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

Monthly Progress Report for June 2005

Prepared by

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Introduction

This is the June 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 June 2005 Reporting Period

- *Task 1— Project Administration, Major Project Reports, and Computer Hardware and Systems Administration:* RMC staff participated in several meetings, including the Fire Emissions Joint Forum meeting in Denver, the Inter-RPO Meeting in Denver, and the Attribution of Haze Workgroup meeting in Seattle.

- *Task 2—Emissions Modeling, Processing, and Analysis:* We 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. This month we began modeling the non-WRAP on-road mobile-source sector, and completed processing the biogenic, offshore area- and point-source, WRAP ammonia, and windblown dust sectors.

- *Task 4—Air Quality Model Evaluation for 2002 Annual Simulation:* No new model simulations were completed, but we explored alternative approaches to completing the model evaluation, including unpaired-in-time and unpaired-in-space comparisons.

- *Task 5—Testing and Further Improvements to the Windblown Dust Emissions Modeling Methodology:* The CMAQ model was run with and without the latest windblown dust emissions estimates. Various analyses of the modeling results are underway. Comments on the draft final task report are being addressed, including revisions to numerous displays and analysis results. We continued discussions on the windblown dust emissions model, including the unresolved issues of the transport fraction and the coarse-to-fine-mass ratio.

- *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. EPA released their BART guidance on June 15. Its contents did not change the basic approach for BART modeling. No additional work was performed during this reporting period as we wait for the results of a conference call among WRAP states in mid-July to decide how they wish to address the BART issue.

- *Task 7—Sensitivity Studies Designed to Evaluate Uncertainties in Fire Emissions:* We completed quality assurance of fire emissions, and installed the Fire Emission Production

Simulator (FEPS) to be used in calculating fire plume rise when new fire data become available in July.

- *Task 8—Preliminary Meteorological, Emissions, and Air Quality Modeling Activities for Alaska:* We continued writing the Alaska MM5 modeling report and performing the Alaska CALPUFF modeling. Options regarding what Alaska needs to do for their 2007 visibility SIP and how to finish up this phase of the WRAP Alaska modeling were discussed on a June 29 conference call.

- *Task 10—Preparation and Reporting of Geographic Source Apportionment Results:* We discussed source apportionment options at the Attribution of Haze workgroup meeting in Seattle.

- *Task 11—Technology Transfer:* We are preparing technology transfer documents to be posted to the web site.

- *Task 12—Computer Hardware:* As of June 30, we were still attempting to install and configure the two new RAID5 disk systems.

June 2005 RMC Status Report

Below we discuss our progress during this monthly reporting period (June 2005) and expected activities during the next reporting period (July 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 June monthly progress report and prepared invoices. We continued to work on finalizing subcontract modifications. The

delay in approving the subcontracts for ENVIRON and UNC is in the UCR Office of Research Affairs.

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

Computer Hardware and Systems Administration:
Hardware activities are discussed under Task 12. We expanded the computer server room at UCR by including about 200 ft^2 of office space and adding shelf units to better organize disk drives used for archiving project data.

Expected Progress During the Next Reporting Period:
We will conduct the July Modeling Forum and project management calls, prepare the July progress report, finalize the subcontract modifications, and continue work 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 in June 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 completed modeling the biogenic, offshore area- and point-source, WRAP ammonia, and windblown dust emission sectors, and began processing the non-WRAP on-road mobile-source emissions sectors for the Base 2002 emissions simulation. Continued dialogue between the RMC and the emissions inventory contractors attempted to determine the time frame for receiving all of the inventories needed to complete the Base 2002 simulation. With the inventory lockdown date of July 15 looming, it does not appear that all of the sources will be ready. In particular, the WRAP stationary area and point-source inventories will not be available to the RMC until the end of July. As these inventories are critical components of the Base 2002 modeling, we will likely have to move the lockdown date to the beginning of August. The fire sources are supposed to be delivered to the RMC by July 1.

Some RPOs (CENRAP and MANE-VU) have generated new temporal profiles and cross-reference files (xref) for some of their emissions. We used these profiles and the xref to update SMOKE ancillary files for temporal allocation. Also, MANE-VU has updated their xref for spatial allocation. We used this update to revise our spatial xref file for processing emissions.

Through our weekly emissions modeling conference calls, the RMC determined how we will group the emissions sectors for the Base 2002 simulation. We will model the following 20 sectors as separate sources that will be merged to create the final emissions for the Base 2002 simulation:

- WRAP fires (combined agricultural, prescribed burns, wildfires, etc.)
- non-WRAP point fires (VISTAS)
- CENRAP area fires
- stationary point (non-WRAP)
- stationary point (WRAP, including CA offshore)
- stationary area (all U.S. and VISTAS fires)
- non-WRAP on-road mobile
- WRAP on-road mobile
- nonroad mobile (all U.S., including West Coast port/near-port shipping)
- West Coast shipping lanes
- offshore point (Gulf)
- offshore area (Gulf)
- anthropogenic dust (agricultural, construction, mining, road)
- windblown dust
- biogenic
- anthropogenic NH_3 (WRAP and CENRAP only; other RPOs in stationary area)
- all Mexico (area-like)
- Mexico point
- all Canada (area-like)
- Canada point

We are on the sixth 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 continued preparing a comparison between the WRAP Fire Emissions Joint Forum (FEJF) plume rise approach for fires and an alternative plume rise approach. The Fire Emission Production Simulator (FEPS) was installed at the RMC and will be used to estimate the heat flux from the WRAP fires in order to apply the SMOKE plume rise algorithm to those fires. We summarized the preliminary comparisons between these two approaches at the U.S. EPA Fire Modeling Meeting the week of June 6.

Preparation of the 2002 Model Performance Report, 2018 Base Case Modeling Report, and 2005-06 Project Report:
We generated two additional versions of the 2005-06 emissions modeling work plan that explicitly define the various 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 quality assurance 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 July. We will be moving toward an inventory lockdown date of August 1, 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:
After learning that we would not be receiving the final WRAP stationary area and stationary point inventories until late July, we had to push the inventory lockdown date back to August 1. Our progress on completing the Base 2002 simulation is limited by the availability of the emissions inventories. We still do not have inventories for the following regions and sectors:

- WRAP, CENRAP, Mexico stationary area
- WRAP, CENRAP, Mexico anthropogenic dust
- WRAP, CENRAP, MWRPO, Mexico road dust
- CENRAP, MWRPO, Mexico nonroad mobile
- WRAP CENRAP, MWRPO, Mexico aircraft, locomotive, shipping
- Pacific shipping lanes
- WRAP, Mexico on-road mobile
- WRAP, CENRAP, MWRPO, Mexico stationary point
- WRAP fires

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 analysis of the two new sets of CMAQ simulations for April and May 2002, using the 12-km CMAQ model for the Pre02d base case and windblown dust inventory.

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 further investigate the unpaired-in-space and unpaired-in-time approaches for model evaluation.

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:
Comments on the draft final task report were addressed. We ran the CMAQ model both with and without the latest dust emission estimates, and began analyzing the results. Model performance evaluations of the CMAQ results were conducted. A number of graphical displays of emission estimates and modeling results and analyses were revised for the final task report.

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

Expected Progress During the Next Reporting Period:
The windblown dust emissions model task report will be revised and finalized with the latest emissions estimates, CMAQ modeling runs and analyses, and numerous revisions to presentation graphics. 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. On June 15, EPA released the BART guidance. The content of this guidance does not require any substantial changes to the preliminary BART modeling technical plan prepared previously. Further work on this task is awaiting guidance from the WRAP states after they participate in a conference call in mid-July to discuss this issue.

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:
We completed quality assurance on the fire emissions data. We also installed the Fire Emission Production Simulator (FEPS) to be used in calculating fire plume rise when new fire data become available in July.

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

Expected Progress During the Next Reporting Period:
We expect to receive the revised fire emissions data in early July and begin processing them in SMOKE. We will use the FEPS to develop new plume rise height estimates for the fire sensitivity simulations.

Difficulties Encountered and Resolutions:
None.

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. A conference call was conducted on June 29 that included Alice Edwards of the Alaska Department of Environmental Conservation, Tom Moore of WRAP, and Ralph Morris of the RMC to discuss how to finish up the current WRAP Alaska modeling and what additional analysis will be needed to develop the December 2007 visibility SIP for Alaska. The following action items were identified during the conference call:

- Finish Alaska MM5 meteorological modeling report.
- Finish Alaska CALPUFF modeling and write report; include chapter on potential Weight of Evidence (WOE) analysis that Alaska can use to project reasonable visibility progress for the visibility SIP.
- Contact Cathy Cahill at University of Alaska Fairbanks on what analysis they have been doing studying arctic haze.
- Analyze WRAP fire emissions for Alaska and see whether they can be integrated into 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:
No new work was performed on this task during June.

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

Expected Progress During the Next Reporting Period:
In July 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:
We will compile and test CAMx PSAT on the WRAP 36-km modeling domain.

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:
We began preparing technology transfer documents for posting to the web site.

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:
In May we ordered two new RAID5 data storage systems and an additional thirty-two 400-GB disk drives for archiving project data. We received these in mid-June and began archiving old project data to disk drives. During the last two weeks of June we attempted to install and configure the new RAID5 systems using a new file server. However, the RAID5 disk systems did not function properly under any of the operating systems that we tested on the new file server. We continued working to try to bring these new systems online. The lack of disk space did not interfere with the project during June because we are still waiting for emissions datasets needed to start the next round of visibility modeling.

Note: As of July 7 we were able to get the RAID5 systems working by reducing the data transfer speed. We are communicating with the vendor about approaches to achieve the full rated data transfer speed.

Expected Progress During the Next Reporting Period:
We will complete installation of the new RAID5 systems by July 10. We will also continue to archive older data from the Sections 308 and 309 work that we do not expect to use again.

Difficulties Encountered and Resolutions:
None.