Air Dispersion Modeling

Melissa Sheffer, Meteorologist

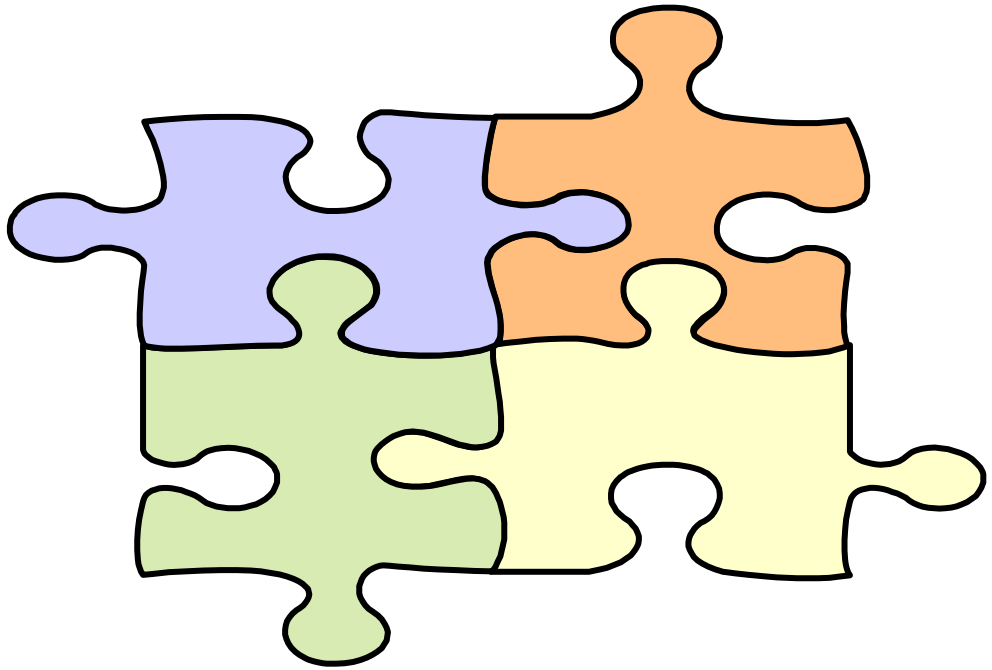
U.S. EPA - Region 5

Sheffer.Melissa@epa.gov

Talk Outline

- What is air dispersion modeling?
- Why and how do we use it?
- Strengths/Weaknesses

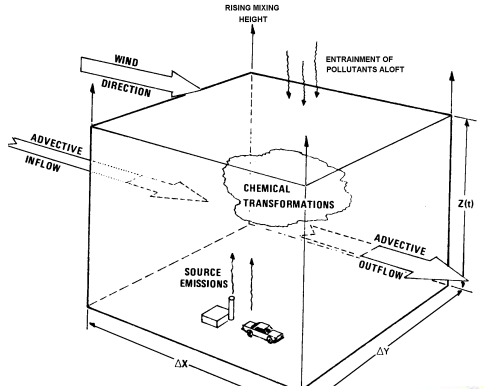
Air dispersion modeling is the piece of the puzzle that allows us to link emissions to air quality for specific sources.

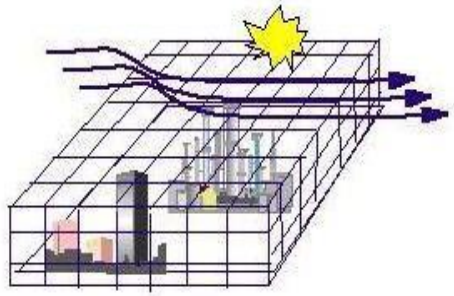


Air Quality Modeling

Photochemical models:

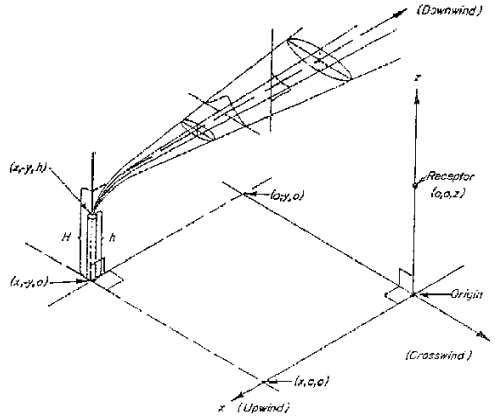
- 3-D Eulerian grid-based
- Ozone and PM2.5 Regional Scale
- Thousands of sources





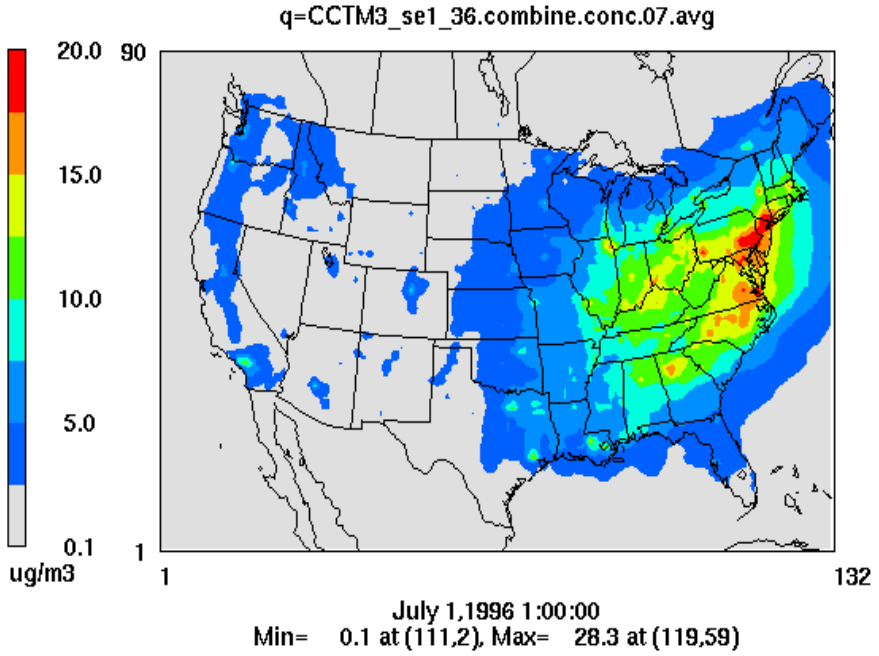
Dispersion models:

- Gaussian plume model
- Non-reactive pollutants
- Local scale
- Small number of sources

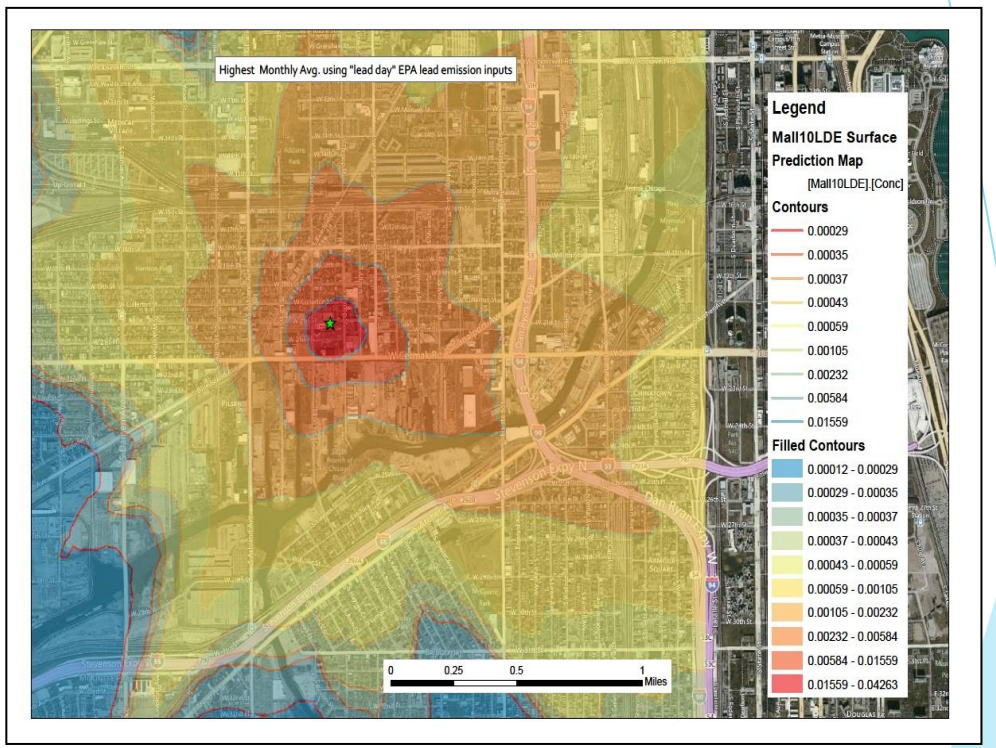


Photochemical Models

Annual Avg PM 2.5

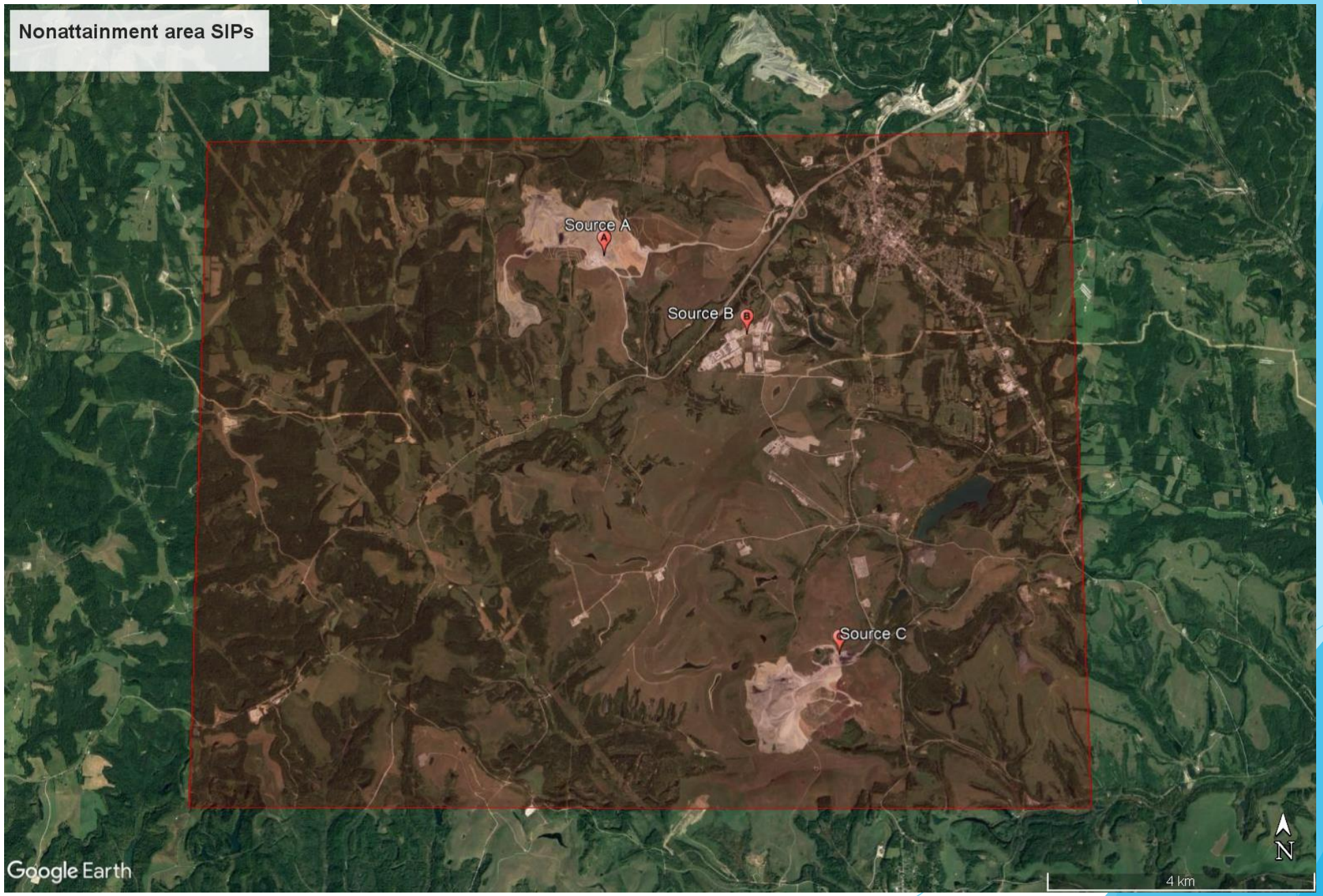


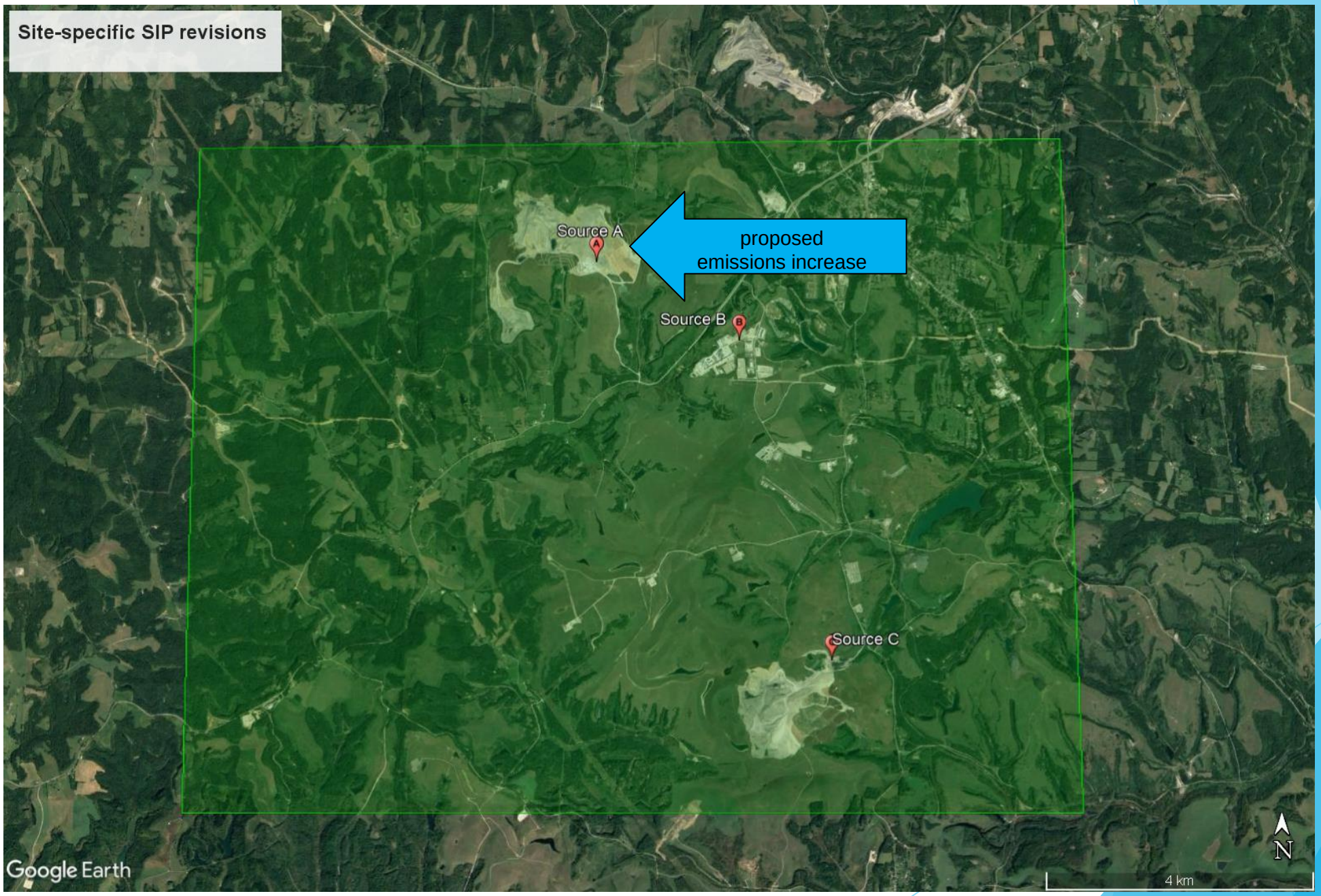
Dispersion Models

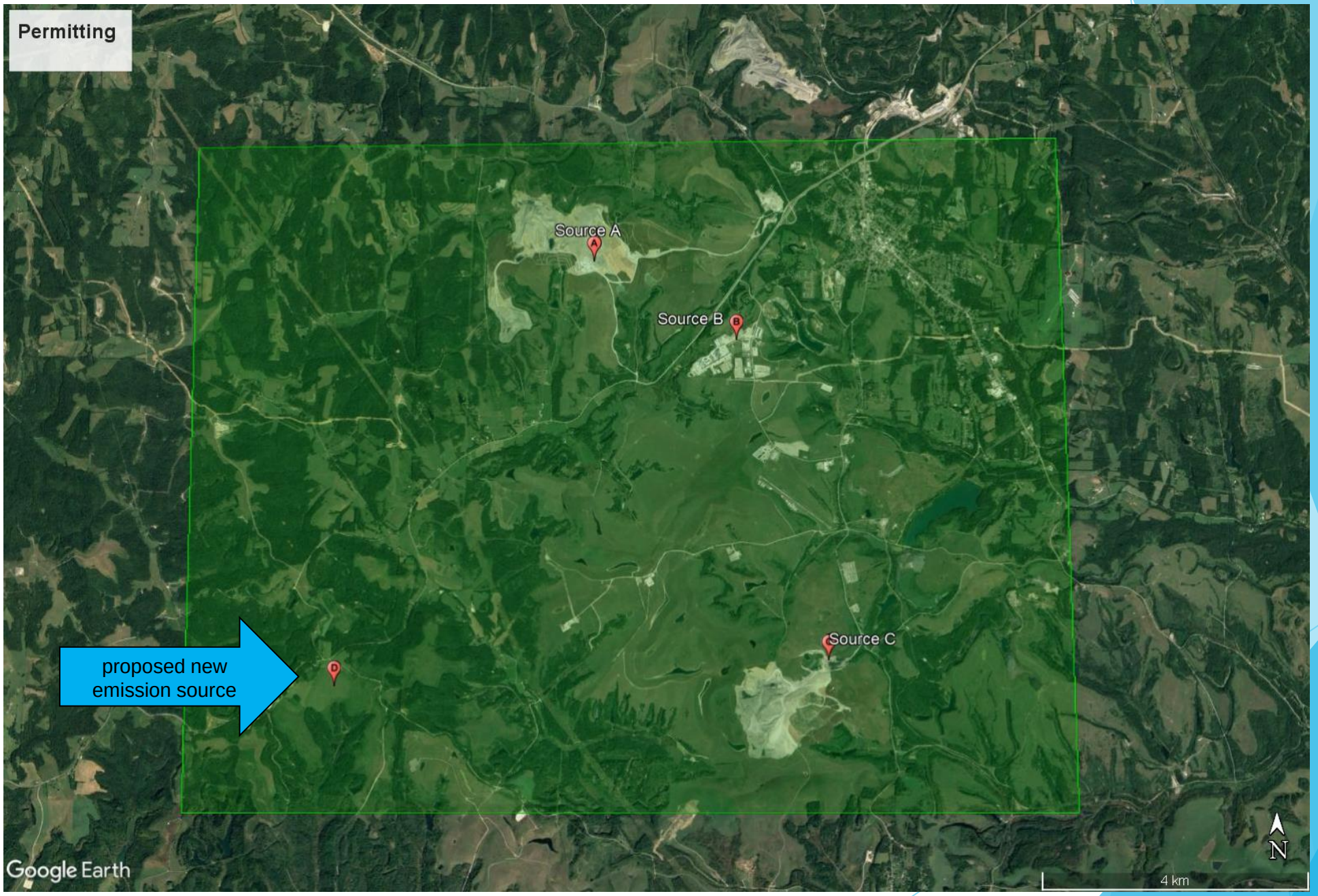


Why do we use dispersion models?

- In the regulatory realm, dispersion models allow us to determine if existing and/or proposed emission limits are adequate to attain the National Ambient Air Quality Standards and thresholds for non-reactive criteria pollutants (SO_2, Pb, NO_2, Primary PM, CO).
  - Nonattainment area SIPs
  - Site-specific SIP revisions
  - Permitting


Nonattainment area SIPs
Source A
Source B
Source C
Google Earth
4 km
N


Site-specific SIP revisions
Source A
proposed
emissions increase
Source B
Source C
Google Earth
4 km
N


Permitting
Source A
Source B
Source C
proposed new emission source
Google Earth
4 km
N

Dispersion Modeling Workhorse: AERMOD

- AERMOD is the **A**merican Meteorological Society/**E**nvironmental Protection Agency **R**egulatory **MOD**el
- EPA "preferred" regulatory dispersion model since 2005 when it replaced the Industrial Source Complex (ISC3) model
- Appendix W Guideline on Air Quality Models (40 CFR Part 51)
  - https://www.epa.gov/scram/clean-air-act-permit-modeling-guidance#appw

AERMOD Modeling System

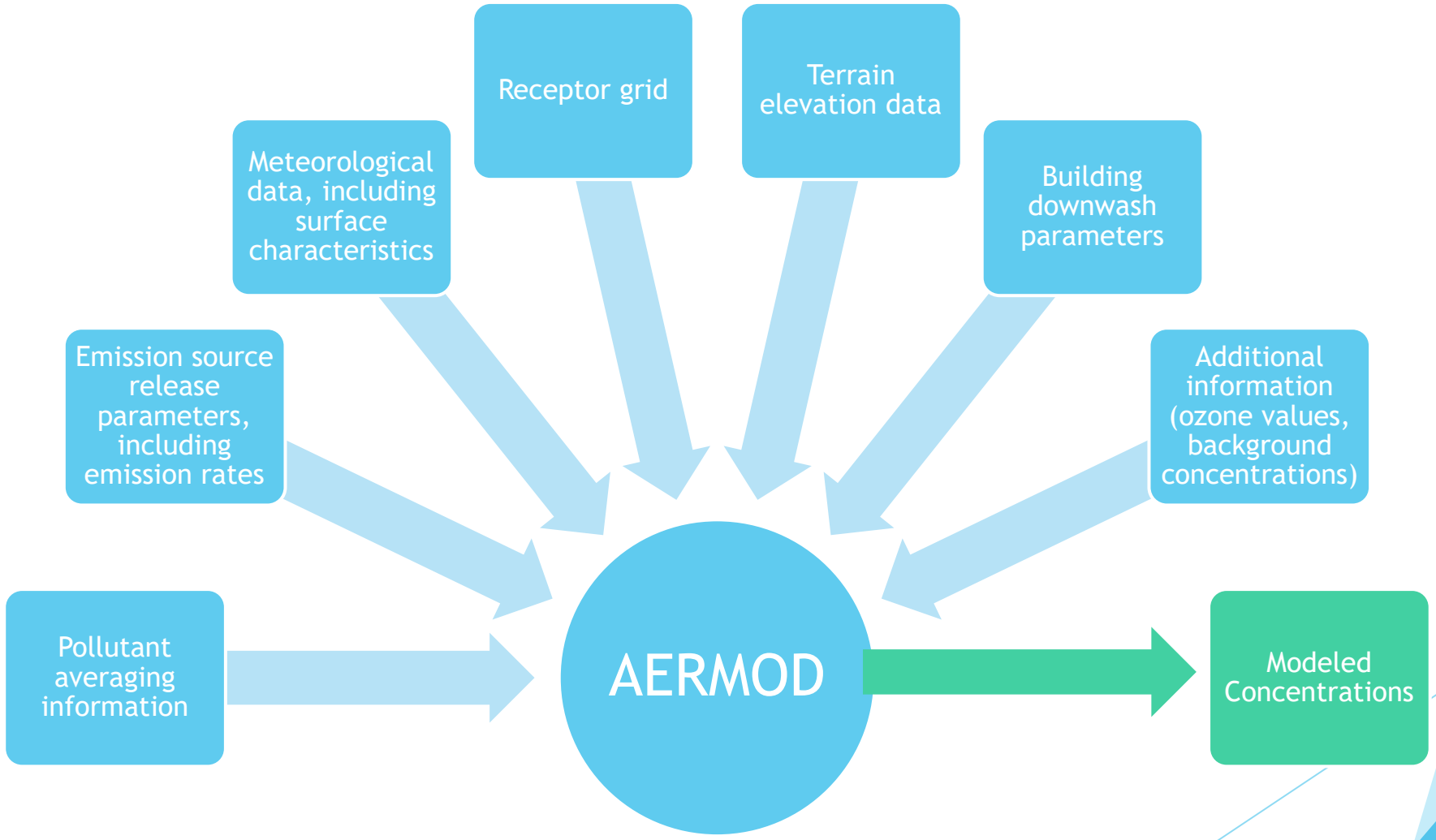
- The AERMOD modeling system includes:
  - AERMOD
  - Pre-processors:
    - AERMET
    - AERMINUTE
    - AERSURFACE (not a regulatory requirement to use)
    - AERMAP
    - BPIP-PRIME
  - Post-Processors:
    - LEADPOST

https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models#aermod

AERMOD Input Information Needs

- Emissions (mass/time such as grams/second or pounds/hour)
- Release parameters (e.g., stack parameters)
- Coordinates (emission sources, buildings, receptors)
- Receptor grid (where to calculate impacts)
- Nearby building dimensions
- Meteorological data (wind speed and direction, temp., sky cover, surface characteristics)
- Terrain elevation
- Background concentrations (if modeling criteria pollutants)

AERMOD Input and Output Flow

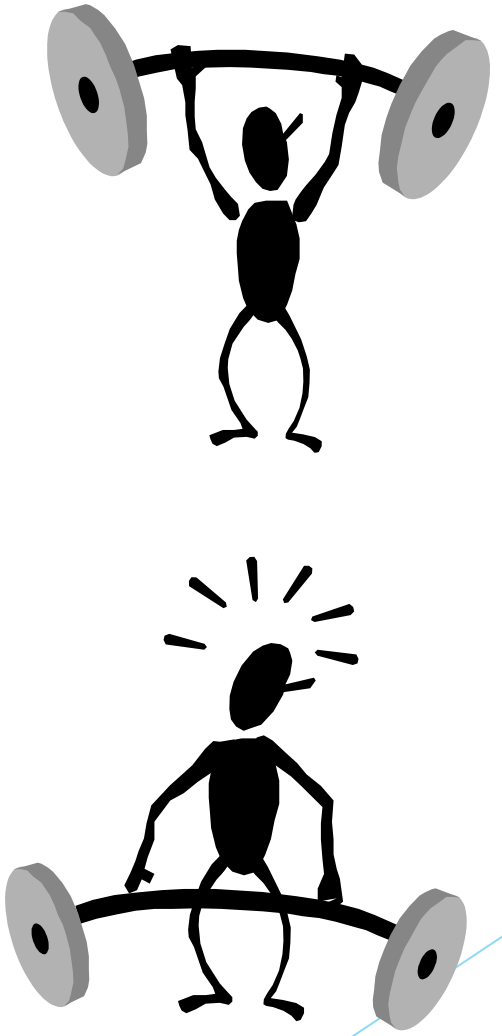


Source Types

- Point
- Volume
- Area
- Open pit
- Line
- Flare
- Buoyant line

Dispersion Modeling Strengths and Weaknesses

- Strengths
  - Reliable Predictions
  - Widely applicable
  - Relatively fast
  - Relatively inexpensive
  - Results over a large spatial domain
  - Can examine future sources/scenarios
- Weaknesses
  - Predictions, not measurements
  - Added uncertainty
  - Dependent on input data validity/availability



Modeling Guidance and Information

- EPA's Support Center for Regulatory Air Modeling (SCRAM)
  - Model Information and Downloads
  - Guidance and Support
  - Training and Resources
  - Applications and Tools
  - Related EPA Memorandum

  - www.epa.gov/scram

Points to Remember

- Dispersion models link emissions to air quality concentrations for specific sources.
- Modeled results are only as good as the quality of the inputs and the model's applicability to your situation.
- Air quality models are critical to the implementation of the Clear Air Act by allowing us to evaluate the air quality impacts against the NAAQS and set appropriate emission limits for new and existing sources of pollution.

Air and Radiation Division's Modeling Resource Group

- Phuong Nguyen – Air Toxics Modeling
- Mike Leslie – Mobile Source Modeling
- Mike Langman – Permit Modeling
- Dan Wolski – Permit Modeling
- Emily Crispell – SIP Modeling and Lead Waiver Modeling
- Melissa Sheffer – SIP Modeling