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

Monthly Progress Report for April 2005

Prepared by

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Introduction

This is the April 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 April 2005 Reporting Period

- *Task 1— Project Administration, Major Project Reports, and Computer Hardware and Systems Administration:* We finalized the 2005-06 work plan.

- *Task 2—Emissions Modeling, Processing, and Analysis:* The RMC initiated the data collection and quality control process for the inventories to be used in the first iteration of the Base 2002 annual simulation.

- *Task 4—Air Quality Model Evaluation for 2002 Annual Simulation:* We completed a model performance evaluation for the Preliminary 2002 version D case and posted results to the RMC web site.

- *Task 5—Testing and Further Improvements to the Windblown Dust Emissions Modeling Methodology:* A revised draft of the final task report was prepared and submitted to the Dust Emissions Joint Forum for review.

- *Task 6—BART Source Sensitivity Screening Using CALPUFF:* We developed a preliminary design of the CALPUFF modeling approach to address the requirements of the BART provisions of the Regional Haze Rule.

- *Task 7—Sensitivity Studies Designed to Evaluate Uncertainties in Fire Emissions:* We completed QA and preliminary work on processing of new fire emissions data.

- *Task 8—Preliminary Meteorological, Emissions, and Air Quality Modeling Activities for Alaska:* Alaska emissions were processed for input into CALPUFF. UCR reran MM5 for the first part of 2002 using the correct sea ice configuration, and ENVIRON reran MM5 for days from the second half of 2002 that had become corrupted due to a disk failure.

April 2005 RMC Status Report

Below we discuss our progress during this monthly reporting period (April 2005) and expected activities during the next reporting period (May 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, and conference calls to discuss the 2005-06 work plan. The work plan was finalized this month. Each contractor also contributed to the March monthly progress report and prepared invoices. We continued to work on finalizing subcontract modifications.

Major Project Reports:
Work continued on the 2004 RMC project final report.

Computer Hardware and Systems Administration:
None.

Expected Progress During the Next Reporting Period:
The same kinds of administrative tasks will be conducted, and work will continue on the 2004 RMC project final report.

Difficulties Encountered and Resolutions:
UCR's CE-CERT laboratory has had several unscheduled power outages due to construction on a new facility. This has required considerable extra effort to manage computer systems and has resulted in several periods during which the RMC web site was inaccessible.

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 was to begin collecting the data for and preparing the RMC computing systems to be used in the first iteration of the Base 2002 annual simulation (Base02a). We met with Eastern Research Group (ERG) employees and representatives from the Mexican air quality community in an ad hoc meeting at the EPA Emissions Inventory Conference in Las Vegas, NV, during the week of April 12 to discuss the status of the revised Mexican emissions inventories. Highlights from this meeting:

- The Mexican emissions inventory should be ready for release in the June 2005 time frame. Mexico does not want to release the final inventories until the underlying databases that support the inventories are also ready to release.
- As the Mexican point-source inventory contains limited information about stack parameters, the RMC will apply U.S. SCC-based defaults. We will first provide ERG and Mexico the default stack parameters that we will apply to the Mexican sources for review before the final modeling of the data.
    - ERG will prepare a list of the SCCs for the major point sources before the inventory is released to the RMC. We will then use this list to cross reference with the defaults that we will apply to these sources in an effort to expedite the review in anticipation of the June release of the inventory.
    - Along with the default stack parameters, we will also provide a list of the temporal and spatial allocation profiles for the top emissions sources in Mexico.
- ERG will provide the Mexican inventories to all RPOs and the EPA when the data are ready to distribute.
- ERG will provide guidance on methodologies they have developed for projecting the Mexican data to future years. This information will be used during preparation of the inventories for the first round of 2018 modeling that we will perform later in 2005.
- ERG will send the GIS Shapefiles that they have for Mexico to us for use in creating spatial surrogates.
- The RMC and ERG will coordinate on creating maps of the inventory data by Mexican county and SCC to send to Mexico for QA/QC.
- The meeting attendees agreed that a presentation of the 2002 air quality modeling results should be made to Mexico, along with a demo of CMAQ and SMOKE to describe the process of using the inventories to make air quality evaluations.

In addition to this discussion about the Mexican inventories, the RMC emissions modeling team also had a conference call to discuss the availability of the U.S. and Canadian inventories to include in the simulation Base02a. The result of this call was a first iteration of the RMC

emissions modeling work plan to define the emissions-related tasks that will be conducted over the next 12 months.

Other tasks we performed in April included downloading updated 2002 emissions for VISTAS and MANE-VU from their respective web sites and preparing them for use in SMOKE, and working on preparing 2002 updated emissions inventory data for the WRAP and CENRAP regions.

Preparation of the 2002 Model Performance Report, 2018 Base Case Modeling Report, and 2005-06 Project Report:
We generated the first iteration of the 2005-06 emissions modeling work plan that explicitly defines the different emissions simulations and their accompanying datasets. The information in this spreadsheet is used to track the schedules of the data deliveries and modeling for each major emissions simulation to be conducted by the RMC. As we prepare the technical reports for the major emissions modeling tasks, we will pull information from this spreadsheet to describe the emissions inventories that composed each simulation.

Expected Progress During the Next Reporting Period:
We expect to begin modeling and QA work for the emissions sectors that are available for the Base02a simulation. As of the writing of this report, only the WRAP fires and the nonshipping U.S. offshore sources are ready to model.

Difficulties Encountered and Resolutions:
We discovered some formatting and consistency problems with the Phase II fire inventories. The problems included some fire events that did not have dates associated with them, and inconsistencies between the numbers of sources in the different files that combine to form the fire inventories. We are working with Air Sciences to rectify these issues.

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, 2000-04 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 revised annual CMAQ modeling for the Pre02d case on the WRAP 12-km domain. We also completed the model performance evaluation, including the typical UCR model evaluation plots; we produced a variety of scatter plots by site, by day, and for all sites and all days; time-series plots; and model vs. ambient overlay plots. All of these results were posted on the project web site. We also presented the summary results for comparisons of the 12-km vs. 36-km grids during the April 18 Modeling Forum conference call. We continued to improve the UCR model performance evaluation (MPE) software package by incorporating a Microsoft Access database program designed to provide additional/alternative model evaluation analyses, including stacked bar charts for extinction contribution from major aerosol species. In addition,

we automated the process of generating the performance criteria/goals bugle plots and soccer plots for visualizing performance metrics among different ambient monitoring networks and different species.

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:
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:
A revised draft of the final task report was prepared and submitted to the Dust Emissions Joint Forum (DEJF) for review.

Preparation of the 2002 Model Performance Report and 2005-06 Project Report:
None.

Expected Progress During the Next Reporting Period:
Comments on the revised draft of the final task report will be addressed. Based on recommendations provided in the draft report, additional improvements to the methodology will be considered and implemented, as directed by the DEJF.

Difficulties Encountered and Resolutions:
None.

Task 6: BART Source Sensitivity Screening Using CALPUFF

Purpose:
To perform CALMET/CALPUFF modeling to address the Best Available Retrofit Technology (BART) modeling requirements in the final EPA BART Rule.

Progress During This Reporting Period:

Technical Activities:
We developed a preliminary technical plan for performing CALPUFF modeling to address the BART requirements of the Regional Haze Rule. We expected to update this preliminary modeling plan after EPA released the final BART modeling guidance, which was scheduled to be released April 15, 2005. However, EPA has delayed this release until June 15, 2005.

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:
Progress will depend on whether the 2005 contract for this project is put in place.

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:
Initial QA and preprocessing work was completed on the fire emissions data.

Preparation of the 2002 Model Performance Report and 2005-06 Project Report:
None.

Expected Progress During the Next Reporting Period:
We will continue processing the fire emissions data.

Difficulties Encountered and Resolutions:
Some problems with the Air Sciences files were found and conveyed to them.

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:
UCR reran MM5 for Alaska for the first half of 2002 using the correct setting for sea ice and transferred the data to ENVRON. Also, ENVIRON reran MM5 for days from the second half of 2002 that had become corrupted due to disk failure. Available emissions were processed for input into CALPUFF. CALPUFF runs will be performed separately for the following major source categories: on-road mobile, most nonroad mobile, area, airport, ports, railroad, and point sources. Preliminary CALPUFF test runs were performed for a few days.

Preparation of 2005-06 Project Report (inclusion of this task in 2002 Model Performance Report and 2018 Base Case Modeling Report is TBD):
None.

Expected Progress During the Next Reporting Period:
We will finish the Alaska 2002 MM5 modeling report, and preliminary CALPUFF runs for 2002.

Difficulties Encountered and Resolutions:
Not all of the 2004 Alaska work could be completed by March 31, 2005, so some of the Alaska 2004 budget has been rolled over to the 2005 work effort.

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 May 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 researching techniques to add lighting NO_x to the emissions estimates.

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:
None.

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:
None.

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:
None.

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.