ENV 207
Environmental Degradation and Pollution

Lecture 1

Chapter 1: Air Pollution

Lecture Outline

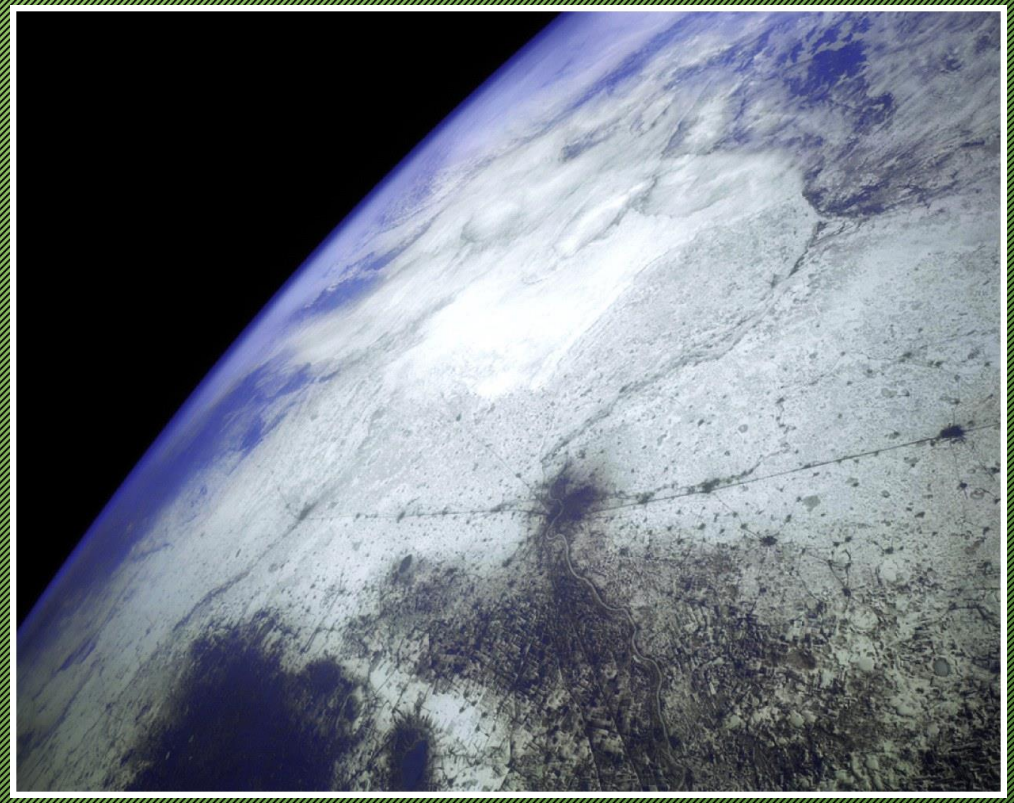
- Atmosphere as a Resource
- Types and Sources of Air Pollution
  - Major Classes of Air Pollutants
  - Sources of Outdoor Air Pollutants
  - Urban Air Pollution
- Effects of Air Pollution

Recommended Book:
Understanding Environmental Pollution, By Marquita K Hill. Cambridge University Press. 2010.

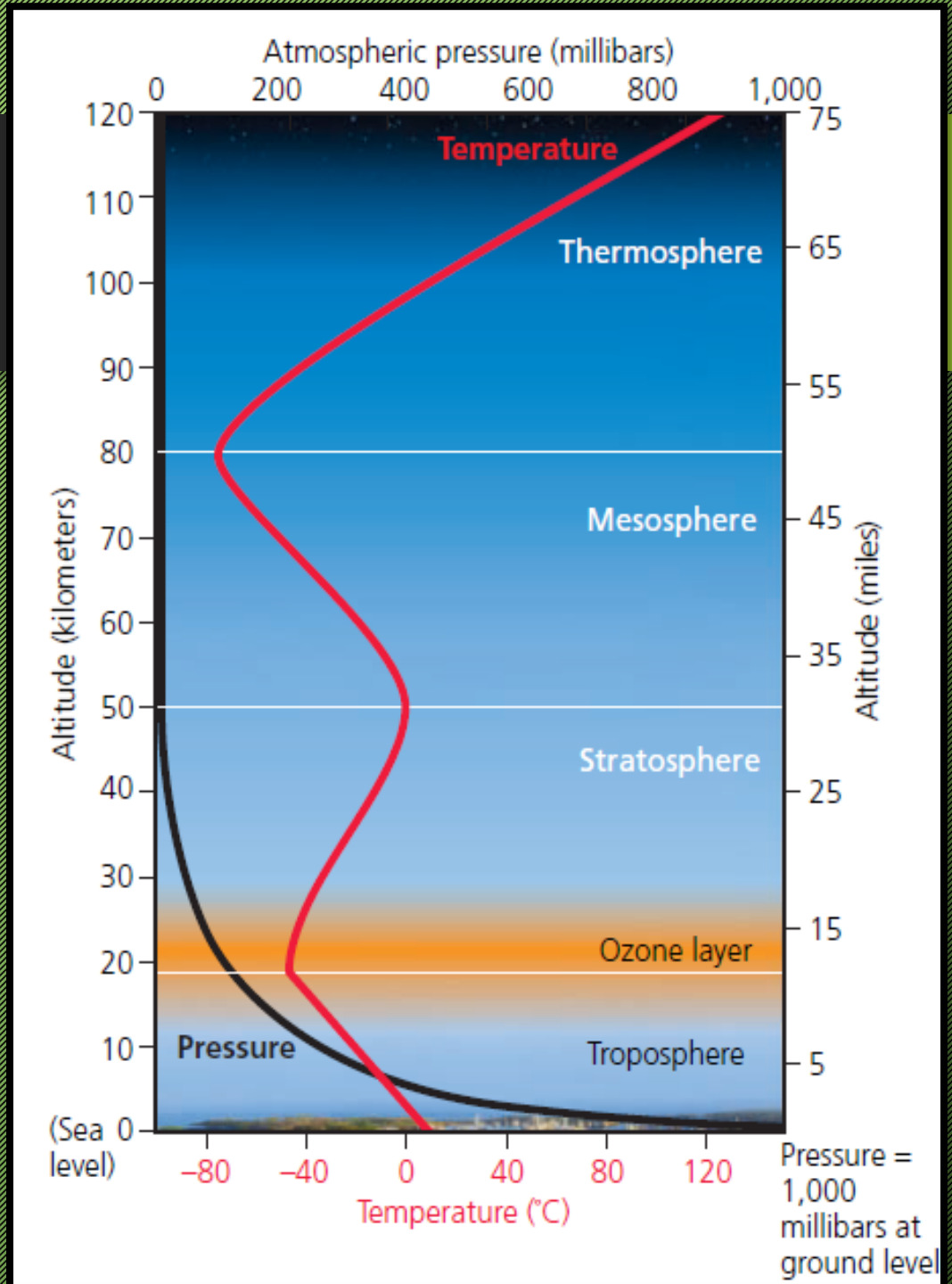
Atmosphere as a Resource

- **Atmospheric Composition**
  - Nitrogen 78.08%
  - Oxygen 20.95%
  - Argon 0.93%
  - Carbon dioxide 0.04%

- **Ecosystem services**
  - Blocks UV radiation
  - Moderates the climate
  - Redistributes water in the hydrologic cycle



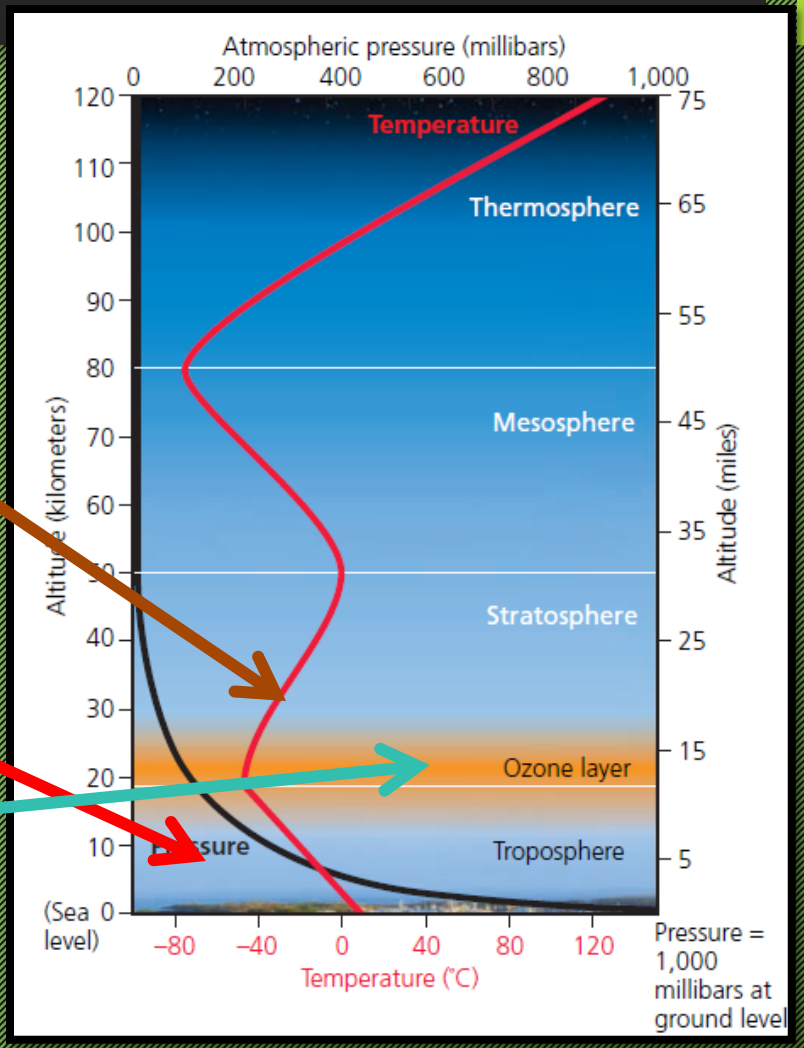
Layers in the Atmosphere



Atmosphere consists of several layers …

- Layers are spherical
- The two inner most layers:
  - Troposphere (density of gas)
  - Stratosphere

O_3 layer



Air Movements in the Troposphere Play a Key Role in the Earth's Weather and Climate

- About **75-80%** of the earth's air mass is found in the **troposphere**
- Extends only about:
  - 17 kilometers above sea level at the equator and
  - 6 kilometers above sea level over the poles.
- **Important variables:** Rising and falling air currents, and concentrations of CO_2 and other greenhouse gases.

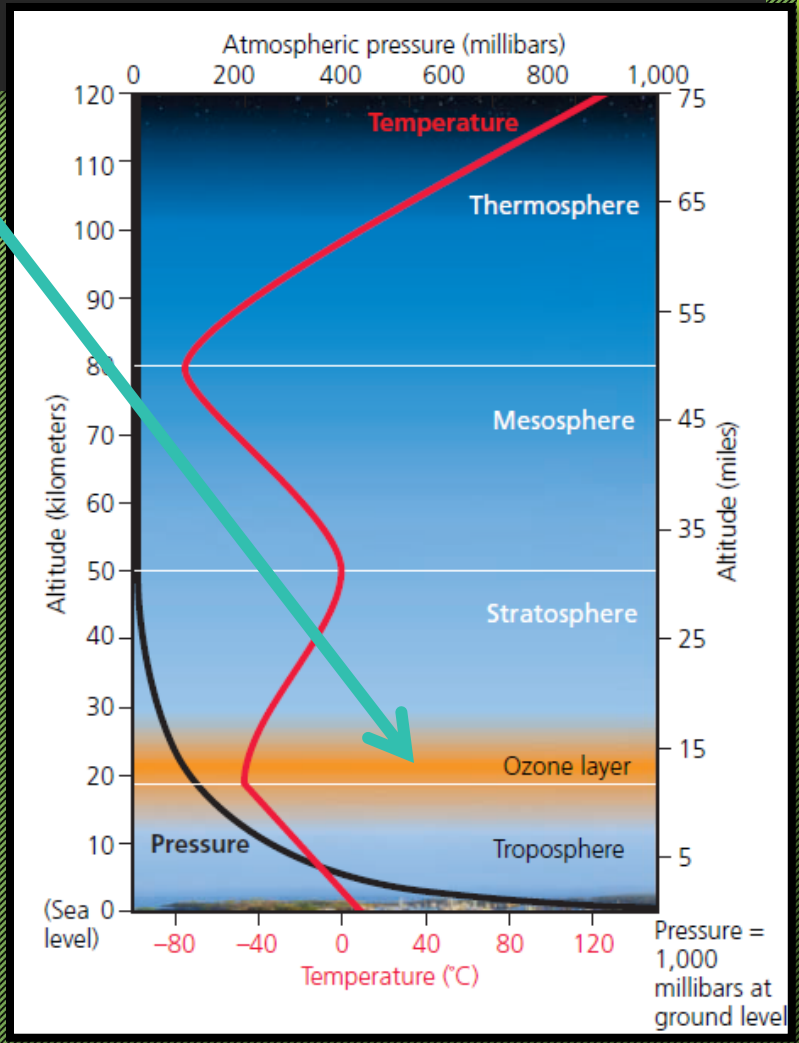
The Stratosphere Is Our Global Sunscreen

- Extends from about 17 to about 48 kilometers above the earth's surface

- Exceptions from Troposphere:
  - Its volume of water vapor is about 1/1,000 that of the troposphere
  - Its concentration of ozone (O3) is much higher.

The Stratosphere Is Our Global Sunscreen

- **Ozone Layer:**
  - Much of the atmosphere's small amount of ozone is concentrated
  - Roughly 17-26 kilometers above sea level
  - This "**global sunscreen**" of ozone in the stratosphere keeps about 95% of the sun's harmful UV radiation reaching the Earth surface



POLLUTION

- What is a pollutant?
- Example:
  - Toxic oil enclosed within a tanker (?)

Just as a weed is "a plant out of place," a pollutant is "a chemical out of place."

- Waste **Versus** Pollutant

Why does pollution happen?

- Because no process is 100% efficient
- Lack of prevention
- Unwillingness to invest in technology

"Pollution is a symbol of design failure."

Definition

- **Air Pollution:** Chemicals added to the atmosphere by natural events or human activities in high enough concentrations to be harmful

- **Ambient Air Pollution:** Air pollution in the troposphere, the lowest layer of our atmosphere.

Pollution Facts

World Health Organization | Health Topics | Countries | Newsroom | Emergencies | Data | About WHO

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Total environment

24%

of all estimated global deaths are linked to the environment

Household air pollution

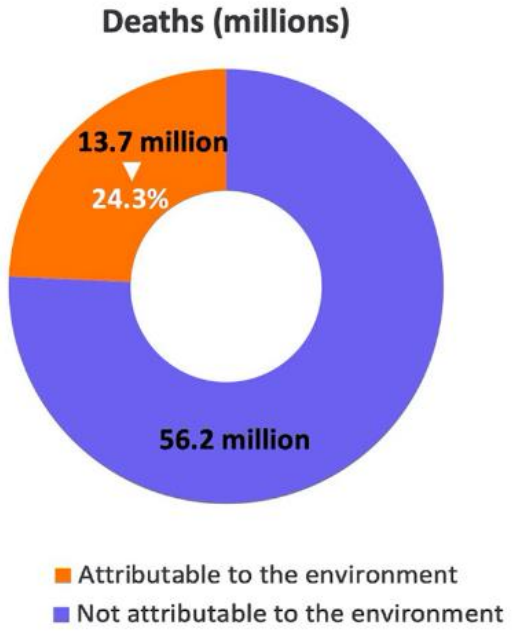
3.2 million

deaths every year as a result of exposure to indoor smoke from cooking fuels

Ambient air pollution

4.2 million

deaths every year as a result of exposure to fine particulate matter



Types of Air Pollution

Sources of Air Pollution

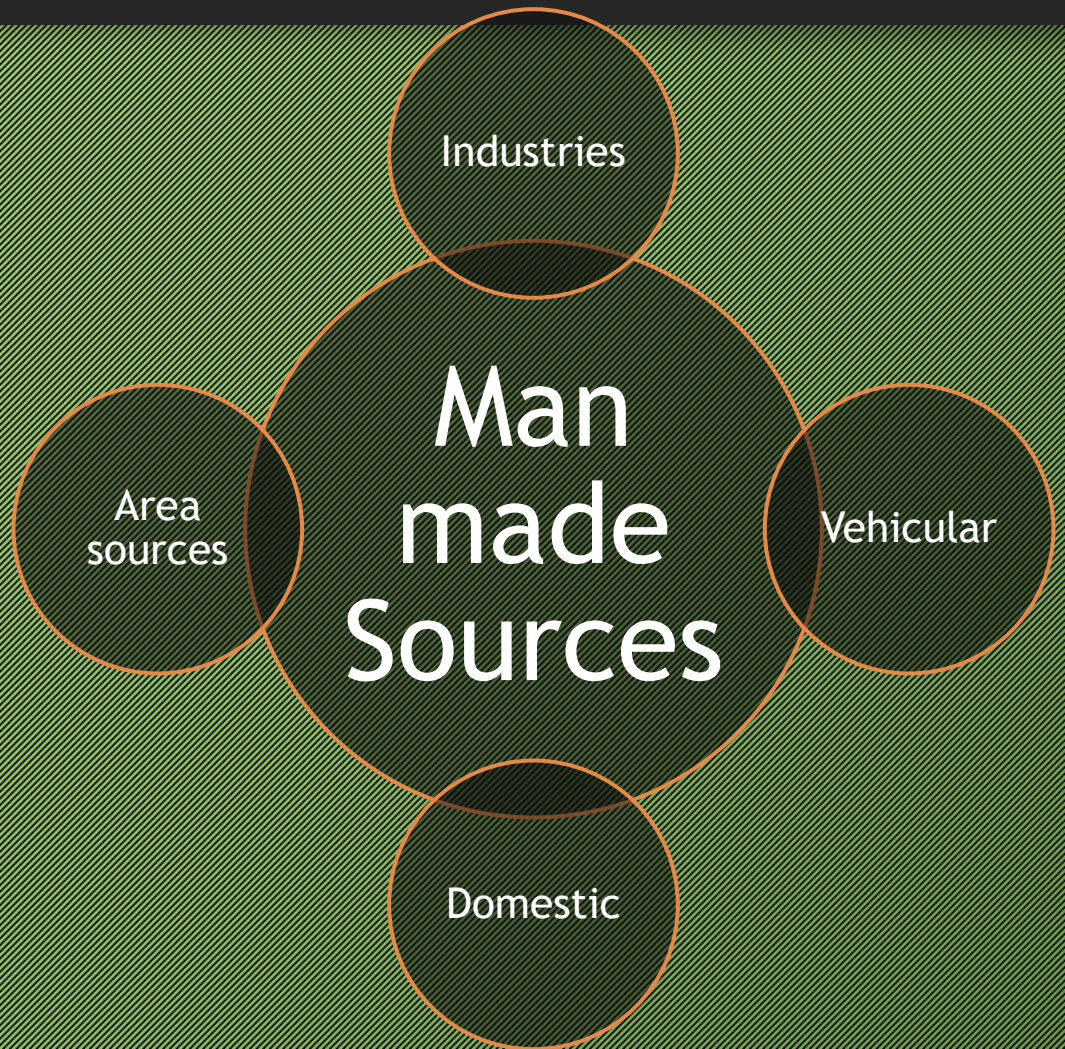
Natural Sources

Volcanoes, Forest fire, Biogenic sources

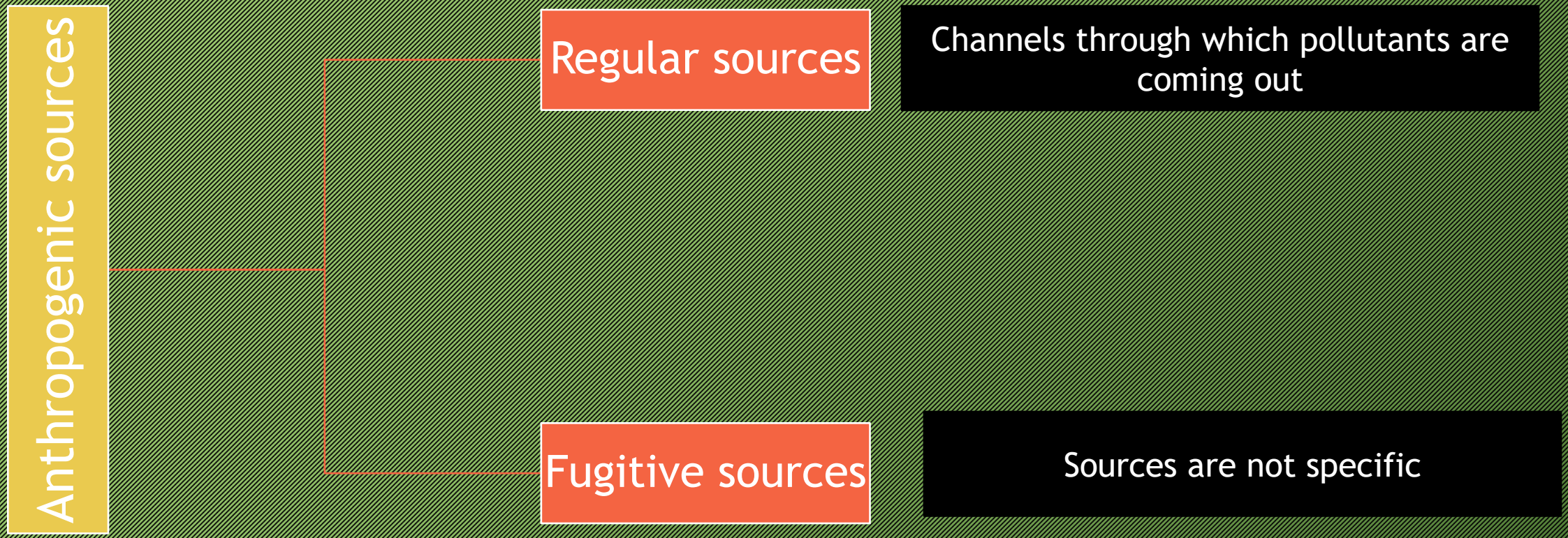
Anthropogenic sources

Our Focus

Anthropogenic Sources of Air Pollutants



Anthropogenic Sources of Air Pollutants



We mostly explore regular sources of pollution. Fugitive sources are of great significance

- Recap:
  - Why are we putting small emphasis on natural sources of air pollutants?
  - How is fugitive sources different from regular sources?

Natural Versus Manmade:
- Amount of production
- Extent of damage (global vs local)
- Frequency of emission
- Mechanism to control

Regular sources are known and visible
Fugitive sources are known but not visible
Extent of damage from fugitive sources are sometimes greater

What are the FUGITIVE sources?

- “PAVED” & “UNPAVED” road
- Building construction/demolition activities
- Agricultural activities
- Refuse (garbage) burning
- Leakage

Do you find these fugitive sources around your residence?

Significance of FUGITIVE sources

- Impact is **HIGH**
- **Low AWARENESS**
- **QUANTIFICATION is difficult**
- **POOR regulation**
- **ACCUMULATIVE**

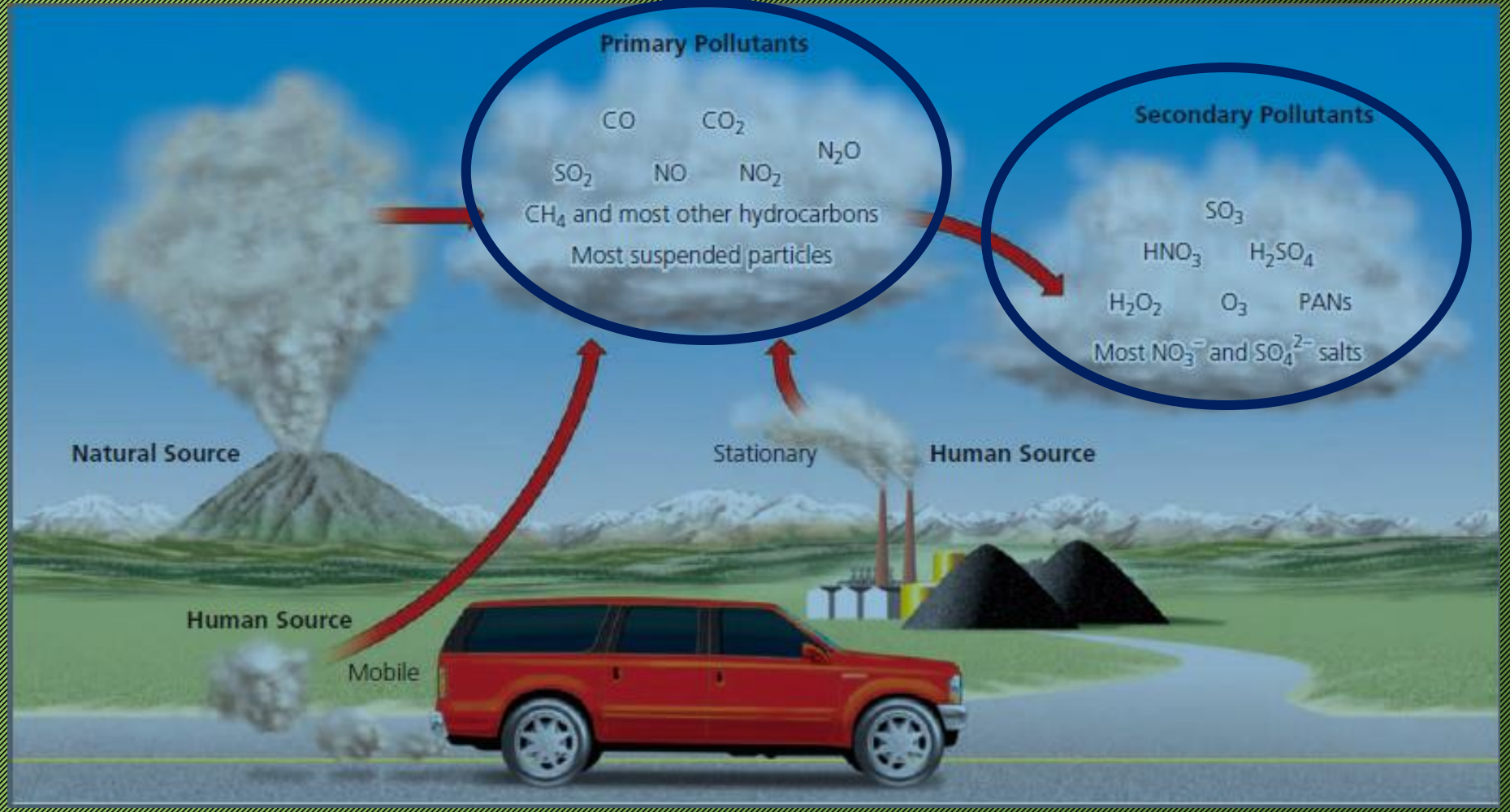
How to control FUGITIVE sources?

- Good housekeeping
- Maintain moisture level in material handling
- Regular checking
- Enclose sites of construction to prevent the spread of dust
- Wind break and shelter belt to filter and break up wind to protection from wind and blowing soil, sand, dust, etc.

Types of Air Pollutants

- Primary Air Pollutant
  - Harmful substance that is emitted directly into the atmosphere
- Secondary Air Pollutant
  - Harmful substance formed in the atmosphere when a primary air pollutant reacts with substances normally found in the atmosphere or with other air pollutants

Types of Air Pollutants



Criteria Air Pollutants (CAP)

- **Criteria air pollutants:** The term originated with the US 1970 Clean Air Act.
- That law required EPA to set standards (National Ambient Air Quality Standards) to protect human health and welfare from pollutants in ambient air.
- **Six CAPs:** Carbon monoxide (CO), Sulfur dioxide (SO_2), Nitrogen dioxide (NO_2), Ozone (O_3), Particulates or particulate matter (PM10), Lead (Pb)

Why are they called Criteria Air Pollutants?

- Reason 1: **Primary standards:** Set of limits designed to protect public health based on sound science.
- Reason 2: **Secondary standards:** Set of limits designed to prevent environmental and property damage.
- The US EPA now calls these pollutants, the six *principal pollutants* or six *common pollutants*.