



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

**Monthly Progress Report
for December 2004**

Prepared by

University of California at Riverside (UCR)

ENVIRON International Corporation

University of North Carolina/Carolina Environmental Program (UNC-CEP)

Introduction

This is the December 2004 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.

Responsibilities of the RMC include:

- Meteorological modeling
- 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

More details on the WRAP 2004 activities can be found in the WRAP RMC 2004 work plan, which is available on the WRAP RMC web site:

http://www.cert.ucr.edu/aqm/308/reports/RMC_2004_Workplan_Final_Version_03_01_04.pdf

The WRAP Technical Coordinator (Mr. 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 regular 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.

The WRAP RMC 2004 work effort, described next, has focused on developing the modeling analysis needed for preparing the §308 Regional Haze SIPs and TIPs due in 2007/2008.

Overview of WRAP RMC 2004 Work Effort

The WRAP RMC 2004 work has focused primarily on developing a 2002 annual air quality modeling database that can be used to simulate visibility impairment in the western United States. 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. In addition, the WRAP 2004 RMC activities include preliminary visibility modeling for Alaska, a WRAP state whose size and remoteness from the other states make it inefficient to include with the other states' modeling domain. The WRAP 2004 RMC work effort as laid out in the 2004 work plan is divided into 13 tasks, listed below. Note that Task 8 is not covered in this report because it did not receive funding for 2004. Also note that because the WRAP 2003 ammonia emissions modeling update activities were still gathering data at the end of 2003, the remaining funding in the 2003 budget was rolled over to 2004 and the work is presented as Task 0.5.

- Task 0.5: 2002 Ammonia Emissions Inventory for WRAP Region
- Task 1: Project Administration
- Task 2: Test, Improve, Quality Control, Obtain External Peer Review, and Finalize 36-km and 12-km MM5 Simulations for Eventual Use in CMAQ
- Task 3: 2002 Base Year Emissions Modeling, Processing, and Analysis
- Task 4: Air Quality Model Evaluation for 2002 Annual Simulation
- Task 5: Preparation and Reporting of Geographic Source Apportionment Results
- Task 6: Further Analysis of Model Performance in Regard to the Contribution of Natural Emissions to Visibility Impairment
- Task 7: Evaluation and Comparison of Alternative Models
- Task 8: Improvement of WRAP Spatial, Chemical Speciation, and Temporal Allocation Profiles (*not funded*)
- Task 9: Testing and Further Improvements to the Windblown Dust Emissions Modeling Methodology
- Task 10: Continued Improvement to Model Evaluation Software
- Task 11: Sensitivity Studies Designed to Evaluate Uncertainties in Fire Emissions
- Task 12: Preliminary Meteorological, Emissions, and Air Quality Modeling Activities for Alaska
- Task 13: Training Courses for the WRAP States and Tribes

Highlights for the December Reporting Period

- *Task 1—Project Administration:* We installed a new, high-speed network switch and experimented with systems configurations to optimize network performance.
- *Task 2—Test, Improve, Quality Control, Obtain External Peer Review, and Finalize 36-km and 12-km MM5 Simulations for Eventual Use in CMAQ:* The 2002 MM5 36/12-km model simulation using the revised configuration was completed in December. We are in the process of archiving the 1.7 TB of data on seven 250-GB FireWire disks, and performing the model performance evaluation.
- *Task 3—2002 Base Year Emissions Modeling, Processing, and Analysis:* We worked on the modeling, QA, and documentation of simulation Pre02d. Documentation for simulation Pre02d will consist of a Pre02d simulation final report and a comparison between simulations Pre02c and Pre02d in the 2004 final report. Also, we generated annual total gridded emissions for individual source types (biogenics, windblown dust, etc.) from the netCDF CMAQ inputs, transferred them to ASCII format, and sent them to Air Resource Specialists (ARS).
- *Task 4—Air Quality Model Evaluation for 2002 Annual Simulation:* We ran the CMAQ Meteorology-Chemistry Interface Processor (MCIP) to preprocess the output from the MM5 simulations for both the 36-km and 12-km domains.
- *Task 5—Preparation and Reporting of Geographic Source Apportionment Results:* We completed additional postprocessing of the source attribution simulation and delivered the results to ARS.
- *Task 7—Evaluation and Comparison of Alternative Models:* We began assembling the January and July 2002 databases for transfer from UCR to ENVIRON for the CAMx PM Source Apportionment Technology (PSAT) comparisons with the CMAQ Tagged Species Source Attribution (TSSA) PM source apportionment.
- *Task 9—Testing and Further Improvements to the Windblown Dust Emissions Modeling Methodology:* The initial model performance evaluation was completed in December. We began preparing the draft final task report, and expect to complete it in the first week of January.
- *Task 11—Sensitivity Studies Designed to Evaluate Uncertainties in Fire Emissions:* We finished analyzing the CMAQ fire scenario sensitivity simulation and presented results to the WRAP Fire Emissions Joint Forum in Las Vegas on December 8. We completed additional postprocessing of the fire emissions sensitivity simulations and delivered results to ARS.
- *Task 12—Preliminary Meteorological, Emissions, and Air Quality Modeling Activities for Alaska:* MM5 modeling for Alaska for 2002 was completed, and we began processing the MM5 data for input into CALMET/CALPUFF.

December 2004 RMC Status Report

Below we discuss our progress during this monthly reporting period (December 2004) and the expected activities during the next monthly reporting period (January 2004). We also describe any difficulties encountered and their resolutions.

Task 0.5: 2002 Ammonia Emissions Inventory for WRAP Region

Purpose:

To review current ammonia emissions generation techniques and develop a GIS-based ammonia emissions model.

Progress During This Reporting Period:

No additional work was performed during December. We are waiting for the revised 2002 MM5 meteorological data.

Expected Progress During the Next Reporting Period:

The ammonia model will be rerun using the new MM5 meteorology data when they become available. The development of the user's guide is still ongoing. No comments have been received on the draft final task report. The report will be revised to create the final task report during the first week of January.

Difficulties Encountered and Resolutions:

None.

Task 1: Project Administration

Purpose:

To manage the WRAP RMC activities, participate in WRAP conference calls, attend WRAP meetings, and prepare project status reports.

Progress During This Reporting Period:

General Activities:

UCR, ENVIRON, and UNC-CEP participated in various conference calls and administered the 2004 WRAP RMC work effort. Conference calls included the monthly WRAP Modeling Forum call, the WRAP Emissions Forum calls, and the WRAP RMC Project Management call. Each contractor also contributed to the November monthly progress report and prepared invoices. We continued to work on finalizing subcontract modifications that have been delayed by several months because of staff changes in the UCR Office of Research Affairs.

Computer Systems Administration:

We performed ongoing computer systems maintenance and updated the project web site as needed. We are experimenting with new computer systems configurations in an attempt to enhance system performance. This includes installing the OpenMosix software for managing

computing clusters; testing a new, high-speed network switch; and reconfiguring file servers to increase I/O speed.

Expected Progress During the Next Reporting Period:

We will begin working on the 2004 WRAP RMC final report and the 2005 work plan.

Difficulties Encountered and Resolutions:

None.

Task 2: Test, Improve, Quality Control, Obtain External Peer Review, and Finalize 36-km and 12-km MM5 Simulations for Eventual Use in CMAQ

Purpose:

To perform MM5 modeling for 2002 on the 36-km Inter-RPO continental U.S. grid and a 12-km western U.S. WRAP grid.

Progress During This Reporting Period:

We completed the annual 2002 MM5 36/12-km simulation using the final configuration based on the sensitivity tests and comments from the peer reviewers. The 2002 annual 36/12-km MM5 database is being assembled onto archive disks for backup and distribution.

Expected Progress During the Next Reporting Period:

During January 2005 we will evaluate the revised WRAP 2002 36/12-km MM5 simulation. The 36-km MM5 performance will be compared with the MM5 runs performed by VISTAS and CENRAP across the US. We will also compare the revised 36-km and 12-km MM5 results against each other in the western states.

Difficulties Encountered and Resolutions:

None.

Task 3. 2002 Base Year Emissions Modeling, Processing, and Analysis

Purpose:

To extend the work completed on the interim 2002 inventory by integrating the missing emissions sources into the modeling; to assimilate the results of applying the new analysis tools and QA plan for improving the emissions modeling process; and to integrate the final 2002 emissions inventories into a base 2002 emissions data set.

Progress During This Reporting Period:

Most of the work during December focused on completing the simulation, QA, and documentation of emissions case Pre02d. We prepared emissions regressions, spatial plots, time-series plots, and vertical profiles of the Pre02d emissions for QA purposes. We will announce the posting of these emissions QA graphics when they are made available on the WRAP RMC web site.

We continued working with the WRAP and ERG, the Mexican-emissions inventory contractor, to develop a protocol for transferring the 1999 Mexican emissions inventory to U.S. contractors

for modeling. We worked on finalizing the confidentiality requirements related to the point-source data; these require that the data be distributed with a nondisclosure agreement. How to develop the agreement and distribute the data, and the time frame for their delivery, were negotiated during a conference call between CEP, WRAP, and ERG, with ERG serving as the liaison for Mexico. These conversations indicated that a draft of the data should be available in March 2005.

Also as part of this task, we generated annual total gridded emissions for individual source types (biogenics, windblown dust, etc.) from the netCDF CMAQ inputs, transferred them to ASCII format, and sent them to Air Resource Specialists (ARS).

Expected Progress During the Next Reporting Period:

We will finish merging the component files for case Pre02d and generate CMAQ-ready emissions. During the final modeling of case Pre02d, we will QA and document the simulation. We will also work on summarizing the project activities for all of 2004 for the 2004 WRAP RMC final report. When simulation Pre02d is completed we will begin work on the actual 2002 base case simulation version A. Simulation Base02a will begin in January. It will include new Gulf of Mexico emissions and other inventory updates.

Difficulties Encountered and Resolutions:

We originally modeled all 3-D point-source emissions with 19 layers. However, to conserve time and disk space, we were supposed to have modeled only the wildfires and prescribed fires with 19 layers, and limited the rest of the point-source emissions to 15 layers. After discovering this modeling mistake, we reprocessed those sources that were supposed to have their emissions allocated to only 15 layers. Also, during our QA of the fire emissions, we discovered that there was no temporal variability in the modeled WRAP agricultural fire emissions in January. A review of the emissions inventory files showed that the year field in the inventories was incorrectly set to 1996. Changing this field to 2002 and reprocessing the emissions fixed the error.

Task 4: Air Quality Model Evaluation for 2002 Annual Simulation

Purpose:

To test the 2002 base year air quality modeling performed with CMAQ, including a preliminary simulation using the 2002 interim emissions inventory followed by several iterations with bug fixes or updates, and sensitivity experiments.

Progress During This Reporting Period:

We ran the CMAQ Meteorology-Chemistry Interface Processor (MCIP) to preprocess the output from the MM5 simulations for both the 36-km and 12-km domains.

Expected Progress During the Next Reporting Period:

During January 2005 we plan to finish an annual model simulation using CMAQ version 4.4, the Pre02d emissions inputs prepared in November, and the preliminary 2002 MM5 36-km data. This will be the last "Preliminary" test case before we begin testing with the new 2002 MM5 simulations.

Difficulties Encountered and Resolutions:

None.

Task 5: Preparation and Reporting of Geographic Source Apportionment Results

Purpose:

To implement, test, and apply Tagged Species Source Attribution (TSSA) particulate matter (PM) algorithms in CMAQ.

Progress During This Reporting Period:

We continued to process results of the source attribution model simulations and to provide results to ARS for additional analysis. We are implementing a new approach to creating stacked-bar time-series plots of contributions to beta extinction at each IMPROVE site. These plots will be compared with similar plots of monitoring data; we expect that this will be useful for assessing the model performance on best- and worst-visibility days.

Expected Progress During the Next Reporting Period:

We will finish development of the stacked-bar time-series plots.

Difficulties Encountered and Resolutions:

None.

Task 6: Further Analysis of Model Performance in Regard to the Contribution of Natural Emissions to Visibility Impairment

Purpose:

To perform modeling without anthropogenic emissions to help elucidate natural background visibility levels.

Progress During This Reporting Period:

We began work on the content for a task write-up for the 2004 WRAP RMC final report.

Expected Progress During the Next Reporting Period:

We will continue working to develop a plan to assess haze from natural emissions sources.

Difficulties Encountered and Resolutions:

None.

Task 7: Evaluation and Comparison of Alternative Models

Purpose:

To analyze alternative models to CMAQ for 2002 modeling.

Progress During This Reporting Period:

We began processing the new February and July 2002 36-km results for CAMx.

Expected Progress During the Next Reporting Period:

The CAMx model will be applied using the Pre02d emissions inputs and the new February and July 2002 36-km MM5 data; the model performance will then be compared with CMAQ's. The CAMx PM Source Apportionment Technology (PSAT) and CMAQ TSSA PM source apportionment schemes will be applied for July 2002 and intercompared.

Difficulties Encountered and Resolutions:

(1) Delays in obtaining the final MM5 meteorological fields were postponing the application of alternative models. However, the final 2002 MM5 fields were completed in December 2004, so this is no longer a problem. (2) The premerged emissions files used in the CMAQ TSSA source apportionment modeling were deleted to generate additional disk space for other WRAP modeling activities, so there are delays in getting the premerged emission data for the CAMx PSAT modeling.

Task 9. Testing and Further Improvements to the Windblown Dust Emissions Modeling Methodology

Purpose:

To further refine and test the WRAP windblown dust model.

Progress During This Reporting Period:

The initial model performance evaluation was completed during December. We began preparing the draft final task report and expect it to be completed by the first week of January.

Expected Progress During the Next Reporting Period:

The draft final task report will be completed and submitted for comment. An additional model run will be completed using the new MM5 data, updated agricultural data for the eastern U.S. states, and application of transport fractions. Any comments received on the draft final report will be addressed as we prepare and submit the final task report.

Difficulties Encountered and Resolutions:

We are currently waiting for the new MM5 data to be processed for use in the windblown dust model.

Task 10. Continued Improvement to Model Evaluation Software

Purpose:

To continue the development of model evaluation software for meteorology, emissions, and air quality modeling. This includes expanding existing evaluation tools to include metrics on model bias and error, and creating visualizations for additional evaluation metrics.

Progress During This Reporting Period:

None.

Expected Progress During the Next Reporting Period:

None.

Difficulties Encountered and Resolutions:

None.

Task 11: Sensitivity Studies Designed to Evaluate Uncertainties in Fire Emissions

Purpose:

To perform fire sensitivity simulations as requested by the Fire Emissions Joint Forum (FEJF).

Progress During This Reporting Period:

We completed analysis of CMAQ sensitivity simulations and presented results at the FEJF meeting on December 8 in Las Vegas.

Expected Progress During the Next Reporting Period:

We will generate stacked-bar time-series plots showing the change in contribution to beta extinction resulting from each of the fire emissions sensitivity cases.

Difficulties Encountered and Resolutions:

None.

Task 12: Preliminary Meteorological, Emissions, and Air Quality Modeling Activities for Alaska

Purpose:

To perform MM5 modeling of Alaska and preliminary dispersion modeling using a Lagrangian puff model.

Progress During This Reporting Period:

During December we completed most of the Alaska 2002 MM5 simulations.

Expected Progress During the Next Reporting Period:

In January 2005 we will complete the remaining Alaska MM5 simulation and reformat the MM5 data for input into CALMET/CALPUFF. We will also begin processing the observed meteorological data for input into CALMET and emissions data for input into CALPUFF.

Difficulties Encountered and Resolutions:

The project started later than expected due to competing priorities with the WRAP continental U.S. 2002 MM5 modeling. Alaska modeling is proceeding quickly now, although the current scope of work will not be completed until 2005.

Task 13: Training Courses for the WRAP States and Tribes

Purpose:

To conduct training activities as needed to transfer datasets and technology to WRAP member tribes and states.

Progress During This Reporting Period:

None.

Expected Progress During the Next Reporting Period:

Additional one-day training classes will be held as requested by the WRAP. Also, the computer equipment page on the RMC web site will be updated to include recommended hardware configurations and a list of frequently asked questions (FAQs).

Difficulties Encountered and Resolutions:

None.