WRAP Regional Modeling Center - Simulation Specifications

Scenario Name: 2002 Base B Simulation

RMC Code: "base02b"

Date Specifications Prepared: March 24, 2006

Time Window for Modeling/Analysis: emissions modeling start date, targeted tech memo publication date, start simulation March 27, 2006, complete analysis results analysis by April 21, 2006.

Description: 2002 Annual 36-km CMAQ air quality model simulation using Base 2002 B actual emissions.

Purpose/Objective: Evaluate model performance for the regional haze air quality actual 2002 conditions. Provide actual 2002 base case air quality and visibility conditions in the Western Class I Areas.

Expected Analysis Methods: This case is being used to evaluate the acceptability of the air quality model performance for an historical episode (.i.e., calendar year 2002). If the model performs well for the historical period it is assumed that the model can also be used to estimate future air quality and the benefits to achieved by emissions control strategies. For the present mode simulation, a full model performance evaluation (MPE) includes the following analysis products:

- Standard displays of spatial distribution of concentrations of relevant pollutants (Sulfate, Nitrate, PM, OC, EC, etc..) for the same time averaging period used for the following monitoring networks:
  - IMPROVE
  - NADP
  - CASTNet
  - AQS gas phase measurements.
- Time series plots of measured and modeled species concentrations
- Scatter plots of modeled prediction versus ambient data
- Stacked-bar time-series charts of daily contributions to light extinction at each IMPROVE site.
- Stacked-bar charts of contributions to light extinction for the 20% best and 20% worst days at each IMPROVE site

Input Data:

Emissions – emission data and QA found at:
http://pah.cert.ucr.edu/aqm/308/Base02b_36.shtml

- BEIS3 biogenic emissions (includes soil NO emissions)
- Actual 2002 fire emissions from all fire types
- Windblown fugitive PM dust emissions – all components from WRAP WB Dust model
- All NH3 emissions from WRAP NH3 model
- Stationary point source emissions based on CEM data where available
- Documentation on input data, model settings, and modeling/QA procedures provided through standard reporting products: WRAP_2005-06_Emissions_Workplan: ***http://pah.cert.ucr.edu/aqm/308/docs.shtml***

    - Simulation schedule and input files
    - SMOKE configuration information/settings
    - Documentation of problems encountered with corrections, outstanding issues, and other important information about simulation clean02a
    - Parent EI and maps/tables of changes for this run
    - Detail dependent on purpose/objective and results analysis methods

Other Inputs and Model Settings

- Initial and Boundary Conditions based on a 2002 GEOS-CHEM simulation.
- Model version, settings and configuration same as for 2002 Base A: CMAQ version 4.5 with CB4 chemistry, version AE3 aerosol mechanism, and Yarmatino advection scheme.
- Time period simulated – annual, typical year, RMC simulation of MM5 used for meteorology.

Results of Model Performance Evaluation

Analysis Products – complete results for the MPE are available on the RMC webpage at:
http://pah.cert.ucr.edu/aqm/308/cmaq.shtml#base02bvsbase02a36k,
and it includes the following products:

- Daily, seasonal and annual spatial distributions of Regional Haze contributing pollutants compared to the previous 2002 Base A simulation. These plots are used to show changes in the model predictions that we caused by improvement in the 2002 B emissions inventory.
- Comparison of the 2002 Base B MPE with the previous 2002 Base A (base02a) MPE.
- Monthly averaged model performance metrics:
http://pah.cert.ucr.edu/aqm/308/results_Base02b/base02b36k_vs_base02a36k/MPE/eval.shtml
- Stacked-bar time-series plots at each IMPROVE site:
http://pah.cert.ucr.edu/aqm/308/results_Base02b/base02b36k_vs_base02a36k/stackedbar_plots/wrapbase02b36k_CMAQv45YAMO_IMPROVEv1_obs_vs_mod.pdf

- Unpaired in time and/or space analysis - comparisons of extinction contribution from major aerosol species are relaxed in time (for up to 2 weeks) and/or space (surrounding 9 grid cells) for each IMPROVE site for the averages of both the best 20% and the worst 20% visibility days.
- Bugle plots - Monthly Performance Goal (PG) and Performance Criteria (PC)
- Bar Plots summarizing fractional bias(FB) and fraction gross error with results presented grouped both by species and by monitoring networks.

Note that those products listed above for which a specific weblink is not given can all be found listed individually at: **http://pah.cert.ucr.edu/aqm/308/cmaq.shtml#base02bvsbase02a36k.**

Other relevant products on the RMC webpage include the original 2002 Base A MPE using CMAQ version 4.4:
http://pah.cert.ucr.edu/aqm/308/cmaq.shtml#base02a

and a comparison of the Base A MPE for CMAQ versions 4.5 and 4.4:
http://pah.cert.ucr.edu/aqm/308/cmaq.shtml#base02aV45YAMOvsV44

Summary of Key Findings

Although official guidance is not yet available for visibility modeling, performance goals and performance criteria have been defined based on typical model performance in other air quality modeling studies. Performance goals represent the standard of performance expected in previous ozone air quality modeling studies, while performance criteria indicate the level of performance that has been achieved in large number of previous fine particulate matter (PM2.5)modeling studies. Figure 1 through 6 show bugle plots which summarize the model comparison to the ambient monitoring data relative to the performance goals and criteria. The model performance for 2002 Base B meets the performance goals or the performance criteria for most components of PM2.5. The only exceptions to this are for coarse material data for which the model has poor performance, and for data points in the Speciation Trends Network (STN) which include urban influence sites. The performs better for clean or rural conditions that are typical of the Class I areas.

A project report that discusses these results and other MPE products in more detail is available at **http://pah.cert.ucr.edu/aqm/308/reports/final/2002_MPE_report_main_body_FINAL.pdf**

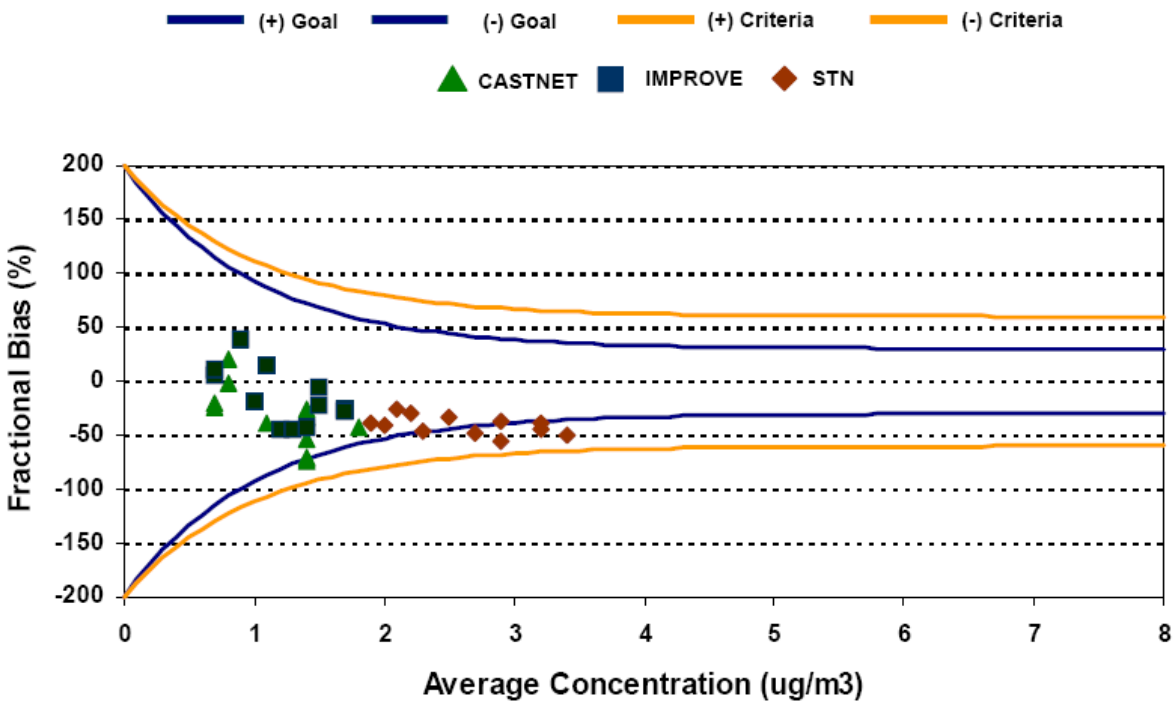

Figure 1. Model performance for sulfate (SO4) where each data point shows a monthly average of fractional bias at all IMPROVE sites in the WRAP region.

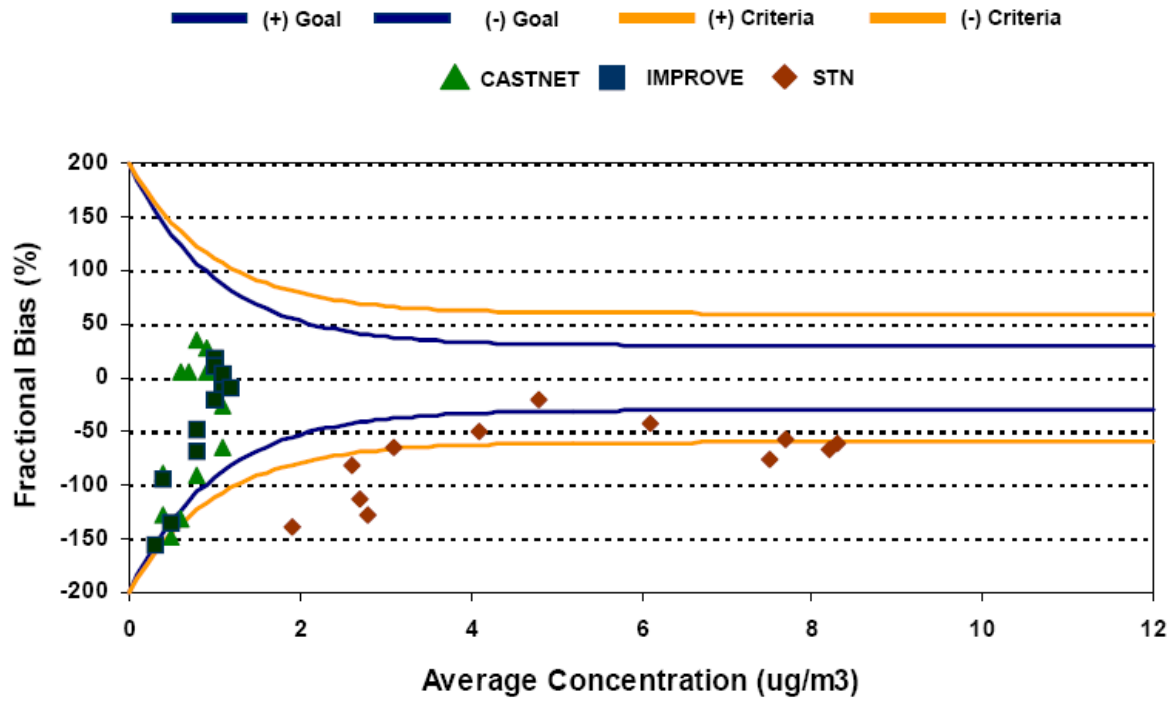

Figure 2. Model performance for nitrate (NO3) where each data point shows a monthly average of fractional bias at all IMPROVE sites in the WRAP region.

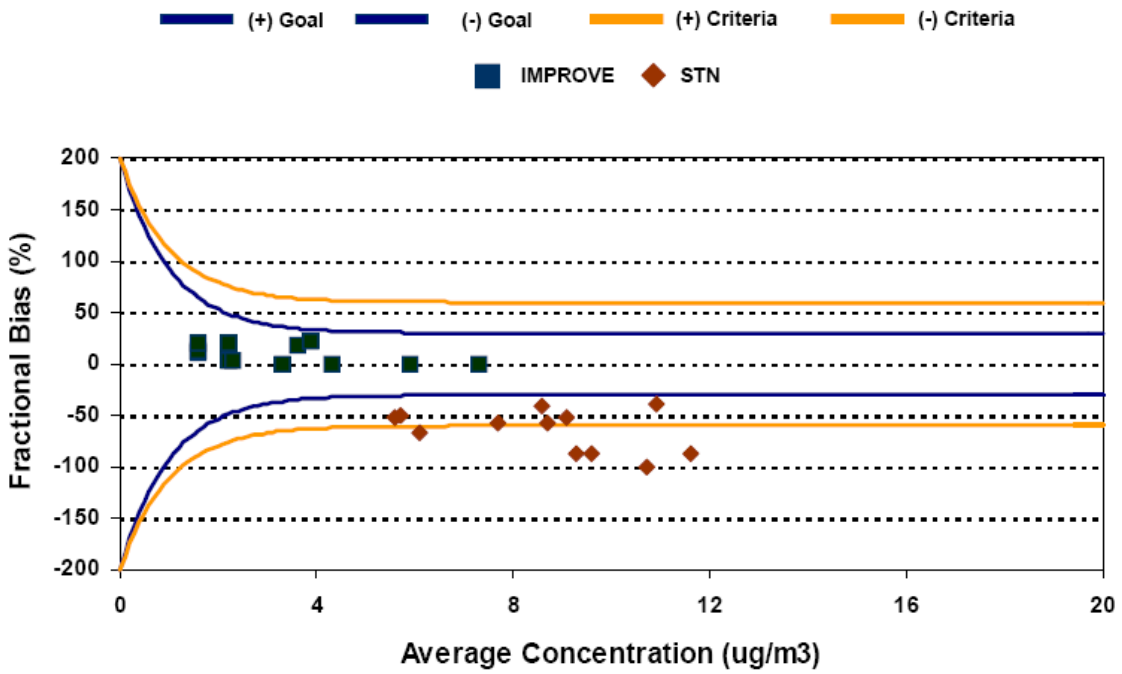

Figure 3. Model performance for total organic carbon (OC) where each data point shows a monthly average of fractional bias at all IMPROVE sites in the WRAP region.

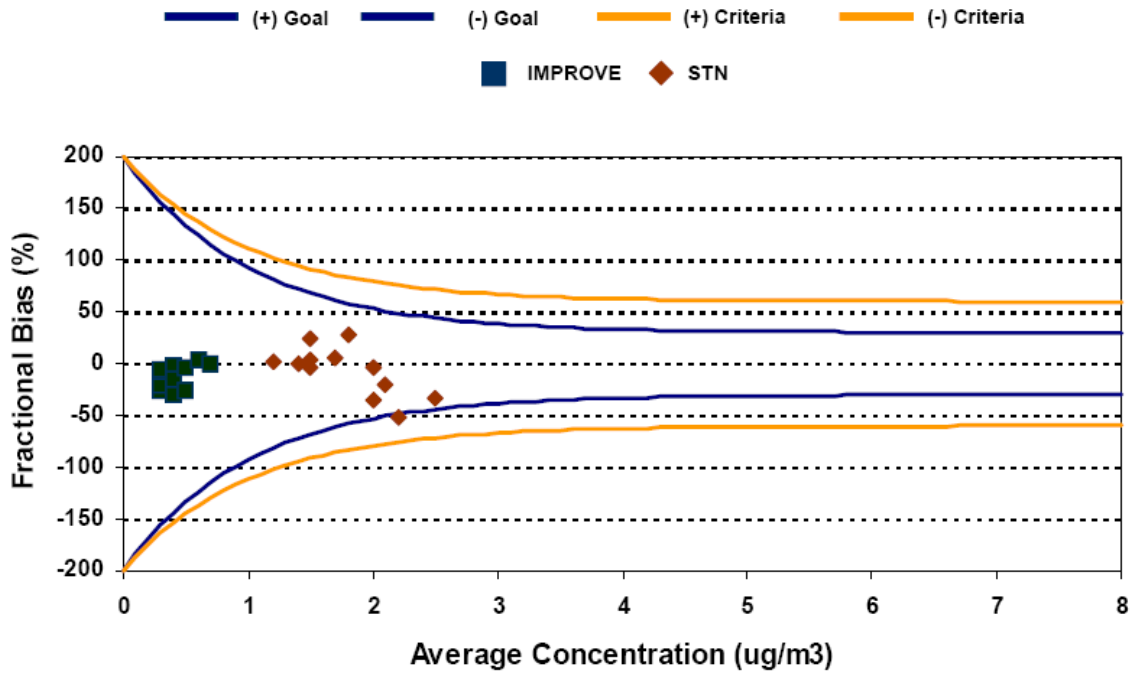

Figure 4. Model performance for elemental carbon (EC) where each data point shows a monthly average of fractional bias at all IMPROVE sites in the WRAP region.

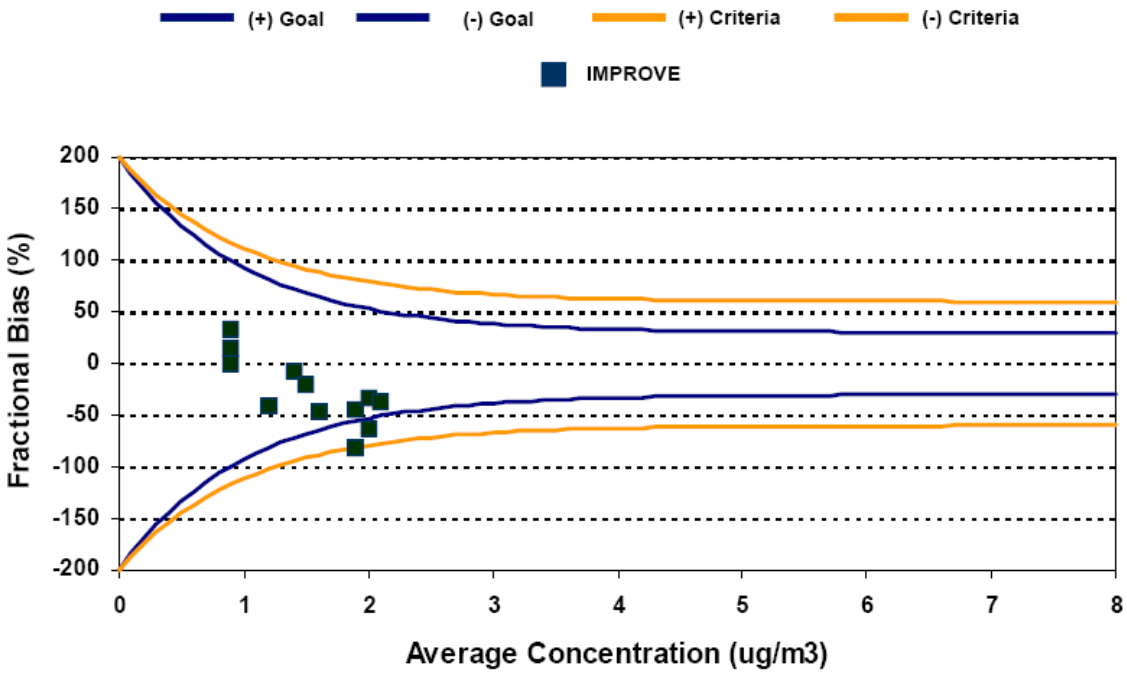

Figure 5. Model performance for soil where each data point shows a monthly average of fractional bias at all IMPROVE sites in the WRAP region.

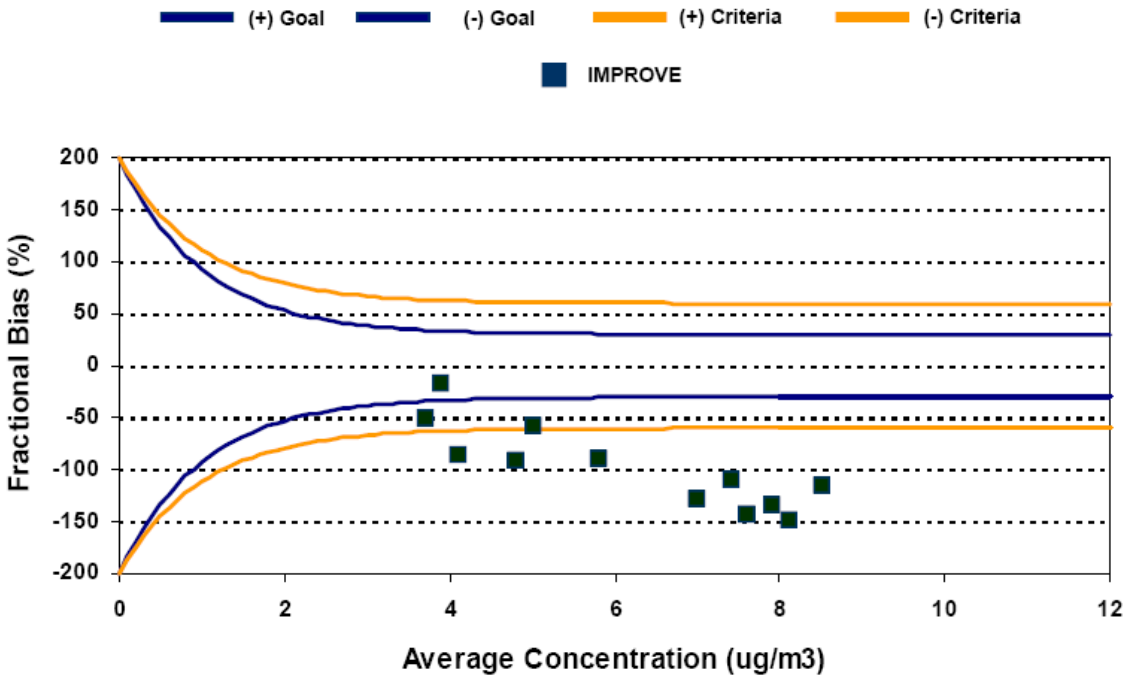

Figure 5. Model performance for coarse material (CM) where each data point shows a monthly average of fractional bias at all IMPROVE sites in the WRAP region.

Interpretation/Recommendations

The model performance for 2002 Base B meets the performance goals and performance criteria for most components of PM2.5. The 2002 Base B performance was very similar to the 2002 Base A model performance, with a very small degradation in model performance for some species, most notably for slightly larger sulfate under predictions. These results are consistent with reduced SOx emissions in 2002 Base B compared to the Base A case. The very small changes in model performance show that the changes to the emissions in Base B had only a very minor effect on model performance. In comparing the three different MPEs completed (CMAQ 4.4 Base A; CMAQ 4.5 Base A; and CMAQ 4.5 Base B) we found that all 3 versions of the MPE met the performance goals or performance criteria for most species, and that the model performance is fairly robust with respect to significant updates in the air quality model itself and the emissions input data. Based on the results of the MPE we recommend that the modeling system can be used for further analysis of planning scenarios and future emissions reduction scenarios.