

- **QGIS**

- Free alternative to ArcGIS, geospatial analysis and connecting data to 'shapefiles'

- **CartoDB**

- online editor only, but very **easy** to use

- **Mapbox**

- also has online editor, though not nearly as powerful
- create the offline editors [TileMill](#) and [Mapbox Studio](#)
- [Turf.js](#) for spatial analysis
- [Mapbox.js](#) for developing web apps.

- **R**



# HOW DO WE GET TO A MAP?

**HealthData.gov**

Home Data Blog Q & A Ideas Developers

Search entire site...

**Asthma Emergency Department Visit Rates by ZIP Code in 2012**

This dataset contains counts and rates (per 10,000) of asthma (ICD9-CM, 493.0-493.9) emergency department visits among California residents by ZIP Code and age group (all ages, 0-17, 18+) for 2012. For more information please go to [www.californiabreathing.org](http://www.californiabreathing.org)

Download the Data: Other Other Other Other

**Agency and Program Information**

Agency:	State of California
Federated Catalog:	State of California (CDPH)
Data Series Location:	<a href="https://cdph.data.ca.gov/d/fqaj-k8t7">https://cdph.data.ca.gov/d/fqaj-k8t7</a>

Ask a Question

Please enter your question below:

Content limited to 128 characters, remaining

W50X43

What code is in the image? \*

Enter the characters shown in the image.

Ask C

<https://www.healthdata.gov/data/dataset/asthma-emergency-department-visit-rates-zip-code-2012>

- <http://tinyurl.com/datadownload-dlab>



# Asthma rates

Zip code	Number of visits for children (0-17)	Age-adjusted rate for children (per 10,000)	Number of visits for adults (18+)	Age-adjusted rate for adults (per 10,000)	Number of visits for all ages	Age-adjusted rate for all ages (per 10,000)	County FIPS code
90001 (33.973271508000494, -118.24896959899968)	221	108.6	212	64.9	433	76.2	6037
90002 (33.94895251300045, -118.24697958699971)	215	113.3	223	66	438	78.2	6037
90003 (33.96335186100049, -118.27393599999971)	295	125.2	264	65.2	559	80.7	6037
90004 (34.07572239300049, -118.30301712299968)	179	134	186	38.6	365	63.2	6037
90005 (34.05907233200048, -118.30301712299968)	73	87.4	59	19.3	132	36.9	6037
90006 (34.05010424100044, -118.2926890439997)	144	98.2	125	28.7	269	46.6	6037
90007 (34.02833141800045, -118.28507659499968)	101	145.2	109	48.3	210	73.3	6037
90008 (34.01097312100046, -118.34158773599972)	126	176.4	212	88.4	338	111.1	6037
90011 (34.00790120200048, -118.25903697699971)	336	88.2	247	43.3	583	54.9	6037
90012 (34.059480762000476, -118.24204800599972)	15	46.6	56	18.9	71	26	6037
90013 (34.04726260700045, -118.24609754999972)			140	105.9	147	112.4	6037
90014 (34.04475119400047, -118.2527367189997)			66	100	72	129.2	6037
90015 (34.04012376300045, -118.26498963499972)	59	143.7	66	47.7	125	72.4	6037
90016 (34.02888323300044, -118.35308896599969)	157	130.1	229	64.3	386	81.3	6037
90017 (34.05230281300044, -118.26338632799968)	70	118.9	57	36.9	127	58.1	6037
90018 (34.03077331100047, -118.31686899999971)	192	144.4	241	62.7	433	83.8	6037
90019 (34.04884418900048, -118.33610868499972)	147	107.1	221	43.7	368	60.1	6037
90020 (34.06636325100044, -118.30164844599972)	72	95.5	74	24.2	146	42.5	6037
90021 (34.03012156000045, -118.24177861599969)			38	190.3	47	221.4	6037
90022 (34.023543222000455, -118.15512616999968)	146	71.1	198	44.1	344	51	6037
90023 (34.02418193800048, -118.20195663999971)	158	104.1	127	40	285	56.5	6037
90024 (34.06136215000049, -118.4402367409997)			43	12.1	52	15.5	6037
90025 (34.04518134900047, -118.45025632399972)	21	38.1	52	14.8	73	20.8	6037
90026 (34.07687382000046, -118.26535895999967)	128	91.6	165	31.4	293	46.9	6037
90027 (34.10546395500046, -118.2923675139997)	46	80.1	144	38.4	190	49.2	6037
90028 (34.10072355400047, -118.32821815499972)	40	136.3	127	48.7	167	71.3	6037
90029 (34.08989145600049, -118.29490934299969)	96	125.2	95	32.7	191	56.5	6037
90031 (34.07752122500045, -118.2131059239997)	79	77.4	81	27.5	160	40.3	6037
90032 (34.08151428500048, -118.17678602299969)	127	108.4	128	37.4	255	55.7	6037
90033 (34.04856176400045, -118.2115199969997)	172	117.2	228	72.2	400	83.8	6037
90034 (34.02829231300046, -118.40269589399969)	75	76.7	117	26.9	192	39.7	6037
90035 (34.05421027100044, -118.38387767499972)	22	36.4	62	27.2	84	29.6	6037
90036 (34.06889204400045, -118.35077742299967)	24	39.1	65	23.1	89	27.3	6037
90037 (34.00349102100046, -118.28709702299972)	236	124	254	60.6	490	76.9	6037
90038 (34.08898335000049, -118.32483774099973)	57	106.5	74	32.8	131	51.8	6037
	46	81.5	89	41.8	135	54.6	6037

Download file from: <http://tinyurl.com/datadownload-dlab>



# Asthma rates

Zip	children-number of visits for (0-17)	Children-Age-adjusted rate (per 10,000)	Adults-Number of visits (18+)	adults-Age-adjusted rate (per 10,000)	All Ages - Number of visits	all ages-Age-adjusted rate (per 10,000)	County FIPS code
94002	14	23.7	58	28.2	72	27.1	6081
94010	32	34.8	66	19.4	98	23.4	6081
94014	70	72.4	194	50.8	264	56.4	6081
94015	82	72.9	189	37.6	271	46.7	6081
94019	29	67.5	25	19	54	31.5	6081
94022			12	10.4	20	12.7	6085
94024					14	8.4	6085
94025	53	50.4	58	19.2	111	27.3	6081
94030	15	36.2	78	41.2	93	39.9	6081
94038					12	32.6	6081
94040	28	35.8	34	14	62	19.6	6085
94041			13	11.5	23	18	6085
94043	13	22.5	34	16.7	47	18.2	6085
94044	45	60.2	111	39.7	156	45	6081
94061	53	58.5	100	34.7	153	40.9	6081
94062	18	32.8	45	22.9	63	25.4	6081
94063	87	101.9	130	57.7	217	69.1	6081
94065					14	12.4	6081

Download file from: <http://tinyurl.com/datadownload-dlab>



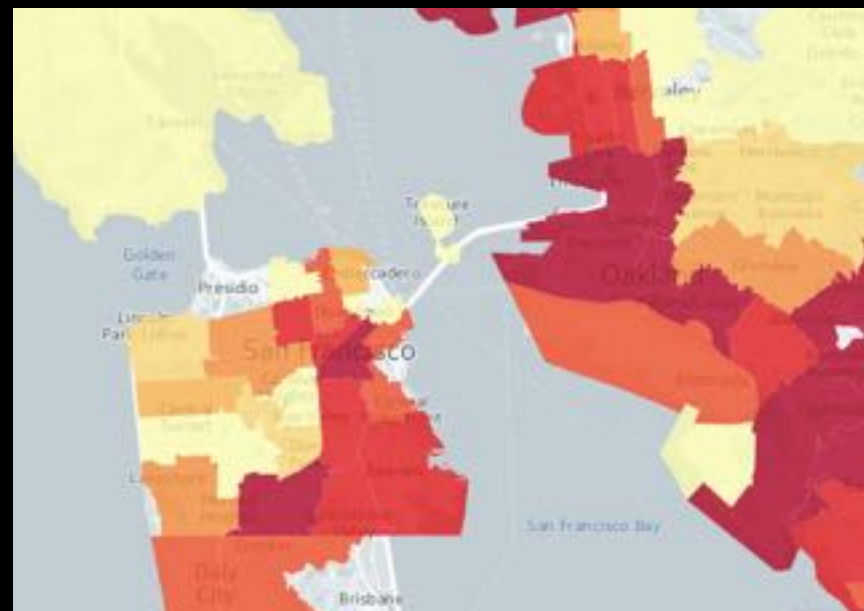
# FLOWCHART FOR MAPMAKING

children-number of visits for (0-17)	Children-Age-adjusted rate (per 10,000)	Adults-Number of visits (18+)	adults-Age-adjusted rate (per 10,000)	All Ages - Number of visits	all ages-Age-adjusted rate (per 10,000)	County FIPS code
94002	72.4	58	28.2	72	27.1	6081
94010	32	66	19.4	98	23.4	6081
94014	70	194	50.8	264	56.4	6081
94015	82	189	37.6	271	46.7	6081
94019	29	25	19	54	31.5	6081
94022		12	10.4	20	12.7	6085
94024				14	8.4	6085
94025	53	58	19.2	111	27.3	6081
94030	15	78	41.2	93	39.9	6081
94038				12	32.6	6081
94040	28	34	14	62	19.6	6085
94041		13	11.5	23	18	6085
94043	13	34	16.7	47	18.2	6085
94044	45	111	39.7	156	45	6081
94061	53	100	34.7	153	40.9	6081
94062	18	45	22.9	63	25.4	6081
94063	87	130	57.7	217	69.1	6081
94065				14	12.4	6081



Asthma data  
by zip code

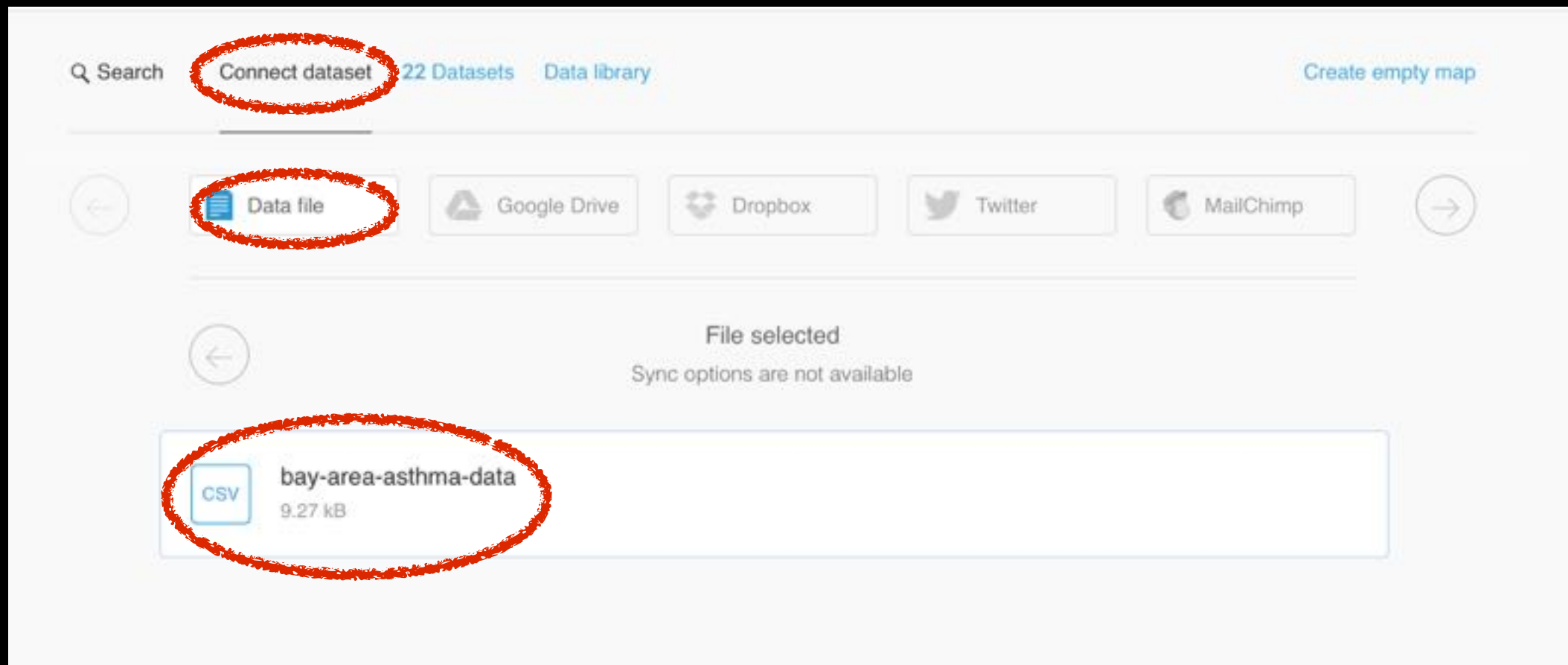
A **shapefile**  
of zip code  
boundaries





# LET'S MAKE A CARTODB MAP!

1. Download file from: <http://tinyurl.com/publichealthmapping>
2. Open [cartodb.com](http://cartodb.com) and log into your account.
3. Click on 'New Map'
4. Click on 'Connect Dataset' and upload the file:  
bay-area-asthma-data.csv





# 1) Select Data View

DATA VIEW

MAP VIEW

Edit ▾

PUBLISH

## 2) Select Zip

adjusted_rate_per_10_000 ▾	children_number_of_visits_for_0_17 ▾ number	county_fips_code ▾ number	county_name ▾ string	zip ▾
----------------------------	--	------------------------------	-------------------------	-------

## 3) Select Georeference

94		6001	Alameda	
null		6001	Alameda	
113		6001	Alameda	
133		6001	Alameda	
46		6001	Alameda	
195		6001	Alameda	
21		6001	Alameda	94542
236		6001	Alameda	94544

Order  ASC  DESC

Rename column...

Change data type...

Georeference...

Add new column...

Filter by this column

Delete this column



# STEPS TO CREATE CARTODB MAP

Lon/Lat Columns   City Names   Admin. Regions   **Postal Codes**   IP Addresses   Street Addresses

1) Select Postal Codes

Select the column that has the Postal Codes  
Georeference your data by postal codes.

2) Select Zip

1 In Which Column Are Your Postal Codes Stored?   zip

2 Country Where Postal Codes Are Located, If Known

3) Type 'United States' on the bottom of this dropdown

Select column or type it	▼
adults_number_of_visits_18	N
all_ages__number_of_visits	N
all_ages_age_adjusted_rate_p...	N
children_age_adjusted_rate_pe...	N
children_number_of_visits_for_...	N
United States	T.

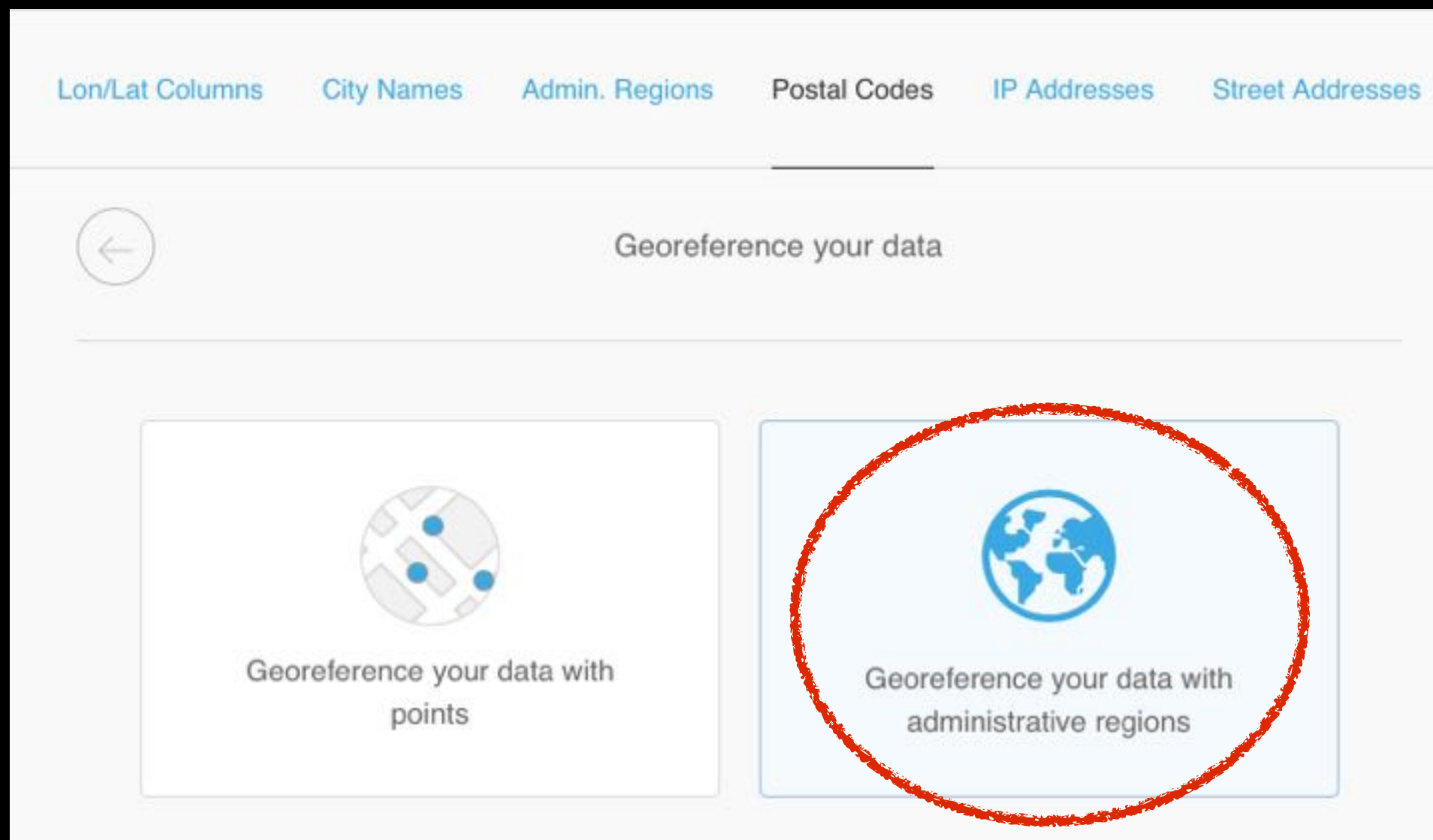
all values. Geocode all your rows, even those with geometry data.

CONTINUE



# STEPS TO CREATE CARTODB MAP

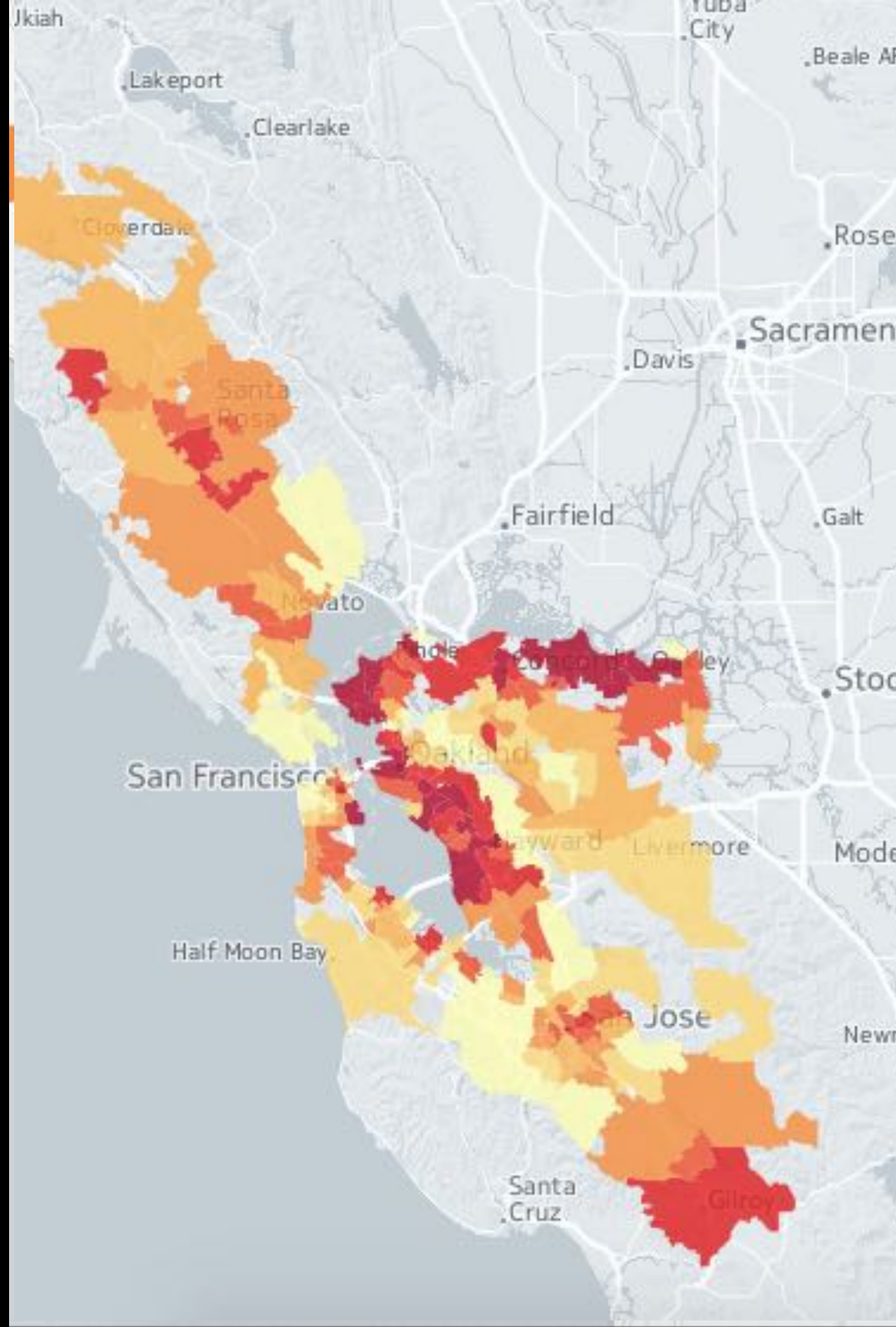
7. Select Georeference your data with administrative regions.





# YOUR CARTODB MAP!

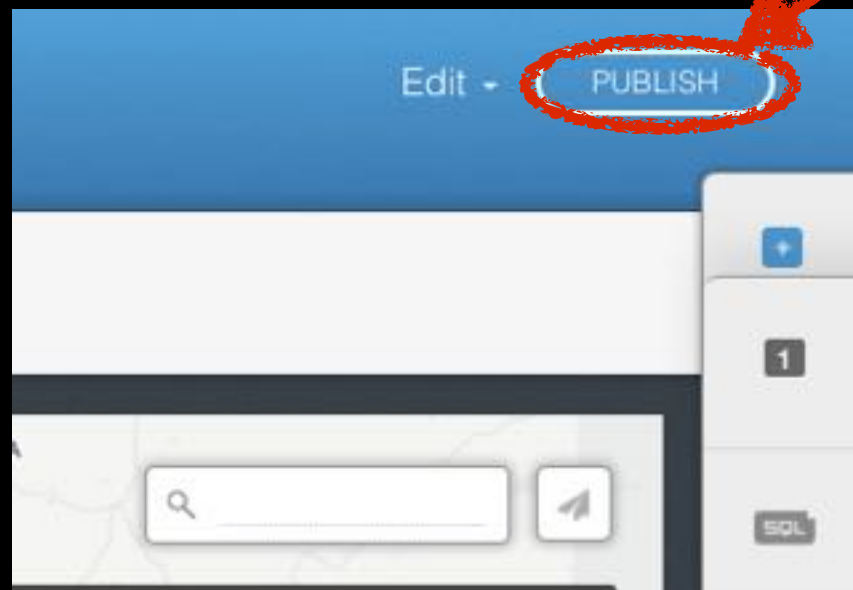
- Zoom into California and view your new map!
- Click on 'wizards' on the right, select 'choropleth' and try playing with the settings.
- Pick a column to color your data by.
- Try to add an infobox and legend!
- Experiment with filters!



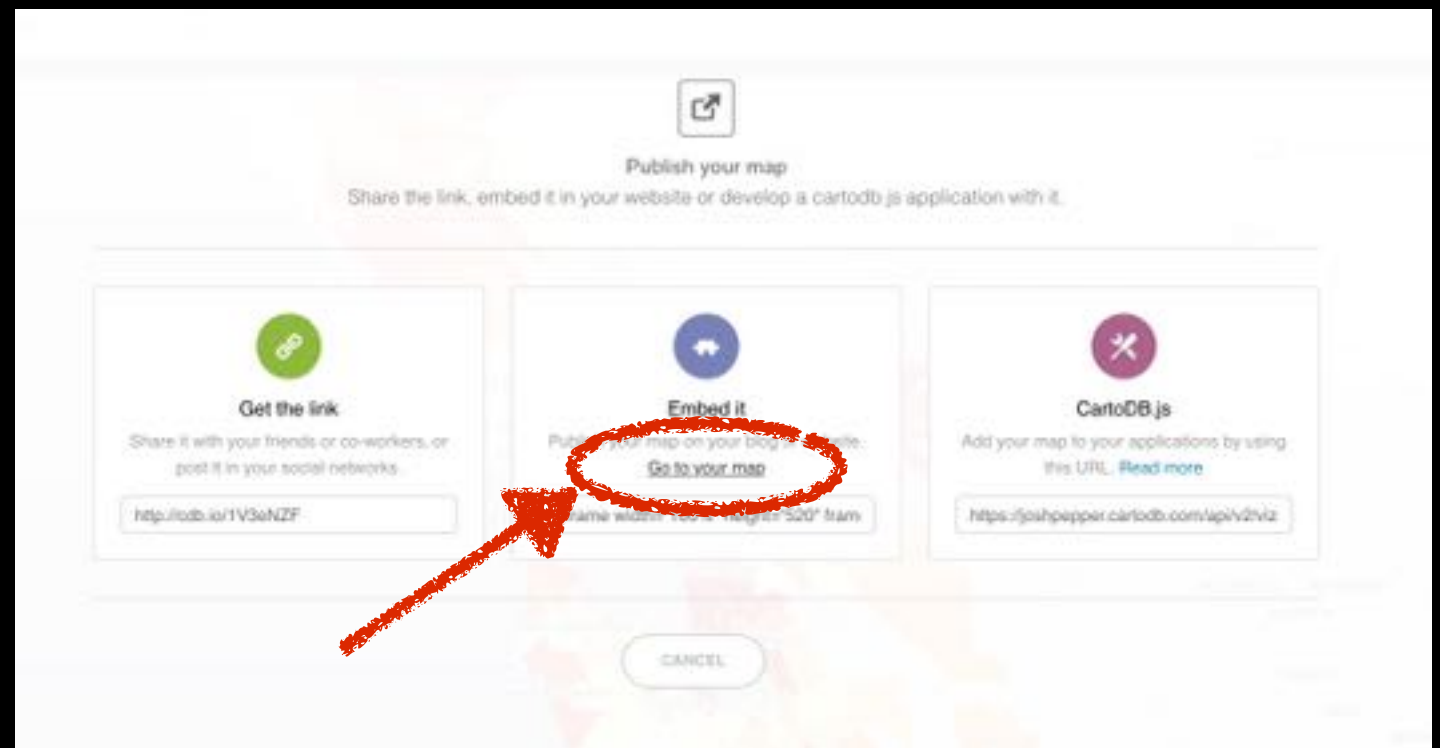


# SHARE YOUR WEBMAP!

**Step 1:** Click Publish in top right corner



**Step 2:**  
Click 'Go to your map'



my map: <http://tiny.cc/dlab-asthma-map>



# PUBLIC HEALTH DATA SOURCES

- **City of Berkeley Open Data Portal**
  - <http://www.ci.berkeley.ca.us/ContentDisplay.aspx?id=105239>
- **SF OpenData**
  - <https://data.sfgov.org>
- **healthdata.gov**
- **Compiled national resources by the NY DPH**
  - <https://www.health.ny.gov/statistics/chac/national.htm>
- **Large, national health surveys**
  - [http://www.cdc.gov/nchs/data\\_access/hdi/hdi\\_data\\_sources.htm](http://www.cdc.gov/nchs/data_access/hdi/hdi_data_sources.htm)



# COME FEBRUARY 24ND: WEBMAPS IN R, USING LEAFLET

The image shows the RStudio interface with a script editor on the left, a console at the bottom left, an environment pane at the top right, and a webmap viewer on the right.

```
1 #Load packages
2 library(rgdal)
3
4 #set working directory
5 setwd("~/Dropbox/JMP/Presentations/Mapping in R")
6
7 # From https://www.census.gov/geo/maps-data/data/cbf/cbf_state.html
8 asthmaData <- readOGR(dsn="data", layer="bay_area_asthma_data")
9
10 #make legend pallete
11 pal <- colorNumeric(
12   palette = "YlOrRd",
13   domain = asthmaData$children_a
14 )
15
16 #create map
17 leaflet(asthmaData) %>%
18   addTiles(urlTemplate = "http://api.tiles.mapbox.com/v4/mapbox.light/{z}/{x}/{y}.png?access_token=pk.eyJ1Ijoiam9zaHBlchBlciIsImEiOiJuTWdrY2k4In0.HCCXtgU04scrTB_-ON4kja") %>%
19   addPolygons(
20     stroke = FALSE, fillOpacity = 0.5, smoothFactor = 0.5,
```

**Environment**

Object	Value
Global Environment	
asthmaData.points	228102 obs. of 7 variables
mydata	13550 obs. of 85 variables
Values	
asthmaData	Large SpatialPolygonsDataFrame (207 elements, 4.1 Mb)
basemap	List of 9
m	List of 7

**Console**

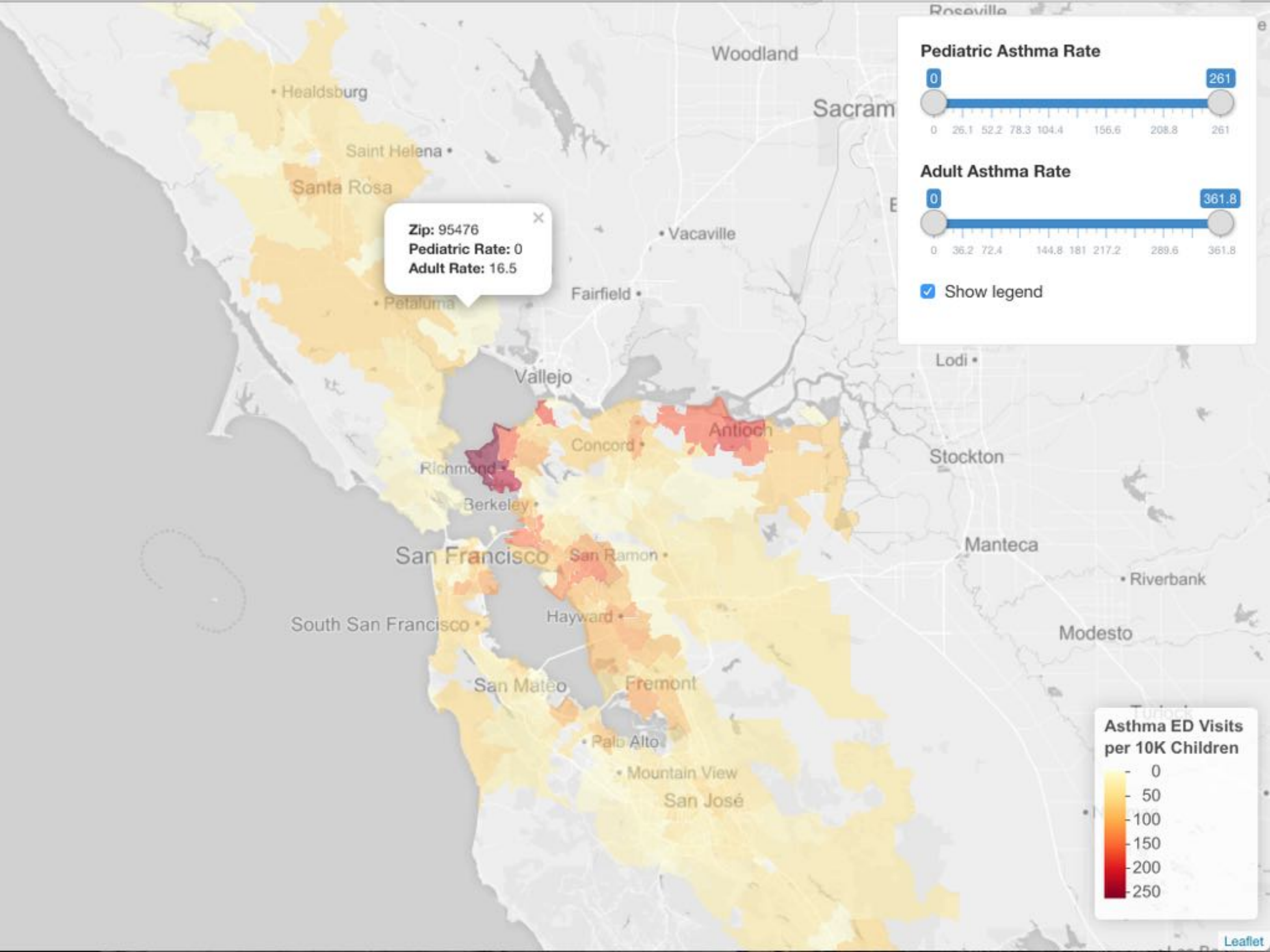
```
+ ) %>%
+ addLegend("topright", pal = pal, values = ~children_a,
+   title = "Asthma ED Visits <br/> per 10K Children",
+   opacity = 1
+ )
> leaflet(asthmaData) %>%
+ addTiles(urlTemplate = "http://api.tiles.mapbox.com/v4/mapbox.light/{z}/{x}/{y}.png?access_token=pk.eyJ1Ijoiam9zaHBlchBlciIsImEiOiJuTWdrY2k4In0.HCCXtgU04scrTB_-ON4kja") %>%
+ addPolygons(
+   stroke = FALSE, fillOpacity = 0.5, smoothFactor = 0.5,
+   color = ~colorQuantile("YlOrRd", n=10, asthmaData$children_a)(children_a),
+   popup = ~paste("<strong>Zip:</strong>",zip,
+     "<br>",
+     "<strong>Rate:</strong>",children_a)
+ ) %>%
+ addLegend("topright", pal = pal, values = ~children_a,
+   title = "Asthma ED Visits <br/> per 10K Children",
+   opacity = 1
+ )
> |
```

**Webmap Viewer**

Asthma ED Visits per 10K Children

Legend: 50, 100, 150, 200, 250, NA

Zip: 94607  
Rate: 150



Zip: 95476  
Pediatric Rate: 0  
Adult Rate: 16.5

### Pediatric Asthma Rate

0 261

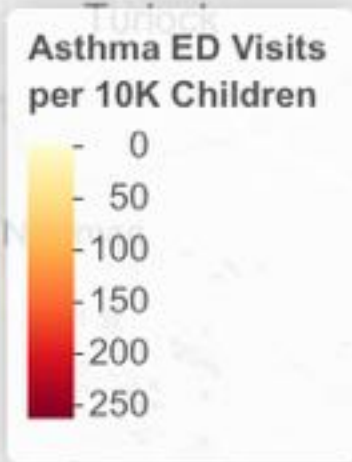
0 26.1 52.2 78.3 104.4 156.6 208.8 261

### Adult Asthma Rate

0 361.8

0 36.2 72.4 144.8 181 217.2 289.6 361.8

Show legend





# KEEP EXPLORING!! SOME ADDITIONAL RESOURCES:

- **Choosing colors**
  - [colorbrewer2.org](http://colorbrewer2.org)
  - [color.adobe.com](http://color.adobe.com)
- **Creating and hosting online maps**
  - [www.mapbox.com](http://www.mapbox.com)
  - [www.cartodb.com](http://www.cartodb.com)
- **Spatial Analysis**
  - <http://www.qgis.org/en/site/>
  - Turf.js
  - Georeferencing: [batchgeo.com](http://batchgeo.com) (and CartoDB, and Mapbox)
- **Tutorials / Examples**
  - <http://docs.cartodb.com/tutorials.html>
  - <http://academy.cartodb.com/>
  - <https://www.mapbox.com/mapbox.js/example/v1.0.0/>
  - <https://www.mapbox.com/guides/>
  - <https://www.mapbox.com/tilemill/docs/crashcourse/introduction/>



# THANK YOU!

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