AIR QUALITY RESEARCH PROGRAM

Texas Commission on Environmental Quality
Contract Number 582-22-20017
Awarded to The University of Texas at Austin

Quarterly Report
August 15, 2022 – November 14, 2022

Submitted to

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PREPARED IN COOPERATION WITH THE TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

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Texas Air Quality Research Program

Quarterly Report

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OVERVIEW

The goals of the State of Texas Air Quality Research Program (AQRP) are:

(i) to support scientific research related to Texas air quality, in the areas of emissions inventory development, atmospheric chemistry, meteorology, and air quality modeling,

(ii) to integrate AQRP research with the work of other organizations, and

(iii) to communicate the results of AQRP research to air quality decision-makers and stakeholders.

PROGRAM ACTIVITIES FOR THE QUARTER

Between August 15, 2022 and November 14, 2022, the AQRP efforts were focused primarily on executing subaward agreements between The University of Texas and the subaward entities. The Research Projects section of this report indicates project subaward status and summary details of progress made to date.

Once Subaward Agreements are fully executed, all project details will be posted on the AQRP website (https://aqrp.ceer.utexas.edu/projects.cfm).

As of the November 15, 2022, projects 22-019, 22-020, and 22-023 have not been fully executed. Although there are no communicated issues with the subaward agreement language, the sub entities' legal signatories are in the process of reviewing. The AQRP expects these three projects to be fully executed in December 2022. Projects 22-003, 22-006, 22-008, and 22-010 have fully executed subaward agreements in place. All projects have a retroactive start-date of August 22, 2022, to allow for project initiation expenses (such as report writing, equipment purchases, personnel effort, etc.) prior to full execution. Expiration date for all projects is August 31, 2023. Summary details of awarded projects are listed in Appendix A.

Projects, regardless of subaward agreement status, submitted Monthly Technical Reports (MTR) on the 10th of each month in the quarter. No technical concerns from AQRP Project Managers or TCEQ Project Liaisons have been raised. Project MTRs will be posted on the AQRP website (https://aqrp.ceer.utexas.edu/projects.cfm) by mid-December 2022.

Quarterly reports from all projects were collected on October 31, 2022. All reports have received acceptance by AQRP Project Managers and TCEQ Project Liaisons. Project Quarterly Reports will be posted on the AQRP website (https://aqrp.ceer.utexas.edu/projects.cfm) by mid-December 2022.

Projects 22-006 and 22-010 are currently in the process of working with The University of Texas at Austin (UT) and Fort Worth Meachum Airport legal counsel to gain site access. Due to UT's extensive history with negotiating Site Access Agreements (SAAs) with publicly and privately

owned property, the AQRP Project Manager, Vincent Torres, volunteered to lead the effort to execute an SAA or Easement Agreement between UT and Forth Worth Meachum Airport. On November 4, 2022, the AQRP Program Manager, in coordination with UT Legal, provided a public lands Easement Agreement template and an SAA template for the airport legal counsel to review. At the time of this report submission, Fort Worth Meachum Airport legal counsel are reviewing the Easement Agreement and SAA templates for consideration. Projects 22-006 and 22-010 do not have access to the Meachum Airport site currently. AQRP Project and Program Managers are communicating frequently with the TCEQ and Principal Investigators from projects 22-006 and 22-010 to disseminate the details and status of the agreement review.

Due to personnel changes at the TCEQ, Sushil Gautam became Project Liaison for 22-023 as well as the TCEQ AQRP Project Manager Back-up (previously Madison Knapp). And the Project Liaison Back-up for 22-023 is now Lam Nguyen, replacing Peter Hoholick. The Project liaison for 22-020 is now Bob Gifford, replacing Bipin Sharma.

The TCEQ is working with the AQRP Program Manager to amend the Prime Agreement to allow for the submission of the Personnel Eligibility List (PEL) in lieu of the monthly Level of Effort Certification (LEC) form, to decrease the time and effort involved in monthly reporting. An amendment is planned to be executed by next quarter.

Last quarter, the TCEQ approved a budget modification needed to fund a redesign the AQRP website hosted at UT. The AQRP website redesign project is progressing. A new site map has been approved by the UT web development team coordinating the effort. The site map and status updates are discussed and reviewed with Jocelyn Mellberg to ensure TCEQ expectations are considered in the planning process.

The Financial Status Report (FSR) section of this report includes accounting through October 2022 from Fiscal Year 2022-2023 (FY 22-23). The month of November 2022 expenses cannot be reported until the University accounting month closes in early December 2022.

Throughout the reporting period, the AQRP Program Manager communicated regularly with the TCEQ Project Manager regarding program deadlines, deliverables, program updates, submission of monthly FSRs, and provided any addition information as requested by the TCEQ.

Next quarter, the AQRP plans to complete pending subaward agreement executions, audit project FSRs, collect and publish MTRs and quarterly reports to the AQRP website, progress on the website redesign project, communicate weekly with the TCEQ with program updates, ensure all AQRP FSRs are submitted and documented properly with the TCEQ, and perform regular financial reconciliation of the grant at UT. The AQRP intends to poll all project Principal Investigators (PIs), TCEQ, and AQRP affiliates for a preferred date and time for the 2023 AQRP Workshop, to be held in the latter half of August 2023. A date for the 2023 Workshop will be solidified next quarter.

BACKGROUND

Section 387.010 of House Bill (HB) 1796 (81st Legislative Session), directs the Texas Commission on Environmental Quality (TCEQ) to establish the Texas Air Quality Research Program (AQRP). The University of Texas at Austin (UT) was selected by the TCEQ to administer the program. A contract for the administration of the AQRP was established between the TCEQ and UT. Consistent with the provisions in HB 1796, up to 10% of the available funding is to be used for program administration; the remainder (90%) of the available funding is to be used for research projects, individual project management activities, and meeting expenses associated with an Independent Technical Advisory Committee (ITAC).

The current AQRP contract was executed for the 2022-2023 biennium and funding of $750,000 per year was awarded.

RESEARCH PROJECT CYCLE

The Research Program is implemented through a nine-step cycle each biennium. The steps in the cycle are described from project concept generation to final project evaluation for a single project cycle.

1) The project cycle is initiated by developing (in year 1) or updating (in subsequent years) the research priorities. The Air Quality Research Program (AQRP) Director, in consultation with the Independent Technical Advisory Committee (ITAC), the Advisory Council (the Council) and the Texas Commission on Environmental Quality (TCEQ), develop research priorities; the research priorities are released along with a Request for Proposals (RFP).
2) Project proposals relevant to the research priorities are solicited. The RFP will be found at http://aqrp.ceer.utexas.edu/ once released.
3) The ITAC performs a scientific and technical evaluation of the proposals.
4) The project proposals and ITAC recommendations are forwarded to the TCEQ. The TCEQ evaluates the project recommendations from the ITAC and comments on the relevancy of the projects to the State of Texas's air quality research needs.
5) The recommendations from the ITAC and the TCEQ are presented to the Council and the Council selects the proposals to be funded.
6) All Investigators are notified of the status of their proposals, either intent to fund, not funded, or contingent (not funded at this time, but being held for possible reconsideration if funding becomes available).
7) Intent to fund projects are assigned an AQRP Project Manager at UT Austin and a Project Liaison at TCEQ. The AQRP Project Manager is responsible for ensuring that project objectives are achieved in a timely manner and that effective communication is maintained among investigators involved in multi-institution projects. The AQRP Project Manager has responsibility for documenting progress toward project measures of success for each project. The AQRP Project Manager works with the researchers, and the TCEQ, to create an approved work plan for the project.

   The AQRP Project Manager also works with the researchers, TCEQ, and the Program's Quality Assurance officer to develop an approved Quality Assurance Project Plan (QAPP) and Work Plan for each project. Subaward Agreements are issued. The AQRP Project Manager reviews monthly, quarterly, annual, and final reports from the researchers and works with the researchers to address deficiencies.
8) The AQRP Director and the AQRP Project Manager for each project describe progress on the project in the ITAC and Council meetings dedicated to on-going project review.
9) The project findings are communicated through multiple mechanisms. Final reports are posted to the AQRP web site (http://aqrp.ceer.utexas.edu/); research briefings are developed for the public and air quality decision makers; and a bi-annual research conference/data workshop is held.

During this quarter, the AQRP performed step 7.

Research Projects
FY 2022-2023 Projects

Project 22-003 (Atmospheric and Environmental Research, Inc.)

Title: Evaluating the Ability of Statistical and Photochemical Models to Capture the Impacts of Biomass Burning Smoke on Urban Air Quality in Texas	**STATUS: ACTIVE** (08/22/2022 – 08/31/2023)
	Funded Amount: $161,388
PI: Matthew Alvarado	**AQRP Project Manager**: Elena McDonald-Buller
	TCEQ Project Liaison: Chola Regmi

Abstract: Understanding the impact of domestic fire smoke on urban air quality (AQ) requires understanding (i) the chemistry of the smoke before it reaches the city and (ii) the changes in the urban production rate of ozone (O_3) and particulate matter ($PM_{2.5}$) caused by the smoke. The relative importance of these two pathways on the air quality impacts of domestic fire smoke is not well understood and it is unclear which processes should be targeted to reduce the overall uncertainty.

In addition, three-dimensional (3D) photochemical models like the Comprehensive Air Quality Model with Extensions (CAMx) can have trouble representing the near-source chemistry of the smoke plume and the impact of smoke mixing with urban pollution due to a combination of low spatial resolution near fires and incorrect representation of the chemistry of smoke-specific volatile organic compounds (VOCs). These limitations in physical approaches have led to the development of a variety of statistical approaches to estimate the impact of biomass burning on urban AQ. However, little work has been done to compare the statistical and 3D photochemical approaches or to identify priorities for further development of both approaches. Thus, the United State Environmental Protection Agency (US EPA) and United States (US) Forest Service organized assessment of smoke research needs noted this was a key priority for future smoke chemistry research. A statistical analysis of the impacts of domestic fire emission on urban air quality in Texas and a statistical evaluation of the ability of the CAMx model to simulate these impacts would greatly help TCEQ air quality managers understand the impacts of domestic fires on Texas air quality and human health.

Thus, the objectives of this project are to:

(1) Use generalized additive models (GAMs) driven with satellite and surface observations to examine the impact of fires on background and total O_3 and $PM_{2.5}$ in Texas urban areas.
(2) Examine the ability of CAMx photochemical model to simulate these fire impacts by applying similar statistical methods to the CAMx results.
(3) Use any statistically significant differences found to prioritize different approaches to improve the ability of CAMx to simulate the impacts of domestic fires on air quality.

This project will examine the impact of fires on urban AQ in Texas using statistical modeling. Two urban areas will be examined: Houston-Galveston-Brazoria (HGB) and El Paso. Background O_3 and $PM_{2.5}$ concentrations will be estimated using the lowest value observed at sites near the border of the area of interest, as TCEQ has done in the past (e.g., Berlin et al., 2013). Analyzing the impacts of fires on background and urban sites separately will allow examination of the change in O_3 and

$PM_{2.5}$ due to the mixing of smoke with urban pollution separately from the impact of smoke before it mixes with urban pollution. The same statistical methods will be applied to both the real-world surface observations and CAMx-simulated surface observations to determine if the impact of fires on urban air quality as simulated in CAMx is statistically equivalent to the impacts seen in the real-world data. Statistically significant differences will be examined to determine avenues for improving the handling of smoke and urban air chemistry in the photochemical models.

Project Update: The Project PI held the project kickoff. The team began gathering Stochastic Time-Inverted Lagrangian Transport (STILT) footprint modeling. The team began gathering Hazard Mapping System (HMS) smoke and fire data and translating it into Generalized Additive Mixed Model (GAMM) predictors.

Preliminary Analysis: None.

Data Collected: None.

Identify Any Problems or Issues Encountered and Proposed Solutions or Adjustments: None.

Goals and Anticipated Issues for the Succeeding Reporting Period: The following project tasks are expected to continue in the next reporting period.

- Compile meteorological and fire predictors into single dataset (Task 1).
- Gather and evaluate CAMx output from TCEQ (Task 2).

Detailed Analysis of the Progress of the Task Order to Date: Completed initial drafts of Work Plan and QAPP. Held project kickoff.

Project 22-006 (Aerodyne Research, Inc. (ARI) (Primary), Baylor University (Collaborator))

Title: Hydrogen Cyanide for Improved Identification of Fire Plumes in the $(BC)^2$ Network	**STATUS: PENDING EXECUTION**
	Funded Amount: $108,480 (ARI: $51,255; Baylor: $57,225)
PI: Tara Yacovitch (ARI) **Co-PI:** Rebecca Sheesley (Baylor) **Co-PI**: Sascha Usenko (Baylor)	**AQRP Project Manager**: Vincent Torres
	TCEQ Project Liaison: Erik Gribbin

Abstract: Wildfire incidents in the US have and will continue to increase with a changing climate. Smoke can impact the local air quality in Texas from both local/in-state fires, and transported emissions from other parts of the US and from Mexico. The 2020 Black and Brown Carbon $(BC)^2$ study demonstrated how wavelength-dependent aerosol optical properties could be used to track the influence of biomass burning. The $(BC)^2$ network operated in El Paso, Houston, and Galveston in 2020-21 and is being expanded to include Dallas-Fort Worth (DFW) in 2022 and 2023. Hydrogen cyanide (HCN) is a small nitrogen-containing molecule produced in significant quantities from biomass burning, and in limited quantities from vehicle combustion. The goal of this project is to improve smoke plume characterization with the addition of HCN to the $(BC)^2$ smoke monitoring network. This goal explicitly addresses the AQRP's 2022-2023 research priorities, notably "Domestic Fire Emissions" including transported emissions from wildfires (domestic, international) and their impacts on exceptional events in Texas. Performing this monitoring at a Dallas-Fort Worth site ties in with the AQRP's 2022-2023 research priority "Changing Emission Patterns in Texas", which includes additional research along the Interstate-35. This project will deploy a laser-based instrument to measure HCN at a new $(BC)^2$ network site in Dallas-Fort Worth. The work is laid out as 3 tasks: 1) Design measurement campaign; 2) Execute field campaigns; and 3) Data Analysis.

Project Update: The project team continues to hold regular project meetings in the lead up to the campaign.

The HCN instrument's performance at Aerodyne Research, Inc. offices was deemed acceptable, so the instrument and auxiliary equipment was packed in a crate and ground shipped to Baylor University. Aerodyne Scientist Conner Daube then flew to Baylor to assist with the physical integration of the instrument into a $(BC)^2$ network trailer that is powered and set up at Baylor University. While there, he was assisted by 2 Baylor graduate students in Dr. Usenko's group, who participated in the integration and received training on the instrument's operation, maintenance, and troubleshooting.

The HCN instrument performed well upon turn-on (<30 parts per thousand (ppt) 1-second noise), but suffered a detector problem resulting in a performance degradation (~130 ppt 1-second noise) after the instrument was moved a relatively short-distance into its final vibration-damping mount. Aerodyne Research, Inc. engineers provided remote troubleshooting assistance, and the issue was traced back to the high-gain setting of the infrared detector. We have a plan to replace this component prior to deployment at DFW (described below), but have chosen to leave the old detector installed in the instrument so that we can operate the instrument while at Baylor, collect some test data, and watch for any additional problems that arise. At this time, the instrument is running, and Baylor graduate students are communicating closely with Aerodyne on its operation. The instrument is also connected

to the internet, enabling remote access, and allowing the instrument computer to send out email status reports and/or interlock/crisis emails to Aerodyne project personnel.

Site planning is continuing through the $(BC)^2$ network program, led by Sascha Usenko, and in coordination with Doug Boyer (TCEQ, for the $(BC)^2$ network project) and Vince Torres (AQRP, for this HCN project and the related AQRP project 22-010, Principal Investigator: Ed Fortner). The two candidate sites are the Arlington Municipal Airport site (in between Dallas and Fort-Worth, near I-20) and the Meacham Airport (Fort Worth Northwest site). Both sites require electrical upgrades to host an additional $(BC)^2$ trailer. An electrician comfortable working with the state and with airports has been identified, and the electrical needs have been specified. Currently, the plan will be to deploy the trailer with HCN sensor to the first site that is ready to host it.

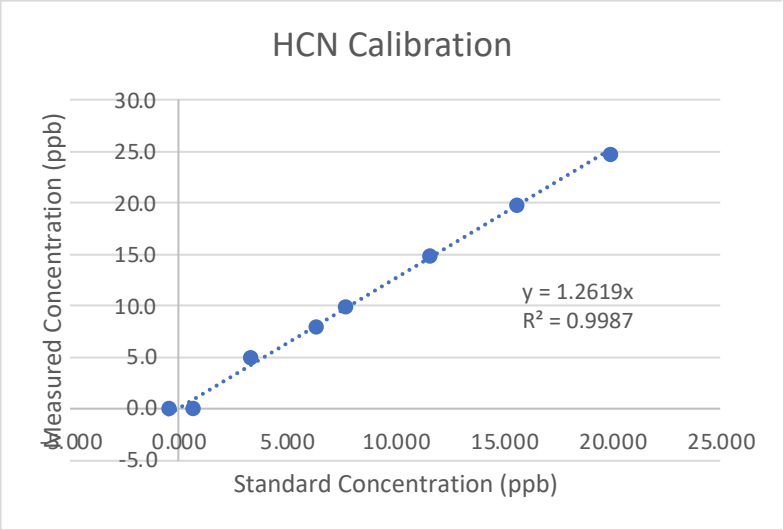
Preliminary Analysis: During the instrument integration, a first calibration of the HCN sensor was done using a 5 parts per million (ppm) commercial calibration tank. The calibration factor is m=1.26 where True = m * Raw. Linearity is excellent. For comparison, calibration factors for this same HCN spectral line, in a different instrument chassis and using a different calibration tank from the same vendor, was True = 1.01 * Raw. At this stage, we attribute the difference in calibration factors to uncertainties in the tanks. The FIREX tank was a "GasCo" tank; this project's tank was also a GasCo tank but purchased through a local reseller called "Calibration Controls". More detail is being requested of the seller to better understand the uncertainty in the specified tank concentrations.

Table 22-006-1. HCN Calibration #1 - 5 ppm HCN in N2 balance, 10/26/2022

HCN calibration #1 (at Baylor U.) - 1 PM local (6PM UTC)

HCN (ppb)	***UZA (sccm)***	***HCN (sccm)***	***Meas. (ppb)***	***Calc. (ppb)***
5000	5050	0	-0.46	0
5000	5050	10	7.69	9.9
5000	5050	20	15.6	19.8
5000	5050	5	3.29	5
5000	5050	15	11.6	14.9
5000	5050	25	19.9	24.8
5000	5050	8	6.34	7.9
5000	5050	0	0.631	0

Table 22-006-2. HCN Calibration Measured Concentration



Data Collected: Ambient data indoors and from Aerodyne's rooftop has been collected. Ambient data at Baylor University is also being collected. This data is not part of the project deliverables but can be used for instrument testing and quality assurance.

Identify Any Problems or Issues Encountered and Proposed Solutions or Adjustments: The detector issue encountered during integration is a concern. The degradation of instrument performance pushed the instrument outside of specifications as outlined in the Quality Assurance Protection Plan (QAPP), and so we have decided that Conner Daube will travel back to Baylor with a drop-in replacement detector. We have some flexibility on the timing of this visit, and so will attempt to schedule it to coincide with the planned deployment of the trailer to the DFW field site, for additional troubleshooting of any issues related to the move or to power at the site.

Such an emergency visit was planned for in the project budget; should emergency maintenance be required during the Spring campaign; it will not require a dedicated trip due to the presence of Aerodyne personnel in the area as part of the mobile lab project 22-010.

Progress on site access and power is progressing but is also a concern, since we now know that both candidate sites require electrical upgrades. We are mitigating its effects on campaign timing by integrating the instrument into the $(BC)^2$ trailer at Baylor University, so that the trailer can be fully functional as soon as possible. The HCN sensor is currently operating in the trailer.

Goals and Anticipated Issues for the Succeeding Reporting Period: Site power upgrades are expected in the next reporting period, and the trailer is therefore expected to be deployed to Dallas-Fort-Worth at that point. The HCN instrument detector replacement is also expected to occur in the next project period.

Detailed Analysis of the Progress of the Task Order to Date: Project progress continues, with significant progress made on both the instrument integration and site access fronts.

Personnel Changes: As described in the Workplan documents, and discussed directly with AQRP project management, Dr. Yacovitch will be on leave beginning mid-December 2022 for

approximately 4 months. Conner Daube will take over project management and reporting during her absence. He is already heavily involved in the project.

Project 22-008 (University of Houston (Primary), St. Edward's University (Collaborator))

Title: Modeling analysis of TRACER-AQ and over-water Measurements to improve prediction of on-land and offshore ozone	**STATUS: PENDING EXECUTION** (UH: PENDING; St. Ed's: ACTIVE)
PI: Yuxuan Wang (UH) **Co-PI**: James Flynn (UH) **Co-PI**: Paul Walter (St. Ed's)	**Funded Amount**: $181,724 (UH: $175,621; St. Ed's: $6,103) **AQRP Project Manager**: Elena McDonald-Buller **TCEQ Project Liaison**: Barry Exum

Abstract: The Tracking Aerosol Convection ExpeRiment-Air Quality (TRACER-AQ) study, including the Galveston Offshore Ozone Observations (GO3) field campaign, provided unprecedentedly rich observations of ozone air pollution covering both offshore and onshore locations that are needed to validate current air quality models. During the TRACER-AQ period (July – October 2021), there were six multi-day ozone episodes, resulting in over 20 days during which at least one land-based site or ship-based measurement with Maximum Daily 8-hour Average (MDA8) ozone concentrations exceeded the current National Ambient Air Quality Standard (NAAQS) of 70 ppbv. The project team's preliminary analysis of TRACER-AQ observations has revealed definitive gaps in the Weather Research and Forecasting (WRF) model and WRF-driven photochemical models in replicating the observations. This AQRP project will address these issues via continued efforts of model-observation comparisons and photochemical model intercomparisons using three models driven by the same high-resolution WRF meteorology and emissions (CAMx, WRF-GC, and WRF-Chem). The activities are designed to focus on the following primary science questions:

1. Which configurations and simulation settings of WRF most accurately replicate the extensive meteorological data collected as part of TRACER-AQ?
2. How well do coupled mesoscale meteorological and photochemical grid modeling of coastal/maritime boundary layers replicate observations?
3. How well do photochemical grid models predict over-water concentrations and formation rates of ozone?
4. What are the spatial distributions of ozone and ozone precursors during TRACER-AQ on days with on-land monitors recording exceedances of the NAAQS and how well does the photochemical model predict such distributions?
5. Which emission source categories affect ozone formation over Galveston Bay and the Gulf of Mexico?

The project specifically targets the AQRP Priority Research Area FY2022-2023: *TRACER-AQ and over-water measurements*. The project will lead to improvements in meteorological and photochemical models to better simulate on-land and offshore ozone in the Houston-Galveston-Brazoria (HGB). The model intercomparison will characterize the strengths and weaknesses of the regulatory model, CAMx, in the context of other air quality models. The modeling interpretation of TRACER-AQ observations will better understand offshore O_3 formation and transport and their effects on high ozone episodes on land that directly relate to ozone exceedances.

Project Update: For Task 3 (Meteorological model evaluation and improvement), we have conducted a new WRF simulation using daily re-initialization, namely [Re-init] in Table 22-008-1.

The model simulation is broken into many 30-hour segments. The first 6 hours of each segment, that is 18:00-23:00 UTC of a previous day, will be discarded to permit spin-up. The subsequent 24 hours, that is 0:00-23:00 UTC of the following day, is used for analysis and as input for air quality models.

Table 22-008-1. List of model experiments. The first five simulations are conducted for another TCEQ-funded project. The last three are proposed in this AQRP project.

Simulations	BC Meteorology	PBL	Microphysics	Nudging	Reinitializing
[Base]	NCEP FNL	MYNN	2M	No	No
[WSM6]	NCEP FNL	MYNN	WSM6	No	No
[YSU]	NCEP FNL	YSU	2M	No	No
[ACM2]	NCEP FNL	ACM2	2M	No	No
[ERA5]	ECMWF ERA5	MYNN	2M	No	No
[HRRR]	HRRR	MYNN	2M	No	No
[Nudged]	NCEP FNL	MYNN	2M	Yes	No
[Reinit]	NCEP FNL	MYNN	2M	No	Yes

Preliminary Analysis: Offshore boat meteorological measurements are used to validate WRF simulations. The three simulations proposed in Task 3 is combined with five simulations from another TCEQ-funded project to select the simulations with best performance over water. Figure 22-008-1 and Table 22-008-2 show the spatiotemporal variability between boat-observed and WRF-modeled meteorology for five ozone episodes, that is July 28, August 25, September 6-11, September 23-26, and October 6-9 in 2021.

Figure 22-008-1. Time series of (a) air temperature, (b) relative humidity, (c) wind speed, (d) wind direction and (e) boundary layer height between 1-min boat observations and WRF model simulations for five ozone episodes, that is July 28, August 25, September 6-11, September 23-26, and October 6-9 in 2021.

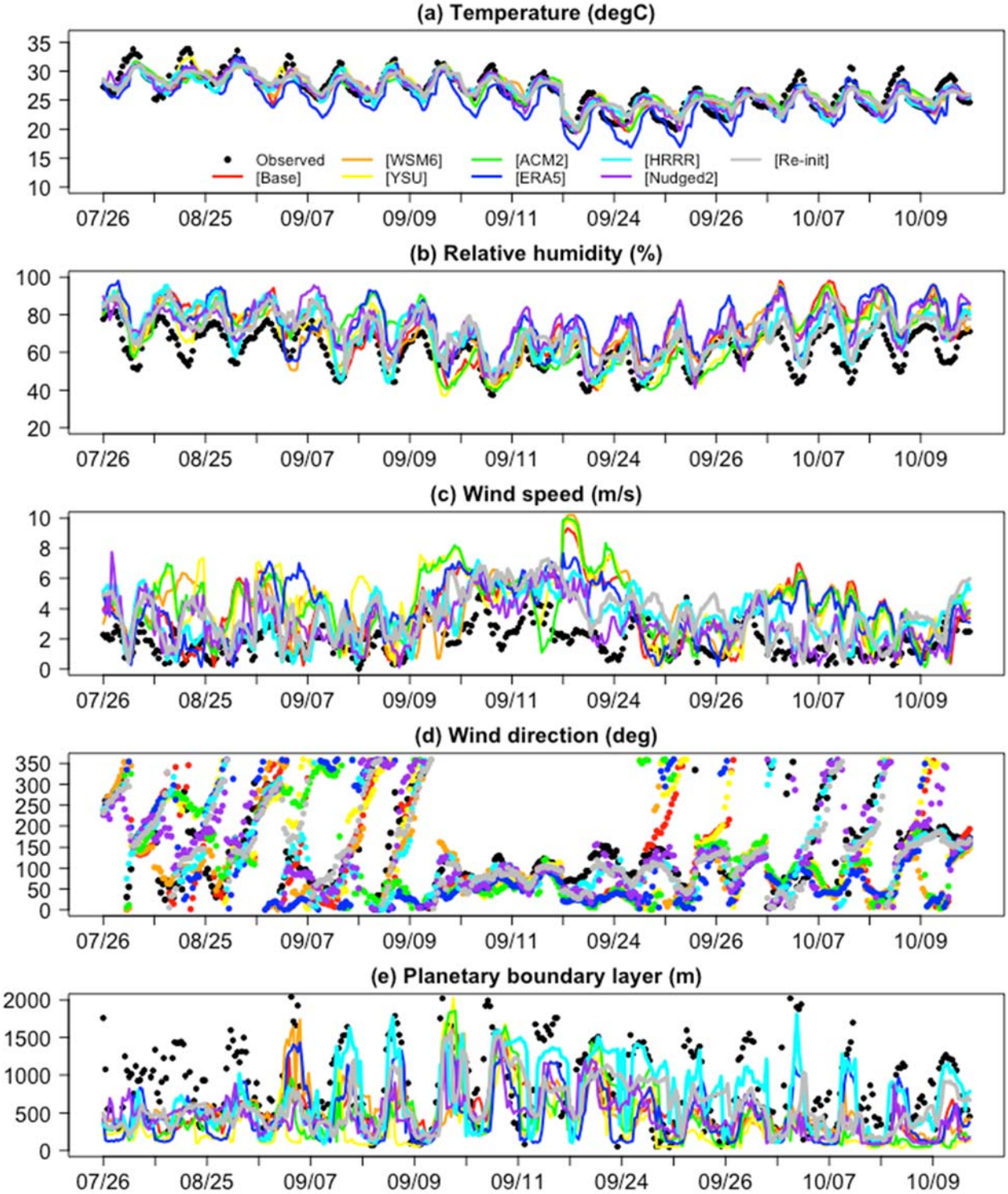


Table 22-008-2. Performance metrics of spatiotemporal variability between boat-observed and WRF-modeled meteorology for five ozone episodes. One-minute meteorology is used for calculation of performance metrics below. All metrics have the same unit as meteorological variables, except that correlation coefficient (R) and normal mean bias (NMB) are unitless.

Variables	Simulation	OBS	MOD	R	NMB	MB	MAE	RMSE
	[Base]		26.45	0.77	0	-0.11	1.71	2.14
	[WSM6]		26.5	0.75	0	-0.05	1.77	2.2
	[YSU]		26.78	0.78	0.01	0.22	1.71	2.1
Temperature (°C)	[ACM2]	26.55	26.51	0.75	0	-0.04	1.78	2.21
	[ERA5]		24.85	0.75	-0.06	-1.7	2.21	3
	[HRRR]		26.3	0.75	-0.01	-0.25	1.89	2.29
	[Nudged]		26.3	0.87	-0.01	-0.25	1.26	1.65
	[Re-init]		26.53	0.76	0	-0.02	1.71	2.15
	[Base]		70.24	0.64	0.15	9.28	11.95	14.59
	[WSM6]		71.09	0.61	0.17	10.14	11.76	14.38
	[YSU]		68.2	0.65	0.12	7.24	10.96	13.29
Relative humidity (%)	[ACM2]	60.96	69.35	0.56	0.14	8.4	12.75	15.33
	[ERA5]		74.38	0.6	0.22	13.42	14.66	17.23
	[HRRR]		69.2	0.7	0.14	8.24	10.38	12.68
	[Nudged]		73.35	0.75	0.2	12.39	12.87	14.92
	[Re-init]		69.68	0.67	0.14	8.72	10.25	12.42
	[Base]		2.47	0.16	0.74	1.67	2.2	2.78
	[WSM6]		2.62	0.14	0.82	1.85	2.33	2.92
	[YSU]		2.17	0.13	0.99	2.22	2.63	3.19
Wind Speed (m/s)	[ACM2]	0.73	1.99	0.15	0.92	2.07	2.49	3.09
	[ERA5]		1.89	0.22	0.78	1.74	2.21	2.72
	[HRRR]		1.68	0.52	0.59	1.32	1.69	2.05
	[Nudged]		1.75	0.37	0.41	0.92	1.57	1.96
	[Re-init]		2.02	0.3	0.69	1.55	2	2.41
	[Base]		118.78	0.32	-0.08	-11.45	57.74	75.38
	[WSM6]		113.5	0.26	-0.13	-19.1	60.4	77.29
	[YSU]		135.77	0.26	-0.11	-16.44	63.52	81.13
	[ACM2]		125.25	0.27	-0.11	-17.2	68.93	85.92
Wind direction (deg)	[ERA5]	144.15	96.69	0.18	-0.17	-25.2	69	85.3
	[HRRR]		137.93	0.58	-0.08	-12.53	41.54	58.16
	[Nudged]		146.95	0.45	-0.05	-7.68	47.87	65.51
	[Re-init]		146.96	0.62	-0.1	-14.98	42.98	59.66
	[Base]		499.27	0.32	-0.42	-356.3	529.63	699.67
	[WSM6]		526.69	0.3	-0.38	-328.88	526.38	691.82
	[YSU]		322.22	0.3	-0.62	-533.36	612.29	817.16
Boundary layer height (m)	[ACM2]	855.58	443.6	0.3	-0.48	-411.97	562.12	747.06
	[ERA5]		464.75	0.47	-0.46	-390.83	507.51	680.3
	[HRRR]		671.27	0.38	-0.22	-184.31	461.3	637.68
	[Nudged]		462.09	0.41	-0.46	-393.48	516.18	696.37
	[Re-init]		569.57	0.25	-0.33	-286	518.21	689.22

Data Collected: None.

Identify Any Problems or Issues Encountered and Proposed Solutions or Adjustments: None.

Goals and Anticipated Issues for the Succeeding Reporting Period: WRF simulations of Task 3 will be evaluated in the succeeding report period.

Detailed Analysis of the Progress of the Task Order to Date: N/A.

Project 22-010 (Aerodyne Research, Inc.)

Title: Dallas Field Study (DFS); Ozone Precursors, Local Sources and Remote Transport Including Biomass Burning	**STATUS: ACTIVE** (08/22/2022-08/31/2023)
	Funded Amount: $228,418
PI: Edward Fortner	**AQRP Project Manager**: Vincent Torres
	TCEQ Project Liaison: David Westenbarger

Abstract: The Dallas Fort Worth (DFW) Metropolitan area is the most populous metropolitan area (MSA) in the state of Texas and the fourth most populous MSA in the country. It is also experiencing a high rate of growth and is located along the Interstate 35 (I-35) corridor an area which the AQRP 2022-2023 research priority "Changing Emission Patterns in Texas" addresses as a research focus. The Aerodyne Mobile Laboratory (AML) will conduct measurements in the Spring of 2023 in the DFW area. This projects first objective is to conduct measurements of point sources in the DFW metropolitan area characterizing the volatile organic compounds (VOC) signature of these sources. This will lead to a better understanding of the VOC component of regional ozone production and an improved assessment of optimum strategies for ozone reduction in the DFW area.

The second goal of this project is to determine the influence of biomass burning impacted airmasses on the DFW metropolitan area. We will conduct measurements upwind and downwind of the DFW when biomass burning impacted airmasses enter the DFW area and determine the impact of these airmasses relative to typical ambient airmasses transiting the DFW area. We will also characterize any wildfires regionally by conducting measurements of the biomass burning plume better characterizing the evolvement of the plume over time. This goal is complimentary to the AQRP 2022-2023 research priority of "Domestic Fire Emissions".

Project Update: Progress on the following Tasks have been made:

Task 2: Base Site Selection:
The Fort Worth Northwest Site owned by TCEQ at the Meachum field airport remains the preferred staging site at this time although other sites including the TCEQ site at Arlington Municipal Airport are also being considered. Currently Vince Torres and RoseAnna Goewey (AQRP) are coordinating with the airport manager Dakota Shaw at Fort Worth Meachum Field to execute a site access agreement at the Fort Worth Northwest Site. Dr. Sascha Usenko at Baylor University has also contacted a local electrical company to conduct work at the Northwest Site which will benefit the related AQRP project 22-006 as well as AQRP project 22-010. This company will visit the site soon to give an estimate of the cost to improve the electrical capacity of the site to accommodate powering the Aerodyne Mobile Laboratory.

Task 3: Campaign Planning:
Concerns which are being focused on at this time are establishing a field staffing plan for the rotation of Aerodyne personnel during this campaign. Some personnel will be on-site for the entire campaign while others will be split into first and second half crews. The Aerodyne Mobile Laboratory itself and key instrument availability is also being scheduled for the time period of March-April with May considered to be an alternate measurement month if needed. A two-week integration plan at Aerodyne is scheduled to occur prior to the deployment of the Aerodyne Mobile Laboratory. The necessary

ordering of calibration equipment is also occurring to ensure its availability for the measurement campaign.

Preliminary Analysis: N/A.

Data Collected: None.

Identify Any Problems or Issues Encountered and Proposed Solutions or Adjustments: None.

Goals and Anticipated Issues for the Succeeding Reporting Period: Progressing on the Northwest site electrical needs is a priority over the next few weeks. Issues which may arise here will be a point of focus for both the 22-006 and the 22-010 projects.

Detailed Analysis of the Progress of the Task Order to Date: Tasks 2 and 3 are proceeding on schedule at this point.

Personnel Changes: Regarding conducting GC-EI-ToF-MS measurements we have always planned to have a combination of Dr. Megan Claflin and Dr. Brian Lerner executing these measurements and that is still the staffing plan for this instrument. Dr. Lerner will now take the lead in these measurements however due to Dr. Claflin having commitments to other projects. Since Dr Lerner will be leading these measurements a bio for Dr. Lerner is now included below.

> **Dr. Brian Lerner Bio:**
> Dr. Brian Lerner is an analytical chemist with 19 years of postdoctoral experience. His research interests include advanced gas chromatographic and mass spectrometric techniques for the detection and quantification of gas phase species. Currently, he leads the GC development work at Aerodyne Research, Inc., including pre-concentration systems and the Aerodyne GC-EI-ToF. Dr. Lerner holds a Ph.D. in Chemistry and a master's degree in Environmental Science from University of Colorado. He has over 100 publications. He has participated in multiple field campaigns with ARI, including the 2019 FIREX-AQ campaign in the Western US, the 2020 NSF CLOROX field campaign at Oliktok Point, AK and the 2021 NASA Michigan-Ontario Ozone Source Experiment (MOOSE). For these campaigns the Aerodyne GC-EI-TOF-MS and GC-Vocus-TOFMS quantified hydrocarbon, halocarbon, and oxygenated volatile organic compounds (VOCs).

Project 22-019 (University of Houston)

Title: Refining Ammonia emission using inverse modeling and satellite observations over Texas and the Gulf of Mexico and investigating its effect on fine particulate matter	**STATUS: PENDING EXECUTION**
	Funded Amount: $131,366
	AQRP Project Manager: Elena McDonald-Buller
PI: Yunsoo Choi	**TCEQ Project Liaison**: Khalid Al-Wali

Abstract: The overall goal of this project is to conduct an inverse modeling study over the State of Texas and the Gulf of Mexico using Community Multiscale Air Quality (CMAQ) models integrated with ammonia (NH_3) remote sensing data from the Cross-track Infrared Sounder (CrIS) for 2019. Objectives of this project are 1) updating the emissions inventory over Texas and the Gulf of Mexico; 2) investigating the contribution of the updated NH_3 emissions on fine particulate matter ($PM_{2.5}$) concentrations; and 3) analyzing the effect of adjusted NH_3 emissions on atmospheric chemistry. In this inverse modeling study, we will use CrIS satellite observations to adjust National Emissions Inventory (NEI) NH_3 emissions, which are highly uncertain owing to a lack of NH_3 observations and therefore more likely to result in errors in the calculated bottom-up NH_3 emissions. To proceed with the emission adjustment approach, we will apply the iterative Finite Difference Mass Balance (iFDMB) inverse modeling technique to revise the NEI NH_3 emissions with respect to CrIS observations. Since running iFDMB is computationally expensive and requires numerous iterations, the employment of a reduced complexity CMAQ model (RCCM) for simulations can reduce the burden of computations while maintaining the accuracy of predictions. We will conduct the iFDMB by implementing a RCCM to simulate NH_3 concentrations over the regions of interest. Following this project, we will develop adjustment factors for modifying NH_3 emissions until they reach an optimum state in which NH_3 concentrations are the closest to the CrIS observations. After updating the emissions inventory, we will investigate the consequent impacts of the adjusted NH_3 emissions on the behaviors of such atmospheric constituents as the concentrations of $PM_{2.5}$ and inorganic $PM_{2.5}$ species.

Project Update: Progress updates for Tasks 1-3 are listed below:

Task1: Preparation of comprehensive satellite, in situ, and modeling data for the iterative Finite Difference Mass Balance (iFDMB) method: The UH-AQF modeling team evaluated Weather Research & Forecasting (WRF) model performance against Meteorological Assimilation Data Ingest System (MADIS) observations for 2019 over the modeling domain. To do so, the team developed a python code to download and prepare the MADIS observations to evaluate WRF results. The evaluation showed that the performance of WRF in simulating meteorological parameters is reasonable. Furthermore, CrIS satellite observations have been gathered using a python code developed within the framework which will be used to perform the inverse modeling. The UH-AQF modeling team has also worked on emissions modeling setup by gathering National Emissions Inventory (NEI) 2017 modeling platform, preparing meteorological data in the format required by Community Multiscale Air Quality (CMAQ) using the Meteorology-Chemistry Interface Processor (MCIP), and setting up the Sparse Matrix Operator Kernel Emissions (SMOKE) scripts and modeling domain within the NEI 2017 platform.

Task2: Development of the Reduced-Complexity CMAQ Model (RCCM) for NH_3 and refinement of NH_3 emissions using iFDMB with the combination of CMAQ model and CrIS satellite observations: No activities during the reporting period.

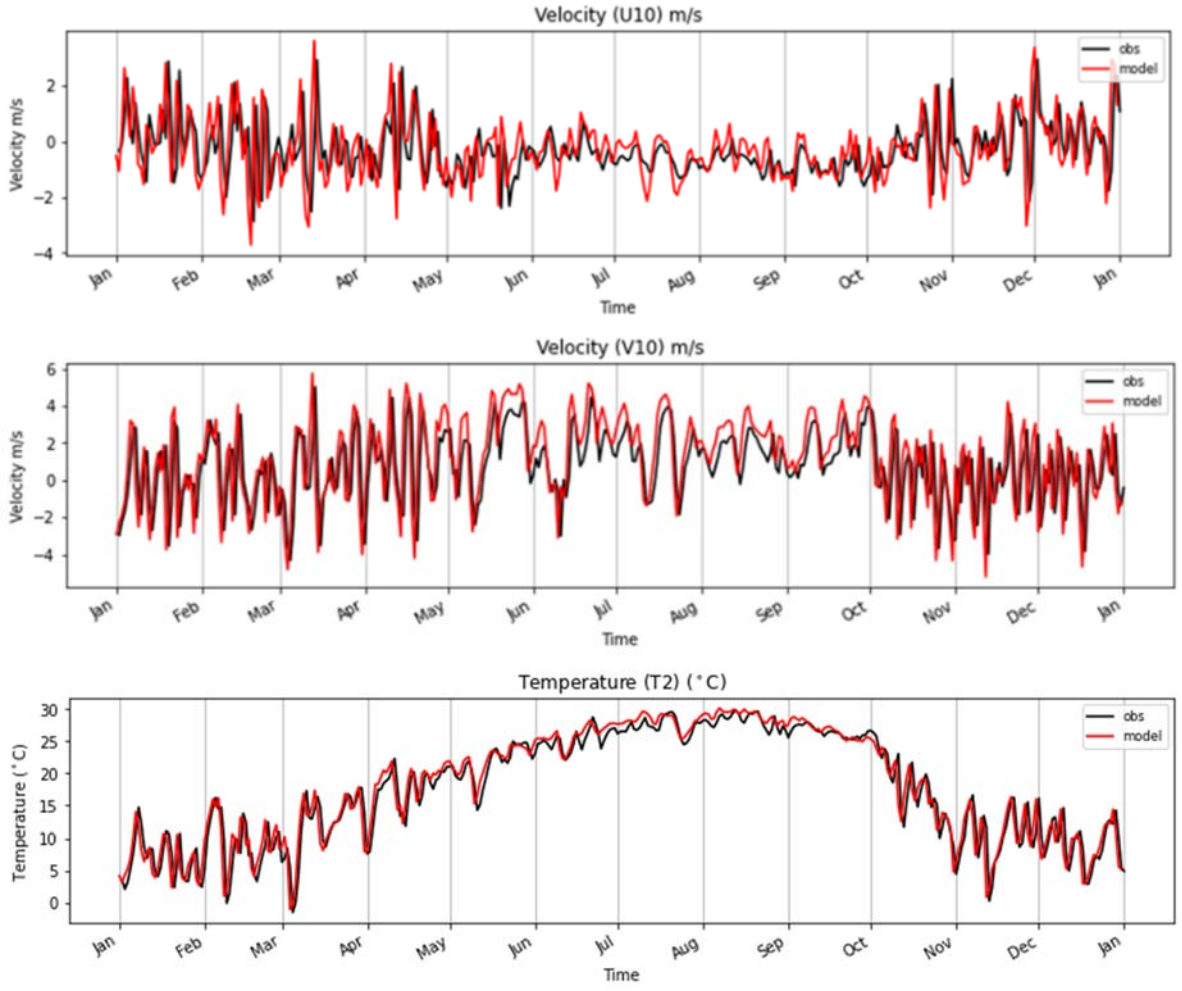
Task3: Investigation of $PM_{2.5}$ concentrations using the updated emission inventory: No activities during the reporting period.

Preliminary Analysis: The statistical evaluation of WRF model performance against MADIS data is shown in Table 22-019-1 for temperature, U-component, and V-component of wind. Also, Figure 22-019-1 depicted the spatial plot of temperature simulated by the WRF model in August.

Table 22-019-1: Statistical evaluation of WRF model performance against MADIS data for 2019 (hourly dataset)

Variable	R	IOA	RMSE	MAE
Wind Speed in x direction (U10)	0.66	0.79	1.89	1.51
Wind Speed in y direction (V10)	0.78	0.86	2.19	1.74
Temperature at 2 meters (T2)	0.95	0.96	2.94	2.26

Figure 22-019-1. Timeseries plots for evaluating WRF model performance against MADIS data in 2019. U10, V10: wind speed in x and y directions, respectively, T2: Temperature.



Data Collected: CrIS observations data for 2019 have been collected.

Identify Any Problems or Issues Encountered and Proposed Solutions or Adjustments: None.

Goals and Anticipated Issues for the Succeeding Reporting Period: UH-AQF team will finish modeling emissions for the modeling period.

Detailed Analysis of the Progress of the Task Order to Date: None.

Project 22-020 (Texas A&M University)

Title: Quantifying the Emissions and Spatial/Temporal Distributions of Consumer Volatile Chemical Products (VCPs) in the Greater Houston Area	**STATUS: PENDING EXECUTION** **Funded Amount**: $160,182 **AQRP Project Manager**: Elena McDonald-Buller
PI: Yue Zhang **Co-PI**: Qi Ying	**TCEQ Project Liaison**: Bob Gifford

Abstract: Air pollution is the fifth largest cause of death in the world. Volatile organic compounds (VOCs) can also undergo chemical reactions with atmospheric oxidants to form major atmospheric pollutants, such as photochemical ozone (O_3) and particulate matter (PM). With this changing emission profile of carbonaceous compounds in urban areas, volatile chemical products (VCPs) have become one of the most significant sources of anthropogenic VOCs. VCPs typically consist of organic species from consumer products and business activities, including cleaning agents, printing inks, personal care products, pesticides, and coatings. In the populated urban regions, such as New York City, where O_3 formation is VOC-limited, VCPs account for more than half of the 20 ppb maximum daily average 8-h (MDA8) O_3 attributed to anthropogenic VOCs. As the fourth largest city in the US, with more than 7 million people in the surrounding areas, Houston has no reported ambient measurements of the VCP to our knowledge, highlighting the urgent need to update the VCP emission inventory in the Greater Houston Area validated by ambient measurements with detailed spatial and temporal resolution. Our primary hypothesis is that the VCPs in the Greater Houston Area account for a significant portion of the total VOC emission and have important implications on the regional ozone concentrations that were previously not captured by the emission inventory and models. To address this hypothesis, our primary goal is to use existing field measurement data to provide temporal, spatial, and seasonal information of the VCPs in the Greater Houston Area and use a high spatial resolution regional chemical transport model with a detailed photochemical mechanism to further improve the VCP emission inventory and understand the impacts of VCP on air quality, including ozone.

Project Update: Successfully deployed our instrument (Vocus, aerosol mass spectrometer, CO monitor, NO_2 monitor, soot monitor, scanning electric mobility sizer, ozone monitor, and other supporting devices) around Houston

Designed four different routes around Houston to sample the volatile consumer products (VCP) and other species in the Greater Houston area

Data Collected: The Project has collected full suite of data of the trace gases (Vocus), particle phase chemical composition (AMS), CO, NO_2, O_3, aerosol size distribution, GPS location through our deployment around the Houston.

The project has collected the above gas and particle information both during the day and at night, during weekends and weekdays, and on sunny and cloudy days.

Identify Any Problems or Issues Encountered and Proposed Solutions or Adjustments: The deployment initially took longer than expected so the team members had to work until 2-3 am for the

first couple of deployment. As we streamlined the process the deployment schedule resumed to be reasonable.

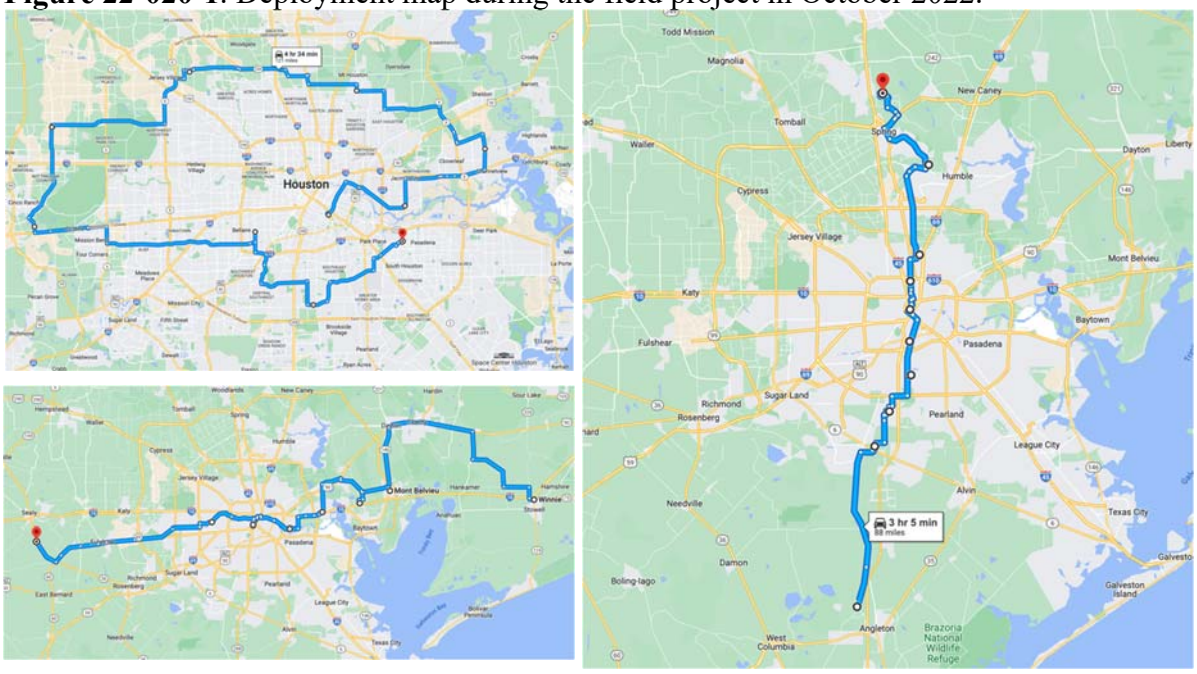
Goals and Anticipated Issues for the Succeeding Reporting Period:

1. First goal is to provide at least 10 deployment-related data to the AQRP
2. Second goal is to understand the VCP and aerosol concentration in the ambient environment in Houston
3. Third goal is to understand whether the current VCP inventory matches the ambient data.

   Based on the current progress, our first goal is on track. We will analyze the data after the field deployment to achieve the second and the third goal.

Detailed Analysis of the Progress of the Task Order to Date: We are currently conducting field measurement and performed some of the data analysis. Below are the route maps we have conducted during this field study. We plan to analyze the full suite of data after the deployment finishes.

Figure 22-020-1. Deployment map during the field project in October 2022.



In addition, below are the exterior and the interior images of the mobile lab. We have a wireless 5G service that can connect all instruments and project the screen to the front passenger seat.

Figure 22-020-2. Exterior, roof top, and interior image of the mobile laboratory.

Project 22-023 (The George Washington University (Primary), Ramboll (Collaborator))

Title: Source-sector NOx emissions analysis with sub-kilometer scale airborne observations in Houston during TRACER-AQ	**STATUS: PENDING EXECUTION** (GWU: PENDING; Ramboll: ACTIVE)
PI: Daniel Goldberg (GWU) **Co-PI**: Greg Yarwood (Ramboll)	**Funded Amount**: $248,146.60 (GWU: $103,425; Ramboll: $144,721.60) **AQRP Project Manager**: Elena McDonald-Buller **TCEQ Project Liaison**: Sushil Gautam

Abstract: Nitrogen oxide (NO_X) emissions are a critical participant in ozone formation. Many North American cities already have NO_X-limited ozone formation during the warm season (Jin et al., 2020; Jung et al., 2022), and the remaining cities should have primarily NO_X-limited conditions in the coming years (Koplitz et al., 2021). Further reducing ozone production rates within cities will therefore require improved quantification of NO_X emissions. One major limitation of our current observing network is the inability to accurately quantify NO_X emissions on a sector-by-sector basis in a timely fashion, with the exception of continuous emissions monitoring systems (CEMS) on electricity generating units. Many non-road sources of NO_X emissions, such as industrial or construction emissions, have large uncertainties (Zawacki et al., 2018).

In this project we will use fine spatial resolution nitrogen dioxide (NO_2) information (250 × 560 m^2) from the Geostationary Coastal and air pollution events Airborne Simulator (GCAS) instrument (Janz et al., 2019; Nowlan et al., 2018), available during the September 2021 NASA/TCEQ Tracking Aerosol Convection ExpeRiment – Air Quality (TRACER-AQ) field campaign, to better understand the fine-scale structure of NO_X emissions in the Houston metropolitan area including a sector-by-sector analysis.

Complementing the airborne observations, the Comprehensive Air Quality Model with Extensions (CAMx) will be run with a fine spatial resolution (444 × 444 m^2) using the 2019 TCEQ emissions inventory. The model output will then be compared to data from the GCAS and the Tropospheric Monitoring Instrument (TROPOMI) in order to identify gaps in our understanding of NO_X emissions. We will compare/contrast NO_2 concentrations near large CEMS and non-CEMS point sources, major highways, large population centers, airports, railyards, and commercial marine vessels to determine whether the magnitude of the NO_X emissions agree between the inventory and observations. We will also use GCAS observations to estimate NO_X emissions directly from individual point sources or quasi-points sources (e.g., airports, petrochemical complexes, etc.). To maximize the value of the airborne measurements, we will use a Generalized Additive Model (GAM) to estimate the contributions from different NO_X emission sectors that best matches the airborne retrievals.

This work maps to at least four Research Priority Areas of the Texas Air Quality Research Program (AQRP), as shown in the table below. This project will combine aircraft and satellite observations with high resolution models, to provide actionable information about TCEQ's

2019 Emissions Inventory for NO_X. These results will provide a new perspective for aiding in decision-making for improving ozone air quality in the region.

Table 22-023-1. How this project will respond to the AQRP Research Priority Areas

Research Priority Area	How this project will be addressing the Research Priority
Utilize TRACER-AQ and over-water measurements	A central dataset used will be the GCAS measurements acquired during TRACER-AQ to infer sectorized NO_X emissions addressing TRACERAQ science objectives on Ozone Photochemistry and Model Evaluation
Improve emissions inventories	Satellite and aircraft measurements, aided by machine learning, will be used to directly estimate instantaneous NO_X emission rates, often from individual sources or sectors of sources such as on-road, non-road, commercial marine, and rail.
Improve accuracy of photochemical grid models	Model (CAMx) will be tested against the GCAS observations to identify where improvement is needed in NO_X emissions by sector, therefore improving model performance.
Use of satellite and other remote sensing data	Utilize aircraft (GCAS) and satellite (TROPOMI and TEMPO) to better understand spatial patterns of NO_2 and its relationship to NO_X emissions

Project Update: Updates by project tasks are listed below:

Task 1: Simulate NO_2, HCHO, O_3 at 444 × 444 m^2 spatial resolution using WRF-CAMx: The WRF-CAMx 444 × 444 m^2 grid has been defined and WRF has been run for 5 days, for all of the domains (36, 12, 4, 1.333, and 0.444 km). It has been decided that WRF-CAMx will be run for the August 20, 2021 - September 27, 2021 timeframe to coincide with the TRACER-AQ measurements and provide adequate model spin-up.

Task 2. Process the GCAS measurements: Preliminary comparison between GCAS and Pandora NO_2 and HCHO in the TRACER-AQ domain has been completed. This is assuming the NASA GEOS-CF simulation *a priori* profiles. GCAS agrees with Pandora to within ± 21% for NO_2.

Task 3. Process the satellite NO_2 data: The satellite data has been processed to the WRF-CAMx grid.

Task 4. Calculating NO_X from NO_2 airshed measurements: Processing of the GCAS data for this analysis has begun.

Task 5. Comparison of NO_2, HCHO, O_3 between model, aircraft, and satellite: Task 5 has not yet been initiated.

Task 6. Use of machine learning to estimate emission factors for individual sectors: Task 6 has not yet been initiated.

Preliminary Analysis: None.

Data Collected: None.

Identify Any Problems or Issues Encountered and Proposed Solutions or Adjustments: Project approvals are occurring later than anticipated and we will adjust task schedules as needed.

Goals and Anticipated Issues for the Succeeding Reporting Period: Continue developing WRF-CAMx modeling platform by simulating meteorology for the entire modeling period and processing biogenic, line-source (on-road mobile, rail and shipping) and EGU emissions.

The GCAS measurements will be re-processed in two manners: 1) to more explicitly account for missing data, and subsequently 2) re-gridded to the WRF-CAMx grid.

Detailed Analysis of the Progress of the Task Order to Date: None.

FINANCIAL STATUS REPORT

The Air Quality Research Program (AQRP) contract was awarded for FY 22-23 for $750,000 per year. Funds were distributed across several different reporting categories as required under the contract with TCEQ. The reporting categories are listed below in detail.

Program Administration: Limited to 10% of the overall funding per fiscal year. This category includes all staffing, materials and supplies, and equipment needed to administer the overall AQRP. It also includes the costs for the Council meetings.

ITAC: These funds are to cover the costs, largely travel expenses, for the Independent Technical Advisory Committee (ITAC) meetings.

Project Management: Limited to 8.5% of the funds allocated for Contractual budget category. Each research project is assigned a Project Manager to ensure that project objectives are achieved in a timely manner and that effective communication is maintained among investigators in multi-institution projects. These funds are to support the staffing and performance of project management.

Research Projects / Contractual: These are the funds available to support the research projects that are selected for funding.

Program Administration

Program Administration includes salaries and fringe benefits for those overseeing the program, as well as materials and supplies, travel, equipment, and other expenses. This category allows indirect costs in the amount of 10% of salaries and wages. Table 1 details the FY 22-23 Administration budget.

Dr. David Allen, Principal Investigator and AQRP Director, is responsible for the overall administration of the AQRP. RoseAnna Goewey, AQRP Program and Grant Manager, coordinates all aspects of program management. Randy George, AQRP Information Technology (IT) Manager, assists the Director and Program Manager with all website development updates, data storage, and handling of all other IT related issues. Nohemi Cazares, Senior Administrative Associate, performs required accounts payable services to ensure timely reimbursement payments to subaward entities.

The University of Texas at Austin's federally negotiated fringe rates for full-time/benefits eligible employees is 30% through August 31, 2023. The University of Texas at Austin's Cost Rate Agreement was finalized in June 2022 and can be viewed in detail at https://research.utexas.edu/wp-content/uploads/sites/5/2022/06/FY23_Fringe_Benefit_Rates_063022.pdf.

Table 1: Administration Budget FY 22-23

Budget Category	FY22 Budget	FY23 Budget	Total Budget	Expenses*	Remaining Balance
Personnel/Salary	$44,702.77	$51,800.00	$96,502.77	$37,331.43	$59,171.34
Fringe Benefits	$13,812.96	$16,265.00	$30,077.96	$11,530.56	$18,547.40
Supplies	$12,013.99	$1,755.00	$13,768.99	$780.37	$12,988.62
Total Direct Costs	$70,529.72	$69,820.00	$140,349.72	$49,642.36	$90,707.36
Indirect Costs	$4,470.28	$5,180.00	$9,650.28	$3,733.15	$5,917.12
Total Costs	**$75,000.00**	**$75,000.00**	**$150,000.00**	**$53,375.51**	**$96,624.48**

**Expenses as of October 2022*

ITAC

There are no ITAC expenditures in this reporting quarter. Table 2 details the FY 22-23 ITAC budget.

Table 2: ITAC Budget FY 22-23

Budget Category	FY22 Budget	FY23 Budget	Total Budget	Expenses*	Remaining Balance
Travel	$5,000.00	$5,000.00	$10,000.00	$0.00	$10,000.00
Supplies	$625.00	$625.00	$1,250.00	$0.00	$1,250.00
Total Direct Costs	$5,625.00	$5,625.00	$11,250.00	$0.00	$11,250.00
Indirect Costs	$0.00	$0.00	$0.00	$0.00	$0.00
Total Costs	**$5,625.00**	**$5,625.00**	**$11,250.00**	**$0.00**	**$11,250.00**

**Expenses as of October 2022*

Project Management

There are no Project Management expenditures in this reporting quarter. Table 3 details the FY 22-23 Project Management Budget.

Table 3: Project Management Budget FY 22-23

Budget Category	FY22 Budget	FY23 Budget	Total Budget	Expenses*	Remaining Balance
Personnel/Salary	$38,000.00	$38,000.00	$76,000.00	$15,067.06	$60,932.94
Fringe Benefits	$11,438.00	$11,932.00	$23,370.00	$4,556.89	$18,813.11
Supplies	$3,012.00	$2,518.00	$5,530.00	$108.78	$5,421.22
Other	$1,875.00	$1,875.00	$3,750.00	$0.00	$3,750.00
Total Direct Costs	$54,325.00	$54,325.00	$108,650.00	$19,732.73	$88,917.27
Indirect Costs	$3,800.00	$3,800.00	$7,600.00	$1,506.71	$6,093.29
Total Costs	**$58,125.00**	**$58,125.00**	**$116,250.00**	**$21,239.44**	**$95,010.56**

**Expenses as of October 2022*

RESEARCH PROJECTS

Research projects have been selected this reporting quarter and Subaward Agreements have been fully executed for 22-003, 22-006, 22-008, and 22-010 as of November 15, 2022. Remaining projects (22-019, 22-020, and 22-023) are expected to be fully executed. Table 4 shows the FY 22-23 Research Project budgets. The FY 22-23 budget allocates $1,222,500.00 for research projects.

Table 4: FY 22-23 Contractual/Research Project Budget

FY 22 Contractual Funding		**$611,250.00**		
FY 22 Total Contractual Funding		**$611,250.00**		
Project Number	**Institution**	**Amount Awarded**	**Cumulative Expenditures**	**Remaining Balance**
22-003	Atmospheric and Environmental Research, Inc (AER)	$161,388.00	$0.00	$161,388.00
22-006	Aerodyne Research, Inc. (ARI)	$51,255.00	$0.00	$51,255.00
22-006	Baylor University	$57,225.00	$0.00	$57,225.00
22-008	University of Houston	$175,621.00	$0.00	$175,621.00
22-008	St. Edward's University	$6,103.00	$0.00	$6,103.00
22-010	Aerodyne Research, Inc.	$228,418.00	$0.00	$228,418.00
22-019	University of Houston	$131,366.00	$0.00	$131,366.00
22-020	Texas A&M University	$160,182.00	$0.00	$160,182.00
22-023	The George Washington University	$103,425.00	$0.00	$103,425.00
22-023	Ramboll	$144,721.60	$0.00	$144,721.60
FY 22 Total Contractual Funding Awarded		$1,219,704.60		
FY 22 Contractual Funds Expended (Init. Projects)			$0.00	
FY 22 Contractual Funds Remaining to be Spent				$611,250.00
FY 22 Contractual Funding Carry-Forward		**PENDING**		
FY 23 Contractual Funding		**$611,250.00**		
FY 23 Total Contractual Funding		**$611,250.00**		
Project Number	**Institution**	**Amount Awarded**	**Cumulative Expenditures**	**Remaining Balance**
22-003	Atmospheric and Environmental Research, Inc (AER)	$161,388.00	$0.00	$161,388.00
22-006	Aerodyne Research, Inc. (ARI)	$51,255.00	$0.00	$51,255.00
22-006	Baylor University	$57,225.00	$0.00	$57,225.00
22-008	University of Houston	$175,621.00	$0.00	$175,621.00
22-008	St. Edward's University	$6,103.00	$0.00	$6,103.00
22-010	Aerodyne Research, Inc.	$228,418.00	$0.00	$228,418.00
22-019	University of Houston	$131,366.00	$0.00	$131,366.00
22-020	Texas A&M University	$160,182.00	$0.00	$160,182.00
22-023	The George Washington University	$103,425.00	$0.00	$103,425.00
22-023	Ramboll	$144,721.60	$0.00	$144,721.60
FY 23 Total Contractual Funding Awarded		$1,219,704.60		
FY 23 Contractual Funds Expended (Init. Projects)			$0.00	
FY 23 Contractual Funds Remaining to be Spent				$611,250.00
Total Contractual Funding		**$1,222,500.00**		
Total Contractual Funding PENDING AWARD		**$2,795.40**		
Total Contractual Funding Remaining to be Awarded		**$2,795.40**		
Total Contractual Funds Expended to Date			**$0.00**	
Total Contractual Funds Remaining to be Spent				**$1,222,500.00**

APPENDIX A. CONTRACTUAL RESEARCH PROJECTS APPROVED FOR FUNDING (BIENNIUM 2022-2023)

Proj. Nbr.	Project Title	Research Priority Area	PI, *Collab. PI*	Co-PI, *Collab. Co-PI*	Primary Institution, *Collab. Institution*	Institution Budget	Total Project Budget	AQRP Project Manager	TCEQ Liaison, Backup Liaison
22-003	Evaluating the Ability of Statistical and Photochemical Models to Capture the Impacts of Biomass Burning Smoke on Urban Air Quality in Texas	Domestic fire emissions	Matthew Alvarado	n/a	Atmospheric and Environmental Research, Inc (AER)	$161,388.00	$161,388.00	Elena McDonald -Buller	Chola Regmi, Thuy Phi
22-006	Hydrogen Cyanide for Improved Identification of Fire Plumes in the $(BC)^2$ Network	Domestic fire emissions	Tara Yacovitch *Rebecca Sheesley*	n/a *Sascha Usenko*	Aerodyne Research, Inc. *Baylor University*	$51,255.00 *$57,225.00*	$108,480.00	Vincent Torres	Erik Gribbin, Alexander Adame
22-008	Modeling analysis of TRACER-AQ and over-water Measurements to improve prediction of on-land and offshore ozone	TRACER-AQ and over-water measurements	Yuxuan Wang *Paul Walter*	James Flynn *n/a*	University of Houston *St. Edward's University*	$175,621.00 *$6,103.00*	$181,724.00	Elena McDonald -Buller	Barry Exum, Miranda Kosty
22-010	Dallas Field Study (DFS); Ozone Precursors, Local Sources and Remote Transport Including Biomass Burning	Changing emission patterns in Texas	Edward Fortner	n/a	Aerodyne Research, Inc.	$228,418.00	$228,418.00	Vincent Torres	David Westenbarger, Cara Scalpone
22-019	Refining Ammonia emission using inverse modeling and satellite observations over Texas and the Gulf of Mexico and investigating its effect on fine particulate matter	Improve emission inventories	Yunsoo Choi	n/a	University of Houston	$131,366.00	$131,366.00	Elena McDonald -Buller	Khalid Al-Wali, Shay Guerin
22-020	Quantifying the Emissions and Spatial/Temporal Distributions of Consumer Volatile Chemical Products (VCPs) in the Greater Houston Area	Improve emission inventories	Yue Zhang	Qi Ying	Texas A&M University	$160,182.00	$160,182.00	Elena McDonald -Buller	Bob Gifford, Michael Ege
22-023	Source-sector NOx emissions analysis with sub-kilometer scale airborne observations in Houston during TRACER-AQ	TRACER-AQ and over-water measurements	Daniel Goldberg *Greg Yarwood*	n/a *n/a*	The George Washington University *Ramboll*	$103,425.00 *$144,721.60*	$248,146.60	Elena McDonald -Buller	Sushil Gautam, Lam Nguyen