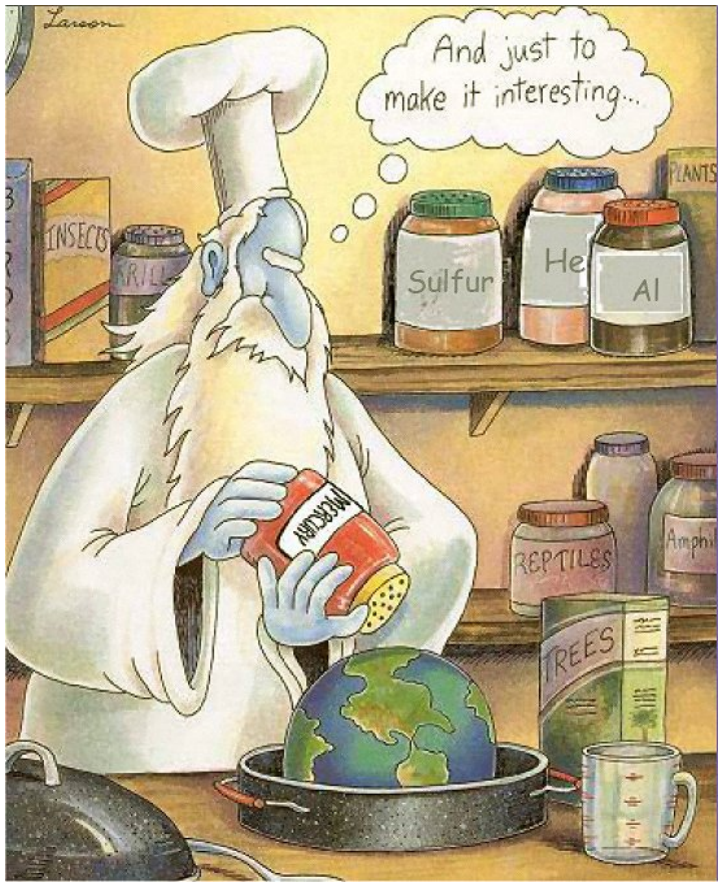
Emissions Inventory Development and Preparation for Modeling



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Our Goals

- Explain basic elements of air pollution that are relevant to emissions inventories, the history behind air regulatory and inventory programs, and why it is important to develop an air pollutant emissions inventory periodically
- Provide information on how to develop an air pollutant emissions inventory using detailed examples
- Explain how air pollutant emissions inventories are used for modeling

Overview

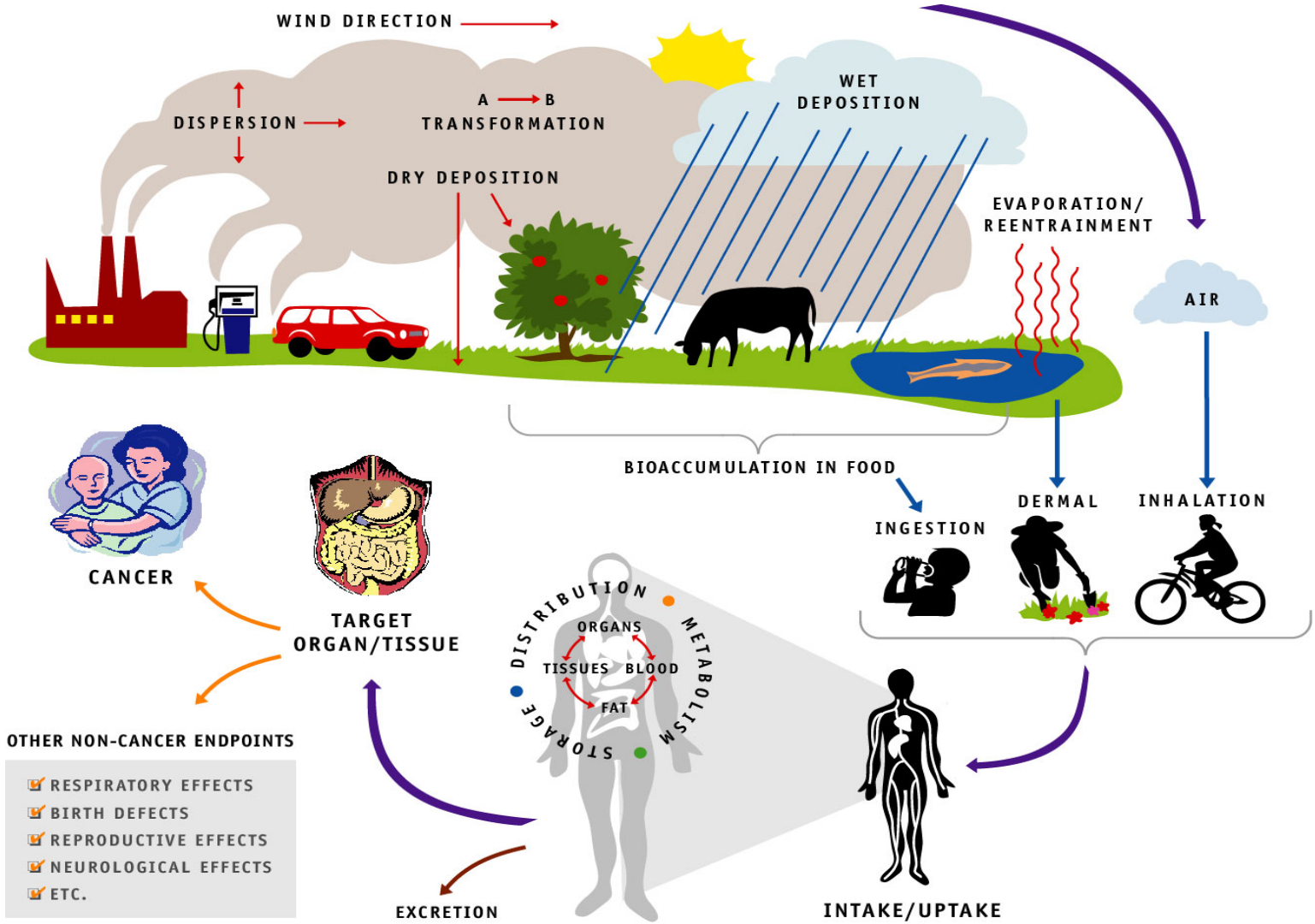
- Introduction
  - Basic elements of air pollution that are relevant to emissions inventories
  - History of Air Program
  - Uses/ Reasons to Prepare Air Pollutant Emissions Inventories
- Pollutant Definitions, Pollutant grouping for modeling
- Source Category Definitions
- Emission Inventory Modeling Parameters
- Emission Inventory Compilation
- Point Sources
- Nonpoint Sources
- Fires
- Mobile Sources
- Wrap Up!

Introduction

Air Pollution - Definition

- Presence of substances in the air in concentrations that create health and environmental problems
- Sources
  - Naturally occurring
  - Man-Made
- Mixture
  - Gases
  - Water Droplets
  - Particles

Air Pollution Effect on Humans



Emission Types

- Anthropogenic (man-made)
  - Stationary sources
    - Indoors
    - Outdoors
  - Mobile sources
    - Onroad
    - Nonroad
    - ALM
- Natural
  - Plants and soils
  - Lightning and volcanoes
  - Wildfires

Adverse Impacts of Air Pollutants

- Health and environmental effects can be acute or chronic
- Impact of substance is related to:
  - Atmospheric lifetime of pollutant
  - Concentration of pollutant
  - Exposure of organism to pollutant
  - Dose response of pollutant
- Emission inventories are an important component of risk assessment studies

Atmospheric Lifetime of Pollutants

- Often discussed as *half-life* or the natural lifetime of a pollutant with respect to reactive species such as OH (hydroxyl radical)
- Depends on balance between sources and sinks (removal mechanisms)
- Half-life range for compounds in the troposphere is from seconds hours to weeks to years
- Affects transport properties of pollutant
- Effects of deposition, suspension, and re-entrainment

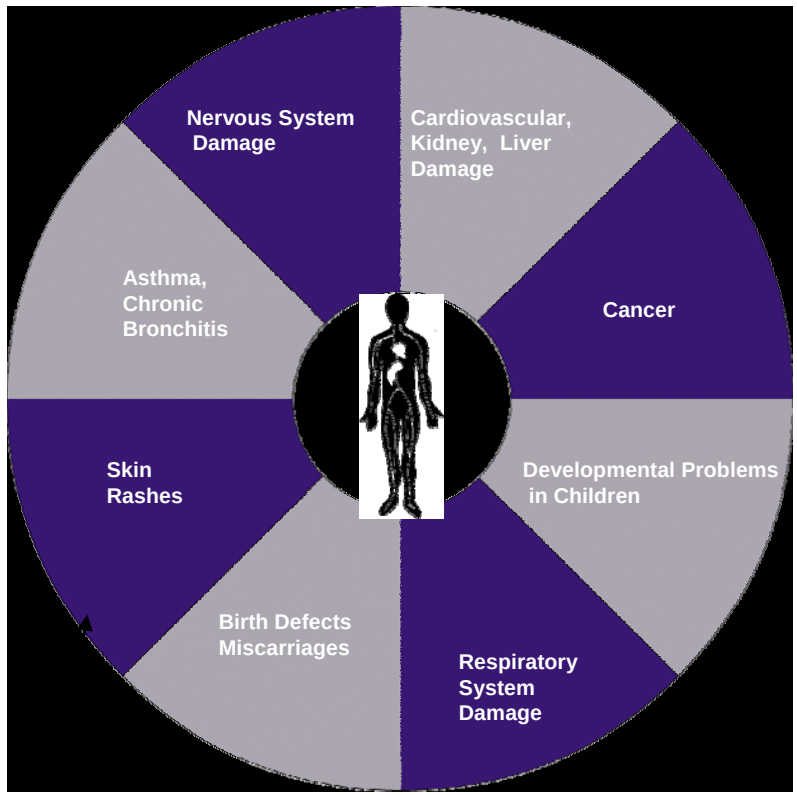
Concentration Units

Concentration of Air Pollutants may be reported in following units:

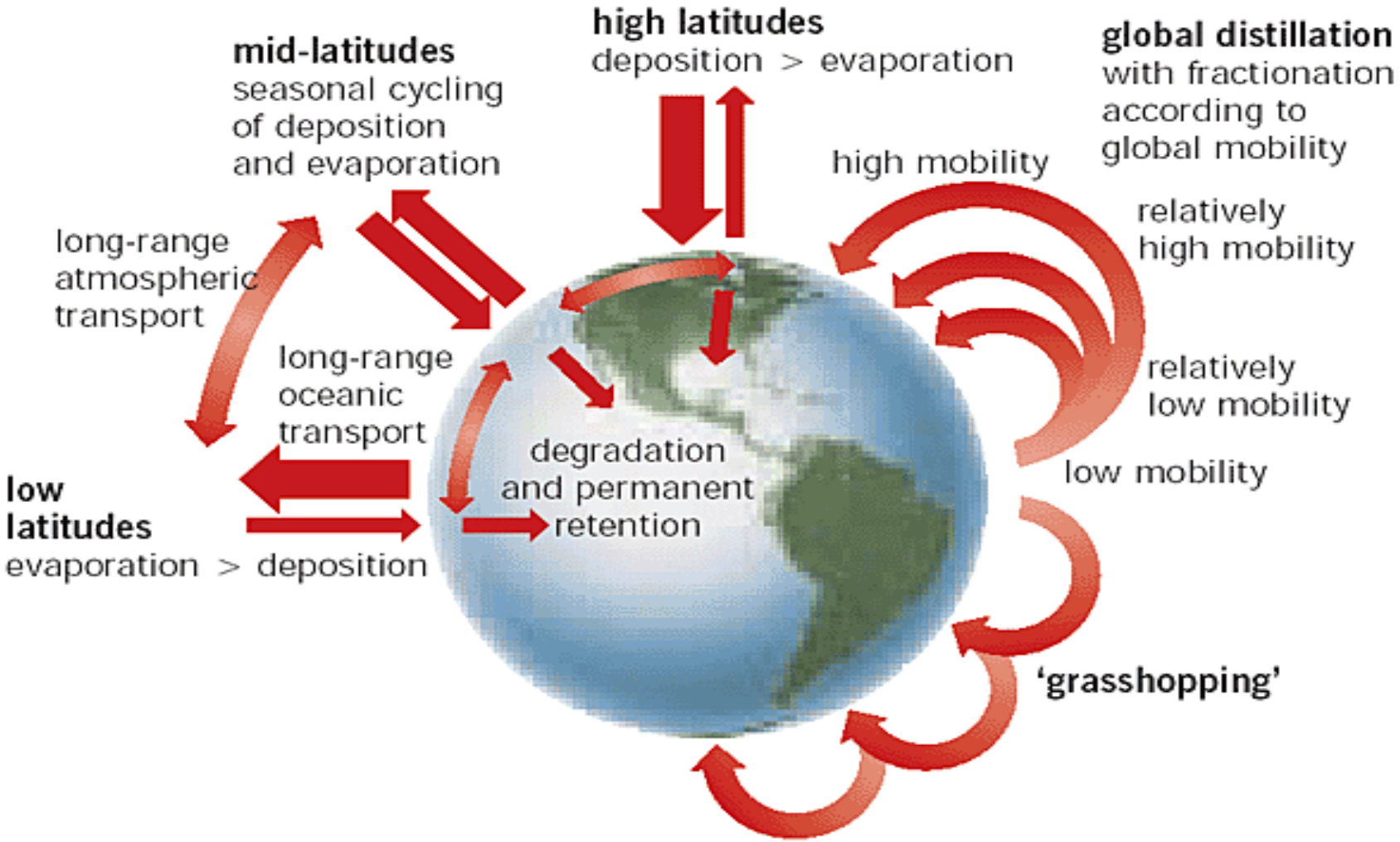
- Parts per million (ppm) or parts per billion (ppb)
  - For gaseous pollutants
  - Assumes a dimensionless volume fraction ($V_{pollutant}$:V_{air})
- Microgram per cubic meter (µg/m^3)
  - For gaseous pollutants and particles
- Conversion of µg/m^3 to ppm
  - µg/m^3 = ppm x 40.9 x molecular weight of pollutant (MW)
- Example:
  - Convert 0.120 ppm of O_3 to µg/m^3 when MW of O_3 = 48
  - 0.120 ppm x 40.9 x 48 = 236 µg/m^3

Human Health Effects

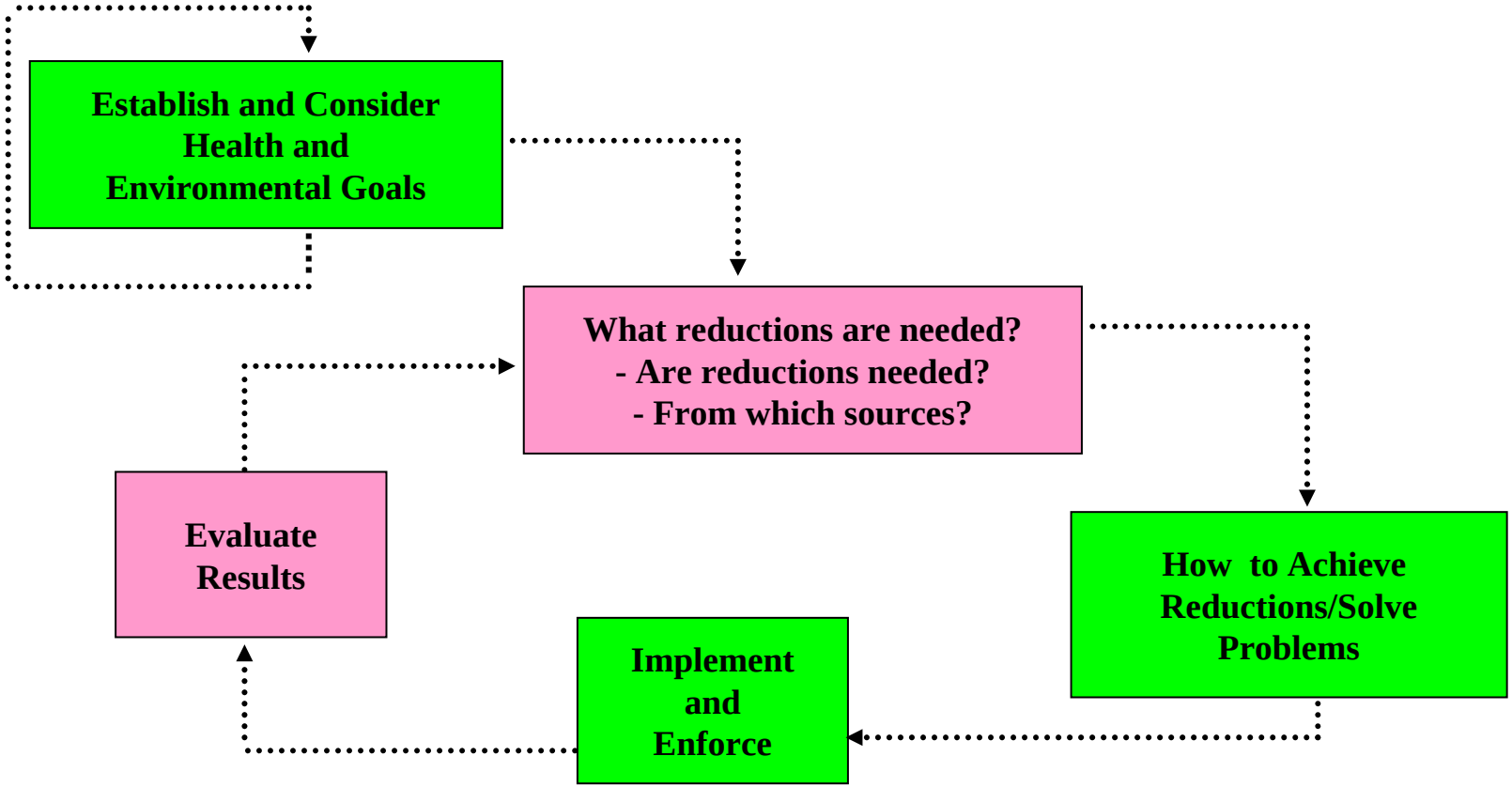
- Air pollutants can cause acute or chronic health effects.
- The impact on health depends on:
  - Age and overall health condition of the individual
  - Exposure time and dose
- Common health effects
  - Cancer and Noncancer Effects
  - In severe conditions, death



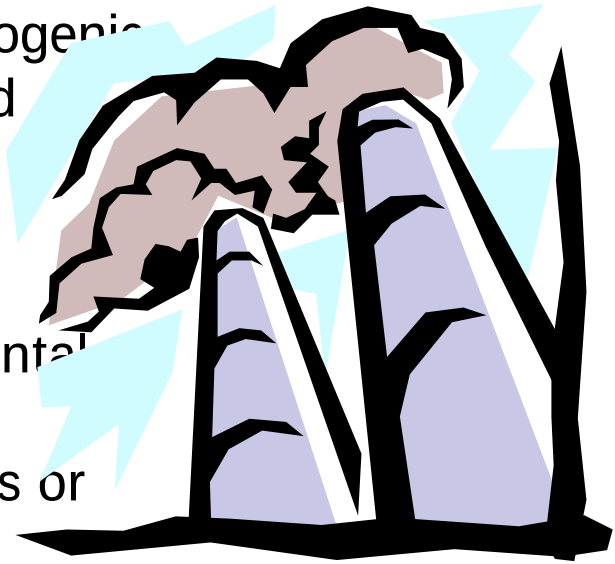
Long Range Transport of Persistent Pollutants



Air Quality Management Model



Summary: Principles of Air Pollution



- Air pollutants can be directly emitted by anthropogenic and natural sources to the atmosphere or formed in the atmosphere by chemical reactions
- Air pollutants can have impacts on a local, regional, or global scale
- Air pollutants have human health and environmental effects
- Humans may be exposed to air pollutants indoors or outdoors
- Focus of training is on:
  - CAPs for which air quality standards have been established by various agencies
    - PM, CO, NO_2, SO_2, Pb, NH_3, O_3
  - Air toxics - HAPs
- The air quality management model is an approach for describing how air pollution control programs may be established and implemented

Air Pollution Control in the 21st Century

Act Locally

Think Globally

City /Town

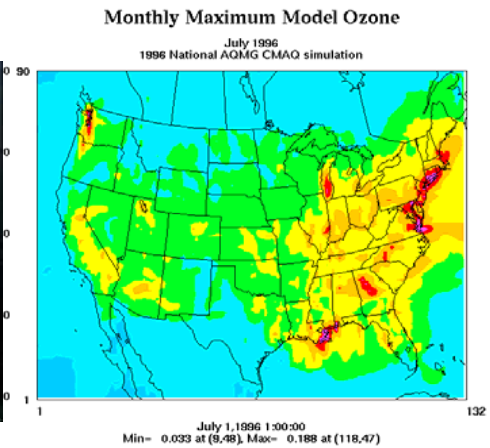
County

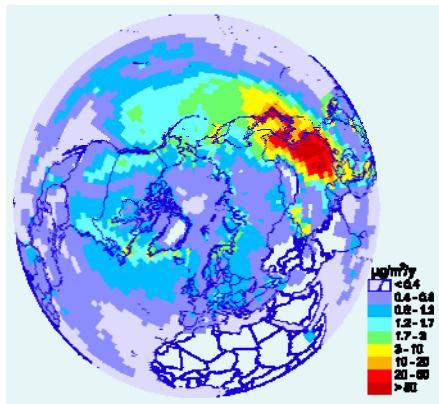
State/ Multi-Counties

Nation/ Multi-State

International

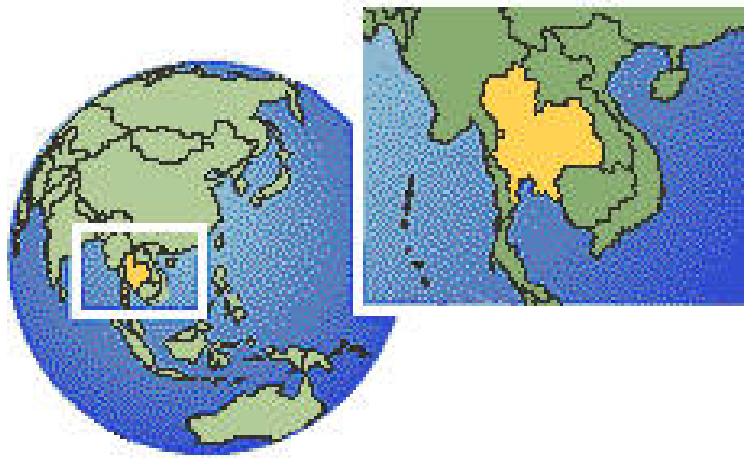
1920 1950 1970 1980 1990 2000



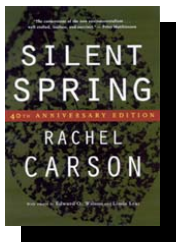


Scale of Air Pollution Problems

- Local Scale
  - Impacts from a single source or group of sources
  - May examine health impacts on specific receptors
- Regional Scale
  - 500 to several thousand km^2
- County to Continental Scale
  - Scale
  - Tens of thousands of km^2
  - May address international transboundary pollution
- Global Scale
  - Transport of pollutants across globe



US Air Pollution Program History*



PHS Air Pollution Control Act

1st CAA

65 CAAA

67 CAAA

70 CAAA EPA

77 CAAA

90 CAAA

1955 1963 1965 1967 1970 1977 1989 1990 FUTURE

Research Tech. Assistance for Air Pollution Control

Prevention & Abatement of Air Pollution

Mobile Sources

SIPS

Air Quality for CAPS & HAPS

PSD Mobile Sources

6 NESHAPS
(1977 thru 1989)

Benzene NESHAP
10-6 as Ample
Margin of Safety

HAPS:
202–Mobile Air Toxics
129–Combustion – Sources
112b–List 189 HAPS
112d–MACT
112f– Residual Risk
112c6–7 PBTS
112c3/112k–Urban Area Source
112m–Great Waters
112n–Special Studies, Hg

*For a summary of history of Air Quality Standards in US , see Handouts 1 and 2.

1990 Clean Air Act CAP Requirements

- CERR – Consolidated Emissions Reporting Rule, Mandatory reporting of CAP Emissions Inventories by state and local agencies and tribes

- AERR – Air Emission Reporting Rule, replaces CERR, proposed

- Handouts 3 and 4

1990 Clean Air Act Toxics Requirements

http://www.epa.gov/ttn/atw/eparules.html

- Section 112(d) MACT source category
  - Handouts 5 and 9
- Section 112(b)HAP listing/delisting
- Section 112(k), Urban Area Source Program
  - Handouts 6, 7, and 9
- Section 112(c)(6)
- Section 112(f), Residual Risk Program
  - Handouts 8 and 9
- Section 112(m), Great Waters Program
- Section 112(n), Special Studies, e.g., Hg

What Is an Air Pollutant Emission Inventory?

Inventory - current comprehensive listing by sources of air pollutant emissions in a geographic area during a specific time period

Why Do We Need Air Emission Inventories?

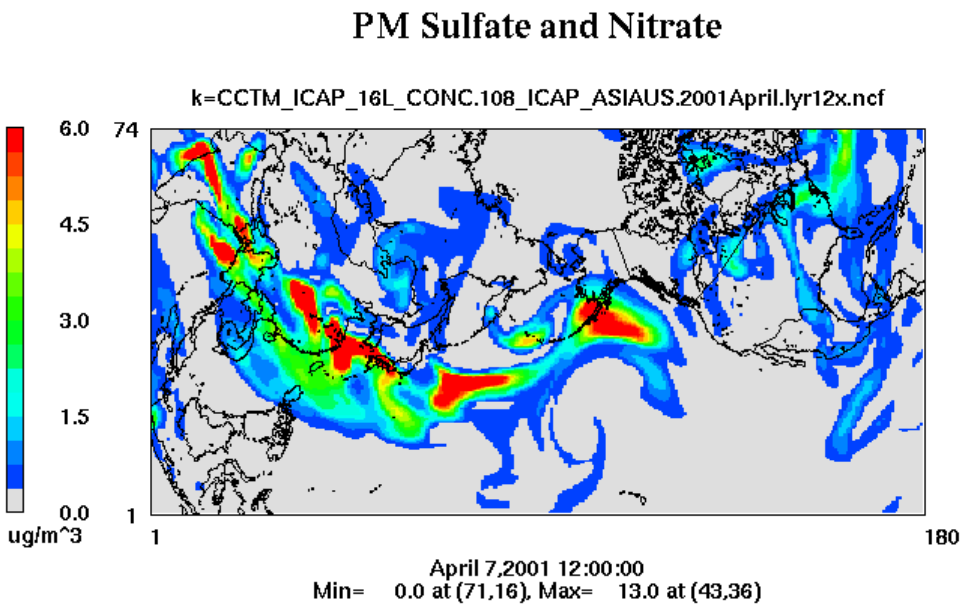
- Public interest in clean air
- Fundamental Component of Air Quality Management Plan
  - To identify sources and problem areas
  - To establish a baseline for future planning
  - To develop air quality control plans and mitigation strategies
  - To establish regulations and permit conditions for industrial facilities and basis for emissions trading programs

Why Do We Need Air Emission Inventories?

- Fundamental Component of Air Quality Management Plan
  - To measure progress/changes over time to achieve cleaner air (track trends or progress toward air quality goals)
  - To determine compliance with environmental regulations

Why Do We Need Air Emission Inventories?

- **To use in Modeling**
  - Air quality modeling predict ambient concentration

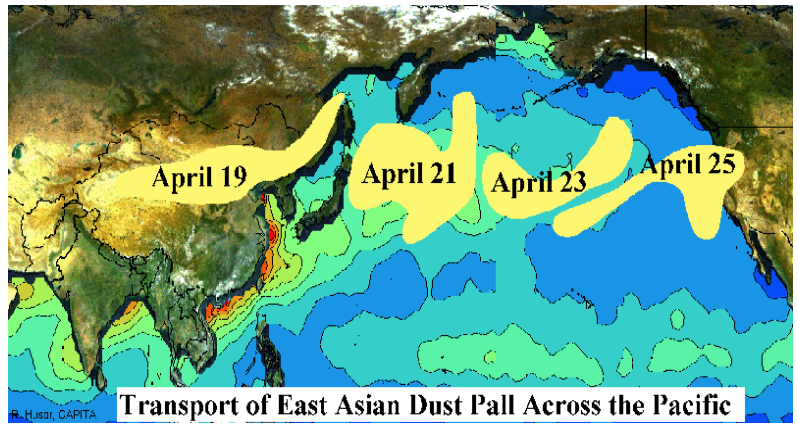


  - Exposure modeling and risk assessments predict human health and ecological risks

- **To help site ambient monitors**

Why Do We Need Air Emission Inventories?

- Global Assessments
  - To understand the impact of air pollution from your country on other nations



Transport of East Asian Dust Pall Across the Pacific

  - To determine compliance with international treaties, for example, United Nations Framework Convention on Climate Change (UNFCCC)

What Do You Use Air Emission Inventories for in Your Agency?

- Describe your country's air quality management program
  - Goals
  - Problems: Pollutants and sources
  - Reduction strategies (regulations, voluntary reductions, trading, etc.)
  - Implementation and Enforcement activities
  - Evaluation of results
- Describe how emission inventories are used in your air quality management program.
- Describe potential uses for emission inventories in your air quality management program.

Questions or Comments?