

# **Analysis of Environmental Inequality in California**

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The social factors associated with  
worse air pollution in Southern  
California



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# Background & Intro

- Pollutant level is higher in areas with lower income
- short-term exposures to ozone, nitrogen dioxide, sulphur dioxide are thought to increase the risk of respiratory diseases
- Some respiratory diseases related to air pollution include Asthma, Chronic Obstructive Pulmonary Disease(COPD)
- Reduction of pollution exposure will lead to a better life expectancy



# Questions Proposed

- Explore how each county's business or factory types, average income, diseases, are related to the seriousness of air pollution in its range
- We refer to Air Quality Index of NO<sub>2</sub>, SO<sub>2</sub>, O<sub>3</sub>, and CO for seriousness of air pollution
- Lower avg income, higher diseases rate, higher facility emission, factory related to fossil fuel / manufacturing -> higher AQI

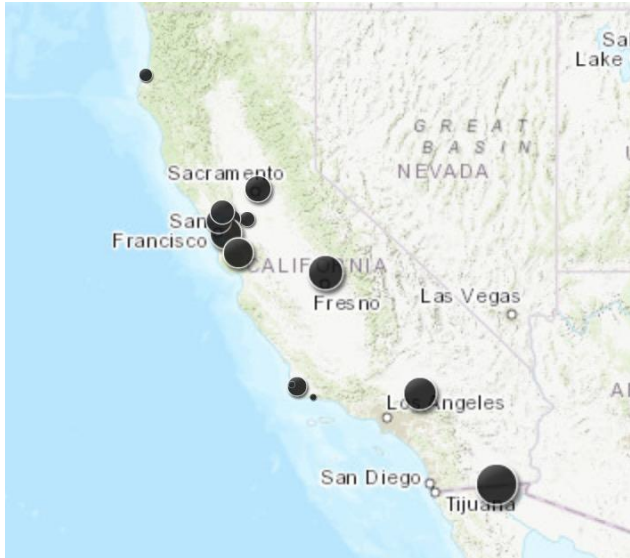


# Data Used

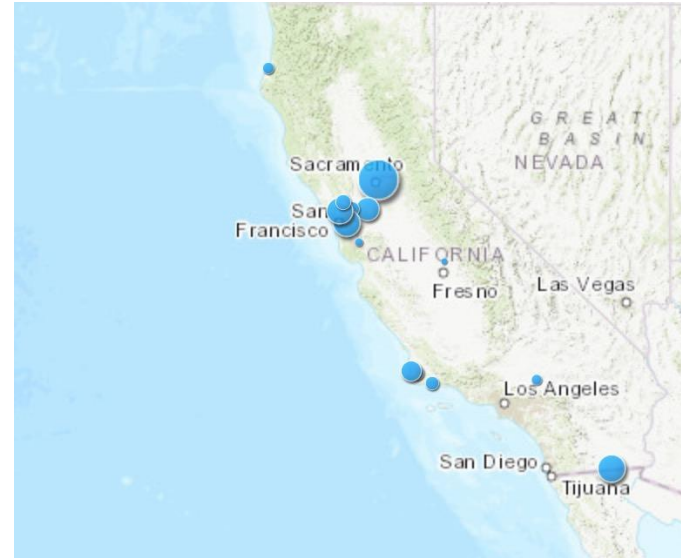
- US Household Income Statistics
- US Facility Level Air Pollution
- US Pollution Data (monitoring site)
- NAICS Dictionaries
- Reported Asthma Cases in 2014
- Reported COPD Cases in 2014
- USA County Layer

# Symbol Repr - Greenhouse Gases Air Quality Index

- NO<sub>2</sub>

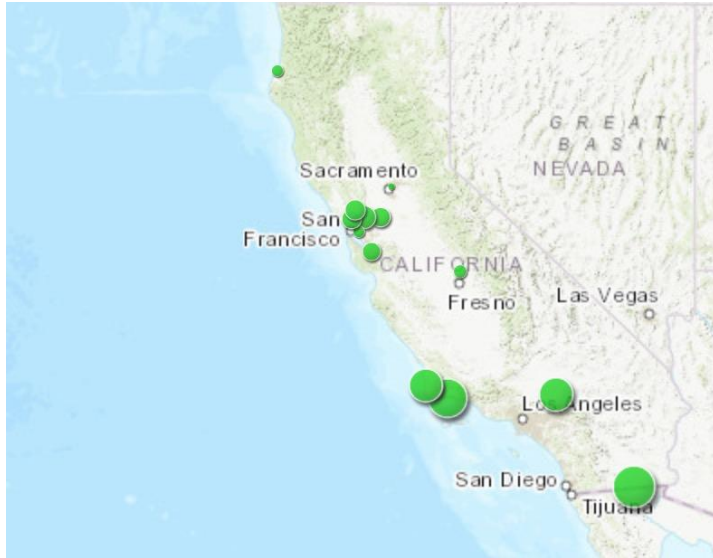


- SO<sub>2</sub>

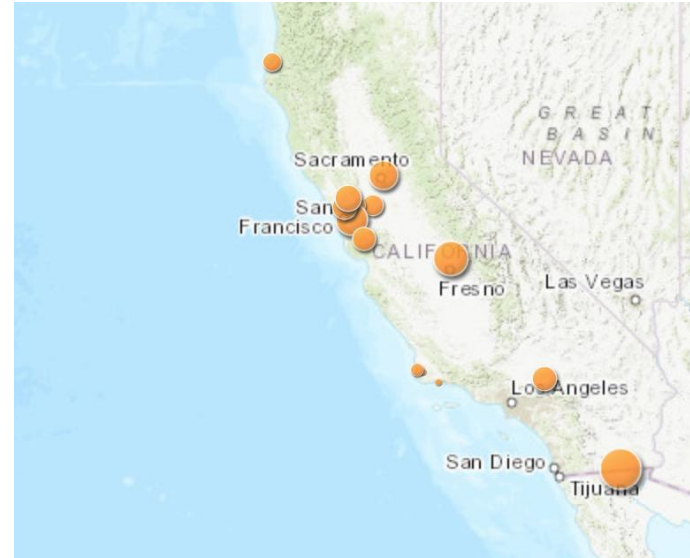


# Symbol Repr - Greenhouse Gases Air Quality Index

- O3

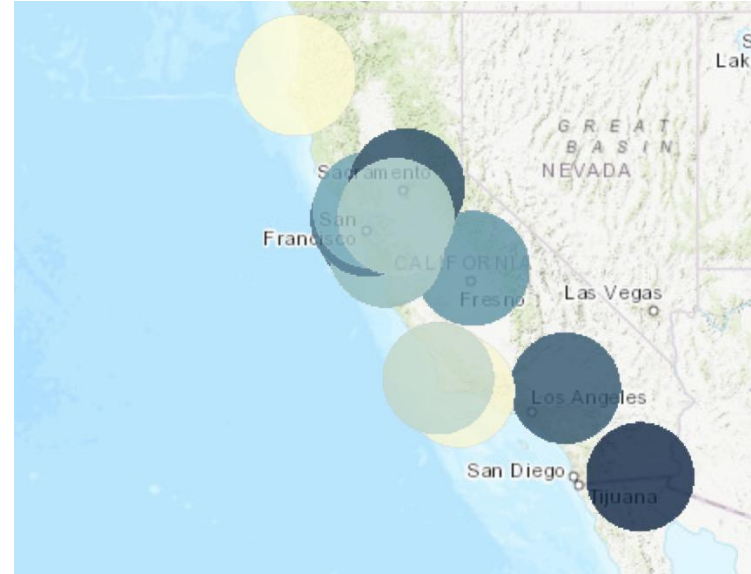


- CO



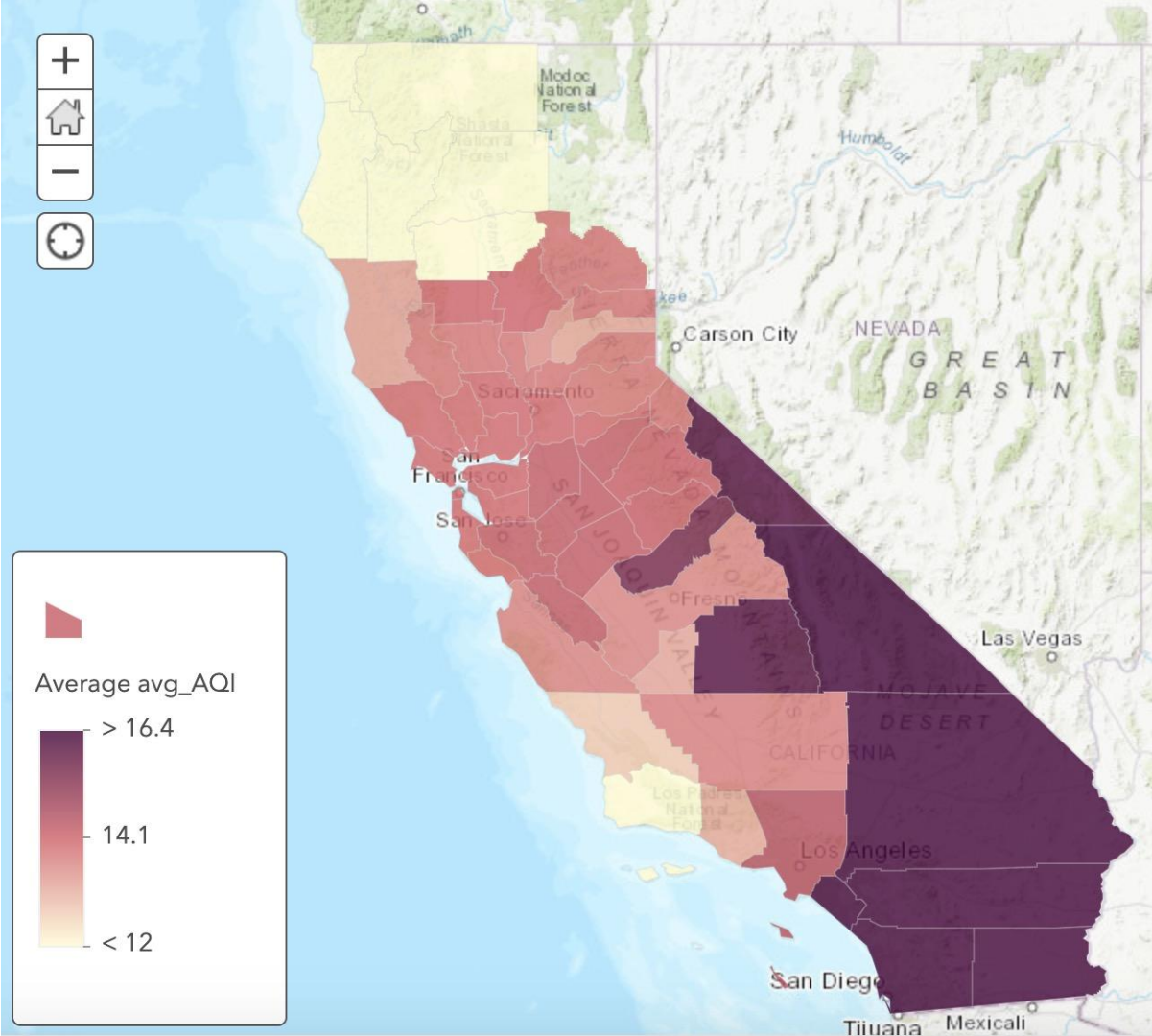
# Buffered Average AQI (Normalized)

- Not all counties have monitoring site
- Used create\_buffer to cover neighboring counties of those with monitoring site
- Normalized greenhouse gases
- AQI and calculated average
- The darker of color the higher AQI



# Spatial Join CA County Layer w/ buffered Layer

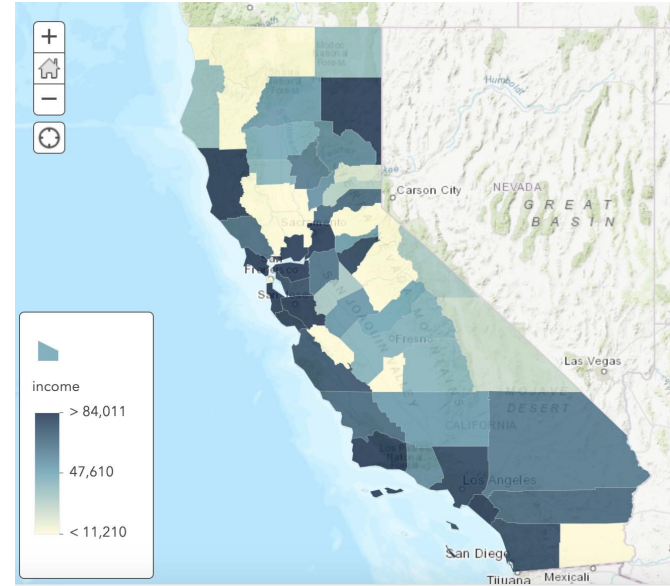
We can see a clear trend that the air quality become worse and worse when getting towards the Southeastern of CA





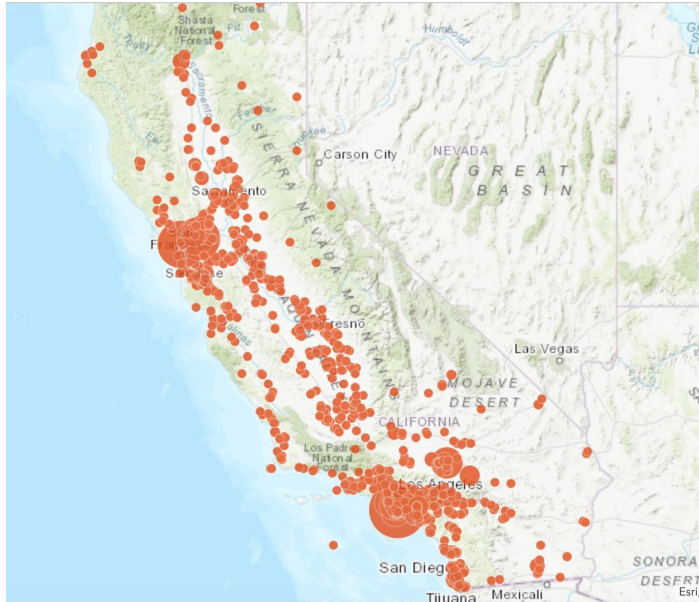
# Analysis

- With the finding that Southern California has worse air quality
- Explore social factors interact with air quality
  - Local income, Facility emission, Facility type, asthma and copd rate
- Image: average income by county

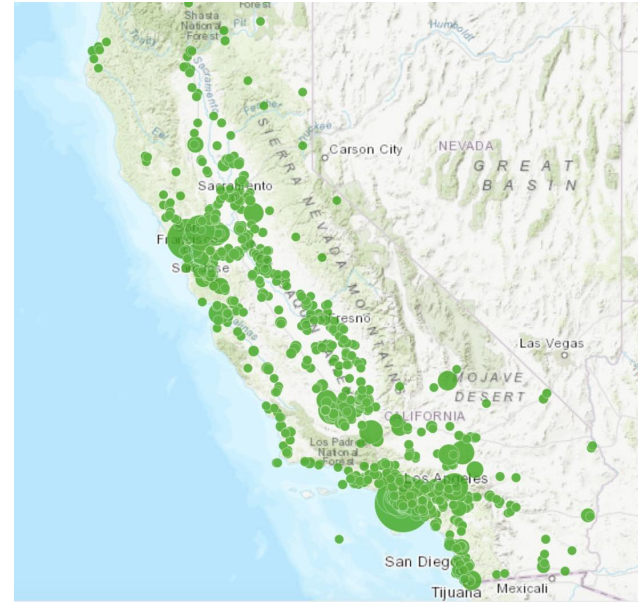


# Facility TRI & GHG Emission

TRI: Toxic Release Inventory

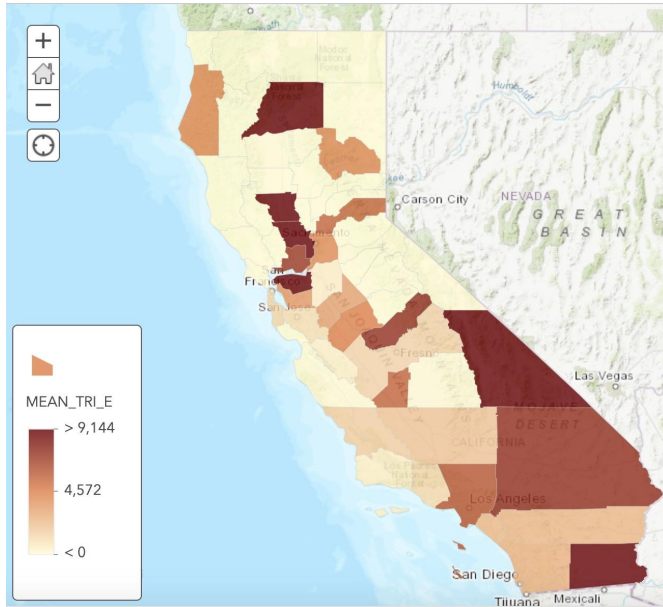


GHG: Greenhouse gas

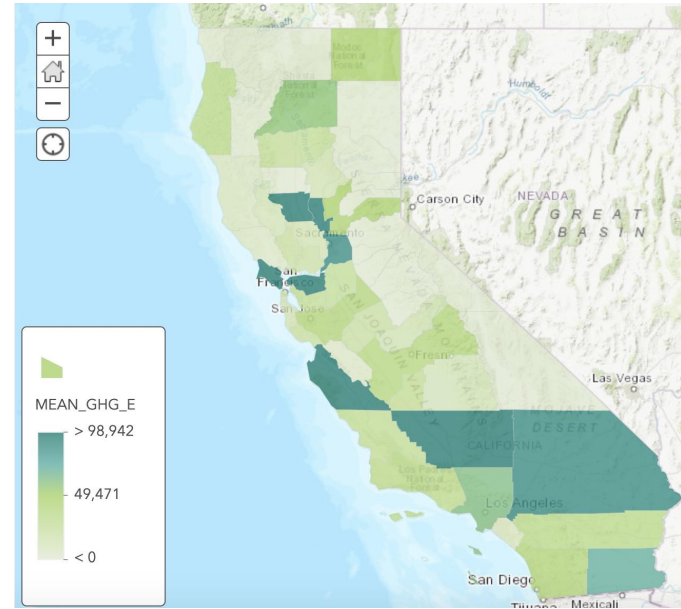


# Aggregation of facilities points to counties

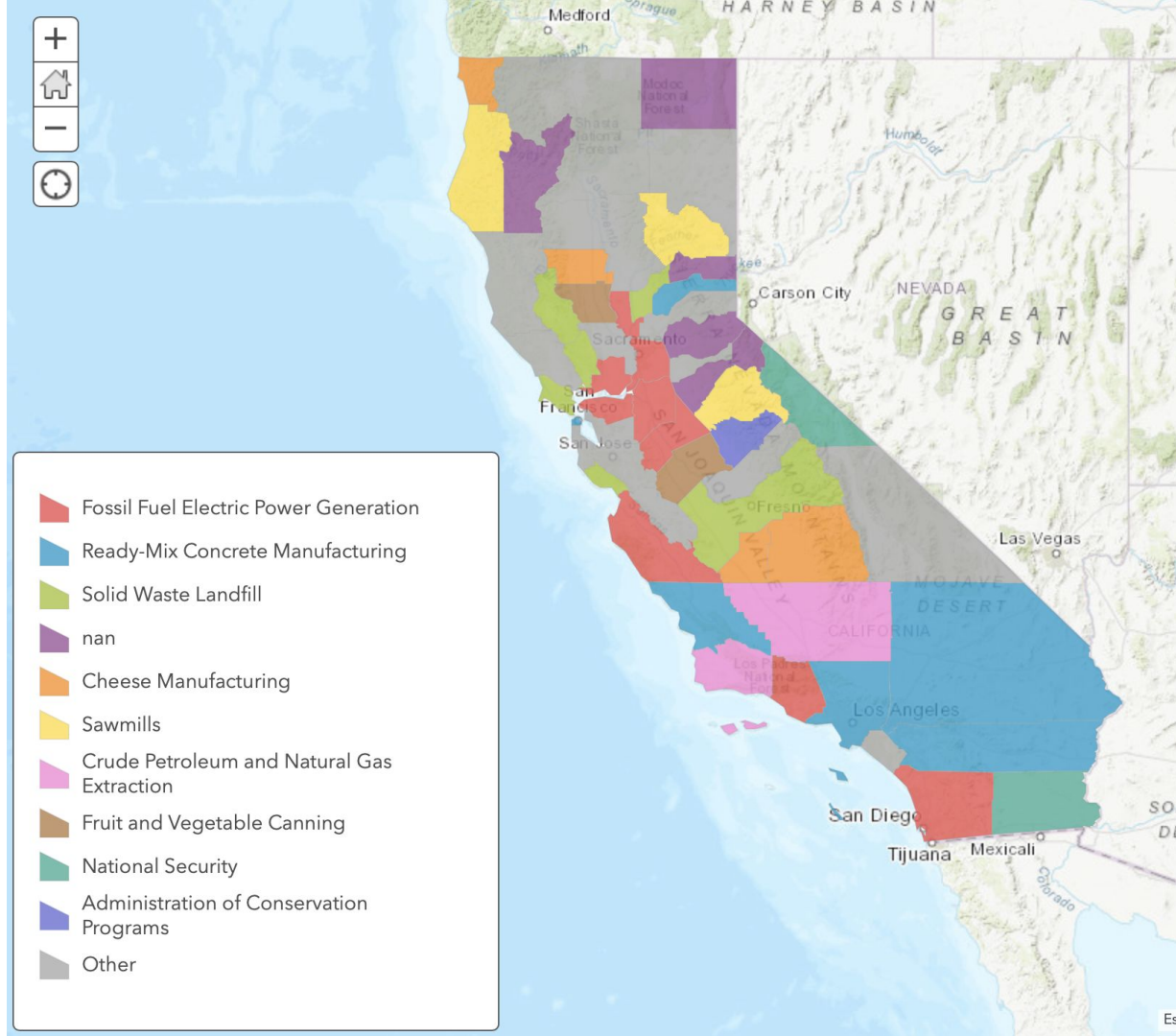
TRI: Toxic Release Inventory



GHG: Greenhouse gas

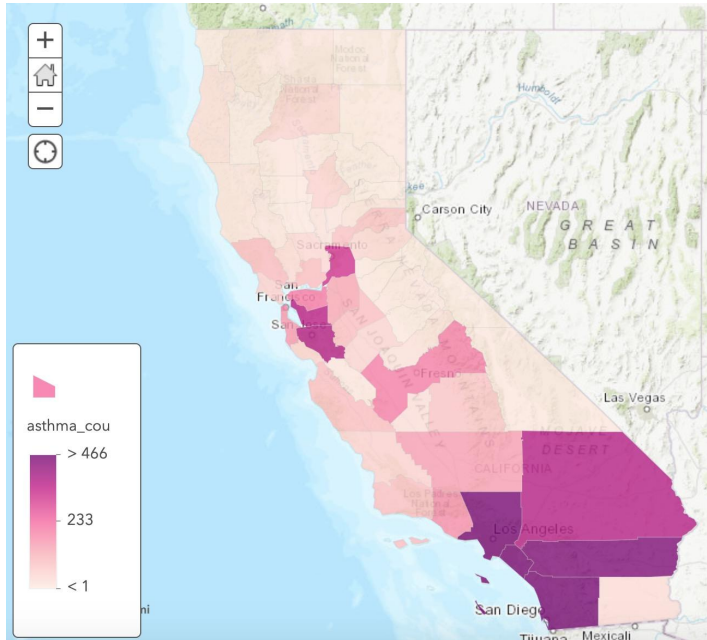


# Most Common Industry Type by County

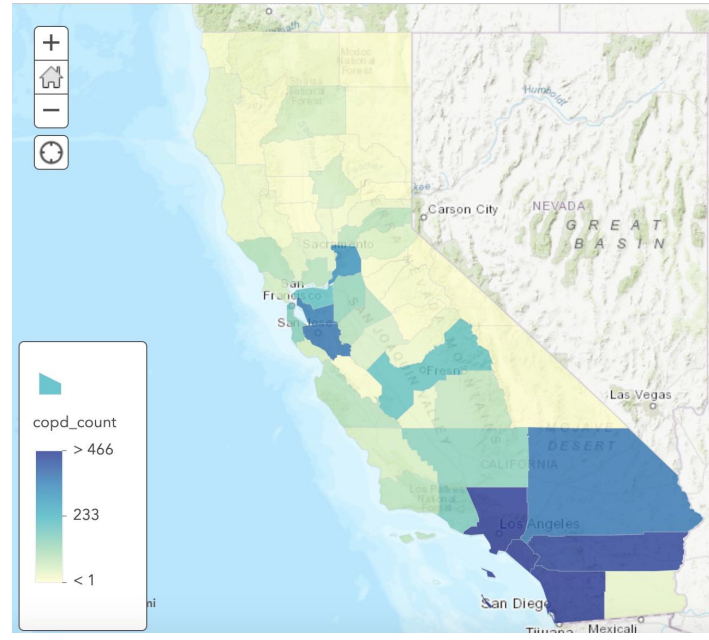


# Asthma & COPD Cases Count

Asthma



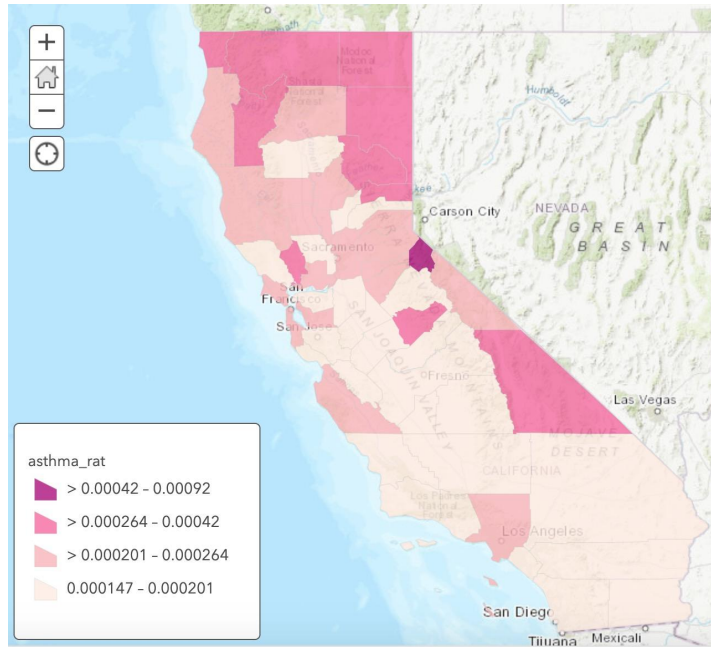
COPD



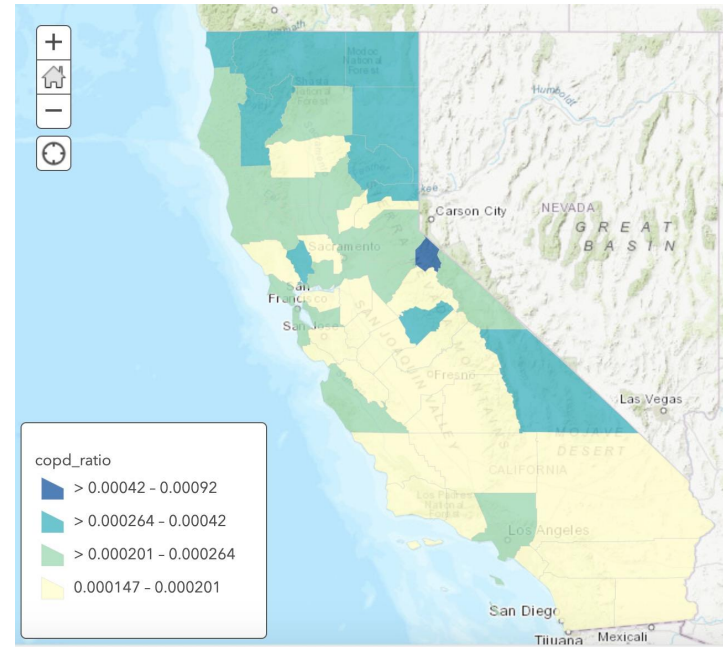


# Asthma & COPD Incidence Rate

Asthma



COPD



# Train and Classify

- Model used: Random Forest Classifier
- Total 6 features to train
  - income, facility emissions of TRI & GHG, facility types, incidence rate of asthma & COPD
  - Divided into 4 groups
- Discretize normalized average AQI into five equal-size quantiles

57.14%

**Mean TRI Emission & Mean GHG Emission** as Features



42.86%

**Most Common Industry Type** as Single Feature

28.57%

**Income** as Single Feature

64.29%

**Incidence Rate of Asthma & Incidence Rate of COPD** as Features

# Discussion

- Main industry type in each area is associated with its air quality
  - Limit numbers of facilities related to fossil fuels, crude petroleum, and ready-mix concrete manufacturing
  
- Average emission of all facilities in an area is associated with air quality
  - Regulate TRI and GHG emission of each facility
  - Preprocessing before release/emission

# Limitations of Analysis

- ★ 80 miles buffer for each monitoring site
- ★ Represent overall air quality by computing average normalized AQI of all four GHG AQI
- ★ One to one spatial join of buffers and county polygons
- ★ Data for reported asthma and COPD cases in 2014
  - Unreported Cases?
  - Short term vs. long term exposure?

# Conclusion & Future Works

- Encourage local government to regulate businesses and factories
- Possible further investigation with individual long term and short term exposure data, and also more monitoring sites
- Research can be extended to the association of industry/health and other environmental pollution besides air pollution

Thank You!

