Appendix M

Georgia Environmental Protection Division Comments on: "Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5 and Regional Haze" October 27, 2006

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Grid Cells Used to Calculate RRFs

Pages 24-27 describe the use of cells "near" a monitor rather than the cell containing the monitor in the modeled attainment test. Although three reasons are listed why this is appropriate, we feel that the use of the cell containing the monitor is more appropriate and will lead to more realistic future DVs at the monitor locations. We find it hard to justify using unmonitored grid cells near the monitor to describe what is happening at the monitor. Model performance evaluations (MPE) are only conducted for the grid cells containing monitors; therefore, we feel that the model attainment test should remain consistent with the MPE and only use these grid cells. In addition, calculating RRFs based on nearby cells that change locations between the baseline simulation and future simulation (not paired in space) can lead to erroneous and misleading conclusions.

To address any potential issues arising from predicted peak "migration", we propose that the cells "near" the monitor undergo the "unmonitored area analysis" described in Section 3.4 on Page 28. Although these grid cells will not be used in the actual modeled attainment test to project future design values, they would still be examined along with the other unmonitored areas. As part of the WOE, an overall exposure metric (weighted by population) could be evaluated in the array of nearby grid cells to quantify reductions in exposure.

Uncertainty in the formulation of the model and the model inputs is not a good reason to use an array of nearby grid cells instead of the cell containing the monitor. There can be very large (and very real) differences in precursor emissions, pollutant formation/deposition processes, and resulting pollutant concentrations between neighboring grid cells within the array. Arbitrarily taking the maximum value or the average value is not an accurate way to characterize the changes occurring at the monitor. If the model performance at the grid cell with the monitor is extremely poor on a specific day, consideration should be given to removing this day from the RRF calculation.

To diminish the likelihood of inappropriate results occurring from the geometry of the superimposed grid system, we feel the best solution is to find the exact location of the monitors in the grid cells. If a monitor is near a grid border (e.g., offset from the center of grid by more than 25%), multiple grid cells could be averaged by bi-linear interpolation instead of just using the cell containing the monitor.

The use of nearby grid cells is especially inappropriate in situations where there are major emission reductions from large point sources or significant area/mobile sources located within the array of nearby cells. For example, if we simulate the installation of SCRs at a large utility located two grid cells to the left of the monitor (assume 7x7 array for 4-km grid), the model might predict lower future ozone concentrations in the array even when the wind is blowing in the completely opposite direction from the monitor.

<u>Application of Dispersion Models</u>
Section 5.3 outlines a procedure for using a dispersion model for primary PM2.5 in an attainment test. However, the procedure is not clearly described and may not be feasible. For example, it is not clear how to accurately identify primary versus secondary components of PM2.5 at the monitor (Step 2, Page 61) or the percentage of total primary PM2.5 at the monitor due to local sources (Step 3, Page 61). How do you accurately split OC into primary versus secondary components? What if there is no speciation information at the monitor in question? The guidance should give more details on how these questions should be approached. For example:

- If speciation data exists, use the EC tracer approach of CMB to identify SOA. Next, define primary PM as: PM2.5 - sulfate - nitrate - ammonium - SOA.
- If speciation data is not available, but there is a nearby speciation monitor, estimate total primary PM by the difference between total PM2.5 at the site in question and all secondary components at the speciation monitor. Again, this would require an EC tracer or CMB analysis for the speciation monitor.

Alternatively, a much easier and straightforward approach would be to use the absolute response from the dispersion model instead of the relative response. Absolute concentration differences resulting from the control of these local sources would simply be subtracted from the future DVs calculated using the photochemical model. This approach may be especially appropriate and introduce the least amount of uncertainty at sites that do not have any speciated monitoring data.

<u>Model Performance</u>
Not all days simulated by the model will be used in the RRF calculations. For example, only ozone days over 85 ppb will be used for ozone projections and only the 20% best and worst days will be used for regional haze projections. The guidance should stress that the model performance on these days should be examined in more detail with specific emphasis on precursor performance and indicator ratios. In addition, a second set of performance statistics should be developed based on the limited set of modeled days used in the RRF calculations. Finally, the guidance should make allowances for removing poor performing days from the RRF calculations as part of WOE.

<u>Specific Comments</u>
Pages v – viii: Page numbers listed in the "Table of Contents" do not match those in the text starting at page 28. The page discrepancies vary between one and three pages throughout the document.

RRF - The document first introduces the concept of "RRF" as "relative reduction factor" and then later switches to "relative response factor". A consistent definition should be used throughout the document.

Page 30, Section 3.4.2: The first time "CAIR" is mentioned, the acronym should be written out and a reference added.

Page 196, Section on Direct Decoupled Method (DDM): DDM stands for "Decoupled Direct Method", not "Direct Decoupled Method". Note that DDM is a "direct method" of sensitivity analysis that is "decoupled" from the system. Here is the original citation:

- Dunker, A.M. (1984) The Decoupled Direct Method For Calculating Sensitivity Coefficients In Chemical-Kinetics. *J. Chem. Phys*. **81**, 2385-2393.

One of the first published applications of DDM in an advanced 3-dimensional Eulerian grid model was back in 1997. A reference to this paper should be added in this section:

- Yang Y.J., Wilkinson J.W. and Russell A.G. (1997) Fast, direct sensitivity analysis of multidimensional photochemical models. *Environ. Sci. Technol.* **31**, 2859-2868.

Note that the above reference is incorrectly listed in the "Reference" section as "*in press*". Also, it should also be noted that DDM has been implemented in CMAQ (as well as CAMx) and that the CMAQ version is capable of calculating higher order ozone sensitivities which can capture the non-linear ozone responses to precursor emissions. Here are some additional references:

- Cohan, D. S., Hakami, A., Hu, Y. T., and Russell, A. G. (2005). Nonlinear Response of Ozone to Emissions: Source Apportionment and Sensitivity Analysis. *Environ. Sci. Technol.* **39**, 6379-6748.
- Hakami, A., Odman, M. T., and Russell, A. G. (2003). High-order, direct sensitivity analysis of multidimensional air quality models. *Environ. Sci. Technol.* **37**, 2442-2452.
- Hakami, A., Odman, M. T., and Russell, A. G. (2004). Nonlinearity in atmospheric response: A direct sensitivity analysis approach. *J. Geophys. Res.* **109**, D15303.

Pages 191-192: New reference for "bugle plots":

- Boylan, J.W. and Russell, A.G (2006). PM and Light Extinction Model Performance Metrics, Goals, and Criteria for Three-Dimensional Air Quality Models. *Atmos. Environ.* **40**, 4946-4959.