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

Monthly Progress Report for May 2005

Prepared by

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Introduction

This is the May 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 May 2005 Reporting Period

- *Task 2—Emissions Modeling, Processing, and Analysis:* The RMC continued the data collection and quality control process for the inventories to be used in the first iteration of the Base 2002 annual simulation. We had several conference calls to discuss the emissions modeling work plan, and began work on modeling the 2002 inventories that we already have on hand.

- *Task 4—Air Quality Model Evaluation for 2002 Annual Simulation:* We completed a model performance evaluation for the Preliminary 2002 version D case and also did additional evaluation of the windblown dust sensitivity results.

- *Task 5—Testing and Further Improvements to the Windblown Dust Emissions Modeling Methodology:* The latest results from the windblown dust emissions model were presented at the WRAP Dust Conference in Palm Springs on May 12. Comments on the revised draft task report from the Dust Emissions Joint Forum were received May 31 and will be addressed during the next reporting period.

- *Task 6—BART Source Sensitivity Screening Using CALPUFF:* Previously we developed a preliminary design of the CALPUFF modeling approach to address the requirements of the BART provisions of the Regional Haze Rule. No additional work was performed during this reporting period as we wait for EPA to release the BART guidance in June.

- *Task 8—Preliminary Meteorological, Emissions, and Air Quality Modeling Activities for Alaska:* Work continued on writing the Alaska MM5 modeling report and performing the Alaska CALPUFF modeling.

- *Task 9—Further Analysis of Model Performance in Regard to the Contribution of Natural Emissions to Visibility Impairment:* We opened dialogue within the emissions modeling community to explore the efforts required to develop an emissions inventory for lightning NO_x.

- *Task 12—Computer Hardware:* We ordered two new RAID5 data storage systems and an additional thirty-two 400-GB disk drives.

May 2005 RMC Status Report

Below we discuss our progress during this monthly reporting period (May 2005) and expected activities during the next reporting period (June 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. Each contractor also contributed to the April 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:
None.

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 continue 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 installed SMOKE version 2.2 on the RMC computers and added unreleased code enhancements for testing an alternative fire plume rise approach for the WRAP modeling. We installed the emissions inventories for the MANE-VU RPO and MRPO on the RMC computers to augment the inventories that we already have for CENRAP and VISTAS. We began to model and quality assure the emissions inventories for these non-WRAP portions of the modeling domain that the RMC already has. We modeled and initiated the quality assurance process (QA) on the CENRAP on-road mobile-source inventories and began preparing the inventories for the other RPOs.

We are on the fourth iteration of the emissions modeling work plan that lays out our approach for emissions modeling through August 2006. Through our discussions of the emissions modeling approach over the past month, and in light of the reality regarding when we can expect all of the emissions inventories that will compose the base 2002 emissions simulation to become available, we decided to diverge from the original 2005-06 work plan and target a single base 2002 simulation rather than two separate simulations. In addition, we also modified the approach that we will take for the planning 2002 modeling by making iterative additions of these inventories to the base 2002 simulation. These iterative additions will allow us to evaluate the individual impacts of the new inventories on model performance.

We began comparing an alternative plume rise approach for fires to the WRAP Fire Emissions Joint Forum (FEJF) approach. We plan to summarize the comparison between these two approaches and present the results at the U.S. EPA Fire Modeling Meeting the week of June 6, 2005.

Preparation of the 2002 Model Performance Report, 2018 Base Case Modeling Report, and 2005-06 Project Report:
We generated three additional versions of the 2005-06 emissions modeling work plan that explicitly define the different emissions simulations and their accompanying datasets. As we finalize the emissions modeling work plan for the Base 2002 simulation, we will make the work plan available to the WRAP Modeling Forum via the RMC web site. We also began QA on the model-ready emissions for the non-WRAP portions of the modeling domain for which we already have emissions inventories. The products of this QA work will be added to the 2002 model performance report.

Expected Progress During the Next Reporting Period:
We plan to continue modeling and QA work for the emissions sectors that are available for the Base02a simulation. We expect to have the majority of the inventories for the Base 2002 simulation at the RMC by the end of June. We will be moving toward an inventory lockdown date of July 15, 2005. As these new inventories arrive, we will model and QA them in preparation for combining them with the other inventories for the Base 2002 simulation.

Difficulties Encountered and Resolutions:
To complete the comparison between the two fire plume rise approaches, we need additional information about the fires that we want to model. We have contacted Air Sciences requesting daily heat flux information on a limited number of fires, but as of the writing of this report we have not received these data and cannot complete the comparison.

We corresponded with Environment Canada regarding the availability of updated Canadian point-source data. The new 2002 data will not be available until later in the summer of 2005, so we obtained a copy of the 2000 Canadian point-source data. We will use these data in the final 2002 version A emissions inventory.

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, 2000-2004 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 additional model performance evaluation work for the Pre02d CMAQ simulation. We also analyzed $PM_{2.5}$ and coarse mass in the CMAQ Pre02 36-km base case and windblown dust (WBD) sensitivity case. The objective was to understand why the WBD case resulted in relatively small increases in ambient $PM_{2.5}$ and coarse mass. About half of the increased WBD emissions deposited out in areas close to the source region, but this did not fully explain the WBD sensitivity results. Therefore, we performed two new sets of CMAQ simulations for April and May 2002, using the 12-km CMAQ model for the Pre02d base case and WBD inventory. The simulations were still in progress as of May 31.

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:
We will analyze results from the two new WBD sensitivity simulations on the 12-km CMAQ model. No other CMAQ simulations are expected until the Base 2002 version A emissions inventory is completed.

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:
The results of the latest windblown dust emissions modeling were presented at the WRAP Dust Conference in Palm Springs on May 12. Comments on the revised draft task report were received from the Dust Emissions Joint Forum (DEJF) on May 31.

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

Expected Progress During the Next Reporting Period:
We will address the comments on the revised draft task report. Improvements to the methodologies will be incorporated as appropriate.

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:
Previously 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. During this reporting period no additional work was performed under this task as we wait for EPA's BART guidance to be released.

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 quality assurance 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. At the FEJF meeting in Denver on June 7, we will meet with the FEJF to discuss plans for completing the vertical plume rise and small-fire sensitivity modeling.

Difficulties Encountered and Resolutions:
Some problems with the Air Sciences files were found and conveyed to them in April. We need to follow up with Air Sciences to get updated emissions data.

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:
Based on direction given at the April 26-27, 2005, joint meeting of the Tribal Data Development Workgroup and the Emissions Forum on WRAP issues related to Alaska (held in Anchorage, AK), we began finalizing the Alaska 2002 MM5 modeling report. We also continued with the Alaska CALMET/CALPUFF modeling.

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:
None.

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:
We began researching the available approaches for modeling NO_x emissions from lightning. We have opened a dialogue with the modeling community through the M3List modeling listserv and are collecting information from the literature to begin developing a conceptual approach for a lightning NO_x model. We did not test the sea salt/surf zone emissions model in May as we had originally planned.

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

Expected Progress During the Next Reporting Period:
In June 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 beginning development of a prototype model for lighting NO_x emissions estimates. We will also review the natural emissions modeling results from the Section 309 modeling that was completed in 2003.

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:
We ordered two new RAID5 data storage systems and an additional thirty-two 400-GB disk drives for archiving project data. We could not negotiate a discount on the price from Apple for their RAID5 storage, so we used the same vendor, Area Electronics, that we have used in the

past. The total cost was about $27,000, which we split between two projects. We charged $14,921 of this to the WRAP project, which leaves about $20,000 of the budgeted equipment funds to purchase additional disk storage or computers in the future.

Expected Progress During the Next Reporting Period:
We will build new file servers and install the new RAID5 systems. We will also archive older data from the Sections 308 and 309 work that we do not expect to use again.

Difficulties Encountered and Resolutions:
None.