Final Ozone/PM2.5/Regional Haze Modeling Guidance Summary

Region IV Modeling Workshop

March 28, 2007

Ozone/PM2.5/Regional Haze Modeling Guidance

- "Guidance on the use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze"
  - Original draft- January 2001
  - Draft final- September 2006
  - Final version- March 2007
- Final ozone guidance has been incorporated into the final PM2.5 and RH guidance (single, slimmed down, 253 page document)

What’s in the Guidance?

- Part I- Using Model Results
  - Modeled Attainment tests
    - 8-hour ozone NAAQS
      - Unmonitored area analysis
    - Annual and 24-hour PM2.5 NAAQS
      - Unmonitored area analysis
      - Local area analysis (high primary PM2.5 areas)
    - Regional Haze reasonable progress
  - Supplemental analyses/weight of evidence
  - Activities to support Mid-Course review and future modeling
  - Required documentation

What's in the Guidance?

- Part II- Generating Model Results
  - Conceptual description
  - Modeling protocol
  - Selecting a model(s)
  - Choosing days/episodes
  - Selecting domain & spatial resolution
  - Developing met inputs
  - Developing emissions inputs
  - Evaluating model performance/diagnostic analyses

Final O3/PM/RH Guidance

- Ozone- nearly unchanged compared to final ozone guidance
  - Minor wording changes to incorporate existing ozone document into unified guidance
- PM2.5- significant updates compared to 2001 draft
  - Minor updates in final version compared to 2006 draft final
- Regional Haze- some updates compared to 2001 draft
  - Relatively minor updates in final version compared to 2006 draft final

Choosing an Air Quality Model

- There is no “preferred model”
  - Models should meet Appendix W requirements for “alternative models”
- Models should be:
  - Peer reviewed
  - Demonstrated to be applicable to the problem being addressed
  - Adequate data bases should be available to run the model
  - Model should be shown to have performed adequately in the past
  - Source code must be available at no cost (or for reasonable cost)
- Vast majority of States/RPOs will use CMAQ or CAMx for ozone, PM2.5, and regional haze
  - Use of AERMOD for local primary PM2.5 issues (local area analysis)
- Modeling guidance does not address dispersion modeling of PM2.5 for NSR/PSD

Recommendations for “Episode” Selection

- Recommendations are essentially unchanged from original drafts
  - Annual PM2.5 NAAQS
    - Model full year or >= 15 days per quarter
  - 24 Hour NAAQS
    - Model days > 65 ug/m3* or “high end of distribution”
    - Model days in each quarter (as appropriate)
  - Regional Haze
    - Model a full year (or more) or at least 10 worst (and best) visibility days at each Class 1 area

*We expect the attainment test for the new 24-hr PM2.5 standard to be the same or similar to the procedures in the current version of the modeling guidance. As part of the implementation process for the revised standard, the procedures in the guidance will be re-evaluated.

Horizontal Resolution

- Recommendations are essentially unchanged from original drafts
  - PM2.5 <= 12 km resolution for urban scale modeling
    - <= 36 km for regional modeling
    - Higher resolution may be necessary in areas with high primary PM2.5 concentration gradients
  - Recommend <= 36 km resolution for regional haze modeling

Weight of Evidence/Supplemental Analyses

- All attainment demonstrations should include "supplemental" analyses to corroborate the modeling results
  - Three main categories of supplemental analyses
    - Modeling
    - Trends
    - Diagnostic analyses
- *Weight of evidence* applies when future design values are "close to" NAAQS (either above or below)

Weight of Evidence

- Recommended WOE range:
  - Annual PM2.5 14.5-15.5 ug/m3
  - 24-hour PM2.5 62-67 ug/m3
  - 8 hour Ozone 82-87 ppb
- If concentration is >WOE range: “More qualitative results are less likely to support a conclusion differing from the outcome of the modeled attainment test”

Base Year Design Value Calculation

- 5 year weighted average design value (ozone, annual, and 24-hour NAAQS)
  - More stable "anchor point" than a single design value period
  - Same methodology used for CAIR and PM NAAQS rule
  - Consideration should be given to the impact of "extreme" meteorology and/or large emissions changes (during the 5 year period)

Base Modeling Year

- Guidance recommends 2002 as the base emissions year
  - Recommendation based on EPA memo establishing 2002 as a base year for inventory submittals

Modeled Attainment Tests- Refresher

- All O3/PM2.5/RH modeled attainment tests use model estimates in a “relative” sense
  - Premise: models are better at predicting relative changes in concentrations than absolute concentrations
- Relative Response Factors (RRF) are calculated by taking the ratio of the model’s future to current predictions of PM2.5 or ozone
- RRFs are calculated for ozone and for each component of PM2.5 and regional haze

Speciated Modeled Attainment Test (SMAT)

- SMAT test is essentially the same as implemented in CAIR (and PM NAAQS rule)
- Recommend interpolating species concentrations to FRM sites (when necessary)

Speciated PM2.5 Mass Components as defined in SMAT

- **PM2.5$_{FRM}$** = { [OCMmb] + [EC] + [SO4] + [NO3$_{FRM}$] + [NH4$_{FRM}$] + [water] + [crustal material] + [0.5] }
  - OCM$_{mb}$- organic carbon mass by difference
  - EC- measured elemental carbon
  - SO4- measured sulfate ion
  - NO3$_{FRM}$- nitrate retained on the FRM filter
  - NH4$_{FRM}$- ammonium retained on the FRM filter
  - Water- particle bound water mass attached to sulfate, nitrate, and ammonium
  - Other primary particulate- soil and other inorganic mass
  - Blank mass- a constant 0.5 ug/m3 blank mass

SMAT Components- More detail

- $NO3_{FRM}$ – Retained nitrate
  - Calculated using hourly temperature and relative humidity data
    - EPA will provide default pre-calculated retained nitrate concentrations
- $NH4_{FRM}$- Retained ammonium
  - Recommend calculating “indirect” ammonium concentrations using retained nitrate, sulfate, and degree of neutralization of sulfate (DON)
- Particle bound water
  - Recommend using EPA default water equation
    - Two 21 term equations (low acidity and high acidity cases)

Model Attainment Test Software (MATS)

- Software has been developed to apply modeled tests
  - Performs ozone, PM2.5, and regional haze tests
  - Interpolates ambient data (where necessary) for ozone and PM2.5 tests
  - Creates “gradient adjusted” spatial fields for unmonitored area analysis

MATS

- Intend to provide consistent set of ambient data for all States to use
  - Ozone and PM2.5 design values
  - Pre-screened daily average STN and IMPROVE data for PM2.5 test
  - Official IMPROVE visibility data for 2000-2004 base period

Status of MATS

- Released beta version with ozone and regional haze analyses
- PM2.5 tests still under development
- Reviewing draft version of users guide
- Expect full release of ozone and regional haze version in April
- Version with PM2.5 in May

Unmonitored Area Analysis (UAA)

- Calculate future year design values in unmonitored areas
  - Uses interpolated ambient design values and model output
  - Supplemental analysis to the monitored based tests
- Similar tests for ozone and PM2.5
- UAA not designed to look for unmonitored PM micro-scale hotspot issues
  - 12 km resolution should be sufficient

Local Area Analysis

- Focused on evaluating influence of primary PM2.5 at monitors
  - New test provides a method to examine local primary PM source contributions at FRM monitors
- Replaces “hotspot” analysis from draft PM2.5 (2001) guidance
  - 2001 guidance specified dispersion modeling in unmonitored areas with high primary PM emissions
- Local area analysis can use either dispersion model or fine grid Eulerian model (1km?)

Model Performance Evaluation

- Revised details of model performance evaluation chapter
  - Added recommendations (with examples) to include “new” plots and metrics
    - “Soccer” plots
    - “Bugle” plots
  - Enhanced discussion of diagnostic analyses
- Included appendix with a summary of performance statistics for ~30 model applications from across the country
  - No specific performance recommendations for PM2.5

Regional Haze Updates

- Uniform rate of progress vs. reasonable progress language
  - Significant updates to language
  - Consistently used term “uniform rate of progress” or “glidepath” when applicable
    - Modeling will determine future visibility change relative to the glidepath
    - Modeling does not define or determine reasonable progress
- IMPROVE equation
  - Included new IMPROVE equation
  - Recommended use of either equation or both
    - Use of new equation should include a justification

Summary of Updates and Clarifications Since September 2006 Draft Final PM2.5/RH

- Numerous wording updates and clarifications
- Additional references
- Revised 24 hour PM2.5 NAAQS
  - Attainment test for new NAAQS is likely to be the same as old NAAQS
    - Will update the guidance, as necessary, when implementation of revised NAAQS is completed (designations and implementation rule)
- Local area analysis
  - Added references to help separate primary and secondary PM
  - Technique unchanged from draft final
- Five year weighted average
  - Suggest closely examining met and emissions patterns during 5 year period (especially middle year)

Summary of updates since September 2006 final draft

- Clarify which model days are used in RRF calculations
  - Ozone- all model days > threshold
  - Annual PM2.5- all model days
  - 24-hr PM2.5 – all violating days or high end of the distribution of model days
  - Regional haze- Only measured days (20% best and 20% worst)
- 24-hr. attainment test
  - More details on why choose 98th percentile value and next highest values from other 3 quarters
- Crustal vs. soil vs. other PM
  - Used term “other primary particulate” (OPP)
  - Continue to use crustal or fine soil for visibility
- Emissions modeling
  - More information on aircraft, locomotive and marine

Next Steps

- Post final version of guidance on SCRAM
  - Early April
- Release ozone and regional haze version of MATS
  - April
- Release final version of MATS (with PM2.5 tests)