AQRP Monthly Technical Report

PROJECT TITLE	Novel Observations and Quantified Source Apportionment of Ozone, Particulate Matter and Contributing Precursors in the El Paso Area	**PROJECT #**	24-024
PROJECT PARTICIPANTS	Pawel Misztal, Lea Hildebrandt-Ruiz, David Sullivan, Elena McDonald-Buller, Yosuke Kimura	**DATE SUBMITTED**	6/10/2025
REPORTING PERIOD	**From:** 5/1/2025 **To:** 6/10/2025	**REPORT #**	9

A Financial Status Report (FSR) and Invoice will be submitted separately from each of the Project Participants reflecting charges for this Reporting Period. I understand that the FSR and Invoice are due to the AQRP by the 15th of the month following the reporting period shown above.

Detailed Accomplishments by Task for reporting period

Task 2b: A Comprehensive Air Quality Model with Extensions (CAMx) simulation with the Reactive Tracer (RTRAC) algorithm was completed to examine toluene and ethylene oxide concentrations and emission source contributions in the El Paso-Juarez modeling domain. Ethylene oxide was modeled explicitly in RTRAC; emission sources included commercial sterilization facilities and publicly owned wastewater treatment plants in Texas and New Mexico. Ethylene oxide emissions information for Mexico was not available. Explicit toluene (TOLU) emissions were used for most source categories, except area and point sources in Mexico and fires (wildfires, prescribed, and agricultural) for which the Carbon Bond 6 (CB6) lumped TOL species (representing toluene and other monoalkyl aromatics) was used as a surrogate.

CAMx simulated 95th percentile concentrations of ethylene oxide and toluene concentrations during 2022 are shown in Figures 1 and 2, respectively. The Chamizal site is the most comprehensively instrumented within the Texas Commission on Environmental Quality (TCEQ) network, including auto-GC measurements for air toxics as well as monitoring of ozone, fine particulate matter ($PM_{2.5}$), nitrogen oxides (NO_x), sulfur dioxide (SO_2), and meteorological parameters. Ethylene oxide has not been routinely measured at existing stationary monitoring sites in El Paso. The top 10% of CAMx simulated ethylene oxide concentrations and emission source contributions by prevailing wind direction at Chamizal are shown in Figure 3. Contributions from commercial sterilization facilities to peak ethylene oxide concentrations at Chamizal varied with wind direction, with the largest associated with emissions from the New Mexico facility under northwesterly winds. Emissions in the U.S. Environmental Protection Agency's (EPA's) 2022v1 modeling platform from this source were approximately 0.48 tons per year (tpy) versus 0.023 tpy collectively from the two sources located in El Paso. Comparisons of CAMx simulated against measured toluene concentrations via a box and whisker analyses at Chamizal (Figure 4) suggested reasonable agreement of interquartile ranges but a low model bias with higher observed values. CAMx simulated emission source contributions to toluene concentrations at Chamizal, shown in Figure 5, are dominated by Mexican onroad sources and to a lesser extent point and area sources.

(a) (b)

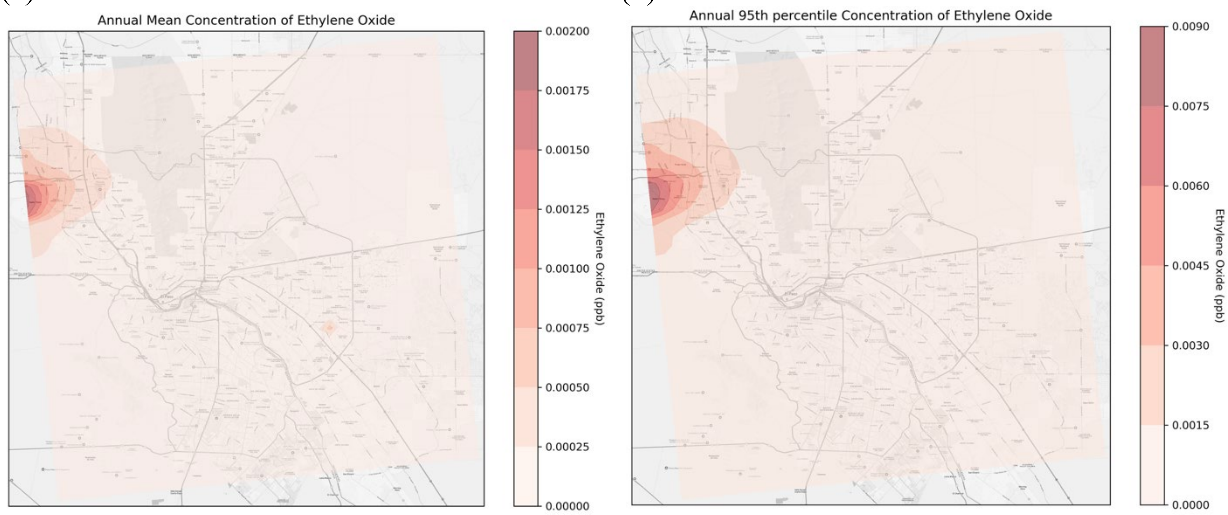

Figure 1. Simulated 2022 annual (a) mean and (b) 95th percentile concentrations of ethylene oxide by grid cell from the CAMx RTRAC simulations. Note differences in scales between plots.

(a) (b)

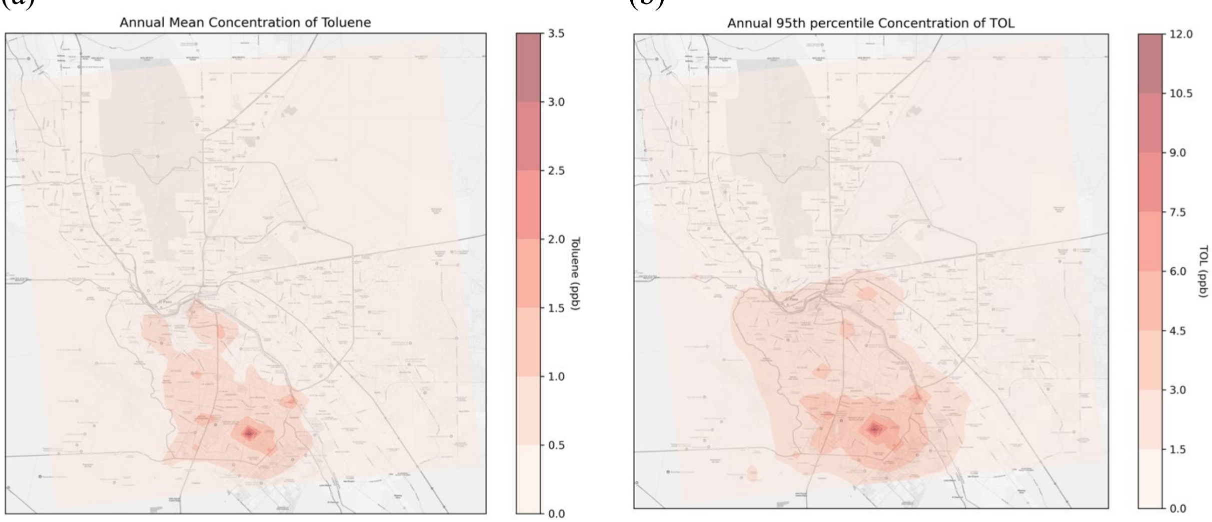

Figure 2. Simulated 2022 annual (a) mean and (b) 95th percentile concentrations of toluene by grid cell from the CAMx RTRAC simulations. Note differences in scales between plots.

(a) (b)

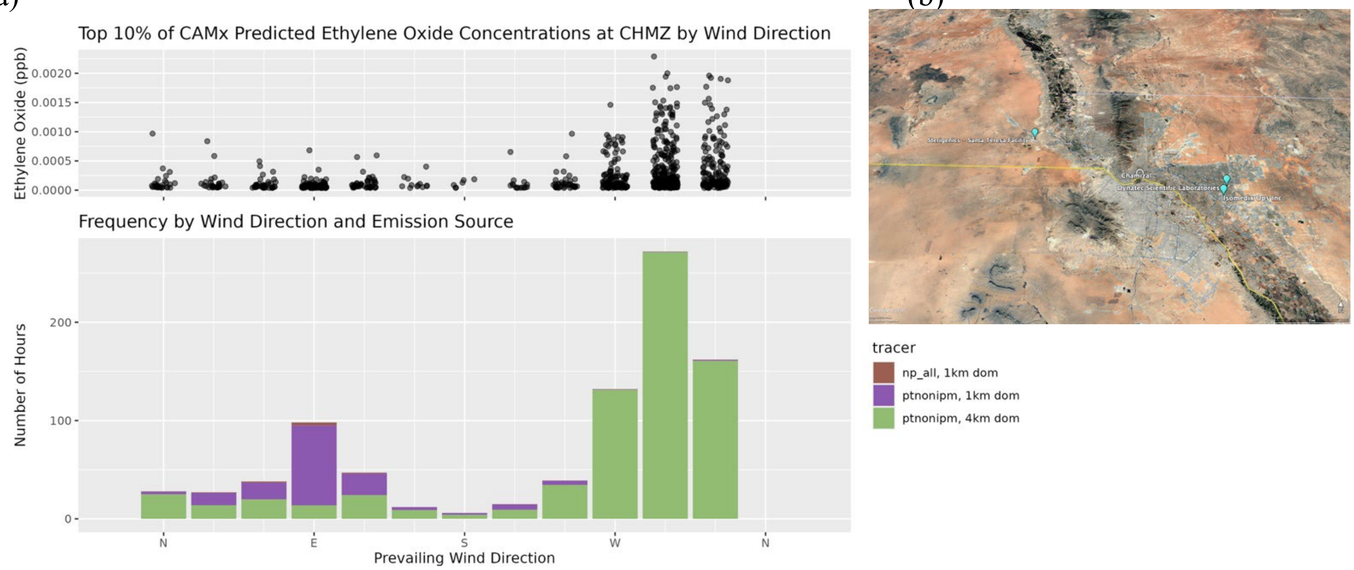

Figure 3. (a) Top: Annual top 10% of CAMx simulated ethylene oxide concentrations by prevailing wind direction. Bottom: Frequency by wind direction and contributions from nonpoint and non-electric generating unit (EGU) point sources. (b) Locations of point sources of ethylene oxide in the EPA 2022v1 inventory. Note that the Sterigenics facility is within the 4-km and other facilities within the 1-km El Paso-Juarez modeling domains.

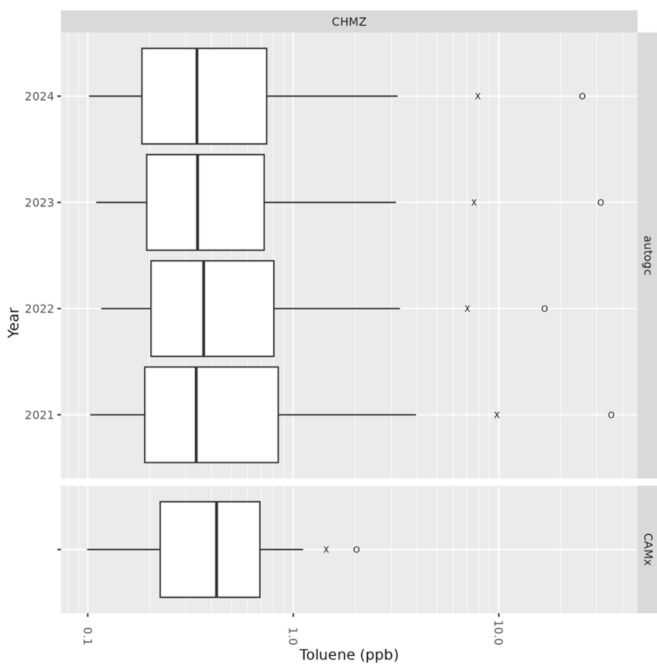

Figure 4. Box and whisker plots of measured concentrations during 2021 - 2024 versus CAMx simulated concentrations for the 2022 base year of toluene at Chamizal. The box shows the median and interquartile range, whiskers extend to 5th and 95th percentiles, x indicates 99th percentile, and o indicates maximum concentration.

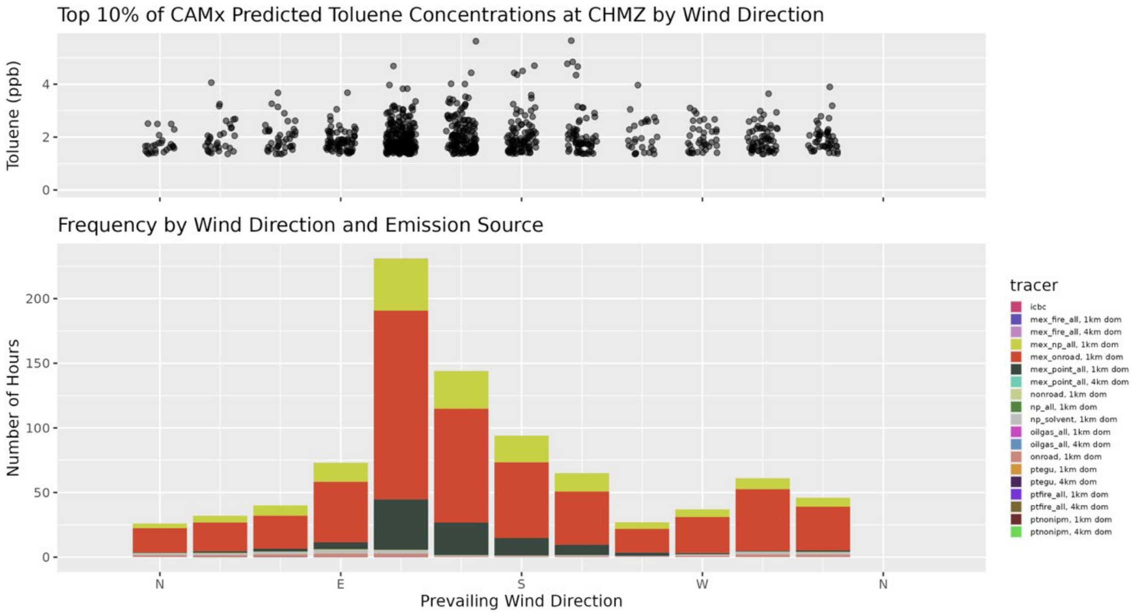

Figure 5. Top: Annual top 10% of CAMx simulated concentrations of toluene by prevailing wind direction. Bottom: frequency by wind direction and emission source contributions.

Task 3: Observational activities in May and early June were centered on the preparation and execution of the second intensive field campaign in El Paso, conducted during the late spring/early summer period. Mobile measurements were carried out from May 12–22, with a follow-up stationary deployment at UTEP from June 4–10. During the stationary phase, several targeted nighttime and early morning mobile tracks were performed to expand the spatiotemporal dataset, especially to compensate for two days impacted by major dust storms. The executed routes from this campaign are overlaid with the winter tracks in Figure 6, highlighting areas of overlap and expansion.

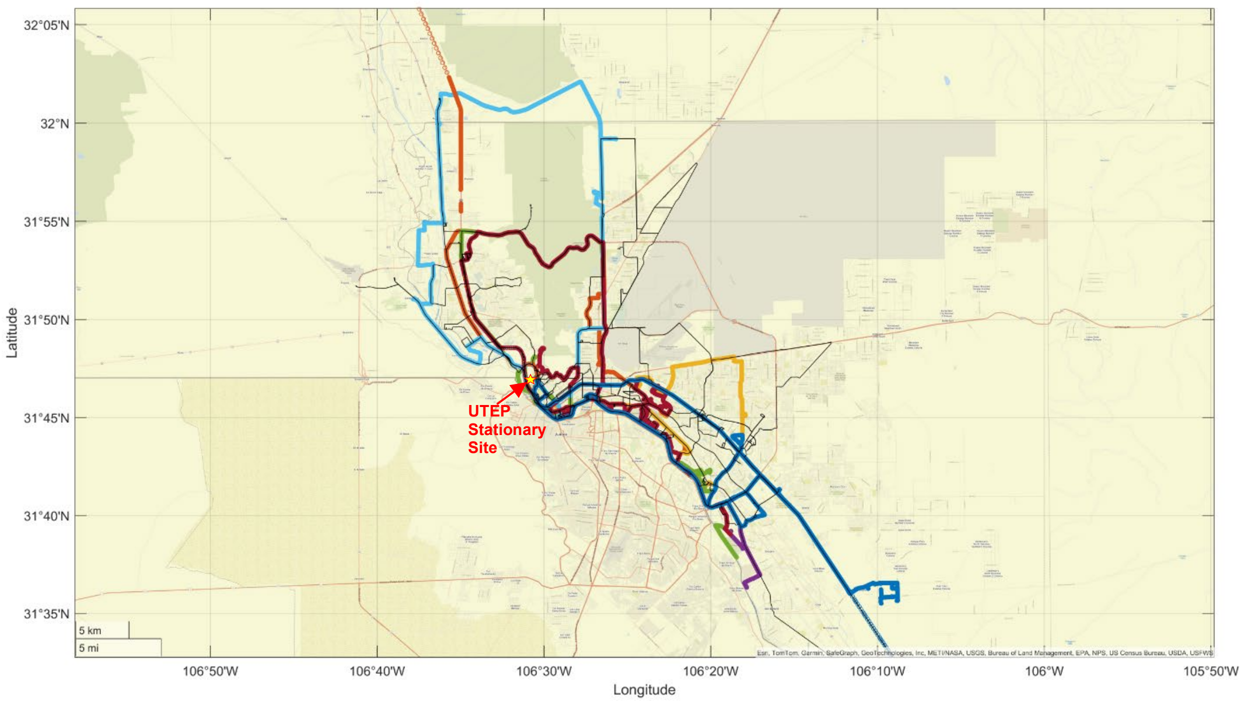

Figure 6. Completed driving measurement tracks; thin black line denotes winter campaign, while the colored thick lines represent late spring/early summer campaign.

Compared to the winter deployment, the spring campaign captured a distinct set of meteorological and source conditions. Wind patterns were predominantly westerly, enabling the team to track cross-border contributions from Juárez more effectively by driving along the U.S. – Mexico border. Temperatures frequently exceeded 90 °F, sharply contrasting with the sub-40 °F conditions during the polar vortex in winter. Dust storms occurred during early campaign days. These events provided unique opportunities to study coarse-mode dust interactions with gas-phase VOCs, while simultaneously requiring caution to protect instrument inlets and electronics from particulate overload. During dust events, elevated VOCs were observed with reduced PM1 signals, suggesting that in addition to direct sources, larger particles may potentially act as carriers for semi-volatile compounds advected over long distances.

The campaign's mobile tracks (Figure 6) targeted both previously sampled areas and new hotspots identified during real-time preview analysis. Repeated drives allowed direct seasonal comparisons, while new regions such as the wastewater treatment plant in southern El Paso revealed high concentrations of hydrogen sulfide (H_2S), sulfur-containing VOCs, and reduced nitrogen compounds (e.g., trimethylamine). A similar but chemically distinct source was found near the Las Cruces plant. The team also captured emissions from agricultural zones, noting ammonium nitrate aerosol and elevated methane likely linked to livestock or fertilizer usage. Border drives showed consistent enhancements in aromatics and sulfur compounds, particularly downwind of Juárez. In addition, high concentrations of solvent-like VOCs were observed downwind Juárez and near trains and industrial corridors.

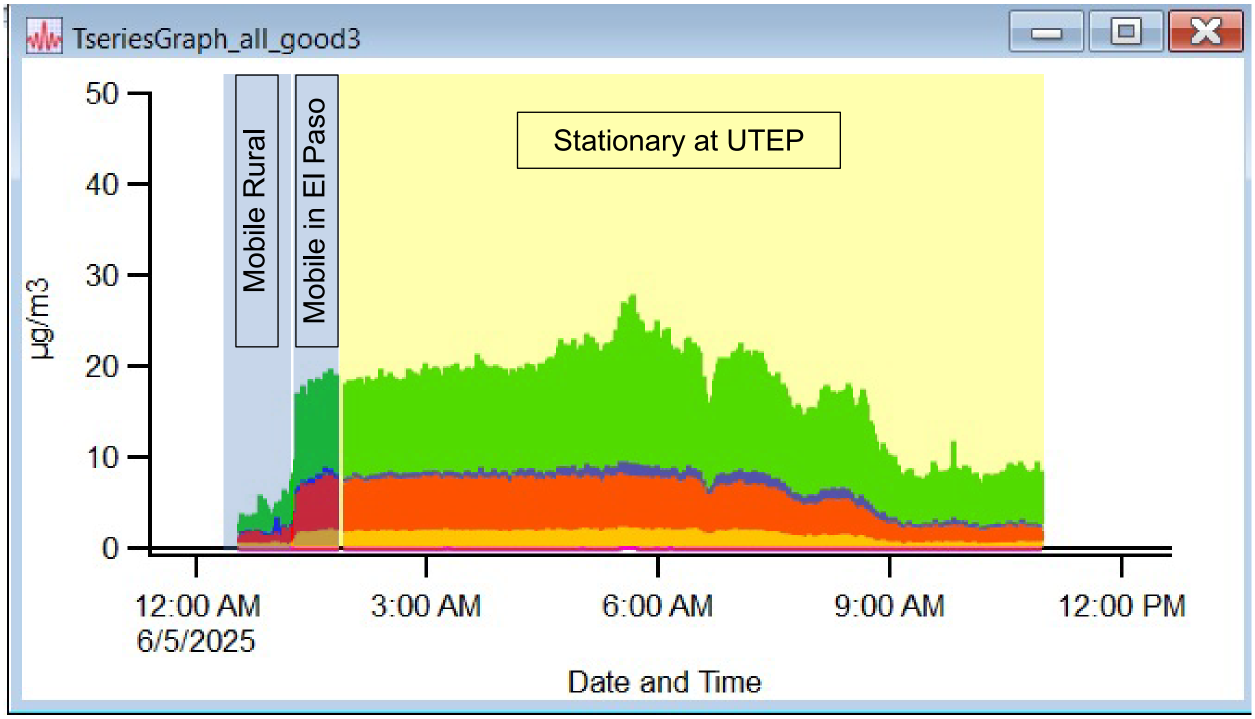

Figure 7. Preliminary real-time preview data of the might-time drive from Las Cruces to El Paso followed by stationary measurements at the UTEP site overnight and in the morning (CDT time).

Multiday stationary measurements at the UTEP site showed fascinating variabilities due to wind direction, ranging from very clean to heavily polluted air masses. The data also captured strong diel patterns driven by planetary boundary layer (PBL) dynamics. These observations will be directly compared with the speciated GC measurements collected at the UT Austin trailer to further resolve source profiles and temporal trends.

Overall, the campaign produced an extensive dataset of chemically speciated gases and aerosols, collected under diverse meteorological and source conditions. The team conducted repeated intercomparisons collocating with TCEQ monitors (Chamizal, Ascarate Park, Lower Valley) and made targeted visits to known and newly identified sources including refineries, gas stations, landfill flares, cooking sources, and vehicle hotspots. Multiple fire plumes, including suspected biomass burning and industrial flaring, were observed. Despite occasional instrument interlocks and power management challenges under extreme heat, which were resolved in real-time, the instrument uptime was close to 100%. The cooling ducts and insulations were critical to ensure uninterrupted measurements. These early observations will inform holistic analysis across campaigns, detailed source apportionment, and further data analysis workflows to address project objectives.

Figure 8. Select photographs from the May/June field campaign. **Top left:** Interior van layout with visible instrumentation and active cooling ducts. **Top right:** Van during co-location at the UTEP stationary monitoring site. **Middle left:** Research team preparing for mobile deployment. **Middle right:** Measurement activities near the wastewater treatment plant. **Bottom left:** Mobile sampling conducted near the U.S. – Mexico border. **Bottom right:** Measurement during a mild dust storm with reduced visibility.

Preliminary Analysis

As described above.

Data Collected

No

Identify Any Problems or Issues Encountered and Proposed Solutions or Adjustments

None

Goals and Anticipated Issues for the Succeeding Reporting Period

The modeling team will continue to evaluate CAMx simulated concentrations against measurements of criteria pollutants at stationary monitoring site locations within the El Paso and Juarez areas. Intercomparisons of modeled and measured toluene concentrations and characterization of emission source contributions will be made at two El Paso monitoring sites with Volatile Organic Canister (VOC) canister sampling. To the best of our knowledge, air toxics are not currently measured in Chihuahua, Mexico. We will continue to draft materials for the final report and anticipate meeting with the field teams to develop plans for intercomparisons of datasets.

The observation team will continue post-processing and quality assurance of the late spring/early summer campaign data, applying the same workflows used for the winter dataset to enable consistent cross-seasonal analysis. The upcoming work will focus on spatial mapping and source-resolved characterization of both gas-phase and particle-phase pollutants, with particular interest in identifying key contributors to secondary PM formation. In addition to mobile observations, the co-located stationary measurements at the UTEP site will be directly compared with complementary instrumentation from the UT Austin trailer, including GC-based VOC speciation.

A coordinated effort will be made to harmonize datasets from both campaigns to develop a robust picture of seasonal variability, emission source profiles, and pollutant transport dynamics in the El Paso–Juárez airshed. This integration will support improved source attribution, inform future mitigation strategies, and strengthen the scientific basis of the final report.

Detailed Analysis of the Progress of the Task Order to Date

None

Do you have any publications related to this project currently under development? If so, please provide a working title, and the journals you plan to submit to.

☐**Yes** ☒ **No**

Do you have any publications related to this project currently under review by a journal? If so, what is the working title and the journal name? Have you sent a copy of the article to your AQRP Project Manager and your TCEQ Liaison?

☐ **Yes** ☒ **No**

Do you have any bibliographic publications (ie: publications that cite the project) related to this project that have been published? If so, please list the reference information. List all items for the lifetime of the project.

☐ **Yes** ☒ **No**

Do you have any presentations related to this project currently under development? If so, please provide working title, and the conference you plan to present it (this does not include presentations for the AQRP Workshop).

☐ **Yes** ☒ **No**

Do you have any presentations related to this project that have been published? If so, please list reference information. List all items for the lifetime of the project.

☐ **Yes** ☒ **No**

Have any personnel changes occurred that were not listed in the original proposal? If so, please include a detailed description of the personnel change(s) below.

☐ **Yes** ☒ **No**

Are any delays expected in the progress of the research? If so, please include a detailed description of the potential delay below.

☐ **Yes** ☒ **No**

Describe any possible concerns/issues (technical or non-technical) that AQRP should be made aware of.

Are you anticipating using all the available funds allocated to this project by the end date? If not, why and approximately what is the amount to be returned?

☒ **Yes** ☐ **No**

Submitted to AQRP by
Pawel Misztal