Weight of Evidence for Regional Haze Reasonable Progress

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Questions

- Why are supplemental analyses and weight of evidence needed for ozone/PM2.5 attainment demonstrations and RH reasonable progress demonstrations?
- How are supplemental analyses used in attainment and reasonable progress demonstrations?
- What are some examples of supplemental analyses?
- How is the reasonable progress test for regional haze different from an attainment demonstration?
- What supplemental analyses are appropriate for regional haze?

Why are supplemental analyses and weight of evidence needed for attainment demonstration purposes?

- By definition, models are reasonable but simplistic approximations of complex phenomena.
- Model inputs (emissions, meteorological, IC/BC, landuse, etc.) and model code are subject to uncertainty.
- In recognition of these uncertainties, the regional modeling community has evolved over the past decade:
  - from using models in an absolute sense w/ attainment “bright lines” (90s),
  - to using the model in a relative sense to project an expected change in air qulality which can be used to assess whether attainment will be reached in the future via a “bright line” determination (recent national rules),
  - to using the modeling as the primary element in a suite of tools that assist in an assessment of present and future air quality trends (next round of attainment demonstrations).

Why are supplemental analyses and weight of evidence needed for attainment demonstration purposes?

- As part of their recommendations to transform the SIP process into one that is more performance-oriented, the CAAAC AQM workgroup recommended increased use of weight of evidence within State/Local attainment demonstrations.

- *"EPA, in conjunction with S/L/T and affected stakeholders, should modify its guidance to promote weight-of-evidence (WOE) demonstrations for both planning and implementation efforts. In particular, these demonstrations should reduce reliance on modeling data as the centerpiece for SIP/TIP planning, and should increase use of monitoring data and analyses of monitoring data, especially for tracking progress. Enhanced tracking and ambient monitoring data is a better use of available resources than intensive local modeling."*

- Guidance notes that AQ models still represent best tool for integrating emissions and meteorological data with known chemistry.

What does the draft final ozone guidance say about supplemental analyses and weight of evidence?

- All attainment demonstrations should include supplemental analyses to assess the validity of the modeled attainment test projection.
  - Guidance suggests amount of supporting information should be greatest for those areas with modeled projections near the NAAQS.
- Three separate types of supplemental analyses should be considered within an attainment demonstration.
  - Additional air quality modeling evidence
  - Trends in ambient air quality and emissions
  - Other air quality analyses that can identify potential control targets

What does the draft final ozone guidance say about supplemental analyses and weight of evidence?

- “Weight of evidence” differs from “supplemental analyses” in that:
  - 1) WOE is a set of supplemental analyses for areas whose attainment test results indicate future AQ levels near the NAAQS.
  - 2) WOE combines and weights the various supplemental analyses with the results of the attainment test … the end result being an aggregate, weighted conclusion as to whether a set of control strategies will yield attainment by the relevant future year.

What does the draft final ozone guidance say about supplemental analyses and weight of evidence?

- Can all attainment demonstrations use weight of evidence aggregations to “reverse” the conclusion from the modeled attainment test?
  - Yes, in both directions
    - model projects attainment, yet WOE suggests nonattainment; or,
    - model projects nonattainment, yet WOE suggests attainment
  - However, the further the attainment projection is from the NAAQS, the more compelling the contrary evidence produced by corroboratory analyses must be to draw a conclusion differing from that implied by the modeled attainment test results.

Regional Haze Test

- The modeling test for regional haze differs from PM2.5 and ozone in that;
  - Reasonable progress goals are not standards (e.g. NAAQS), they are goals
  - The evaluation of reasonable progress, as defined in the regional haze rule, is already a form of weight of evidence
    - Costs, remaining life of sources, etc are weighed against further emissions controls
  - States should show how (and whether) they can meet the defined goal
- Despite the differences, many of the same air quality analyses and principles used for PM2.5 and ozone attainment demonstrations can be applied to the regional haze test

Specifically, what types of supplemental analyses should be completed as part of a reasonable progress demonstration? Element 1: Additional AQ Modeling

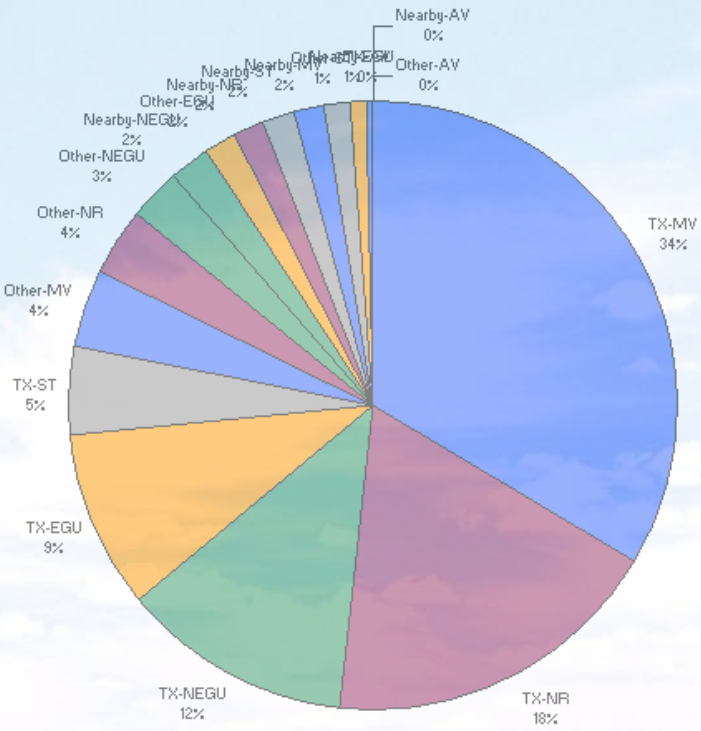
- Use of “other” available regional (or local) AQ modeling projections
  - In order for SA/WOE usage, one would need to make the case that the regional modeling was appropriate for use in the local area (e.g., episodes, base/future emissions, performance, etc.)
- Multiple AQ Models / Input Data Sets (aka, alternative basecases)
  - There may be different, technically-plausible combinations of models, model physics options, and model input data sets that yield acceptable base year model performance.
  - Focus on the sensitivity of estimated relative reduction factors to variations in inputs or model formulations
- Use of same modeled attainment demonstration but with the reasonable progress test calculated in an alternative manner than in the guidance (examples on next slide)
  - Requires justification for why approach is equally valid

Alternative Modeled Reasonable Progress Calculations

- Alternative RRF technique for averaging across 20% worst/best days
- Alternative visibility calculation (don’t use default IMPROVE equation)
- Day specific f(RH) factors
- Throw out extreme days (due to natural events) and recalculate 20% worst days
- Examine how 20% worst days may change in the future year (don’t assume the base and future days are the same)
- Examine performance on 20% best days
  - If degradation is predicted by the model, is it believable

Other Modeling Tools for supplemental analyses

- Use of alternate AQ modeling techniques to help explain why reasonable progress should (or should not) have been demonstrated.
  - Photochemical source apportionment
  - DDM
  - Response surface modeling



Specifically, what types of supplemental analyses should be completed as part of a reasonable progress demonstration? Element 2: Emissions and AQ Trends

- May be possible to extrapolate future trends in visibility based on measured historical trends of air quality and emissions.
- Several complicated elements to these analyses
  - May be necessary to normalize historical AQ and visibility data trends to account for year-to-year meteorological variations.
  - Must have a solid conceptual model of PM formation in the area of interest (e.g., which PM species dominate, how are they formed)
  - Must have an accurate accounting of year-to-year changes in actual emissions that lead to poor visibility in Class I areas.
- Goal is to develop a curve that relates past emissions changes to differences between historical and current visibility.
  - Curve can then be extrapolated to account for expected changes in relevant emissions by the future year.

Specifically, what types of supplemental analyses should be completed as part of an attainment demonstration? Element 3: Other AQ analyses

- Observational models can take advantage of monitored data to draw conclusions about the relative importance of different types of PM2.5 emissions.
  - Strength of evidence is proportional to the completeness of the ambient data base
- Possible AQ analyses for PM2.5 attainment and reasonable progress demonstrations
  - Receptor modeling (CMB, PMF)
    - Are the relationships between emissions and visibility consistent between receptor models and photochemical models?
    - Can the receptor model identify local sources which may be contributing to visibility impairment in Class I areas?
  - Indicator species

Weight of Evidence/Supplemental Analyses: Summary

- All reasonable progress demonstrations should include supplemental analyses to corroborate the modeling results. Supplemental analyses may include:
  - Alternative modeling and/or postprocessing of model output
  - Emissions trends
  - Ambient data analysis and trends (including meteorologically adjusted trends)
  - Receptor-based and/or observational model analyses

- For those areas where reasonable progress test projections are close to the reasonable progress goal, an aggregate weight of evidence determination should be made subjectively based on the results of the supplemental analyses

Weight of Evidence/Supplemental Analyses: Summary

- The weighting factors associated w/ each of the individual supplemental analyses should weigh each type of analysis according to:
  - the credibility of the analysis, as well as
  - its ability to address the question being posed (i.e., is the strategy adequate for meeting the goal by a defined deadline?).
- The conclusions derived from the weighted supplemental analyses are combined to make an overall assessment as to whether meeting the air quality goal is likely.