Welcome

APTI 452
Principles and Practices of Air Pollution Control

Administrative

Administrative

Facilities

Administrative

- Facilities
  - Rest Rooms

Administrative

- Facilities
  - Rest Rooms
- Schedule/breaks

Administrative

- Facilities
  - Rest Rooms
- Schedule/breaks
- Cell Phones

Administrative

- Facilities
  - Rest Rooms
- Schedule/breaks
- Telephones/Cell Phones
- Lunch
- Sign-In Sheet

Introduction

- **Materials**
  - **Registration Form**
  - **Notebooks/Agenda**
  - **Evaluation form - online**
  - **Misc Info**

Ground Rules

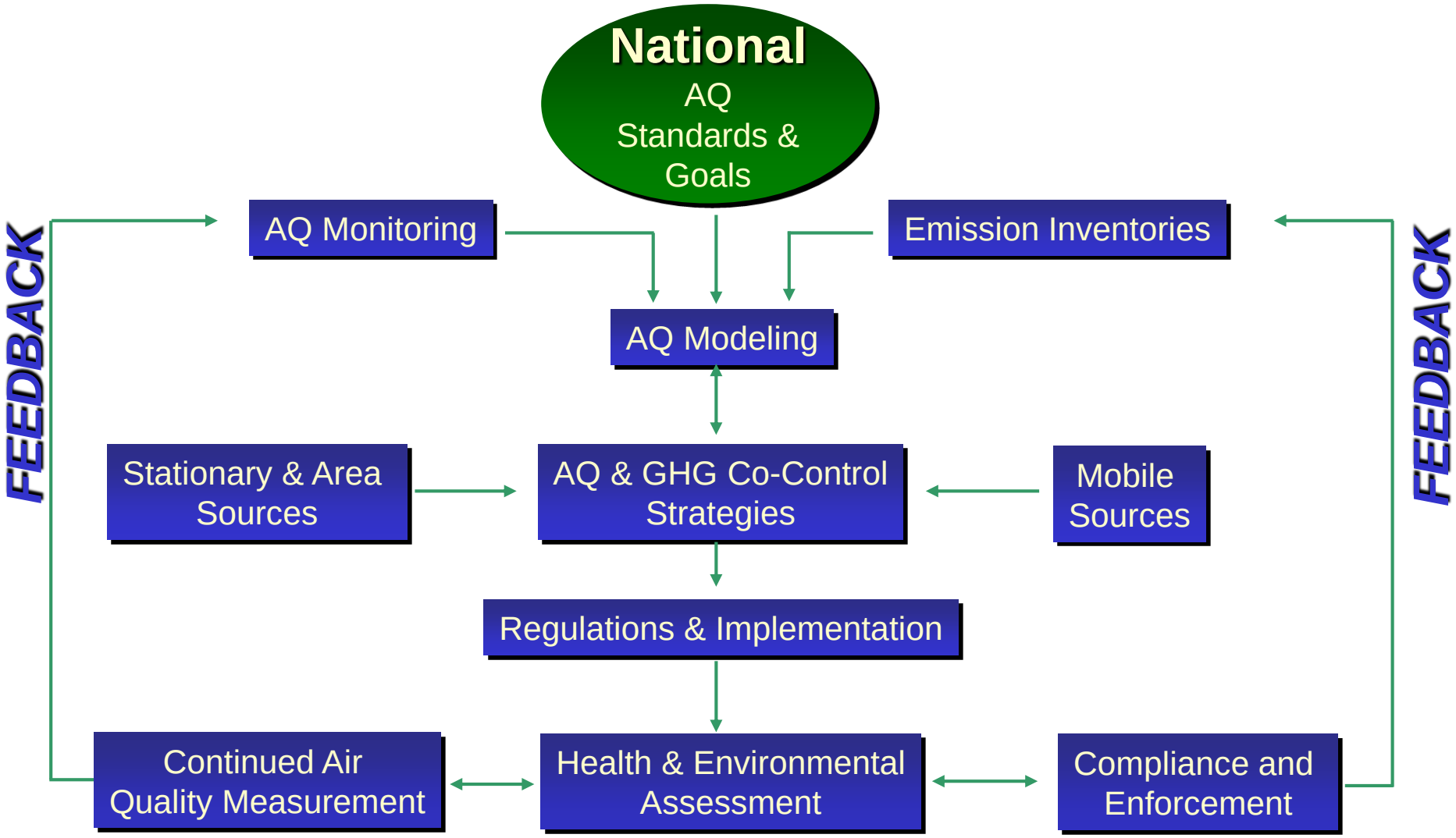
- **Ask questions**
- **Participate**
- **Provide instructors with benefit of your experience**
- **Be on Time**
- **Feedback on Evaluations**

Pre - Test

Air Quality Management

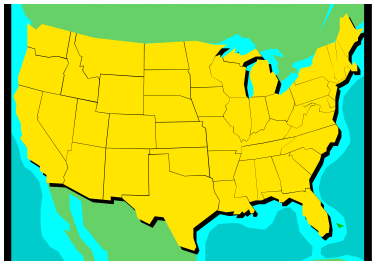
The Heart of the Process

U.S. Air Quality Management Process



Federal-Regional-State Roles

FEDERAL

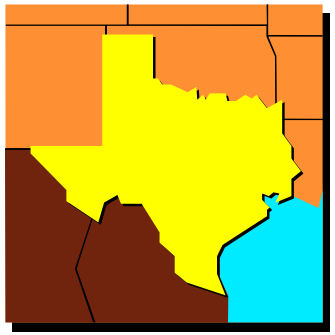


- National standards, rules, and enforcement
- Consistency of policies and programs
- Technical guidance
- Report on progress in reducing air pollution
- Ultimate authority & accountability

REGIONAL

- Conduct assessment and characterization
- Help develop multi-state strategies and trading programs
- Regional planning/coordination for implementation of national programs

STATE



- State rules
- Source Permits
- Compliance & enforcement
- Implementation Plans
- Implement national rules & guidance
- Monitoring, modeling, emission inventories

Air Quality Management Cycle

ESTABLISH GOALS

70's: .08 ppm ozone & TSP

80's: .12 ppm ozone & PM-10

Now: .08 ppm ozone & PM-2.5

WHAT REDUCTIONS ARE NECESSARY?

-- Monitors: better job with fewer monitors

-- Inventories: improved factors with 90, 96, 99, 02 inventories

-- Modeling: EKMA > UAMV > CMAQ

HOW TO ACHIEVE

-- 1970: NSPS, FMVCP

-- 1977: Nonattainment designations, PSD, Auto I/M

-- 1990: More nonattainment Market Based program for SO2, Mobile source controls Fuels, MACT,CAIR

IMPLEMENT

-- Voluntary programs

-- SIP credits

-- Regional approaches

-- Innovative State and local measures

EVALUATE RESULTS

-- Trends Analysis

-- Attainment demo's

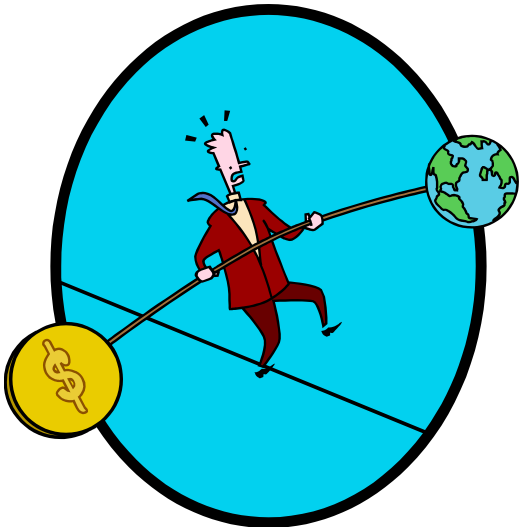
-- Expanded public information:

* AQI

* AIR*Now*

Some Major Issues

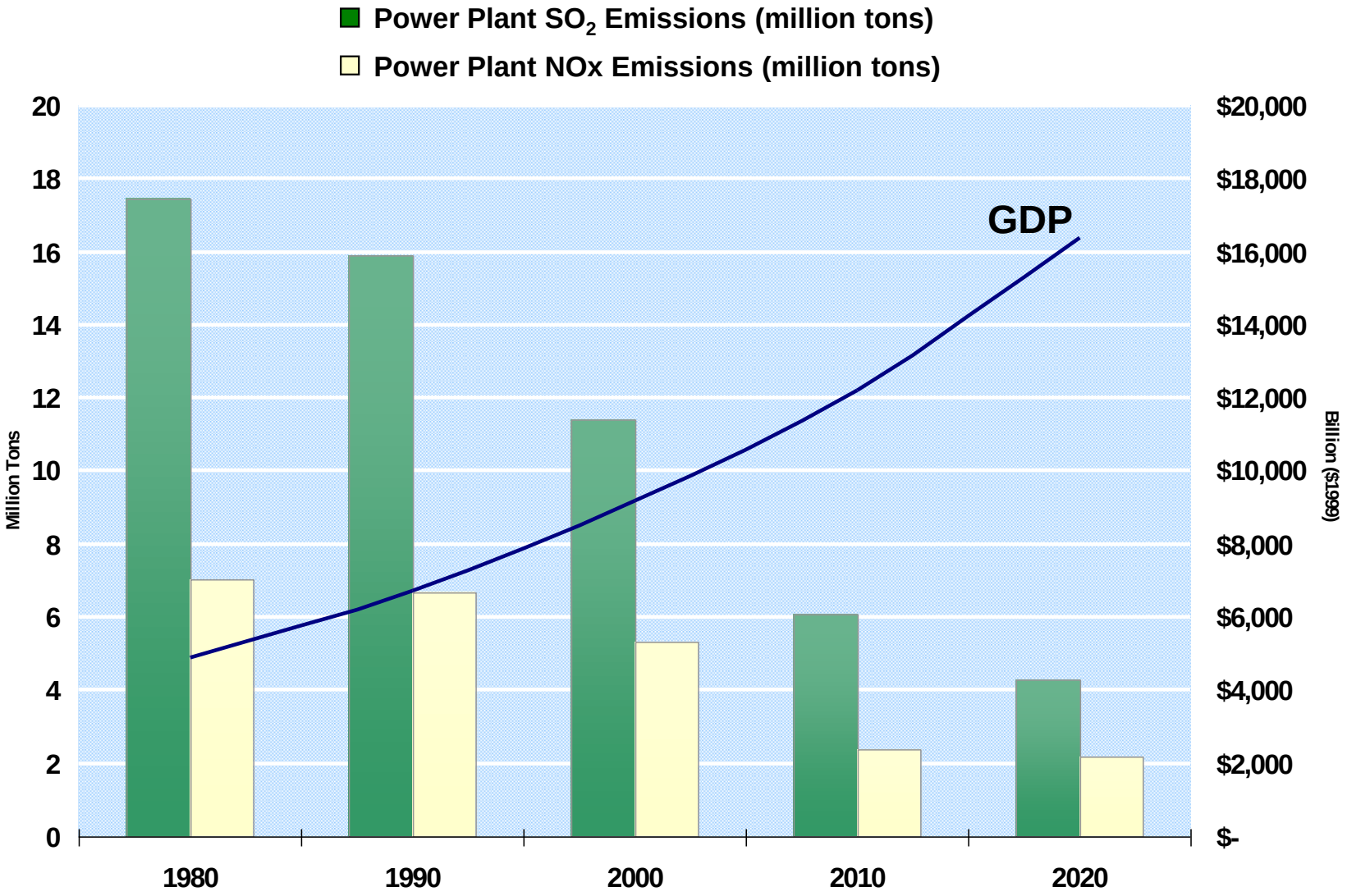
- Regional and international transport of air pollution
- Effective market-based approaches for reducing air pollution
- Evaluating, communicating, and reducing risk to public health from air toxics
- Multi-pollutant effects
- Multi-media approaches
- Balancing “carrot and stick“ in our regulations & programs



Citizen Involvement

- Public Participation
  - Hearings on Rules/Permits
  - Comment Periods on Proposed Rules
  - Workshops
- Administrative Review
  - Agency Review Boards
- Legal Review
  - State Courts
  - Federal Courts

Economic Growth & Environmental Improvement



Sources: 1980 - 1999 emissions data are from the National Air Pollutant Emissions Trend Report (EPA, March 2000). Projections for SO_2, NOx and mercury are derived from the Integrated Planning Model (IPM). GDP data for 1980 - 2000 is from the Bureau of Economic Analysis, U.S. Department of Commerce. The GDP projection for 2010 is from OMB's Analytical Perspectives Report for 2003, Table 2-1. The 2010 to 2020 projection follows EIA's assumptions in AEO 2001 of 3% growth per year.

Summary

- Air Quality Standards/Goals and Timelines are key
- Technical Tools and Information are essential
- Air Quality Management Process is iterative and adaptable
- Transparency is important to maintain credibility
- Focus on results not just process

APTI Course 452

Principles and Practices of Air Pollution Control

Chapter 1:
Control Program History

Chapter Overview

- Control Program History
- Air Pollution Control Programs
- Hierarchy of Government Responsibilities
- Air Pollution Management
- Future Focus of Responsibilities

Air Pollution Control Programs

- Air Pollution Episodes
- Improvements in Science
- Changes in Society and Economy
- Environmental Activism and Public Awareness

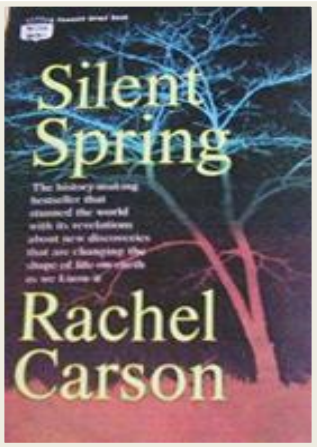
Improvements in Science

- Health Effects
- Atmospheric Chemistry
- Air Monitoring
- Computers

Changes in Society and Economy

- Longer Life Span
- Costs of a Higher Standard of Living
- An Affordable Luxury?

Environmental Activism and Public Awareness



Earth Day

SIERRA CLUB
FOUNDED 1892

NRDC

The Nature Conservancy
Saving the Last Great Places

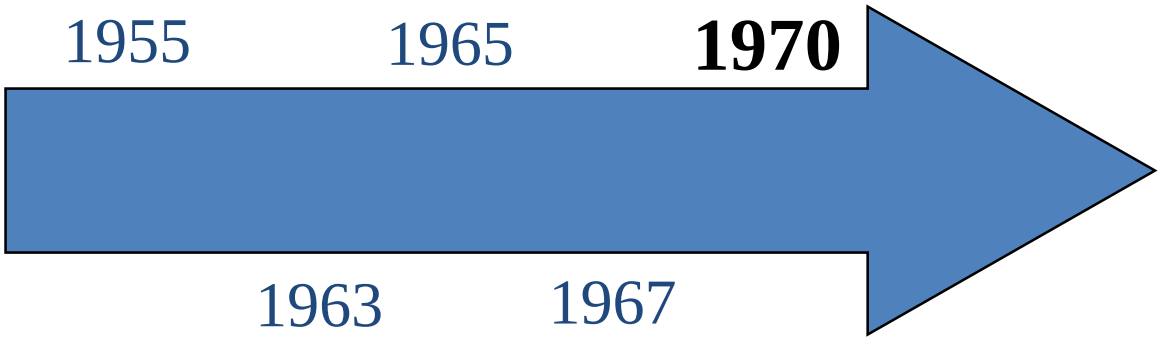
NATIONAL WILDLIFE FEDERATION

Friends of the Earth International

Hierarchy of Government Responsibilities Pre/Post 1970

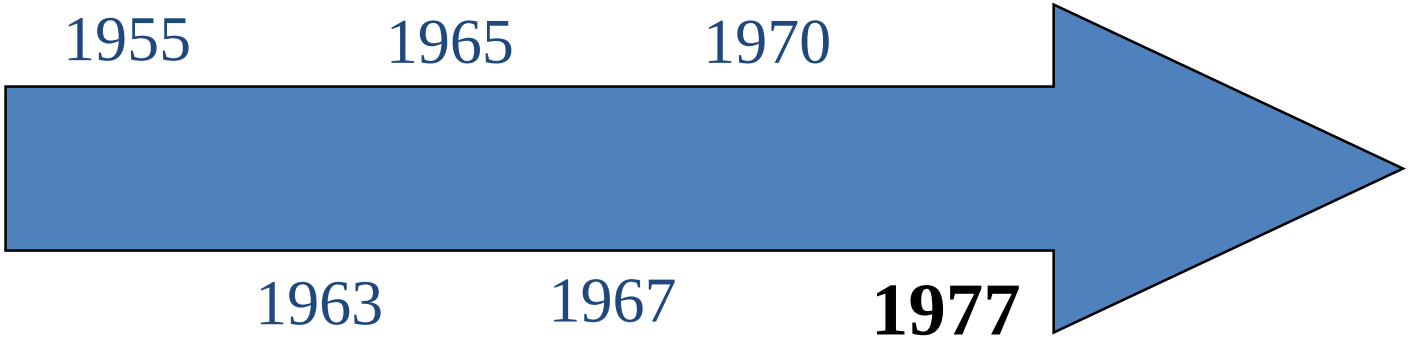
- **Local**
- **State**
- **Federal**

Legislative Landmarks



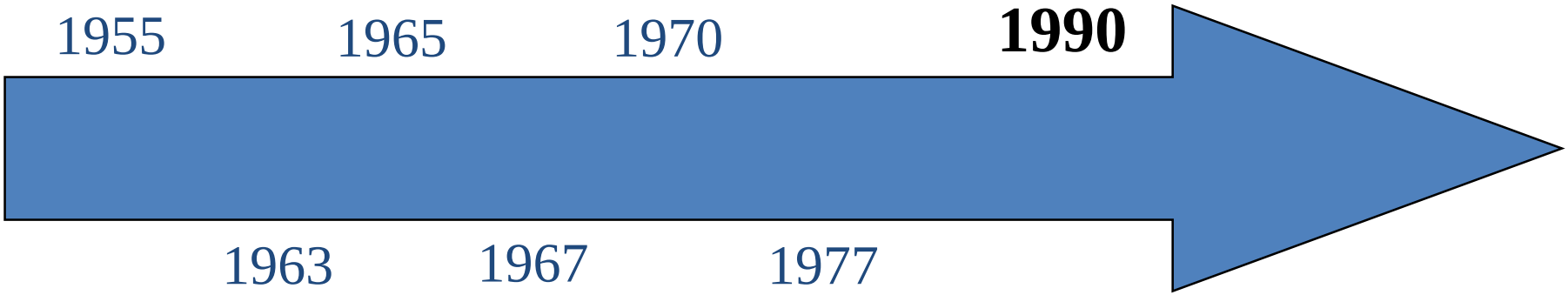
Clean Air Act Amendments of 1970

Legislative Landmarks



Clean Air Act Amendments of 1977

Legislative Landmarks



Clean Air Act Amendments of 1990

Regulatory Landmarks

- 1993 Schedule to end CFC's
- 1994 New HAP standards for Chemical plants
- 1996 Lead out of Gasoline Rule
- 1999 Regional Haze Rule
- New Tailpipe Emissions Rule
- 2004 Off Road Vehicle
- 2005 Clean Air Interstate Rule (CAIR)
- 2005 Clean Air Visibility Rule (CAVR)

Regulatory Landmarks

2006 NAAQS For Particulates

2009 Greenhouse Gas Rule

2011 New Boiler Regs

- Mercury Regs
- Cross-State Air Pollution Rule

2012 Oil and Nat.Gas Rule (Fracking)

2013 Power Plant Carbon Rule

2014 New Ozone Standards (late 15)

Air Pollution Management

- Strategies
- Implementation

Types of Control Strategies

- Emission Standard
- Economic Incentive
- Cost-Benefit
- Air Quality Standard (Air Quality Management)

Strategies: A Comparison

Table 1-1. Comparison of Air Quality Management Strategies

Strategies	Cost	Simplicity	Enforceability	Flexibility	Adaptability
Air Quality Management	Good	Poor	Fair	Fair	Fair
Emission Standards	Terrible	Excellent	Excellent	Poor	Fair
Emission Taxes	Fair	Excellent	Excellent	Unnecessary	Good
Cost-benefit Analysis	Excellent	Terrible	Unknown	Unknown	Good

(Source: A.C. Stern, *Air Pollution* Vol. V (Academic Press: New York, 1977), p. 33.

Implementation

- National Ambient Air Quality Standards (NAAQS)
- Air Monitoring
- Source Inventories
- Air Pollution Modeling
- Enforcement

Future Focus of Responsibilities

- Current Situation - Control
- New Strategies - Prevention
- Other Issues

Chapter Summary

- Control Program History
- Why Air Pollution Control Programs?
- Hierarchy of Government Responsibilities
- Air Pollution Management
- Future Focus of Responsibilities

Questions?

APTI Course 452

Principles and Practices of Air Pollution Control

Chapter 2:
Human Health and Environmental Effects
Of Air Pollution

Chapter Overview

- Hazardous Effects of Air Pollutants on the Human Body Systems
- Criteria Pollutants
- Toxic Air Pollutants
- Environmental Effects of Air Pollution
- Risk Assessment

Hazardous Effects of Air Pollutants on the Human Body Systems

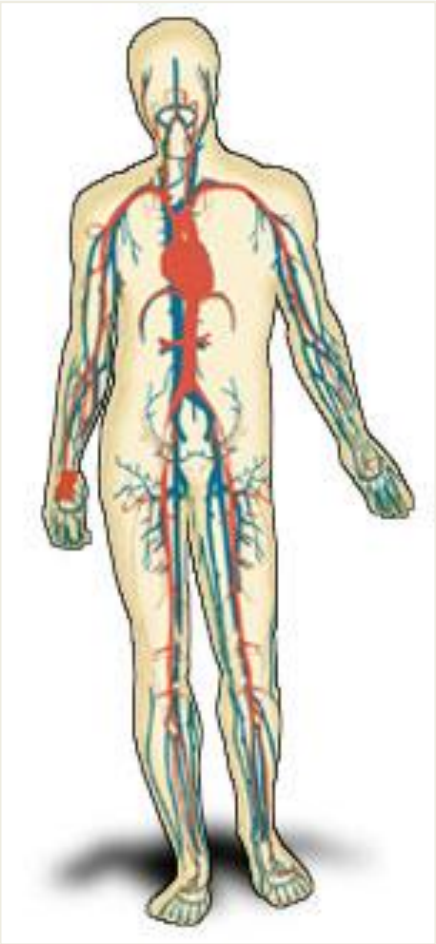
- Pollutant Movement Through the Body
- Upper Respiratory System
- Lower Respiratory System

Pollutant Movement Through the Body

- Entry Points
- Susceptible Groups
- Basic Health Effects

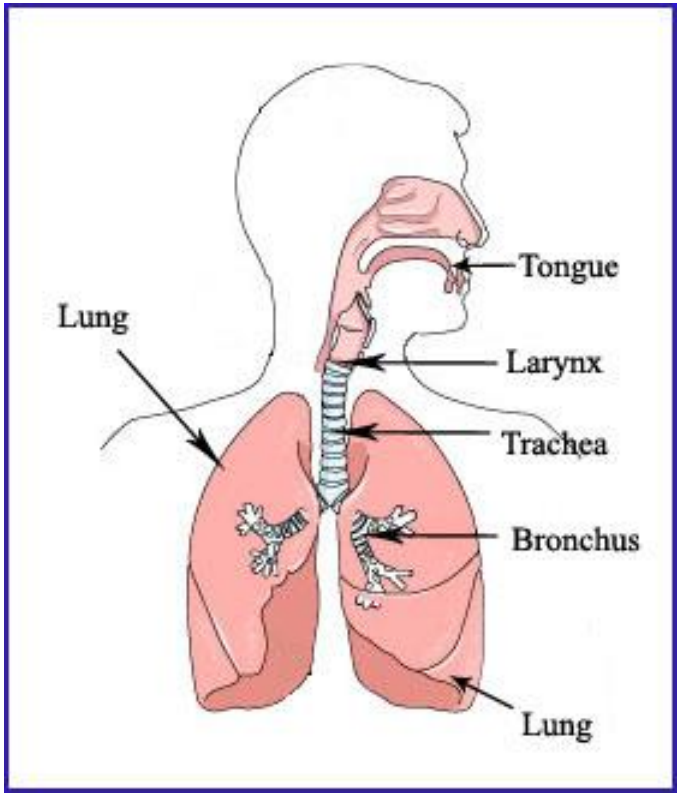
Pollutant Movement Through the Body (cont.)

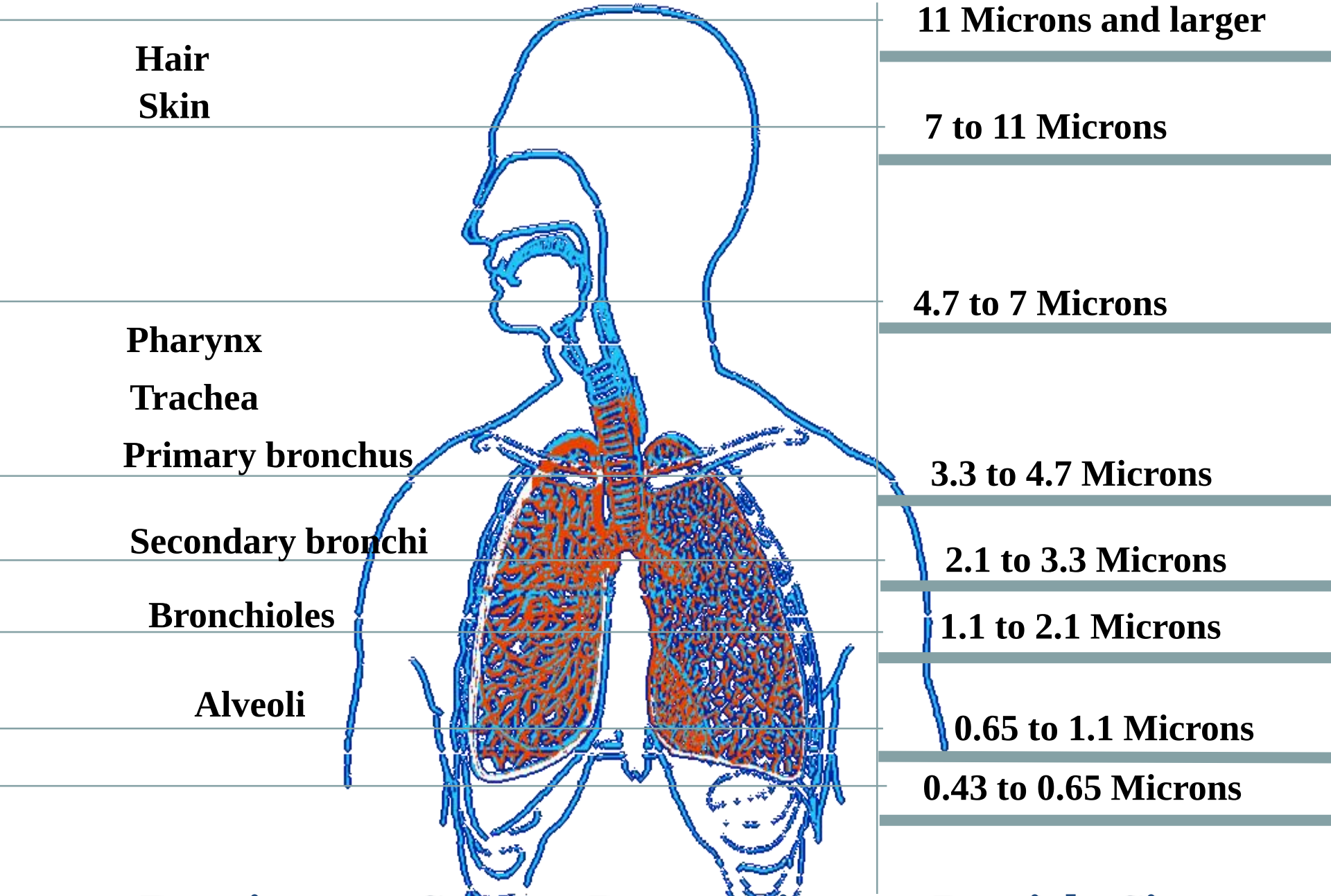
- Entry Points
- Susceptible Groups
- Basic Health Effects



Upper Respiratory System

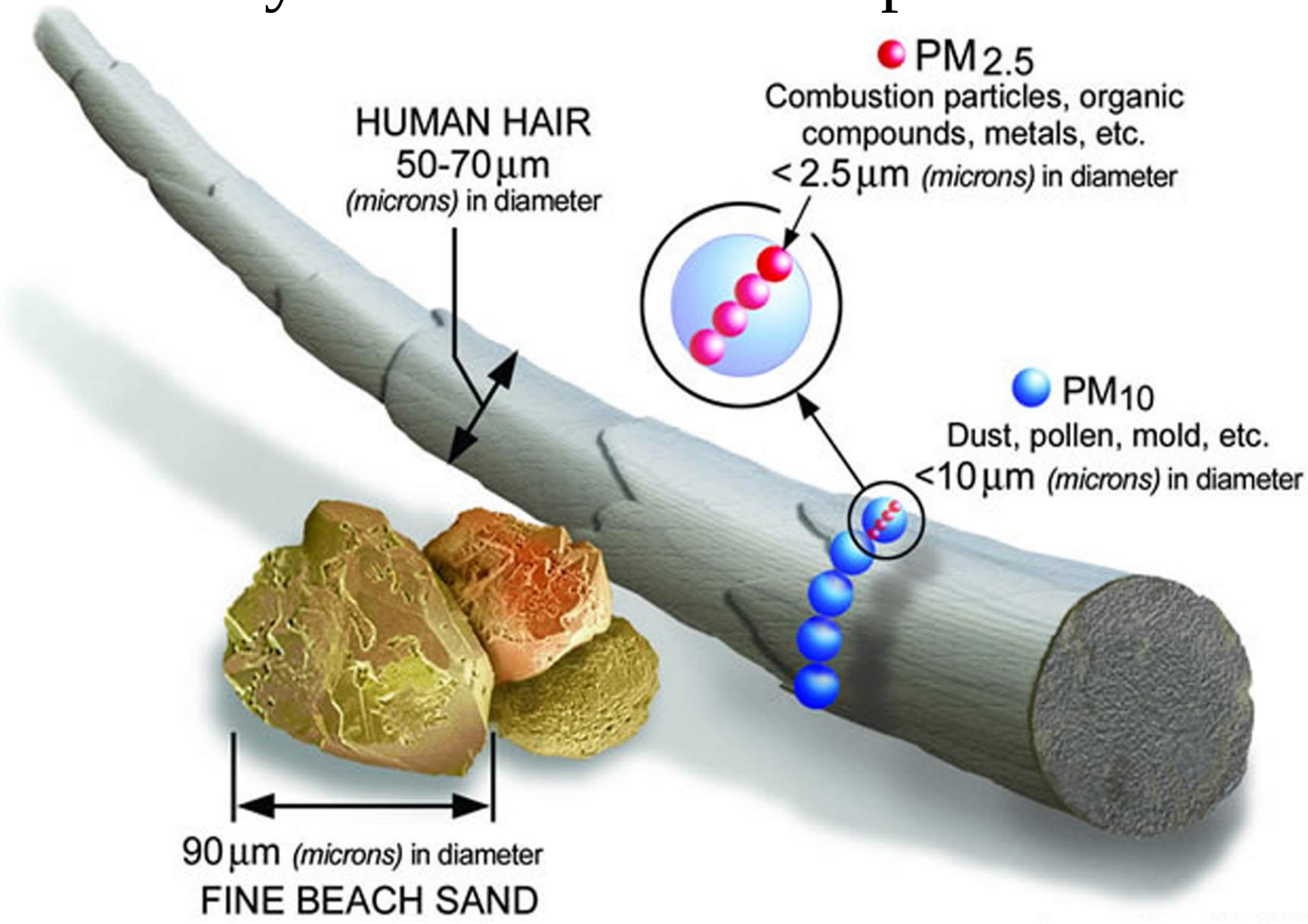
- Entry
- Defenses
  - Cilia
- Affect



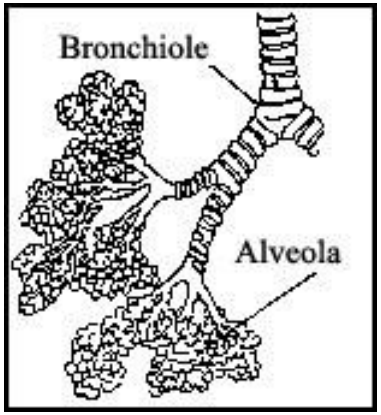


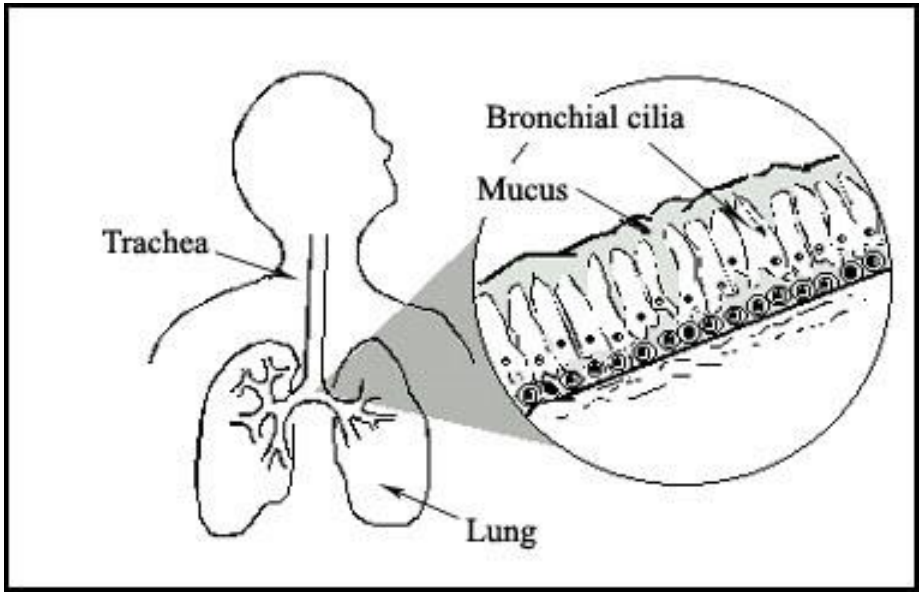
Respiratory System Penetration vs. Particle Size

Physical Diameter Comparison



Lower Respiratory System





Criteria Pollutants

O_3: Ozone

CO: Carbon Monoxide

NOx: Oxides of Nitrogen

SOx: Oxides of Sulfur

PM_{10}: Particulate Matter < 10 microns

Pb: Lead

Criteria Pollutants

- Particulate Matter (PM)
- Lead (PB)
- Sulfur Dioxide ($S0_2$)
- Carbon Monoxide (CO)
- Nitrogen Dioxide (NO_2)
- Ozone (O_3)

Particulate Matter (PM)

- Health Effects
- Sources of Pollutant
- Trends in PM Levels

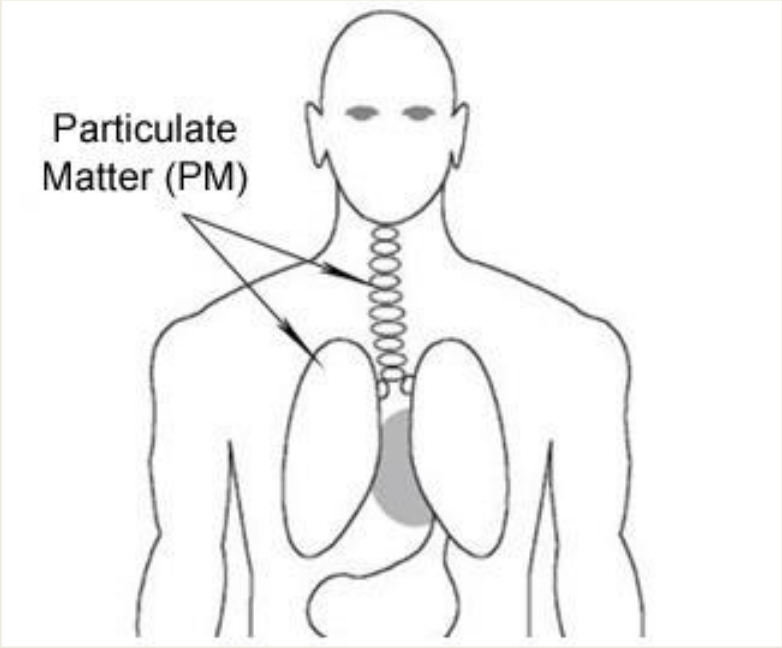
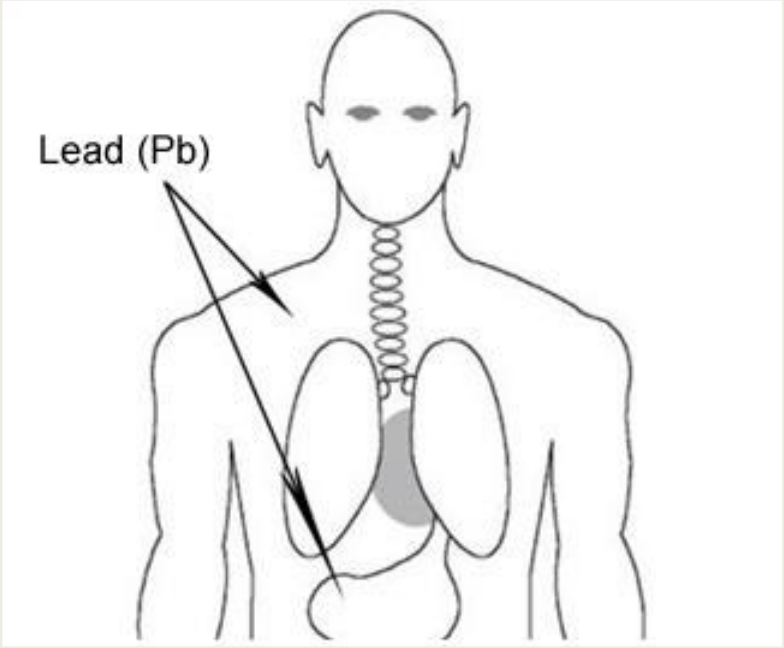


Table 2-6. Summary of PM causal determinations by exposure duration and health outcome.

Size Fraction	Exposure	Outcome	Causality Determination
$PM_{2.5}$	Short-term	Cardiovascular Effects	Causal
		Respiratory Effects	Likely to be causal
		Central Nervous System	Inadequate
		Mortality	Causal
	Long-term	Cardiovascular Effects	Causal
		Respiratory Effects	Likely to be Causal
		Mortality	Causal
		Reproductive and Developmental	Suggestive
		Cancer, Mutagenicity, Genotoxicity	Suggestive
$PM_{10-2.5}$	Short-term	Cardiovascular Effects	Suggestive
		Respiratory Effects	Suggestive
		Central Nervous System	Inadequate
		Mortality	Suggestive
	Long-term	Cardiovascular Effects	Inadequate
		Respiratory Effects	Inadequate
		Mortality	Inadequate
		Reproductive and Developmental	Inadequate
		Cancer, Mutagenicity, Genotoxicity	Inadequate
UFPs	Short-term	Cardiovascular Effects	Suggestive
		Respiratory Effects	Suggestive
		Central Nervous System	Inadequate
		Mortality	Inadequate
	Long-term	Cardiovascular Effects	Inadequate
		Respiratory Effects	Inadequate
		Mortality	Inadequate
		Reproductive and Developmental	Inadequate
		Cancer, Mutagenicity, Genotoxicity	Inadequate

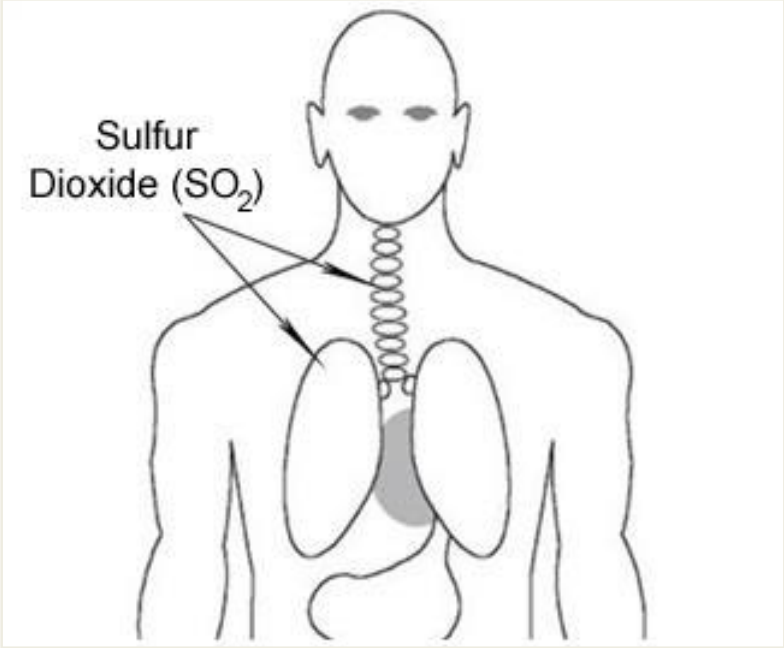
Lead (PB)

- Health Effects
- Sources of Lead
- Trends in Lead Levels



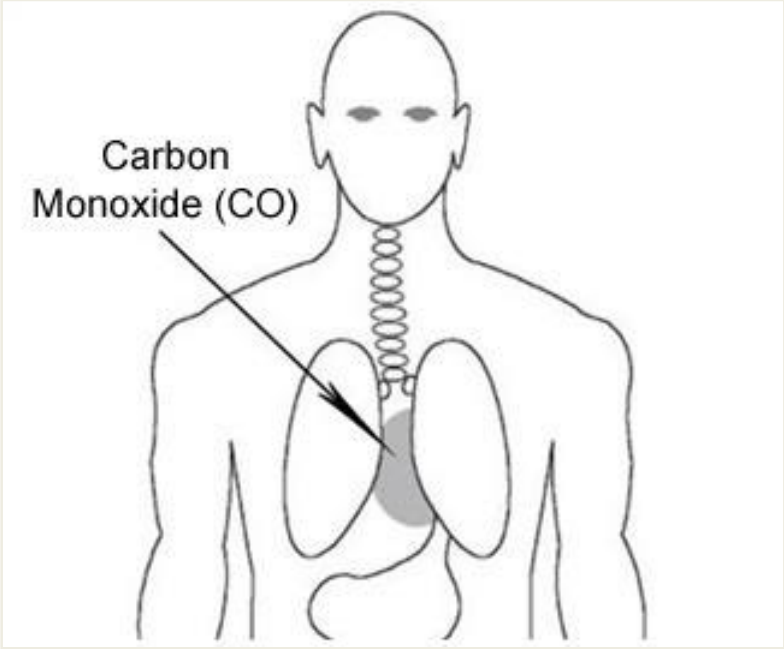
Sulfur Dioxide (SO_2)

- Health Effects
- Sources of SO_2
- Trends in SO_2 Levels



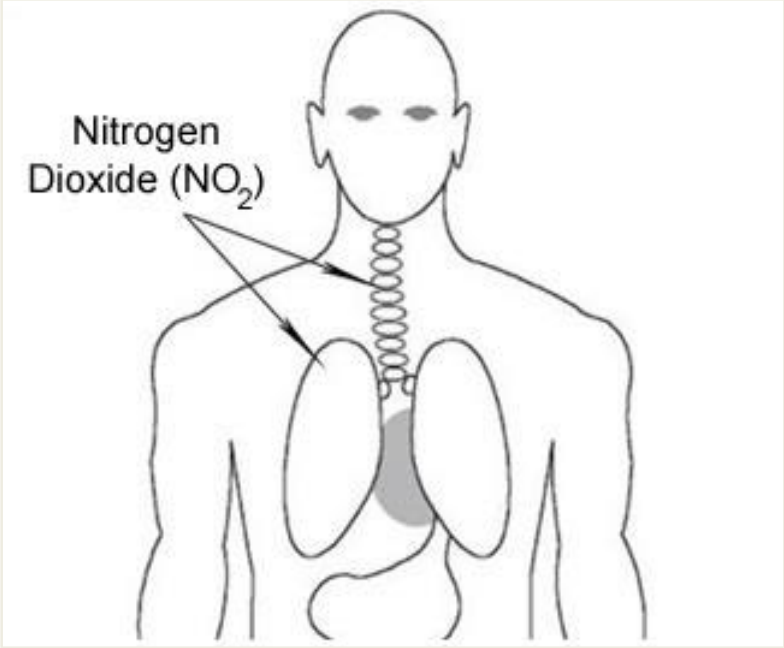
Carbon Monoxide (CO)

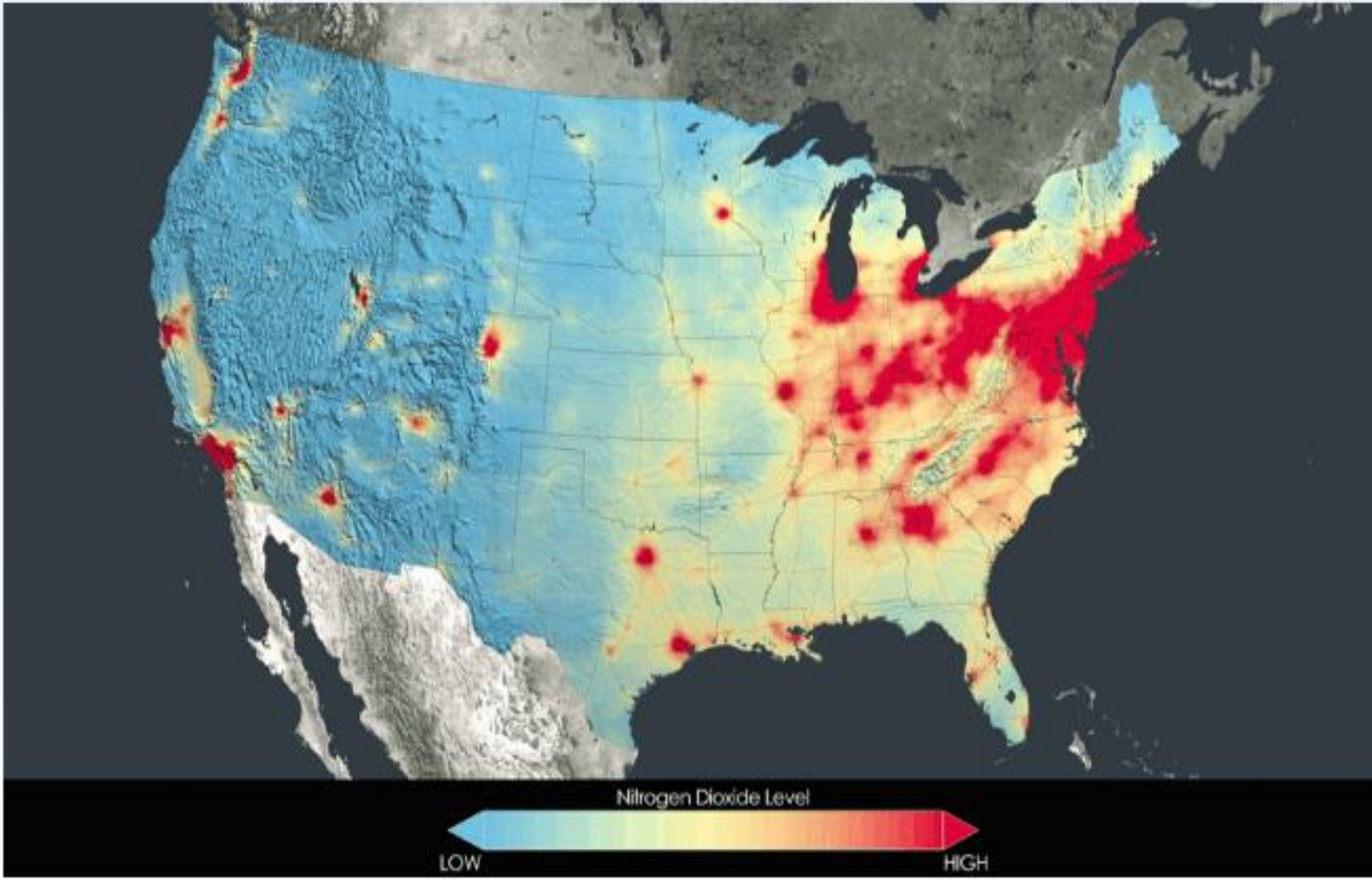
- Health Effects
- Sources of CO
- Trends in CO Levels



Nitrogen Dioxide (NO_2)

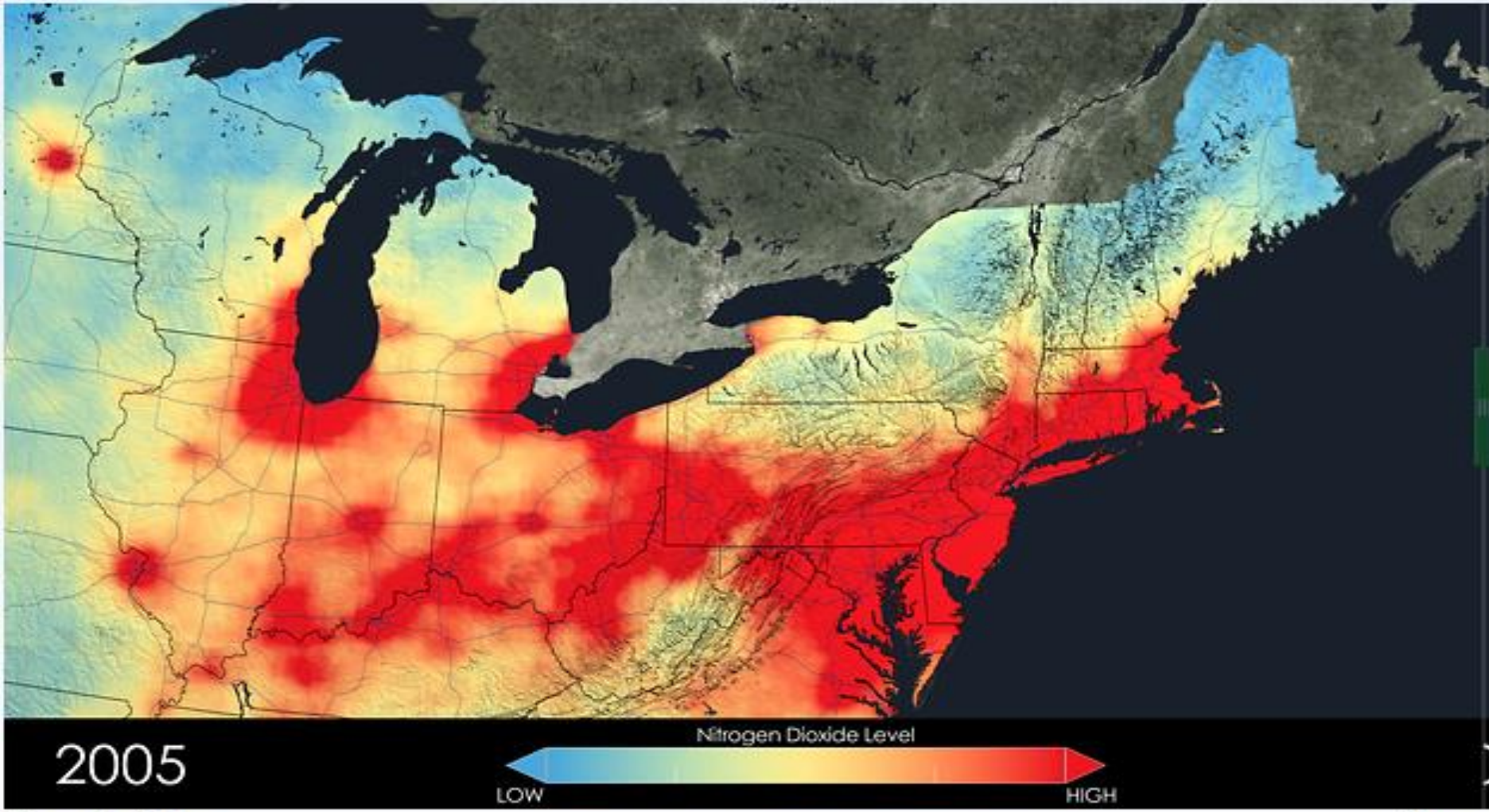
- Health Effects
- Sources of NO_2
- Trends in NO_2 Levels





Nitrogen dioxide pollution, averaged yearly from 2005-2011, has decreased across the United States.

Before and After Images:



Show only before

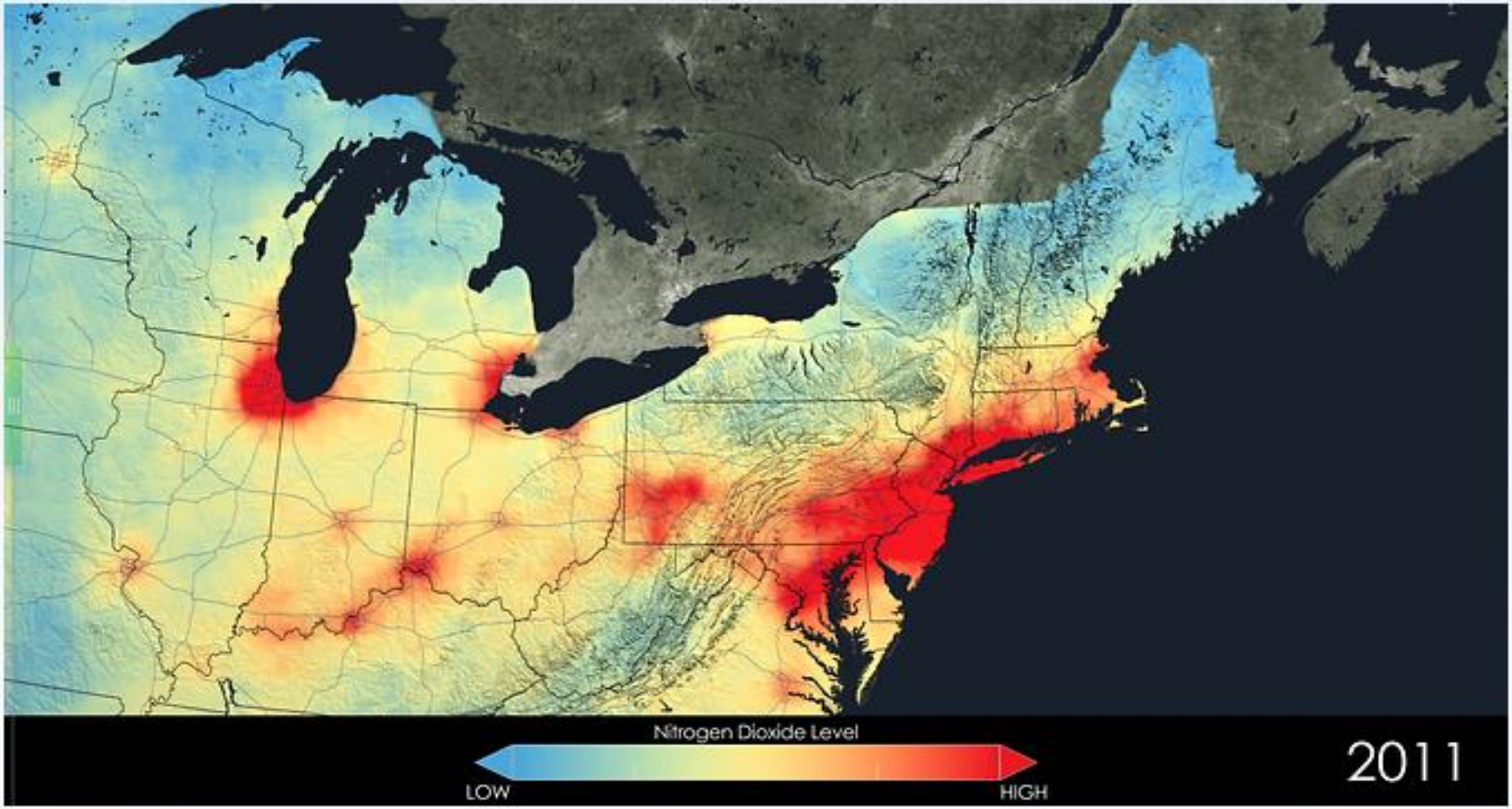
Show o

Caption:

Pollution builds up along the U.S. East Coast as it passes from one city to the next, particularly in the Northeast Corridor. These citi include Richmond, Washington, Baltimore, Philadelphia, New York City, Boston and all the smaller cities in between. Some of the la absolute changes in nitrogen dioxide have occurred in this corridor.

Image Credit: NASA Goddard's Scientific Visualization Studio/T. Schindler

Before and After Images:



Show only before

Show only after

Caption:

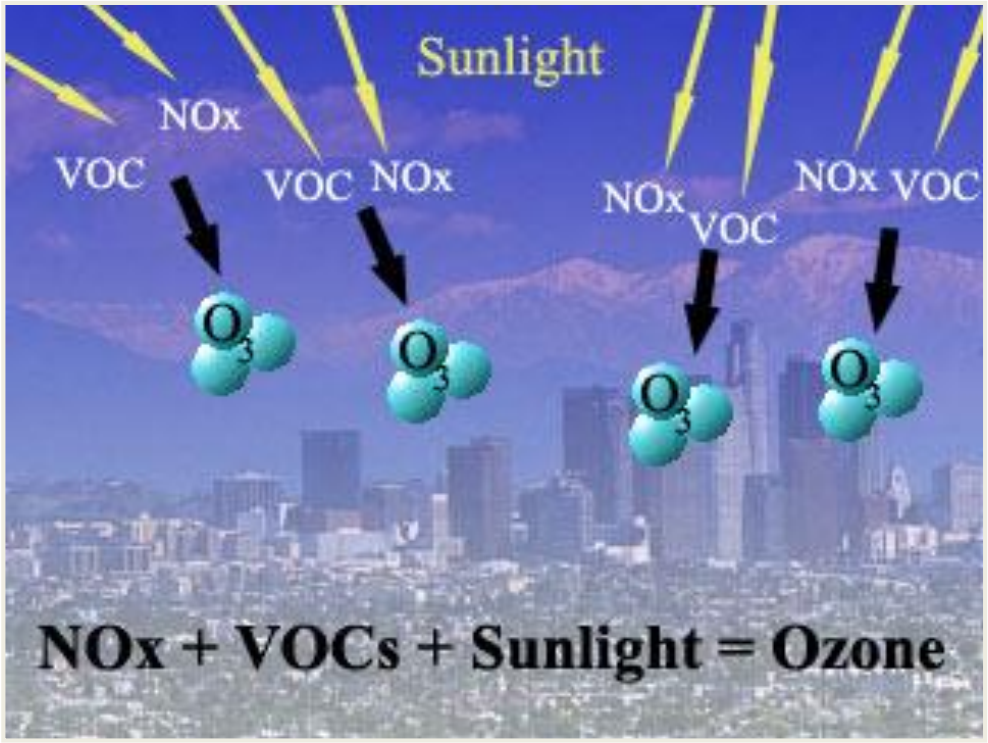
Pollution builds up along the U.S. East Coast as it passes from one city to the next, particularly in the Northeast Corridor. These cities include Richmond, Washington, Baltimore, Philadelphia, New York City, Boston and all the smaller cities in between. Some of the largest absolute changes in nitrogen dioxide have occurred in this corridor.

Image Credit: NASA Goddard's Scientific Visualization Studio/T. Schindler

New NASA Images Highlight U.S. Air Quality Improvement | NASA

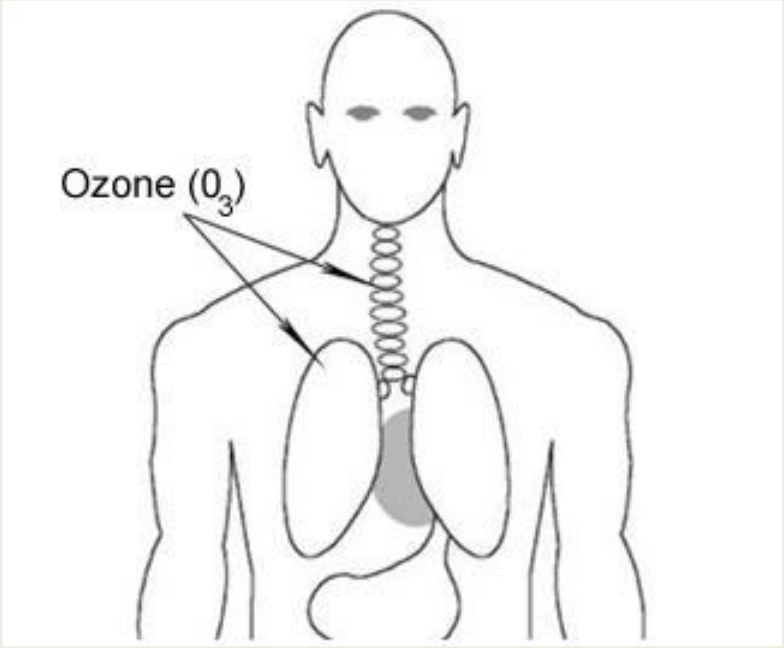
http://www.nasa.gov/content/goddard/new-nasa-images-highlight-us-air-quality-improvement/#.U8a-VI1dVBY

Ozone (O_3) Formation



Ozone (O_3)

- Health and Environmental Effects
- Sources of 0_3
- Trends in Ozone Levels



Pollutant [final rule cite]		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide [76 FR 54294, Aug 31, 2011]		primary	8-hour	9 ppm	Not to be exceeded more than once per year
			1-hour	35 ppm	
Lead [73 FR 66964, Nov 12, 2008]		primary and secondary	Rolling 3 month average	0.15 $\mu g/m^3$ (1)	Not to be exceeded
Nitrogen Dioxide [75 FR 6474, Feb 9, 2010] [61 FR 52852, Oct 8, 1996]		primary	1-hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		primary and secondary	Annual	53 ppb (2)	Annual Mean
Ozone [73 FR 16436, Mar 27, 2008]		primary and secondary	8-hour	0.075 ppm (3) (0.07ppm)	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particle Pollution Dec 14, 2012	$PM_{2.5}$	primary	Annual	12 $\mu g/m^3$	annual mean, averaged over 3 years
		secondary	Annual	15 $\mu g/m^3$	annual mean, averaged over 3 years
		primary and secondary	24-hour	35 $\mu g/m^3$	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24-hour	150 $\mu g/m^3$	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide [75 FR 35520, Jun 22, 2010] [38 FR 25678, Sept 14, 1973]		primary	1-hour	75 ppb (4)	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

as of October 2011

Effects of Criteria Pollutants

CRITERIA POLLUTANT	BODY SYSTEM	HEALTH EFFECTS	
Particulate Matter ($PM_{2.5}$ and PM_{10})	**Lower respiratory system.**	▪ Asthma ▪ Bronchitis ▪ Reduced lung function	▪ Cancer ▪ Heavy metal poisoning
Lead (Pb)	**Organs and soft tissue.**	▪ Anemia ▪ High blood pressure ▪ Cancer	▪ Neurological disorder ▪ Intellectual function
Carbon Monoxide (CO)	**Circulatory system.**	▪ CO poisoning ▪ Angina pectoris ▪ Neurological dysfunction	▪ Brain damage ▪ Fetal abnormalities ▪ Asphyxiation
Nitrogen Dioxide (NO_2)	**Respiratory system.**	▪ NO_2 poisoning ▪ Asthma ▪ Lowered resistance to infection	
Sulfur Dioxide (SO_2)	**Respiratory system.**	▪ Asthma ▪ Bronchial constriction ▪ SO2 poisoning	▪ Heart attack
Ozone (O_3)	**Respiratory system.**	▪ Lung inflammation ▪ Reduced lung elasticity ▪ Transient cough	▪ Chest pain ▪ Throat irritation ▪ Nausea

Toxic Air Pollutants

- Nature and Sources
- Health and Environmental Effects
- Trends in Toxic Air Pollutants

Toxic Air Pollutants (cont.)

- Nature and Sources
- Health and Environmental Effects
- Trends in Toxic Air Pollutants

Environmental Effects of Air Pollution

- Environmental Issues
- Acid Rain
- Visibility
- The Greenhouse Effect
- Stratospheric Ozone Depletion

Environmental Issues

- Ecosystem
- Property Damage
- Quality of Life

Acid Rain

- Nature and Source of the Problem
- Health and Environmental Effects

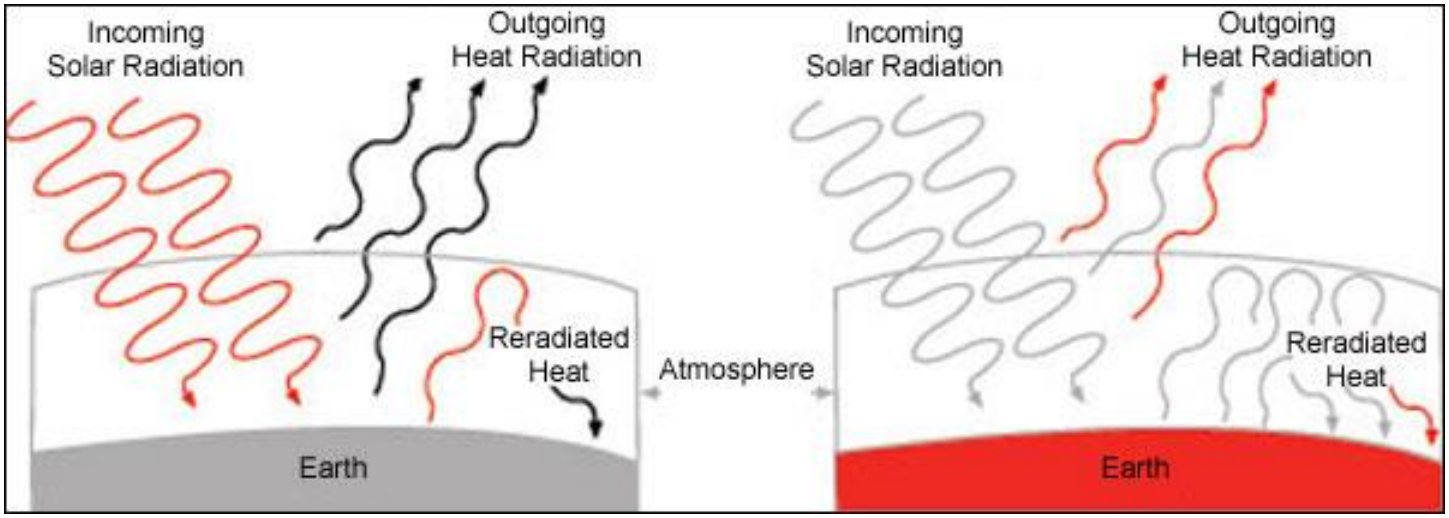
Visibility

- Nature and Source of the Problem

The Greenhouse Effect

- Nature and Source of the Problem
- Health and Environmental Effects
- International Developments

The Greenhouse Effect (cont.)



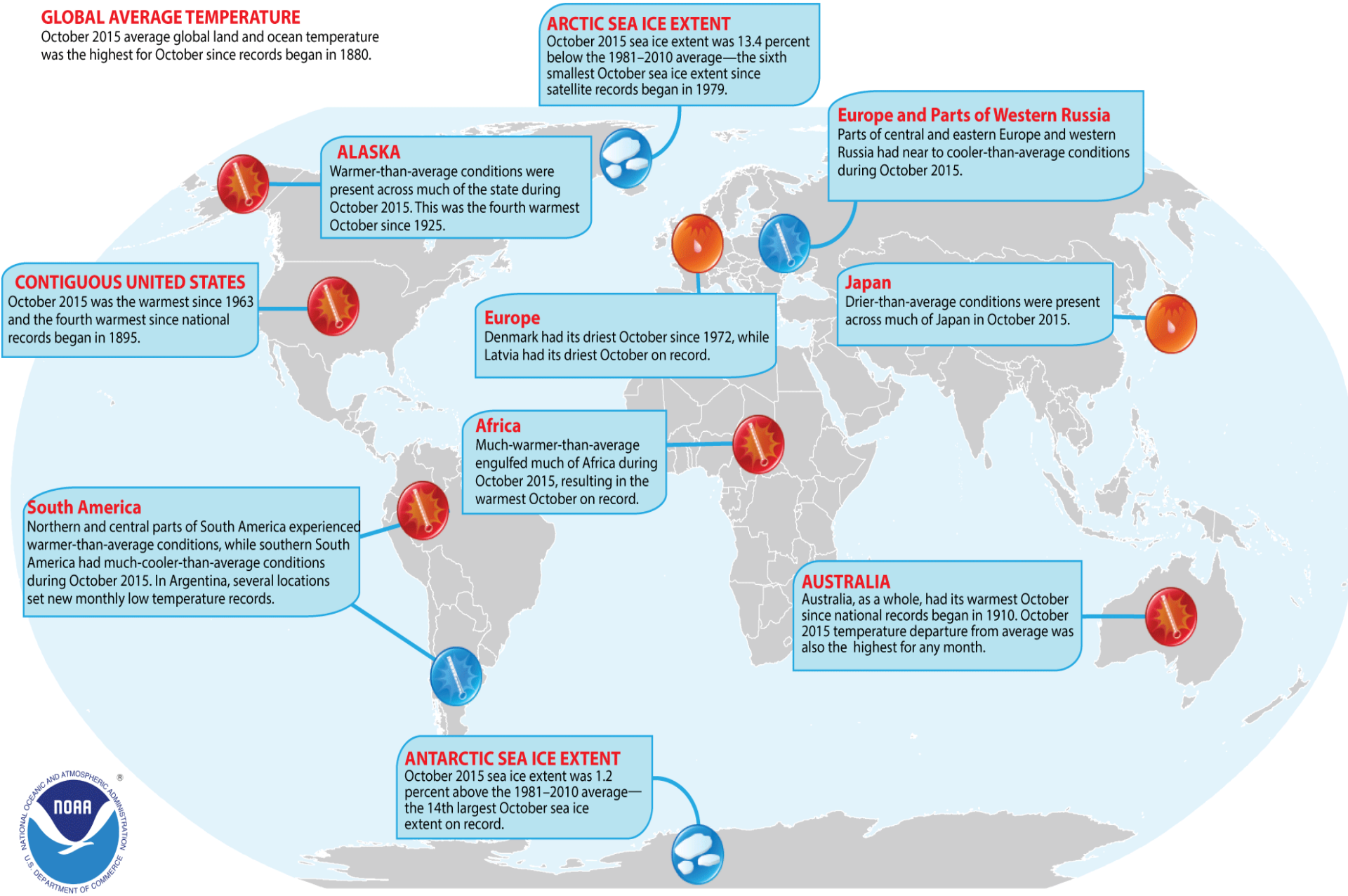
The Greenhouse Effect (cont.)

- Nature and Source of the Problem
- Health and Environmental Effects
- International Developments

The Greenhouse Effect (cont.)

- Nature and Source of the Problem
- Health and Environmental Effects
- International Developments
- State of the Climate in 2015
- http://www.climate.gov

Selected Significant Climate Anomalies and Events October 2015

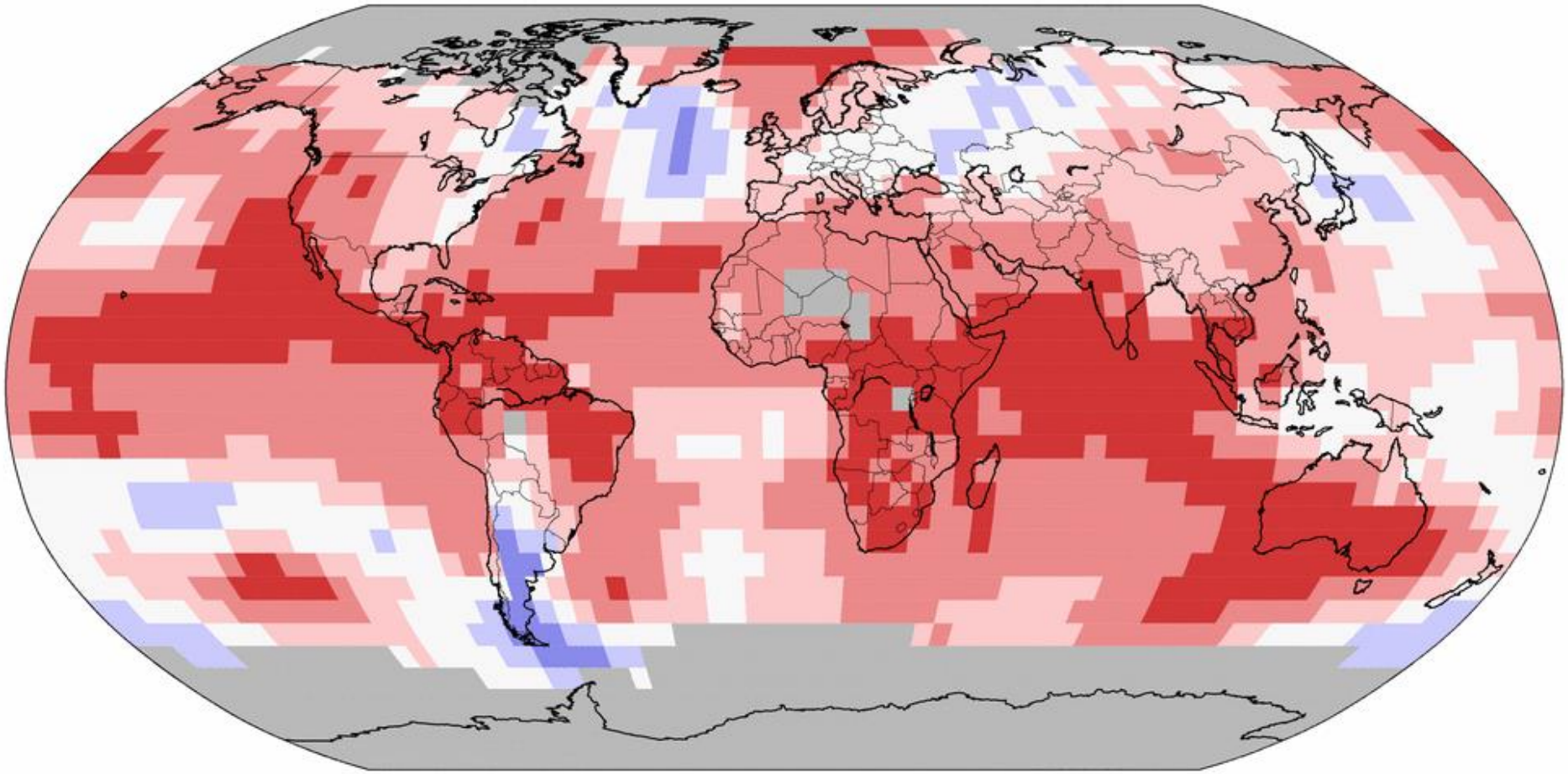


Please Note: Material provided in this map was compiled from NOAA's State of the Climate Reports. For more information please visit: http://www.ncdc.noaa.gov/sotc

Land & Ocean Temperature Percentiles Oct 2015

NOAA's National Centers for Environmental Information

Data Source: GHCN–M version 3.3.0 & ERSST version 4.0.0

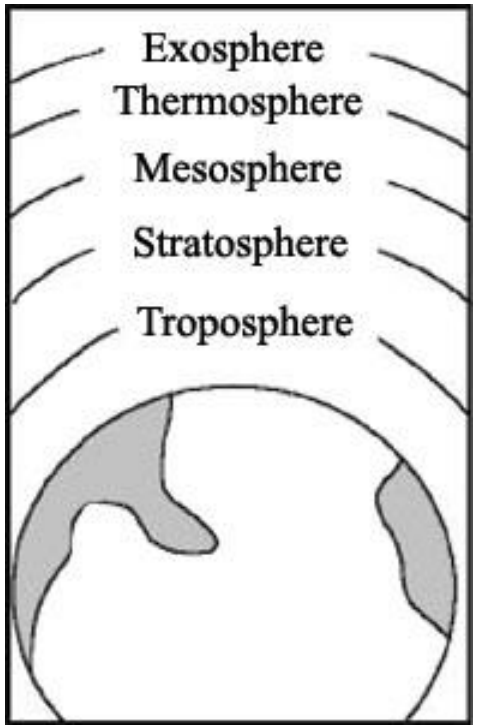


Record Coldest | Much Cooler than Average | Cooler than Average | Near Average | Warmer than Average | Much Warmer than Average | Record Warmest

Tue Nov 17 06:54:45 EST 2015

Stratospheric Ozone Depletion

- Nature and Scope of the Problem
- Human Health Effects
- Programs to Restore the Stratospheric Ozone Layer
- Trends in Stratospheric Ozone Depletion



Stratospheric Ozone Depletion

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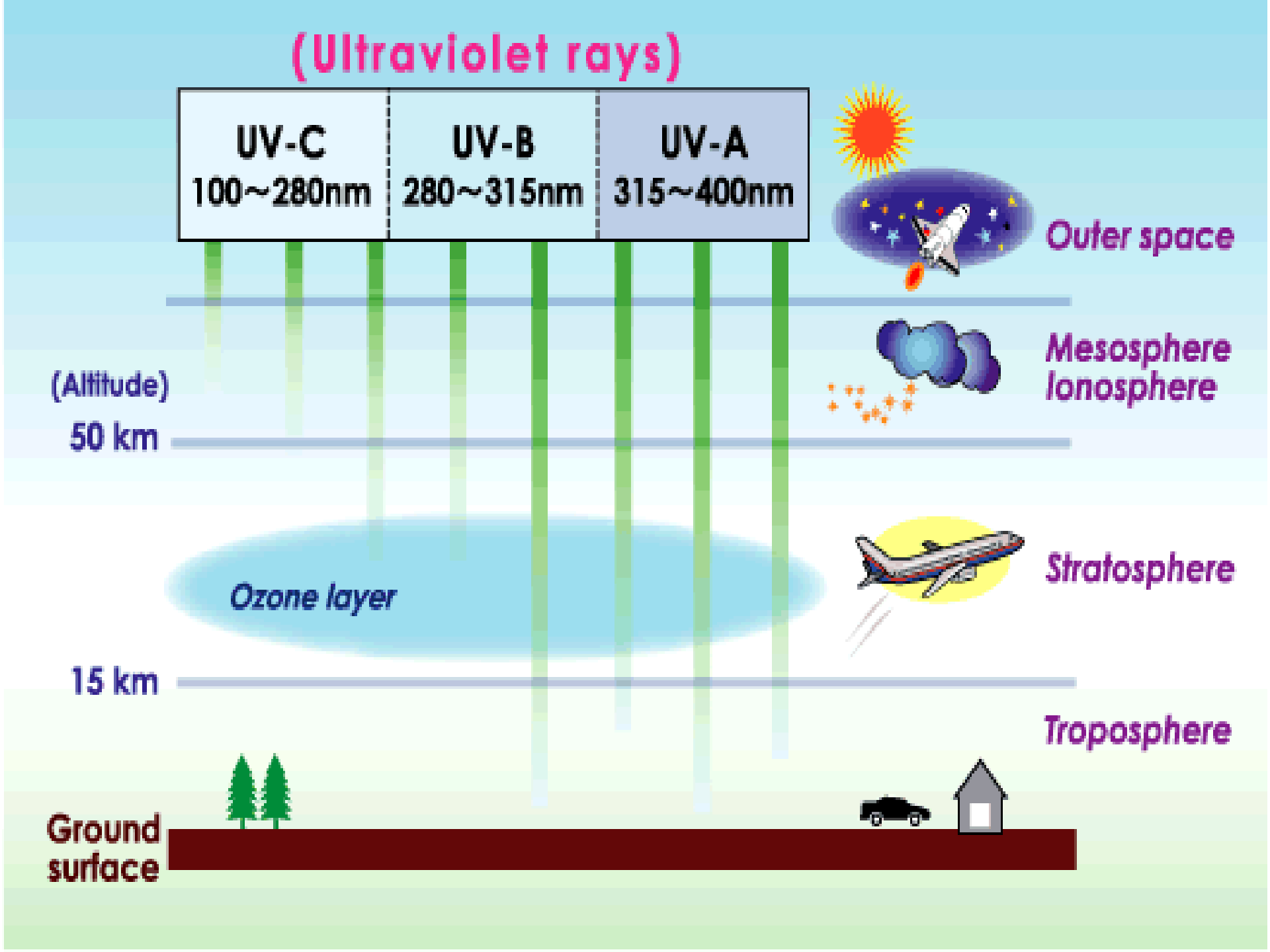
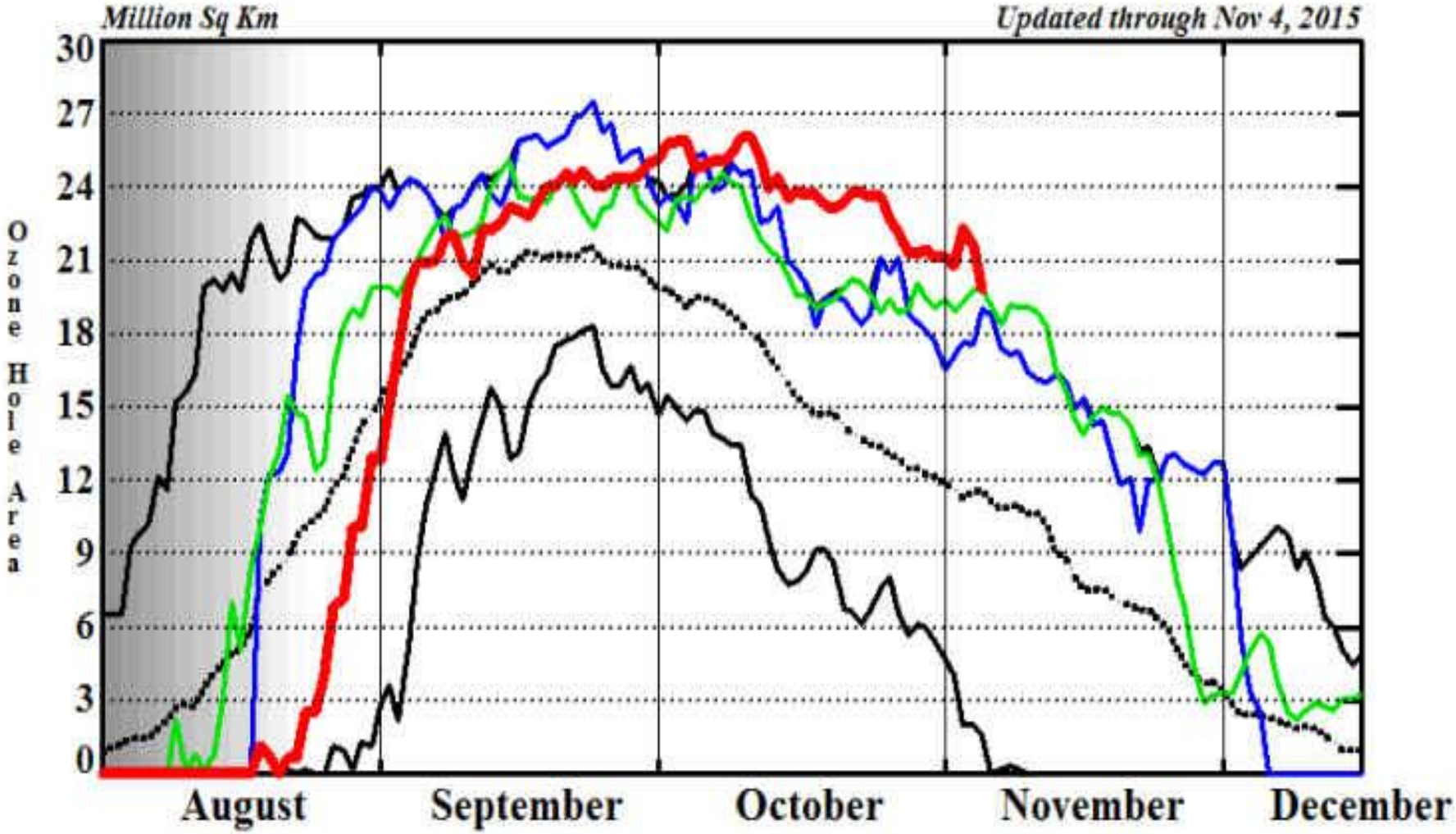
- Programs to Restore the Stratospheric Ozone Layer
- Trends in Stratospheric Ozone Depletion

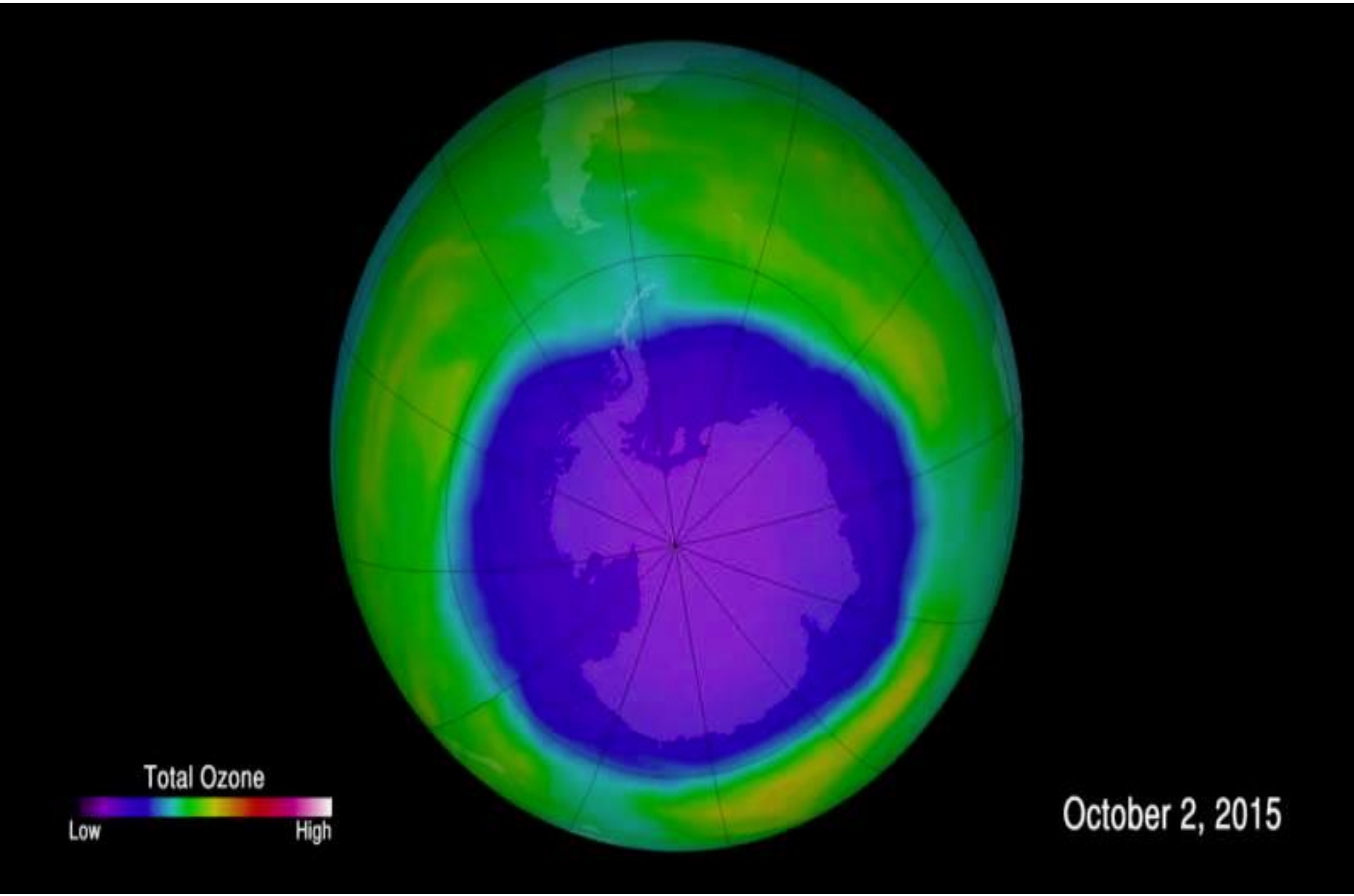

(Ultraviolet rays)
UV-C
100~280nm
UV-B
280~315nm
UV-A
315~400nm
Outer space
Mesosphere
Ionosphere
(Altitude)
50 km
Ozone layer
Stratosphere
15 km
Troposphere
Ground
surface

2015 Southern Hemisphere Ozone Hole Area

NOAA S-NPP OMPS

Current Year Compared Against Past 10 Years




Total Ozone
Low
High
October 2, 2015

Risk Assessment

- Health Risks

- Risk Assessment

Risk Assessment Process

Hazard Identification

Human Studies

Animal Studies

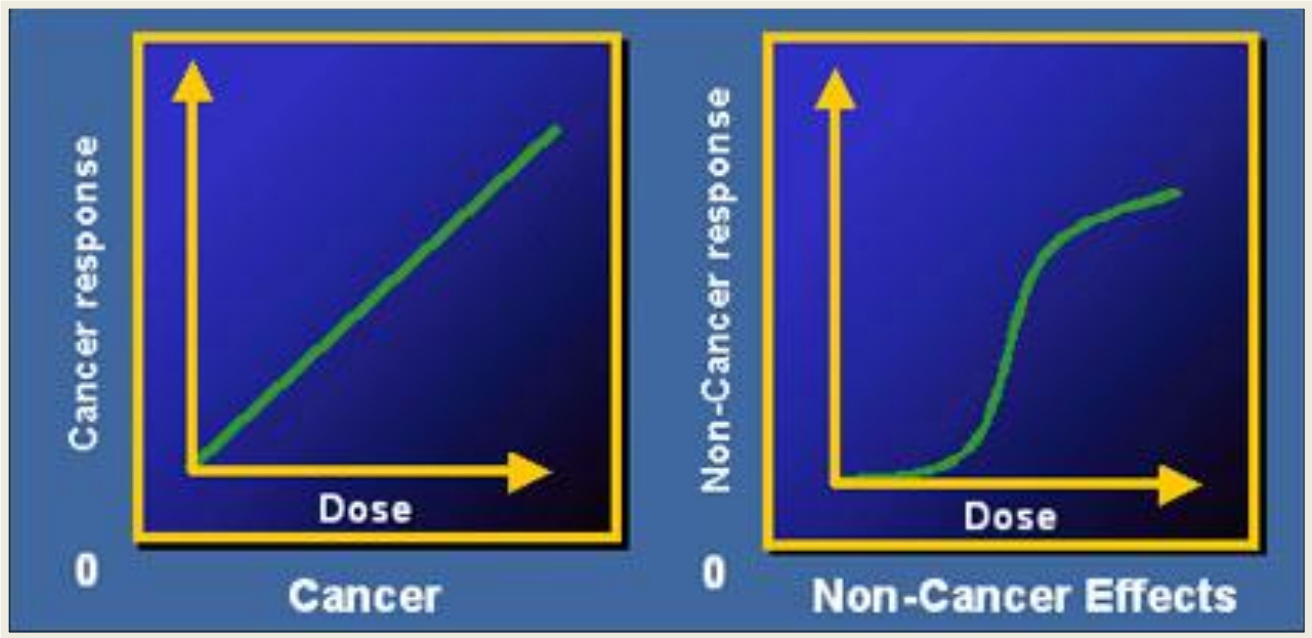
Computer Models

Exposure Assessment

- Exposure?

- Determine:
  - Sources
  - Amounts of toxins
  - Number of people
  - Pollution per person

Dose-Response Assessment



Risk Characterization

Maximum Lifetime Exposure X Dose Relationship = Maximum Individual Lifetime Risk

Uncertainty of Risk

- Extrapolation Issues
- Inaccuracy
- Making Assumptions

Chapter Summary

- Hazardous Effects of Air Pollutants on the Human Body Systems
- Criteria Pollutants
- Toxic Air Pollutants
- Environmental Effects of Air Pollution
- Risk Assessment

APTI Course 452

Principles and Practices of Air Pollution Control

Chapter 3:
Transport and Dispersion of Air Pollution

Chapter Overview

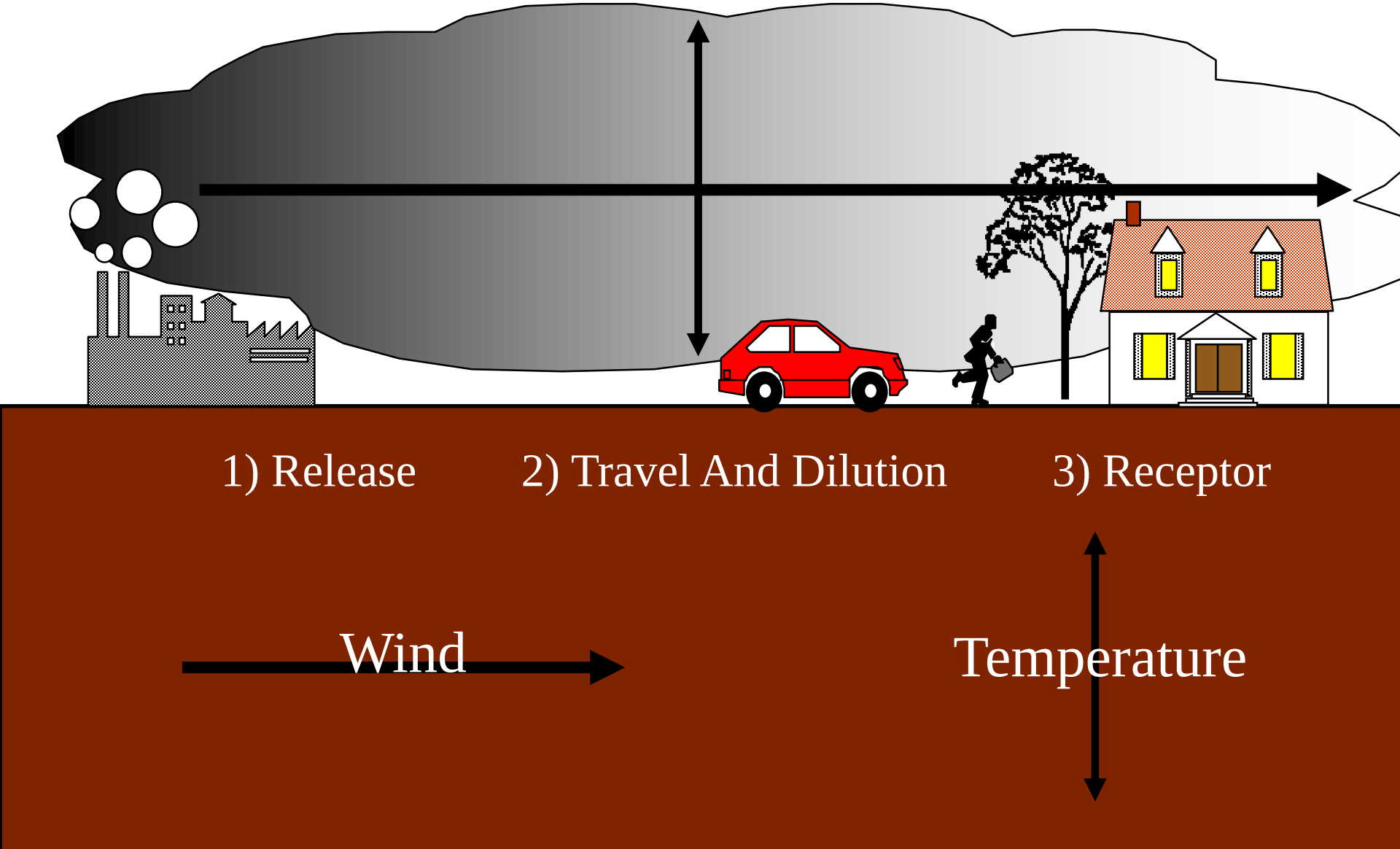
- Wind Speed and Direction
- Atmospheric Stability
- Topography
- New Sources

Essence of Air Pollution Meteorology

Diffusion = Expanding of Pollutant Cloud

Transport = Moving of Pollutant Cloud

AIR POLLUTION CYCLE



Video

I. Introduction

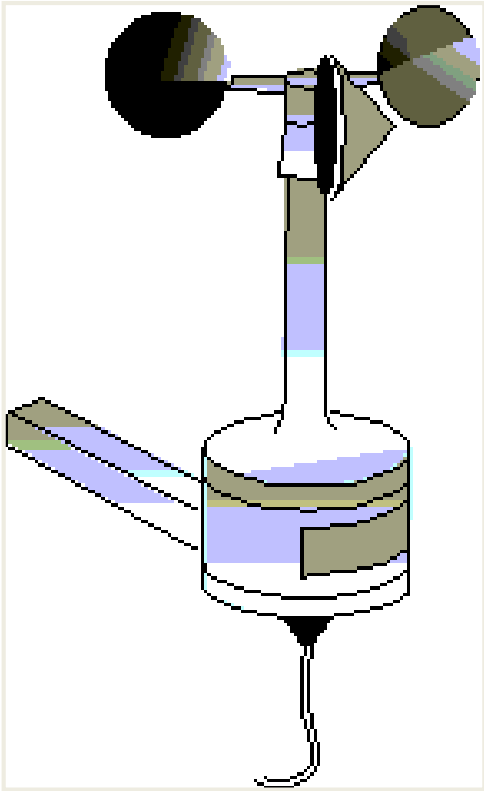
&

II. Atmospheric Thermodynamics

(8:33)

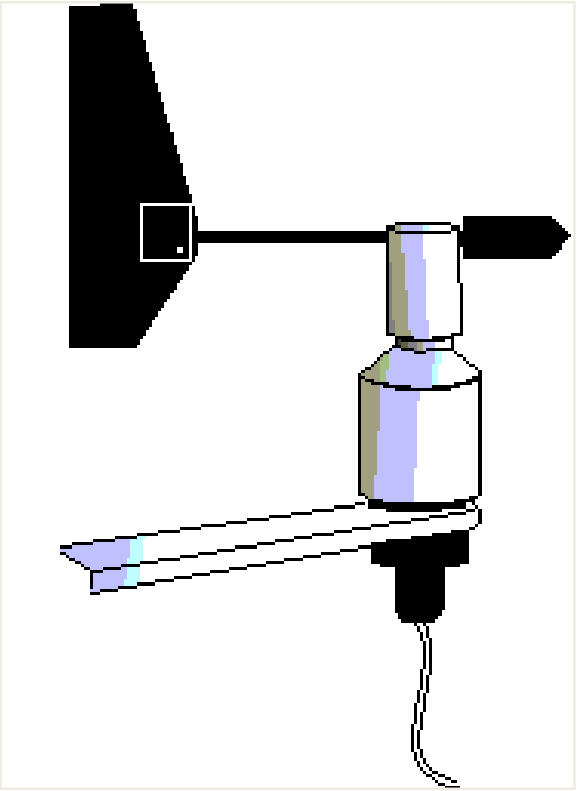
Wind Speed

- Horizontal Motion
- Effect on Pollutant Concentration
- Measurement



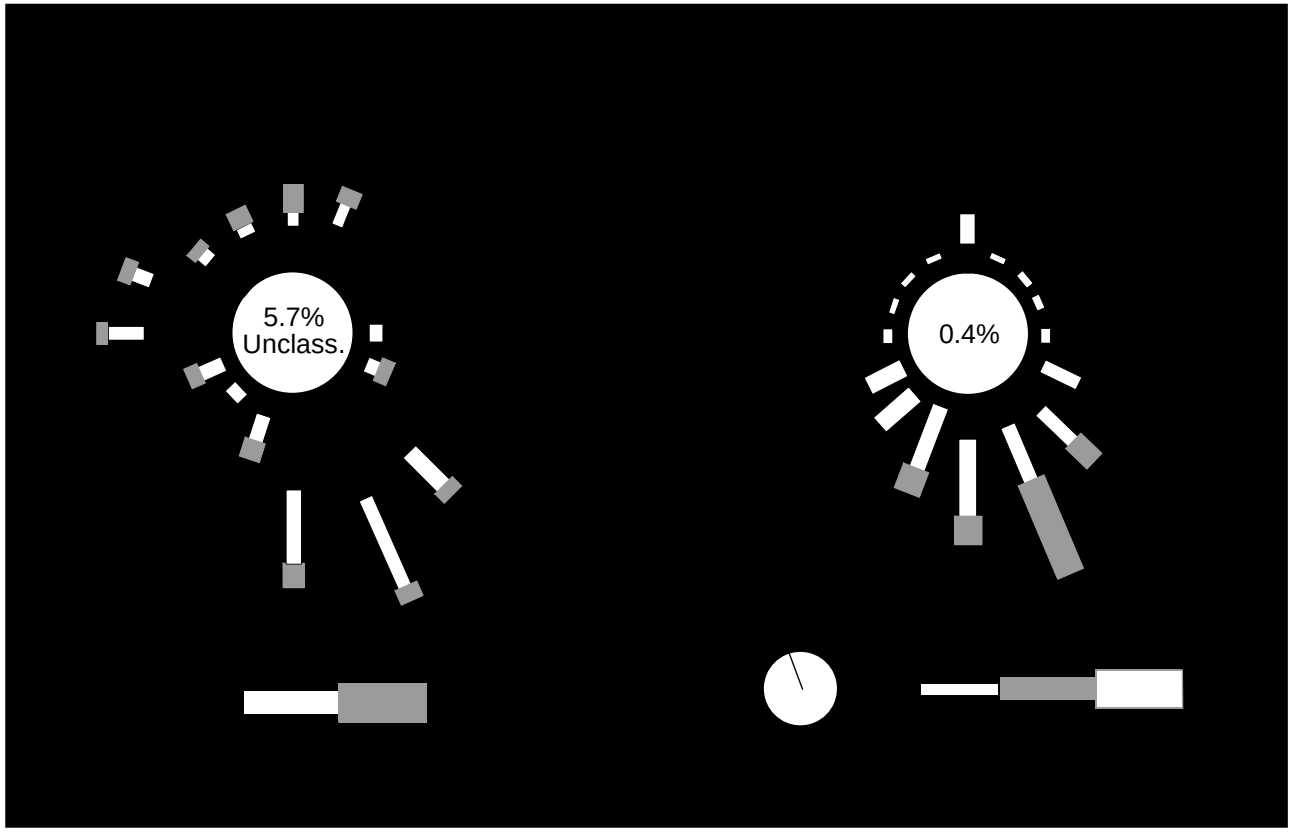
Wind Direction

- Importance
- Tools
- Gathering Data



10-2002

Wind Direction- Wind Rose



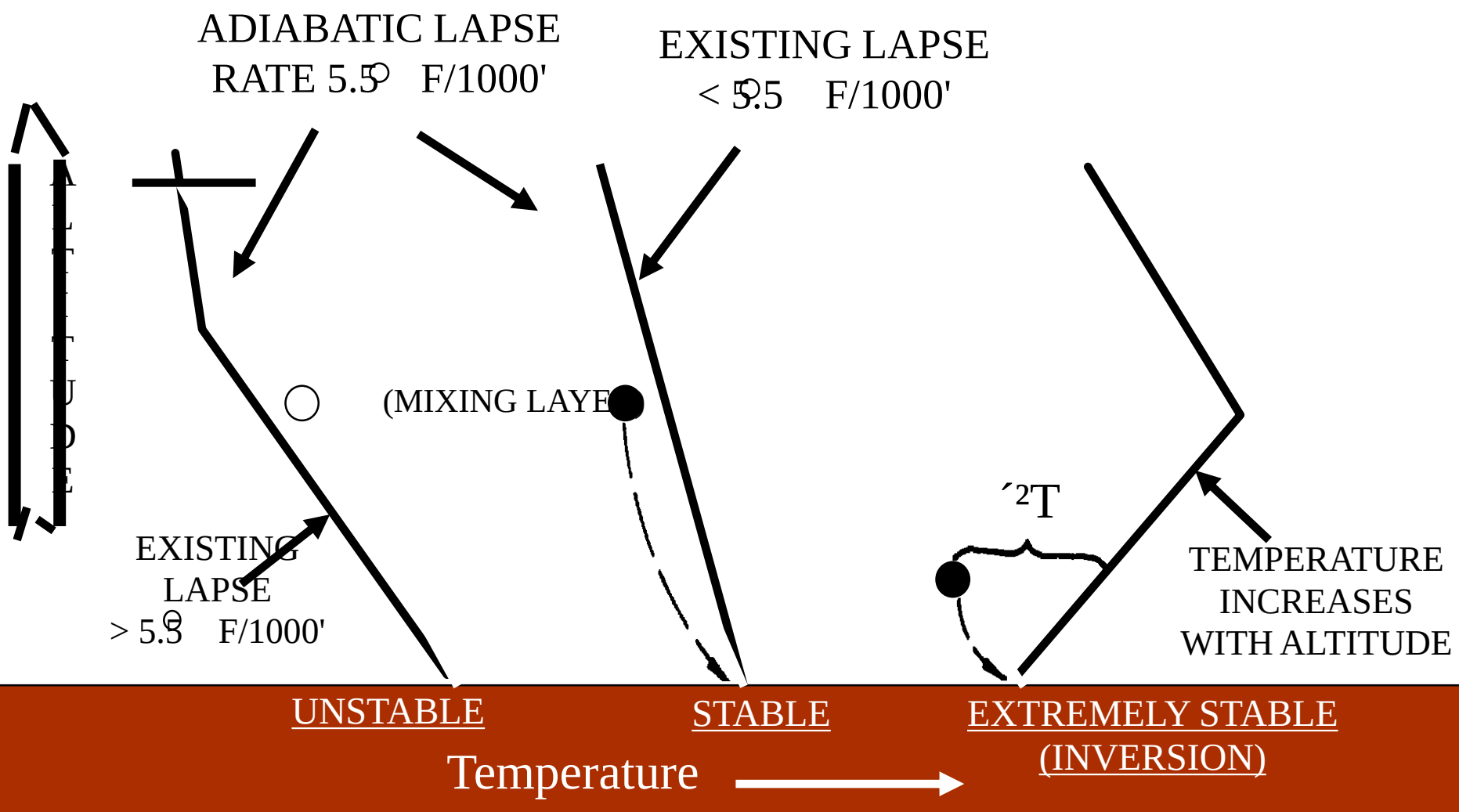
Atmospheric Stability

- Vertical Movement of Air
- Differential Heating
- Conduction vs. Convection
- Turbulence
  - Thermal
  - Mechanical

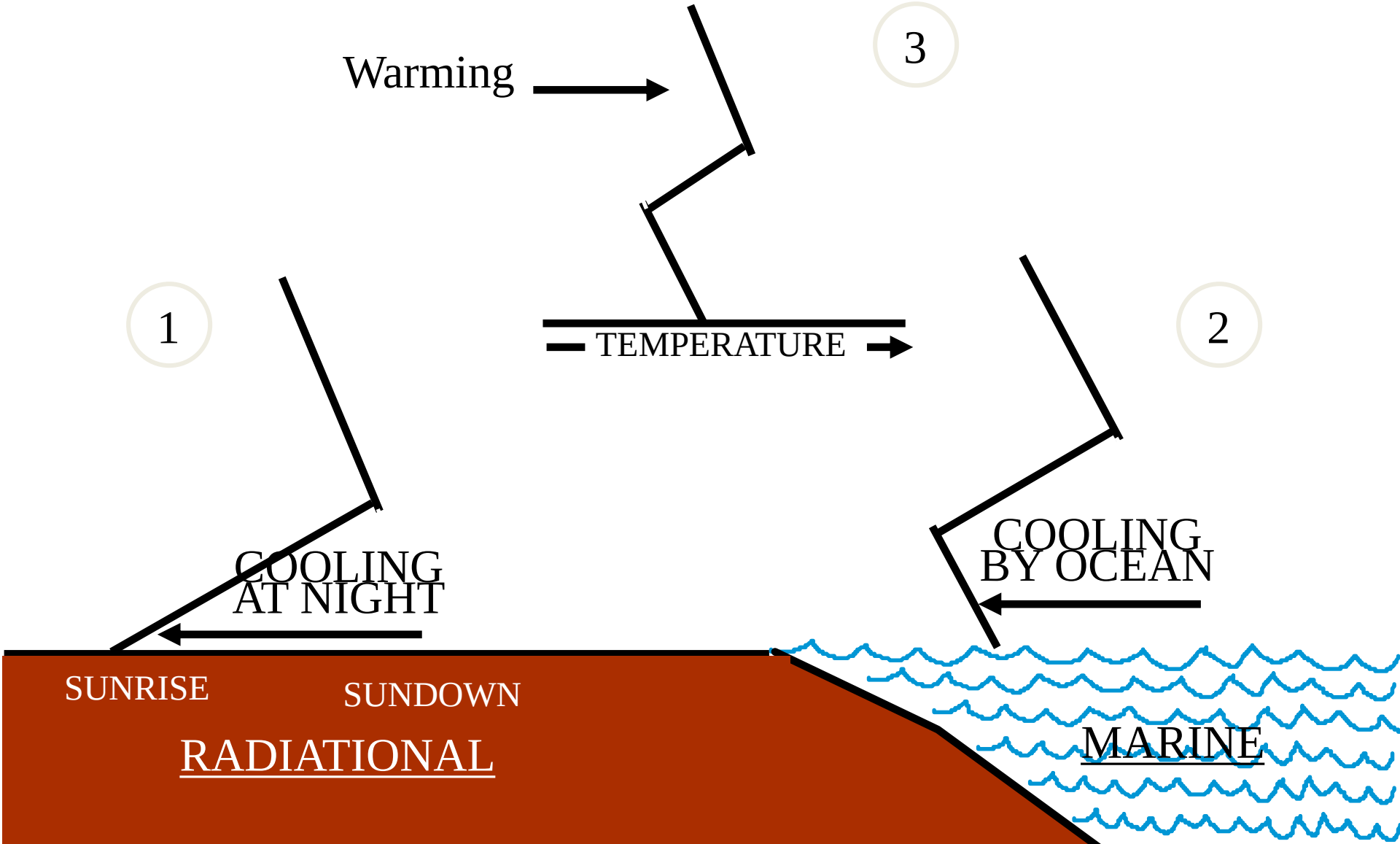
Atmospheric Stability (cont.)

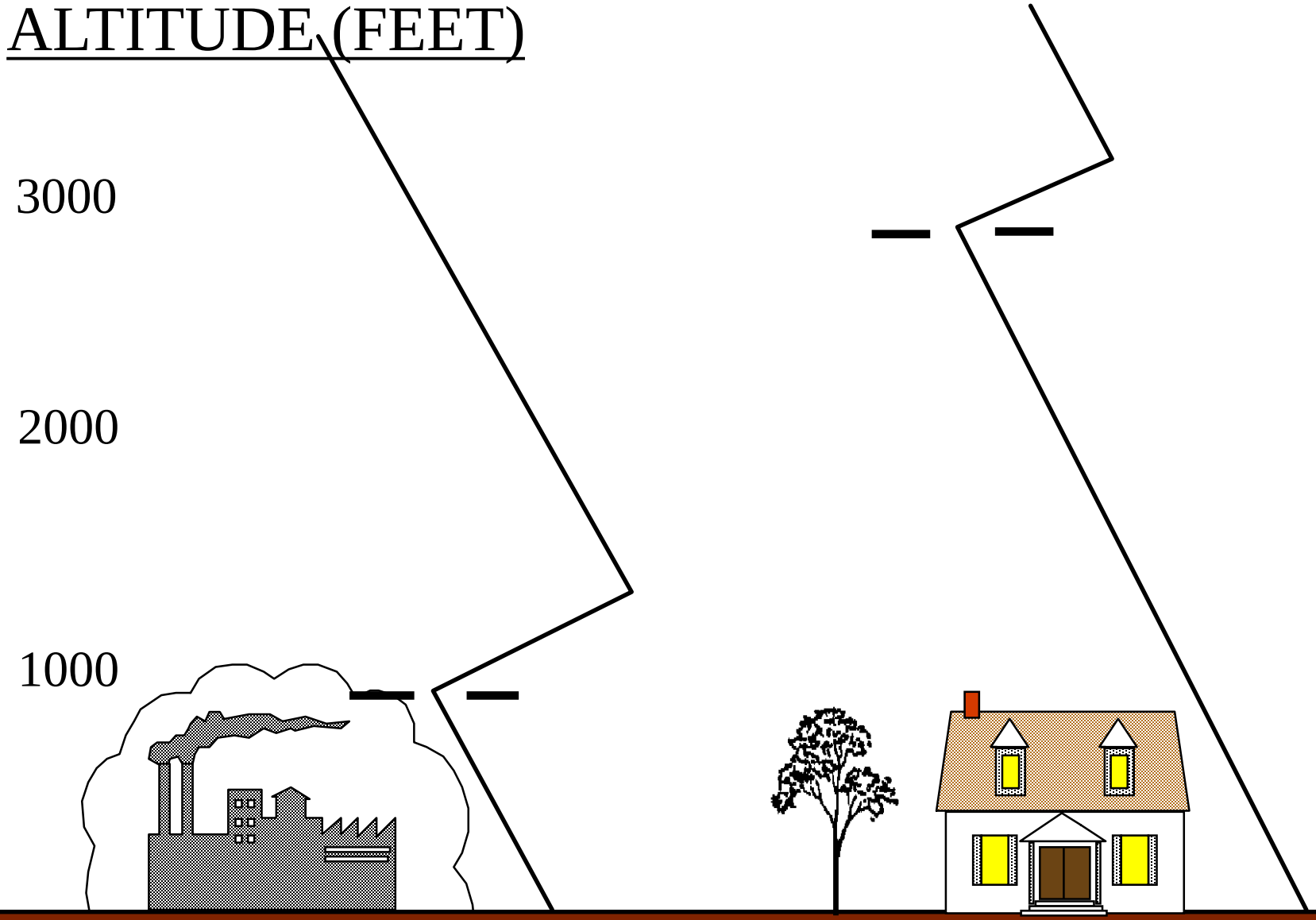
- Adiabatic Lapse Rate
- Environmental Lapse Rate
- Plumes
- Plume Types

ATMOSPHERIC STABILITY



INVERSIONS


Warming
3
1
TEMPERATURE
2
COOLING
AT NIGHT
COOLING
BY OCEAN
SUNRISE
SUNDOWN
RADIATIONAL
MARINE

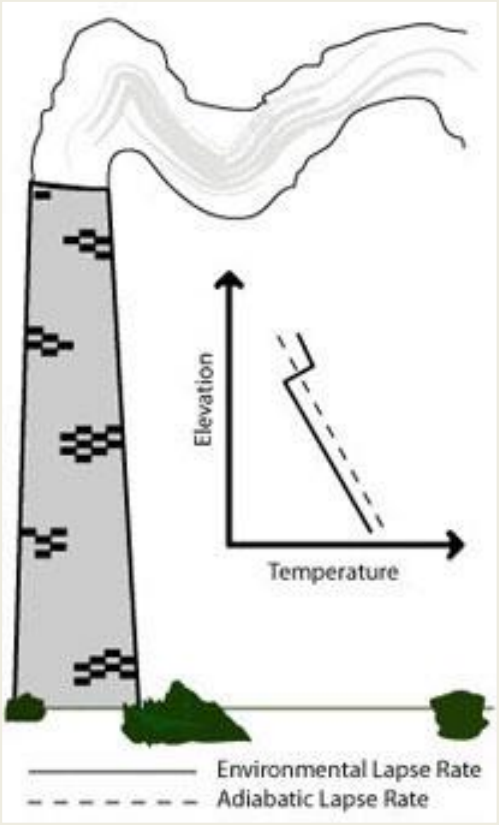


EPISODE CONDITIONS

ADEQUATE VOLUME

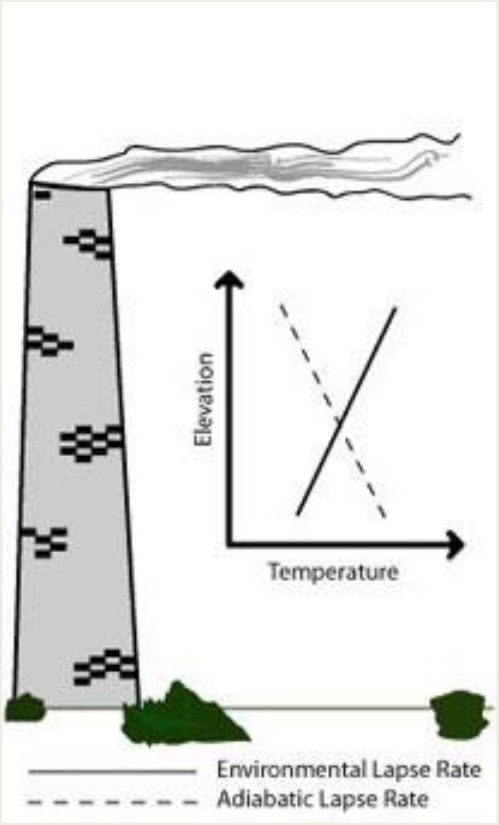
Looping Plumes

- Unstable Atmosphere
- Changing Temperature and Pressure
- Sunny Days with Wind



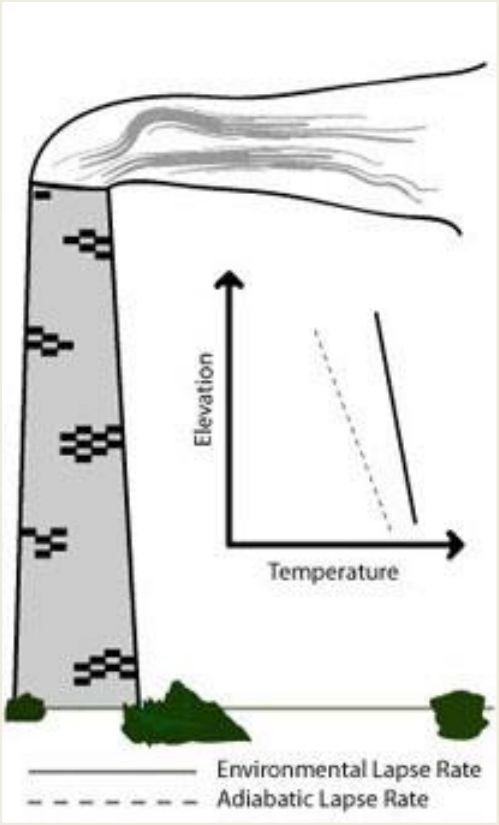
Fanning Plumes

- Stable Conditions
- Wind moving horizontally
- Early Morning



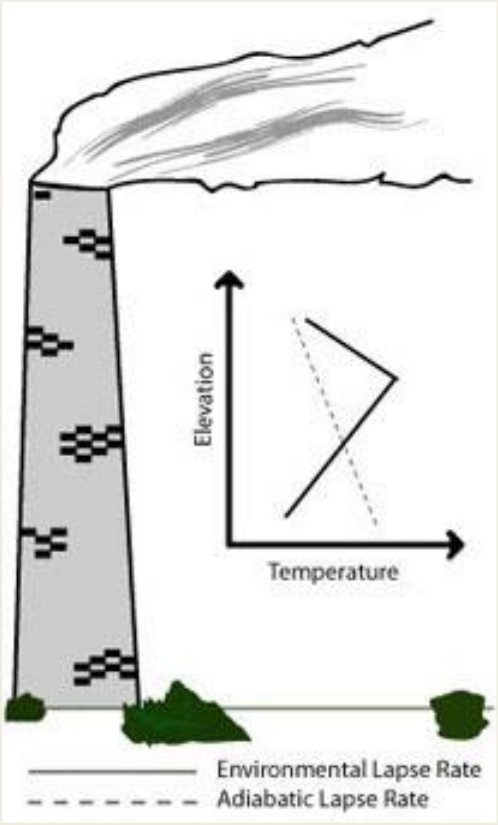
Coning Plumes

- Neutral or Slightly Unstable Conditions
- Large Billows
- Partly Cloudy Days



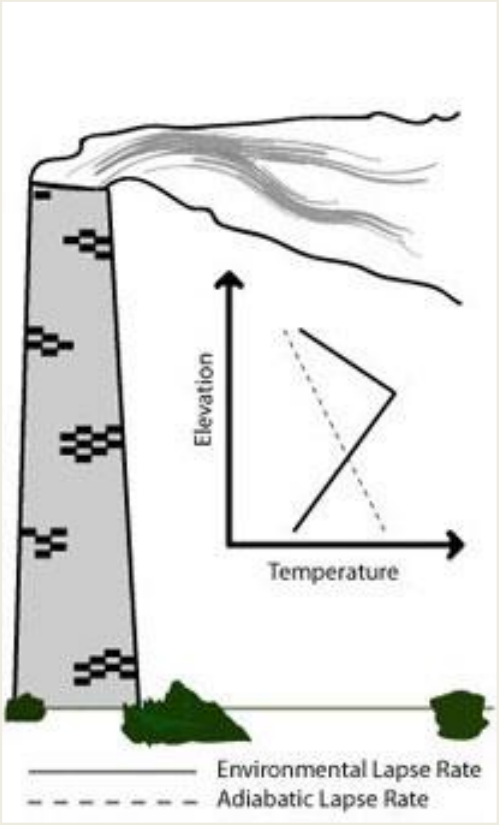
Lofting Plumes

- Stable Conditions
- Above the Inversion Layer
- Smokestack Height
- Effective Dispersion



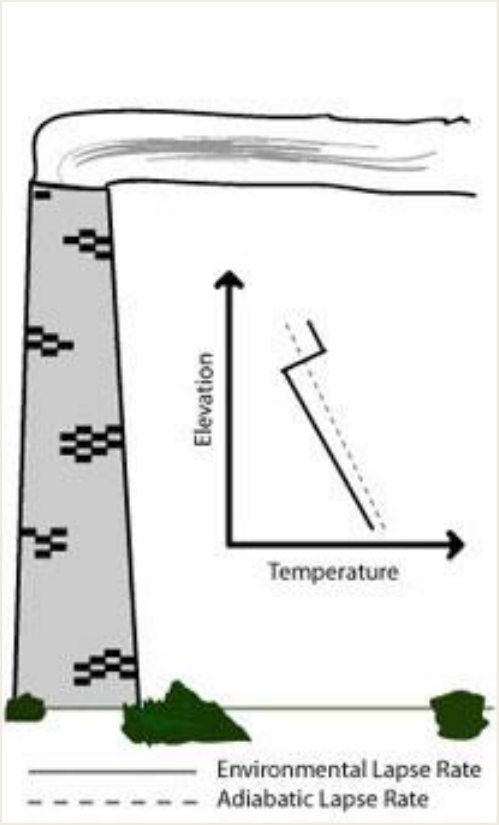
Fumigating Plumes

- Early Morning
- Below the Inversion Layer
- High Concentrations of Pollutants at the Surface



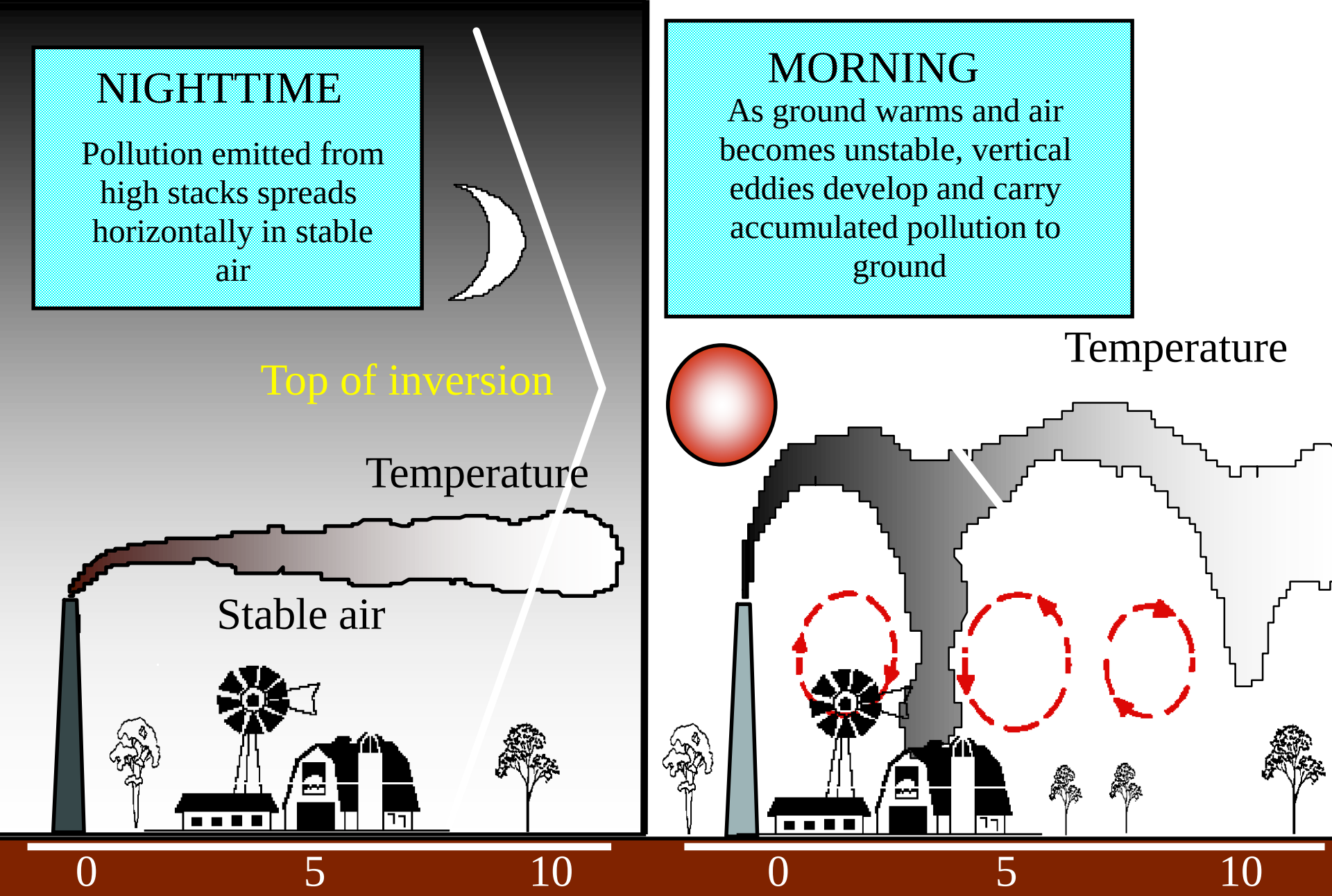
Trapping Plumes

- Clear and Sunny Days
- Inversion layer above and below
- Most Favorable Type



KIMBERLY

10-2002


NIGHTTIME
Pollution emitted from high stacks spreads horizontally in stable air
Top of inversion
Temperature
Stable air
MORNING
As ground warms and air becomes unstable, vertical eddies develop and carry accumulated pollution to ground
Temperature
0
5
10
0
5
10
Temperature (°C)

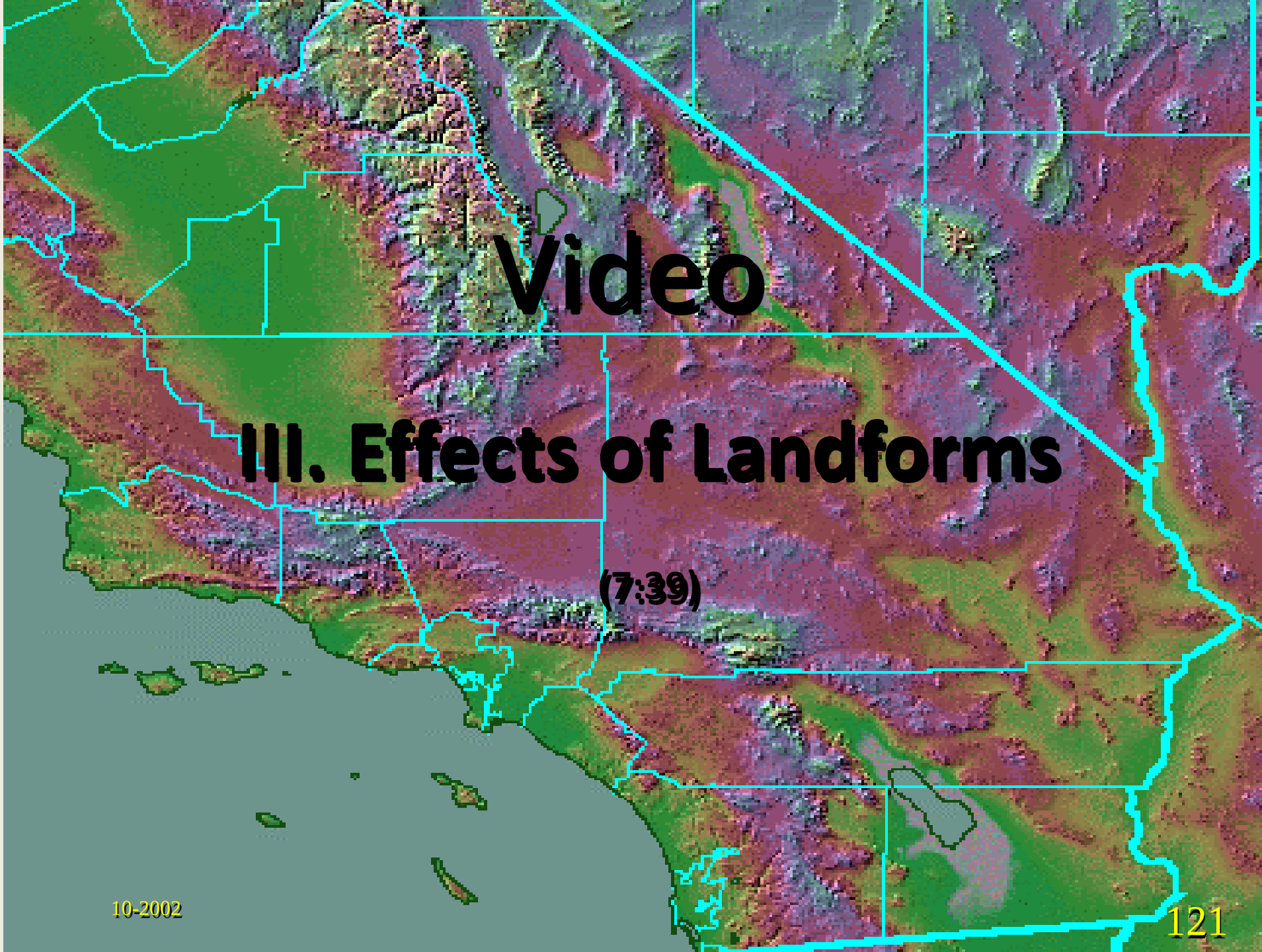
Video

III. Atmospheric Moisture

&

IV. Meteorological Instruments

(11:57)



Video

III. Effects of Landforms

(7:39)

Topography

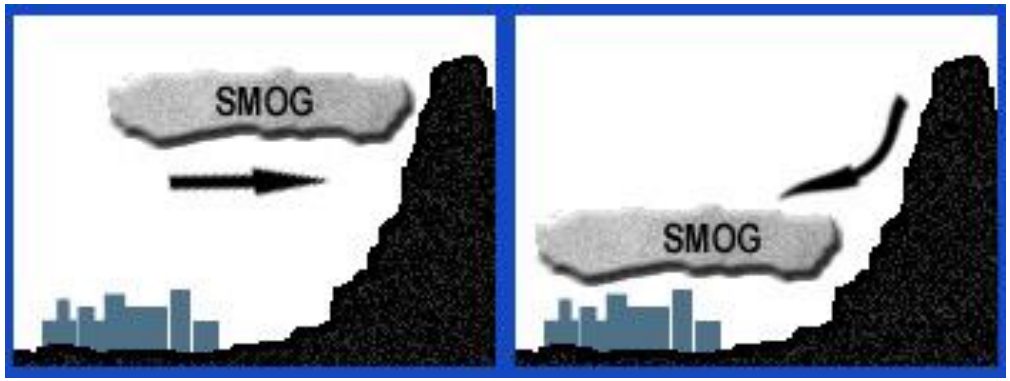
- Lakes and Oceans
- Valleys
- Mountains

Topography (cont.)

- Lakes and Oceans

- Valleys

- Mountains



New Source Review (NSR)

- Prevention of Significant Deterioration (PSD)

- 40 CFR Part 51 Appendix W
  - modeling

Chapter Summary

- Wind Speed and Direction
- Atmospheric Stability
- Topography
- Dispersion Modeling

APTI Course 452

Principles and Practices of Air Pollution Control

Chapter 4:
Indoor Air Pollution

Chapter Overview

- Sources and Effects of Indoor Air Pollution
- Sick Building Syndrome
- Controls of Indoor Air Pollution
- EPA’s Approach and Progress

Sources of Indoor Air Pollution

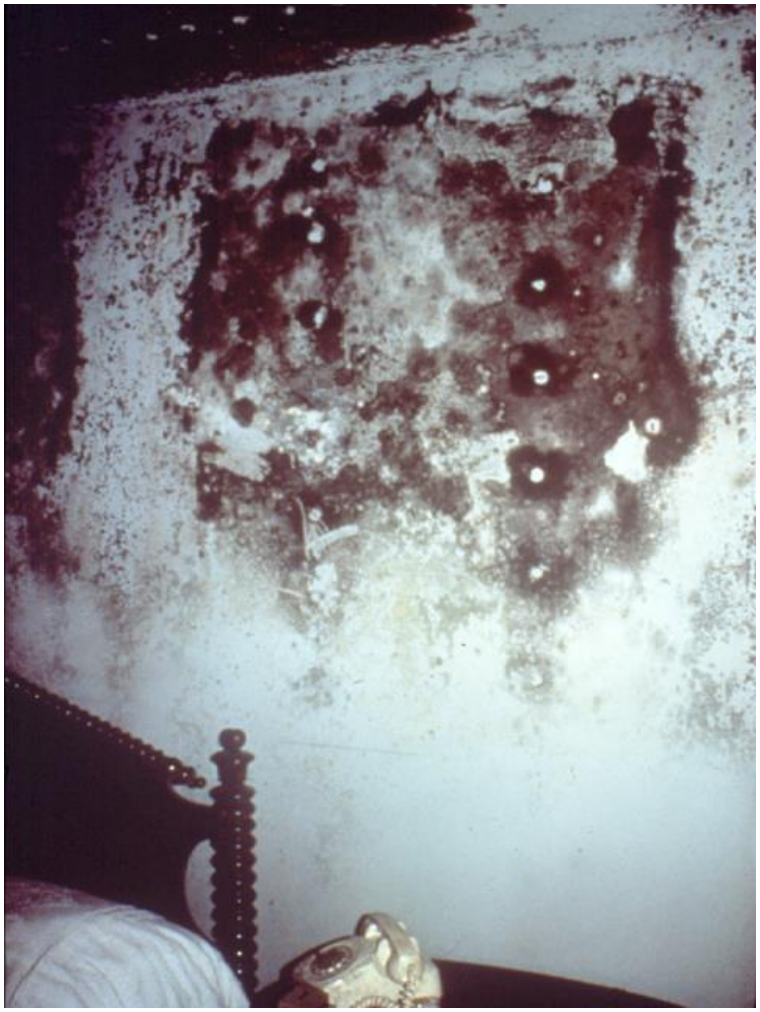
Sources and Effects of Indoor Air Pollution

- Biological Contaminants
- Radon
- Environmental Tobacco Smoke
- Stoves, Heaters, Fireplaces and Chimneys

- Asbestos
- Pesticides
- Organic Chemicals
- Formaldehyde
- Lead
- Carbon Monoxide
- Nitrogen Oxide

Biological Contaminants

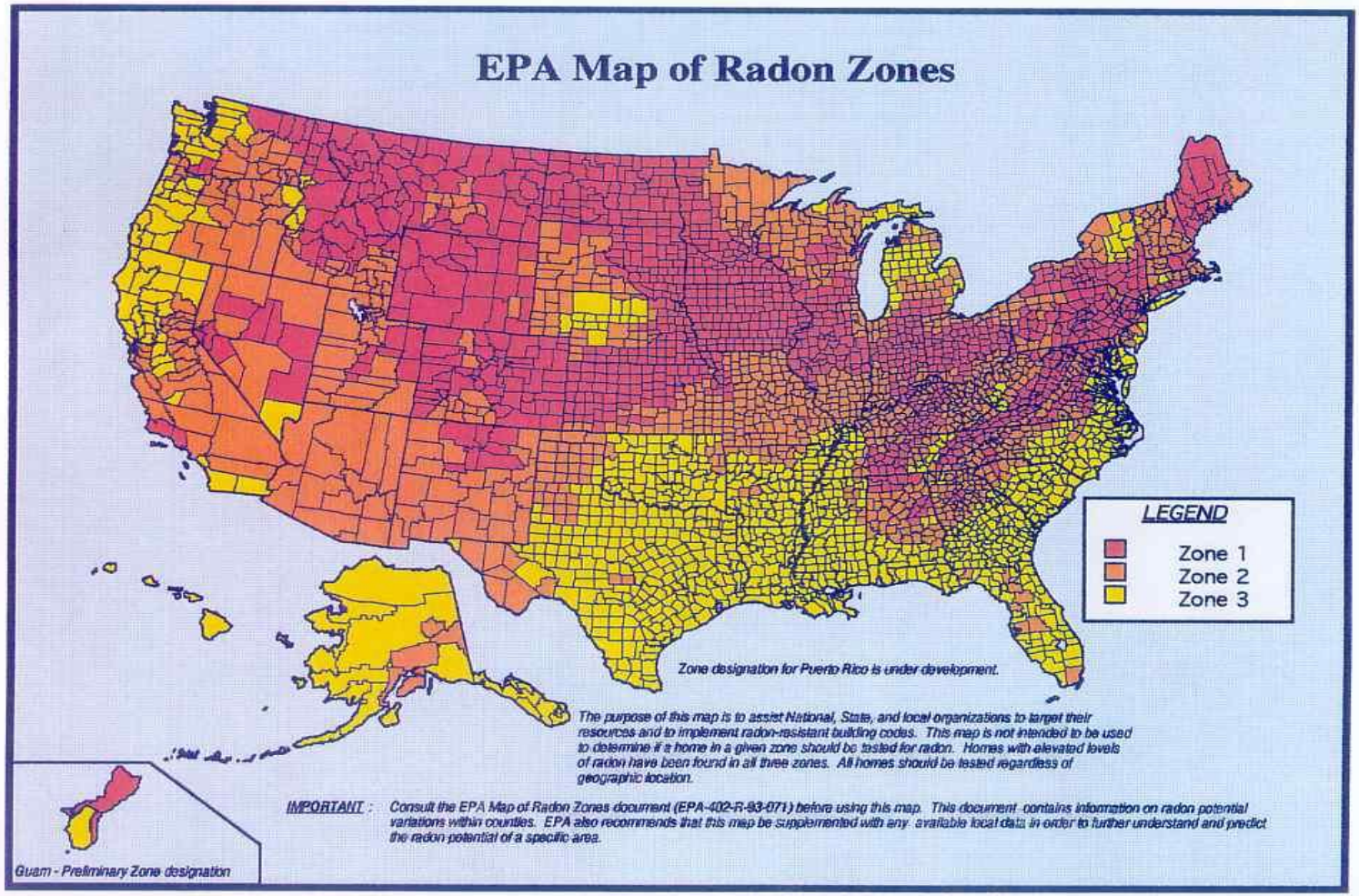
- Sources
  - Bacteria
  - Molds, mildew
  - Viruses
  - Animal dander
  - Dust mites, cockroaches
  - Pollen
  - House Dust
  - Pets
  - Poorly Maintained Air Conditioners



Biological Contaminants

- Health Effects
  - Asthma
  - Eye, nose and throat irritation
  - Shortness of breath
  - Dizziness, lethargy
  - Fever and humidifier fever
  - Digestive problems
  - Influenza and other infections
- Ways to Reduce Exposure

Radon


EPA Map of Radon Zones
LEGEND
Zone 1
Zone 2
Zone 3
Zone designation for Puerto Rico is under development.
The purpose of this map is to assist National, State, and local organizations to target their resources and to implement radon-resistant building codes. This map is not intended to be used to determine if a home in a given zone should be tested for radon. Homes with elevated levels of radon have been found in all three zones. All homes should be tested regardless of geographic location.
IMPORTANT : Consult the EPA Map of Radon Zones document (EPA-402-R-93-071) before using this map. This document contains information on radon potential variations within counties. EPA also recommends that this map be supplemented with any available local data in order to further understand and predict the radon potential of a specific area.
Guam - Preliminary Zone designation

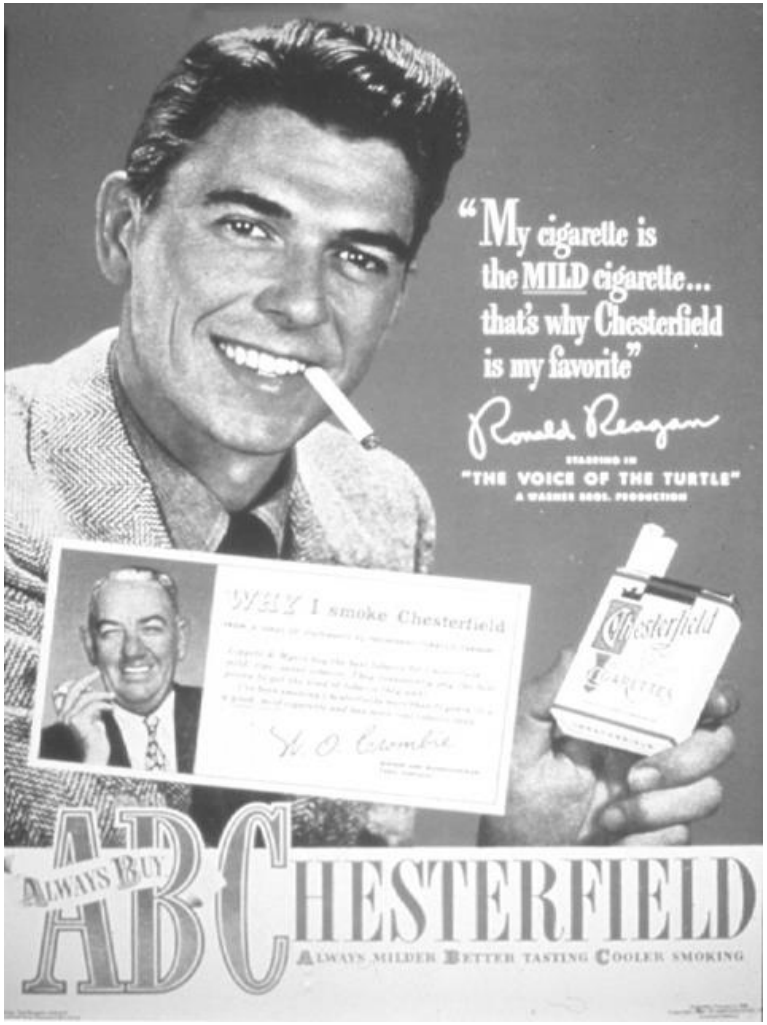
Radon

- Soil under buildings and groundwater
- Health Effects – Lung Cancer

- Ways to Reduce Exposure

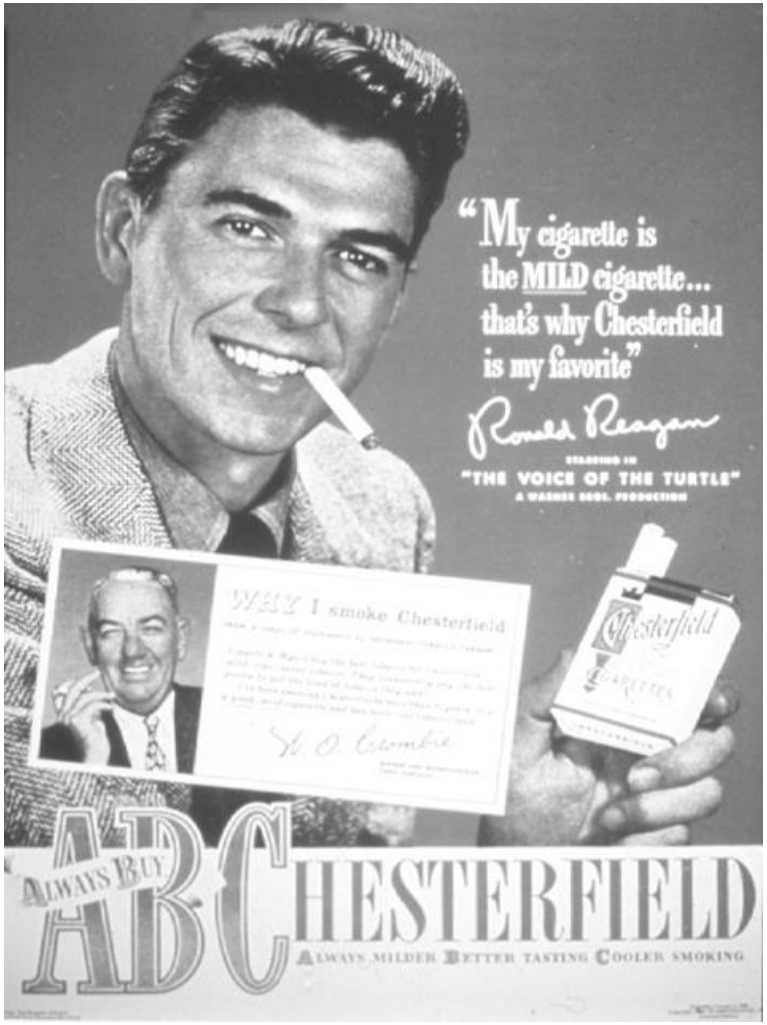
Environmental Tobacco Smoke

- What is it?



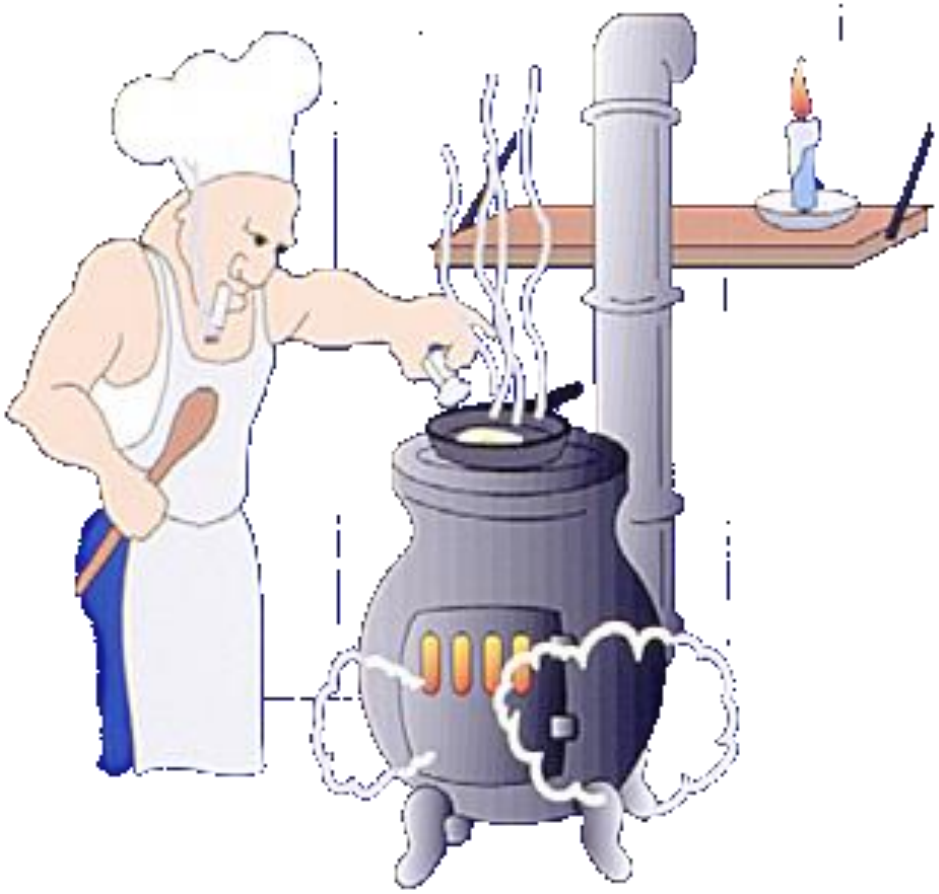
Environmental Tobacco Smoke

- What is it?
  - Cigarettes
  - Cigars
  - Pipes



Stoves, Heaters, Fireplaces and Chimneys

- What is it?
- Health Effects
- Ways to Reduce Exposure



Asbestos

- What is it?
- Health Effects
- Ways to Reduce Exposure

Pesticides

- What are they?
- Health Effects
- Ways to Reduce Exposure

Organic Chemicals

- What are they?
- Health Effects
- Ways to Reduce Exposure

Formaldehyde

- What is it?
- Health Effects
- Ways to Reduce Exposure

Formaldehyde

- What is it?
- Health Effects
- Ways to Reduce Exposure

Lead

- What is it?
- Health Effects
- Ways to Reduce Exposure

Lead

- What is it?
- Health Effects
- Ways to Reduce Exposure

Carbon Monoxide

- What is it?
- Health Effects
- Ways to Reduce Exposure

Nitrogen Oxides

- What is it?
- Health Effects
- Ways to Reduce Exposure

Sick Building Syndrome

- What is it?
- What its effects?
- What are its causes?

Sick Building Syndrome

- What is it?
- What its effects?
- What are its causes?

Controls of Indoor Air Pollution

- Source Control
- Ventilation
- Air Cleaners

EPA’s Approach and Progress

- EPA Indoor Air Program
- Other Federal Agencies

Chapter Summary

- Sources and Effects of Indoor Air Pollution
- Sick Building Syndrome
- Controls of Indoor Air Pollution
- EPA’s Approach and Progress

APTI Course 452

Principles and Practices of Air Pollution Control

Chapter 5:
The United States Clean Air Act

Chapter Overview

- National Ambient Air Quality Standards
- Air Quality Control Regions
- State Implementation Plans (SIPs)
- New Source Review: Permit Requirements
- Hazardous Air Pollutants
- Federal Enforcement

National Ambient Air Quality Standards

- The Six Criteria Pollutants
- Primary NAAQS
- Secondary NAAQS

Air Quality Control Focus

- 1970 Clean Air Act-AQCRs
- 1977 CAAA-Attainment, Nonattainment or Unclassifiable
- 1990 CAAA-Nonattainment classifications
- Design Value

State Implementation Plans (SIPs)

- Historical Context
- Provisions
- Enforceability

SIPs- Historical Context

- 1970- Entire State
- 1977- Nonattainment Areas
- 1990-Nonattainment Areas
- NAAQS Changes

SIPs- Provisions

- Ambient air quality monitoring network
- Establish Emission Inventories
- Conduct air quality modeling
- Emission Control Strategies
- Demonstrate attainment
- Establish a permit system for new sources
- Enforcement procedures and policy

SIPs- Rulemaking Options

- EPA Approval
  - Conditional
  - Partial
  - Full
- EPA Disapproval
  - FIPs
  - Sanctions
- Federal Weight

Pre-Construction Review of New Sources

Attainment Pollutants

Nonattainment Areas

New Source Performance Standards (NSPS)

- New Source Performance Standards (NSPS)
  - 65 Source Categories
  - Apply everywhere

- Modification
  - Changes that do not effect emissions
  - Changes that effect emissions

Prevention of Significant Deterioration (PSD)

- Prevention of Significant Deterioration (PSD)
  - Attainment Pollutants
  - Major Sources
  - Major Modifications

Requirements For Attainment Pollutants

- BACT(Best Available Control Technology)
  - Economics a factor
- PSD Classification Areas
- Increment Consumption

Requirements for Non-attainment Pollutants

- Major Sources
- Major Modifications
- LAER (Lowest Achievable Emission Rate)
  - Economics not a factor
- Common Ownership Compliance
- Emission Offsets

Hazardous Air Pollutants

- Health Based Standards (1970 CAA)
  - NESHAPS
- Technology Based Standards (1990 CAA)
  - MACT
  - Major Sources
- Residual Risk

Other CAAA Programs

- Acid Rain Program
  - Sulfur Dioxide Emission Reduction Program
  - Nitrogen Oxides Emission Reduction Program
- Operating Permit Program
- Stratospheric Ozone Protection Program
- Visibility Protection Program
- Mobile Source and Fuels Program

Federal Enforcement

- Civil Action
- Administrative Penalties
- Criminal Action
- Citizen Suits
- EPA Emergency Powers

Other Strategies

- Interstate Air Pollution
- Greenhouse Gas Emissions

Chapter Summary

- National Ambient Air Quality Standards
- Air Quality Control Regions
- State Implementation Plans (SIPs)
- New Source Review: Permit Requirements
- Hazardous Air Pollutants
- Federal Enforcement

Questions?