AIR QUALITY RESEARCH PROGRAM

Texas Commission on Environmental Quality
Contract Number 582-15-50047
Awarded to The University of Texas at Austin

Annual Report

September 1, 2019 – August 31, 2020

Submitted to

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Texas Air Quality Research Program

Annual Report

September 1, 2019 – August 31, 2020

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 YEAR

Between September 1, 2019 and November 30, 2019, the AQRP Project Administration efforts focused primarily on finalizing project invoices, draft reports, and final reports from the Fiscal Year (FY) 2018-2019. By December 31, 2019, all FY2018-2019 projects had submitted their final invoices and completed their projects. A full list of the awarded projects from FY 2018-2019 are listed in Appendix C. The Financial Status Report section of this report includes accounting from both the FY 2018-2019 and FY 2020-2021. The FY 2020-2021 biennium request for proposals was released in the second quarter. Project reviews and rankings were obtained from the TCEQ and the Independent Technical Advisory Council (ITAC). Based on these reviews and rankings, the AQRP Advisory Council approved projects and budgets. Once the Council approved FY 2020-2021 projects, AQRP staff began working with successful Principal Investigators (PIs) to finalize Work Plans and develop Quality Assurance Project Plans. The Program Manager at The University of Texas at Austin (UT Austin) coordinated the new or amended primary contracts with sub-award institutions as well as the Task Orders that incorporated the Statements of Work, QAPP, and Budgets.

In March 2020, the COVID-19 pandemic shifted AQRP and sub-award institutions to work-from-home statuses. In July 2020, the AQRP, with approval from the TCEQ, requested all sub-award entities review their need for Personal Protective Equipment (PPE) to ensure appropriate health-safety environments for themselves and their research staff on their AQRP project during the COVID-19 pandemic. Project 20-003 (Rice University) requested a budget increase to cover essential PPE for their field study. Project 20-003 had their budget increase request approved for COVID-19 related PPE in August 2020.

Contracting delays with Project 20-020, the University of Wisconsin-Madison (UW), were encountered due to the sub-award entity belonging to the sovereignty of the State of Wisconsin. While the contract was being negotiated, the AQRP Project Manager informed UW and Ramboll to stop all research work until the contract was resolved. Additional contracting meetings with

UW's and UT Austin's legal teams were required to discuss the master contract details. UW's master contract was fully executed on August 24, 2020, with no modifications made to the master contract template. All FY 2020-2021 funded projects were fully executed by August 31, 2020.

When 2020-2021 Task Orders were fully executed, the Program Manager coordinated posting the project information, abstract, Scope of Work, and QAPP on the AQRP website (http://aqrp.ceer.utexas.edu/projects.cfm).

Two projects in the 2020-2021 fiscal year (20-003 and 20-004) began discussions regarding a possible amendment to their Scope of Work, QAPP, and Budget to reflect changes that were unavoidable due to COVID-19 related delays:

> Project 20-003 (Lead PI: Robert Griffin, Institution: Rice University, "Characterization of Corpus Christi and San Antonio Air Quality During the 2020 Ozone Season") is pending a Task Order amendment that will modify the timeline of the project. Due to COVID-19 related delays, the researchers requested to conduct their field work in Spring 2021, instead of the originally approved Summer 2020. The AQRP Advisory Council, ITAC, and TCEQ provided feedback regarding the requested timeline modification; no objections were presented. The amended Task Order, to include an updated Scope of Work, QAPP and budget, is expected to be fully executed in November 2020 for all entities in the project (Rice University, Baylor University, and the University of Houston). As of August 31, 2020, details have not been finalized to issue a Task Order Amendment. Additional information regarding this pending amendment will be included in the subsequent quarterly report.
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> Project 20-004 (Lead PI: James Flynn, Institution: University of Houston, "Galveston Offshore Ozone Observation (GO3)") began discussions of an amendment for an alternate schedule, due to travel delays caused by COVID-19, as well as a possible budget adjustment to incorporate modified data collection and analysis. A Task Order amendment will be issued by UT if the Advisory Council, ITAC, and TCEQ all approve of the modifications and budget adjustment. As of August 31, 2020, details have not been finalized to issue a Task Order Amendment. Additional information regarding this pending amendment will be included in the subsequent quarterly report.

A full list of the funded projects for FY 2020-2021 is provided in Appendix A, as well as the projects selected for funding if the initially approved projects could not be performed (contingency projects). A full list of all proposals submitted to the AQRP FY 2020-2021 biennium Request for Proposals is provided in Appendix B. The Scopes of Work are included in this report for all FY 2020-2021 funded projects.

The Financial Status Report section of this report includes accounting from both FY 2018-2019 and FY 2020-2021. Remaining funds in FY 2018-2019 have been approved by the TCEQ to be carried forward into FY 2020-2021.

Due to COVID-19 health-safety concerns, work-from-home status was implemented across UT Austin and the TCEQ from March 2020 through August 2020. It is estimated for this status to continue through August 2021 at UT Austin. Approval was granted by the TCEQ to extend the

Annual Report deadline to October 30, 2020 to accommodate a shifted financial closure time-period that UT Austin has adopted during the implemented work-from-home period. Approval was granted by TCEQ to submit monthly FSRs, Quarterly Reports, and Annual Reports as a single PDF instead of the hardcopies that have previously been required. Hardcopies of all documents will be delivered to TCEQ if required at a later date.

COVID-19 related delays caused research contractual processing delays to subawards, UT Austin financial deadline adjustments, PPE budget adjustment requests, and travel delays that will result in Task Order amendments for modified timelines and/or budgets as described above for projects 20-003 and 20-004 in the subsequent quarters. A decision regarding the AQRP Workshop, planned for August 2021, to be held virtually due to COVID-19 travel restrictions will be made in the next quarter. If held virtually, re-budgeting travel and expenses for the typically in-person workshop will be addressed in the next quarterly report.

Program activities in the following quarter will focus on completing the Task Order amendments for Project 20-003, corresponding with the Advisory Council, ITAC, and TCEQ regarding the possible Task Order amendment for Project 20-004, processing the Task Order amendment for Project 20-004 if approved, auditing individual project Financial Status Reports (FSR), Project Manager reviews of Monthly Technical Reports, budget revision discussions and planning due to possibly holding the AQRP Workshop virtually, Project Manager reviews of project Quarterly Reports, and UT Austin internal subaward account reconciliations.

BACKGROUND

Section 387.010 of HB 1796 (81st Legislative Session), directs the Texas Commission on Environmental Quality (TCEQ, Commission) to establish the Texas Air Quality Research Program (AQRP). The University of Texas at Austin was selected by the TCEQ to administer the program. A contract for the administration of the AQRP was established between the TCEQ and the University of Texas at Austin. 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 AQRP contract was renewed for the 2020-2021 biennium and funding of $750,000 per year was awarded.

RESEARCH PROJECT CYCLE

The Research Program is implemented through a 9 step cycle. 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 strategic research priorities. The AQRP Director, in consultation with the ITAC, the Council and the TCEQ, develop research priorities; the research priorities are released along with a Request for Proposals.
2) Project proposals relevant to the research priorities are solicited. The Request for Proposals can be found at http://aqrp.ceer.utexas.edu/ .
3) The Independent Technical Advisory Committee (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'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. The Council also provides comments on the strategic research priorities.
6) All Investigators are notified of the status of their proposals, either funded, not funded, or not funded at this time, but being held for possible reconsideration if funding becomes available.
7) Funded 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) for each project. The AQRP Project Manager reviews monthly, 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 Program web site; research briefings are developed for the public and air quality decision makers; and a bi-annual research conference/data workshop is held.

During this reporting period, Program activity concentrated on Steps 1 through 7 for FY 2020-2021 projects.

Independent Technical Advisory Committee (ITAC)

The AQRP funding is to be used primarily for research projects, and one of three groups responsible for selecting the projects is the Independent Technical Advisory Committee (ITAC). The ITAC is composed of between 9 and 15 individuals with scientific expertise relevant to the Program. The ITAC is charged with recommending technical approaches, establishing research priorities, and reviewing, commenting, and advising on all projects to ensure that the projects facilitate air quality improvement in Texas. Members of the ITAC consist of the TCEQ Project Director (or designee), and representatives with air quality expertise from research institutions with extensive expertise in air quality research in Texas. The members of the ITAC are listed in Table 1. The members of the ITAC are drawn from Texas universities active in air quality research, national laboratories that have participated in air quality studies in Texas, and institutions that have expertise not available in Texas and that have participated in air quality studies in Texas.

The ITAC membership is intentionally drawn from air quality researchers who have experience in Texas. These researchers and their colleagues will likely have interest in responding to the requests for research proposals issued by the AQRP. This raises potential confidentiality and conflict of interest issues, and the contract between TCEQ and the University of Texas at Austin requires that the AQRP maintain and implement an appropriate written policy on conflict of interest. Specifically for the ITAC, all members are required to certify:

> *Confidentiality:* As a member of ITAC I understand that I will have access to proposals submitted to the Air Quality Research Program. Subject to any legal requirements, I agree to keep the information in these proposals confidential until the selection process is completed and it is appropriate to release information to the public. I understand that there may be certain information that comes to me in my role as a member of ITAC that retains its confidential nature even after the process is concluded. I also understand that I will review said proposals and may have access to the reviews made by other ITAC members. I agree to keep these reviews and the identity of the reviewers confidential until such time as this information is released to the public. (NOTE: For the reviews and reviewers, this information may never be released.)
>
> *Conflict of Interest:* As a member of ITAC, I agree that I will not evaluate, comment on, or vote on proposals in which I or my home institution is involved, including but not limited to, any financial interest, or in which I have another form of conflict of interest. I understand that ITAC members with conflicts of interest must leave the meeting room or the conference line when a proposal with which they have a conflict is discussed, voted on or otherwise being considered. I understand that I must recuse myself from participating in or attempting to influence at any time the ITAC's or the AQRP Council's consideration or decision concerning such proposals. I agree to bring any issues concerning a possible conflict of interest to the attention of the Director of the Air Quality Research Program or the TCEQ Project Director. If there is a question of interpretation regarding whether a conflict of interest exists, I agree that the decision regarding whether a conflict of interest exists will be made by the Director of the Air Quality Research Program or the TCEQ Project Director.

All members of the ITAC agreed to abide by these conflicts of interest and confidentiality provisions prior to participating in the review of proposals.

Table 1. Independent Technical Advisory Committee Members

Name	Title	Organization
David Allen	Gertz Regents Professor in Chemical Engineering, Professor and Director, AQRP	The University of Texas at Austin
William Carter	Emeritus Research Chemist, Center for Environmental Research and Technology	University of California - Riverside
Don Collins	Professor, Department of Chemical and Environmental Engineering	University of California - Riverside
James Crawford	Research Scientist, Chemistry & Dynamics Science Directorate	NASA
Joost de Gouw	Professor, Cooperative Institute for Research in Environmental Sciences (CIRES) /Dept of Chemistry	University of Colorado
Robert Griffin	Professor, Civil and Environmental Engineering	Rice University
Tho Ching (Thomas) Ho	Aldredge Endowed Chair, Regent's Professor and Chair, Dan F. Smith Department of Chemical Engineering; Director, Texas Air Research Center	Lamar University
Golam Sarwar	Research Scientist	EPA ORD
Stephanie Shirley	Senior Technical Specialist	Texas Commission on Environmental Quality (TCEQ)
Christine Wiedinmyer	Associate Director for Science, Cooperative Institute for Research in Environmental Sciences (CIRES)	University of Colorado
Greg Yarwood	Principal	Ramboll

TCEQ Relevancy Review

Once the ITAC has reviewed and ranked research project proposals according to technical merit, they are submitted to the TCEQ for a relevancy review. The TCEQ reviews proposals for relevancy to the State's air quality research needs. TCEQ approval is required for a project to receive funding from the Program.

Advisory Council

The final group responsible for selecting AQRP research projects is the Advisory Council. The Council consists of between 7 and 11 members. Two Council members with relevant scientific

expertise are nominated by the TCEQ. As defined in the AQRP contract, up to four members of the Council can be county judges from the Houston-Galveston-Brazoria (HGB) and Dallas-Fort Worth (DFW) non-attainment counties. Additional members should have a general background in air quality and business practices, and can include elected officials, business community representatives, environmental group representatives, and members of the general public. The Council's responsibilities are to attend meetings with TCEQ Management and the AQRP to understand the statewide project goals for the funding period, to select for funding the projects reviewed by the ITAC and ranked by the TCEQ, and to assist with the presentation of project final results at locations throughout the state.

Table 2. Advisory Council Members

Name	Title	Organization
Daniel Baker	Senior Consultant in Air Quality	Shell Global Solutions
Laurie Barker	Special Council	Texas Commission on Environmental Quality (TCEQ)
Chris Klaus	Senior Program Manager	North Central Texas Council on Governments
Ralph Marquez	Proprietor	Environmental Strategies and Policy
Chris Rabideau	Environmental Scientist	Chevron
Cyrus Reed	Conservation Director	Sierra Club
Chris Owen	Senior Technical Specialist	Texas Commission on Environmental Quality (TCEQ)

RESEARCH PROJECTS
FY 2020-2021 Projects

Project 20-003 **STATUS: Active – 07/17/20-08/31/21**

Characterization of Corpus Christi and San Antonio Air Quality During the 2020 Ozone Season *[with revised sampling dates pending approval of revised task order]*

Rice University – Dr. Robert Griffin
University of Houston – Dr. James Flynn
Baylor University – Dr. Rebecca Sheesley

AQRP Project Manager – Vincent Torres

TCEQ Project Liaison – Erik Gribbin

Original Funded Amount: $286,427, **Amended Funded Amount:** $288,727
(Rice: $73,261.00; U of Houston: $115,668.00; Baylor: $99,798.00)

Abstract:
This project will focus on the air quality and atmospheric chemistry in two urban areas of Texas (Corpus Christi and San Antonio) that have received comparatively less attention from the local research community, despite having air quality issues documented by state and local monitoring efforts. A mobile air quality laboratory with the capability of measuring relevant trace gases, particulate matter, and meteorological parameters will be deployed during the latter part of the 2020 ozone season (late August – early October*) [new task order would deploy sampler in 2021]*. Through combined stationary and mobile measurements, these measurements will allow characterization of the chemical nature of air being transported into Corpus Christi from the Gulf of Mexico (two weeks of stationary measurements), being transported out of Corpus Christi (one week of mobile measurements downwind), being transported into San Antonio (one week of mobile measurements upwind and two weeks of stationary measurements), and being transported out of San Antonio (one week of mobile measurements downwind). Data analysis will allow assessment of temporal and spatial patterns of air pollutants, determination of statistical values (mean, median, interquartile range, etc.) of air pollutant concentrations and particle compositions, calculation of important air quality parameters such as the production rate of ozone, and characterization of the organic fraction of the particulate matter to provide insight into the sources and chemical processes that impact its concentration. Data measured in the 2020 campaign also will be compared to data generated during the 2017 San Antonio Field Study, which occurred in the spring portion of the ozone season. These data analysis techniques will be supplemented by three-dimensional air quality modeling that will be evaluated through comparison to the measured data. The air quality modeling, among other topics, will be used to investigate response of predicted air pollutant concentrations to changes in emission inputs from a variety of source types.

Project Update: The bulk of the work performed was related to Task #1, campaign preparation.

The largest accomplishment for this project was an adjustment so that the planned field work will occur in spring 2021 rather than fall 2020 due to delays associated with task orders and the COVID pandemic. This entailed submission of a request and revision of the QAPP and statement of work. It also necessitated alteration of travel plans (cancelation and rebooking of lodging and RV sites for the mobile air quality laboratory).

In addition, the team has begun training of new graduate students and research staff and initiated instrumentation and mobile air quality laboratory preparation. Specifically, instrument evaluations have begun to allow for identification of maintenance issues required prior to deployment. In addition, a data comparison was performed using collocated measurements of the Baylor PTR-MS and the UH Aerolaser HCHO instrument. We identified necessary upgrades on the coolant system for the PTR-MS and will plan an additional comparison for further validation prior to deployment.

Identified Issues: As referenced above delays in finalizing task orders and issues associated with the COVID pandemic have necessitated shifting the field work from fall 2020 to spring 2021. With approval from the AQRP, we have adjusted and added to the scientific questions to be addressed using our field data analysis and modeling.

Due to COVID-19 health safety requirements for PPE, Project 20-003 requested and was approved additional funding for PPE supplies in the amount of $2,300 for Rice University (Rice University's Original Funded Budget: $70,961, Amended Funded Budget: $73,261).

Project 20-004 **STATUS: Active – 07/17/20-08/31/21**

Galveston Offshore Ozone Observation (GO3) *[with possible shifting of sampling period]*

University of Houston – Dr. James Flynn
St. Edward's University – Dr. Paul Walter

AQRP Project Manager – Vincent Torres

TCEQ Project Liaison – Doug Boyer

Funded Amount: $201,754.00
(U of Houston: $133,494.00; St. Ed's University: $68,260.00)

Abstract:
This project addresses the 2020-2021 Texas Air Quality Research Program Priority Area of Monitoring Ozone in Galveston Bay and Offshore. The project aims to deploy two small automated sampling systems on commercial boats operating in Galveston Bay (Larry Willis, commercial shrimper) and the offshore waters adjacent to Galveston Island (Ryan Marine Services, crew launch boat operator) to collect routine measurements of O_3 and meteorology, including boundary layer height, during May-September 2020 *[possible change in date, pending modification to task order]* through a collaboration with the University of Houston (UH) and St. Edward's University (SEU). A third boat, owned and operated by UH, will be utilized for special studies in Galveston Bay as well as for launches of up to 20 ozonesondes to examine vertical profiles of O_3 and confirm ceilometer measurements of boundary layer height. Coupled with 3-D chemical transport modeling, this study will shed light on the conditions and processes that may result in high O_3 over the water and subsequent impacts on the HGB urban area.

The study is designed to focus on the following primary science questions:

1. How frequently does high ozone reside over the water during the ozone season, and how does the observed frequency compare to that simulated by photochemical models?
2. How does O_3 over water compare with O_3 and O_X ($O_3 + NO_2$) over adjacent land?
3. How is O_3 formation over the water impacted by local circulation patterns?
4. What are the characteristics of the boundary layer over the water during high O_3 events, and how do the observed boundary layer heights compare to model predicted heights?
5. How do small O_3 and meteorology sampling systems installed on commercial vessels help us better understand O_3 in Galveston Bay and the Gulf of Mexico?

The proposed instrumentation packages will include an O_3 monitor, GPS, all-in-one weather station, and a ruggedized PC with a cellular data connection. The package will operate autonomously when power is available. A ceilometer will be installed on one of the vessels to measure boundary layer height over the water, which is often parameterized in photochemical models and can have a significant impact on model results. The data, which is logged locally, will be sent to servers at UH when within cellular coverage.

Modeling activities will utilize the Weather Research and Forecasting (WRF) driven GEOS-Chem (WRF-GC). The model will simulate ozone distributions in the HGB region during the measurement periods with a focus on ozone over the water and land-water ozone gradient. WRF has a powerful and flexible grid system, including multiple nested grids and moving

nested grids. For the proposed work, the inner-most model domain of WRF-Chem will be set over the sampling areas at a resolution of 1 km x 1 km, allowing replications of fine-scale temporal and spatial dynamics specific to coastal regions such as sea/bay breeze. In addition to confirming the presence or absence of high O_3 over the water and the conditions which occur during high O_3 events, the results from this project are expected to provide more accurate parameterizations for future modeling studies and to identify partners and methodologies for additional studies.

Project Update: St. Edward's University received the complete O_3 sonde order and 2B Tech O_3 monitor parts. Teams purchased battery, alternator, cabling for science power system on the Galveston Bay shrimp boat. We built heavy-duty instrument chassis for offshore instrument system based on warnings from Ryan Marine Service that the M/V Red Eagle still operates in heavy seas. All major components in the offshore chassis were mounted. Teams replaced rusted pontoon trailer with new old-stock galvanized trailer better suited for saltwater use. We delivered seat cushions to upholstery shop for economy/utility grade recovering. Previously the boat had been stored outside and the seating was not serviceable.

All major orders have been completed. Smaller components are being purchased as needed to ensure compatibility with major components. The project is on schedule relative to the date funds became available.

Identified Issues: There are two issues at this time. The first is the schedule for deployment. While still on track relative the elapsed time since receiving the fully executed Task Order, there is little time left in the 2020 O_3 season. The first of the boat systems should be ready for deployment on the M/V Red Eagle before the end of September 2020. The second issue relates to the Galveston Bay measurement platform. Although the shrimp boat operator is still happy and willing to work with us, he has now requested a complete liability waiver. UH has been working with our Division of Research and believe we have identified a path forward. Between this delay and the time needed for UH to order the ceilometer, efforts have focused on preparing the instrumentation for the Gulf measurements.

Project 20-005 **STATUS: Active – 07/28/20/08/31/21**

Using Satellite Observations to Quantify Surface PM2.5 Impacts from Biomass Burning Smoke

Atmospheric and Environmental Research Inc. – Dr. Matthew Alvarado

AQRP Project Manager – Elena McDonald-Buller

TCEQ Project Liaison – Fernando Mercado

Funded Amount: $173,692.00

Abstract:
Biomass burning smoke can have major impacts on surface $PM_{2.5}$ concentrations both near the fires and hundreds of miles downwind. These smoke impacts pose two challenges for air quality managers. First, they want to accurately report the potential smoke impacts in time for the public to take protective actions. Second, they need to estimate the recent impacts of smoke on $PM_{2.5}$ in order to determine which elevated $PM_{2.5}$ episodes may fall under the US EPA Exceptional Events Rule (EER). The EER determines the conditions under which the US EPA will forgo comparison of policy relevant air monitoring data to a relevant National Ambient Air Quality Standard (NAAQS).

NOAA and NASA satellite observations provide valuable information on the locations of fires and transport of smoke. Existing analysis products, such as the NOAA Hazard Mapping System (HMS) Fire and Smoke product, provide observed fire locations and identify regions that are being impacted by biomass burning smoke. However, there are multiple products that use different techniques to identify smoke plumes, and thus may disagree on the extent of the area covered by biomass burning smoke. In addition, as these products primarily use passive, single-angle geostationary and polar satellite observations (due to their greater spatial coverage), these products do not currently provide information on the height of the smoke plumes or estimates of the surface impacts of the observed smoke. **An analysis of existing smoke products that increases our confidence in the identification of smoke and provides an estimate of smoke height and surface $PM_{2.5}$ impact would greatly help TCEQ air quality managers protect the public and properly enforce air quality standards.**

In this project, we will evaluate the ability of these existing remote sensing smoke products to accurately and consistently identify regions impacted by smoke. We will compare and evaluate the smoke products using additional polar satellite observations that are sensitive to smoke, specifically observations of CO and NH_3 from CrIS and AIRS and aerosol absorption Angstrom exponent (a proxy for brown carbon) from OMI. We will evaluate two methods for estimating the height of the plumes detected by the HMS and other smoke products: the plume height estimates from the MODIS MAIAC algorithm and a new method based on the observed transport direction of the smoke plumes. Finally, we will test different statistical and model-based approaches to estimate the impact of the observed smoke on surface $PM_{2.5}$.
The objectives of this project are thus:

1. **To compare different methods for identifying smoke plumes from NOAA and NASA remote sensing imagery;**

2. **To investigate different remote sensing techniques to estimate the height and vertical profiles of these smoke plumes; and**
3. **To investigate new statistical and machine learning methods to relate the smoke AOD observations to surface $PM_{2.5}$ concentrations.**

This work directly responds to the AQRP priority research area ***"Estimate Impacts of Smoke from Biomass Burning"*** by investigating the question "*Is it possible to quantify ground level impacts of biomass burning ($PM_{2.5}$) using remote sensing tools, such as the NOAA Hazard Mapping System (HMS) Fire and Smoke product?*".

Project Update: We have gathered data from the NOAA HMS and GOES-R Smoke and Dust Mask products and developed Python scripts to apply quality flags, process, and compare the data (Task 1). We have also explored the use of TROPOMI UVAI data as an additional source of data on smoke aerosols.

We have gathered and begun comparisons of three different smoke products, the first milestone of Task 1 from the task order.

Data Collected: Gathered NOAA HMS and GOES Smoke and Dust product data, as well as TROPOMI UVAI data, for recent US and Texas smoke events.

Identified Issues: We found that the ASDTA data from our initial proposal is no longer being produced. To account for this, we have added a third smoke dataset from TROPOMI ultraviolet aerosol index (UVAI) observations to conserve the total amount of datasets being examined.

Project 20-007 **STATUS: Active 07/21/20-08/31/21**

Texas urban vegetation BVOC emission source inventory

Ramboll US Corporation – Dr. Tejas Shah
Wildland Solutions – Alex Guenther

AQRP Project Manager – Elena McDonald-Buller

TCEQ Project Liaison – Miranda Kosty

Funded Amount: $70,000.00
(Ramboll: $50,277.00; Wildland Solutions: $19,723.00)

Abstract:
The overall goal of this project is to improve numerical predictions of regional ozone and aerosol distributions in Texas by using more accurate estimates of biogenic volatile organic compound (BVOC) emissions in Texas urban areas. Isoprene and other BVOC strongly influence atmospheric chemistry in urban Texas urban areas and can dominate the total VOC reactivity of at least some Texas urban locations (Anderson et al. 2019). Although there have been significant advancements in the models used to simulate BVOC emissions, there are still major uncertainties limiting predictability of Texas air quality simulations. Urban areas are the most challenging for BVOC emissions estimation, due to heterogeneity and a lack of vegetation information, and yet they continue to be the least studied. Recent ground surveys of urban tree inventories and increasingly higher resolution remote sensing data products have substantially improved the potential for characterizing the landcover inputs required for biogenic emission models. Therefore, we propose to improve both the Model of Emissions of Gases and Aerosols from Nature (MEGAN, Guenther et al., 2012) and the Biogenic Emission Inventory System (BEIS, Geron et al. 1994) frameworks for estimating BVOC emissions in Texas urban areas. To accomplish this, we will use urban tree inventories and aerial and satellite imagery to develop a high spatial resolution (~1 km) gridded inventory of time-varying Leaf Area Index (LAI), total vegetation cover, and the relative abundance of high BVOC emitting trees (e.g., live oaks, deciduous oaks, sweetgum, palms, pines, juniper) and other vegetation cover types for three Texas urban areas: Austin, Houston, San Antonio.

The primary deliverable will be more accurate landcover inputs for biogenic VOC emission models for estimating BVOC emissions for the urban and suburban areas. Outcomes will include improved biogenic emission estimates and a better understanding of the current uncertainties in urban biogenic emission model simulations. The overall benefit of this project will be more accurate VOC emission estimates for the Texas air quality simulations that are critical for scientific understanding and the development of regulatory control strategies that will enhance efforts to improve and maintain clean air.

Project Update:
Task 1: High Resolution (8-day, 10-m) LAI and Vegetation Cover Fraction for Urban Texas:
Processed Sentinel 10-m resolution 4-band data for 2019 for Houston, Austin and San Antonio using the ESA SNAP tool to generate Leaf Area Index (LAI) and Vegetation Cover Fraction (VCF) distributions. The data were quality checked and processed using ARCGIS to synthesize and interpolate the data.

Task 2. BVOC Emitting Tree Distributions for Three Major Texas Urban Areas:
Developed tree key for using aerial imagery and ground observations (using Google Earth and Google Street Map) to identify the dominant Houston, Austin and San Antonio trees including high BVOC emitters. Identified training and evaluation areas in Houston. Initiated approach for quantifying tree species composition for individual landcover types in Houston and Austin.

Task 3. MEGAN and BEIS input data, processors and results:
Task 3 has not yet been initiated.

Project 20-009 **STATUS: Active – 07/27/20-08/31/21**

Ozone Measurements and Platform Emission Factor in the Gulf of Mexico

Aerodyne Research, Inc. – Dr. Tara Yacovitch

AQRP Project Manager – Vincent Torres

TCEQ Project Liaison – Doug Boyer

Funded Amount: $12,989.00

Abstract:
A ship-based measurement campaign of offshore oil and gas rigs in the Gulf of Mexico has been funded by the United Nations through the Clear Air and Climate Coalition. This campaign is expected to occur in the late winter/spring of 2021, at the beginning of Houston's ozone season. This proposal aims to supplement the instrument manifest with an ozone monitor, and to support the analysis of emission factors using existing measurements of methane, ethane CO, CO_2 and NOx.

Figure 1. The proposed measurement vessel (left), the Research Vessel Trident, owned and operated by Texas A&M University out of Galveston. This vessel's laboratory space (right) is used to house measurement instrumentation.

As of this writing, we are in negotiations with UNEP, two platform operating companies as well as Texas A&M – Galveston regarding the timing and logistics of this project. All parties are committed to a successful deployment, but we do not have a guarantee on the exact timing of the project. Because the proposed work here is contingent on the other project, we do not yet have confirmed dates for the UNEP sponsored project.

Project Update: The ozone instrument that will be used for this project has been installed on the Aerodyne Mobile Laboratory for an unrelated project. NOx measurements are also available on the mobile lab, which will provide additional diagnostic information during ozone titration events.

The ozone monitor is responding to additions of zero-air gas and is functioning normally. It is logging to a data analysis and display computer, as it will be on the ship. Calibration of the monitor will be done prior to its deployment on the vessel, in several months.

We continue to be in close contact with campaign management, but have no new updates on industry partners.

Project 20-011 **STATUS: Active – 07/28/20-08/31/21**

Improving Estimates of Wind-Blown Dust from Natural and Agricultural Sources

Ramboll US Corporation – Dr. Chris Emery

AQRP Project Manager – Elena McDonald-Buller

TCEQ Project Liaison – Barry Exum

Funded Amount: $113,615.00

Abstract:
Ramboll will critically evaluate current windblown dust (WBD) emission models and identify and adapt alternative landcover, soil and activity datasets with which to update Ramboll's existing WBD emissions modeling framework. Using the Comprehensive Air quality Model with extensions (CAMx), we will assess the effects of the WBD emission updates on speciated particulate matter (PM) concentrations at monitoring sites located in federally protected Class I Areas throughout the south-central US. Our project directly addresses an AQRP priority research area by focusing on improving speciated, size-resolved WBD emission estimates for air quality modeling, in particular to support the Texas Commission on Environmental Quality's (TCEQ) current visibility modeling for the federal Regional Haze Rule (RHR).

Visibility impairment is predominantly caused by PM in fine and coarse size ranges. Whereas fine PM commonly includes a multitude of primary and secondary inorganic and organic compounds from a variety of sources, including crustal (soil-derived) components, the majority of coarse PM derives from direct emissions of crustal material. Current TCEQ modeling exhibits especially large underestimates of coarse crustal PM concentrations, indicating a need to improve emission estimates from dust sources. Soil emissions are especially difficult to estimate given the variety of source mechanisms and environmental conditions that lead to high spatial and temporal variations. Improving dust emissions and modeled concentrations requires refined vegetative and soil datasets and emission parameterizations. Visibility simulations will benefit from enhanced WBD modeling and explicit treatment of elemental species (e.g., Ca, Fe, Mn), which influence secondary PM chemistry (e.g., sulfate, nitrate) and enable more refined model evaluation because they are explicitly monitored. The CAMx WBD emission model provides an existing framework to efficiently test updated parameterizations and to incorporate enhanced and/or more locally specific landcover, soil and activity data. Computing dust emissions outside CAMx (in a preprocessor) is more flexible and transparent than implementing an "in-line" dust scheme inside CAMx.

Project Update: Task 1: Review Current CAMx WBDUST Estimates
Started review of WBDUST emission estimates and resulting CAMx concentrations for $PM_{2.5}$ soil components and coarse PM mass against IMPROVE data. Comparisons were previously conducted for 3 projects: two using the 2016 EPA Modeling Platform and one using the 2014 WRAP Visibility Platform.

Task 2: Review Alternative Methods and Datasets
Completed detail review of several peer-reviewed journal articles describing wind-blown dust

schemes employed in other models: WRF (AFWA), WRF (UoC), and CMAQ. Developed a spreadsheet to facilitate comparisons among WBDUST and these other component formulations, and carefully considered best approaches for WBDUST revisions. Began implementing certain algorithm updates with initial process testing to understand dust emission sensitivity.

Task 3: Update the WBDUST Model and Evaluate Impacts in CAMx MP
No activities during the reporting period.

Task 4: Project Reporting and Presentation
Prepared for and conducted a project kickoff meeting with AQRP Project Manager and TCEQ Liaisons on August 21. Introduced personnel, presented scope of work and schedule. Developed July MTR and FSR and submitted to AQRP on August 10 and 19, respectively.

This project initiated on July 28 with the execution of the AQRP Task Order. All tasks remain on budget and on schedule for completion according to our work plan.

Preliminary Analysis: From our Task 1 review, all modeling results resulted in very similar large dust under predictions at monitoring sites throughout the western US. From our Task 2 review and initial process sensitivity testing, we see promising improvements in using certain algorithm formulations from the CMAQ approach, both in space and time. The CMAQ approach offers an intriguing balance between formulation complexity and external data requirements, whereas the WRF approaches tend to be more complex and require soil characterization data that are highly uncertain and not clearly available in all cases.

Project 20-020 **STATUS: Active – 08/21/20-08/31/21**

New Satellite Tools to Evaluate Emission Inventories: Is a 3-D Model Necessary?

University of Wisconsin-Madison – Dr. Tracy Holloway

AQRP Project Manager – Elena McDonald-Buller

Ramboll US Corporation – Dr. Jeremiah Johnson

TCEQ Project Liaison – Mark Muldoon

Funded Amount: $222,677.00
(UW-Madison: $125,000.00; Ramboll: $97,677.00)

Abstract:
This study will develop best-practice recommendations for the utilization of satellite data for emissions evaluation. Because of their radiative properties, nitrogen dioxide (NO_2) and sulfur dioxide (SO_2) are among of a small group of gas-phase air pollutants that may be reliably detected from space. These gases have short atmospheric lifetimes, such that satellite-based observations are a useful an indicator of fuel combustion. Although the characterization of gas-phase emissions has emerged as one of the leading areas for air quality utilization of satellite data, multiple atmospheric processes affect the relationship between satellite-derived column abundance and near surface. We will evaluate two different methods to compare satellite NO_2, and to a limited extent SO_2, with emission inventories developed by the Texas Commission on Environmental Quality (TCEQ).

Our proposal directly responds to two Priority Research Areas for the Air Quality Research Program (AQRP): the use of remote sensing for (1) point source and (2) county-level emissions. We will develop methods to leverage remote sensing capabilities to improve emission inventories, without undermining the process-based nature of the inventories, essential for their use in air quality management.

These methods include:

1) Comparison of satellite-derived NO_2 and SO_2 from TROPOMI for summer 2019 with model simulations from a WRF-CAMx modeling system developed for the TCEQ;

2) Simpler approaches to comparing NO_X emissions and TROPOMI data that don't require a photochemical grid model, especially the Exponentially Modified Gaussian (EMG) approach. These simpler methods will be extended to SO_2 as resources and data integrity allow.

This analysis will evaluate methods by which high-resolution satellite may be compared with emissions inventories, and to assess the necessity of computationally intensive modeling approaches. Study goals include the validation of the TCEQ 2020 inventory (including the value of alternate methods to calculate on-road mobile emissions), as well as recommendations and software to support future TCEQ utilization of satellite data for emission evaluation. Results emerging from the proposed study will be submitted as a manuscript for peer-reviewed publication.

Project Update: The Ramboll team paused work after receiving a stop work order on Project 20-020 on August 4 and resumed work on Task 1 after receiving notice to proceed on August 21.

Task 1: Simulate NO2 and SO2 amounts with the high-resolution WRF-CAMx model
The Ramboll modeling team continued project planning and development of the 2019 WRF-CAMx modeling platform. As part of this work, Ramboll processed CEM data for 2019.

Task 2. Compare model simulations with TROPOMI and near-surface observations
Task 2 has not yet been initiated.

Task 3. Compare satellite data and emissions for power plants and urban areas
Task 3 has not yet been initiated.

Task 4. Evaluate mobile emissions assessments performed with and without
Task 4 has not yet been initiated.

Due to contracting delays between the University of Wisconsin-Madison (UW) and The University of Texas at Austin, a stop-work order was requested for both UW and Ramboll by the AQRP Project Manager until the UW master contract was resolved. The master contract was resolved and fully executed on August 24, 2020.

Project 20-026 **STATUS: Active – 08/24/20-08/31/21**

Improve Cloud Modeled by WRF using COSP and Generative Adversarial Network

Texas A&M University – Dr. Zheng Lu

AQRP Project Manager – Elena McDonald-Buller

TCEQ Project Liaison – Bright Dornblaser

Funded Amount: $98,427.00

Abstract:
The cloud fields modeled by meso-scale models play an important role in the application of predicting local air quality. The cloud fields can strongly affect the formation, transportation, as well as deposition of many gaseous and particulate species, through regulating radiative transfer, influencing aqueous chemistry, and altering precipitation. However, it is very challenging to accurate predict the microphysical and macrophysical properties of cloud fields.

In this proposal, we plan to run **WRF** model with Texas in the center of model domain. Modeled cloud fields are feed into Cloud Feedback Intercomparison Project (CFMIP) Observation Simulator Package (**COSP**), so that modeled cloud can be directly compared to satellite observations. The objective is to select optimal combination of initiation state (the selection of reanalysis data) and physical packages (namely microphysics, cumulus parameterization, planetary boundary layer scheme) for the cloud simulation.

With modeled and observed cloud fields, we train a **GAN** (Generative Adversarial Network), a type of deep learning technique. We will perform super-resolution and image-to-image translation applications to modeled cloud microphysical fields over Texas, so that they can gain much detailed fine features, and become more accurate compared to observed cloud fields. Improved cloud fields will undoubtedly improve Texas air quality prediction.

Project Update: We download and examining the re-analysis data on NCAR Cheyenne HPC. The re-analysis data include North America Mesoscale, NCEP FNL, and ECWMF datasets.

Data Collected:
1. Generated geogrid output.
2. Generated met files from three reanalysis data.
3. Generated wrfinput and wrfbdy from GFS reanalysis.
4. Performed WRF simulating with the configuration combination of the Morrison scheme, ACM2 PBL scheme.

Project 20-028 **STATUS: 08/07/20-08/31/21**

Quantification and Characterization of Ozone Formation in Central San Antonio

Drexel University – Dr. Ezra Wood

AQRP Project Manager – Vincent Torres

TCEQ Project Liaison – Erik Gribbin

Funded Amount: $71,369.00

Abstract:
In July 2018 the US Environmental Protection Agency (EPA) classified Bexar County, in which San Antonio is located, as being in nonattainment of the National Ambient Air Quality Standard for ozone (O_3) of 70 parts per billion (ppb). Although the official attainment status will ultimately be determined in the courts, it is possible that regulators will eventually need to make science-based decisions on effective mitigation strategies, including emission reduction programs. Since ozone in San Antonio is both transported from outside the city and produced locally by photochemical reactions involving nitrogen oxides (nitric oxide, NO, and nitrogen dioxide, NO_2, collectively referred to as "NOx") and volatile organic compounds (VOCs), these decisions will require knowledge of the following:

A. How much ozone and its precursors (NOx and VOCs) are transported into the city,
B. How much ozone is created within the urban core of the city,
C. Information on the spatial and temporal nature of the local and regional ozone formation photochemical "regime", i.e., where and when ozone formation would be responsive to reductions in NOx emissions versus reductions in VOC emissions.

These questions were partially addressed as a result of the TCEQ/AQRP-funded San Antonio Field Study, in which several research groups (including Drexel) collected data at four sites in and around San Antonio during May 2017. The Drexel peroxy radical instrumentation which enables direct calculation of the ozone production rate was not deployed to central San Antonio, and photochemical modeling of the air masses there has yielded a wide range of ozone formation rates depending on which chemical mechanism is used in the model. The resulting knowledge gaps regarding how much ozone is formed within the urban core and how it will respond to changes in precursor emissions need to be addressed in order to develop effective ozone mitigation plans.

This research project will address this major shortcoming via analysis of data to be collected in the high-NOx central part of San Antonio during a ~7 to 10 day field project during late Summer of 2020. We will quantify the instantaneous ozone production rate, characterize its dependence on NOx and VOCs, determine under what conditions it is VOC-limited vs. NOx-limited, and conduct zero-dimensional modeling of the observed air masses. Comparison of the modeled ozone formation rates to those determined experimentally should identify which chemical mechanism used in photochemical modeling is most accurate for this region and will inform future comprehensive 3-dimensional photochemical modeling of the area.

This project is designed to be conducted in collaboration with measurements to be taken by the research team comprising Rice University, Baylor University, and University of Houston. The importance of this work likely extends beyond San Antonio air quality for two reasons:
1. Photochemical models have been unable to accurately predict ozone formation rates in several other cities under high-NOx conditions, and 2. Since the new O_3 air quality standard is only ~20 to 30 ppb higher than background concentrations, an increasing number of US cities are finding that small differences in locally-made O_3 can make the difference between attainment and non-attainment of the air quality standard.

Project Update: The goal of Task #1 is to prepare for the field deployment to San Antonio which is currently scheduled for the first two weeks of May 2021. The main part of this task was commencing the training of graduate student Alexa Rhoads to use the ECHAMP peroxy radical sensor. PI Ezra Wood has trained her to use the basic tools of the lab and worked with her to get her up to speed using the software tools required to analyze the ECHAMP data (Matlab). Additionally PI Wood has kept in contact with Rob Griffin from Rice University and agreed to the tentative dates for the field deployment of early May in San Antonio.

No work has been done on Task #2 (Field Deployment), Task #3 (Data Quality Assurance), or Task #4 (Data Analysis). Limited work has been done for Task #5 (Project Reporting and Presentation) including this report.

Tasks 1 and 5 are in progress. Tasks 2, 3, and 4 have not started.

Identified Issues: COVID19-related restrictions at Drexel University have limited us to only having one person in our research lab at a time which has slightly lowered the pace of progress. We are now approved to have two people working in lab at a time which should increase the pace of progress.

FINANCIAL STATUS REPORT

The AQRP contract was renewed for the FY 2018-2019 biennium and additional funding of $750,000 per year was awarded. For the FY 2020-2021, the AQRP was renewed for additional funding of $750,000 per year. For each year in FY 2018-2019 and FY 2020-2021, the 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 ITAC meetings.

Project Management – limited to 8.5% of the funds allocated for Research Projects. 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 a whole, 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. Remaining funds from FY 2018-2019 Administration budget in the amount of $214.91 was approved by the TCEQ to carry forward into the FY 2020-2021 Administration budget.

During the year, several staff members were involved, at various levels of effort, in the administration of the AQRP. Dr. David Allen, Principal Investigator and AQRP Director, is responsible for the overall administration of the AQRP. RoseAnna Goewey, AQRP Program Manager, assisted Dr. Allen with program management. Susan McCoy and Nohemi Cazares assisted with program administration as AQRP is hosted at the Center for Energy and Environmental Resources (CEER) at The University of Texas at Austin. Denzil Smith was responsible for the AQRP Web Page development and for data management.

In FY 2019-2020 (09/01/2019-08/31/2020), the federally negotiated fringe rates are listed below. Fringe rates are estimated to have a 0.50% increase in Full-time, Part-time/Benefits Eligible category for subsequent years and a decrease to 5.68% in Part-time/Non-benefits Eligible category for all subsequent year:

Full-time, Part-Time/Benefits Eligible (including Graduate Students)	29.8%
Part-time/Non-benefits Eligible	5.10%

Table 3: Administration Budgets

Administration Budget (includes Council expenses)
FY 2018-2019

Budget Category	FY18 Budget	FY19 Budget	Total Budget	Expenses*	Remaining Balance
Personnel/Salary	$54,327.32	$55,069.42	$109,396.74	$109,396.74	$0.00
Fringe Benefits	$13,751.44	$13,980.40	$27,731.84	$27,516.93	$214.91
Travel					
Supplies	$1,488.50	$443.22	$1,931.72	$1,931.72	$0.00
Equipment					
Other					
Contractual					
Total Direct Costs	$69,567.26	$69,493.04	$139,060.30	$138,845.39	$214.91
Authorized Indirect Costs *10% of Salaries and Wages*	$5,432.74	$5,506.90	$10,939.70	$10,939.70	$0.00
Total Costs	**$75,000.00**	**$75,000.00**	**$150,000.00**	**$149,785.09**	**$214.91**

**Expenses as of August 2020*

Administration Budget (includes Council expenses)
FY 2020-2021

Budget Category	FY18 Budget	FY19 Budget	Total Budget	Expenses*	Remaining Balance
Personnel/Salary	$53,700.00	$53,700.00	$107,400.00	$34,550.86	$72,849.14
Fringe Benefits	$12,930.00	$12,930.00	$25,860.00	$10,296.17	$15,563.83
Travel					
Supplies	$3,000.00	$3,000.00	$6,000.00	$709.41	$5,290.59
Equipment					
Other					
Contractual					
Total Direct Costs	$69,630.00	$69,630.00	$139,260.00	$45,556.44	$93,703.56
Authorized Indirect Costs *(10% of Salaries and Wages)*	$5,370.00	$5,370.00	$10,740.00	$3,455.08	$7,284.92
Total Costs	**$75,000.00**	**$75,000.00**	**$150,000.00**	**$49,011.52**	**$100,988.48**

**Expenses as of August 2020*

ITAC

ITAC expenditures were incurred in FY 2018-2019 and were only charges against 2018 funding. ITAC expenditures in FY 2020 consist of the February 2020 ITAC meeting travel expenses. Future costs for ITAC in FY 2021 are not expected at this time.

Due to COVID-19 travel restrictions, ITAC related travel and expense funds in FY 2020 and 2021 were rebudgetted to contractual subaward funds. The TCEQ approved to have the ITAC budget reduced by $3,125 in both 2020 and 2021 fiscal years, crediting the amount to the subawards budget category for use by research contractual subawards in FY2020 and FY2021. Additional FY2020-2021 ITAC funds may be rebudgetted in the future due to unused funds related to continuing COVID-19 restrictions, with approval from the TCEQ.

Table 4: ITAC Budgets

ITAC Budget
FY 2018-2019

Budget Category	FY18 Budget	FY19 Budget	Total Budget	Expenses*	Remaining Balance
Personnel/Salary					
Fringe Benefits					
Travel	$7,500.00	$7,500.00	$15,000.00	$4,384.23	$10,615.77
Supplies	$1,500.00	$1,500.00	$3,000.00	$284.86	$2,715.14
Equipment					
Other					
Contractual					
Total Direct Costs	$9,000.00	$9,000.00	$18,000.00	$4,669.09	$13,330.91
Authorized Indirect Costs	$0.00	$0.00	$0.00	$0.00	$0.00
10% of Salaries and Wages					
Total Costs	**$9,000.00**	**$9,000.00**	**$18,000.00**	**$4,669.09**	**$13,330.91**

**Expenses as of August 2020*

ITAC Budget
FY 2020-2021

Budget Category	FY18 Budget	FY19 Budget	Total Budget	Expenses*	Remaining Balance
Personnel/Salary					
Fringe Benefits					
Travel	$4,375.00	$4,375.00	$8,750.00	$3,481.62	$5,268.38
Supplies	$1,500.00	$1,500.00	$3,000.00	$90.00	$2,910.00
Equipment					
Other					
Contractual					
Total Direct Costs	$5,875.00	$5,875.00	$11,750.00	$3,571.62	$8,178.38
Authorized Indirect Costs *(10% of Salaries and Wages)*	$0.00	$0.00	$0.00	$0.00	$0.00
Total Costs	**$5,875.00**	**$5,875.00**	**$11,750.00**	**$3,571.62**	**$8,178.38**

**Expenses as of August 2020*

Project Management

Project Management funds in FY 2018-2019 were expended on salaries, fringe benefits, and required materials and supplies for the AQRP Program Managers and QAPP reviewer. At the close of the FY 2018-2019 Project Management accounts on 02/29/20, $32,446.01 remained to be carried forward into FY 2020-2021 project Contractual funds. Project management will be utilized in the same manner in FY 2020-2021. Total Program Management expenses for FY 2020-2021 to date are listed in the table below.

Table 5: Project Management Budgets

Project Management Budget
FY 2018-2019

Budget Category	FY18 Budget	FY19 Budget	Total Budget	Expenses*	Remaining Balance
Personnel/Salary	$37,780.06	$38,060.00	$75,840.06	$55,642.15	$20,197.91
Fringe Benefits	$10,938.15	$9,134.00	$20,072.15	$14,423.12	$5,649.03
Travel					
Supplies	$142.50	$1,000.00	$1,142.50	$142.50	$1,000.00
Equipment					
Other	$1,861.28	$1,718.00	$3,579.28	$0.00	$3,579.28
Contractual					
Total Direct Costs	$50,721.99	$49,912.00	$100,633.99	$70,207.77	$30,426.22
Authorized Indirect Costs	$3,778.01	$3,806.00	$7,584.01	$5,564.22	$2,019.79
10% of Salaries and Wages					
Total Costs	**$54,500.00**	**$53,718.00**	**$108,218.00**	**$75,771.99**	**$32,446.01**

**Expenses as of August 2020*

Project Management
FY 2020-2021

Budget Category	FY18 Budget	FY19 Budget	Total Budget	Expenses*	Remaining Balance
Personnel/Salary	$36,480.69	$36,480.69	$72,961.38	$20,922.14	$52,039.24
Fringe Benefits	$10,871.25	$10,871.25	$21,742.50	$6,234.80	$15,507.70
Travel					
Supplies	$1,000.00	$1,000.00	$2,000.00	$756.00	$1,244.00
Equipment					
Other	$2,500.00	$2,500.00	$5,000.00	$0.00	$5,000.00
Contractual					
Total Direct Costs	$50,851.94	$50,851.94	$101,703.88	$27,912.94	$73,790.94
Authorized Indirect Costs *(10% of Salaries and Wages)*	$3,648.06	$3,648.06	$7,296.12	$2,092.22	$5,203.90
Total Costs	**$54,500.00**	**$54,500.00**	**$109,000.00**	**$30,005.16**	**$78,994.84**

**Expenses as of August 2020*

Research Projects

In FY 2018-2019, there were eight projects requesting $1,223,541.60 in funding, that were selected out of forty (40) proposals submitted to the AQRP RFP for the biennium. Table 6 on the following page shows the distribution of the projects across the fiscal years for FY 2018-2019. Funds remaining to be spent in the Contractual budget form FY 2018-2019 have been approved by the TCEQ to carry forward into FY 2020-2021 Contractual funding. Projects for FY 2020-2021 have been selected. Nine projects were selected for funding and are having Work Plans, QAPP, and Budgets reviewed by Project Managers, the TCEQ, and the UT AQRP Program Manager. Table 6 on the following page shows the distribution of FY 2020-2021 projects across fiscal years.

The FY 2018 – 2019 budget allocated $1,223,000.00 for research projects ($750,000 per fiscal year). After all FY 2016 – 2017 research projects and program activities were complete, $7,559.39 in FY 2017 funds remained ($1,558,35 in Research/Contractual and $6,001.04 in Project Management). These funds were all transferred to the Research/Contractual category, and then assigned to partially fund project 19-023. These funds were expended first, so that all FY 2017 funds will be spent by Spring of 2019. That left a shortage of $541.61 in Research/Contractual funding. In order to fully fund all research projects, $782 will be transferred from the FY 2019 ITAC funds to the FY 2019 Research/Contractual category. Even though the total shortfall is $542, the FY 2018 projects do not use all of the funds allocated to them. The AQRP is not permitted to move funds between fiscal years. Therefore, the FY 2019 shortfall is $782.

The AQRP has submitted to the TCEQ that the final approved FY 2018-2019 invoices will result in $15,626.90 of research contractual funds to be carried forward into the FY 2020-2021 biennium contractual funding. Table 6 and Appendix C reflect actual invoiced amounts that have been approved and paid from AQRP FY 2018-2019.

The FY 2020-2021 budget allocates $1,253,250.00 for research projects ($753,125 per fiscal year, which includes a $3,125 per fiscal year of reallocated ITAC funds that will not be utilized on travel expenses due to COVID-19 travel restrictions). The reallocation of ITAC budget funds was approved by the TCEQ in August 2020. PPE additional funding was awarded to Project 20-003 in the amount of $2,300.00. No other sub-awardees requested PPE funding. Remaining Contractual funds may be distributed in the subsequent quarters to projects requesting amendments due to unavoidable COVID-19 delays. All Contractual budget reallocations will receive review by the Advisory Council, ITAC, and TCEQ prior to approval.

Table 6: FY 2018-2019 and FY 2020-2021 Contractual/Research Project Budgets

FY 2018-2019 Contractual Budget

FY 18 Contractual Funding		**$611,500**		
FY 18 Contractual Funding Transfers		**$0**		
FY 18 Total Contractual Funding		**$611,500**		
Project Number	**Institution**	**Amount Awarded** (Budget)	**Cumulative Expenditures**	**Remaining Balance**
18-005	UC - Irvine	$ 139,193.00	$ 130,718.77	$ 8,474.23
18-005	Ramboll	$ 28,953.00	$ 28,950.23	$ 2.77
18-007	Ramboll	$ 150,000.00	$ 150,000.00	$ -
18-010	TAMU	$ 121,000.00	$ 118,019.80	$ 2,980.20
18-022	UT Austin	$ 85,768.00	$ 85,766.65	$ 1.35
18-022	Sonoma Tech, Inc.	$ 86,346.00	$ 86,346.00	$ -
FY 18 Total Contractual Funding Awarded		**$ 611,260.00**		
FY 18 Contractual Funds Expended (Init. Projects)			**$ 599,801.45**	
FY 18 Contractual Funds Remaining to be Spent				**$ 11,698.55**
FY 19 Contractual Funding		**$ 611,500.00**		
FY 19 Contractual Funding Transfers		**$ 782.00**		
FY 19 Total Contractual Funding		**$ 612,282.00**		
Project Number	**Institution**	**Amount Awarded** (Budget)	**Cumulative Expenditures**	**Remaining Balance**
19-023	UT Austin	$ 85,736.61	$ 85,723.65	$ 12.96
19-023	Ramboll	$ 65,013.00	$ 65,013.00	$ -
19-025	Aerodyne Research, Inc.	$ 199,974.00	$ 199,722.22	$ 251.78
19-031	Baylor University	$ 98,087.00	$ 97,825.82	$ 261.18
19-031	University of Houston	$ 33,207.00	$ 29,804.96	$ 3,402.04
19-040	Drexel University	$ 130,264.00	$ 130,264.00	$ -
FY 19 Total Contractual Funding Awarded		**$ 612,281.61**		
FY 19 Contractual Funding Expended (Init. Projects)			**$ 608,353.65**	
FY 19 Contractual Funds Remaining to be Spent				**$ 3,928.35**
Total Contractual Funding		**$ 1,223,782.00**		
Total Contractual Funding Awarded		**$ 1,223,541.61**		
Total Contractual Funding Remaining to be Awarded		**$ 240.39**		
Total Contractual Funds Expended to Date			**$ 1,208,155.10**	
Total Contractual Funds Remaining to be Spent				**$ 15,626.90**

FY 2020-2021 Contractual Budget

FY18 Contractual Funds Carry Forward		**$ 18,109.35**		
FY 20 Contractual Funding		**$ 614,625.00**		
FY 20 Contractual Funding Transfers		**$ -**		
FY 20 Total Contractual Funding		**$ 632,734.35**		
Project Number	**Institution**	**Amount Awarded**	**Cumulative Expenditures**	**Remaining Balance**
20-003	Rice University	$ 70,961.00	$ -	$ 70,961.00
20-003	Rice University (PPE)	$ 2,300.00	$ -	$ 2,300.00
20-003	University of Houston	$ 115,668.00	$ 10,249.32	$ 105,418.68
20-003	Baylor University	$ 99,798.00	$ -	$ 99,798.00
20-004	University of Houston	$ 20,000.00	$ -	$ 20,000.00
20-004	St. Edward's University	$ 31,109.35	$ -	$ 31,109.35
20-005	AER	$ 173,692.00	$ -	$ 173,692.00
20-007	Ramboll	$ 6,311.68	$ -	$ 6,311.68
20-007	Wildland Solutions	$ 8,244.06	$ 5,750.00	$ 2,494.06
20-009	Aerodyne Research, Inc.	$ 12,989.00	$ -	$ 12,989.00
20-011	Ramboll	$ 28,403.75	$ 2,670.15	$ 25,733.60
20-020	University of Wisconsin-Madison	$ 26,785.71	$ -	$ 26,785.71
20-020	Ramboll	$ 20,928.65	$ -	$ 20,928.65
20-028	Drexel University	$ 17,842.15	$ -	$ 17,842.15
FY 20 Total Contractual Funding Awarded		$ 635,033.35		
FY 20 Contractual Funds Expended (Init. Projects)			$ 18,669.47	
FY 20 Contractual Funds Remaining to be Spent				$ 614,064.88
FY19 Contractual Funding Carry Forward		**$ 43,294.47**		
FY 21 Contractual Funding		**$ 614,625.00**		
FY 21 Contractual Funding Transfers		**$ -**		
FY 21 Total Contractual Funding		**$ 657,919.47**		
Project Number	**Institution**	**Amount Awarded**	**Cumulative Expenditures**	**Remaining Balance**
20-004	University of Houston	$ 113,494.00	$ -	$ 113,494.00
20-004	St. Edward's University	$ 37,150.65	$ -	$ 37,150.65
20-007	Ramboll	$ 43,965.32	$ -	$ 43,965.32
20-007	Wildland Solutions	$ 11,478.94	$ -	$ 11,478.94
20-011	Ramboll	$ 85,211.25	$ -	$ 85,211.25
20-020	University of Wisconsin-Madison	$ 98,214.29	$ -	$ 98,214.29
20-020	Ramboll	$ 76,748.35	$ -	$ 76,748.35
20-026	Texas A&M University	$ 98,427.00	$ -	$ 98,427.00
20-028	Drexel University	$ 53,526.45	$ -	$ 53,526.45
FY 21 Total Contractual Funding Awarded		$ 618,216.25		
FY 21 Contractual Funds Expended (Init. Projects)			$ -	
FY 21 Contractual Funds Remaining to be Spent				$ 657,919.47
Total Contractual Funding		**$ 1,290,653.82**		
Total Contractual Funding Awarded		**$ 1,253,249.60**		
Total Contractual Funding Remaining to be Awarded		**$ 37,404.22**		
Total Contractual Funds Expended to Date			**$ 18,669.47**	
Total Contractual Funds Remaining to be Spent				**$ 1,271,984.35**

Appendix A
FY 2020-2021 Funded Projects

Prop. #	Title	Budget	PI	Co-PI	Institution	Total Budget Approved
20-003	Characterization of Corpus Christi and San Antonio Air Quality During the 2020 Ozone Season	$ 70,961.00	Griffin, Robert	n/a	Rice University (Prime Sub)	$ 288,727.00
		$ 2,300.000	Griffin, Robert	n/a	Rice University - PPE	
		$ 115,668.00	Flynn, James	Wang, Yuxuan	University of Houston	
		$ 99,798.00	Usenko, Sascha	Sheesley, Rebecca	Baylor University	
20-004	Galveston Offshore Ozone Observation (GO3)	$ 133,494.00	Flynn, James	Wang, Yuxuan	University of Houston (Prime Sub)	$ 201,754.00
		$ 68,260.00	Walter, Paul	Morris, Gary	St. Edward's University	
20-005	Using Satellite Observations to Quantify Surface PM2.5 Impacts from Biomass Burning Smoke	$ 173,692.00	Alvarado, Matthew	n/a	Atmospheric and Environmental Research, Inc. (AER)	$ 173,692.00
20-007	Texas urban vegetation BVOC emission source inventory	$ 50,277.00	Shah, Tejas	n/a	Ramboll US Corporation (Prime Sub)	$ 70,000.00
		$ 19,723.00	Wildland Solutions	n/a	Wildland Solutions	
20-009	Ozone Measurements and Platform Emission Factors in the Gulf of Mexico	$ 12,989.00	Yacovitch, Tara	n/a	Aerodyne Research, Inc.	$ 12,989.00
20-011	Improving Estimates of Wind-Blown Dust from Natural and Agricultural Sources	$ 113,615.00	Emery, Chris	n/a	Ramboll US Corporation	$ 113,615.00
20-020	New Satellite Tools to Evaluate Emission Inventories: Is a 3-D Model Necessary?	$ 125,000.00	Holloway, Tracy	n/a	University of Wisconsin-Madison (Prime Sub)	$ 222,677.00
		$ 97,677.00	Johnson, Jeremiah	n/a	Ramboll US Corporation	
20-026	Improve Cloud Modeled by WRF using COSP and Generative Adversarial Network	$ 98,427.00	Lu, Zheng	n/a	Texas A&M University	$ 98,427.00
20-028	Quantification and Characterization of Ozone Formation in Central San Antonio	$ 71,368.60	Wood, Ezra	n/a	Drexel University	$ 71,368.60

Appendix B
FY 2020-2021 Submitted Proposals and Contingency Abstracts

Proposal #	Title	Total Budget	PI	Institution
20-001	Changing Precipitation Dynamics in Southeastern Texas over the Past Three Decades: Amount, Intensity, Duration, and Storm Type	$ 105,845.00	Talbot, Robert	University of Houston
20-002	Measurements of Pollutant transportation into San Antonio during 2020	$ 180,995.00	Thompson, Jon	Texas Tech University
20-003 (funded)	Characterization of Corpus Christi and San Antonio Air Quality During the 2020 Ozone Season	$ 286,427.00	Griffin, Robert	Rice University
20-004 (funded)	Galveston Offshore Ozone Observation (GO3)	$ 201,754.00	Flynn, James	University of Houston
20-005 (funded)	Using Satellite Observations to Quantify Surface PM2.5 Impacts from Biomass Burning Smoke	$ 173,692.00	Alvarado, Matthew	Atmospheric and Environmental Research, Inc. (AER)
20-006	Unprecedented Air Quality Measurements in Austin, Texas: Understanding the Sources and Formation of Ozone Particulate Matter	$ 245,409.00	Hildebrandt Ruiz, Lea	University of Texas at Austin
20-007 (funded)	Texas urban vegetation BVOC emission source inventory	$ 130,931.00	Shah, Tejas	Ramboll US Corporation
20-008	Central Texas Air Quality: Corpus Christi, Austin, San Antonio Field Study	$ 249,969.00	Yacovitch, Tara	Aerodyne Research, Inc.
20-009 (funded)	Ozone Measurements and Platform Emission Factors in the Gulf of Mexico	$ 12,990.00	Yacovitch, Tara	Aerodyne Research, Inc.
20-010 (contingency)	Using remote-sensing smoke products to quantify the impact of biomass burning smokes on ground-level particulate matter concentrations in Texas	$ 188,322.00	Wang, Yuxuan	University of Houston
20-011 (funded)	Improving Estimates of Wind-Blown Dust from Natural and Agricultural Sources	$ 113,615.00	Emery, Chris	Ramboll US Corporation
20-012	Computationally Efficient Deep Learning Model to Improve Meteorological Models over Texas: AI-Powered Data Assimilation, Bias-Correction, and Sensitivity Analysis	$ 175,644.00	Choi, Yunsoo	University of Houston
20-013	Deep Learning and chemical Transport Models Integration with In Situ and Remote Sensing Data to Accurately Estimate Emissions within Texas and Surrounding States	$ 187,759.00	Choi, Yunsoo	University of Houston
20-014 (contingency)	Utilization of Remote Sensing Data to Improve Meteorological Fields for Air Quality Simulations	$ 161,753.00	Pour-Biazar, Arastoo	University of Alabama at Huntsville

Appendix B (continued)

20-015	Baseline Air Quality Measurements in Taft, Texas, Analysis of Available Data & An Assessment of the Use of Unmanned Aerial Vehicles Using Low Cost Sensors for Selective Air Monitoring Applications	$ 334,758.00	Torres, Vincent	University of Texas at Austin
20-016	Optimized WRF Configurations for Texas Air Quality Simulations	$ 148,745.00	Hegarty, Jennifer	Atmospheric and Environmental Research, Inc. (AER)
20-017	Novel methods for estimating particulate matter air quality impacts of smoke from biomass burning using Geostationary satellites	$ 200,725.00	Nair, Udaysankar	University of Alabama at Huntsville
20-018	Air-quality Conscious and Cost-effective Industrial Emission Control for Texas Air-quality Improvement	$ 201,184.00	Xu, Qiang	Lamar University
20-019	Reduced Combustion Mechanisms for the Ammonia/Natural Gas/Air System and CFD Simulations for Turbine/Internal Combustion Engine Emissions	$ 150,000.00	Chen, Daniel H.	Lamar University
20-020 (funded)	New Satellite Tools to Evaluate Emission Inventories: Is a 3-D Model Necessary?	$ 222,677.00	Holloway, Tracy	University of Wisconsin-Madison
20-021	A critical evaluation of soil layers in land surface models for improving simulations of dust emissions	$ 194,686.00	Wu, Yu-Ling	Earth System Science Center
20-022	Implementing Dust Speciation for Improved Representation of Dust Impacts on Chemistry	$ 119,198.00	Liu, Xiaohong	Texas A&M University
20-023	Ozone Measurements in Galveston Bay and the Gulf of Mexico in support of air quality modeling	$ 232,701.00	Ying, Qi	Texas A&M University
20-024	Improving biogenic emissions in urban areas and evaluating their impact on ozone and secondary organic aerosol	$ 186,494.00	Ying, Qi	Texas A&M University
20-025	Near-Real-Time Application of Remote Sensing Tools to Verify, Validate and Improve Emissions of NO2 and SO2 for Texas Air Quality Modeling	$ 186,979.00	Pavlovic, Nathan	Sonoma Technology, Inc.
20-026 (funded)	Improve Cloud Modeled by WRF using COSP and Generative Adversarial Network	$ 98,427.00	Lu, Zheng	Texas A&M University
20-027	Austin 2020 Air Quality Field Study	$ 223,260.00	Walter, Paul	St. Edward's University
20-028 (funded)	Quantification and Characterization of Ozone Formation in Central San Antonio	$ 71,368.60	Wood, Ezra	Drexel University
20-029	Evaluating Opportunities to Improve County-level Emissions of Oxides of Nitrogen Using Satellite-based Observations	$ 185,509.00	Capps, Shannon	Drexel University

Project 20-010 **STATUS: CONTINGENCY**

Using remote-sensing smoke products to quantify the impact of biomass burning smokes on grand-level particulate matter concentrations in Texas

University of Houston – Dr. Yuxuan Wang AQRP Project Manager – n/a

Baylor University – Dr. Sascha Usenko TCEQ Project Liaison – n/a

Proposed Amount: $188,322.00

Abstract:
Due to its geography, Texas is susceptible to smokes from both in-state and out-of-state fires. While current satellites can provide routine products of fire and smoke locations, the spatiotemporal information of fire plumes seen from above by the satellites may not correlate well with air quality impacts at the ground due to complex vertical structures and chemical heterogeneity of fire plumes, both of which are challenging for satellites to observe. Previous studies used either statistical methods or numerical models to estimate surface air quality impacts of fire emissions from satellites, but these approaches have inherent drawbacks, including computational expenses and small signal to noise ratios to quantify individual transport events.

To address the shortcomings of the existing approaches, we propose here a new hybrid method that integrates recent advances in aerosol reanalysis model, machine learning, and surface observation of biomass burning indicators and develop an automatable system for real-time detection of individual events of biomass burning smokes in Texas and quantification of the associated surface impacts. First, we will build a machine-learning emulator for a state-of-the-science aerosol reanalysis model (Navy Aerosol Analysis and Prediction System, NAAPS), which provides mechanistic relationships between smoke aerosol optical depth (AOD), surface smoke concentrations, and smoke height for numerous past events of fire emissions transport to Texas. As the NAAPS aerosol reanalysis outputs already assimilated satellite AOD, smoke AOD from NAAPS is consistent with satellite products, a major strength compared to other free-running aerosol models. Second, the trained emulator will apply to satellite fire and smoke products to generate mechanistic-based quantitative hindcast predictions of smoke height and ground level impacts of fire smoke in Texas. Third, the emulator-predicted smoke impacts will be compared with and validated by independent, ground-based measurements of smoke indicators, including aerosol optical properties (e.g. (BC)2 2019 in El Paso, and potentially (BC)2 2020 at three sites in Houston and again in El Paso) for validation and confirmation of individual events across Houston and between Houston and El Paso and chemical speciation (e.g. West Liberty site) for confirmation of longer-term trends (i.e. identification of peak seasons). Finally, we will demonstrate the end product, which is an automatable system that can translate incoming fire and smoke products from satellites into ground-level smoke concentrations and smoke height over Texas and validate the prediction with surface-based optical measurements in near-real-time.

The proposed project specifically targets the AQRP Priority Research Area FY2020-2021:

Estimate Impacts of Smoke from Biomass Burning. The proposed emulator-prediction approach will be computationally lean yet mechanistically based. It leverages on and links to previous and ongoing ground-level measurements of smoke indicators funded by the state. Furthermore, the emulator approach is adaptable and can be readily updated to fit improved versions of mechanistic models that incorporate new scientific understandings on fire emissions, chemistry, and transport.

Project Update: n/a

Project 20-014 **STATUS: CONTINGENCY**

Utilization of Remote Sensing Data to Improve Meteorological Fields for Air Quality Simulations

University of Alabama at Huntsville – Dr. Arastoo Pour-Biazar

AQRP Project Manager – n/a

TCEQ Project Liaison – n/a

Proposed Amount: $161,753.00

Abstract:
This proposal is in response to the call by the State of Texas Air Quality Research Program (AQRP) seeking studies to support Texas Air Quality research priorities. The work proposed here addresses priority areas with respect to meteorological modeling. In particular, the project focuses on enhancing the meteorological input for air quality simulations by assimilating satellite-observed cloud fields in an optimized Weather Research and Forecasting (WRF) model configuration for Texas. While this work specifically addresses meteorological priority areas, the project also contributes to several other priority areas as the improvements in cloud field improves vertical transport of pollutants, affects radiation, and influences the biogenic emissions. The improvements in cloud simulation will be enhancing the overall photochemical simulation and lead to better understanding of ozone and PM formation over Texas.

With the support of the TCEQ, either directly or through AQRP, the University of Alabama in Huntsville (UAH) has been developing techniques to improve the realization of clouds in air quality simulations. These efforts started with using satellite observations to correct for the radiative impact of clouds in both the CMAQ and the CAMx models. While these techniques significantly improved air quality simulations, it introduced a physical inconsistency in the modeling system as the insolation and photolysis fields did not agree with the other attributes of the model (such as precipitation, vertical transport, heterogeneous chemistry, wet deposition, etc.) Currently, both CMAQ and CAMx use ancillary information from the meteorological model to diagnose cloud attributes that are critical to air quality simulations (such as convective parameterization or photolysis rate calculation). Therefore, any error emanating from the meteorological model will propagate to the photochemical model. Assimilating observed clouds in the meteorological model will eliminate such inconsistencies.

With partial support from TCEQ, UAH has developed a cloud assimilation system (CAS) that dynamically corrects model clouds in the meteorological model based on the satellite observations (Pour-Biazar et al., 2015). CAS is particularly suitable for retrospective regulatory applications as it utilizes satellite observation. CAS has been evaluated for air quality simulations over the summer of 2006 and the summer of 2013. Both these studies indicated significant improvements in model cloud and radiation fields over the contiguous United States. Subsequent air quality simulations substantially improved due to correction in biogenic hydrocarbon emissions and photolysis rates. Yet, the improvements are not uniform over all the regions, and the system's dependency on model configuration has not been thoroughly tested.

We are proposing to conduct a study to investigate the performance of CAS over Texas. Furthermore, the study will attempt to improve and fine-tune the CAS for Texas air quality studies. The proposed study will investigate the use of additional observed information, such as lightning activity data and satellite-observed total precipitable water, to improve the initiation of convection and perform moisture adjustment where needed. The study will also investigate the influence of different WRF configurations on the performance of the CAS over Texas and will recommend an optimized configuration.

The Weather Research and Forecasting (WRF) model will be used for simulations over the summer of 2016. WRF simulations will take advantage of improved cloud simulation by applying a technique developed at UAH under a previous TCEQ funded project. The technique uses GOES cloud observations to dynamically correct cloud fields in WRF.

The project will leverage resources from a current NASA activity for acquiring the data needed for this study. Arastoo Pour-Biazar and Andrew White will be responsible for model simulations and refinements to CAS. Richard McNider will be helping in the evaluation of the results. A research associate will assist the team in model simulations and evaluation of results.

Project Update: n/a

Appendix C
FY 2018-2019 Research Projects

Project No.	Project Title	Start Date	End Date	Funding Awarded	Total Project Expenditures*	Funding to be Carried Forward to 20-21
	Lead Institution	***PI***				
18-005	Next steps for improving Texas biogenic VOC and NO emission estimates	10/31/2018	8/31/2019	$168,146.00	$159,669.00	$8,477.00
	University of California - Irvine	*Alex Guenther*				
18-007	DDM Enhancements in CAMx: Local Chemistry Sensitivity and Deposition Sensitivity	10/16/2018	8/31/2019	$150,000.00	$150,000.00	$0.00
	Ramboll	*Greg Yarwood*				
18-010	A synthesis study of the role of mesoscale and synoptic-scale wind on the concentrations of ozone and its precursors in Houston	10/26/2018	8/31/2019	$121,000.00	$118,019.80	$2,980.20
	Texas A&M University	*Qi Ying*				
18-022	Development and Evaluation of the FINN v.2 Global Model Application and Fire Emissions Estimates for the Expanded Texas Air Quality Modeling Domain	9/1/2018	8/31/2019	$172,114.00	$172,112.65	$1.35
	The University of Texas at Austin	*Elena McDonald-Buller*				
19-023	Emission Inventory Development and Projections for the Transforming Mexican Energy Sector	9/18/2018	8/31/2019	$150,749.61	$150,736.65	$12.96
	The University of Texas at Austin	*Elena McDonald-Buller*				
19-025	Apportioning the Sources of Ozone Production during the San Antonio Field Study	10/16/2018	9/30/2019	$199,974.00	$199,722.22	$251.78
	Aerodyne Research, Inc.	*Tara Yacovitch*				
19-031	Detecting events and seasonal trends in biomass burning plumes using black and brown carbon: (BC)2 El Paso	10/26/2018	9/30/2019	$131,294.00	$127,630.78	$3,663.22
	Baylor University	*Rebecca Sheesley*				
19-040	Analysis of Ozone Production Data from the San Antonio Field Study	9/18/2019	9/30/2019	$130,264.00	$130,264.00	$0.00
	Drexel University	*Ezra Wood*				
**Funding as of May 2020*			**TOTALS**	**$1,223,541.61**	**$1,208,155.10**	**$15,386.51**
			CONTRACTUAL FUNDS NOT AWARDED	**n/a**	**n/a**	**$240.39**
			TO BE CARRIED FORWARD TO 20-21	**n/a**	**n/a**	**$15,626.90**