



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

**Monthly Progress Report  
for April 2006**

Prepared by

University of California, Riverside (UCR)

ENVIRON International Corporation

University of North Carolina's Carolina Environmental Program (UNC-CEP)

## Introduction

This is the April 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 (please refer to the 2005-06 work plan for background information):

- 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 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

## Highlights for the April 2006 Reporting Period

- *Task 1—Project Administration, Major Project Reports, and Computer Hardware and Systems Administration:* We completed revisions to the 2006 work plan and budget.
- *Task 2—Emissions Modeling, Processing, and Analysis:* We completed the data collection, modeling, and QA for the Planning 2002 version B simulation (Plan02b). We also began the data preparation and modeling for Base 2018 version B simulation (Base2018b). We prepared the Plan02b data for input to CMAQ and for a test simulation of CAMx with PSAT. We continued the BART source selection process and the preparation of worksheets that the states will use to confirm the selection of the BART-eligible sources.
- *Task 4—Air Quality Model Evaluation for 2002 Annual Simulation:* We completed the annual CMAQ 36-km Planning 2002 version B and Base 2018 version B simulations. 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 wind-blown dust emissions in April-May. We reorganized the visibility modeling section of the Web site and posted several model specification sheets.
- *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. The results will be evaluated and the final report completed during May.
- *Task 6—BART Source Sensitivity Screening Using CALPUFF:* A preliminary draft WRAP RMC CALPUFF BART modeling protocol was prepared and reviewed by the Modeling Forum cochairs. We also began processing the 2001, 2002, and 2003 36-km MM5 data for BART CALPUFF modeling.
- *Task 8—Preliminary Meteorological, Emissions, and Air Quality Modeling Activities for Alaska:* The WRAP Alaska CALPUFF modeling database was evaluated for suitability for BART modeling.
- *Task 10—Preparation and Reporting of Geographic Source Apportionment Results:* We had additional discussions to finalize plans for emissions source categories and source region

groupings to be used in the CAMx/PSAT simulation. We performed QA and made revisions to how we process the point-source emissions for allocating them to the correct state. The initial PSAT simulation, which will begin in May, will be performed with the Planning 2002 version B emissions.

- *Task 11—Technology Transfer:* 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.

## **April 2006 RMC Status Report**

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

### ***Task 1: Project Administration, Major Project Reports, and Computer Hardware and 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 project reports subtask covers preparation of four reports: the 2004 final report, the 2002 model performance report, the 2018 base case modeling report, and the RMC 2005-06 project final report. The computer hardware and 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. In addition, we participated in conference calls with the WRAP Modeling Forum to finalize revisions to the RMC work plan and budget for 2006.

##### *Major Project Reports:*

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 April was to begin the modeling and QA of the Planning 2002 version B simulation (Plan02b). Continuing the refinements and corrections that we included in Base02b, the updates for simulation Plan02b encompassed many of the changes that we made to complete both the typical 2002 version A simulation (Plan02a) and the Base02b simulation. After integrating the changes made for simulation Base02b with the typical-year fire data from the WRAP and VISTAS regions, we addressed some issues that we discovered while performing QA on the Plan02a and Base02b simulations. We expanded the list of fugitive dust SCCs for the Plan02b simulation, extracting these sources from the area-source inventory to the explicit fugitive dust inventory. We adjusted the  $PM_{2.5}/PM_{10}$  ratios for these dust sources before appending them to the rest of the existing fugitive dust inventory. While we discovered an incorrect application of  $PM_{2.5}$  and VOC speciation profiles for non-Federal rangeland fires in the WRAP region, we decided that the amount of time and effort that would be needed to reprocess these emissions was not justified due to the small impact that these sources have on the total inventory (<0.5% of the  $PM_{2.5}$  inventory in the WRAP region alone). Finally, we changed from using the actual 2002 area fires in the VISTAS region to the typical-year fires, designed specifically for planning simulations.

In April, we also began work on the 2018 Base version B (Base2018b) simulation. Tasks that we completed included the collection of new projection factors for the non-WRAP inventories, the application of these factors to the Plan02b inventories, refining the list of sources that compose the fugitive dust inventory and readjustment of the  $PM_{2.5}/PM_{10}$  ratio for these sources, and corrections to the non-WRAP on-road mobile emissions by reprocessing with corrected 2018 emissions factors.

Finally, we worked on a list of tasks to improve how the RMC communicates emissions modeling results and transfers data to the WRAP constituents. We improved the layout of the RMC emissions modeling Web pages by reorganizing how the simulations are presented and improving the type of information that we present with each simulation. This update to the Web pages includes adding specification sheets for each simulation that describe in detail the purpose of each simulation, the associated data sets, timing of the simulations, and where the results and data sets may be obtained. We also extracted the daily netCDF CMAQ emissions data to ASCII files to facilitate the conversion of these data to GIS format. We began to compile and refine the emissions data and SMOKE installation into an ftp area on the RMC servers for open electronic

distribution to the modeling community. Finally, we continued working on the selection of sources in the WRAP 2002 inventories that are eligible for control under the BART rule. We will identify all of the sources from the 2002 inventory that are BART-eligible and generate worksheets that we will distribute to the WRAP states and tribes to review. Based on the review results, we will include the BART sources in sensitivity simulations to assess their effects on the air quality modeling results.

*Preparation of the 2002 Model Performance Report, 2018 Base Case Modeling Report, and 2005-06 Project Report:*

We documented the changes to simulation Plan02b relative to the Base02b and Plan02a simulations. We will include the documentation of these changes in the 2005-06 midyear report. We also continued to compile a list of the changes that will be implemented in the Base 2018 version B (Base2018b) simulation relative to the initial versions of these simulations.

Expected Progress During the Next Reporting Period:

In May, we plan to begin version B of the Base 2018 simulation. 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 April we discovered some emissions issues that we will address in future modeling. These issues include:

- Corrections to the Base 2018 version A point-source inventories were identified by several WRAP states. We will receive a list of these corrections and apply them to the 2018 WRAP stationary point inventories before modeling for simulation Base2018b.
- There are inconsistencies in the way that we applied transport factors for fugitive dust between the Plan02a and Base2018a inventories. We will correct these errors in simulation Base2018b.

***Task 4: Air Quality Model Evaluation for 2002 Annual Simulation***

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, and sensitivity experiments.

Progress During This Reporting Period:

*Technical Activities:*

We completed model performance evaluation work for the CMAQ 36-km Base 2002 version B simulation. We also finished a two-month model simulation and data analysis for the zero windblown dust sensitivity simulation. We reorganized the RMC Web site to better present links to all information for each model simulation in a tabular format. We completed model specification sheets for several previous model simulations and posted these to the Web site. We

finished annual CMAQ model simulations for the Planning 2002 version B and the Base 2018 version B scenarios. We completed testing with CMAQ to determine the effect of the number of CPUs used in model simulations and found that the effect was generally small, with random errors in some grid cells that were similar to the errors previously noted that result from numerical noise in the ISORROPIA thermodynamics algorithm.

*Preparation of the 2002 Model Performance Report, 2018 Base Case Modeling Report, and 2005-06 Project Report:*

None.

Expected Progress During the Next Reporting Period:

We will complete analysis for the Planning 2002 version B and the Base 2018 version B annual CMAQ simulations. We will also perform additional analysis for the organic carbon (OC) aerosols for the Base 2002 B and the Clean 2002 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. (This is an optional task that is a follow-on to the 2004 task covering the same topic, and will be implemented only if we are directed to do so by the WRAP Dust Emissions Joint Forum.)

Progress During This Reporting Period:

*Technical Activities:*

CMAQ air quality modeling was performed with and without the windblown dust emissions. The results of the simulations will be evaluated and documented in the task final report.

*Preparation of the 2002 Model Performance Report and 2005-06 Project Report:*

None.

Expected Progress During the Next Reporting Period:

The windblown dust emissions model task report will be revised to discuss the updates to the model and the results of the CMAQ modeling runs. The task final report will be completed before the end of May.

Difficulties Encountered and Resolutions:

None.

## **Task 6: 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 preliminary draft WRAP RMC BART CALPUFF modeling protocol 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.

We also continued processing the 2001, 2002, and 2003 36-km MM5 data for CALMET/CALPUFF modeling.

#### *Preparation of the 2002 Model Performance Report, 2018 Base Case Modeling Report, and 2005-06 Project Report:*

None.

### Expected Progress During the Next Reporting Period:

We will update the draft BART modeling protocol and start discussing the approach with the affected WRAP-region states. Emission data received from the states will be processed for CALPUFF modeling, and we will finish processing MM5 data for CALMET/CALPUFF modeling.

### Difficulties Encountered and Resolutions:

None.

## **Task 7: Sensitivity Studies Designed to Evaluate Uncertainties in Fire Emissions**

### 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 2002 Model Performance 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 8. Preliminary Meteorological, Emissions, and Air Quality Modeling Activities for Alaska***

Purpose (exact purpose is TBD):

To model point and urban sources in Alaska using a 2002 modeling database based on the MM5, CALMET, and CALPUFF models.

Progress During This Reporting Period:

*Technical Activities:*

We began evaluating the Alaska CALPUFF database for its suitability for BART modeling. The specification of key inputs (e.g., ammonia) specific to Alaska was evaluated.

Expected Progress During the Next Reporting Period:

We will continue preparing the Alaska CALPUFF modeling report.

Difficulties Encountered and Resolutions:

None.

### **Task 9. Further Analysis of Model Performance in Regard to the Contribution of Natural Emissions to Visibility Impairment**

#### Purpose:

To identify the CMAQ “floor” (i.e., the minimum level to which visibility impairment could be reduced by controlling all anthropogenic emissions), and determine whether the base model runs are too “clean.”

#### Progress During This Reporting Period:

##### *Technical Activities:*

We performed no new work on this task during April.

##### *Preparation of the 2002 Model Performance Report and 2005-06 Project Report:*

None.

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

We will re-create the natural emissions simulation during the next two months, further refining the definition of natural emissions sources. We plan on re-creating the windblown dust emissions to differentiate between the natural and anthropogenic components of these data. There is also discussion on whether we should use the typical-fire inventories or continue to use the actual 2002 data.

#### Difficulties Encountered and Resolutions:

None.

### **Task 10. Preparation and Reporting of Geographic Source Apportionment Results**

#### Purpose:

To perform additional source apportionment simulations using either the CMAQ Tagged Species Source Apportionment (TSSA) or CAMx PM Source Apportionment Technology (PSAT) models, with the choice to be made based on further evaluation of both models.

#### Progress During This Reporting Period:

##### *Technical Activities:*

We continued discussing plans for emission source category and source region groupings to be used in the CAMx/PSAT simulation. The initial simulation will be performed with the Planning 2002 version B emissions. We performed QA and revisions to the source region map, and as a result we adopted a new approach for assigning point sources to the correct source region. We performed some additional CPU benchmark simulations with different numbers of tracers in PSAT and determined that it is not feasible to include together in a single simulation the nitrate, sulfate, and primary PM species. The PSAT simulation will therefore include only the nitrate and sulfate families of species.

*Preparation of the 2002 Model Performance Report, 2018 Base Case Modeling Report, and 2005-06 Project Report:*

None.

Expected Progress During the Next Reporting Period:

We will complete the emissions processing and QA and begin the PSAT simulation for the Planning 2002 version B case.

Difficulties Encountered and Resolutions:

None.

**Task 11: Technology Transfer**

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 changed the RMC Web site to track requests for data tracking, and 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).

We reorganized the visibility modeling results section of the Web site to make it easier to find all information about model simulations in a single location. The Web page for visibility modeling results is <http://pah.cert.ucr.edu/aqm/308/cmaq.shtml>.

We added a BART modeling section to the Web site to track progress on completing and delivering BART related modeling products to the states and tribes. The Web page for this is <http://pah.cert.ucr.edu/aqm/308/bart.shtml>.

*Preparation of information on the availability of data and tools, to be included in the 2002 Model Performance Report, 2018 Base Case Modeling 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.