

Memorandum

Date: June 28, 2024

To: Bryce Kuchan, TCEQ

From: Chris Emery, Tejas Shah, Pradeepa Vennam, Katie Tuite, Greg Yarwood

Subject: Contract #: 582-23-459788
Work Order No. 2
Deliverable 6.3: Summary of PM and ozone training sessions and information related to the CAMx box models for PM_{2.5}

1 Background

Several areas of Texas are expected to be designated nonattainment for the revised annual fine particulate matter (PM_{2.5}) National Ambient Air Quality Standard (NAAQS). The TCEQ is preparing a 2022 modeling platform that will support upcoming State Implementation Plan (SIP) revisions for the potential new PM_{2.5} nonattainment areas. In addition, the Regional Haze Third Planning Period SIP revision will also include PM_{2.5} modeling and use the 2022 modeling platform. TCEQ staff require training on the current state-of-the-science regarding PM_{2.5} sources and chemistry, as well as issues and techniques related to PM_{2.5} modeling and model performance evaluation.

This project provided multiple virtual training sessions to TCEQ management and staff, including a conceptual overview of the science of particulate matter pollution, modeling methods, and model performance evaluation. Additional training sessions included a review of ozone/oxidation chemistry concepts and the application of a CAMx PM_{2.5} box model as an educational tool. The knowledge base was synthesized at a level that is accessible to TCEQ air modeling staff at all levels. Citations for peer-reviewed literature articles and other reference material were compiled to serve as a library of supporting information (see also the reference section at the end of this memorandum). Each training session was hosted and recorded by TCEQ using the Microsoft Teams virtual meeting platform.

2 Ozone Training Session

Ramboll developed and conducted a 2-hour virtual informational training session that covered the conceptual overview of ozone/oxidant chemistry and chemical formation regimes. The training included the roles of key precursor emissions, nitrogen oxides (NO_x) and volatile organic compounds (VOC), on oxidizing radicals and ozone formation and destruction cycles. The session also introduced the role of ozone and oxidants on secondary PM formation.

The ozone session was conducted on March 22, 2024; presentation topics are listed below:

- Ozone sources and sinks
- Tropospheric oxidant chemistry
- Chemical regimes
- Responses to precursor changes

- Chemical indicators
- Role of oxidants in secondary PM chemistry
- Condensed mechanisms for modelling

3 PM Training Sessions

Ramboll developed and conducted three 2-hour virtual informational training sessions. Session 1 provided a conceptual overview of the science of PM pollution, covering PM constituents, current understanding of chemistry and its treatment in models, and the types and forms of precursor emissions that drive secondary formation. Session 2 provided more information on source types, and issues and techniques in developing model-ready emission inputs. Particular focus was placed on how organic compound emissions need to be characterized to support the chemical treatment of secondary organic aerosols in models, as well as the types of additional source categories (e.g., ammonia; vehicular PM sources; construction, agricultural and windblown dust; oceanic) and speciation considerations beyond those needed for ozone modeling. Session 3 covered topics on model evaluation, including monitoring data, objective performance techniques, approaches in interpreting results, and an overview of advanced tools such as Particulate Source Apportionment Technology (PSAT) and decoupled direct method (DDM) to investigate source-receptor relationships.

PM session 1 was conducted on April 19, 2024; presentation topics are listed below:

- Summary of the new PM_{2.5} NAAQS and implications
- Characterization and composition
- Health and environmental impacts
- Sources and sinks
- Particulate chemistry
- Modeling PM:
 - Size distributions
 - Deposition and bi directional treatments
 - Chemistry

PM session 2 was conducted on April 24, 2024; presentation topics are listed below:

- Modeling considerations
- Additional PM source categories
- Additional PM and precursor speciation profiles
- Organic compound emissions needed for CAMx and CMAQ

PM session 3 was conducted on May 21, 2024; presentation topics are listed below:

- Monitoring data
- Objective performance techniques
- Regulatory metrics
- Advanced Tools:
 - Source Apportionment (PSAT)
 - Decoupled Direct Method (DDM) of sensitivity analysis
 - Process Analysis

4 PM Box Modeling

Chemical relationships between precursors and secondary PM_{2.5} are more extensive than for ozone because PM_{2.5} has many chemical constituents. “Box models” provide flexible, easy-to-use, and highly effective training tools from which to gain a fuller understanding of PM processes and to learn how precursor emission changes influence PM_{2.5} concentrations.

Ramboll set up and delivered three CAMx “box model” configurations for San Antonio, Dallas/Fort Worth and Northeast Texas. Each box model simulates the evolution of PM_{2.5} constituents within a single grid column given a set of initial conditions, emissions, and environmental inputs. Ramboll delivered a virtual training on box model concepts, their uses and findings on PM processes and responses. The training also included a demonstration on how to change box model inputs (e.g., emissions) and analyze concentration outputs.

The box model training session was conducted on June 26, 2024; presentation topics are listed below:

- Box model overview and background
- Examples from previous box model projects
- camxCE setup
- Model inputs
- Post processing
- Base run model results
- Sensitivity tests

The entire box model setup for the three Texas areas, including source code, input datafiles, preprocessors, post-processors, and final spreadsheet files for all test scenarios, was delivered to TCEQ on June 28, 2024.

5 References

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Combine tool: <https://github.com/USEPA/CMAQ/tree/main/POST/combine>

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