What it Takes to Conduct Air Quality Modeling

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Overview – Modeling Process

- ## Photochemical Model
  - Equations to represent chemical and physical properties of the atmosphere.

- ## Meteorology
  - Input to the model.

- ## Emissions
  - Input to the model.

- ## Boundary Conditions
 - Transport into modeling domain.

Photochemical Model

- Most often used:
    - CMAQ (Community Multiscale Air Quality)
    - CAMx (Comprehensive Air Quality Model with extensions)

- Modeling Domain
    - Could be the entire US and then focused on one area like the east and then Maryland.

- Include meteorology, pollutant emissions, and boundary conditions.

Modeling Domain

- Ozone Transport Region (OTR) Modeling Domain in grey.

- OTR state emissions in blue.

- Sub-Domain could be reduced to the size of a state or another area of special interest.
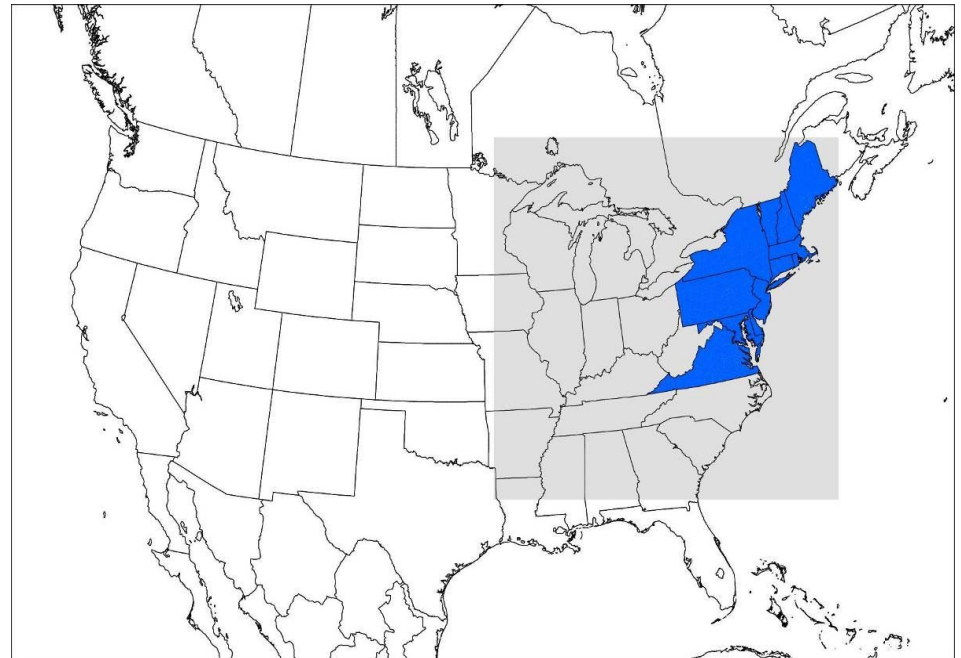
Meteorology

- WRF (Weather Research & Forecasting) model.

- Parameters include winds, temperature humidity, clouds, precipitation, vertical mixing, etc.

- Surface and aloft parameters needed.

Pollutant Emissions

- Prepare an emissions inventory.

- Includes anthropogenic emissions of NO/NO2, SO2, VOCs, PM, CO, and Ammonia.

- Includes biogenic VOC species and NO.

- Source groups mobile (MOVES model), point sources (EGU and Non-EGU), non-road, and area.

- Process using the SMOKE (Sparse Matrix Operator Kernel Emissions) model.

Boundary Conditions

- Have to account for pollutant transport from outside to inside the modeling domain.

- Need to use a global transport model.

- GEOSChem is a global chemistry transport model developed at Harvard University.

- GEOSChem model domain covers the entire globe.

Time Commitment & Cost

- WRF Modeling (Meteorological):
  - Time: ~8-10 months
  - Cost: ~$90,000

- SMOKE Processing (Emissions):
  - Time: 1-2 months
  - Cost: ~$40,000

- Photochemical Modeling:
  - Time: 2-3 months
  - Cost: ~$65,000

Summary

- Input into the photochemical model includes emissions, meteorological and boundary conditions.

- All the models don't run on PCs but instead run on a cluster of computers (not cheap).

- It's an iterative process, takes more than one run to get to the final answer.

- Need to allocate staff time to review and comment on all modeling input (i.e., emissions) and output (pollutant concentrations).