



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

**Monthly Progress Report
for August 2005**

Prepared by

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Introduction

This is the August 2005 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). Mr. Ralph Morris (rmorris@environcorp.com) and Mr. Zac Adelman (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/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 August 2005 Reporting Period

- *Task 1—Project Administration, Major Project Reports, and Computer Hardware and Systems Administration:* We completed the 2004 RMC project final report. We also continued to experiment with optimizing computer configurations, and repaired or replaced several RAID5 disk systems that were failing.
- *Task 2—Emissions Modeling, Processing, and Analysis:* We received the last of the inventories to be used in the first iteration of the Base 2002 annual simulation. We continued work on modeling and QA of the 2002 inventories that we already had on hand. This month we completed modeling the following sectors: WRAP, Canadian, and Mexican on-road mobile; the stationary point; U.S. nonroad mobile; windblown dust; fugitive dust; and road dust. We continued the processing and QA of the stationary-area-source and WRAP oil and gas emissions sectors. We addressed multiple issues with the data and modeling as they arose and continued documenting these issues through the online support database (bugz.unc.edu). We also began posting the emissions QA plots on the RMC web site.
- *Task 4—Air Quality Model Evaluation for 2002 Annual Simulation:* No new model simulations will be completed until the Final 2002 version A emissions are completed in September.
- *Task 5—Testing and Further Improvements to the Windblown Dust Emissions Modeling Methodology:* The windblown dust model was updated with 2001 land use data, new fugitive dust transport factors from EPA, and new fine/coarse PM speciation profiles from MRI. The model was rerun and the results are being analyzed.
- *Task 6—BART Source Sensitivity Screening Using CALPUFF:* We are reviewing and updating the WRAP RMC role in the BART modeling analysis. Based on the results of several conference calls and the WESTAR BART Workshop in Portland (August 31 - September 1), the RMC role will likely be to perform regional modeling using 3-D grid models (CMAQ/CAMx) with some source-specific analysis using PM source apportionment, leaving any CALPUFF source-specific modeling up to the states.

- *Task 7—Sensitivity Studies Designed to Evaluate Uncertainties in Fire Emissions:* We are waiting for the new emissions to be processed before we begin the fire sensitivity simulations.
- *Task 8—Preliminary Meteorological, Emissions, and Air Quality Modeling Activities for Alaska:* The Alaska MM5 report will be submitted in September. CALPUFF analysis continues.
- *Task 11—Technology Transfer:* We are continuing to edit and revise the technology transfer documents that are posted on the RMC web site.
- *Task 12—Computer Hardware:* We finished installing the two new RAID5 systems. We began replacing all of our computer operating systems (OSs) with the Red Hat Enterprise version. This version of the OS is not free, but it does include support and seems to be more reliable than the free versions of the OS that we have used until now.

August 2005 RMC Status Report

Below we discuss our progress during this monthly reporting period (August 2005) and expected activities during the next reporting period (September 2005). 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 August monthly progress report and prepared invoices.

Major Project Reports:

We completed the 2004 RMC project final report.

Computer Hardware and Systems Administration:

Hardware activities are discussed under Task 12.

Expected Progress During the Next Reporting Period:

We will conduct the September Modeling Forum and project management calls, and prepare the September progress report.

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 August was to continue the collection, modeling, and QA of the data for the first iteration of the Base 2002 annual simulation (Base02a). We completed modeling the following emission sectors: WRAP, Canadian, and Mexican on-road mobile; stationary point; U.S. nonroad mobile; windblown dust; fugitive dust; and road dust. We began processing the stationary-area-source and WRAP oil and gas emissions sectors for the Base 2002 emissions simulation. We prepared the fugitive and road dust inventories for modeling by applying county-based transport factors to scale down the raw inventories. We derived the U.S. transport factors from a revised data set provided by Tom Pace of the U.S. EPA. Gerry Mansell of ENVIRON derived land-use-based transport factors for Canada and Mexico using an approach similar to that developed by Pace. These Canadian and Mexican factors are the first of their kind used for modeling non-U.S. dust inventories.

We had extensive correspondence with ENVIRON regarding preparation of the nonroad- and on-road-mobile inventories. The items we discussed included the format of the inventory files that we would be receiving; what temporal, chemical, and spatial allocation profiles to apply to the sources; and the scheduling of the data delivery. We resolved all of these issues through e-mail exchanges with ENVIRON.

After receiving the WRAP stationary-area and stationary-point inventories from ERG, we discovered several errors in the data that we reconciled through multiple correspondences with ERG. The errors that we discovered and corrected with the help of ERG included bad stack parameters and location information in the stationary-point inventory, erroneous emissions values and FIPS codes in the stationary-area sources inventory, and bad formatting in both inventories.

We continued to improve the ancillary emissions files used for modeling the new inventories. Scrutiny of the temporal, chemical, and spatial allocation profiles and cross-reference files for all

of the sectors that we modeled resulted in corrections to several SCC assignments in all of the inventories.

We continued correspondence with ERG regarding the assignment of stack parameters to the Mexican stationary point sources. At the request of the WRAP, the RMC helped guide ERG in creating a revised Mexican inventory that would be available to the entire modeling community. We provided a list of SCC-based stack parameter defaults to ERG and made some recommendations on how to apply them to the Mexican inventory.

We are on the eighth iteration of the emissions modeling work plan that lays out our approach for emissions modeling through August 2006. We have added a new emissions sector to the work plan—oil and gas well emissions—in anticipation of a new inventory that is being prepared by ENVIRON. We also began creating and posting the post-SMOKE emissions QA plots on the UCR web site.

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

We generated one additional version of the 2005-06 emissions modeling work plan that explicitly define the various emissions simulations and their accompanying datasets. As we finalize this work plan for the Base 2002 simulation, we will make it available to the WRAP Modeling Forum via the RMC web site. We also continued quality assurance on the model-ready emissions for both the WRAP and the non-WRAP portions of the modeling domain for which we already have emissions inventories. The products of this QA work will be added to the 2002 model performance report.

Expected Progress During the Next Reporting Period:

We plan to complete the modeling and QA work for the Base02a simulation by the end of September. We will complete the modeling of the stationary area and oil and gas sectors and merge with the rest of the categories to create model-ready emissions.

Difficulties Encountered and Resolutions:

This is a brief description of the emissions problems encountered in August and their resolutions.

- We had no dust transport factors for Canada and Mexico. Options included using an across-the-board factor of 4 reduction or generating land-use-based factors. ENVIRON generated province-level and county-level factors for Canada and Mexico, respectively.
- A mix of monthly and annual inventories for the nonroad sector made applying the correct temporal profiles difficult. As a result we had to split the nonroad sector into nonroad-monthly and nonroad-yearly sectors. A detailed description of this process is available in Comment #1 at http://bugz.unc.edu/show_bug.cgi?id=1751
- We noted several warnings from SMOKE in modeling the stationary-point-source inventory. All of the warnings are related to issues with the inventories and are not within the scope of the RMC to correct. We noted the inventory issues in http://bugz.unc.edu/show_bug.cgi?id=1744

- Several SCCs in all of the sectors used fallback surrogates when spatially allocating the emissions. We went through and corrected these bad assignments and reran the gridding step for these sources.
- A review of the temporal profile assignments revealed that many large sources in all of the sectors used flat monthly profiles when intuitively they should have received seasonally- or monthly-varying profiles. We made corrections where appropriate and noted where improvements are needed. We will include this information in the Base02a technical summary.

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:

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 prepared an extended abstract on the unpaired-in-space and unpaired-in-time approaches for model evaluation, for presentation at the CMAS conference in September.

Difficulties Encountered and Resolutions:

There were additional delays in completing the emissions processing. Our goal now is to start some of the CMAQ modeling of the final 2002 base A case by September 15.

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:

The windblown dust model was updated as follows:

- Incorporation of the latest 2001 land use data
- Implementation of new fugitive dust transport factors (FDTF) from Tom Pace of EPA
- Incorporation of new fine/coarse speciation profiles from MRI

The windblown dust model was rerun with the updates listed above and we began to analyze the results.

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 perform CALMET/CALPUFF modeling to address the Best Available Retrofit Technology (BART) modeling requirements in the final EPA BART Rule.

Progress During This Reporting Period:

Technical Activities:

We had several conference calls and attended the WESTAR BART Workshop in Portland, OR (August 31-September 1). Based on these discussions we will likely revise the role of the WRAP RMC in the BART modeling to focus on regional 3-D grid modeling. CAMx/PSAT will be used to do source-specific modeling and CMAQ and/or CAMx will be used for group BART source modeling needed to evaluate alternative programs. Source-specific modeling using CALPUFF will be up to the states. The level of support provided to the states by the RMC for CALPUFF modeling is under discussion.

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 prepare the modeling protocol for the WRAP RMC's role in BART 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:

None.

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

None.

Expected Progress During the Next Reporting Period:

We will process the fire emissions for the small-fire (i.e., less than 100 acres) sensitivity simulation and to select cases for the plume rise sensitivity.

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 the previous monthly report:

- Finish Alaska MM5 meteorological modeling report: This report will be finished in early September.

- 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 at UAF and she is willing to help however she can. She will assist us in documenting arctic haze, smoke events, Asia 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.
- Preparation of 2005-06 Project Report (inclusion of this task in 2002 Model Performance Report and 2018 Base Case Modeling Report is TBD): None.

Expected Progress During the Next Reporting Period:

We will finish the Alaska 2002 MM5 modeling report and preliminary CALPUFF runs for 2002.

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:

None.

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

None.

Expected Progress During the Next Reporting Period:

In the next two months we anticipate creating a test simulation of a prototype sea salt and surf zone emissions model for adding marine emissions to the WRAP modeling, and beginning development of a prototype model for lightning NO_x emissions estimates. We will also review the natural emissions modeling results from the Section 309 modeling that was completed in 2003.

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:

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 will compile and test CAMx PSAT on the WRAP 36-km modeling domain.

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 continued preparation of technology transfer documents for posting to the web site.

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 post an initial version of the FAQ list on technology transfer on the RMC web site.

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 finished installing the two new RAID5 systems. We began replacing all of our computer operating systems (OSs) with the Red Hat Enterprise version. This version of the OS is not free, but it does include support and seems to be more reliable than the free versions of the OS that we have used until now. We converted several of our Opteron compute nodes into file servers to be used with our RAID5 disk systems. As soon as this was completed, some of our older RAID5 disk systems began to fail. Data was moved to the new disk systems and the older RAID5 systems are currently not in use.

Expected Progress During the Next Reporting Period:

We are evaluating the need for additional compute nodes and disk storage. We have about \$10K remaining in the equipment budget and expect to spend most of this in the next month.

Difficulties Encountered and Resolutions:

None.