



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

**Monthly Progress Report  
for July 2006**

Prepared by

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## Introduction

This is the July 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 below 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

The list above was revised in April 2006 when the work plan was updated, based on revised priorities and funding. The changes are reflected in the rest of this report. The original Task 6 was renumbered to become Task 3, and Tasks 8 through 10 were deleted. Also, the focuses of some of the remaining tasks were changed. In May 2006, Task 5 was deleted from the list below because all work on it was completed.

## Highlights for the July 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. We presented preliminary source apportionment results at the WRAP Attribution of Haze meeting in Denver on July 27, and participated in the WRAP Technical Support System (TSS) meeting on July 25.
- *Task 2—Emissions Modeling, Processing, and Analysis:* We continued to refine the base 2018 emissions inventories and modeling through the creation of simulations Base2018c and Base2018d. These new simulations resulted from a series of corrections to the base 2018 emissions impact point sources outside of the WRAP region and road dust emissions for the WRAP states.
- *Task 3—BART Source Sensitivity Screening Using CALPUFF:* Surface meteorological observations were processed for the CALMET/CALPUFF modeling. A draft final WRAP RMC CALPUFF BART modeling protocol dated July 31, 2006, was prepared and distributed for review.
- *Task 4—Air Quality Modeling:* We continued work on the CAMx/PSAT 2002 and 2018 simulations; we expect these to be completed in August. We processed partial results (i.e., monthly averages for several months) to present at the July 27-28 Attribution of Haze meeting. We prepared a manuscript comparing different approaches for estimating the fire plume rise height.
- *Task 7—Fire Sensitivity, Phase 2: Regional and Mesoscale:* We completed a manuscript describing the comparison of the WRAP default plume rise formula and the approach used in

the Blue Sky plume rise methodology, which uses fire-specific data from the Fire Emissions Production Simulator (FEPS).

- *Task 11—Technology Transfer and Data Distribution:* We replied to several requests for data and information about the visibility modeling.
- *Task 12—Computer Hardware:* We ordered six new 300-GB disk drives for archiving and data transfer.

## **July 2006 RMC Status Report**

Below we discuss our progress during this monthly reporting period (July 2006) and expected activities during the next reporting period (August 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. In addition, we presented preliminary source apportionment results at the WRAP Attribution of Haze meeting in Denver on July 27, and participated in the WRAP Technical Support System (TSS) meeting on July 25.

##### *Preparation of the 2006 report and final project report:*

None.

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

We will conduct conference calls and prepare monthly progress reports. We will also begin work on the next iteration of the work plan, to cover October 2006 through calendar year 2007.

#### 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 July was to fix a series of errors that we discovered in the base 2018 emissions modeling. We discovered that we incorrectly applied monthly temporal profiles for electricity generating units (EGUs) outside of the WRAP states. The inventories for these emissions were prepared as seven-month averages and as such required consistent temporal profiles to allocate the emissions correctly across the months and days of the year. When we first applied the accompanying temporal profiles to these inventories, we observed larger differences from the planning 2002 emissions than we thought were reasonable. We therefore held the temporal profiles constant between the 2002 and 2018 simulations. It was brought to our attention recently that the assumption of the seven-month averaging in the EGU inventories for the VISTAS, CENRAP, MRPO, and MANE-VU regions requires the application of the IPM-based temporal profiles to allocate these emissions correctly in time. To facilitate these corrections we split the point-source processing into two sets: western U.S. points, which include the WRAP states, Canada, and Mexico; and eastern U.S. points, which include the point-source emissions for the rest of the modeling domain. The correction of these emissions resulted in simulation base 2018 version c (Base2018c)

We also corrected two errors in PM<sub>2.5</sub> emissions that resulted in the creation of simulation base 2018 version d (Base2018d). Greg Stella of Alpine Geophysics notified us that the PM<sub>2.5</sub> speciation profile for coal combustion sources that we have been using has a mass fraction estimate 10 times too high for elemental carbon emissions. He recommends that we replace the profile with the standard EPA profile for coal combustion. We also discovered that during the process of reallocating the PM<sub>10</sub> emissions from road dust sources in the WRAP region between PM<sub>2.5</sub> and PMC, we inadvertently allocated all of the emissions to PM<sub>10</sub>. This error effectively zeroed out the PM<sub>2.5</sub> emissions from these sources, resulting in all of the PM mass for road dust in the WRAP region being represented as PMC. To correct this error we re-created the WRAP road dust inventory with the correct PM split factors. After correcting these errors in the PM emissions and combining with the non-WRAP EGU corrections described above, we created simulation Base2018d.

#### *Preparation of the 2006 report and final project report:*

We documented the errors and corrections in the base 2018 simulations and will include details about this work in the 2006 report.

### Expected Progress During the Next Reporting Period:

We plan to continue 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. We

will also continue to summarize and document issues with base 2002, base 2018, and planning 2002 emissions.

Difficulties Encountered and Resolutions:

During July we addressed some questions about emissions issues, and made corrections to the inventories and modeling to fix these issues, as described above.

**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:*

Concerns were raised with the proposal to conduct the WRAP CALMET/CALPUFF modeling using the NOOBS approach (i.e., no meteorological observations) so that the CALMET meteorological fields would be driven by the hourly 36-km MM5 data and the CALMET algorithms. EPA and Federal Land Managers (FLMs) have reported that running CALMET/CALPUFF in the NOOBS mode was less conservative (i.e., estimated lower concentrations) than when observations were also specified, and have traced the lower concentrations to CALMET estimating a more unstable atmosphere when run in the NOOBS mode; when meteorological observations are specified, the sky cover data from the surface meteorological observations are used in the stability calculation. Consequently, during July 2006 we acquired and processed surface meteorological and precipitation observations for input into CALMET. The ADEQ sponsored the processing of observed surface meteorological data for Alaska. The modeling domain for Alaska was also redefined to use a higher resolution (2 km vs. 5 km).

*Preparation of the 2006 report and final project report:*

None.

Expected Progress During the Next Reporting Period:

The WRAP BART exemption screening CALMET/CALPUFF modeling will begin in August 2006, starting with Nevada.

Difficulties Encountered and Resolutions:

The WRAP BART screening modeling has assumed for months that no meteorological observations would be used. A recent request that observations be used has affected schedule and budget. It is unclear whether there is sufficient funding available in the WRAP RMC BART task to complete the modeling at this time.

#### **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 continued the CAMx/PSAT 2002 Planning version B annual and the CAMx/PSAT 2018 simulations, and carried out additional QA on the PSAT model results. We processed partial results (i.e., monthly averages for several months) and presented these results at the July 27-28 Attribution of Haze (AoH) meeting in Denver. These results included monthly average spatial plots showing the impact of each source region/emissions source group, and monthly average bar plots showing the largest 20 contributors to visibility impairment at each receptor site. Examples of these results are included in a PowerPoint file prepared for the AoH meeting and complete results are on the RMC web site. These results also included comparisons of CAMx/PSAT and CMAQ/TSSA source apportionment for the January and July monthly averages. The results are similar for the two models, with CAMx/PSAT showing larger contributions from boundary conditions than did CMAQ/TSSA. However, boundary conditions were one of the largest contributors in both models at most receptor sites. The boundary conditions for both models were obtained from a global GEOS-CHEM simulation for 2002 with 3-h resolution. The web site also includes plots showing the spatial impact of boundary conditions for the monthly average results. The boundary conditions are much larger relative contributors to visibility impairment in the WRAP region compared to other RPOs because emissions within the WRAP region are small compared to emissions within the other RPOs. We expect to complete the CAMx/PSAT 2002 Plan C simulation by August 12, and to complete the 2018 Base B simulation before August 31. At that time we will prepare bar plots showing the largest contributors to visibility impairment for the average of the worst 20% visibility days at each Class I Area.

###### *Preparation of the 2006 report and final project report:*

None.

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

We will produce analysis products from the PSAT simulations using complete PSAT results for 2002 Plan C. These will include bar plots showing contributions of source groups to receptor sites using the monthly average of the PSAT results for the average of the worst 20% days at each receptor site. If the 2018 Base B simulation completes before August 28 (which is likely if there are no major computer failures), we will also process results for the 2018 simulation.

##### 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:*

We completed a manuscript describing the comparison of the WRAP default plume rise formula and the approach used in the Blue Sky plume rise methodology, which uses fire-specific data from the Fire Emissions Production Simulator (FEPS).

##### *Preparation of the 2006 report and final project report:*

None.

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

None.

#### 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 report and final 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. We ordered 6 new 300-GB disk drives for archiving and data transfer.

Expected Progress During the Next Reporting Period:

We need to purge old data from the data storage systems to free up disk space for the CALPUFF simulations.

Difficulties Encountered and Resolutions:

None.