



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

**Monthly Progress Report
for September 2005**

Prepared by

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Introduction

This is the September 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 September 2005 Reporting Period

- *Task 2—Emissions Modeling, Processing, and Analysis:* We completed the modeling for the first iteration of the Base 2002 annual simulation (Base02a). We continued quality assuring the 2002 inventories and the model results that compose the Base02a emissions. We finished posting the emissions QA plots for simulation Base02a on the RMC web site. We addressed multiple issues with the data and modeling as they arose and continued the documentation of these issues through the on-line support database (bugz.unc.edu). In October we will create Base02a emissions for CAMx and begin scheduling for the next annual emissions simulation, the planning 2002 case A (Plan02a).
- *Task 4—Air Quality Model Evaluation for 2002 Annual Simulation:* We modified CMAQ to include new species for separate tracking of windblown dust. We also completed the 2002 Final 36-km model simulation and began the model performance evaluation.
- *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:* The RMC is refining its role in the BART modeling as EPA continues to interpret the guidance. Currently, our role is to assist the states in the CALPUFF modeling by providing MM5 data for CALMET/CALPUFF modeling and a common CALPUFF modeling protocol. We will also be performing regional modeling to support some of the BART requirements.
- *Task 7—Sensitivity Studies Designed to Evaluate Uncertainties in Fire Emissions:* We discussed the setup of the emission sensitivity case with the WRAP fire forum. We plan to begin fire-size sensitivity runs in October.
- *Task 8—Preliminary Meteorological, Emissions, and Air Quality Modeling Activities for Alaska:* The Alaska MM5 report was completed in September. CALPUFF analysis continues to be evaluated and will be used in the Task 6 BART modeling.

- *Task 10—Preparation and Reporting of Geographic Source Apportionment Results:* We discussed the setup with WRAP and began emissions processing for CAMx/PSAT.

September 2005 RMC Status Report

Below we discuss our progress during this monthly reporting period (September 2005) and expected activities during the next reporting period (October 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:

None.

Computer Hardware and Systems Administration:

Hardware activities are discussed under Task 12.

Expected Progress During the Next Reporting Period:

We will conduct the October 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 September was to finalize 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: domain-wide stationary-area-source emissions, WRAP oil and gas emissions, fugitive dust, and road dust. Those dust sectors included adjustments for transport factors that we derived from a revised data set provided by Tom Pace of the U.S. EPA. In addition, we renamed the PM variables in the windblown dust emissions to PMC_WBD and PMFINE_WBD to use for tracking these sources in the air quality model simulations. We reprocessed the agricultural NH₃ inventory after discovering a problem with the soil NH₃ emissions. The agricultural NH₃ data that we included in the Base02a simulation do not contain any soil NH₃ emissions in the WRAP states.

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 new 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 ninth 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), finalizing the document for the Base02a emissions simulation. We also finalized the creation and posting of the post-SMOKE emissions QA plots for Base02a on the UCR web site.

Several people sent e-mails inquiring about the emissions plots that we posted on the RMC web site. We created a frequently asked questions page to answer the questions that we receive about the QA products that we post. ENVIRON alerted us to a lack of oil and gas emissions in CA. After several rounds of correspondence, we discovered that the oil and gas emissions for CA were expected to be represented in the WRAP stationary area file. The stationary area file provided by ERG did not include these emissions. We will not include CA oil and gas emissions in the Base02a emissions simulation; new CA oil and gas emissions will be delivered for the Plan02a simulation.

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 defines 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 QA on the model-ready emissions for both the WRAP and 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 begin the modeling and QA work for the 2002 planning inventory (Plan02a) simulation in October. We will also process three months' worth of Base02a emissions for input to CAMx during October. Finally, we plan to prepare the 12-km-resolution Base02a emissions.

Difficulties Encountered and Resolutions:

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

- Erroneously high soil NH₃ emissions due to bad emissions factors led us to reprocess these data, omitting the soil NH₃.
- We noted several dust-like sources in the stationary-area inventory that we thought should be included in the windblown or fugitive dust sectors. All of these sources are wind erosion from construction and agricultural processes. We were instructed by both ENVIRON and the EPA that these are not fugitive or windblown dust and thus should not receive transport factors. We left these sources in the stationary-area inventory.
- We corrected agricultural and waste burning temporal profiles for sources in the CENRAP states. We had been applying uniform monthly profiles, and corrected these by applying the VISTAS monthly profiles.
- Missing gridding cross references for oil and gas emissions in the WRAP region caused the emissions to be allocated to the fallback surrogate (population). We corrected this issue by assigning these emissions to the rural land area surrogate to avoid allocating them to population.

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 CMAQ simulation with the final emissions inventory (Base02a) that will be used in the model performance evaluation. We began the model performance evaluation by completing the standard performance metrics and plots for the IMPROVE data.

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 model performance evaluation by preparing a variety of model performance analyses, including the following: monthly average bias and error plots; bugle plots; annual stacked bar plots at each site; and stacked bar plots of average model performance at each site for the best and worst average 20% days. We will also complete CAMx simulations for two months (February and July) and will compare CAMx and CMAQ performance. We will begin the CAMx/PSAT simulation when the emissions are completed.

Difficulties Encountered and Resolutions:

We had problems with CMAQ convergence for a single day in the annual simulation. It took several days of debugging to discover the source of the error, which was eventually traced to an error in an MCIP file header on that day. We still do not understand why this error occurred now but not in earlier simulations with the Pre02d case.

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 are analyzing 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:

The role of the RMC for BART modeling continues to be refined. EPA is in the process of further interpretation of the BART guidance, and the RMC's role will be better defined when EPA guidance is more clear. At this time the anticipated RMC role would consist of (1) providing states with MM5 data for CALPUFF modeling and a CALPUFF modeling protocol that can be used by the states or modified as needed; (2) providing assistance to the states in their CALPUFF modeling as needed; and (3) performing regional modeling using CAMx/PSAT and/or CMAQ to examine alternative programs or other aspects of BART.

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:

During October we will process the MM5 data for CALPUFF modeling and prepare a modeling protocol for BART 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:

We participated in conference calls with the WRAP fire forum to define the fire sensitivity cases.

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, and begin the CMAQ fire sensitivity simulations.

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 was finished in 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 begin 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:

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 lighting 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:

We participated in calls with the WRAP to define the setup and emissions processing for the CAMx/PSAT source apportionment simulation.

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 preparing 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 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:

None.

Expected Progress During the Next Reporting Period:

We expect to spend most of the remaining hardware budget to purchase additional disk storage.

Difficulties Encountered and Resolutions:

We have had many failures of the older computer hardware that was purchased in 2002, and considerable effort is being spent maintaining these machines. We will likely retire some of these machines, and complete model simulations on the newer machines.