



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

**Monthly Progress Report
for November 2004**

Prepared by

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Introduction

This is the November 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 that 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 biweekly 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 to develop 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 Mesoscale Model version 5 (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 November Reporting Period

- *Task 0.5—2002 Ammonia Emissions Inventory for WRAP Region:* No additional work was performed, as we are waiting for the revised 2002 MM5 simulations.
- *Task 1—Project Administration:* We adopted a new schedule of project management and Modeling Forum conference calls, and completed the 2004 RMC interim report author draft.
- *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 model configuration was finalized, based on comments of the peer reviewers. A response to their comments was begun and will be submitted in early December. The annual 2002 MM5 36-/12-km simulation was initiated with the final configuration in November; we expect it to be done by the end of December.
- *Task 3—2002 Base Year Emissions Modeling, Processing, and Analysis:* We worked on preparing the 2004 RMC interim report author draft, integrating new 2000 Canadian emissions inventories into simulation Pre02d, and modeling and QA of simulation Pre02d.
- *Task 4—Air Quality Model Evaluation for 2002 Annual Simulation:* We wrote up the CMAQ 2002 Base C model performance for the draft 2004 RMC interim report.
- *Task 5—Preparation and Reporting of Geographic Source Apportionment Results:* We completed postprocessing of the source attribution simulation and delivered results to Air Resource Specialists (ARS).
- *Task 6—Further Analysis of Model Performance in Regard to the Contribution of Natural Emissions to Visibility Impairment:* We worked on preparing the 2004 RMC interim report author draft.
- *Task 7—Evaluation and Comparison of Alternative Models:* We began the application of alternative models by processing the new July 2002 MM5 data for CAMx.
- *Task 9—Testing and Further Improvements to the Windblown Dust Emissions Modeling Methodology:* The 2002 windblown dust emissions modeling was completed and a presentation made to the Dust Forum in Las Vegas. We also initiated the model evaluation and final documentation.
- *Task 10—Continued Improvement to Model Evaluation Software:* We reviewed site description information for IMPROVE sites, and added a list of new map coordinates to be included in model evaluation and analysis.
- *Task 11—Sensitivity Studies Designed to Evaluate Uncertainties in Fire Emissions:* We completed postprocessing of the fire sensitivity simulation and delivered results to ARS.
- *Task 12—Preliminary Meteorological, Emissions, and Air Quality Modeling Activities for Alaska:* For the MM5 modeling we performed analysis to determine when sea ice would break up, and initiated 2002 annual MM5 modeling for Alaska.

November 2004 RMC Status Report

Below we discuss our progress during this monthly reporting period (November 2004) and the expected activities during the next monthly reporting period (December 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 November. We are waiting for the revised 2002 MM5 meteorological data.

Expected Progress During the Next Reporting Period:

We expect to complete revised 36-/12-km MM5 simulations by the end of 2004, at which time the 2002 ammonia emissions will be updated. Any comments received on the draft project report will be addressed and a final report will be completed. A draft user's guide for the modeling system will be developed and delivered by the end of 2004.

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 administrated the 2004 WRAP RMC work effort. Monthly conference calls included the monthly WRAP Modeling Forum calls, the WRAP Emission Inventory calls, and WRAP RMC Project Management calls. Each contractor also prepared monthly progress report text, invoices, and text for the 2004 RMC interim project report, which covers the period from March 1 through September 30, 2004.

Jeanne Eichinger of UNC-CEP settled into her new role of RMC documentation coordinator, performing many editing, scheduling, and documentation tool generation functions to help keep RMC documents on track.

Data Transfer:

UCR is continuing to work with Air Resource Specialists (ARS) to provide source attribution results in a format that can be used by ARS.

Computer Systems Administration:

We performed ongoing computer systems maintenance and updated the project web page as needed.

Expected Progress During the Next Reporting Period:

We will begin working on the 2004 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 reviewed the comments from the peer reviewers and performed additional MM5 sensitivity tests to address them. Based on the peer review comments and sensitivity tests, we revised the MM5 final configuration, updated the modeling protocol, and started preparing a response to the reviewers' comments that will be submitted in early December. The 2002 annual MM5 36-/12-km simulation using the final configuration was initiated and will be completed by the end of December.

Expected Progress During the Next Reporting Period:

We will complete the 2002 annual MM5 36-/12-km simulation.

Difficulties Encountered and Resolutions:

Based on comments from the peer reviewers, we have had to performed additional MM5 sensitivity tests.

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:

Work this month consisted primarily of preparing the 2004 RMC draft interim report, in which

we document in detail all of the RMC emissions modeling work completed through the end of September 2004. The chapter in the report on Task 3 covers the sources and modeling of the 2002 WRAP inventories, progress of the emissions modeling, deliverables, comparison of the different emissions cases, details about sensitivity simulations, and the QA/QC performed on the emissions simulations.

We also continued to simulate, QA, and improve emissions case Pre02d. We made the following changes and/or updates to emissions case Pre02d during November:

- (1) We added new Canadian area- and mobile-source inventories into case Pre02d. EPA announced the availability of 2000 Canadian area and mobile inventories formatted for SMOKE in early November. After fixing some formatting problems with the files distributed by EPA, we integrated the data into the Pre02d modeling.
- (2) With the completion of the new area, mobile, and nonroad simulations, we began creating annual CMAQ-ready emissions for every source category and merging the files together for CMAQ.

To facilitate analysis of the emissions inventories, CEP continued work with the WRAP Modeling Forum contractor ARS to supply a comprehensive summary of the WRAP emissions for case Pre02d. CEP extended the emissions summaries that we created for the WRAP region by grid cell for every source category (except biogenic) contained in case Pre02d to grid cell summaries for the entire 36-km-resolution modeling domain.

CEP began working with the WRAP and ERG, the Mexican emissions inventory contractor, to develop a protocol for transferring the 1999 Mexico emissions inventory to U.S. contractors for modeling. Confidentiality requirements related to the point-source data will require that the data be distributed with a nondisclosure agreement. How to develop the agreement and distribute the data, and the time frame for the delivery of the data, are all being negotiated through multiple conference calls between CEP, WRAP, and ERG, with ERG serving as the liaison for Mexico. The initial conversations are indicating that a draft of the data will be available in January 2005.

Expected Progress During the Next Reporting Period:

We will finish merging the component files for case Pre02d and will 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 RMC final report.

Difficulties Encountered and Resolutions:

The WRAP mobile-source emissions inventory contractor notified the RMC that refueling emissions are included in the precomputed nonroad and on-road emissions inventories, which means that we would be double-counting these sources if we included refueling emissions in the area-source inventory. Inspection of the area-source inventory revealed that we were indeed modeling refueling emissions as area sources in the WRAP. To reconcile this problem, we removed the sources in the WRAP area-source inventory that represent refueling emissions. For the non-WRAP states, for which we are running MOBILE6 to compute mobile-source emissions,

we instead turned off the process in MOBILE6 that computes refueling emissions and retained these emissions in the area-source inventory. In summary, the RMC is treating refueling emissions in the WRAP states differently than in the rest of the region. In the WRAP states, refueling emissions are represented in the on-road mobile-source inventory and were removed from the area-source inventory; in the non-WRAP states, refueling emissions are represented in the area-source inventory and were removed as a MOBILE6 emissions process.

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 documented the CMAQ 2002 Base Case C model performance for the draft 2004 RMC interim report.

Expected Progress During the Next Reporting Period:

During December we plan to begin 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. The processing is initially being completed using the first three approaches shown below; the fourth method in the list is in the planning stage.

- Analyze for each model day at each receptor site.
- Analyze for best and worst 20% days based on ambient data at each site.
- Analyze for best and worst 20% days based on model predictions.
- Analyze for best and worst 20% days based on model predictions stratified in time by month or season; we need to determine how best to implement this approach.

Expected Progress During the Next Reporting Period:

We will work on determining whether and how we should present the source attribution results for the comparison of model results to ambient data unpaired in space or time.

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 worked on the Task 6 text for the 2004 RMC draft interim report.

Expected Progress During the Next Reporting Period:

We will continue working to develop a plan to assess haze from natural emissions sources during 2005.

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 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 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:

Delays in obtaining the final MM5 meteorological fields have postponed the application of alternative models. The final 2002 MM5 fields will be completed in December 2004.

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 completed the windblown dust model simulations; the results are currently being reviewed and evaluated. A presentation was prepared and delivered at the WRAP Dust Emissions Joint Forum Meeting held November 15-16, 2004, in Las Vegas, NV. A more detailed model performance evaluation (MPE), including a comparison with the IMPROVE monitoring ambient data, is underway. We began preparing the draft final report for this task, and also documented the work in the draft 2004 RMC interim report.

Expected Progress During the Next Reporting Period:

We will complete the first two phases of the model performance evaluation, as documented in a technical memorandum to the Joint Emission Dust Forum, and complete and deliver the draft final report for this task.

Difficulties Encountered and Resolutions:

There have been some delays in receiving the results of Desert Research Institute's (DRI) Attribution of Haze project, which are needed to complete the last phase of the MPE. As these results are not expected for several more weeks, the last stage of the MPE will be completed and documented at a later time.

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:

We verified the "representative" latitude-longitude locations for IMPROVE sites and class I areas in the WRAP region. We also conducted the work described below under "Difficulties Encountered and Resolutions."

Expected Progress During the Next Reporting Period:

None.

Difficulties Encountered and Resolutions:

During October, discussion of the site information was a major time sink and a source of frustration; we needed definitive guidance on what site information to use. In November we received a list of sites from ARS, then began analyzing model results for a subset of additional sites taken from the ARS list.

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 all fire sensitivity simulations and began evaluating model results and analysis. The UCR model performance evaluation (MPE) was completed for the preliminary 2002 case with wildfires only (Pre02b_wf) compared with the preliminary 2002 case with no fire emissions (Pre02b). Because the MPE is time consuming to run, we might not complete this for the other cases unless specifically requested. We also completed the evaluation of spatial distribution plots for all the fire sensitivity cases.

Expected Progress During the Next Reporting Period:

We will prepare results for the FEJF meeting to be held December 8-9.

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:

We reviewed the comments received from EPA Region X on the WRAP Alaska modeling protocol and submitted responses. Data addressing when to turn on and off sea ice in the 2002 annual MM5 simulation were acquired and analyzed. We also initiated the 2002 annual MM5 run for Alaska.

Expected Progress During the Next Reporting Period:

We will continue to perform the annual 2002 MM5 simulation for Alaska, process emissions for modeling, and perform preliminary CALMET/CALPUFF sensitivity tests.

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.