



**Western Regional Air Partnership (WRAP)  
Regional Modeling Center (RMC)**

**Monthly Progress Report  
for May 2006**

Prepared by

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## Introduction

This is the May 2006 Monthly Progress Report that covers the activities of the Western Regional Air Partnership (WRAP) Regional Modeling Center (RMC).

## Background

The WRAP RMC is composed of staff from the University of California, Riverside (UCR), ENVIRON International Corporation, and the University of North Carolina's Carolina Environmental Program (UNC-CEP). The Principal Investigator and Project Manager for the RMC is Dr. Gail Tonnesen of UCR ([tonnesen@cert.ucr.edu](mailto:tonnesen@cert.ucr.edu)). Mr. Ralph Morris ([rmorris@environcorp.com](mailto:rmorris@environcorp.com)) and Mr. Zac Adelman ([zac@unc.edu](mailto:zac@unc.edu)) lead the RMC efforts at ENVIRON and UNC-CEP, respectively. The RMC is the contractor for meteorological, emissions, and air quality modeling and analysis performed for the WRAP region's states and tribes to provide the analytical results needed to address the requirements of the EPA Regional Haze Rule.

Current responsibilities of the RMC include:

- Emissions processing and modeling
- Air quality and visibility modeling simulations
- Analysis, display, and reporting of modeling results
- Storage and quality assurance of the modeling input and output files

The tasks and deliverables discussed in this report are based on the WRAP RMC 2005-06 work plan, which is available on the WRAP RMC web site:

<http://pah.cert.ucr.edu/aqm/308/docs.shtml>

The tasks are linked to and based on the WRAP Strategic Plan and the WRAP 2005 Work Plan, found at:

[http://wrapair.org/WRAP/meetings/031014board/Tab\\_4\\_Strategic\\_Plan\\_Final.pdf](http://wrapair.org/WRAP/meetings/031014board/Tab_4_Strategic_Plan_Final.pdf)

[http://wrapair.org/WRAP/documents/041207WRAP\\_CY05\\_Final\\_Workplan.pdf](http://wrapair.org/WRAP/documents/041207WRAP_CY05_Final_Workplan.pdf)

The WRAP Technical Coordinator (Tom Moore) and the cochairs of the WRAP Modeling Forum (John Vimont of the National Park Service, Mary Uhl of the New Mexico Environment Department, and Kevin Briggs of the Colorado Department of Public Health and Environment) provide day-to-day oversight of RMC activities, and the Modeling Forum oversees the activities of the RMC through monthly conference calls, topical conference calls, and periodic in-person meetings and workshops.

The WRAP is one of five Regional Planning Organizations (RPOs) consisting of states, tribes, federal and local agencies, and stakeholders charged with the responsibility for conducting technical analyses and assisting in the development of State Implementation Plans (SIPs) and Tribal Implementation Plans (TIPs) for regional haze in different areas of the United States.

## Overview of WRAP RMC 2005-06 Work Effort

The WRAP RMC 2005-06 work effort is focused on the following activities:

- 1) Finalize the 2002 base case input data and the selection of models to be used for future-year 2018 modeling.
- 2) Implement final performance metrics, displays, and methods to project future-year model results.
- 3) Complete and analyze a 2018 base case modeling scenario.
- 4) Complete and analyze several emissions reduction and emissions sensitivity scenarios.
- 5) Perform additional source apportionment model simulations.
- 6) Complete the visibility modeling effort for Alaska.

The 2005-06 work plan provides additional background information on these activities, and the revisions made to it in April 2006 provide specifics on the tasks being completed during 2006. The revisions are available at <http://pah.cert.ucr.edu/aqm/308/docs.shtml>.

The overall objective of the 2005-06 work plan is to complete all modeling studies and documentation needed for development of §308 SIPs and TIPs for regional haze. The WRAP visibility modeling system comprises the Sparse Matrix Operator Kernel Emissions (SMOKE) emissions model, the Fifth-Generation Mesoscale Model (MM5) meteorological model, and the Community Multiscale Air Quality (CMAQ) model. The WRAP modeling domain consists of a continental U.S. 36-km domain and a western U.S. 12-km domain. The WRAP RMC modeling efforts also include analysis of specific topics to support the other WRAP forums. The RMC's 2005-06 work effort as laid out in the work plan is divided into 12 tasks, listed below. Note that Task 3 is not covered in this report because it was essentially completed by the end of project year 2004.

- Task 1: Project Administration, Major Project Reports, and Computer Hardware and Systems Administration
- Task 2: Emissions Modeling, Processing, and Analysis
- Task 3: Test, Improve, Quality Control, Obtain External Peer Review, and Finalize 36-km and 12-km MM5 Simulations for Eventual Use in CMAQ (*completed in project year 2004*)
- Task 4: Air Quality Model Evaluation for 2002 Annual Simulation
- Task 5: Testing of and Further Improvements to the Windblown Dust Emissions Modeling Methodology

- Task 6: BART Source Sensitivity Screening Using CALPUFF
- Task 7: Sensitivity Studies Designed to Evaluate Uncertainties in Fire Emissions
- Task 8: Preliminary Meteorological, Emissions, and Air Quality Modeling Activities for Alaska
- Task 9: Further Analysis of Model Performance in Regard to the Contribution of Natural Emissions to Visibility Impairment
- Task 10: Preparation and Reporting of Geographic Source Apportionment Results
- Task 11: Technology Transfer
- Task 12: Computer Hardware

This task list was updated in April 2006, based on revised priorities and funding. The changes are reflected in the next section. Task 6 was renumbered to become Task 3, and Tasks 8 through 10 were deleted from the list. Also, the focuses of some of the remaining tasks were changed.

## Highlights for the May 2006 Reporting Period

- *Task 1—Project Administration, Major Reports, and Computer Systems Administration:* We completed project management and Modeling Forum conference calls and additional conference calls on specific topics.
- *Task 2—Emissions Modeling, Processing, and Analysis:* We completed the data collection, modeling, and QA for the Base 2018 version B simulation (Base18b). We fixed some problems with the typical 2002 version B simulation (Plan02b) data for input to CAMx with PSAT. We also addressed several questions about the Plan02b and Base18b emissions results.
- *Task 3—BART Source Sensitivity Screening Using CALPUFF:* A draft WRAP RMC CALPUFF BART modeling protocol was prepared and distributed to States for their review. We held conference calls with the five WRAP States requesting RMC assistance with their BART CALPUFF modeling. The processing of the 2001, 2002, and 2003 36-km MM5 data for BART CALPUFF modeling was completed.
- *Task 4—Air Quality Modeling:* We repeated simulations for some days in the annual CMAQ 36-km Planning 2002 version B simulation, and completed extraction of the model results at Class I areas to be used in visibility projections. We began the CAMx/PSAT 2002 Planning version B annual simulation and carried out QA on the initial PSAT model results. We found an error in the emissions, made corrections, and restarted the CAMx/PSAT simulation. We reorganized the emissions section of the RMC Web site and included links to emissions QA results in the visibility modeling results section of the Web site. We completed an analysis of the organic carbon (OC) aerosols, which showed large contributions to both primary and secondary OC from natural sources.

- *Task 5—Testing of and Further Improvements to the Windblown Dust Emissions Modeling Methodology:* Air quality modeling simulations with and without the windblown dust emissions were performed, and the analysis and evaluation of the results were completed. The final report was finished and submitted to the Dust Emission Joint Forum. This task has now been completed.
- *Task 7—Fire Sensitivity, Phase 2: Regional and Mesoscale:* No new activities this month.
- *Task 11—Technology Transfer and Data Distribution:* We made several revisions to the Web site for tracking data requests and project deliverables. We also responded to several questions and data requests from WRAP members.
- *Task 12—Computer Hardware:* We conducted routine maintenance of computer systems.

## May 2006 RMC Status Report

Below we discuss our progress during this monthly reporting period (May 2006) and expected activities during the next reporting period (June 2006). We also describe any difficulties encountered and their resolutions.

### ***Task 1: Project Administration, Major Reports, and Computer Systems Administration***

#### Purpose:

Within Task 1, the project administration subtask includes deliverables tracking and display, coordination with modeling efforts supported by other RPOs, attending meetings, participating in conference calls, and general project management. The major reports subtask covers preparation of several reports, including an RMC 2005-06 project final report. The computer systems administration subtask includes maintenance, updates, expansion, and optimization of the computing systems (software and hardware updates, maintenance of the project web site and listservs, and data backups and archiving).

#### Progress During This Reporting Period:

##### *Project Administration:*

UCR, ENVIRON, and UNC-CEP participated in monthly project administration and WRAP Modeling Forum conference calls. Each contractor also contributed to the monthly progress report and prepared invoices.

##### *Preparation of the 2006 Midyear Report and 2005-06 Project Report:*

None.

#### Expected Progress During the Next Reporting Period:

We will conduct conference calls and prepare monthly progress reports.

Difficulties Encountered and Resolutions:

None.

**Task 2: Emissions Modeling, Processing, and Analysis**

Purpose:

To develop final emissions inventories for the 2002 model performance evaluation case, a typical 2002 case, a 2018 base case, and several 2018 emissions control strategy cases.

Progress During This Reporting Period:

*Technical Activities:*

Our primary focus in May was to continue the modeling and QA of the Base 2018 version B simulation (Base18b) that we started in April, and to follow up on several technical issues that we discovered during the QA of the typical 2002 version B simulation (Plan02b). The updates for simulation Base18b encompassed many of the changes that we made to complete both Plan02b and the base 2002 version B (Base02b) simulations. The inventory preparation tasks that we completed for Base18b included:

- Refined the list of dust sources in the 2018 area and dust inventories, based on simulation Plan02b
- Developed a new CENRAP 2018 area-source inventory by applying revised projection factors received from CENRAP to the Plan02b area-source inventory
- Modeled 2018 on-road mobile sources for the non-WRAP states with corrected 2018 emissions factors
- Applied a series of corrections to the WRAP 2018 point-source inventory based on guidance from ERG, Inc.
- Developed new MRPO and CENRAP 2018 point-source inventories using revised projection factors received from each RPO.
- Removed IPM temporal profiles for large point sources in the non-WRAP states
- Modeled revised agricultural and prescribed fires in the WRAP region, and corrected the temporal and speciation profiles for the WRAP non-Federal rangeland fires
- Modeled revised Gulf of Mexico offshore area-source inventory

We continued improving the results reporting and data distribution resources on the RMC Web site. We finished posting the SMOKE data files for simulations Base02b and Base18b onto an ftp area on the RMC servers for open electronic distribution to the modeling community. We also continued working on the selection of sources in the WRAP 2002 inventories that are eligible for control under the BART rule.

*Preparation of the 2006 Midyear Report and 2005-06 Project Report:*

We documented the changes to simulation Base18b relative to the Plan02b and Base18a simulations. We will include the documentation of these changes in the 2006 midyear report. We

also continued to compile a list of the changes that will be implemented in the Base2018b simulation relative to the initial versions of these simulations.

Expected Progress During the Next Reporting Period:

In June, we plan to begin version C of the Typical 2002 simulation (Plan02c). We will also complete work on the BART source selection, and distribute the state and tribal worksheets to finalize those sources that we will include in our BART sensitivity modeling.

Difficulties Encountered and Resolutions:

During May we addressed some questions about emissions issues that are explained below.

- Difference plots of on-road mobile-source emissions comparing simulations Base18b and Plan02b raised questions about whether the data were modeled correctly. The questionable differences were in the PM emissions with inconsistent trends throughout the modeling domain, where some regions showed increases moving from 2002 to 2018 and others showed decreases. After scrutiny of the data, we reached the conclusion that the trends in the modeled emissions are consistent with the input inventories and speciation profiles, despite the apparent counterintuitive modeling results. An explanation of the trends in this comparison as they relate to the input data follows.

Question 1: Why do the on-road mobile-source inventories show across the board decreases in PM2.5 but the modeling results show increases in PMFINE?

Answer: The PM2.5 inventory components that are speciated to PMFINE (brake-wear and tire-wear) actually increase from 2002 to 2018. The reason the total inventory PM2.5 decreases is because of very large decreases in the other component of PM2.5, GASPM25.

Question 2: Are the across-the-board decreases in PEC and PSO4 and the across-the-board increases in PMC consistent with the inventories?

Answer: Yes, these trends in the emissions modeling results originate in the inventories

Question 3: Why do the POA emissions modeling results show decreases in all states but CA, NV, and a cell or two in UT and MT, but increases everywhere else?

Answer: The inventory equivalent for POA, OC2\_5, shows only part of the picture, as is seen in the % difference plots for OC2\_5 showing both increases and decreases in the WRAP states. The other part of the picture for POA involves the speciation profiles for the GASPM25 inventory pollutant. These profiles show that GASPM25 goes to PEC and POA. Inventory GASPM25 has large across-the-board decreases from 2002 to 2018. So obviously the decrease in OC2\_5 plus a decrease in GASPM25 will lead to an overall decrease in POA in the modeling results, but for those states where there is an increase in OC2\_5 (AZ, CA, CO, MT, NV, NM, UT) things are not as clear. In the inventories, OC2\_5 consistently is about 55% larger than GASPM25, and at most half of the GASPM25 goes to POA. We concluded that the inventory reductions in GASPM25 from 2002 to 2018 are large enough, outside of CA, to lead to an overall decrease in POA for all the states except CA and NV. In these two states, the increases in OC2\_5 dominate the corresponding decreases in GASPM25.

- We also discovered a units inconsistency in the elevated point source component of the CAMx emissions. We created the original emissions files with units of moles/s. CAMx expects units of moles/h and thus received elevated point source emissions underestimated by a factor of 3600. Rerunning SMOKE with the correct units fixed this problem.
- Questions about the differences in POA emissions between simulations Plan02b and Base18b led to questions about the fire emissions. We discovered that the POA differences were due to changes to the area inventory and to the projection from 2002 to 2018, not due to the fire inventories, as was originally suspected.

### **Task 3: BART Source Sensitivity Screening Using CALPUFF**

#### Purpose:

To assist States in addressing the modeling requirements of the Best Available Retrofit Technology (BART) component of the Regional Haze Rule (RHR).

#### Progress During This Reporting Period:

##### *Technical Activities:*

We prepared a draft WRAP RMC BART CALPUFF modeling protocol dated May 5, 2006, that addressed the following:

- Processing of 2001, 2002, and 2003 36-km MM5 data for BART CALMET/CALPUFF modeling of AZ, MT, NM, NV, SD, and UT.
- BART CALMET/CALPUFF modeling of AZ, NM, NV, SD, and UT for 2001, 2002, and 2003.
- BART CALMET/CALPUFF modeling of AK for 2002.

The processing of the 2001, 2002, and 2003 36-km MM5 data for CALMET/CALPUFF modeling was completed.

Separate conference calls with the states of AK, AZ, NM, NV, SD, and UT were held to go over the modeling approach and obtain comments on the modeling protocol and the request for emissions information.

#### *Preparation of the 2006 Midyear Report and 2005-06 Project Report:*

None.

#### Expected Progress During the Next Reporting Period:

Based on the comments from the states and other parties, the WRAP BART CALPUFF modeling protocol will be updated. We will also work with the states to obtain the emissions information needed from the potential BART-eligible sources.

#### Difficulties Encountered and Resolutions:

None.

#### **Task 4: Air Quality Modeling**

##### Purpose:

To complete the 2002 base-year air quality modeling performed with CMAQ and CAMx, 2000-2004 typical-year modeling, 2018 base case modeling, and a series of 2018 control strategy modeling runs. Also, to perform model bug fixes, model version updates, sensitivity experiments, and source apportionment modeling.

##### Progress During This Reporting Period:

###### *Technical Activities:*

We discovered that two days in the 2002 Planning version B emissions had errors (missing fire emissions), so we repeated simulations for those days and the associated spin-up periods in the annual CMAQ 36-km 2002 Planning version B simulation. We finished extracting the model results at Class I sites for the 2002 Planning and 2018 Base version B simulation model results, and completed the visibility projections at Class I areas. The results show that all WRAP Class I areas fail to achieved the target visibility reductions, and that many sites achieve only around 10%-20% of the target visibility reductions.

We began the CAMx/PSAT 2002 Planning version B annual simulation and carried out QA on the initial PSAT model results. We found an error in the emissions, made corrections, and restarted the CAMx/PSAT simulation. We completed the final model performance evaluation (MPE) for the annual CMAQ Base 2002 version B simulation. We completed a two-month sensitivity simulation with zero windblown dust emissions. We reorganized the visibility emissions modeling section of the RMC Web site and included links to emissions QA results on the visibility modeling results section of the Web site, and posted several model specification sheets. We completed an analysis of the organic carbon (OC) aerosols, which showed large contributions to both primary and secondary OC from natural sources.

We performed additional analysis of the OC aerosols in the CMAQ Base 2002 version B and in the CMAQ clean emissions simulations. The purpose of this analysis was to determine to what extent OC could be attributed to natural primary organic aerosol (POA) emissions and secondary organic aerosols (SOA) from natural VOC versus the amount of OC that was formed from anthropogenic POA and SOA. We found that SOA was primarily from natural emissions, and that there was a large natural contribution to POA from natural fires. Therefore, a substantial fraction of model-simulated OC is uncontrollable because it is produced from natural sources.

###### *Preparation of the 2006 Midyear Report and 2005-06 Project Report:*

None.

##### Expected Progress During the Next Reporting Period:

We will review the partially completed 2002 Planning version B PSAT results and begin considering the modeling of additional emissions control simulations.

##### Difficulties Encountered and Resolutions:

None.

### ***Task 5: Testing of and Further Improvements to the Windblown Dust Emissions Modeling Methodology***

Purpose:

To implement further improvements to the windblown dust emissions modeling methodology, and to test the effect of alternative schemes in CMAQ.

Progress During This Reporting Period:

*Technical Activities:*

Evaluation of the results of CMAQ air quality modeling with and without the windblown dust emissions was completed. The task final report was finished and submitted to the Dust Emissions Joint Forum.

*Preparation of the 2006 Midyear Report and 2005-06 Project Report:*

None.

Expected Progress During the Next Reporting Period:

This task has been completed.

Difficulties Encountered and Resolutions:

None.

### ***Task 7: Fire Sensitivity, Phase 2: Regional and Mesoscale***

Purpose:

To perform additional modeling studies to evaluate sensitivity to uncertainty in the fire emissions inventory. Major uncertainties include the effect of the plume rise height for fire emissions, and the effects of small fires in or near Class I areas.

Progress During This Reporting Period:

*Technical Activities:*

In our previous comparisons of the default Fire Emissions Joint Forum (FEJF) plume rise profiles versus the Clear Skies plume rise formula based on heat flux, we identified substantial differences in the fire plume rise between the two approaches. However, because the Clear Skies approach requires the operation of an MS Windows-based program, the Fire Emissions Production Simulator (FEPS), it is not possible to routinely implement this approach in CMAQ simulations. In conversation with colleagues and with EPA, we learned that EPA is developing software to implement the Clear Skies plume rise algorithm more generally; however, we have not yet determined whether to pursue this approach.

*Preparation of the 2006 Midyear Report and 2005-06 Project Report:*

None.

Expected Progress During the Next Reporting Period:

We will discuss with WRAP what additional work is required to complete this task.

Difficulties Encountered and Resolutions:

None.

**Task 11: Technology Transfer and Data Distribution**

Purpose:

To transfer the models, model evaluation tools, and data sets to the states and tribes so that they can perform additional studies of emissions reduction strategies, including supporting these groups in model setup and operation.

Progress During This Reporting Period:

*Technical Activities:*

We replied to several requests for data and information about the visibility modeling. The Web page for tracking data requests is [http://pah.cert.ucr.edu/aqm/308/data\\_transfer.shtml](http://pah.cert.ucr.edu/aqm/308/data_transfer.shtml).

*Preparation of information on the availability of data and tools, to be included in the 2006 Midyear Report and 2005-06 Project Report:*

None.

Expected Progress During the Next Reporting Period:

We will perform routine updates to the Web site, and respond to data requests from WRAP member states and tribes, as needed.

Difficulties Encountered and Resolutions:

None.

**Task 12: Computer Hardware**

Purpose:

To acquire new/additional equipment to support the RMC's work on the above tasks.

Progress During This Reporting Period:

We conducted routine maintenance and repair of computers and data storage systems.

Expected Progress During the Next Reporting Period:

We will purchase additional hard disks for archiving and data transfer.

Difficulties Encountered and Resolutions:

None.