



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

**Monthly Progress Report  
for February 2005**

Prepared by

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## Introduction

This is the February 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](mailto:tonnesen@cert.ucr.edu)). Mr. Ralph Morris ([rmorris@environcorp.com](mailto:rmorris@environcorp.com)) and Mr. Zac Adelman ([zac@unc.edu](mailto: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](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 February 2005 Reporting Period

- *Task 0.5—2002 Ammonia Emissions Inventory for WRAP Region:* During February, new ammonia emissions using the latest 36-km and 12-km 2002 MM5 data were developed. We also completed the task final report.
- *Task 1—Project Administration:* The primary activities in February were development of the draft 2004 project final report and the RMC work plan for 2005-06; multiple conference calls were held concerning the work plan.
- *Task 2—Test, Improve, Quality Control, Obtain External Peer Review, and Finalize 36-km and 12-km MM5 Simulations for Eventual Use in CMAQ:* During February we reran the 2002 MM5 five-day run segments that had become corrupted, then made backup and distribution disks of the data. The backup disks reside at UCR; the distribution disks are being distributed to the first three groups that requested the data: the National Park Service, Alpine Geophysics, and EPA/OAQPS.
- *Task 3—2002 Base Year Emissions Modeling, Processing, and Analysis:* We finished the 12-km Pre02d emissions modeling and documentation and corrected random errors in the modeling. We completed the 2002 emissions modeling documentation for the 2004 project final report.
- *Task 4—Air Quality Model Evaluation for 2002 Annual Simulation:* We ran the 12-km CMAQ simulations and discovered an error in the ammonia emissions inventory.
- *Task 5—Preparation and Reporting of Geographic Source Apportionment Results:* We continued developing the stacked-bar time-series plots.
- *Task 7—Evaluation and Comparison of Alternative Models:* CAMx PM Source Apportionment Technology (PSAT) source apportionment was set up for February and July 2002 using source regions and categories consistent with the CMAQ TSSA source apportionment runs. We initiated the CAMx PSAT source apportionment runs.
- *Task 9—Testing and Further Improvements to the Windblown Dust Emissions Modeling Methodology:* During February, we ran the model with the latest 36-km and 12-km meteorological data. Agricultural adjustments in the eastern U.S. were included as well. The draft of the final task report on the revised windblown dust model was completed and submitted for review. The final version will be submitted in early March.
- *Task 12—Preliminary Meteorological, Emissions, and Air Quality Modeling Activities for Alaska:* We partially processed Alaska emissions for CALPUFF as well as MM5 data for CALMET.

## February 2005 RMC Status Report

Below we discuss our progress during this monthly reporting period (February 2005) and the expected activities during the next monthly reporting period (March 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 ammonia model was rerun to generate new 36- and 12-km emissions data. We also began preparing the task final report.

#### Expected Progress During the Next Reporting Period:

In March we will complete and deliver the task final report and the user's guide and final code for the WRAP ammonia emissions model.

#### 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 RMC Project Management call, and multiple calls to discuss the 2005-06 RMC work plan. Each contractor also contributed to the January monthly progress report and prepared invoices, and prepared sections of the draft 2004 project final report. 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.

##### *Technology Transfer:*

None.

##### *Computer Systems Administration:*

We are still having problems with the systems, and still trying to debug them. Because we found that the cluster management software we tried was not very reliable, we continue manual

scheduling of jobs on the individual CPUs. We are still having problems with one of our servers, and we suspect that it might be a hardware problem. We are ordering a replacement server and will try to get the problematic server fixed or replaced after the new server is installed.

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 files for some of the 5.5-d chunks of 2002 MM5 simulation were corrupted, so we reran those run segments. A set of backup disks and a set of distribution disks were generated using five 300-GB IDE drives each. The backup disks were shipped to UCR for storage. The distribution disks, along with an external-chassis USB-compatible drive kit, were shipped to the first two groups that had requested the data: the National Park Service in Denver, CO, and EPA/OAQPS in RTP, NC. While the WRAP 2002 MM5 distribution disks were in Denver, Alpine Geophysics also obtained a copy of the data.

Expected Progress During the Next Reporting Period:

In March we will present the results of the WRAP 2002 MM5 simulation at the Modeling Forum meeting in San Francisco March 8-9. We will also document the final WRAP 2002 MM5 model performance in a draft report.

Difficulties Encountered and Resolutions:

Some of the 1.5 terabytes of MM5 output had become corrupted, so some MM5 run segments had to be redone.

***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 February focused on completing the annual 12-km Pre02d emissions

simulation. To utilize the ocean-going shipping emissions that we developed for the WRAP region, we created a set of 12-km shipping surrogates and integrated them with the rest of the 12-km surrogates. We prepared and integrated emissions from the NH<sub>3</sub> and windblown dust emissions models on the 12-km model grid and merged these with the rest of the source categories. We corrected spurious errors in the emissions by rerunning the merge step as the problems were encountered by the RMC air quality modelers. We also worked on completing the 2004 project final report and documenting all of the emissions modeling and QA that we completed over the past 12 months.

Expected Progress During the Next Reporting Period:

We will present a summary of the 2004 emissions modeling work to the WRAP Modeling Forum at the annual meeting in San Francisco March 8-9. We will also finish the 2005-06 RMC work plan, and will prepare for the next round of emissions simulations.

Difficulties Encountered and Resolutions:

We periodically encountered simulation days that did not complete for the 12-km Pre02d simulation. As we became aware of these missing days, we reran SMOKE and created emissions files to complete the annual 12-km simulation. A problem with the NH<sub>3</sub> model's soil emissions prohibited the inclusion of these emissions in the 12-km model result that we will present at the Modeling Forum meeting. We received a corrected set of NH<sub>3</sub> soil emissions from ENVIRON and will integrate these into the base 2002 modeling that we are currently preparing for.

***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 12-km simulations and in the process discovered an error in the ammonia emissions inventory.

Expected Progress During the Next Reporting Period:

After correcting the error in the ammonia inventory, we will complete the 2002 CMAQ 12-km base case simulation using the pre02d emissions and conduct a model performance evaluation.

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 developing the stacked-bar time-series plots. We prepared source apportionment bar plots for individual days in January and July for comparison with the CAMx PSAT results.

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 continued working on the task write-up for the 2004 project final report.

Expected Progress During the Next Reporting Period:

We will continue developing 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 set up CAMx PSAT on the 36-km grid for February and July 2002 using source regions and categories that are consistent with the CMAQ TSSA runs. The CAMx base case runs and PSAT runs for SO<sub>4</sub> and NO<sub>3</sub> were initiated. As we analyzed the output, we found some problems in the way the emissions were entering the CAMx simulations, so the runs were re-initiated with the corrections to the emissions treatment.

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 PSAT and CMAQ TSSA PM source apportionment schemes will be applied for February and July 2002 and the results compared with the CMAQ TSSA PM source apportionment. The results will be documented in the 2004 project final report.

Difficulties Encountered and Resolutions:

Errors in the treatment of emissions in the CAMx/PSAT runs required our redoing the runs. This will be completed in the next reporting period.

***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:

We initiated additional windblown dust model runs. These include the new MM5 meteorological data for the 36- and 12-km grids, the agricultural adjustments for the Eastern states, and the transport fractions.

Expected Progress During the Next Reporting Period:

The draft task final report will be revised to include the latest model runs and a revised model performance evaluation based on results at the 12-km resolution.

Difficulties Encountered and Resolutions:

None.

***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 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 February we continued with the Alaska 2002 MM5 modeling and with processing the emissions for CALPUFF modeling.

Expected Progress During the Next Reporting Period:

We will complete the 2002 Alaska MM5 modeling and initiate CALPUFF modeling.

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 after March 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.