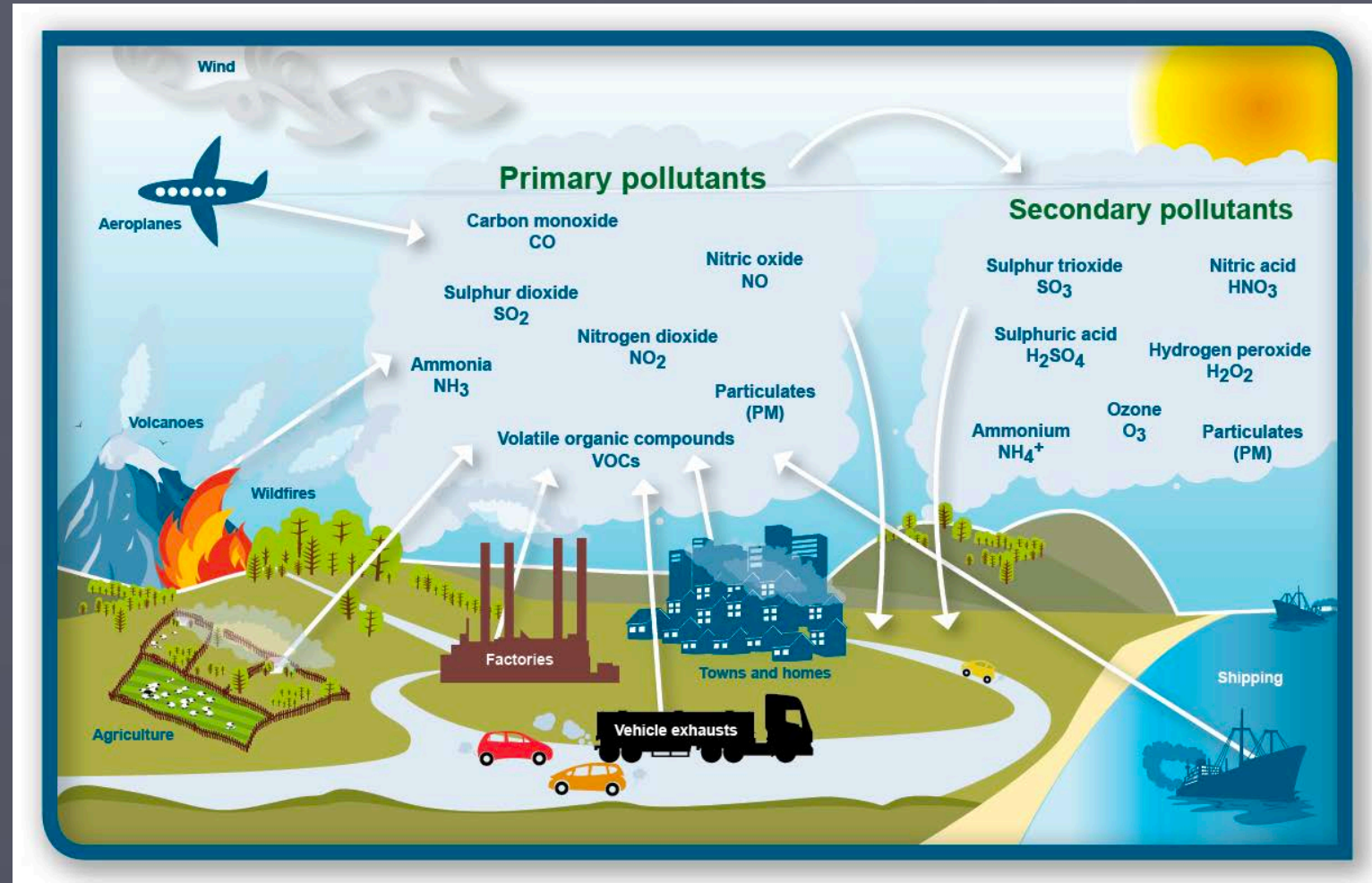


# Pollutants & Human Imprint

The background of the slide is a dark blue-grey color. It features a faint, light-colored map of the United States. In the bottom-left corner, there is a faint compass rose with the letters 'N', 'S', 'E', and 'W' indicating the cardinal directions.

# Air Pollution

- Air pollution refers to particles and molecules in the atmosphere that are harmful to living organisms
  - Can be a result of natural or anthropogenic processes



# Air Quality Index

- Measure of air particulates
  - Specifically looking for particulates that are harmful to human respiratory system
- ground-level ozone
  - particle pollution (also known as particulate matter, including PM2.5 and PM10)
  - carbon monoxide
  - sulfur dioxide
  - nitrogen dioxide

11-19-2010; 13:00; PM2.5; 364.0; 410; Hazardous // Ozone; 0.5; 0; No Reading

about 12 hours ago via BeijingAir AQI Tweet

11-19-2010; 12:26; Past 24hr: PM2.5 avg; 462.6; 475; Hazardous//Ozone 8hr high; 0.5; 1; Good

about 12 hours ago via BeijingAir AQI Tweet

11-19-2010; 12:00; PM2.5; 540.0; 500; Beyond Index // Ozone; 0.1; 0; No Reading

about 12 hours ago via BeijingAir AQI Tweet

11-19-2010; 11:00; PM2.5; 557.0; 500; Beyond index // Ozone; 0.1; 0; No Reading

about 14 hours ago via BeijingAir AQI Tweet

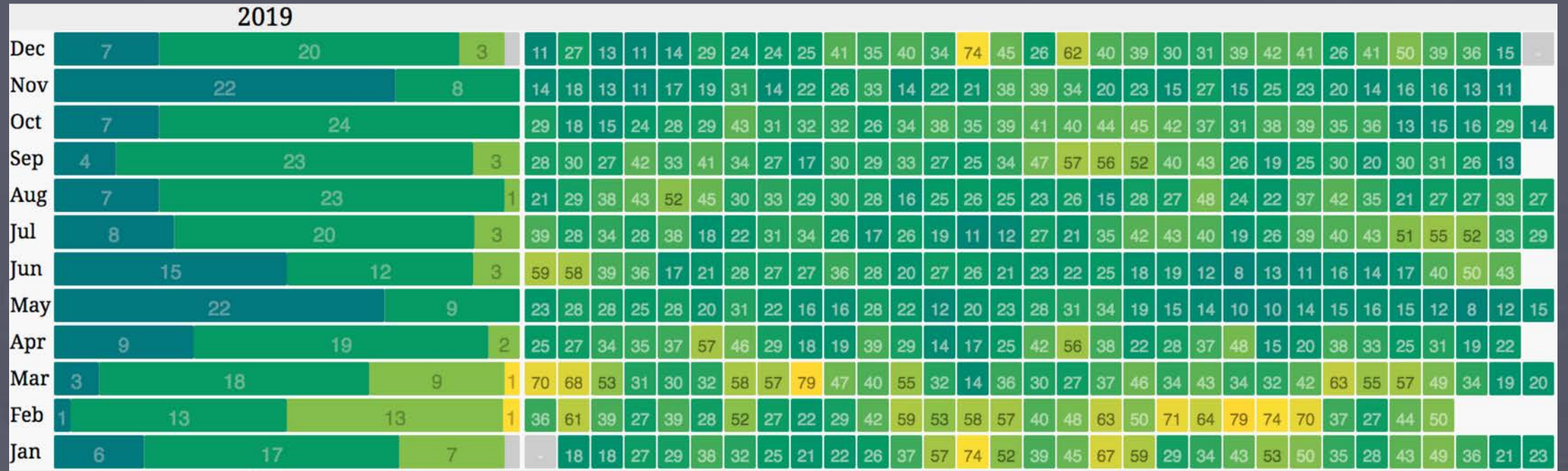
11-19-2010; 08:00; PM2.5; 466.0; 477; Hazardous // Ozone; 0.0; 0; No Reading

about 17 hours ago via BeijingAir AQI Tweet

# Air Quality Index (AQI)

Air Quality Index Levels of Health Concern	Numerical Value	Meaning
Good	0-50	Air quality is considered satisfactory, and air pollution poses little or no risk.
Moderate	51-100	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups	101-150	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy	151-200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	201-300	Health alert: everyone may experience more serious health effects.
Hazardous	> 300	Health warnings of emergency conditions. The entire population is more likely to be affected.

# 2019 AQI Reading at Coffey Station



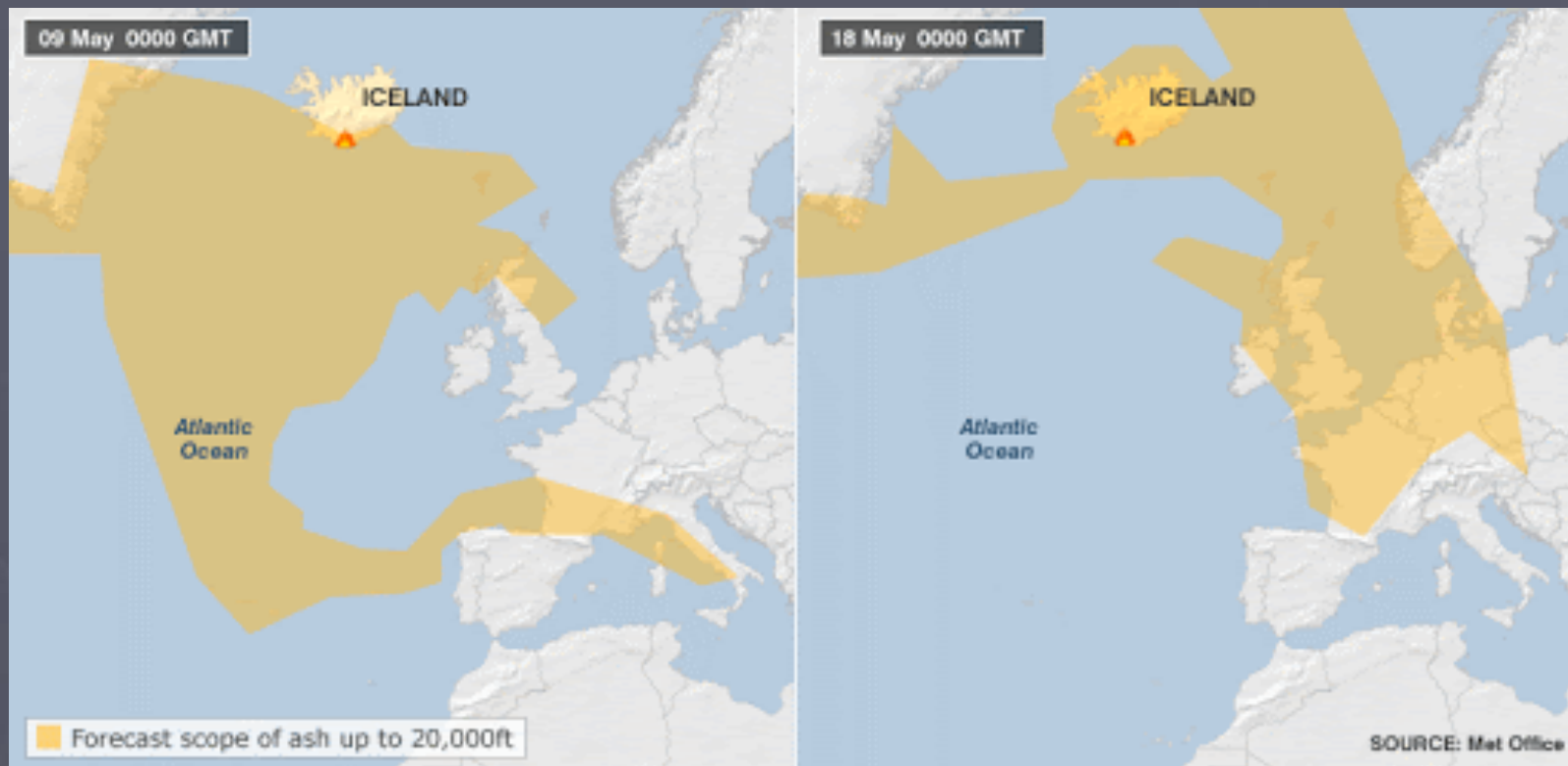
2912 Coffey, Nebraska Monitoring Station (located near Bellevue)  
 Source: Nebraska Department of Environmental Quality

# Natural Causes of Air Pollution

- Volcanic Eruptions
  - Sulfur Oxide & Particulates
- Forest Fires
  - Carbon Monoxide and Dioxide, Nitrogen Oxides, particulates
- Plants/Animals
  - Methane, hydrogen sulfides, hydrocarbons, pollens
- Ocean
  - Salt Spray, Particulates
- Dust/Sand
  - Particulates, viruses



# Case Study: Eyjafjallajökull

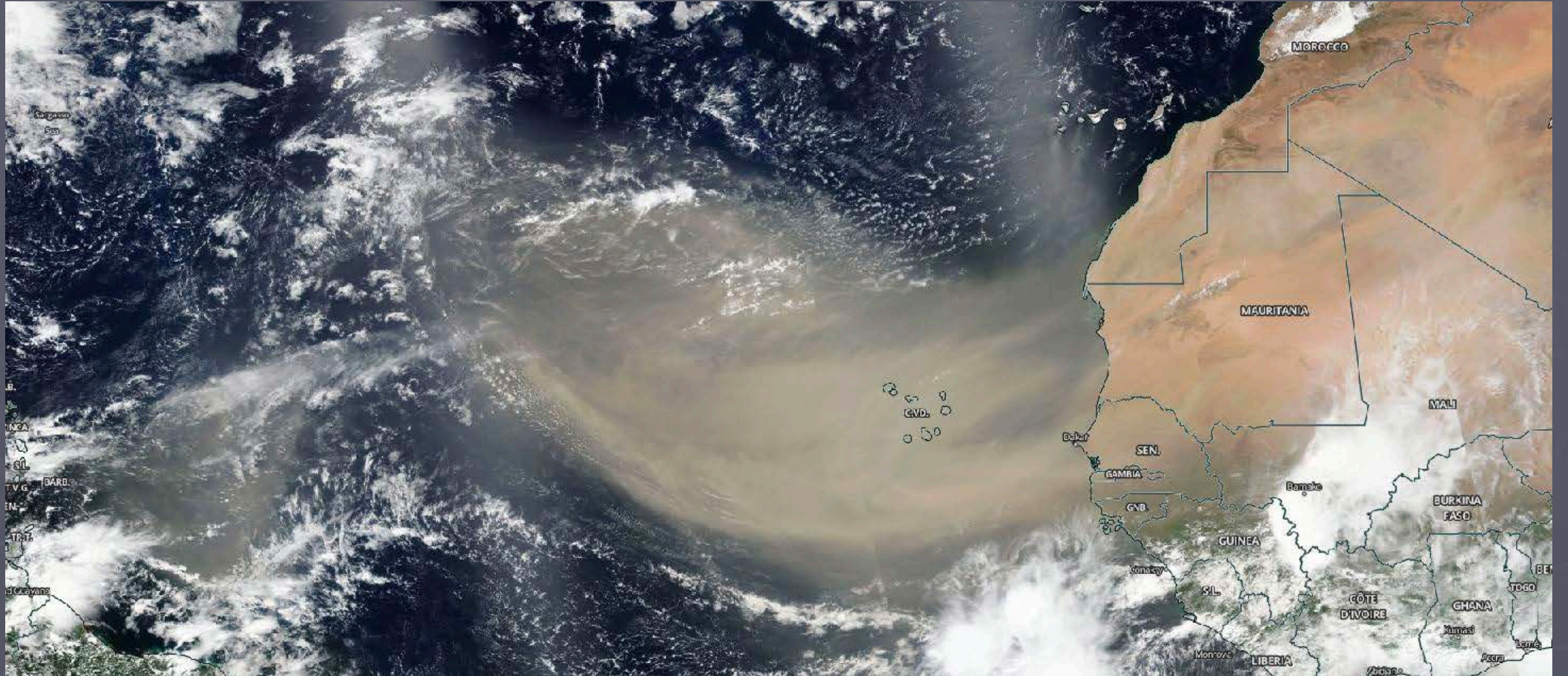


# Case Study: Beijing, China

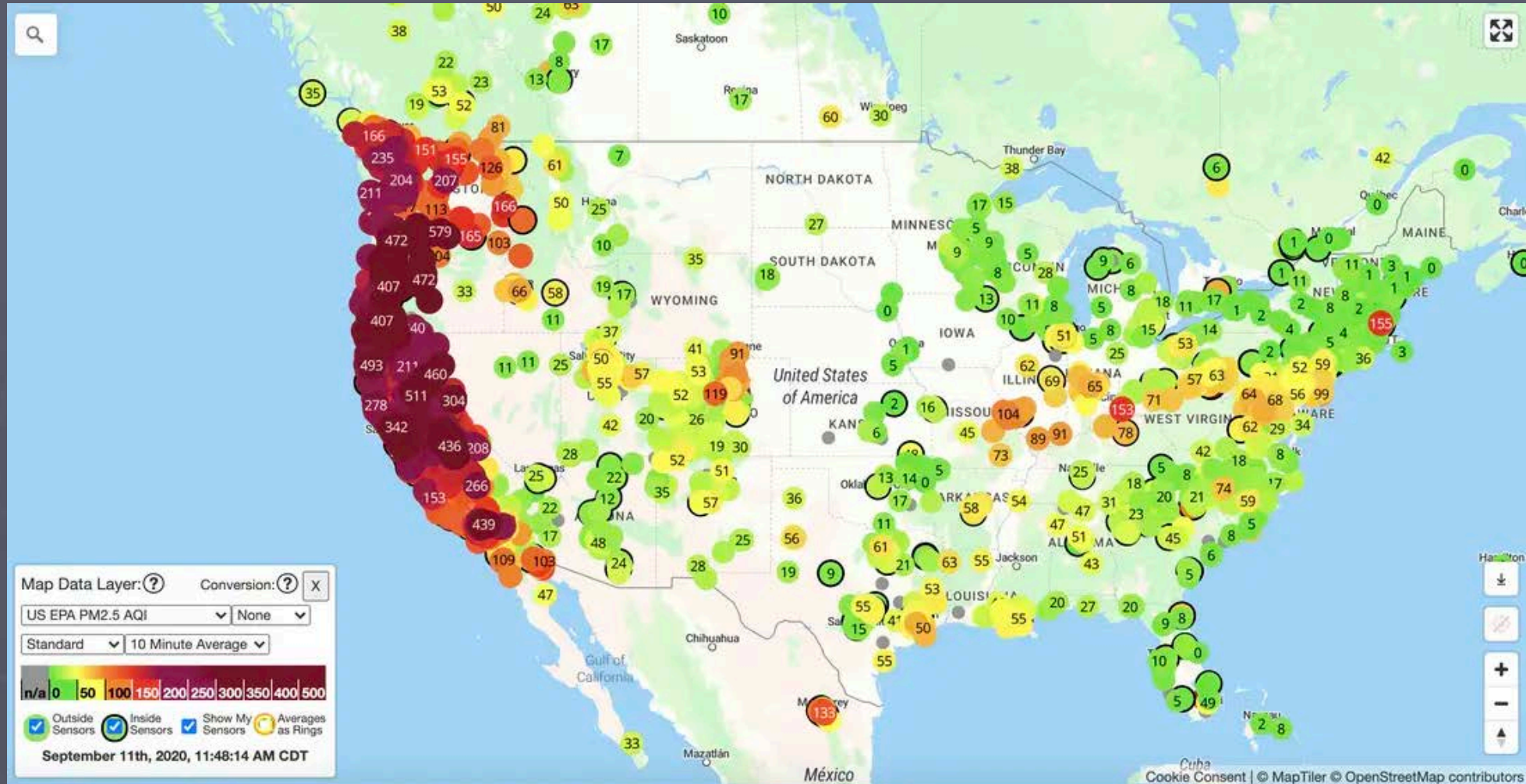




# Case Study: Sahara Dust Plume



# Case Study: 2020 Wildfires



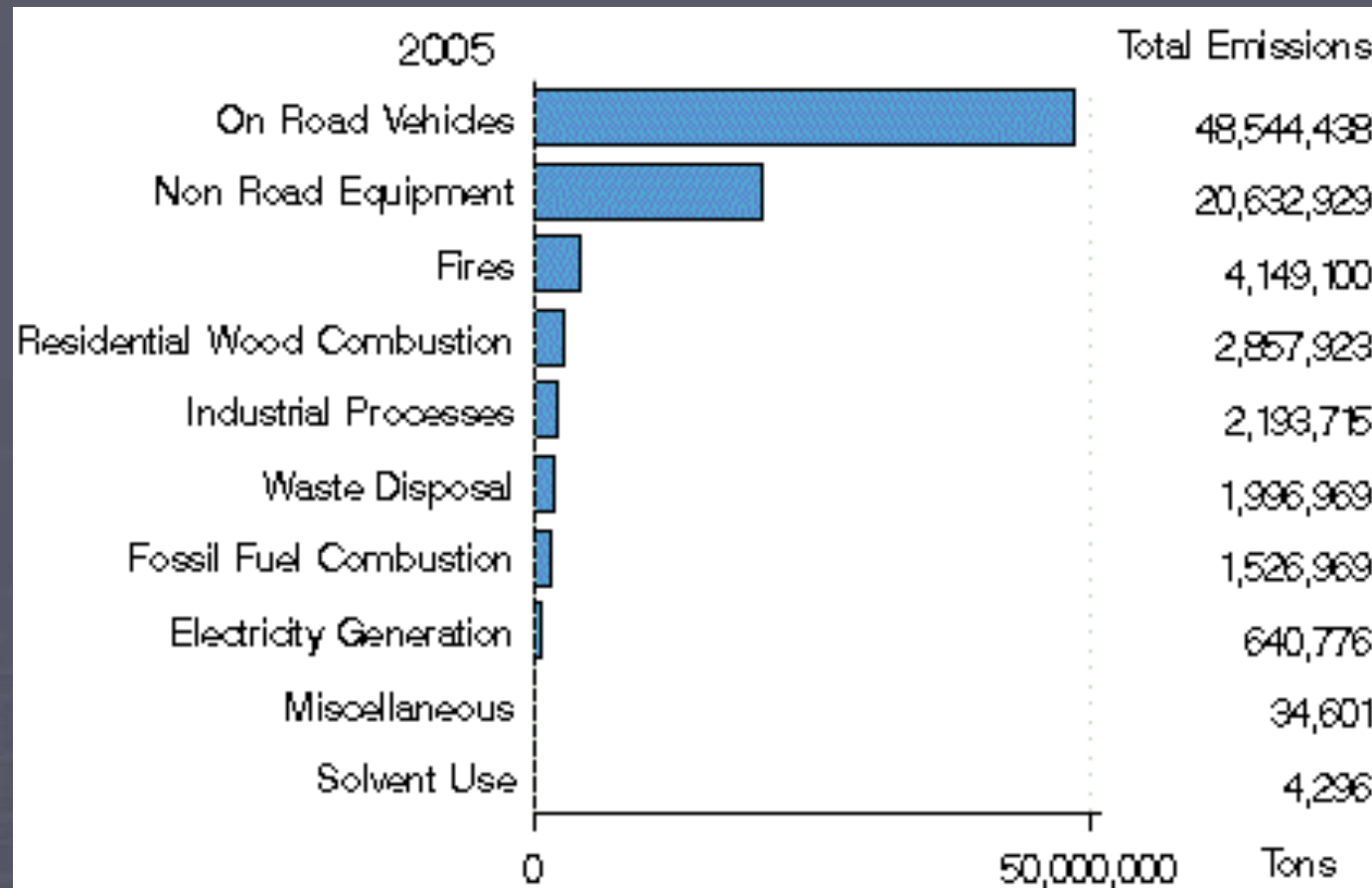
Increases in AQI resulting from wildfires (Sept 11, 2020)

# Anthropogenic Causes of Air Pollution

- Pollution resulting from Human activity and processes
  - Transportation
    - Carbon Monoxide, Nitrogen Oxides, Ground-level ozone, Particulates, Carbon Dioxide
  - Agriculture
    - Nitrogen Oxides, Particulates, Carbon Dioxide, methane
  - Fossil Fuel Combustion
    - Particulates, Carbon Dioxide
  - Industrial Processes
    - Sulfur oxides, Particulates
  - Aerosols
    - Particulates, CFCs



# Case Study: US Emissions 2005



Source: US EPA 2009

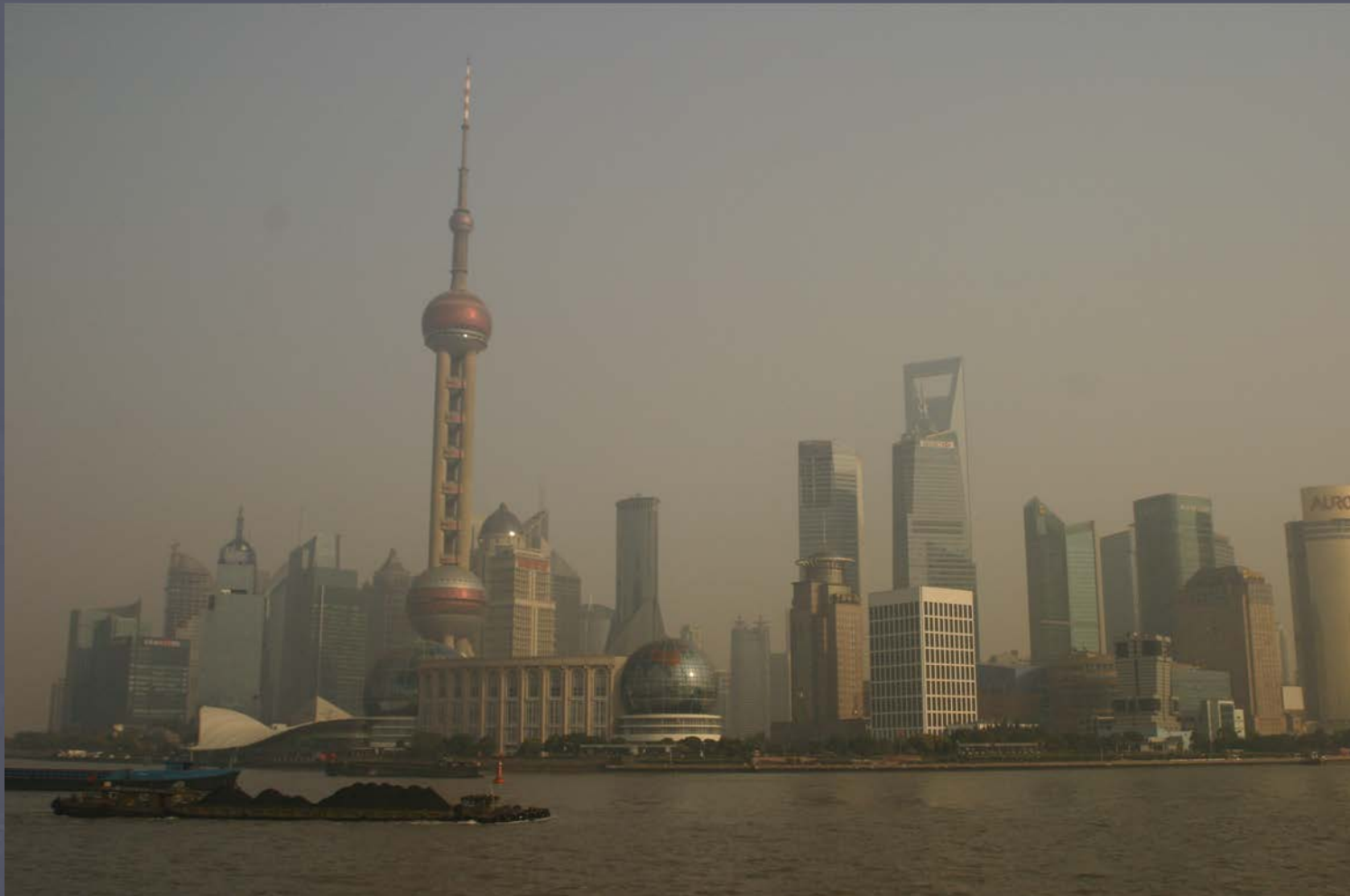
# Smog

- **Photochemical Smog:** Results from the reaction of high levels of Nitrogen oxides and Volatile Organic Compounds (VOCs) with sunlight
  - Both highly concentrated in gasoline exhaust
- **Industrial Smog:** Results from the concentration of carbon dioxide and sulfur oxides
  - Caused by coal-burning industrials and electrical generation

# Shanghai, China (AQI around 30)



# Shanghai, China (AQI about 200-400)



# Great Wall of China (AQI 300-400)

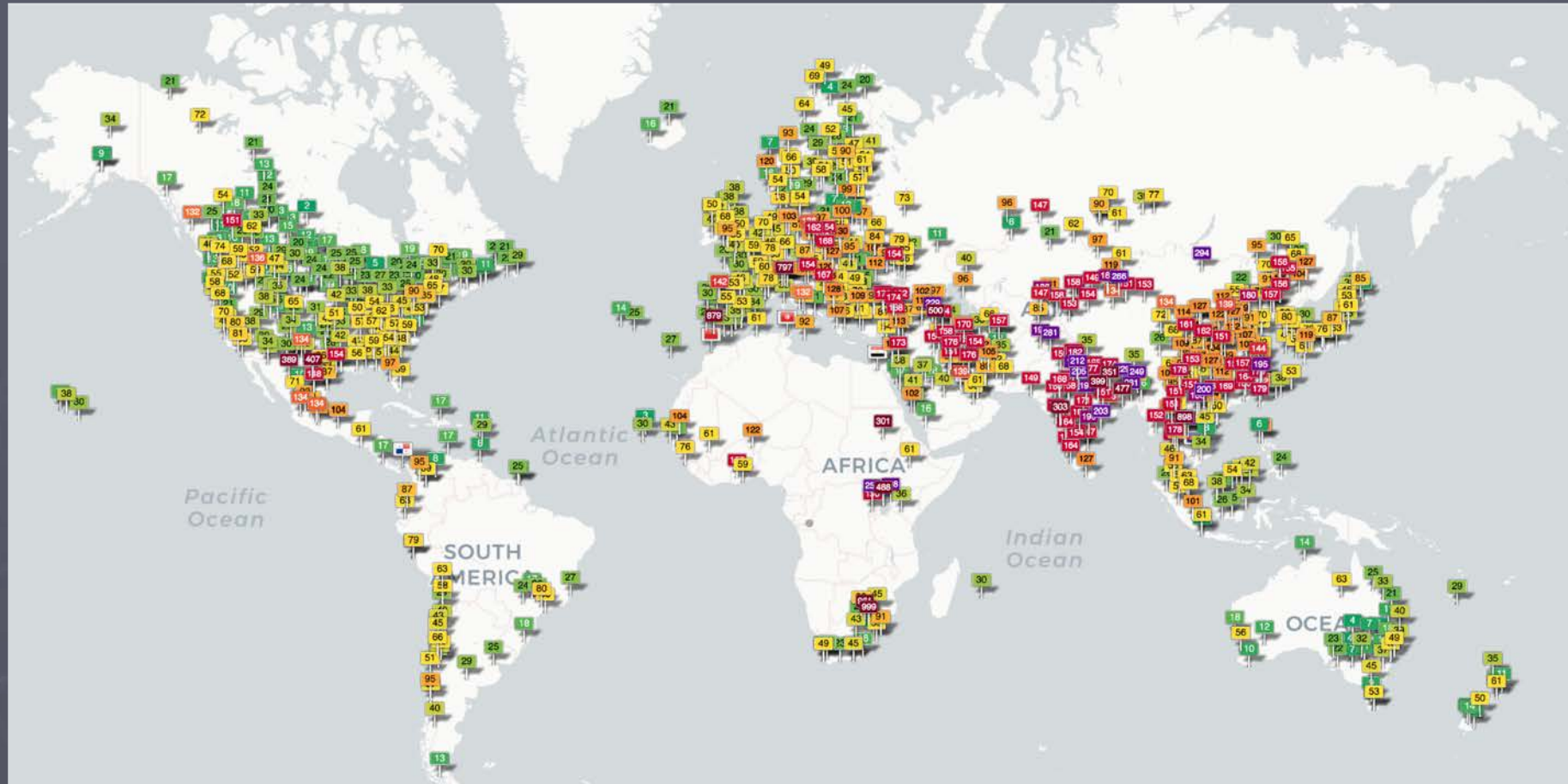




# Shanghai, China (AQI 500+)



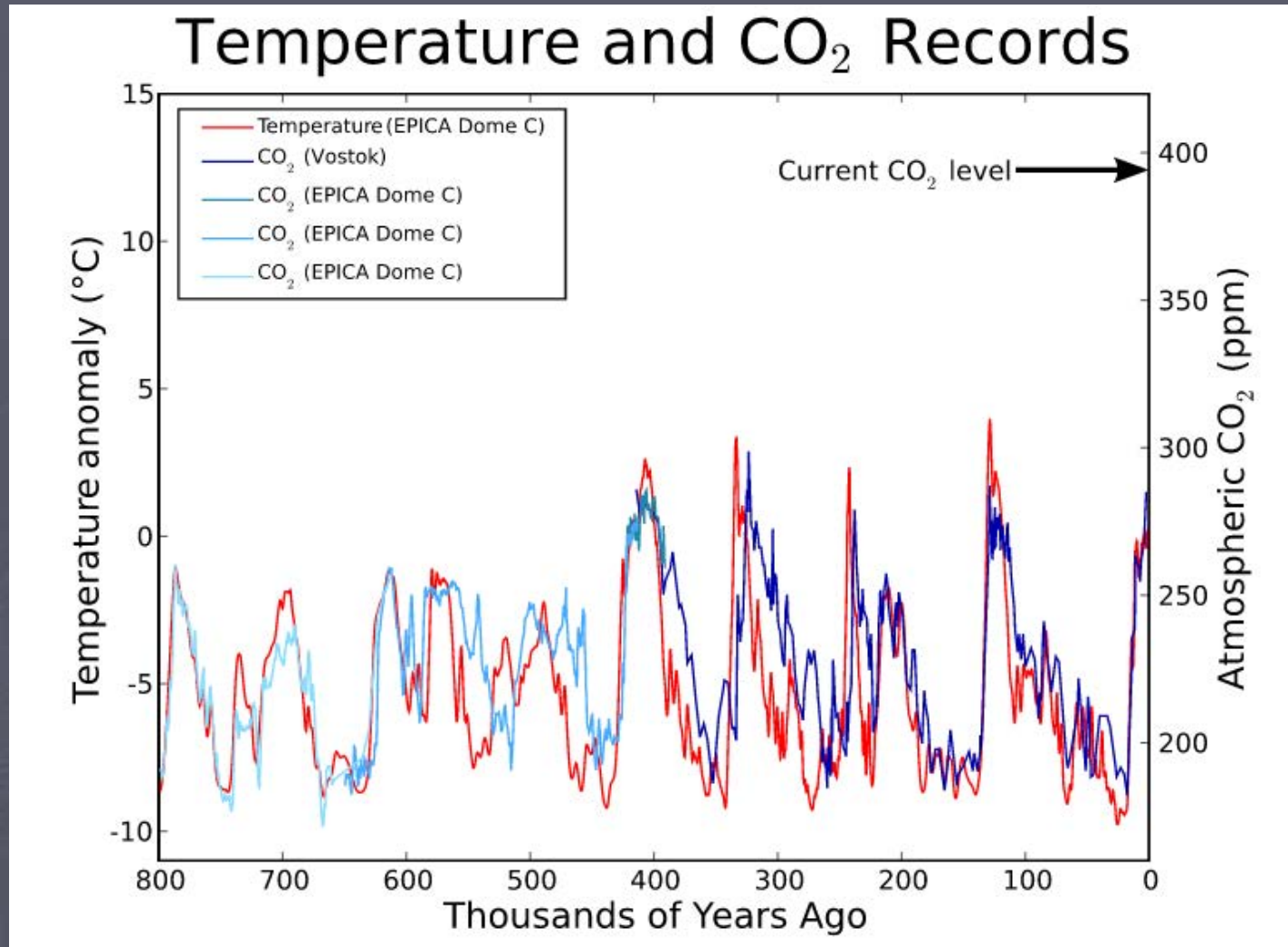
# Global Air Quality (Dec 13, 2020)



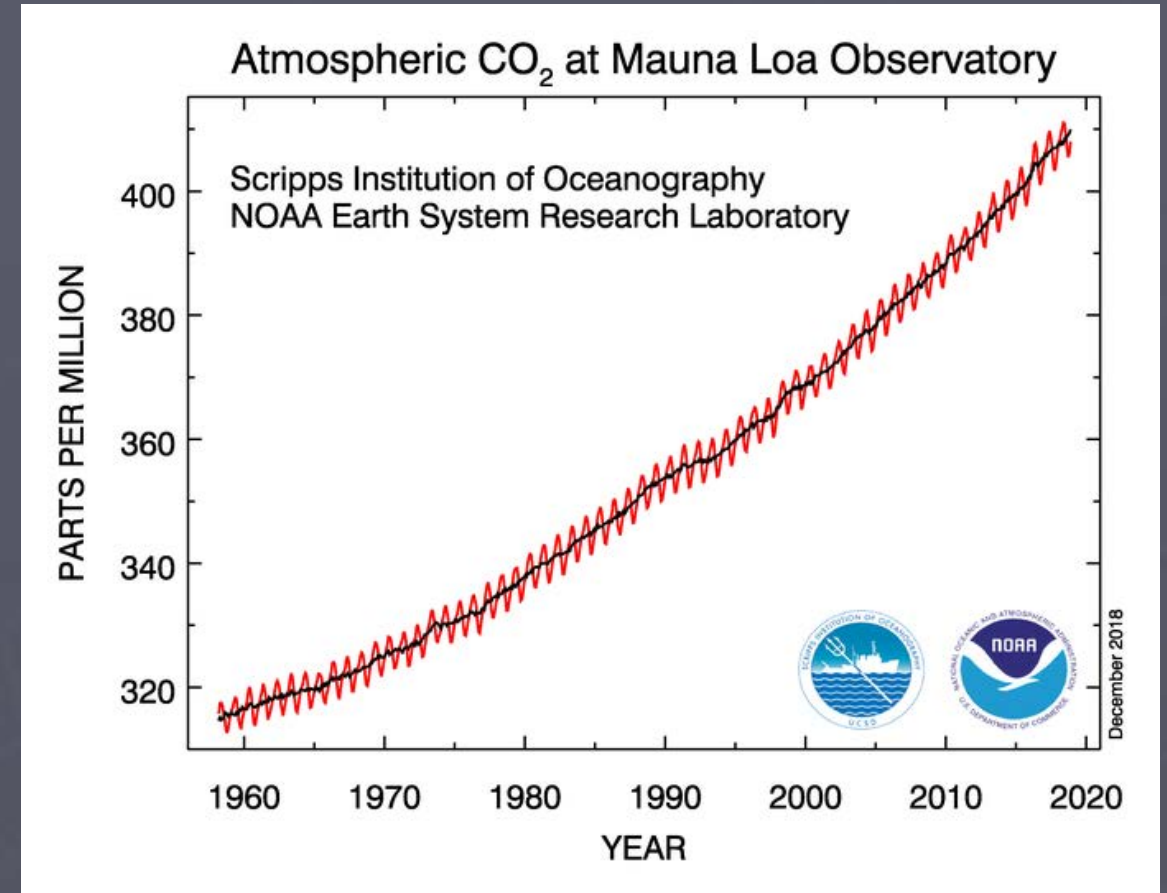
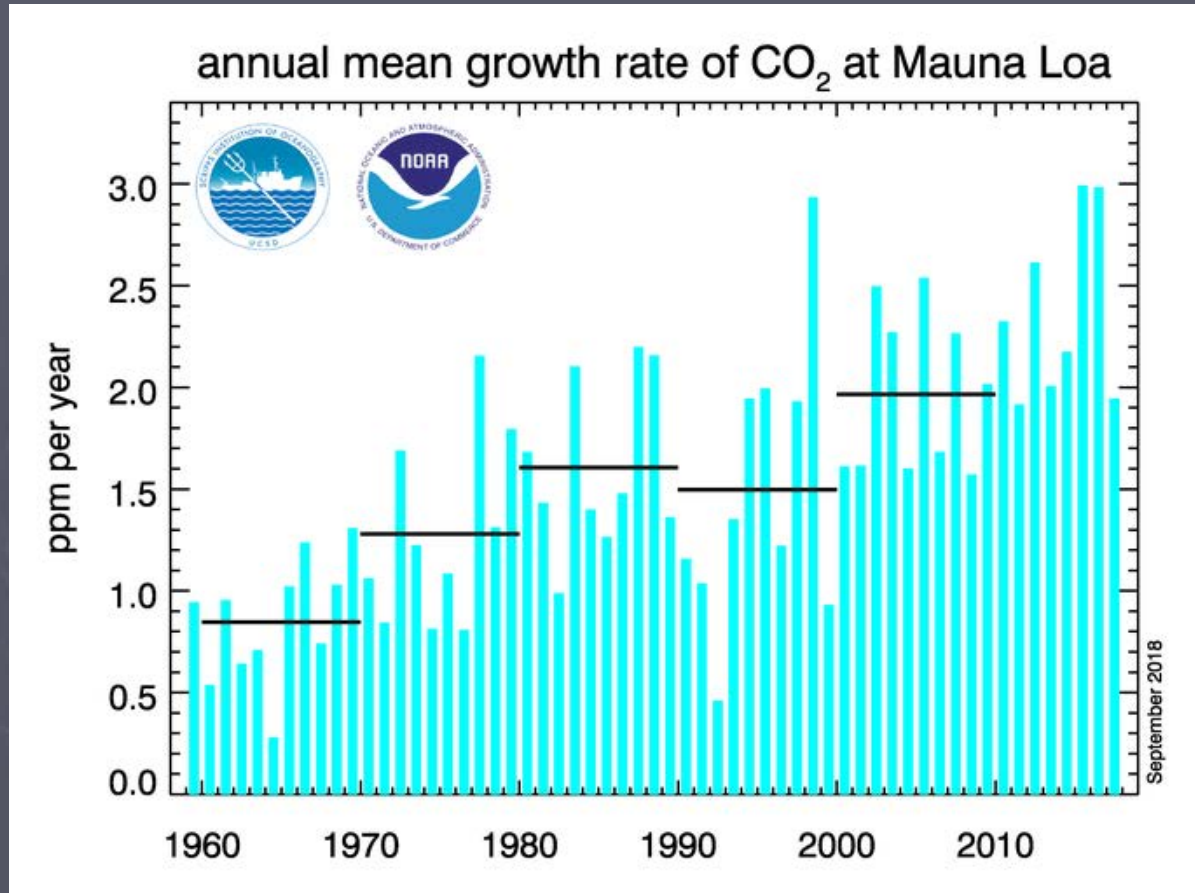
Source: World's Air Pollution ([waqi.info](http://waqi.info))



# Trends in CO<sub>2</sub>



# Trends in CO<sub>2</sub>

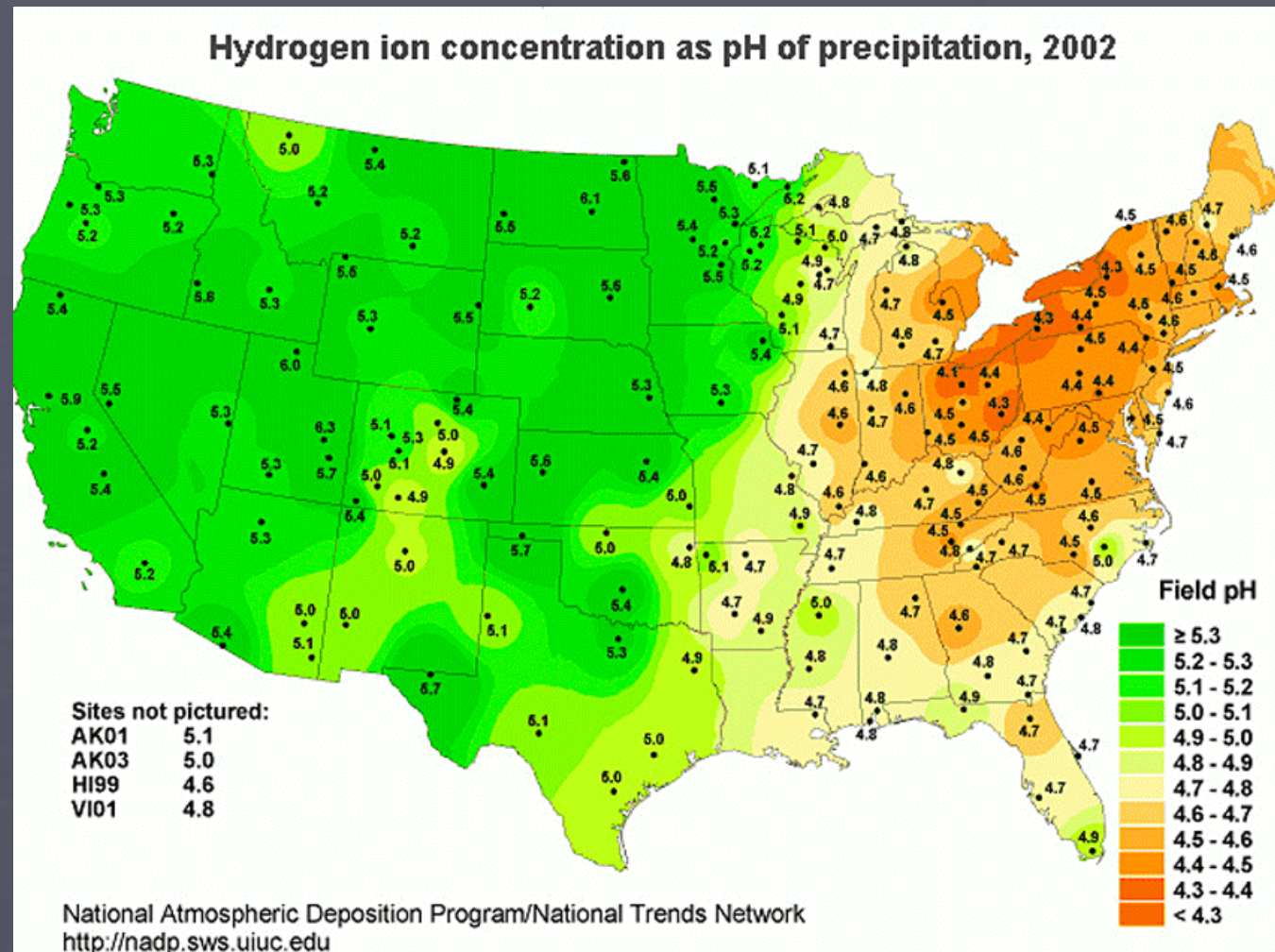


# Acid Rain

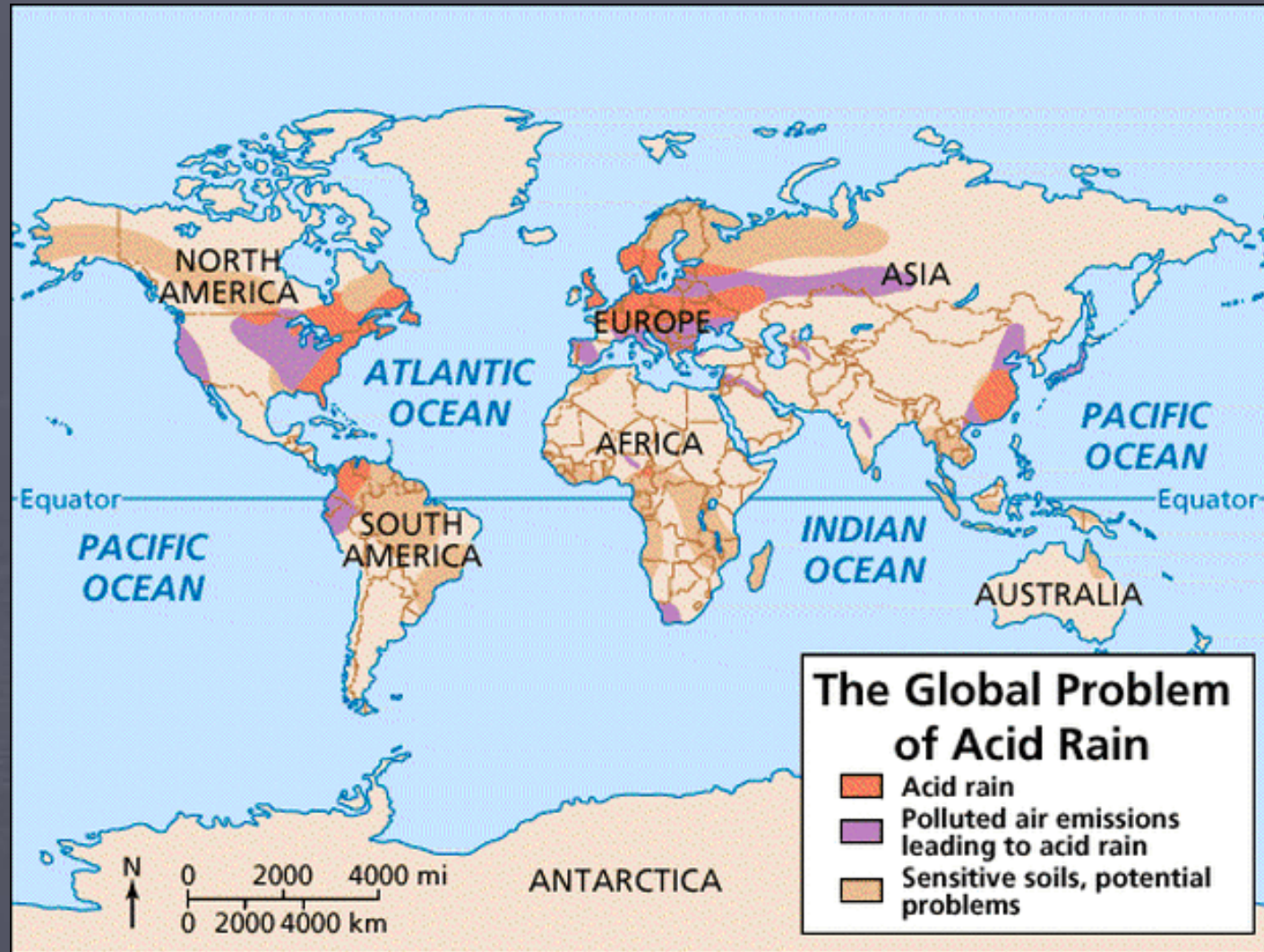
- Nitrogen and Sulfur molecules combine with water in atmosphere & fall to Earth as Acid Rain, Acid Snow, or as Dust/Aerosols
  - Comes down as Sulfuric Acid and Nitric Acid



# Acid Rain in the US



# Global Concentrations of Acid Rain





# Mitigating Effects of Air Pollution

- Prolonged exposure to harmful air can lead to increased health defects – especially for people with pre-existing conditions
  - Respiratory Diseases
    - especially Lung cancer, asthma, emphysema, pneumonia
  - Cardiovascular diseases
- The Clean Air Act
  - Originally passed in 1963 – major amendments in 1970, 1977, 1990
    - Cornerstone piece of US Environmental Legislation
  - Puts the Environmental Protection Agency (EPA) in charge of monitoring AQI
    - AQIs of less than 100 deemed acceptable