

# Satellites, Weather and Climate Module 8b:

## *Air Quality and Remote Sensing*



The  
UNIVERSITY  
of VERMONT



# What is “Air Quality”?

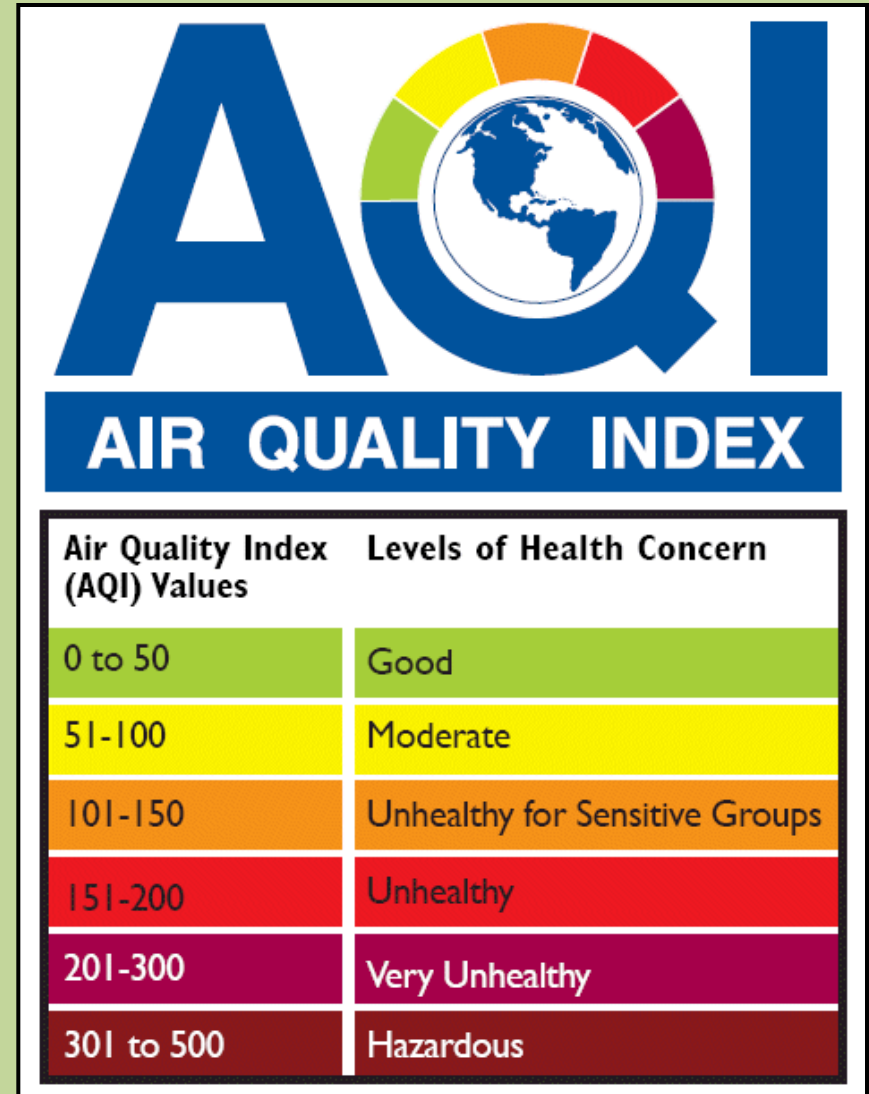
The term “**Air Quality**” can have many different definitions:

- “A measure of the condition of air relative to the requirements of one or more biotic species and or to any human need or purpose.”
- “A measurement of pollutants in the air.”
- “A description of the healthiness of the air.”

**Descriptions of Air Quality can be both quantitative and qualitative.**

*Air Quality is a term that is constantly changing over time.*

*All of the various definitions seek to link and describe the relationship between various concentrations of pollutants in the air with the health of human beings.*





# What is Air Pollution?

“Airborne particles and gases occurring in concentrations that endanger the health and well-being of organisms or disrupt the orderly functioning of the environment.” – Lutgens and Tarbuck

Air pollutants are broken down into two categories:

- *Primary Pollutants*
- *Secondary Pollutants*



“Setting Sun at Ivry” Jean Guillaumin 1869



# Primary Pollutants

Primary Pollutants are airborne particles that are emitted directly from identifiable sources. These tiny structures are known collectively as **Particulate matter (PM)**. Once suspended in either air or water, the mixture of the two becomes known as an **Aerosol**.

## Anthropogenic:

- Combustion Processes
- Chemical Processes
- Nuclear or Atomic Processes
- Roasting, Heating and Refining Processes
- Mining, Quarrying and Farming Processes

## Natural:

- Volcanoes
- Breaking Seas
- Pollens and Terpenes
- Fire
- Blowing Dust
- Bacteria and Viruses



# Airborne Particles

The tiny structures being emitted by primary polluters are known collectively as **Particulate Matter (PM)**. Once suspended in either air or water, the mixture of the two becomes known as an **Aerosol**.

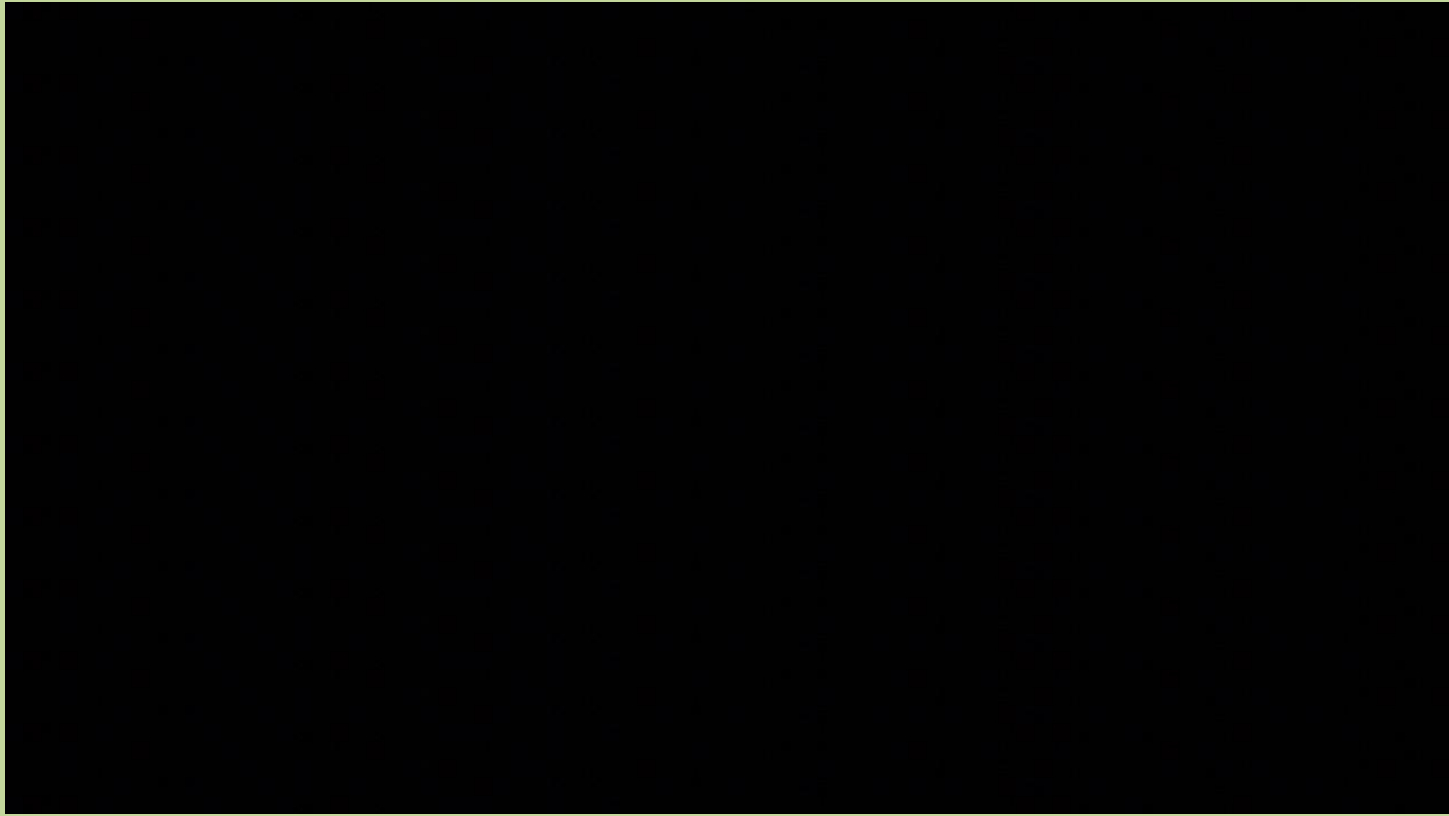


# Secondary Pollutants

Secondary Pollutants are not emitted directly into the air, but form in the atmosphere from reactions taking place between primary pollutants.

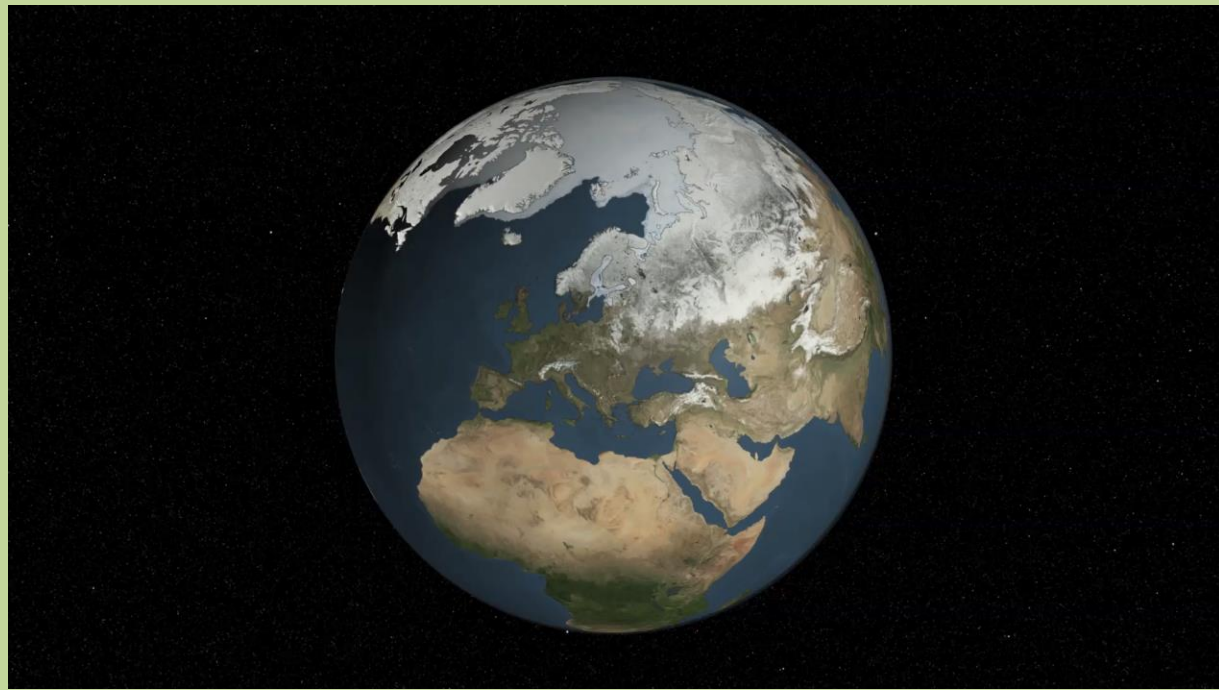
- SMOG (Smoke + Fog)
- VOG (Volcanic + Smog)
- Ground Level Ozone

# Smog



# VOG

Volcanic Smog





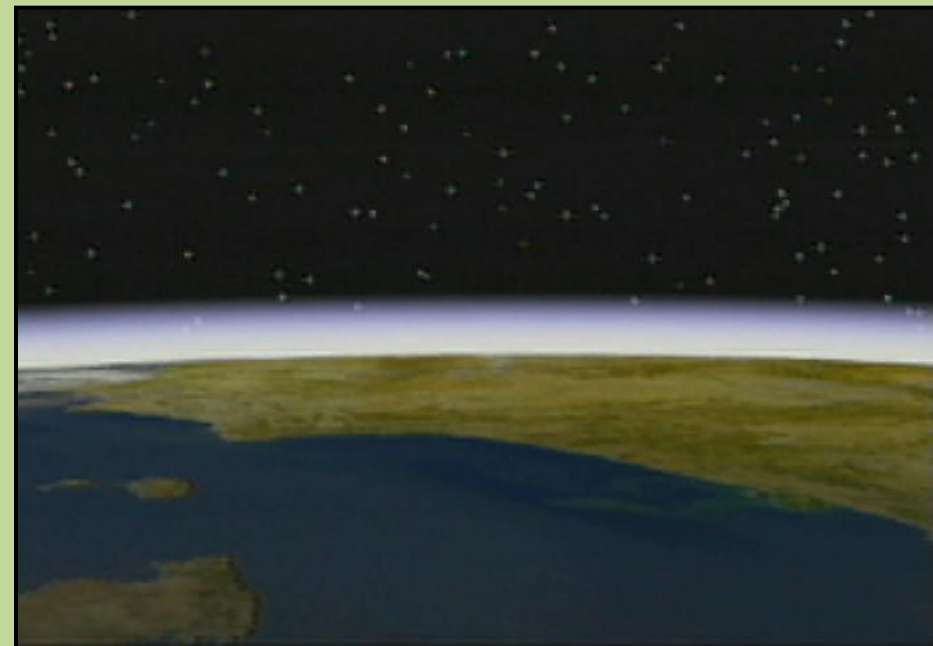
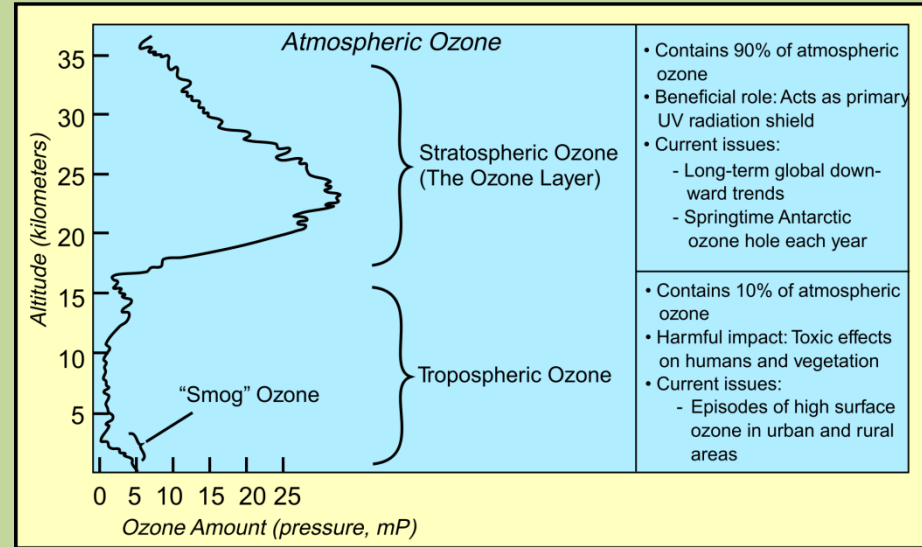
# Ozone

## Stratospheric Ozone: “GOOD” Ozone

- Contains 90% of atmospheric ozone
- Primary “Shield” for UV Radiation from Sun
- Produced by UV rays interacting with Oxygen

## Tropospheric Ozone: “Bad” Ozone

- Other 10% of Atmospheric Ozone
- Forms close to the ground when Hydrocarbons and Nitrogen Oxides react with sunlight.
- Detrimental to human respiratory health
- Slows and alters growth of many species of plants



# How are these pollutants spread?

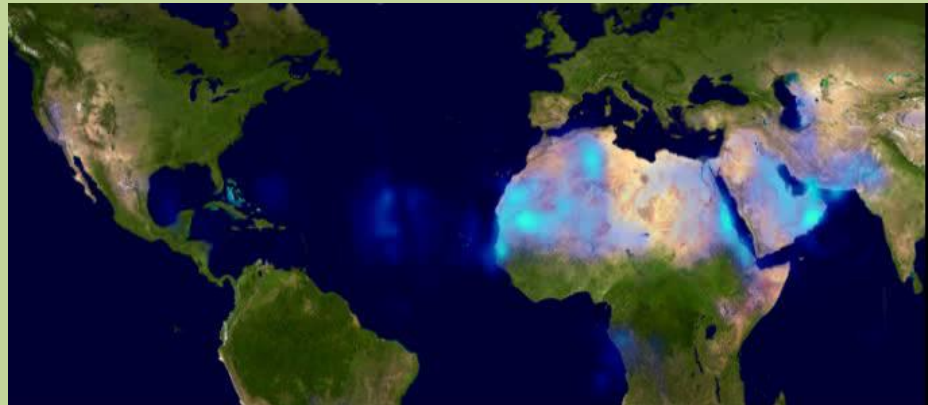
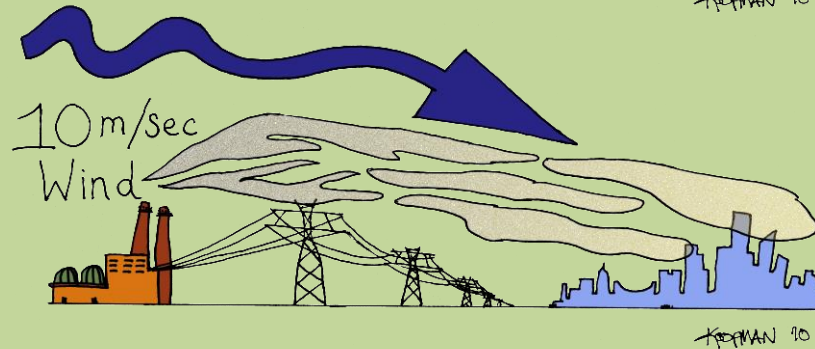
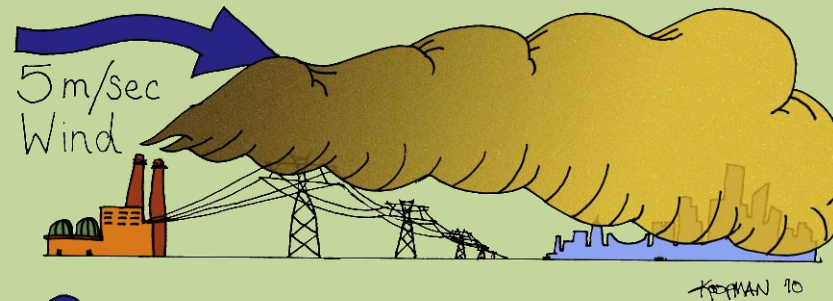
## Wind

“Dilution is the solution to pollution”

Wind causes bodies of polluted air to spread out across the Earth.

When winds are high, these bodies are spread out over larger areas, leading to a lower concentration of pollutants.

When winds are low, these bodies sit and stagnate over a smaller area leading to localized pockets of more concentrated pollution.



# Mixing Depth/Height

The layer of air in between the surface of the Earth and the height at which convection begins to occur is called the “Mixing Depth” or “Mixing Height.”

Hand Drawn illustration

Deeper Mixing Depths allow pollutants to be dispersed within a larger volume of air, leading to greater dilution of pollutants.

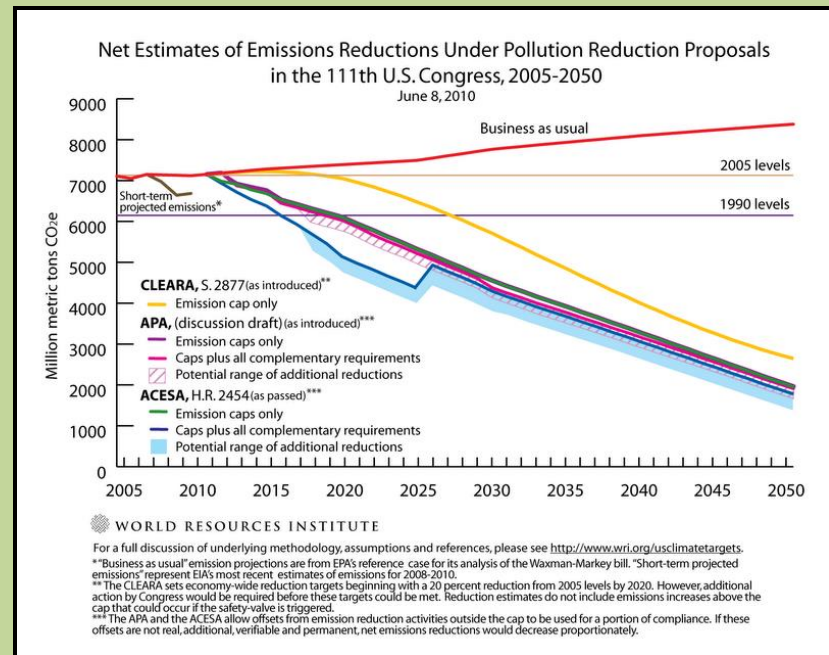
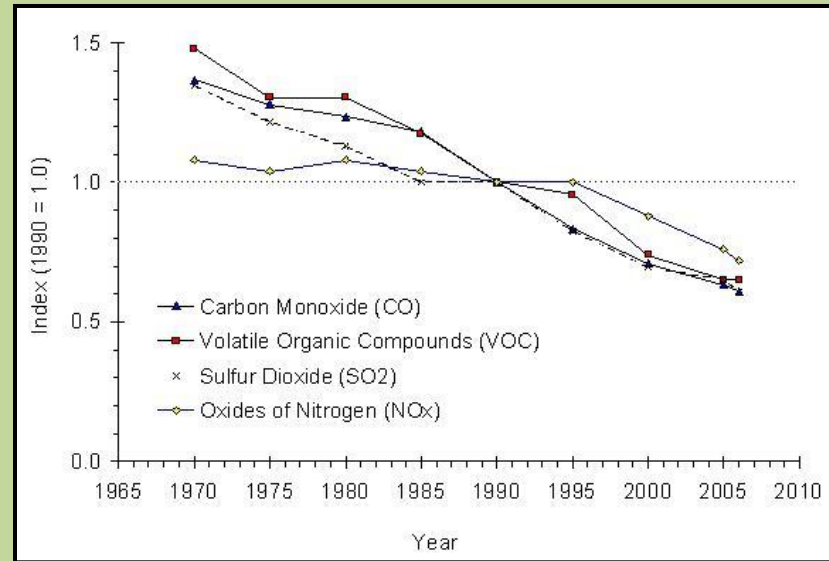
Shallower Mixing Depths “trap” pollutants in a small volume of air, which does not allow bodies of pollutants to disperse as quickly.



# Quantity of Pollutants being emitted

EPA standards Timeline

Equation and group solving

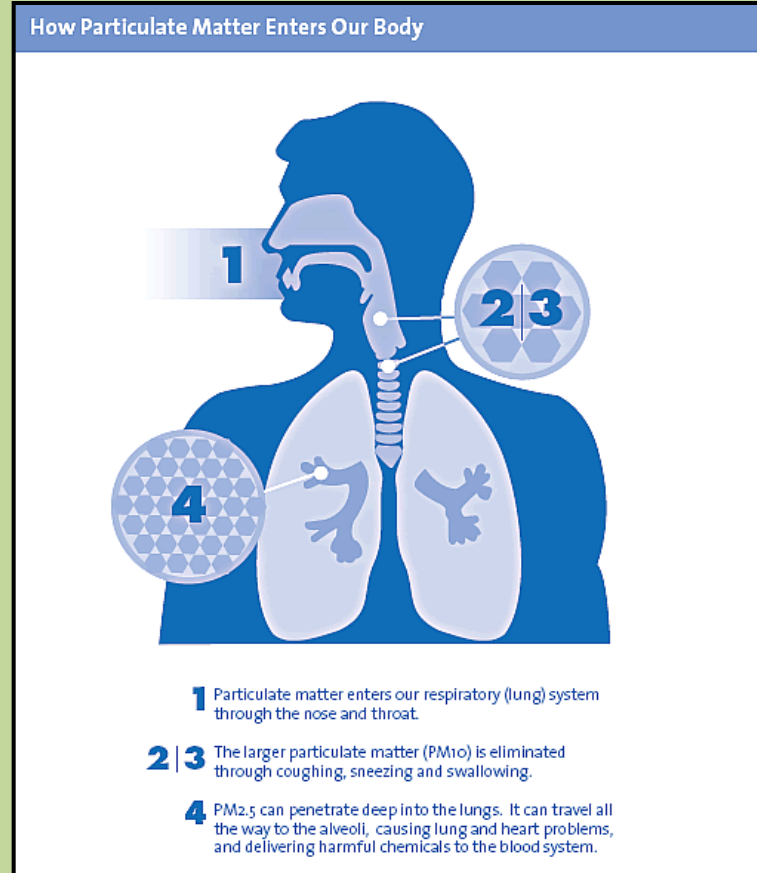


# Measuring Air Quality

Techniques

Monitoring Network Map (Google Earth?)

# Health Impacts of Air Pollution





# Air Pollution and Weather

- Acid Rain
- Condensation Nuclei

## Climate Perspective

- Historical Effects (Laki 1784, various volcanic events)
- Global Dimming?
- Future models

# Remote Sensing of Air Pollutants

Spectrometry



# Satellite RS of Pollutants

GOES

GOES-R Aerosol Mission

NASA Glory

# Further information

## Intermediate

Vermont Ozone and PM2.5 maps:

<http://www.anr.state.vt.us/air/Monitoring/cfm/RealTimeMap.cfm>

Vermont Real Time Air Quality:

<http://www.anr.state.vt.us/air/Monitoring/cfm/RealTimeData.cfm>

Air Quality Index:

<http://www.anr.state.vt.us/air/Monitoring/cfm/AQICurrent.cfm>

North Atlantic Jet:

[http://virga.sfsu.edu/pub/jetstream/jetstream\\_atl/big/1005/](http://virga.sfsu.edu/pub/jetstream/jetstream_atl/big/1005/)

Pollution:

[http://apollo.lsc.vsc.edu/classes/met130/notes/chapter18/la\\_primary.html](http://apollo.lsc.vsc.edu/classes/met130/notes/chapter18/la_primary.html)

National Air Quality:

<http://www.weather.gov/aq/>

## Advanced

NASA Glory Mission:

<http://glory.gsfc.nasa.gov/>

NASA GOES-R Volcanic Ash:

<http://www.goes-r.gov/downloads/Factsheet-Volcanic%20Ash-11-16-09.pdf>

NASA Ozone Hole Watch:

<http://ozonewatch.gsfc.nasa.gov/>