Classifications of Air Pollution

City of Albuquerque

Env. Health Dept

Air Quality Division

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Gases	Particulate Matter
•Carbon Monoxide (CO) •Nitrogen Dioxide (NO_2) •Sulfur dioxide (SO_2) •Ozone (O_3) •Nitrogen Oxide (NO) •VOCs/HAPs (Volatile Organic Compounds/ Hazardous Air Pollutants)	•$PM_{2.5}$ (2.5 microns or less) •PM_{10} (10 microns or less) •Lead •TSP (Total Suspended Particulate) •VOCs/HAPs/metals (Polycyclic Aromatic Hydrocarbons, cadmium, mercury, chromium, etc.)

Ambient standards (gaseous)

Pollutant	Time Average	EPA	NM
CO	1-hr	35.0 ppm	13.1 ppm
	8-hr	9.0 ppm	8.7 ppm
NO_2	24-hr	--	100 ppb
	Annual	53 ppb	53 ppb
SO_2	3-hr	500 ppb	--
	24-hr	140 ppb	100 ppb
	Annual	30 ppb	20 ppb

Carbon Monoxide

- Vehicles, woodburning, generators, and PNM Reeves Generating Station

- Hydroxyl radicals convert CO to CO_2.

Nitrogen oxides

- Combustion processes emit NO.
  e.g. smokestacks, engines, generators

- Free radicals & O_3 convert NO to NO_2.

- Nitric & sulfurous emissions → acid rain.

Sulfur dioxide

- Smokestacks
  1. Coal-fired power plants
  2. Refineries
  3. Smelters
- Largest source in Bernalillo County: GCC Rio Grande Portland Cement Plant
- Fate: dry deposition/gravitional settling; conversion to sulfates

Ozone

- Direct O_3 emissions are rare.
- Formation: photochemical reactions among precursor pollutants.
- High ozone levels occur during afternoons June, July, and August.

More on ozone

- Light winds, plentiful sunshine favor O_3
- On such days, O_3 levels limited by levels of precursor pollutants.

Ozone formation/destruction

- NO/NO_2 & Volatile Organic Compounds
- Hundreds of VOCs
- After sunset, NO destroys ozone

VOC Reactivity

- Some highly-reactive VOCs:
  - ethylene
  - propylene
  - 1,3-butadiene
  - Benzene
  - Toluene

- Perc: low reactivity, removed from list.

More on precursors

- Sources of Volatile Organic Compounds
  1. Gasoline, diesel, ethanol, etc.
  2. Paints, solvents, dry cleaning, etc.
  3. Cigarettes, forest fires, etc.

- VOCs are not criteria pollutants

Stratosphere and ground-level

- Stratospheric O_3 – protective shield.
- Ground-level ozone - harmful pollutant.
- Stratospheric ozone can descend to ground-level behind springtime cold fronts.

Particulates

- Interchangeable terms:
  - Aerosol,
  - Particle,
  - Particulate (matter).
- Smoke and dust are the most common aerosols in Bernalillo County.

Primary PM

- Emitted directly to the atmosphere

1. Geologic material
2. Organic carbon
3. Elemental carbon (a.k.a., soot)
4. Metals released into air from combustion

Elemental/black carbon (soot)

Organic carbon

Secondary PM

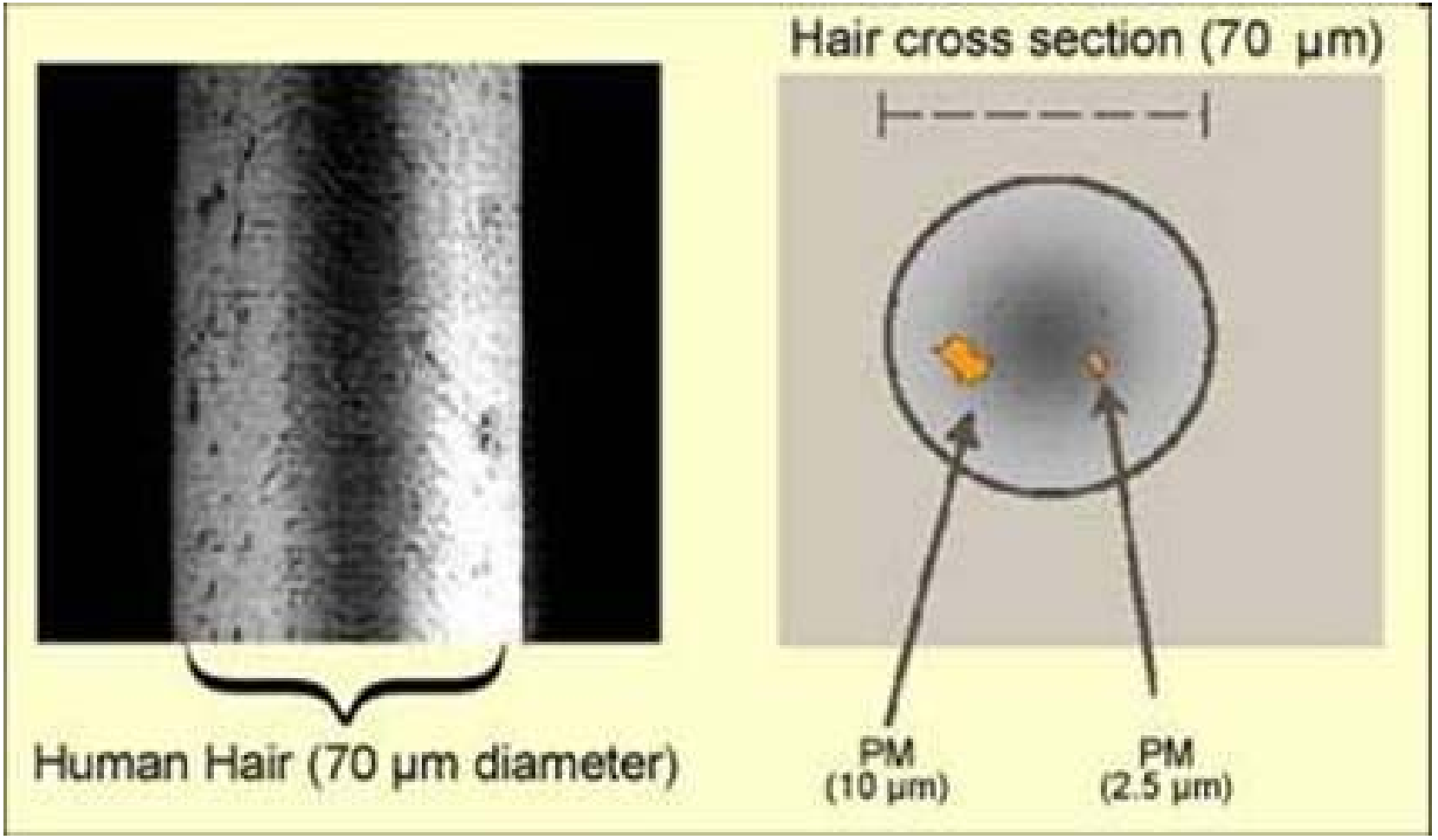
- Classes of particles formed through chemical reactions:

1. Sulfates
2. Nitrates
3. Ammonium compunds
4. Organic carbon compounds

Classification according to size

- Total Suspended Particulate (TSP)
- PM_{10} – 10 microns or less
- $PM_{2.5}$ - 2.5 microns or less

Visualize PM_{10} & $PM_{2.5}$



More terms

- Fine = PM2.5
- “Coarse” means between 2.5 and 10 microns
- Supercoarse is greater than 10 microns

Distinction

- PM10 = Coarse + Fine
- TSP = Supercoarse + Coarse + Fine

- A great deal of confusion over PM10, TSP, coarse, and supercoarse.

Origin of particulates

- Fine particulates are produced chiefly by:
  1. Combustion processes,
  2. Chemical reactions of various gaseous pollutants (Secondary PM).
- Coarse particles are generally emitted directly as a result of:
  1. Mechanical processes that crush or grind larger particles,
  2. Resuspension of dusts.

Sources

- Fine particles: engines, residential wood burning, forest fires, tobacco smoke, big smokestacks, feedlots (precursors), etc.

- Coarse and supercoarse: dust from disturbed surfaces; construction, demolition, mining, crushing and screening operations; tire and brake lining materials; etc.

Particulate standards

Pollutant	Time Average	U.S. EPA	New Mexico
TSP	Annual	--	60 µg/m^3
	24-hour	--	150 µg/m^3
PM10	Annual	--	--
	24-hour	150 µg/m^3	--
PM2.5	Annual	15 µg/m^3	--
	24-hour	35 µg/m^3	--

Air Quality Index – Fine Particles

24-hr average concentrations	Category
0 – 15.4 µg/m^3 (micrograms per cubic meter)	Good 0 – 50
15.5 – 40.4 µg/m^3	Moderate 51 – 100
40.5 – 65.4 µg/m^3	Unhealthy for Sensitive Groups (101 – 150)

Air Quality Index - Ozone

8-hour average concentrations	Category
0 – 60 ppb (parts per billion)	Good 0 – 50
61 – 75 ppb	Moderate 51 – 100
76 – 95 ppb	Unhealthy for Sensitive Groups (101 – 150)

Removal of particulates

- Gravity removes coarse and supercoarse particles. Stoke's law: rate of settling is proportional to the density of the particle and the square of it's radius.
- "Fine particulates can remain suspended for weeks and can be transported thousands of kilometers." (Federal Register)
- Developing showers and thunderstorms consume fine particles, i.e. raindrops condense around fine particles.

Particulate HAPs/VOCs

- Most of the particulate HAPs (Hazardous Air Pollutants) are metallic:

  (e.g. cadmium, mercury, arsenic, lead, chromium).

- PAHs (Polycyclic Aromatic Hydrocarbons) are particulate VOCs.

More on VOCs & HAPs

- Most Volatile Organic Compounds are gases.
- Overlap with Hazardous Air Pollutants.
- Bigger problem indoors?

Indoor VOCs & HAPs

- Methylene Chloride
- Benzene
- Perc (HAP only)
- Formaldehyde

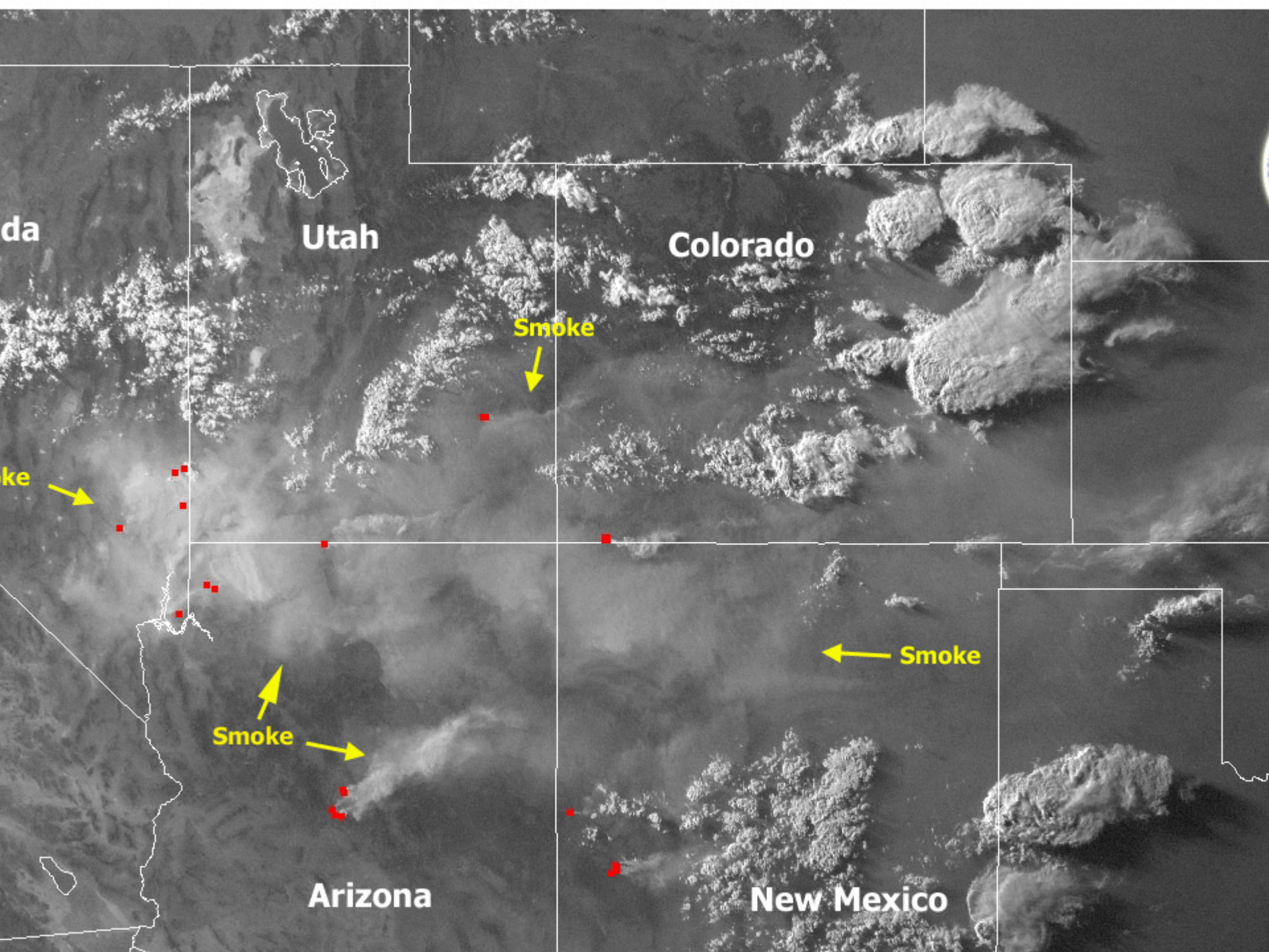
Fugitives

- Fugitive gases: evaporation from a pool of liquid

- Fugitive dust is released into the atmosphere when wind or traffic disturbs soil, piles, etc.

Seasons & Pollution events

- Mid November - January: Inversions and residential woodburning
- Spring winds & Dust storms: mostly supercoarse particles
- Wildfire smoke: spring, summer, fall
- Industrial pollution from Texas: high ozone in August ‘07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