



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

**Monthly Progress Report
for March 2005**

Prepared by

University of California, Riverside (UCR)

ENVIRON International Corporation

University of North Carolina's Carolina Environmental Program (UNC-CEP)

Introduction

This is the March 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.

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 activities for project year 2004 (which has rolled over into early 2005) 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 (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 project year 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 March 2005 Reporting Period

- *Task 0.5—2002 Ammonia Emissions Inventory for WRAP Region:* The task final report was completed and delivered to the WRAP Modeling Forum. The development of the users' guide is continuing.
- *Task 1—Project Administration:* The WRAP Modeling Forum meeting was held in San Francisco, CA, on March 8-9. RMC staff presented results of work completed during the 2004 work-plan period. We also participated in the WRAP planning meeting on March 9. Two additional conference calls were held during March to further develop the work plan and budget for 2005-06.
- *Task 2—Test, Improve, Quality Control, Obtain External Peer Review, and Finalize 36-km and 12-km MM5 Simulations for Eventual Use in CMAQ:* We distributed the WRAP 2002 36/12-km modeling output to the National Park Service, Alpine Geophysics, and EPA/OAQPS, and worked on the 2002 MM5 modeling final report.
- *Task 3—2002 Base Year Emissions Modeling, Processing, and Analysis:* We focused on presenting the RMC modeling work at the annual WRAP Modeling Forum meeting and developing the 2005-06 work plan and budget.
- *Task 4—Air Quality Model Evaluation for 2002 Annual Simulation:* We discovered an error in the soil ammonia emissions inventory for the previous version of the 12-km CMAQ runs. We did new CMAQ emissions for January and July in which we zeroed out the soil emissions so that we would have results for the 12-km domain to present at the March 8-9 Modeling Forum meeting. We then corrected the ammonia soil emissions inventory and repeated the annual 12-km CMAQ simulation. A model performance evaluation was completed comparing the 12-km and 36-km CMAQ results. Also, comparisons of the January and July 12-km zeroed-out soil NH₃ runs with the corrected 12-km runs will provide useful information on the model's sensitivity to soil ammonia emissions, which have very large uncertainty.
- *Task 7—Evaluation and Comparison of Alternative Models:* The CAMx PM Source Apportionment Technology (PSAT) source apportionment was applied for February and July 2002 using source regions and categories consistent with the CMAQ Tagged Species Source Attribution (TSSA) source apportionment runs. The SO₄ PSAT source apportionment modeling results were displayed for Class I areas and compared with the CMAQ TSSA source apportionment. The model performances of CAMx and CMAQ for February and July 2002 were also compared.
- *Task 9—Testing and Further Improvements to the Windblown Dust Emissions Modeling Methodology:* A minor error in the meteorological data processors for use in the windblown dust model was corrected. The model was rerun with the latest 36-km and 12-km meteorological data. The revised draft of the task final report was completed and submitted to the WRAP Dust Emissions Joint Forum.
- *Task 12—Preliminary Meteorological, Emissions, and Air Quality Modeling Activities for Alaska:* The MM5 modeling of several months was redone to correct sea ice definition issues. Emissions were processed for input into CALPUFF.

March 2005 RMC Status Report

Below we discuss our progress during this monthly reporting period (March 2005) and the expected activities during the next monthly reporting period (April 2005). 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:

The task final report was prepared and submitted to the WRAP Modeling Forum. The development of the model user's guide was initiated.

Expected Progress During the Next Reporting Period:

In April we will complete the user's guide and deliver all model code and datasets.

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:

The WRAP Modeling Forum meeting was held in San Francisco, CA, on March 8-9. RMC staff presented results of work completed during the 2004 work-plan period. We also participated in the WRAP planning meeting on March 9. Two additional conference calls were held during March to further develop the work plan and budget for 2005-06.

Technology Transfer:

None.

Computer Systems Administration:

We conducted routine systems administration, hardware repairs, and software updates.

Expected Progress During the Next Reporting Period:

We will continue working on the 2004 project final report and finish the 2005-06 RMC 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:

The 2002 36/12-km MM5 distribution disks, along with an external-chassis USB-compatible drive kit, were shipped to Denver and to Research Triangle Park, NC, where copies were made by the National Park Service and Alpine Geophysics in Denver and by EPA/OAQPS in RTP. Results of the WRAP 2002 MM5 modeling were presented at the March 8-9 Modeling Forum meeting in San Francisco. We also worked on the draft WRAP 2002 MM5 modeling final report.

Expected Progress During the Next Reporting Period:

We will finish documenting the final WRAP 2002 MM5 model performance in a draft report to be submitted in April.

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:

We traveled to San Francisco the week of March 7 and presented the results of the emissions modeling tasks completed in 2004 in preparation for the final 2002 base case and 2018 future-year modeling that we will perform over the next 18 months. We then discussed what we expect to accomplish during 2005-06 to prepare for developing a work plan and budget for that time period. In the second half of March we focused on developing a budget for the 2005-06 emissions modeling tasks and generating a work plan to provide a schedule for the RMC emissions modeling team next year.

Expected Progress During the Next Reporting Period:

We will finalize the 2005-06 budget and work plan in April and begin collecting 2002 emissions inventories from the other RPOs to use in the final 2002 base case modeling. Once the work plan is in place we will develop detailed schedules for the emissions modeling that will include when

we expect to start and finish the milestone modeling simulations over the next 18 months and what data will be included in these simulations.

Difficulties Encountered and Resolutions:

None.

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 discovered an error in the soil ammonia emissions inventory for the previous version of the 12-km CMAQ simulations. We did new CMAQ emissions for January and July in which we zeroed out the soil emissions so that we would have results for the 12-km domain to present at the March 8-9 Modeling Forum meeting. We then corrected the ammonia soil emissions inventory and repeated the annual 12-km CMAQ simulation. A model performance evaluation was completed comparing the 12-km and 36-km CMAQ results. Also, comparisons of the January and July 12-km zeroed-out soil NH₃ runs with the corrected 12-km runs will provide useful information on the model's sensitivity to soil ammonia emissions, which have very large uncertainty

Expected Progress During the Next Reporting Period:

We will prepare additional results and comparisons of the 12-km and 36-km CMAQ runs for presentation during the monthly Modeling Forum conference call.

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:

None.

Expected Progress During the Next Reporting Period:

None.

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 developed a budget and work plan for this task for 2005-06.

Expected Progress During the Next Reporting Period:

We expect to begin exploratory work on integrating missing natural emissions sources into the RMC modeling. We will begin by looking at ways to estimate emissions from lightning NO_x, sea salt, and geogenic sources in preparation for the final 2002 base case simulation.

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 performed CAMx model simulations of February and July 2002, with 15-day spin-up, and compared the CAMx model performance with CMAQ's performance. We then performed CAMx PM Source Apportionment Technology (PSAT) source apportionment modeling using the same geographic source regions and similar source categories as were used in the CMAQ TSSA PM source apportionment runs. PSAT was initially configured to generate SO₄, NO₃, and NH₄ PM source apportionment, but later the NO₃ and NH₄ PSAT simulations were stopped because the results would not be ready in time for the March Modeling Forum meeting. The CAMx PSAT SO₄ source apportionment for February and July 2002 was extracted at Class I areas and the results compared against those generated by CMAQ TSSA. We prepared a PowerPoint presentation documenting the work performed under this task and presented it at the Modeling Forum meeting. See http://pah.cert.ucr.edu/aqm/308/meetings/March_2005/03-08_09-05.SF_CA/Alternative_Model_Mar8-9_2005_MF_Meeting.ppt

Expected Progress During the Next Reporting Period:

This task has been completed.

Difficulties Encountered and Resolutions:

None.

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:

During March, the windblown dust model was run for calendar year 2002 with the latest 36-km and 12-km meteorological data. Agricultural adjustments in the eastern U.S. were incorporated. The fugitive dust transport fractions were also applied in the model runs. A revised draft of the task final report was prepared and submitted to the WRAP Dust Emissions Joint Forum.

Expected Progress During the Next Reporting Period:

ENVIRON and UCR will address any comments on the draft task final report and prepare and submit the final version.

Difficulties Encountered and Resolutions:

A minor error was discovered in the meteorological processors used for the windblown dust model. The error was corrected and the model was rerun for the 36-km and 12-km modeling domains using the latest MM5 meteorological data.

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:

None.

Expected Progress During the Next Reporting Period:

We will continue revising the stacked bar time-series plots using MS Access and creating these plots for the new model evaluation cases. We are also automating the generation of bugle plots and soccer plots for the model performance evaluation.

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:

Several months of the 2002 Alaska MM5 runs were redone to correct an incorrect speciation of the sea ice parameter. The 2002 MM5 results were processed for input into CALMET. Emissions were processed for input into CALPUFF.

Expected Progress During the Next Reporting Period:

We will initiate the Alaska CALPUFF modeling during April and attend the April 26-27, 2005, WRAP Alaska meeting in Anchorage.

Difficulties Encountered and Resolutions:

None.

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.