



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

**Monthly Progress Report
for December 2005**

Prepared by

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Introduction

This is the December 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 December 2005 Reporting Period

- *Task 1—Project Administration, Major Project Reports, and Computer Hardware and Systems Administration:* We completed the draft of the 2002 model performance evaluation report.
- *Task 2—Emissions Modeling, Processing, and Analysis:* We completed the data collection for and began modeling the planning 2002 (Plan02a) annual simulation for CMAQ. We also initiated the data collection and modeling effort for the first base 2018 (Base18a) annual simulation. We converted the base 2002 (Base02a) annual emissions to CAMx format. We also prepared emissions for a fire sensitivity simulation to study the effects of small wildfires. After discovering several problems with the fire sensitivity emissions and CAMx conversions, we made corrections to these data and regenerated the air quality model input files. We also worked with ERG, Inc. to create typical electricity generation unit (EGU) temporal profiles for the stationary point sources and to review the stack parameters that are applied to the latest Mexican point-source inventory.
- *Task 4—Air Quality Model Evaluation for 2002 Annual Simulation:* We completed the annual 36-km CAMx simulation and model performance evaluation and compared these results to the CMAQ 36-km results. We posted all results to the project web site (see <http://pah.cert.ucr.edu/aqm/308/cmaq.shtml>), and presented the evaluation results on the December Modeling Forum conference call.
- *Task 5—Testing and Further Improvements to the Windblown Dust Emissions Modeling Methodology:* No work was performed during December. 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 refined the approach to be taken by the WRAP RMC to assist with the BART modeling analysis.
- *Task 7—Sensitivity Studies Designed to Evaluate Uncertainties in Fire Emissions:* We completed CMAQ simulations for two months (July and November) for the 12-km CMAQ grid in which we removed all small fires, and we performed CMAQ simulations and compared these results to the base case CMAQ 12-km results.

- *Task 8—Preliminary Meteorological, Emissions, and Air Quality Modeling Activities for Alaska:* Alaska modeling was put on hold while the BART modeling approach was developed.
- *Task 10—Preparation and Reporting of Geographic Source Apportionment Results:* We continued to discuss the setup of the source apportionment modeling with WRAP. We revised the work plan to indicate that we will perform the annual CAMx/PSAT simulation using the planning scenarios instead of the 2002 version A model performance evaluation scenario. We continued to perform benchmarks on the PSAT code to prepare for these simulations when the Planning Case 2002 emissions are ready.

December 2005 RMC Status Report

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

Major Project Reports:

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

Expected Progress During the Next Reporting Period:

We will participate in the January 24-25 Modeling Forum meeting in San Diego. We will also finalize the 2002 model performance evaluation 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 December was to complete the modeling and QA of the data for the planning 2002 (Plan02a) and base 2018 (Base18a) annual simulations. Most of the preparation for the Plan02a simulation occurred in November; the data collection for Base18a and the modeling and QA for both simulations occurred this month. Preparation of the 2018 inventories to include in Base18a included the collection of existing inventories from WRAP contractors and other RPOs, and the application of projection factors to the Plan02a inventories for sectors that had not been projected to 2018 already. The RMC also worked with ERG, Inc. to develop a set of typical WRAP electricity generating unit (EGU) temporal profiles to apply in the Plan02a and Base18a simulations. Along with the modeling of these data, we posted all of the standard QA products to the RMC web site, and produced tabular and graphical QA summaries based on the WRAP emissions QA protocol that we will include in the model performance evaluation reports for these simulations.

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 data sets for the Plan02a and Base18a simulations. We finished preparing emissions QA and summary graphics to include in the 2002 model performance evaluation report and completed the emission modeling and QA sections of the draft of this report. We also continued QA on the model-ready emissions for both the WRAP and non-WRAP portions of the modeling domain for simulation Plan02a and Base18a; we will include these QA products in the next model performance evaluation report.

Expected Progress During the Next Reporting Period:

We plan to present the modeling and QA work for the 2002 Base02a, Plan02a, and Base18a simulations at the WRAP Modeling Forum meeting the last week of January. We will also complete the final version of the 2002 model performance evaluation report. Our January activities will also focus on preparing inventory summaries of these three simulations to deliver to Air Resource Specialists.

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 December included:

- Developing the WRAP EGU temporal profiles and cross-reference files took several iterations with ERG before we settled on a data set that matched all of the applicable sources; the first few iterations of this work did not contain enough information for SMOKE to match the profiles with the EGU sources in the WRAP region. The final set of profiles seemed to work with most of the EGU sources in the WRAP region.
- We found several bad FIPS codes in WA and WY in the Base18a stationary point inventory. ERG directed us to delete these records as they represented new facilities that had not yet been built
- We encountered a minor SMOKE configuration problem with the Plan02a runs that carries into the Base18a simulation. It has to do with whether the inventories are assumed to represent 7-day- or 5-day-week emissions (i.e., full-week emissions or weekday emissions only). All of the ENVIRON-prepared inventories assume a 7-day week, so we do not use the WEEKDAY_NORMALIZE function in SMOKE, which renormalizes 5-day inventories to 7-day allocation before running the temporal program. The inventories that ERG prepares assume that these are weekday emissions and thus need to be renormalized across all 7 days. Since we extracted the dust from area EIs, we should renormalize these data as well. We *did not* renormalize the road dust for the Plan2002 case. This was an artifact of using road dust that ENVIRON had provided in the Base02a case, which was based on a 7-day week, and then switching to an EI prepared by ERG, which is apparently based on a 5-day week. We also did not renormalize point or oil and gas sources, and both of these probably should have used this setting. We will make this change in the revised base/future modeling that we do next year. The added uncertainty is small.
- We found a problem with the winter season on-road mobile emissions for the non-CA WRAP states. In comparing Base02a and Plan02a, there are differences for the winter months outside of MT, the only non-CA state where there is supposed to be a difference. By comparing the inventory files for these two cases, we found that the problem is in the inventory and not in the modeling. During the other quarters, there are no differences outside of CA and MT in the inventories. ENVIRON confirmed that the on-road mobile inventory for the winter months in the Base02a simulation was wrong. The Plan02a emissions are correct. They will send us a new file for the Base02b simulation that we will complete in January.

Additional discussion about problems and QA observations about the Plan02a and Base18a simulations area 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 CAMx simulation and model performance evaluation and compared these results to the CMAQ 36-km results. We posted all results to the project web site (see <http://pah.cert.ucr.edu/aqm/308/cmaq.shtml>), and presented the evaluation results on the December Modeling Forum conference call. The evaluation products include those plots and performance metrics that we have found to be most useful during the past three years of visibility, including the following:

- Monthly-average model performance metrics
- Bugle plots (grouped both by species and by monitoring network)
- Animated spatial plots with data overlaid on the model predictions
- Stacked-bar time-series plots for each site
- Stacked-bar plots for the best and worst average 20% days at each site using (1) matched in space and time, (2) relaxed in time, and (3) relaxed in both space and time

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

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

Expected Progress During the Next Reporting Period:

None.

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. The RMC is working with Tom Moore on the development of the BART modeling approach.

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 refine our BART modeling approach, 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 completed CMAQ simulations for two months (July and November) for the 12-km CMAQ grid in which we removed all small fires. We also performed CMAQ simulations and compared these results to the base case CMAQ 12-km results.

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.

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.
- 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:

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 identify the emissions categories that should be analyzed for source apportionment, prepare the needed emissions files, and begin the source apportionment model simulations.

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:

None.

Expected Progress During the Next Reporting Period:

None.

Difficulties Encountered and Resolutions:

None.