



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

**Monthly Progress Report  
for January 2006**

Prepared by

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## Introduction

This is the January 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 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 January 2006 Reporting Period

- *Task 1—Project Administration, Major Project Reports, and Computer Hardware and Systems Administration:* We participated in the WRAP Modeling Forum Meeting and the Attribution of Haze Workgroup Meeting in San Diego, CA, January 24-25. We also participated in conference calls with the WRAP Modeling Forum to revise the work plan for 2006.
- *Task 2—Emissions Modeling, Processing, and Analysis:* We finalized the modeling and QA of the Planning 2002 version A (Plan02a) and Base 2018 version A (Base18a) annual emissions simulations. We presented the progress of the emissions modeling work to date on the current contract at the WRAP Modeling Forum Meeting in San Diego. We also began preparing for version B of the Planning 2002 and Base 2018 simulations.
- *Task 4—Air Quality Model Evaluation for 2002 Annual Simulation:* We completed the annual 36-km CMAQ 2018 simulation and the comparison of CMAQ 2018 with the CMAQ 2002 typical simulation for the purpose of completing the glide path calculations. We posted all results to the project web site (see <http://pah.cert.ucr.edu/aqm/308/cmaq.shtml>), and presented results at the WRAP Modeling Forum Meeting.
- *Task 5—Testing and Further Improvements to the Windblown Dust Emissions Modeling Methodology:* No work was performed during January. We are awaiting air quality modeling results with and without the windblown dust emissions in order to complete the final task report.
- *Task 6—BART Source Sensitivity Screening Using CALPUFF:* We prepared a BART modeling plan outline for review by the appropriate WRAP forums.
- *Task 7—Sensitivity Studies Designed to Evaluate Uncertainties in Fire Emissions:* We continued to analyze and QA the results of the CMAQ small-fire sensitivity simulations for two months (July and November) for the 12-km CMAQ grid in which we removed all small fires. We also selected one wildfire event and applied an alternative plume rise algorithm. We will compare the result reflecting the effects of this different approach with the standard approach that we have been using.

- *Task 8—Preliminary Meteorological, Emissions, and Air Quality Modeling Activities for Alaska:* Alaska modeling remained hold while the BART modeling approach was developed.
- *Task 9—Further Analysis of Model Performance in Regard to the Contribution of Natural Emissions to Visibility Impairment:* We defined the sources in the WRAP emissions inventory database that can be classified as natural and used these to build a simulation derived from Base02a for studying the natural background levels of haze using CMAQ. Results were posted to the project web site.
- *Task 10—Preparation and Reporting of Geographic Source Apportionment Results:* Activities are deferred until we complete revisions to the 2018 Version B emissions.
- *Task 11—Technology Transfer:* We responded to several questions and requests from WRAP member states and tribes.
- *Task 12—Computer Hardware:* We conducted routine maintenance of computer systems.

## January 2006 RMC Status Report

Below we discuss our progress during this monthly reporting period (January 2006) and expected activities during the next reporting period (February 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. We participated in the WRAP Modeling Forum Meeting and the Attribution of Haze Workgroup Meeting in San Diego, CA, January 24-25. We also participated in conference calls with the WRAP Modeling Forum to revise the work plan for 2006.

*Major Project Reports:*

We distributed the final draft of the 2002 model performance evaluation report and are waiting for comments due February 10 from the members of the Modeling Forum.

Expected Progress During the Next Reporting Period:

We will finalize the 2002 model performance evaluation report and revise the 2006 work plan.

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 January was to complete the QA of the data for the Planning 2002 (Plan02a) and Base 2018 (Base18a) annual simulations. Most of the modeling and QA for both simulations occurred in December; however, we did find an issue with the Base18a simulation that caused us to rerun these emissions this month (discussed below in the “Difficulties Encountered and Resolutions” section). We began to compile a list of all of the known issues with the Base 2002 version A (Base02a), Plan02a, and Base18a simulations that we will correct during the next round of modeling. We presented all of the emissions modeling performed to date on the current contract at the WRAP Modeling Forum meeting in San Diego on January 25-26.

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

We finished the emissions chapter and appendices for the 2002 model performance evaluation report. This chapter provides a comprehensive summary of the data collection, modeling, and QA efforts to complete the Base02a emissions simulation and preparation for the Plan02a and Base18a simulations. We are compiling information on simulations Plan02a and Base18a to include in the next major model performance report.

Expected Progress During the Next Reporting Period:

In February, we plan to complete version B of the Planning 2002 and Base 2018 simulations (Plan02b and Base18b, respectively). These simulations will include a series of corrections to issues that we discovered during the first round of modeling of these datasets.

Difficulties Encountered and Resolutions:

There were a host of errors that we encountered in the collection, preparation, and modeling for the Plan02a and Base18a simulations. Whenever we receive new inventory or ancillary data, we invariably encounter problems with the formatting and content of the files. Some of the issues that we confronted and corrected in January included the following:

- We ran MOBILE6 for simulation Base18a with 2002 emissions factors. This configuration problem mixed 2018 activities with 2002 emissions factors and led to a misrepresentation of the on-road mobile emissions estimates outside of the WRAP states. To correct this issue we reran MOBILE6 with the M6YEAR setting in SMOKE set to 2018.
- We discovered that in both the Plan02a and Base18a simulations we had used a set of IPM temporal profiles for non-WRAP EGU sources that caused large increases in the emissions from these sources. While this error is consistent in both simulations, we chose to correct it in the version B modeling for both simulations. We will remove the application of these IPM temporal profiles from the modeling and fall back to the standard CEM-based profiles for these sources.

Additional discussion about problems and QA observations concerning the Plan02a and Base18a simulations is available through the WRAP Emissions Support project management pages at <http://bugz.unc.edu>

#### ***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 the annual 36-km CMAQ 2018 simulation and the comparison of CMAQ 2018 to the CMAQ 2002 typical simulation for the purpose of completing the glide path calculations. We posted all results to the project web site (see <http://pah.cert.ucr.edu/aqm/308/cmaq.shtml>), and presented results at the WRAP Modeling Forum Meeting.

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

We completed the final draft of the 2002 model performance evaluation report.

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

We will revise the emissions inventories for the 2002 typical simulation and the 2018 simulation to develop a version B.

##### Difficulties Encountered and Resolutions:

None.

### **Task 5: Testing 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:*

No work was performed on this task. We are awaiting results from the CMAQ model with and without the windblown dust emissions in order to complete the analysis and the final task 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. CMAQ modeling runs and analyses will be performed using the new dust estimates. We will implement the new results and address the comments on the revised draft task report. Improvements to the methodologies will be incorporated as appropriate.

#### 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:*

The anticipated RMC role could consist of (1) assisting states as requested, such as providing MM5 data for CALPUFF modeling and recommending CALPUFF modeling approaches that can be used by the states; (2) performing CALMET/CALPUFF modeling of BART-eligible sources in Alaska; and (3) performing regional modeling using CAMx/PSAT and/or CMAQ to examine alternative programs or other aspects of BART. We prepared a BART modeling plan outline for review by the appropriate forums.

##### *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 continue to refine our BART modeling approach, finalize the BART modeling plan, and assist states in the BART analysis as requested.

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:*

We continued to analyze and QA the results of the CMAQ small-fire sensitivity simulations for two months (July and November) for the 12-km CMAQ grid in which we removed all small fires. We also processed one wildfire event to determine differences in the plume rise and vertical distribution of the emissions using two plume rise algorithms: (1) hourly precomputed plume rise values supplied by the Fire Emissions Joint Forum, and (2) the EPA/USFS Blue Sky algorithm that uses the spatial area and heat flux to calculate plume rise. We are comparing the vertical distribution of the emissions from this fire event using these two approaches.

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

None.

Expected Progress During the Next Reporting Period:

We will prepare a report describing the fire sensitivity simulations. In addition, after the initial comparison of the two plume rise algorithms, we will choose 5-6 other fire events to process and input to CMAQ for a sensitivity analysis assessing how each plume rise approach affects CMAQ predictions.

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:*

Based on direction given at the April 26-27, 2005, joint meeting of the Tribal Data Development Workgroup and the Emissions Forum on WRAP issues related to Alaska, we began finalizing the Alaska 2002 MM5 modeling report. We also continued with the Alaska CALMET/CALPUFF modeling. Given below is the status of each action item identified during the June 29 conference call described in a previous monthly report:

- Finish Alaska MM5 meteorological modeling report: This report, finished in September, is at [http://pah.cert.ucr.edu/aqm/308/docs/alaska/Alaska\\_MM5\\_DraftReport\\_Sept05.pdf](http://pah.cert.ucr.edu/aqm/308/docs/alaska/Alaska_MM5_DraftReport_Sept05.pdf).
- Finish Alaska CALPUFF modeling and write report, including chapter on potential Weight of Evidence (WOE) analysis that Alaska can use to project reasonable visibility progress for the visibility SIP: QA of the preliminary CALPUFF modeling identified errors in the emissions. These were corrected and the modeling was revised. The revised results are currently being analyzed.
- Contact Cathy Cahill at University of Alaska Fairbanks on what analysis they have been doing studying arctic haze: We have discussed this issue with Dr. Cahill and she is willing to help however she can. She will assist us in documenting arctic haze, smoke events, Asian dust transport, and other elements we will need for the Alaska WOE visibility SIP.
- Analyze WRAP fire emissions for Alaska and see whether they can be integrated into CALPUFF modeling: Due to limited resources we have shelved this task until additional resources become available.
- Prepare a 2005-06 project report that includes CALPUFF evaluation.

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 identified a list of sources in the Base02a emissions inventories that collectively represent natural emissions. We compiled these sources into simulation Base02nt for input to CMAQ for a natural emissions simulation. This simulation included following sources:

- Ammonia from wild animals and soils
- Forest wildfires
- Natural wildfire use
- Prescribed burning for forest management
- Biogenics from BEIS3
- Windblown dust

While all of these sources are represented as explicit sectors in the WRAP inventory database, for the non-WRAP states and the non-U.S. portions of the domain, we extracted the fire, dust, and ammonia sources from the stationary-area-source inventories. We then completed an annual CMAQ simulation for clean conditions, and posted results to the project web site.

Because of uncertainties in the sea salt emissions, we will include sea salt by including the measured data for sodium at IMPROVE sites rather than using modeled sodium.

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

We presented the results of simulation Base02nt at the WRAP Modeling Forum Meeting in San Diego. The summary slides we prepared for this meeting will provide the basis for summarizing this simulation in the next major model performance evaluation report.

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:

As we had already modeled all of these data in simulation Base02a and we just merged selected components together to create this simulation, we did not encounter any significant difficulties. We do anticipate refining the definition of what we include in the natural emissions simulations, but this does not represent a problem with the modeling.

***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:*

None.

*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 expect to begin the CAMx PSAT simulations using the 2018 scenario, but we still need to finish selecting the emissions categories to be analyzed for source apportionment. After finalizing the setup, we will create the needed emissions files and begin the source apportionment model simulations. It could take several months to complete emissions processing and CAMx PSAT modeling.

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 replied to several requests for data and information about the visibility modeling.

*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, 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:

None.

Difficulties Encountered and Resolutions:

None.