O3/PM2.5/Regional Haze Modeling Guidance Summary

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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" April 2007
  - http://www.epa.gov/scram001/guidance/guide/final-03-pm-rh-guidance.pdf

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

Guidance Updates

- Currently updating and reorganizing various chapters
- Potential updates are noted in subsequent slides
- Process- Comments and feedback from different stakeholders
  - States and locals
    - Conference calls
    - Workshops
  - EPA Regional modelers
    - Regularly scheduled conference calls
  - Industry stakeholders
  - Environmental groups

Recommended Modeling Process

- Develop conceptual model
  - What is the nature of the air quality problem?
- Develop a modeling protocol
  - Outline the types of modeling and data analysis that is deemed appropriate for the situation
    - This may vary, especially for PM2.5, due to the different types of PM problems
      - Primary vs. secondary
      - Summer vs. winter
      - Local vs. regional
- Goal of attainment demonstration modeling is to adequately demonstrate that the NAAQS will be attained in the future
  - May not be a one size fits all solution
- Weight of evidence will often be part of the attainment demonstration process
  - Balancing of modeling and data analysis should be considered as part of the protocol development process

EPA SIP Review Responsibilities

- EPA/OAQPS is responsible for issuing overarching modeling guidance
- EPA Regional offices are responsible for reviewing and approving attainment demonstrations
  - States should work closely with their EPA Regional offices in developing and submitting conceptual models, protocols, and modeling
- Regional offices consult with OAQPS when there are “controversial issues” and/or national consistency issues

Guidance Review Topics

- Choosing a model
- Episode selection
- Horizontal resolution
- Weight of evidence
- Base design value calculation
- Attainment tests
- Speciated Modeled Attainment Test
  - Annual PM2.5 test
  - 24-Hour PM2.5 test
- Unmonitored Area Analysis
- Local Area Analysis
- Grid resolution
- Episodes/time periods

Choosing an Air Quality Model

- There is no “preferred model”
  - Models should meet Appendix W requirements for “alternative models”
- Models should be (same language as Appendix W):
  - 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 have used either 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

- Annual PM2.5 NAAQS
  - Model full year or >= 15 days per quarter
- 24 Hour NAAQS
  - Model days > 65 ug/m3 or “high days” (or full year)
  - Model days in each quarter (as appropriate)
- 8 Hour Ozone
  - Model full ozone season or representative episodes
- Regional Haze
  - Model a full year (or more) or at least 10 worst (and best) visibility days at each Class 1 area
- Updates- Add language to address 35 ug/m3 NAAQS, seasonal ozone W126, winter ozone

Horizontal Resolution

- Ozone <= 12km resolution
- 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
    - "Additional" modeling
    - Trends- air quality and emissions
    - 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”

Weight of Evidence

- Updates
  - Numerical WOE “range”
    - Continue to specify suggested range for ozone and PM2.5?
  - Add language to address attainment demonstrations that are submitted close to the attainment date
    - Relative importance of ambient data vs. modeling
    - Near term expected emissions reductions
  - More use of met adjusted ambient data?
  - Voluntary measures and other un-modeled measures
  - Add more examples of supplemental analyses

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
  - Not worst case assumption
  - Consideration should be given to the impact of “extreme” meteorology and/or large emissions changes (during the 5 year period)
  - Potential updates- alternative calculation?, met adjusted concentrations?, other statistical methods?

Modeled Attainment Tests

- 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

Days Used in the RRF Calculations

- Ozone- all model days > concentration threshold
  - Current threshold defaults
    - If 10 or more (modeled) days > 85 ppb then use 85 ppb threshold
    - If less than 10 days > 85 ppb then reduce the threshold (down to as low as 70) until 10 days are used
    - If less than 10 days > 70 ppb then use all days > 70 (with an absolute minimum of 5)
- Annual PM2.5- all model days
- 24-hr PM2.5 – all violating days or high end of the distribution of model days
  - No current default
- Regional haze- Only *measured* days (20% best and 20% worst)
- Updates- Update ozone thresholds

PM2.5 Attainment Test

- Speciated Modeled Attainment Test (SMAT)
  - Species concentrations adjusted to account for differences between CSN and FRM measurements
  - 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
  - Crustal- soil and other inorganic mass
  - Blank mass- a constant 0.5 ug/m3 blank mass

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 or finer

Local Area Analysis

- Focused on evaluating influence of primary PM2.5 at monitors
  - Provides a method to examine local primary PM source contributions at FRM monitors
- Local area analysis can use either dispersion model or fine grid Eulerian model (1km?)
  - Several attainment demonstration SIPs have combined AERMOD with CMAQ (or CAMx) results
  - Exploratory studies on the use of fine grid CMAQ
    - Plume in grid within photochemical model to track local sub-grid scale point source contributions to monitors
  - Eventual solution may be a puff or gaussian model embedded within a photochemical model

Regional Haze Test

- Estimate "current" b_{ext} from monitored data
  - Follow procedures in "Guidance for Tracking Progress under the Regional Haze Rule"
    - Calculate extinction for visibility components
    - Calculate 20% worst days and 20% best days (5 years)
- Model "current" PM concentrations
- Model future PM concentrations
- Calculate RRF for each component (based on change in mass)
  - 20% best days and 20% worst days
- Estimate future b_{ext}
- Convert difference in future and current b_{ext} to deciviews
- Determine if reasonable progress goal is met

Attainment Test Updates

- Ozone
  - Account for new primary NAAQS
  - New test for W126 secondary NAAQS
- Annual PM2.5
  - Potential revised NAAQS
- 24-Hr PM2.5 NAAQS
  - Potential revised NAAQS
  - Revise 24-hr test to better account for calculation of future year 98th percentile days when high days switch seasons between base and future years

Model Attainment Test Software (MATS)

- Software has been developed to apply the recommended modeled attainment tests http://www.epa.gov/scram001/modelingapps_mats.htm
  - Performs ozone, PM2.5, and regional haze tests
  - Interpolates ambient data (where necessary) for ozone and PM2.5 tests
  - Creates “gradient adjusted” fused spatial fields for unmonitored area analysis
    - Fused fields using ambient data and model output

MATS

- Provides consistent set of ambient data for all States to use
  - Official ozone and PM2.5 design values
  - Pre-screened daily average CSN and IMPROVE data for PM2.5 test
  - Official IMPROVE visibility data
- Updated ambient data currently available through 2009

Status of MATS

- Latest official release (version 2.3.1) contains ozone, regional haze, annual and 24-hr PM2.5 tests
  - Forthcoming updates
    - Update 24-hr attainment test methodology
    - Add 24-hr PM2.5 spatial fields
    - Add W126

Next Steps

- Complete revised draft of guidance
  - Release for external review by end of calendar year
  - Outreach
- Updates to MATS