Air Quality Trends

Mercer University
EVE 486

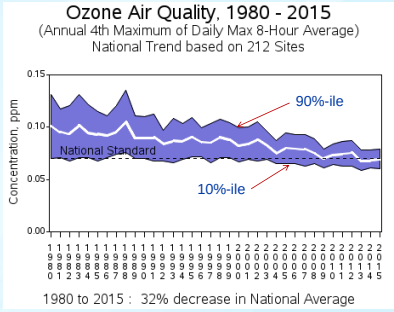
Ozone (O_3) Basics

- A colorless gas (one double bond)
  - Protective in stratosphere (20-50 km)
    - Biogenic
  - Toxic in troposphere (0-20 km)
    - NO_2 + VOCs + sunlight → O_3
    - Chest pains
    - Coughing
    - Throat irritation
- A major form of urban air pollution

Specific O_3 Health Effects

- A strong irritant that restricts airways
- Aggravates respiratory disease (emphysema, bronchitis, asthma)
- Lung damage
- Wheezing, chest pain, headache, nausea
- Reduced resistance to infections
- Increased fatigue
- Reduced athletic performance

Ozone Trends (US)

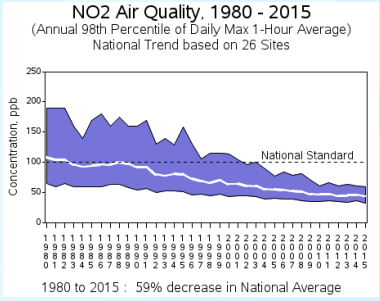


0.07 ppm

Nitrogen Dioxide (NO_2) Basics

- A reactive form of NO_x (a free radical)
  - Mostly anthropogenic
    - Emitted when fossil fuels are combusted
  - A biogenic component, too
    - Soils
    - Oceans
- Exacerbates asthma
- Acid rain
- Health effects
  - Inflamed lining of lungs
  - Very problematic for asthmatics

NO_2 Trends (US)

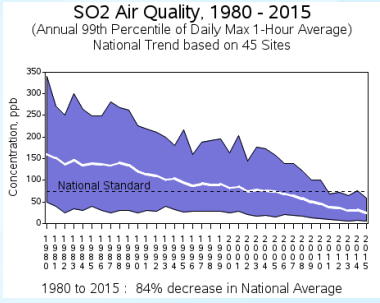


100 ppb

Sulfur Dioxide (SO_2) Basics

- An important form of SO_x
- Fossil fuel combustion
- Acid rain
- Human health effects
  - Asthma exacerbation
  - General respiratory trigger
- Environmental effects
  - Decreases growth of trees, plants
  - Reduces visibility; Acid rain

SO_2 Trends (US)



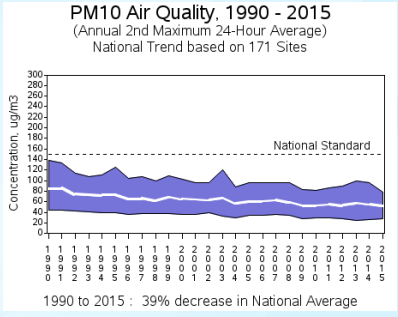
Particulate matter (PM) Basics

- Solid particles and liquid droplets found in air
- Wide size range
- PM_{10}
  - "Coarse," although inhalable
  - Building/road construction
- $PM_{2.5}$
  - "Fine"
  - Combustion

PM Health Effects

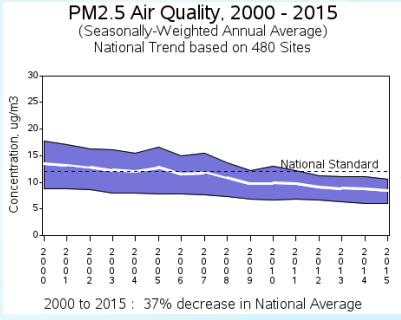
- Short term exposure
  - Asthma attack, acute bronchitis
  - Increased susceptibility to respiratory infections
  - Exacerbates heart disease
- Long term exposure
  - Coughing, difficulty breathing
  - Decreased lung function
  - Irregular heartbeat
  - Premature death (heart disease, cancer)

PM_{10} Trends (US)



150 µg/m³

$PM_{2.5}$ Trends (US)



12 µg/m³

Worldwide Trends

Things not necessarily improving in the rest of the world (particularly developing countries)…

Yale $PM_{2.5}$ world map
(http://visuals.datadriven.yale.edu/pollution-map/)

Global data
(https://ourworldindata.org/air-pollution)