Speciated $PM_{2.5}$ Data Needs for Modeling

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Purpose

- Why do models need ambient data?
  - Background on photochemical modeling
- Why is speciated PM data important for modeling?
  - PM speciation needs from a modeling perspective

Photochemical Grid Modeling ($PM_{2.5}$ and Ozone)

- The purpose of grid modeling is to predict the effects of future control strategies.
  - Controls necessary for SIP attainment demonstrations (States)
  - Air quality impacts of national rules (EPA)
- Basic premise- “If we can replicate the past, we can predict the future.”

Photochemical Modeling-Process

- Model historical episodes or a full year
  - Inputs consist of gridded emissions and meteorological data
- **Evaluate model performance with historical ambient data**
  - Ozone
    - Ozone, NOx, NOy, VOC, CO
  - $PM_{2.5}$
    - PM mass, PM species (SO_4, NO_3, OC, EC, etc.), ammonia, nitric acid

Photochemical Modeling

- If model performance is “acceptable” then the modeling system can be used to predict air quality in the future.
- Emissions are then projected to a future year and the model is run again (the meteorology is held constant)
  - The difference between the base and future year is the predicted future air quality impacts
  - The model can be run again with alternative future year strategies

Why Do Models Need Speciated $PM_{2.5}$ Ambient Data?

- Performance evaluations
- Control strategy selection
- Attainment demonstrations

Model Performance- $PM_{2.5}$

- $PM_{2.5}$ is difficult to model because it is a mixture of many different pollutants
  - Both primary and secondary components
  - Secondary components form through different processes
- Need to verify model performance for each of the $PM_{2.5}$ components
- **A full evaluation cannot be completed without adequate historical speciated $PM_{2.5}$ data**

Performance Evaluations

- Comparisons of model output to ambient data provide confidence that models are working correctly.
- Want to know that models are giving the right answers for the right reasons.
  - This is especially important for secondary pollutants

Right Answer for the Wrong Reasons- Example

- Model predicts 30 ug/m3 of $PM_{2.5}$
  - Sulfate- 15 ug/m3
  - Nitrate- 5 ug/m3
  - Organic carbon- 3 ug/m3
  - Elemental carbon- 5 ug/m3
  - Crustal- 2 ug/m3
- FRM monitor measured 30 ug/m3
- Collocated speciation monitor measured 30 ug/m3
  - Sulfate- 5 ug/m3
  - Nitrate- 16 ug/m3
  - Organic carbon- 6 ug/m3
  - Elemental carbon- 2 ug/m3
  - Crustal 1 ug/m3

Control Strategy Selection

- Future year control strategies may be necessary to meet the NAAQS or Regional Haze rules
- Most PM control strategies don't affect all PM components
  - Primary species don't interact with each other
  - Secondary PM chemistry is complicated
    - NOx strategies mostly affect nitrates, but also affect sulfates and secondary organic carbon

Control Strategy Selection

- The relative importance of each $PM_{2.5}$ component in each area will determine the effectiveness of control strategies.
- **Speciated $PM_{2.5}$ data is needed to help choose and prioritize potential control strategies.**

Attainment Demonstrations

- Historically, model attainment demonstrations had to show " absolute attainment" of the NAAQS in every modeled grid cell
  - One hour ozone standard
    - All grid cells had to predict < 125 ppb on each modeled day

Attainment Demonstrations for $PM_{2.5}$

- Draft $PM_{2.5}$ modeling guidance was released in April 2000
  - New proposed attainment demonstration uses a “relative test” based on historical ambient measurements
  - Example-
    - Given an annual standard of 15 ug/m3 and an observed $PM_{2.5}$ value of 25 ug/m3
    - The model would need to show a 40% reduction in $PM_{2.5}$ ((25-15)/25*100) to pass the test.

Attainment Demonstrations for $PM_{2.5}$

- The proposed attainment test uses component specific reduction calculations
  - The % reduction in each $PM_{2.5}$ component is calculated separately
    - This allows flexibility to combine the results from different modeling techniques, if necessary
      - Urban, fine scale primary PM modeling
      - Regional scale secondary PM modeling
  - **Speciated $PM_{2.5}$ data is needed in order to implement the proposed attainment test**

$PM_{2.5}$ Speciation Data Needs

- How much speciation data do we need and where do we want it?
  - The more the better
  - Highest priority is in areas with the highest FRM mass measurements
  - Should collocate with FRM monitors, if possible
  - Data also needed in rural areas

Summary

- **PM models need speciated $PM_{2.5}$ data**
  - Performance Evaluations
    - Speciated ambient data is needed to verify the model predictions for each PM component
  - Control strategies
    - Speciated data is needed to provide information for selecting future controls
  - Attainment demonstrations
    - Speciated data is needed to implement the proposed “relative” attainment test

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