Lecture 3: Atmospheric Pollution: From Smog to Climate Forcers

A Course in Fundamental of Pollution

Lecture 3: Atmospheric Pollution: From Smog to Climate Forcers

Core Concept: Distinguishing between local/regional air quality issues and global climate change, while understanding their chemical links.

(Introduction)
"The atmosphere is a dynamic chemical reactor, and human activities have become its primary feedstock. We emit a complex mixture of gases and particles that have c onsequences on scales from the local to the planetary.
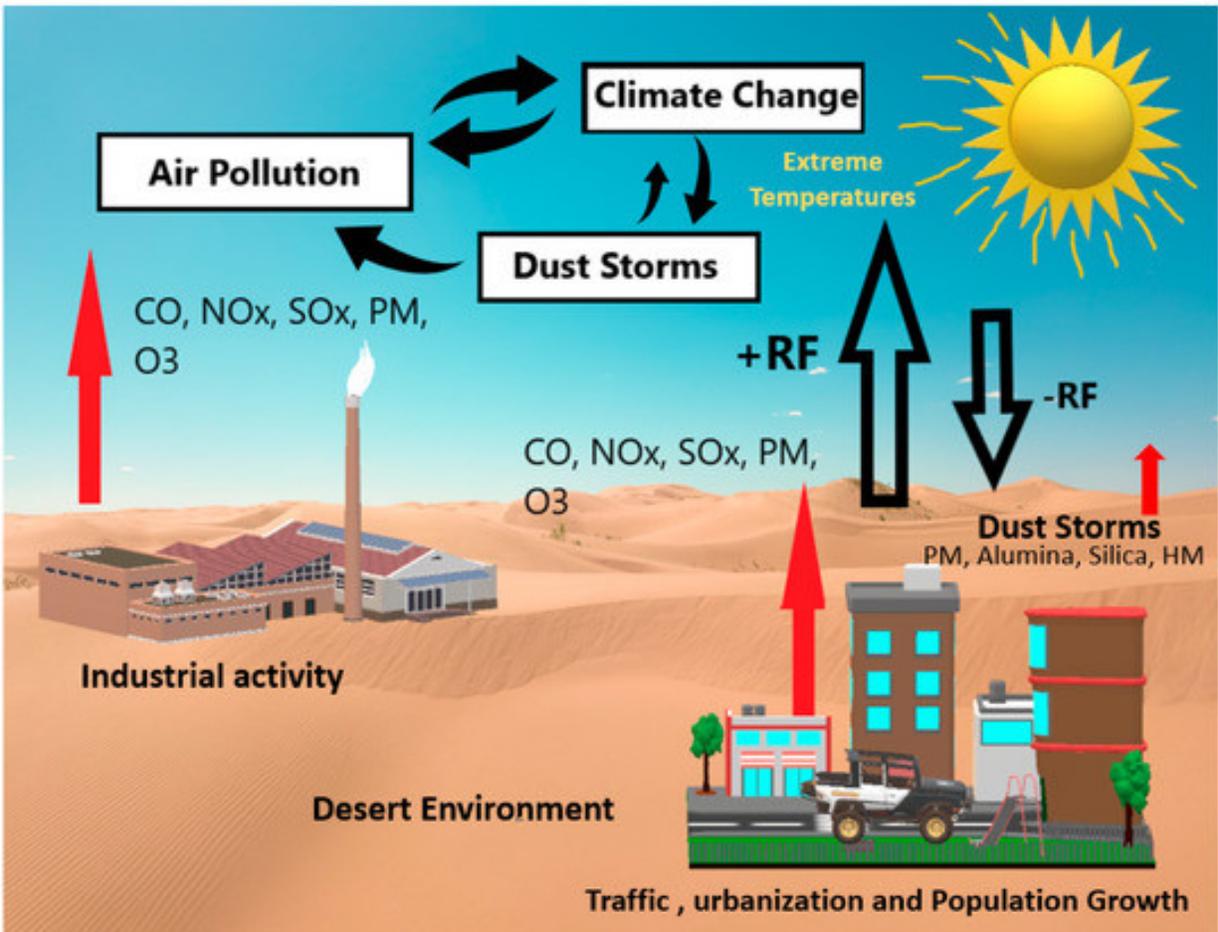
We traditionally focus on **'criteria air pollutants'** regulated to protect human health and the environment:

- **Particulate Matter (PM2.5/PM10):** Microscopic solid or liquid particles that can penetrate deep into lungs and the bloodstream, causing cardiopulmonary disease.
- **Ground-Level Ozone (O3):** A secondary pollutant formed by reactions between NOx and VOCs in sunlight. It is a key component of photochemical smog and a potent respiratory irritant.
- **Nitrogen Oxides (NOx) & Sulfur Dioxide (SO2):** Emitted from fuel combustion, they contribute to smog, acid rain, and particulate formation.
- **Carbon Monoxide (CO):** A product of incomplete combustion that binds to hemoglobin, reducing oxygen delivery in the blood.
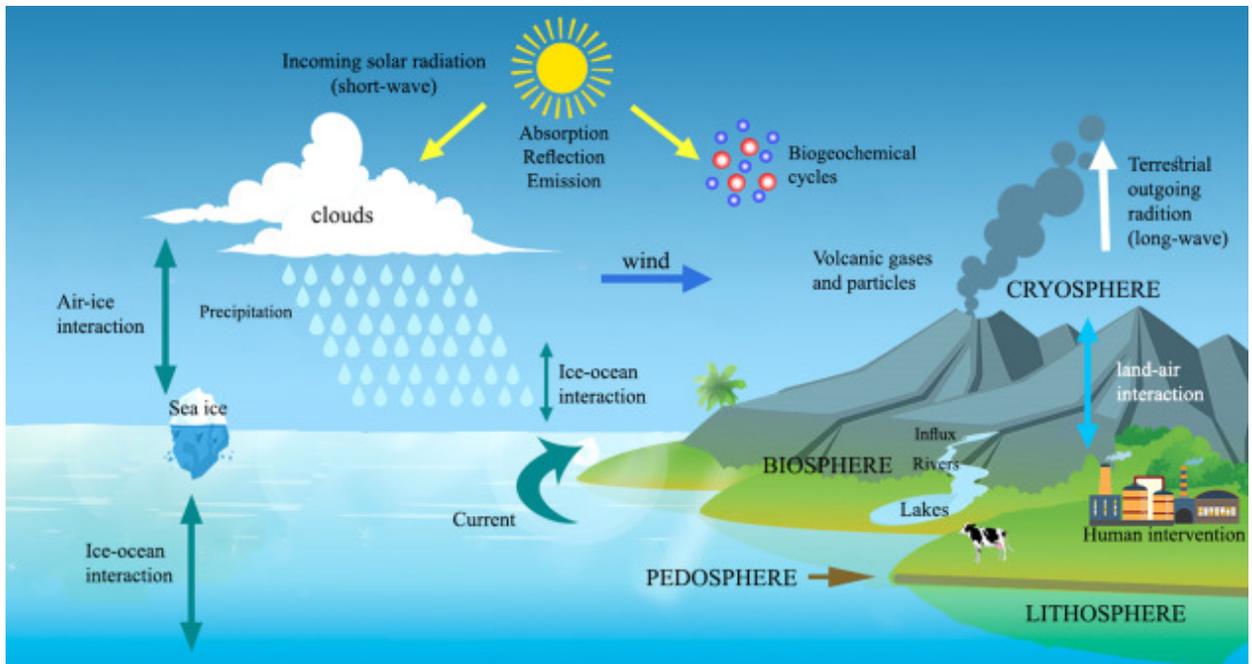
However, we must also look at **Greenhouse Gases (GHGs)** like Carbon Dioxide (CO2), Methane (CH4), and Nitrous Oxide (N2O). While not always toxic at ambient levels, they alter the planet's energy balance by trapping heat in the atmosphere, leading to global climate change. This is the critical link: the combustion of fossil fuels for energy and transportation is the primary source of both traditional air pollutants (a local health crisis) and CO2 (a global climate crisis). Mitigating one, therefore, often mitigates the other, creating a powerful co-benefit for policy action."