

Introduction to Air Pollution

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Outline

- Introductions
- Air Pollution Episodes
- Local Air Quality
- Normal Air
- Types of Air Pollution
- Sources of Air Pollution
- Visibility
- Global Air Quality

London Killer Smog of 1952: More than 12,000 People Died



<http://www.nickelinthemachine.com/wordpress/wp-content/uploads/smog-9.jpg>

Donora, Pennsylvania: 20 died in 1948 by a Killer Smog

Donora's Zinc Works



Donora During the Disaster



The Donora Smog Disaster and the Clean Air Act of 1970
Posted by Nate Brevard, May 24, 2012, accessed January 2013

Los Angeles, Overview and within City

Los Angeles Smog, 2006



Air Pollution in the News: Jan 12th, 2013

- Air Quality Index in Beijing hits 755
 - On a 0 – 500 Scale! Unprecedented Value!
- Particle concentrations > 20 times safe values
- **“Post-Apocalyptic” “Terrifying” “Beyond Belief”**



Image Source: Wang Zhao/AFP/Getty Images

Source: *New York Times* – “On Scale of 0 to 500, Beijing’s Air Quality Tops ‘Crazy Bad’ at 755”

Air Pollution in the News: Jan 6th, 2013

- Tehran, Iran *closes* due to air pollution
- Banks, schools, government offices close for 5 days
- “With air pollution at such high levels, venturing outside could be tantamount to ‘suicide’...”
- “We should wait helpless for winds to pick up and clean the air before we can safely leave our houses. It shows we have lost all power to control our lives.”

Air Pollution at Urbana High School?

- 2009: USA Today uses EPA Model to identify pollution at schools in the US
 - The Smokestack Effect: Toxic Air and America's Schools



What is Air Pollution?

- The United States EPA Clean Air Act , in section 302, defines “air pollution” as material that is emitted or otherwise enters the ambient air and causes negative health effects; or damages plants, property or animals; or causes an unreasonable interference with the enjoyment of life or property.

“Normal” Composition of the Atmosphere

GAS	% BY VOLUME
Nitrogen (N₂)	78
Oxygen (O₂)	21
Argon (Ar)	0.93
Carbon Dioxide (CO₂)	0.038
Neon (Ne)	0.0018
Ozone (O₃)	0.00050
Helium (He)	0.00052
Methane (CH₄)	0.00017
Krypton (Kr)	0.00011

Water vapor (humidity) exists at 1-3% by volume

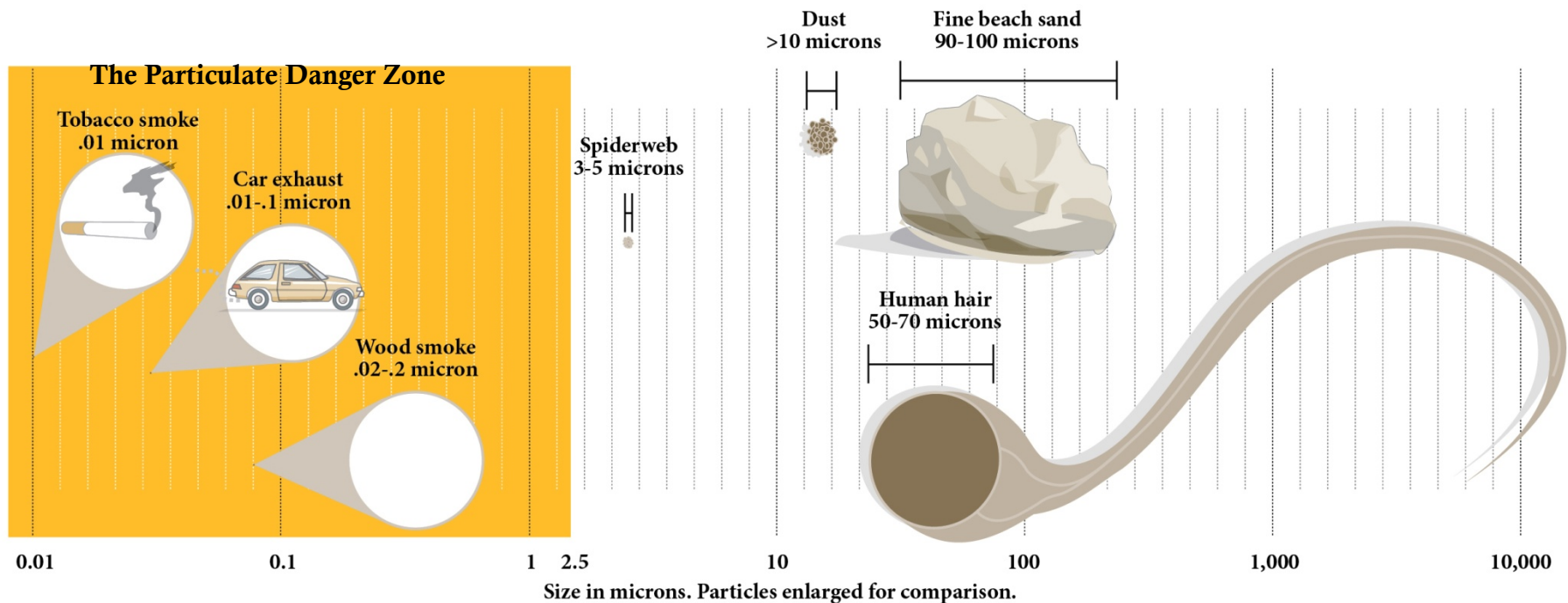
Particles exist from 0.001 to 100 mg/m³ in the atmosphere

Types of Air Pollution

- Primary Pollutant: Emitted Directly from Source
- Secondary Pollutant: Formed in the Atmosphere
- Gases
- Particulate Matter
 - Liquid droplets and/or solid particles

Particulate Matter (PM)

Both **concentration** and **size** are important for particles



**The greatest lung damage results from particulate matter smaller than 2.5 microns (μm).
Smaller particles can penetrate deeper into the lungs.**

Sources of Air Pollution

- Natural Sources
 - Biogenic
 - Non-Biogenic
- Human-Made Sources
 - Anthropogenic
- **DISCUSSION: Brainstorming Sources of Air Pollution**

Industrial Air Pollution



Transportation Air Pollution



Photo From BusinessWeek, Accessed at <http://thecityfix.com/blog/choking-on-smog/>

Agriculture Air Pollution



Colorado's Hayman Wildfire



<http://forestry.about.com/od/fireinforests/ig/wildfire-/Hayman-jpg.htm>

Indoor Smoke Polluting the Air in Nepal



Sources of Air Pollutants

Natural Sources:

Wind Picking up Dust	<ul style="list-style-type: none">• Suspended Particles
Volcanoes	<ul style="list-style-type: none">• Dust (Ash)• Sulfur Dioxide (SO₂)• Carbon Dioxide (CO₂)
Forest Fires	<ul style="list-style-type: none">• Smoke• Ash• Unburned Hydrocarbons• Carbon Dioxide (CO₂)
Vegetation	<ul style="list-style-type: none">• Volatile Organic Compounds• Pollen
Ocean Waves	<ul style="list-style-type: none">• Salt Particles

Sources of Air Pollutants

Human-Made Sources:

Industrial Based Sources: <ul style="list-style-type: none">• Paper Mills• Power Plants• Refineries• Manufacturing	<ul style="list-style-type: none">• Particulate Matter (e.g., ash)• Carbon Dioxide (CO₂)• Sulfur and Nitrogen Oxides (SO_x, NO_x)• Trace Contaminants (e.g., mercury)
Human Based Sources: <ul style="list-style-type: none">• Transportation• Home Furnaces• Fireplaces / Candles• Open Burning of Waste	<ul style="list-style-type: none">• Carbon Monoxide (CO)• Nitrogen Oxides (NO_x),• Volatile Organic Compounds (VOCs)• Particulate Matter (PM)
<ul style="list-style-type: none">• Forest Fires	<ul style="list-style-type: none">• Smoke• Ash• Unburned Hydrocarbons• Carbon Dioxide (CO₂)

Visible Air Pollution (PM)



Good Visibility Day
Visual Range: 225 miles
Grand Canyon:
Clear Day



Bad Visibility Day
Visual Range: 61 miles
Grand Canyon:
Polluted Day

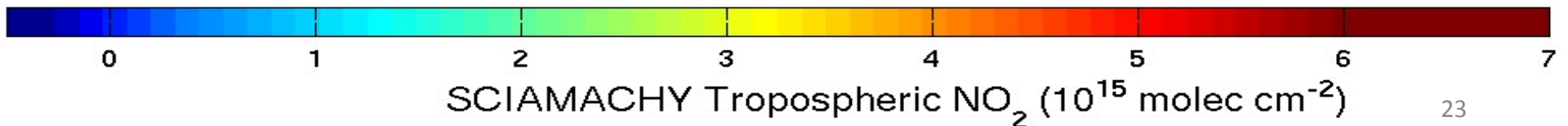
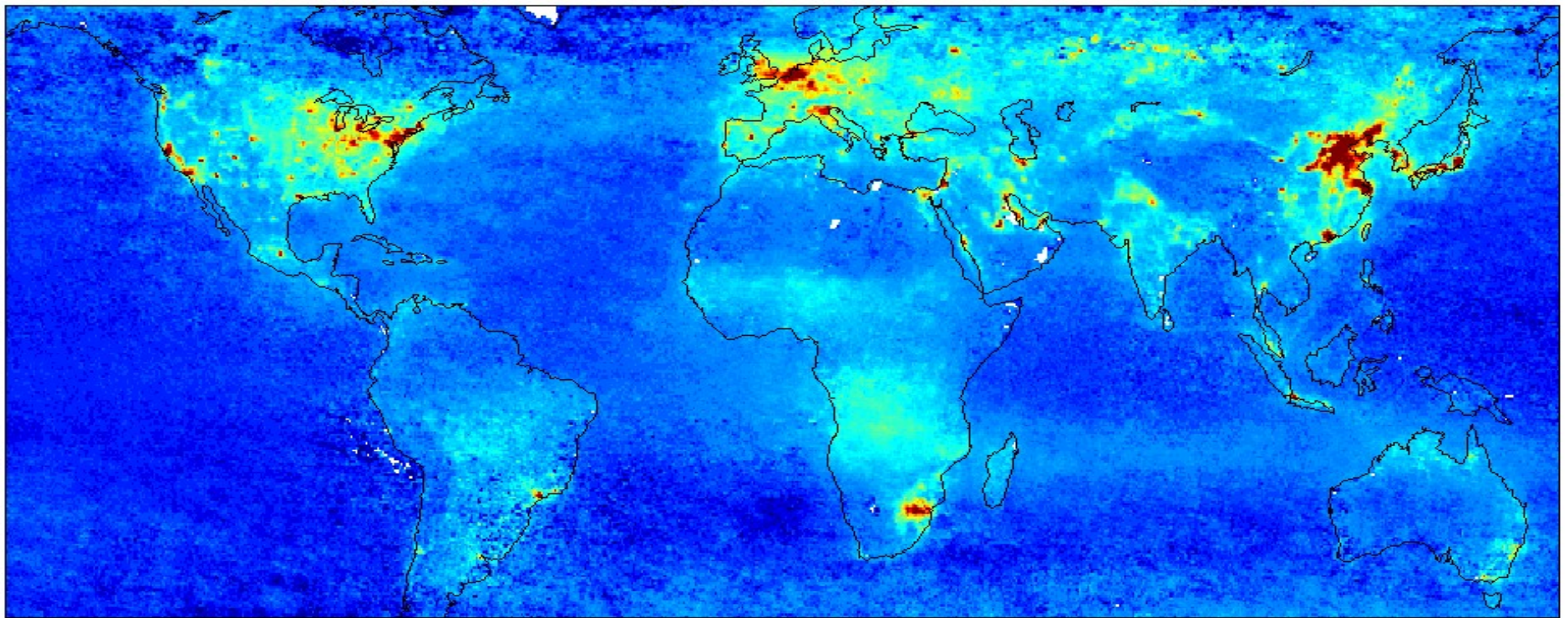
Visibility near Salt Lake City



Images: Time-Science.com | Data: Utah Dept. of AirQuality

“Visualizing” Global Air Pollution by Gases

NO₂ Columns Observed from the SCIAMACHY Satellite Instrument



Next Lectures... (Thursday and Friday)

- Important Air Pollutants
 - Six criteria pollutants in the ambient air
 - Hazardous pollutants emitted to the atmosphere
- Common Units Used for Describing Air Pollution Concentrations
- Ozone Hole, Global Warming, Acid Rain
- Important Air Pollution Regulations
- Cool Pictures