Estimation of PM 2.5 emission in Beijing, China, using weather data

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Motivation

“The air quality is getting WORSE!”

“Public amnesia”

OR

Truth by majority

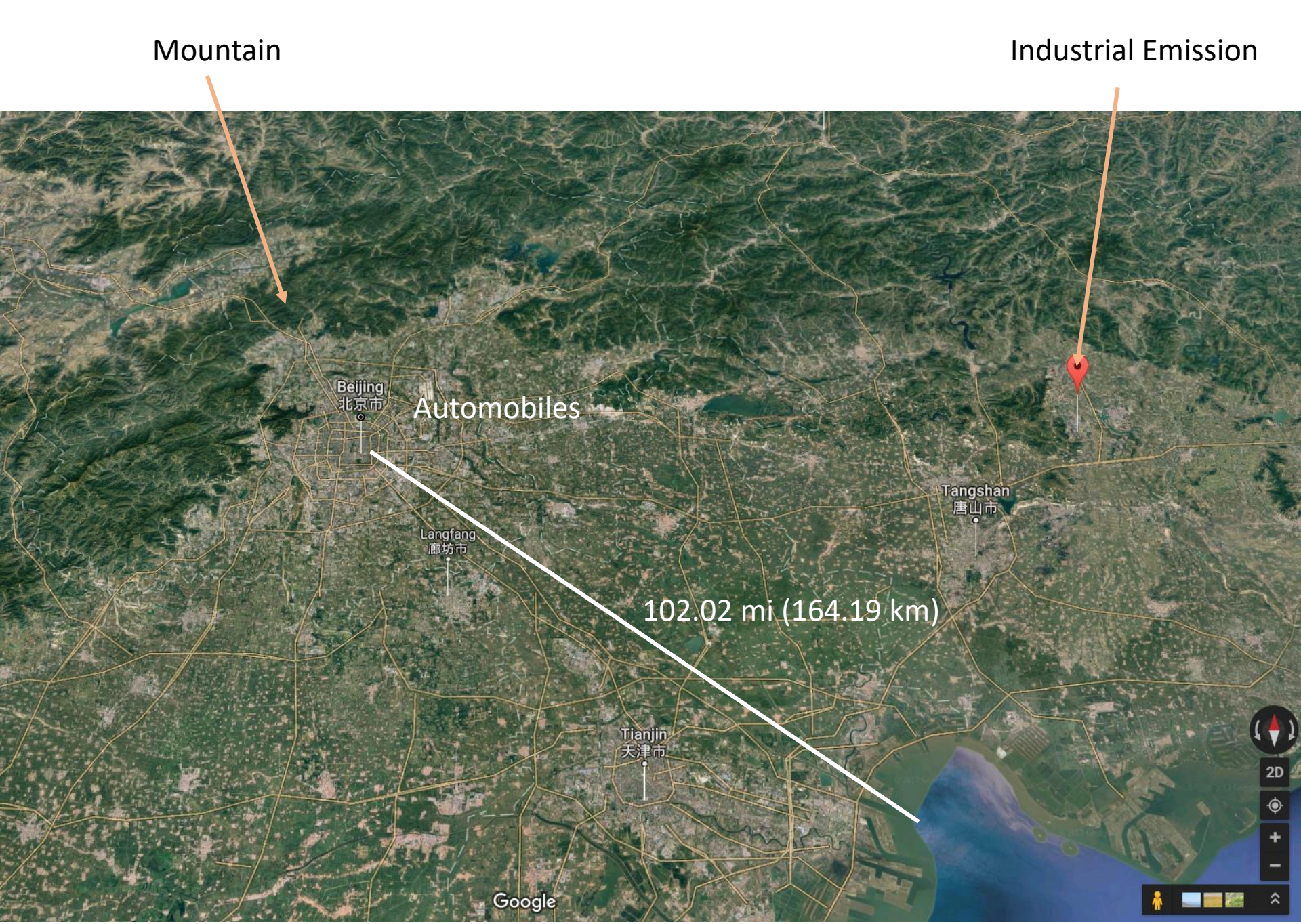
Questions

- How do weather conditions influence $PM_{2.5}$ concentration?
- What does seasonality imply about emission?
- How did policies change the $PM_{2.5}$ emissions?

$$\frac{dm}{dt} = E + F_H + F_V + D$$

Why Beijing?

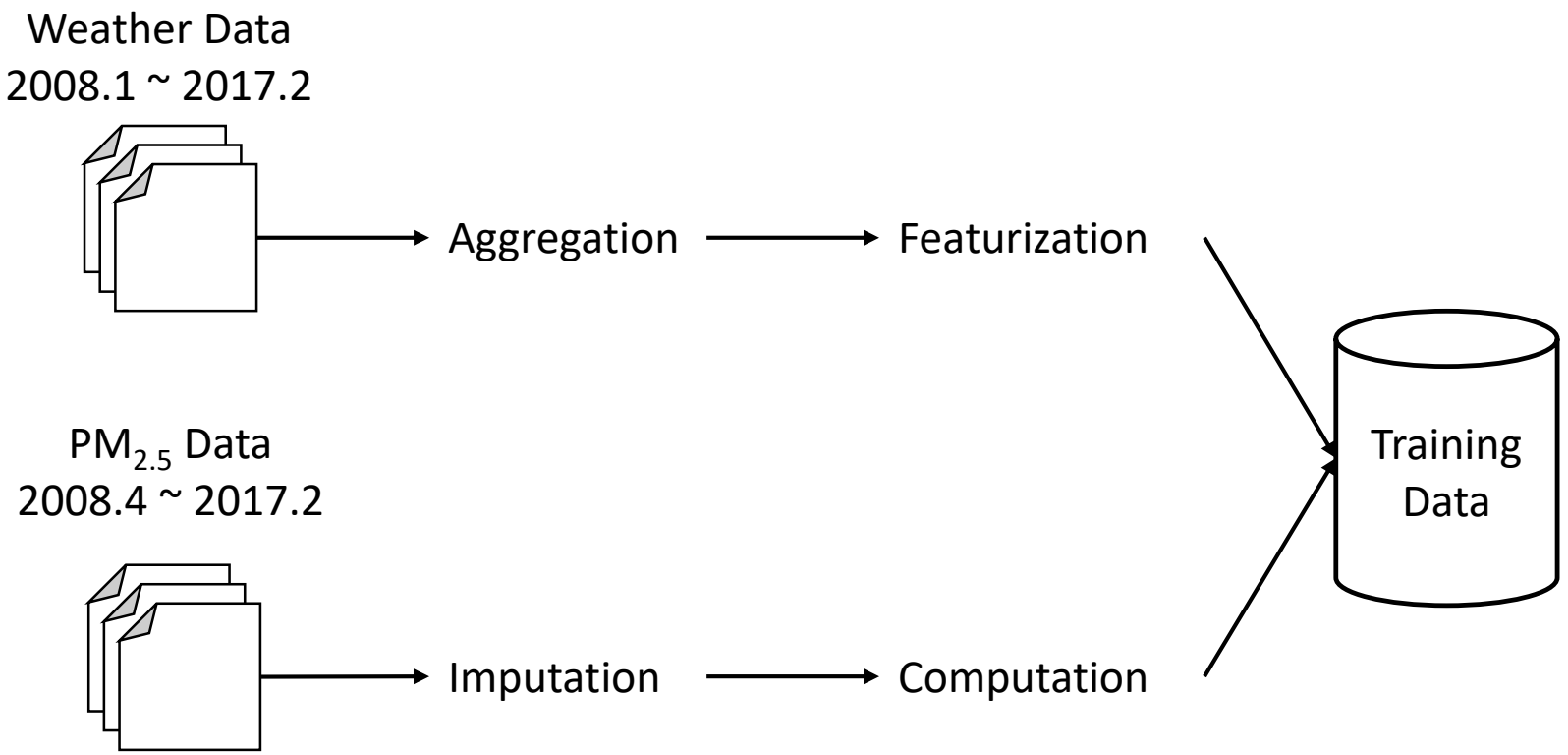
- Familiarity
- China represents a group of developing country
- The special location


Mountain
Industrial Emission
Beijing
北京市
Automobiles
Langfang
廊坊市
Tangshan
唐山市
102.02 mi (164.19 km)
Tianjin
天津市
Google
2D

Data Source

- Weather data: Weather Underground
- PM 2.5 data: U.S. Department of State Air Quality Monitoring Program. (2017). *Mission China*.
- Policy data: Courtesy of Caiwei Huang, Emory undergraduate research assistant of Dr. Saikawa

Methods


Weather Data
2008.1 ~ 2017.2
Aggregation
Featurization
PM2.5 Data
2008.4 ~ 2017.2
Imputation
Computation
Training
Data

Methods - Aggregation

Time	Temp	Wind
15:30	28 ℃	5 mph N
16:00	27 ℃	N/A
16:00	N/A	5 mph E
16:30	25 ℃	0 mph

Time	Temp	Wind
16:00	27.5 ℃	7.07 mph NE
17:00	25 ℃	0 mph

Methods - Imputation

Time	$PM_{2.5}$ ($\mu g/m^3$)
15:00	42
16:00	N/A
17:00	46

Time	$PM_{2.5}$ ($\mu g/m^3$)
15:00	42
16:00	44.0
17:00	46

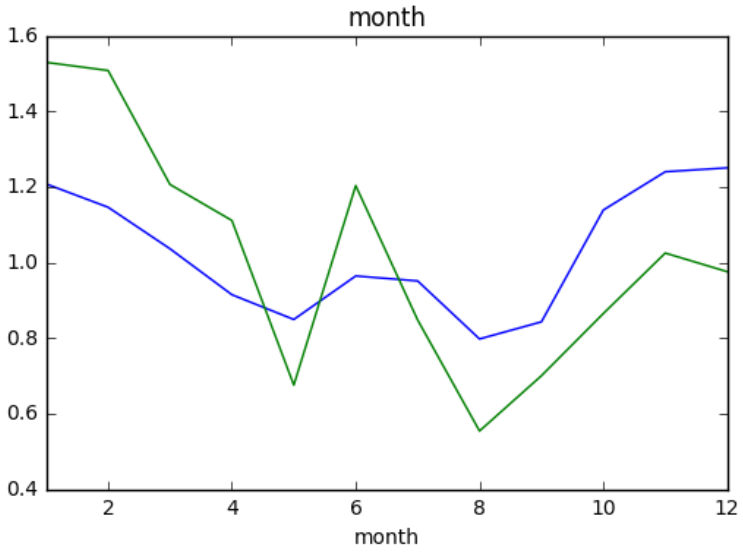
Time	$PM_{2.5}$ ($\mu g/m^3$)
15:00	124
16:00	N/A
17:00	N/A
18:00	128

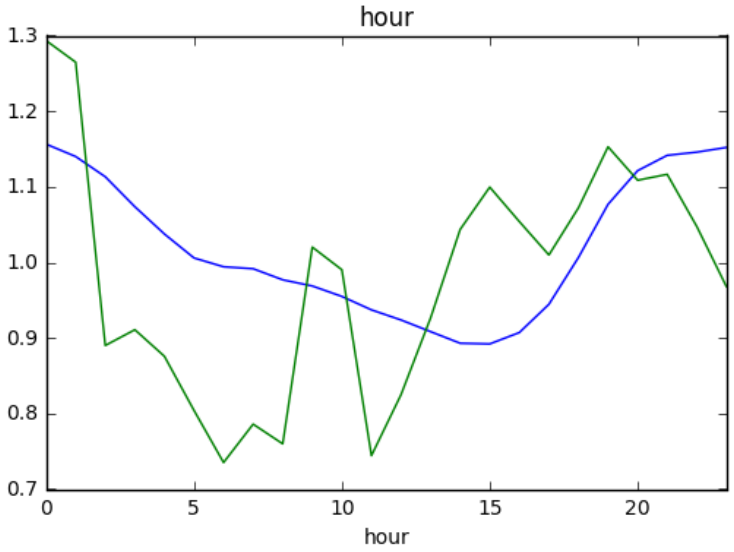
Time	$PM_{2.5}$ ($\mu g/m^3$)
15:00	124
16:00	125.33
17:00	126.67
18:00	128

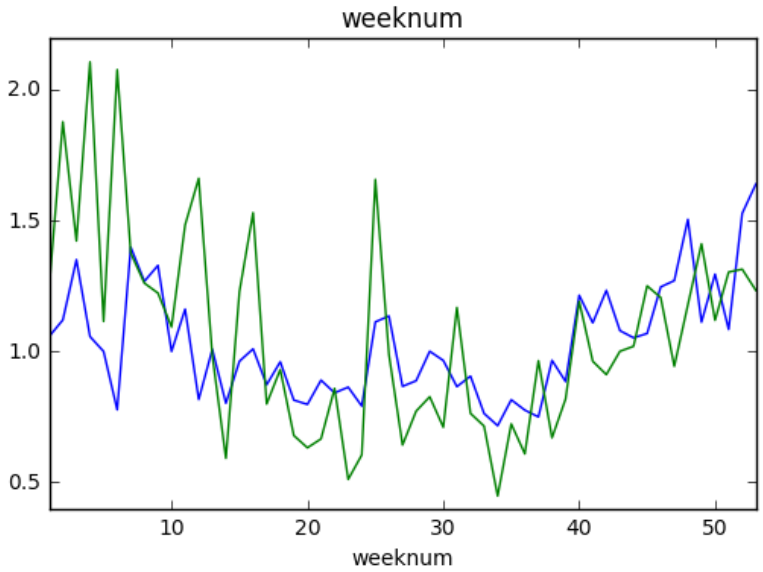
Features

Hour
Month
Temp
Feels like
Humidity
Pressure
Wind Speed North
Wind Speed East
Absolute Wind Speed
Weather Conditions:
- Thunder
- Snow
- Hail
- Rain
- Drizzle
- Cloudy

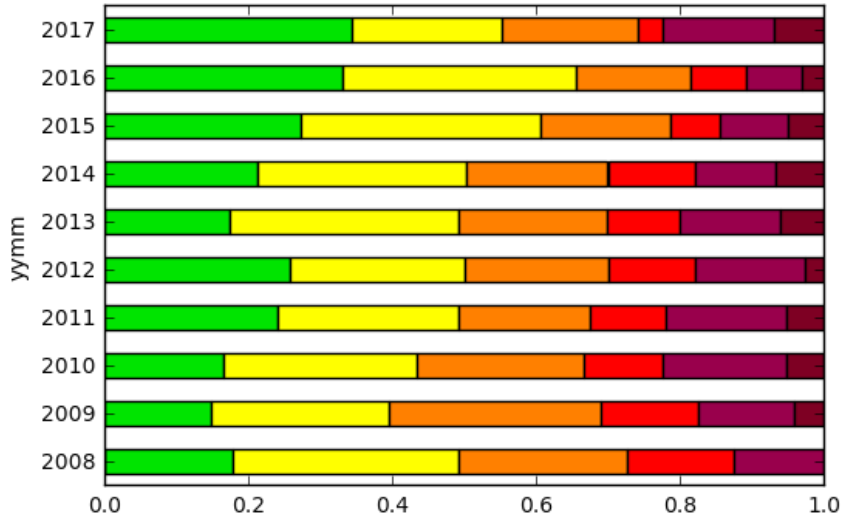
First Glance at Data

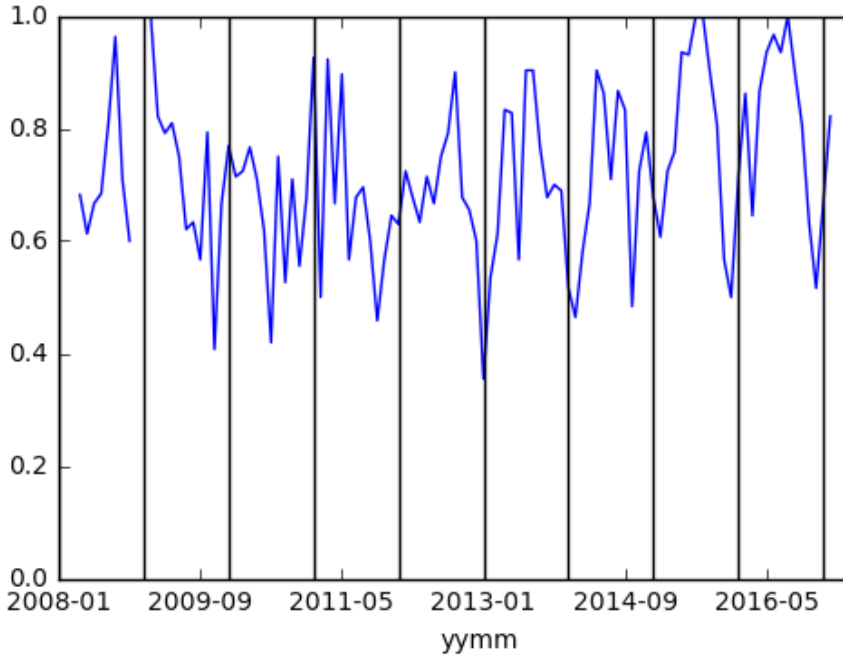






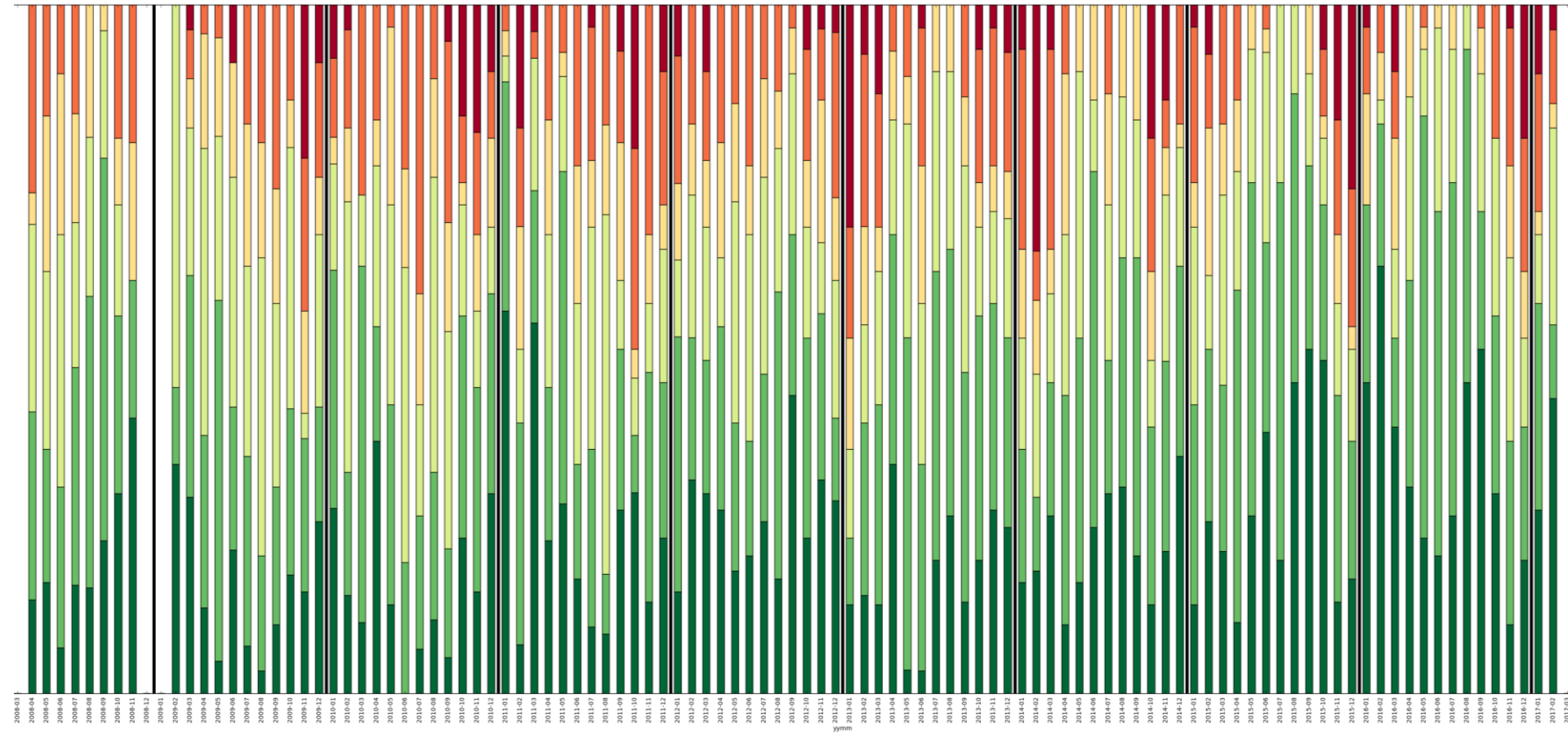
First Glance at Data



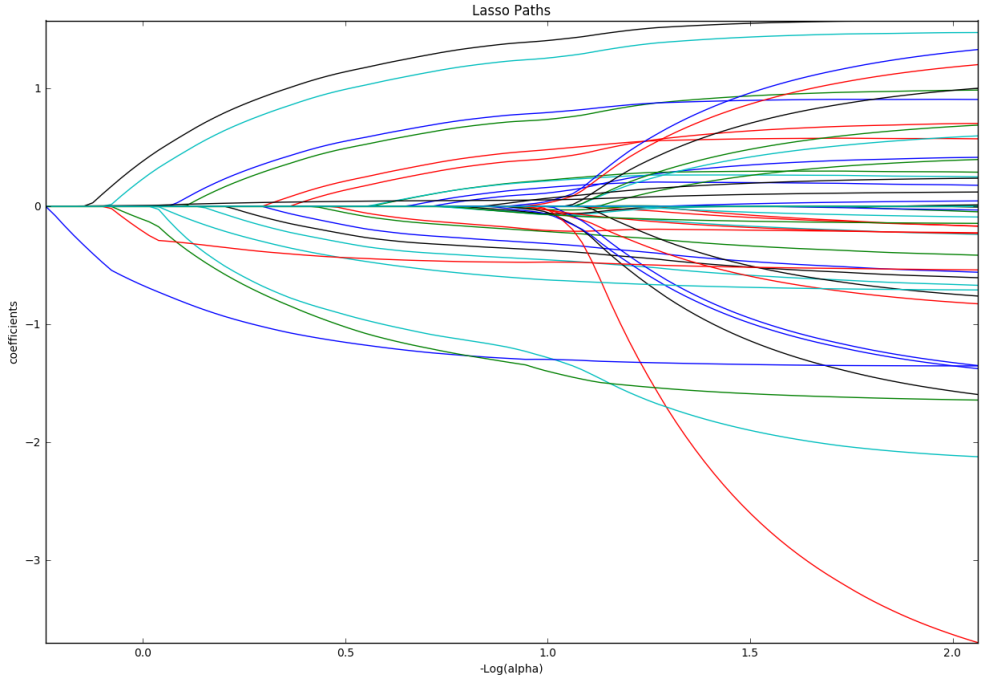


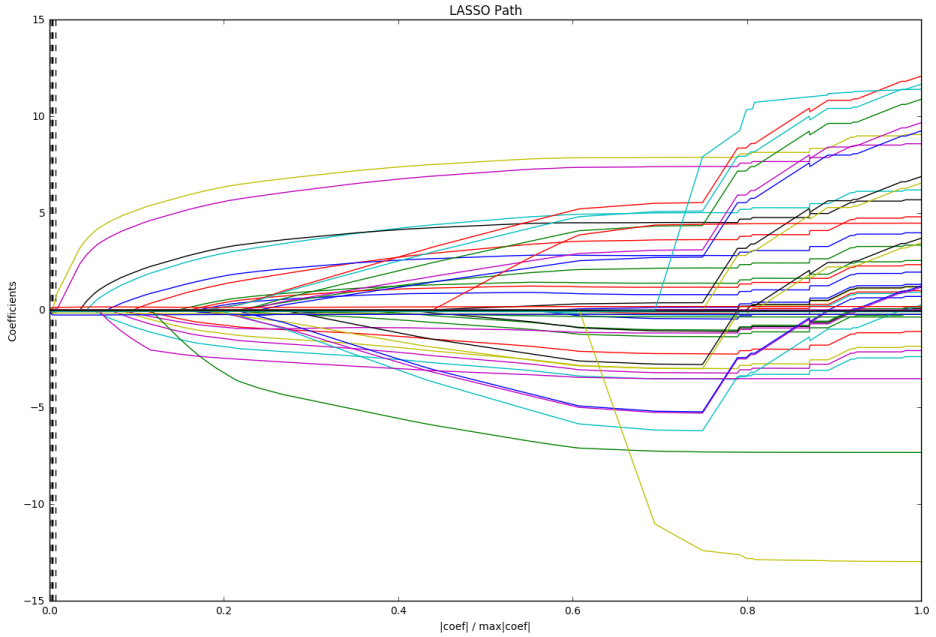
0	35	75	115	150	250

First Glance at Data



Factor Analysis





Next Steps

- Under standing features
- According to $\frac{dm}{dt} = E + F_H + F_V + D$:
  - Reduce weather factors
  - Estimate emission
- Compare the data with policies