



Comparison of NAQFC PM_{2.5} Speciation with IMPROVE and SEARCH Data: Initial Findings

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Goal: Improve Developmental NAQFC PM_{2.5}

Fine particulate matter (PM_{2.5}) forecasts are scheduled to be operational by the National Weather Service (NWS) in FY2015, but current developmental model results exhibit substantial seasonal biases as compared to U. S. EPA AIRNow measurements (Figure 1).

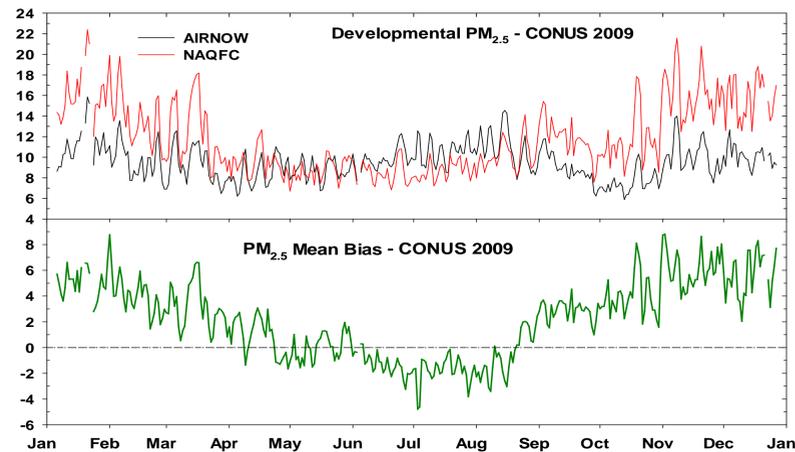


Figure 1. PM_{2.5} daily means and biases ($\mu\text{g m}^{-3}$) at AIRNow sites for the developmental NAQFC for 2009, illustrating typical summer underprediction and winter overprediction.

Approach

ARL has established a continuous evaluation-test-update cycle as a framework for improving PM_{2.5} results from the model. Daily forecast results from the developmental National Air Quality Forecasting Capability (NAQFC) are routinely compared with AIRNow total PM_{2.5} measurements in a daily forecast discussion. Detailed comparison of model results with chemically speciated IMPROVE and SEARCH PM_{2.5} measurements are then performed for periods where AIRNow measurements indicate “interesting” model behavior. Insight gained from these comparisons is used to guide ARL’s research into model updates and improvements. Retrospective model simulations and sensitivity studies are used to test hypotheses generated from these insights. Outcomes from retrospective simulation studies provide justification for ARL’s recommendations to the NWS to update NAQFC model processes or inputs.

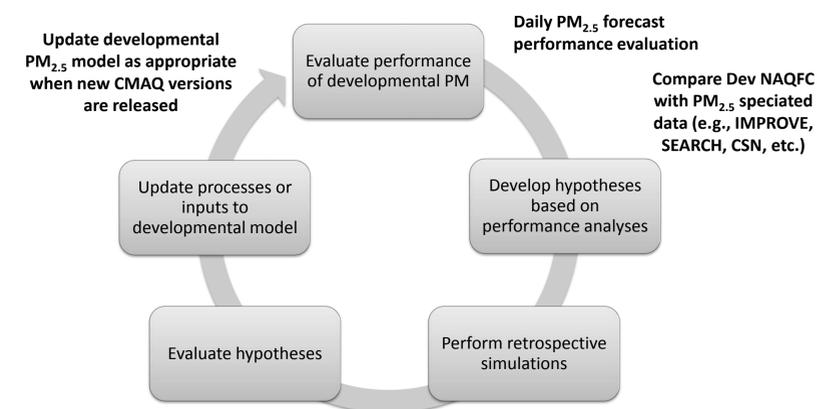


Figure 2. Evaluation-test-update cycle for improving developmental NAQFC PM_{2.5} model performance.

August 2009

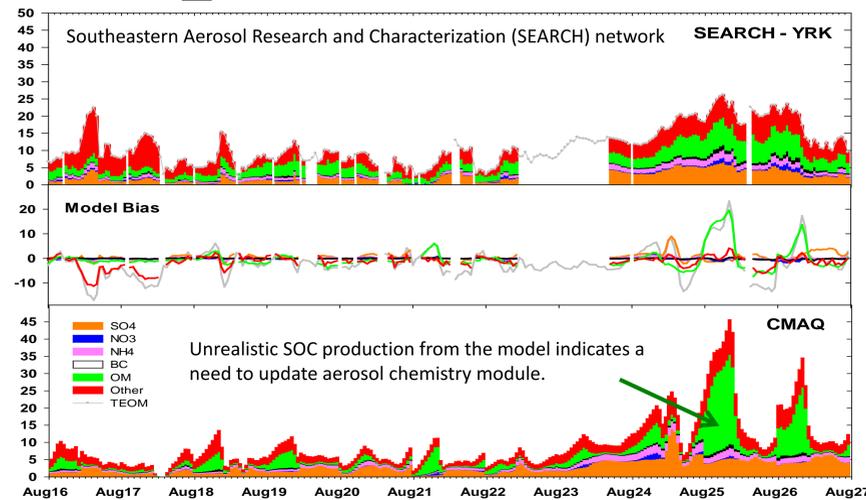


Figure 3. Comparison of hourly speciated SEARCH PM_{2.5} measurements with developmental NAQFC model results for August 2009 ($\mu\text{g m}^{-3}$).

(Model - IMPROVE) Biases - Aug 8, 2009

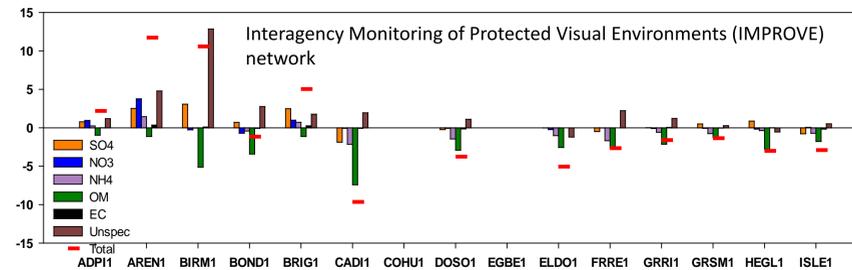
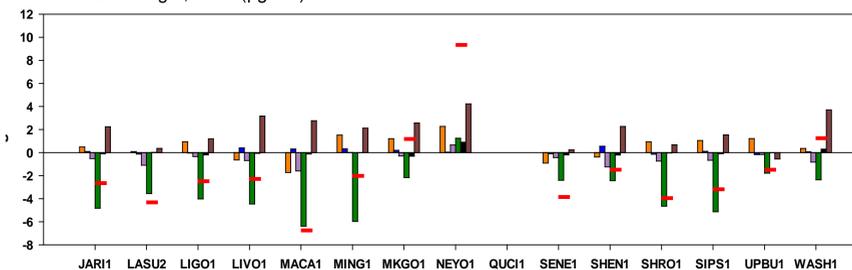


Figure 4. Comparison of 24 hr filter data at 30 IMPROVE sites with developmental NAQFC model results for Aug 8, 2009 ($\mu\text{g m}^{-3}$).



January 2009

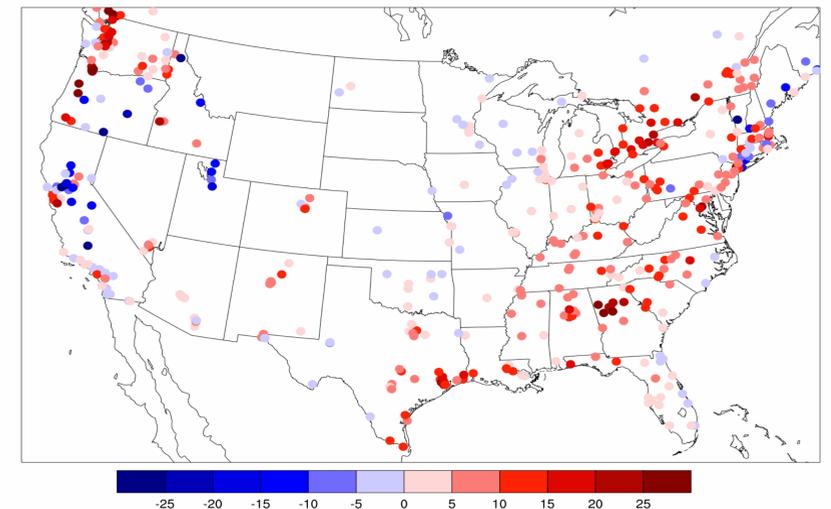


Figure 5. Daily-average PM_{2.5} bias ($\mu\text{g m}^{-3}$) of developmental NAQFC model results with respect to AIRNow measurements on January 13, 2009.

(Model - IMPROVE) Biases - Jan 13-19, 2009

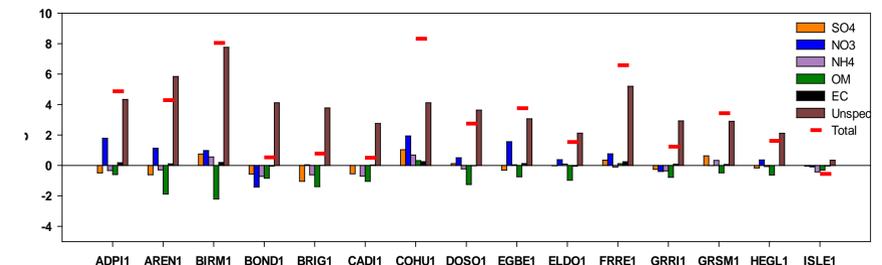


Figure 6. Comparison of 24 hr filter data at 30 IMPROVE sites with developmental NAQFC model results averaged over January 13-19, 2009 ($\mu\text{g m}^{-3}$).

Initial Findings

- Comparison with SEARCH data indicates a need to update the chemical transport model’s aerosol module from AERO4 to AERO5 – updated ΔH_{vap} .
- IMPROVE speciated comparisons for August 2009 illustrate that summer underpredictions are driven by organic matter (OM) underpredictions.
- IMPROVE speciated comparisons for January 2009 illustrate that winter overpredictions are primarily driven by overpredicted unspeciated primary PM_{2.5} emissions.
- PM_{2.5} organic matter is underpredicted in both winter and summer, but is masked by unspeciated primary PM_{2.5} overpredictions in winter.
- IMPROVE speciated comparisons for January 2009 suggest that PM_{2.5} NO₃⁻ may also be contributing to winter overpredictions.

Continuing Analysis

- ARL will continue to analyze additional SEARCH data for other periods in 2009.
- Retrospective simulations for August 2009 are being performed by ARL to test the impact of updating the aerosol module to AERO5.
- A retrospective simulation study is being planned by ARL for January 2009 to investigate improvements to the emission inputs for fugitive dust (a large component of unspeciated primary PM_{2.5}).
- As additional measurement data from IMPROVE, SEARCH and other sources are obtained, analyses will continue for model results for 2010 and beyond.
- Based on findings, ARL will make recommendations to the NWS for improvements to the NAQFC system.