AIR QUALITY RESEARCH PROGRAM

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

Quarterly Report

September 1, 2018 through November 30, 2018

Submitted to

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Texas Air Quality Research Program

Quarterly Report

September 1, 2018 – November 30, 2018

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 September 1, 2018 and November 30, 2018, the AQRP Project Administration efforts focused primarily on executing contractual agreements with the entities performing research projects, while the Project Managers worked with the Investigators to complete project Work Plans, and, as work began, to submit required reports.

Contracting is done using a two-step process. First, a Master Agreement, which describes the general terms and conditions of contracting with The University of Texas at Austin under the AQRP, is put in place with each entity performing work under a research project. Then, once the Work Plan is approved, a Task Order is issued to each entity. The Task Order is a project specific contractual document that outlines the period of performance, budget, and scope of work to be performed.

The Master Agreement contracting process began in the previous quarter. Because some entities had projects during the 2016 – 2017 biennium, they merely needed to have their Master Agreement amended to extend the end date. Most amendments were fully executed by August 31. Those that weren't were executed in early September. Those entities that needed to negotiate a new Master Agreement took a little more time, but were all executed by the end of October.

The Master Agreements were negotiated in parallel with the development, by the project investigators, of the project Statement of Work, Budget and Budget Justification, and Quality Assurance Project Plan (QAPP), in total referred to as the project Work Plan. By the end of October, all research project Work Plans were approved by their AQRP Project Managers and recommended to move forward by their TCEQ Liaisons. Once Work Plans were approved, a Task Order was issued to each of the entities performing the research projects. At the end of November, Task Orders were fully executed for all but one of the projects. That remaining Task Order was fully executed in early December. All eight (8) projects are authorized to begin work.

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).

> Sec. 387.010. AIR QUALITY RESEARCH. (a) The commission shall contract with a nonprofit organization or institution of higher education to establish and administer a program to support research related to air quality.
>
> (b) The board of directors of a nonprofit organization establishing and administering the research program related to air quality under this section may not have more than 11 members, must include two persons with relevant scientific expertise to be nominated by the commission, and may not include more than four county judges selected from counties in the Houston-Galveston-Brazoria and Dallas-Fort Worth nonattainment areas. The two persons with relevant scientific expertise to be nominated by the commission may be employees or officers of the commission, provided that they do not participate in funding decisions affecting the granting of funds by the commission to a nonprofit organization on whose board they serve.
>
> (c) The commission shall provide oversight as appropriate for grants provided under the program established under this section.
>
> (d) A nonprofit organization or institution of higher education shall submit to the commission for approval a budget for the disposition of funds granted under the program established under this section.
>
> (e) A nonprofit organization or institution of higher education shall be reimbursed for costs incurred in establishing and administering the research program related to air quality under this section. Reimbursable administrative costs of a nonprofit organization or institution of higher education may not exceed 10 percent of the program budget.
>
> (f) A nonprofit organization that receives grants from the commission under this section is subject to Chapters 551 and 552, Government Code.

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 on July 29, 2015 for the 2016-2017 biennium. 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).

On September 4, 2017, the AQRP contract was renewed for the 2018 – 2019 biennium and additional 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 all Program activity concentrated on Step 7 of the Research Project Cycle.

RESEARCH PROJECTS

FY 2018 – 2019 Projects

Project 18-005 **STATUS: Active – October 31, 2018**

Next steps for improving Texas biogenic VOC and NO emission estimates

University of California-Irvine – Alex Guenther
Ramboll – Greg Yarwood
AQRP Project Manager – Elena McDonald-Buller
TCEQ Project Liaison – Doug Boyer

Funded Amount: $168,146
(UC-Irvine $139,193, Ramboll $28,953)

Abstract
The emissions of gases and particles into the atmosphere are the primary drivers of regional air quality. There are a wide variety of emission sources including automobiles, factories, and biological organisms including vegetation and microbes. While emissions from combustion sources and industrial activities dominate in urban and industrial locations, biogenic emissions dominate on global scales and contribute to atmospheric composition in urban and nearby areas.

The overall goal of this project is to improve numerical model predictions of regional ozone and aerosol distributions in Texas by reducing uncertainties associated with quantitative estimates of biogenic volatile organic compound (BVOC) and biogenic nitric oxide (BNO) emissions from Texas and the surrounding region. Although there have been significant advancements in the procedures used to simulate these biogenic emissions, there are still major uncertainties that limit predictability of Texas air quality simulations. In this project, we will improve the capability of the Model of Emissions of Gases and Aerosols from Nature (MEGAN) framework to estimate emissions of these compounds for application in numerical air quality models. To accomplish this, we will conduct high quality measurements of speciated BVOC emission factors at eastern Texas field sites near San Antonio, Dallas, and Houston. These results and other recent advances, including an improved approach for modeling BNO emissions, will be integrated into MEGAN.

The primary output of the proposed research will be a more accurate approach for estimating BVOC and BNO emissions. The overall benefit of this project will be more accurate VOC and NO 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 Activities
A summary of activities for the period September 1, 2018 through November 30, 2018 is provided below:

Task 1. Measure Texas BVOC emission factors and their variability
Not yet initiated. UCI has just received the fully executed agreement. The work on this task is expected to start in December 2018.

Task 2. MEGAN model improvements
As in Task 1 above.

Task 3. MEGAN3.1 sensitivity analysis of Texas biogenic emissions
As in Task 1 above.

The project team does not anticipate any issues in completing the tasks on time and the project is expected to proceed as planned.

Project 18-007 **STATUS: Active – October 16, 2018**

DDM Enhancements in CAMx: Local Chemistry Sensitivity and Deposition Sensitivity

Ramboll – Greg Yarwood

AQRP Project Manager – Elena McDonald-Buller
TCEQ Project Liaison – Jim Smith

Funded Amount: $150,000

Abstract
The Texas Commission on Environmental Quality uses the CAMx photochemical air quality model in planning activities for ground-level ozone. Estimating uncertainty in a model's predictions due to uncertainties in all the inputs and parameters, known as a global uncertainty analysis, is a challenge due to the hundreds or even thousands of inputs and parameters and the relatively long computer runtimes for photochemical models. This project will develop a new and efficient sensitivity analysis tool for CAMx called Chemistry Sensitivity Analysis (CSA) that is based on the decoupled direct method (DDM) for sensitivity analysis already present in CAMx. Then, we will use CSA to estimate the uncertainty range in ozone predictions in Texas due to chemistry uncertainty by creating alternative chemistry mechanisms with high and low ozone productivity. Also, we will extend the implementation of DDM in CAMx to calculate sensitivity to dry deposition velocity which has been identified as an important factor influencing ozone predictions. We will combine the effects of estimated uncertainty in the chemistry with uncertainty due to model emissions, boundary concentrations, and dry deposition velocity to estimate an overall uncertainty in CAMx ozone predictions for Texas.

Project Activities
This AQRP project is being performed by Ramboll in collaboration with Dr. Alan Dunker, an independent consultant. A summary of activities for the period September 1, 2018 through November 30, 2018 is provided below:

Task 1: Develop the Chemistry Sensitivity Analysis (CSA) Tool for CAMx
The Ramboll Principal Investigator, Dr. Greg Yarwood, worked with Dr. Alan Dunker to quantify uncertainties in rate constants and stoichiometric coefficients in the reactions included in the CB6r4 mechanism and to identify the most important reactions for the uncertainty analysis.

Task 2: Apply CSA for Ozone in Texas to Investigate Chemical Mechanism Condensation and Uncertainty
This task will be conducted after Task 1 above is completed.

Task 3: Implement DDM for Dry Deposition Velocity in CAMx
This task will be initiated in December 2018.

Task 4: 3-D DDM Analysis
This task has not yet been initiated.

Task 5: Reporting
This task has not yet been initiated.

Ramboll received authorization to begin work on the project in October 2018. We do not expect this delay in initiating the study to impact the overall schedule for delivering the draft final report by August 1, 2019.

We intend to use all funds allocated to the project by 08/31/2019.

Project 18-010 **STATUS: Active – October 26, 2018**

A synthesis study of the role of mesoscale and synoptic-scale wind on the concentrations of ozone and its precursors in Houston

Texas A&M University – Qi Ying

AQRP Project Manager – Elena McDonald-Buller
TCEQ Project Liaison – Jonathan Steets

Funded Amount: $121,000

Abstract
While it is known that low synoptic-scale winds and mesoscale recirculation contribute to high ozone formation in Houston, a comprehensive synthesis of all relevant data and analyses to elucidate the interaction between the mesoscale and synoptic-scale winds and air pollutants is not yet available. An improved understanding of the roles of mesoscale and synoptic-scale processes would allow researchers and policy makers to distinguish between days dominated by local emissions and those dominated by regional contributions. The overall objective of this research is to synthesize existing data, previous analyses, and photochemical model experiments to provide a comprehensive and reconciled description of how mesoscale and synoptic-scale winds affects dispersion and accumulation of air pollutants emitted in the Houston area and from other regions, and how they contribute to high ozone events. The relationship between surface winds and boundary-layer mesoscale transport features will be clarified, and a novel source- and age-resolved regional air quality model will be applied to investigate selected high ozone events under the influence of mesoscale circulations. The results from this study will facilitate a better understanding of the interaction between the mesoscale and synoptic-scale winds and air pollutants and how they contribute to high ozone events in Houston. Such information is extremely useful for understanding high ozone events as they occur and for developing appropriate control strategies and policy options for the unique Texas meteorological environment.

Project Activities
Work on Task 1 has focused on identifying synergies and opportunities for leveraging personnel and computer resources. We are collaborating with Prof. Yangyang Xu of Texas A&M and his graduate student, who are engaged in a research project with the National Center for Atmospheric Research (NCAR) to track transport of Central American biomass burning aerosols across the Gulf of Mexico using WRF-CHEM. For the AQRP project, they are planning to extend the domain northward from their original plan and to run the meteorological model (WRF) an extra few months, to provide meteorological simulations for most if not all of the 2017 warm season. We will use this simulation to obtain a WRF climatology of wind rotation and recirculation, to determine whether the model properly reproduces the patterns of wind change in time and space, and to identify candidate good-performing episodes for WRF-driven CMAQ simulations.

Timely progress has been made on Task 2 of the project, which is to develop a source and age-resolved CMAQ model to analyze contributions of fresh and aged emissions to ozone formation in Houston. A unified source-oriented chemical mechanism for the source/age apportionment of ozone, NOx and VOCs has been developed. In the new source apportionment scheme, a three-regime approach based on PI's previous research was adopted to more accurately account for the

contributions of VOCs and NOx to ozone formation. A new solution scheme which greatly improved the computation efficiency of the model was also developed. This improved solution method has been tested using the TexAQS 2006 summer episode (see Figure 1 below). A technical paper has been drafted to document the unified source-oriented mechanism and the improved efficient solution technique and will be submitted to TCEQ for review soon. In addition, aging of gaseous pollutants can now be treated in the model by using different tagged model species to represent emissions from different times.

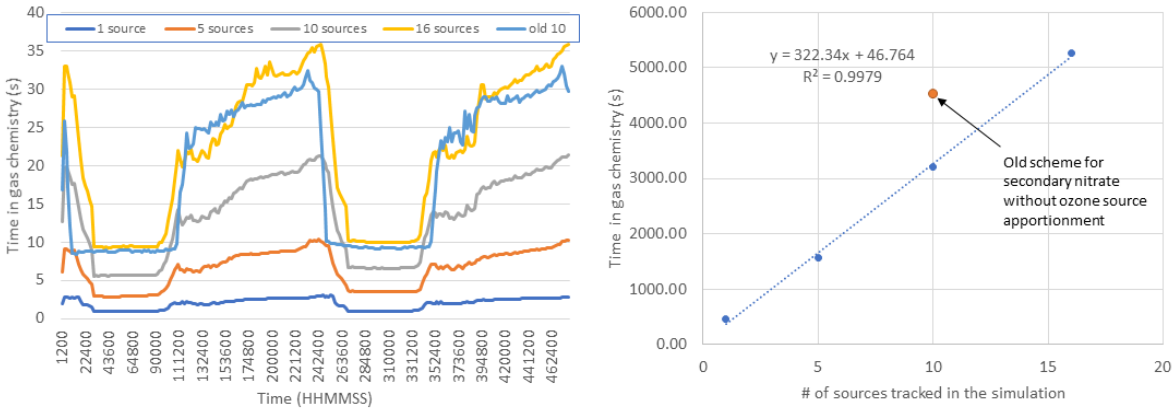

Figure 1(a) Wall-clock time for gas phase chemistry at each time step during the two-day simulation (August 28-29, 2006) for simulations with a different number of sources (including the vanilla type) and (b) total wall-clock time for the gas phase chemistry part of the two-day simulation. Units are seconds. All simulations were performed on a 10-core/20-thread E5-2670 v2. Only 8 cores were requested for these simulations.

At this point, all funds allocated to the project are expected to be used by 8/31/2019.

Project 18-022 **STATUS: Active – September 1, 2018**

Development and Evaluation of the FINN v.2 Global Model Application and Fire Emissions Estimates for the Expanded Texas Air Quality Modeling Domain

University of Texas at Austin – Elena McDonald-Buller
Sonoma Technology, Inc. – Fred Lurmann

AQRP Project Manager – David Sullivan
TCEQ Project Liaison – Stephanie Shirley

Funded Amount: $172,114
(UT Austin $85,768, Sonoma Tech $86,346)

Abstract
Wildland fires and open burning can be substantial sources of ozone precursors and particulate matter. Air quality in Texas can be affected by fire events that occur locally, regionally, or across longer distances from within the United States or across its international borders. With this recognition, the Texas Commission on Environmental Quality's future air quality model domain has been extended to include all of Mexico and large parts of Central America and the Caribbean. The Fire INventory from the National Center for Atmospheric Research (FINN) model estimates daily emissions of trace gases and particles from open biomass burning. The objectives of this project are to leverage new findings and data products from ongoing laboratory studies, surface and airborne field measurement campaigns, and satellite-based sensors in the development of FINN and to produce a fully operational, next generation global FINN application. The new FINN application will be used to develop fire emissions estimates for 2012-2017, a time period that includes 2016, which is the base year for the U.S. Environmental Protection Agency's national air quality modeling platform. FINN performance will be assessed using a new satellite algorithm, the Multi-Angle Implementation of Atmospheric Correction (MAIAC), for aerosol optical depth (AOD) retrievals, with a focus on fire events that originate from within Mexico, Central America, or the Caribbean and influence Texas air quality. The project is a collaborative effort between the University of Texas at Austin, Sonoma Technology, Inc., and Dr. Christine Wiedinmyer.

Project Activities
During the quarter ending 11/30/2018, Dr. Kimura from the University of Texas at Austin traveled to the University of Colorado, Boulder, to work collaboratively with Dr. Wiedinmyer on the FINN development. Efforts included the addition of the Visible Infrared Imaging Radiometer Suite (VIIRS) fire detection product (VNP14IMGTDL_NRT) along with the default Moderate Resolution Imaging Spectroradiometer (MODIS) Active Fire product (MCD14DL) within the FINN preprocessor. The two products can be applied individually or in combination to create a unified fire detection representation within the FINN preprocessor. Algorithms to estimate burned area and characterize underlying land cover in FINN were developed as part of AQRP 14-011. The MODIS Collection 6 burned area mapping product (C6 MCD64A1) is available for monthly time periods at a spatial resolution of 500-m and was investigated as a basis for comparison.

In this work, the FINN preprocessor will be implemented on a public domain spatial database PostGIS for better scalability to a global application. The new preprocessor tool and Interactive Data Language (IDL) code for FINN are being designed to run at a global scale. To facilitate portability, the Docker open source software development system platform was selected to house the FINN tools. The Dockerfile, which is the environment created on Docker, will have necessary applications and libraries along with the FINN processor code.

On October 10, 2018, Dr. McDonald-Buller gave an invited presentation about fire emissions and air quality effects at the Texas Public Safety UAS Summit, which was designed to introduce Texas first responders to emerging technologies that could improve preparation and response.

The project is on-schedule, and all funds allocated are intended to be utilized by August 30, 2019.

Project 19-023 **STATUS: Active – September 5, 2018**

Emission Inventory Development and Projections for the Transforming Mexican Energy Sector

University of Texas at Austin – Elena McDonald-Buller
Ramboll – Greg Yarwood

AQRP Project Manager – David Sullivan
TCEQ Project Liaison – Michael Ege

Funded Amount: $158,309
(UT Austin $93,296, Ramboll $65,013)

Abstract
Within Texas, characterizing emission sources along its border and within Mexico has been recognized as essential for air quality modeling. Mexico's energy sector has been undergoing potentially transformational changes as part of Constitutional reforms ratified in 2013. A primary motivation is to encourage domestic and foreign investment and productivity growth in the oil, gas and power sectors. The reforms have the potential to significantly transform the magnitudes and spatial distributions of emissions from the oil and gas and power generation sectors over the next one to two decades. The overall objective of the proposed project is to apply new information to develop a bottom-up assessment of emissions for the upstream and midstream oil and gas sectors and power sector and to develop future emission projections based on likely outcomes of on-going bid rounds that are attracting new investment for exploration and production of oil and gas resources. Information and analytics for Mexico's upstream and midstream oil and gas sectors and power sector will be used to develop a 2016 base year emissions inventory, which coincides with the U.S. Environmental Protection Agency's national air quality modeling platform and will likely be the basis for future air quality modeling by the Texas Commission on Environmental Quality. Plans and results for the hydrocarbon bid rounds will be used as the basis for three future emissions projections that compare continued development of Mexico's onshore conventional and shallow water resources, which is consistent with historical practices, with expansion of its deep water and onshore shale regions that have been underdeveloped to date relative to their potential. The project is a collaborative effort between the University of Texas at Austin and Ramboll U.S Corporation.

Project Activities
During the quarter ending 11/30/2018, the team made an initial selection of emission source categories that will be the project focus. These include on-shore oil and gas well site exploration and production (upstream sector), off-shore oil and gas exploration and production platforms (upstream sector), compressor stations (midstream sector), natural gas processing plants (midstream sector), and electric power plants. The team expects that Mexico's National Hydrocarbons Information Center (CNIH) and IHS Markit's EDIN database for Mexico will be key data resources, supplemented with investigations of data from the Texas Commission on Environmental Quality (TCEQ), Western Regional Air Partnership (WRAP), and the U.S. Environmental Protection Agency's (EPA's) Triennial National Emission Inventory (NEI). As feasible, annual emissions are expected to be developed for oxides of nitrogen (NO_x), volatile organic compounds (VOCs), carbon monoxide (CO), coarse and fine particulate matter (PM_{10}

and $PM_{2.5}$), and sulfur dioxide (SO_2). The team is currently working on identifying data parameters and extracting data records that will be needed for the base year emission source category development and developing the methods to be applied in the project.

The team began extraction, summary, and visualization of available data from the Exploration and Production (E&P) and Midstream Essentials data domains for Mexico from IHS Markit's EDIN database. As a basis for comparison, the team summarized emissions data for Mexico reported in EPA's NEI developed for year 2018 with an emphasis on oil and gas sources. These summaries provided an understanding of the types of sources reported for each of the oil and gas categories within the NEI platform. The team obtained monthly oil and gas (associated and non-associated) production data at the well level from Mexico's CNIH. Spatial mappings of active oil and gas well locations were created and also scaled by CNIH 2016 annual production. Well locations in the IHS EDIN database indicated reasonable overall agreement with the CNIH well locations and are being used as a supplement to the CNIH data. Monthly oil and gas production totals for Mexico between the two datasets for 2016 were in strong agreement. Comparisons between CNIH 2016 locations of active oil and gas wells and the locations of NOx and/or VOC emissions from oil and gas sources in the year 2018 NEI identified gaps in the presence and spatial density of sources in the NEI.

The project is on-schedule, and all funds allocated are intended to be utilized by August 30, 2019.

Project 19-025 **STATUS: Active – October 16, 2018**

Apportioning the Sources of Ozone Production during the San Antonio Field Study

Aerodyne Research, Inc. – Tara Yacovitch AQRP Project Manager – Elena McDonald-Buller
TCEQ Project Liaison – Bright Dornblaser

Funded Amount: $199,974

Abstract
Ozone high up in the stratosphere is protective against UV rays, but when it is present at ground-level, it is a pollutant that can cause shortness of breath and other respiratory health problems. With new federal ozone standards in effect, it is more important than ever to understand the causes of ozone in and around San Antonio.

Ozone is formed when volatile organic hydrocarbons (VOCs) react with nitrogen oxides (NOx, the primary component in smog). A wide variety of VOCs are present in the air around cities such as San Antonio; they stem from sources as varied as vehicle exhaust, oil and gas extraction, and trees and vegetation. This project aims to discover which sources contribute to the formation of ground-level ozone in and around San Antonio, and in what quantities.

Raw data from the 2017 San Antonio Field Study (SAFS) will be examined closely and analyzed in full to identify characteristic sets of VOCs associated with different source types. Computer modeling of air transport will help identify the broad geographic areas where the measured air originated. An ozone formation computer model, in which individual source categories can be turned on, off, or varied, will be used to understand how each source type contributes to ozone formation in and around San Antonio.

Project Activities
Progress in this first quarter has focused on Task 1 and on getting the other tasks started. Two separate week-long workshops have been held to provide additional technical training to relevant project scientists on the advanced analysis techniques required for Tasks 1 and 2. Good progress on the initial phase of Task 1 (high-resolution analysis) has been made on two of three instruments. These initial results have already been incorporated into Task 2, providing the first hints at different classes of measured VOCs. In coming months, these preliminary results will feed back into Task 1 for help with identification of specific chemical species. The ozone formation computer model used in Task 3 has been chosen and installed on an analysis server. Task 4, which is largely independent of the other tasks, has produced a first set of model results, which will be analyzed for their sensitivity to model inputs in coming months.

The main challenge in the project in these early stages has been a delay in project start date from July 2018 in the original proposal to October 16, 2018. This three-month delay requires that the work schedule be compressed in order to accomplish all goals in a timely manner. In response to this time pressure, work has started on Task 2 (PMF analysis) ahead of schedule. Indeed, the initial results of the Task 2 analysis have proven to be useful for Task 1 analysis (high-resolution Analysis), and will lead to both scientific and time-saving benefits. This project is currently on track to use all available funds and finish by 8/31/2019.

Project 19-031 **STATUS: Active – October 26, 2018**

Detecting events and seasonal trends in biomass burning plumes using black and brown carbon: (BC)2 El Paso

Baylor University – Rebecca Sheesley
University of Houston – James Flynn
AQRP Project Manager – David Sullivan
TCEQ Project Liaison – Erik Gribbin

Funded Amount: $131,294
(Baylor $98,087, UH $33,207)

Abstract
Recent efforts by the Texas Air Quality Research Program (AQRP) and TCEQ to monitor and study air quality in Texas cities has resulted in improved understanding of the processes and sources which control urban air quality in e.g. Houston. As highlighted in the AQRP Priority Research Areas 2018-2019, El Paso is near the National Ambient Air Quality Standards for particulate matter (PM) and ozone (O_3). Reductions in anthropogenic emissions through implementation of cleaner technologies for e.g. motor vehicle exhaust, coal-fired power plants, have refocused efforts to understand the contribution of biomass burning to urban air pollution. This is particularly relevant for El Paso, which can experience large impacts of periodic biomass burning/wildfire plumes transported from out-of-state. Black carbon (BC), a marker for combustion influences on air quality, has been shown to be decreasing in urban areas across the United States due to increased regulation and the use of cleaner fuels. As a result, biomass-burning contributions are likely becoming more important for BC and for urban air quality in general.

We will provide critical insight on the influence of biomass burning on the air quality in El Paso, TX through the characterization of BC and brown carbon (BrC). BrC is the carbon fraction of an aerosol that selectively absorbs short wavelengths of light. The $(BC)^2$ El Paso field campaign will include the deployment of the Baylor air quality trailer, which will be outfitted with a suite of specific technologies developed to assess biomass burning through the monitoring of BC and BrC. Biomass burning plumes will be identified using aerosol composition and light absorption properties, including BC and BrC concentrations, absorption Ångström exponents (AAE), and aerosol light absorption coefficients for specific ultraviolet (UV) and visible wavelengths. The newest technology for real-time monitoring of aerosol absorption is the tricolor absorption photometer (TAP). The TAP measures adsorption at UV, green and red wavelengths to more specifically target biomass burning. This inexpensive and continuous photometer was designed by the National Oceanic and Atmospheric Administration (NOAA) and is commercially produced by Brechtel to address issues with previous photometers, including cost, sensitivity, noise and effective scattering corrections. Although it was only recently available, Baylor and UH PIs have run this instrument successfully during the 2017 San Antonio field campaign (SAFS) in the Baylor air quality trailer. The two goals of $(BC)^2$ El Paso are to 1) address scientific air quality questions of frequency, seasonality, and optical properties of biomass burning plumes in El Paso and 2) to evaluate the TAP instrument suite for application in long-term monitoring at urban sites in Texas.

Project Activities

Although the Work Plan was approved at the end of October, Baylor University has not yet received the fully executed Task Order. For this reason, only a limited number of activities have been started. Equipment orders have been placed and Baylor PIs met with the UH PI to discuss preparations for the project.

The project team does/does not anticipate any issues completing the tasks on time and the project is expected to proceed in December.

Project 19-040 **STATUS: Active – September 18, 2018**

Analysis of Ozone Production Data from the San Antonio Field Study

Drexel University – Ezra Wood

AQRP Project Manager – Elena McDonald-Buller
TCEQ Project Liaison – Mark Estes

Funded Amount: $130,264

Abstract
San Antonio is on the cusp of being in non-attainment of the U.S. Environmental Protection Agency's air quality standard for ozone, also known as photochemical smog. In order to mitigate potentially bad air quality in San Antonio, regulators will benefit from a full understanding of the sources of ozone and how future emissions can affect its concentration. During May 2017, a team of researchers from Drexel University, University of Houston, Rice University, and Aerodyne Research, Inc. conducted a field study focused on ozone air pollution in the greater San Antonio Area. The main goals were to collect data that would enable a determination of the rate at which ozone was being produced by chemical reactions in the air, to determine the relative importance of upwind and urban sources of ozone precursor emissions, and to determine the importance of different types of emissions (e.g., nitrogen oxides from fossil fuel combustion vs. biogenic volatile organic compounds from trees). The measurements from these field measurements were largely successful. In this project, the research team at Drexel University will analyze many aspects of the data in order to address the above goals. This research will consist of three tasks:

1. To characterize the relationship between the ozone production rate (calculated using measured concentrations of nitric oxide and total peroxy radicals) and the concentrations of other pollutants, including nitrogen oxides and volatile organic compounds,

2. To conduct zero-dimensional modeling of the photochemistry (in which spatial variations in pollutant concentrations are not considered) in order to determine if chemical models can successfully characterize the photochemistry, and

3. To conduct 3-dimensional air quality modeling, in which knowledge of emissions, meteorology, and the relevant chemistry are combined to predict spatially-resolved concentrations of ozone and other pollutants.

Project Activities
During the quarter ending 11/30/2018, the project team members succeeded in gathering the data collected by various SAFS participants: the University of Houston, Rice University, and University of Texas at San Antonio. The UH/ Rice data collected at the centrally located Traveler's World site will be used as part of Task #2 of this project: conducting 0-D photochemical modeling of the dataset with several model chemical mechanisms to investigate ozone production rates at four SAFS measurement sites. The ozonesonde and ceilometer data will be used for model evaluation in support of Task 3: apportion ozone concentrations to location-specific emission sources using 3-D air quality modeling with the instrumented Community Multiscale Air Quality model (CMAQ).

Analysis of the ozone production rates calculated using the measurements of peroxy radicals and nitric oxide from SAFS has been summarized in a manuscript entitled “Characterization of Ozone Production in San Antonio, Texas Using Observations of Total Peroxy Radicals” and submitted to the journal *Atmospheric Chemistry and Physics*. Much of this analysis was conducted prior to the start of this project but is highly complementary to the ongoing analysis as part of Task 1 of the current project: to quantify the dependence of the ozone production rate on the concentrations of NOx, VOCs, and other measurements at the three SAFS sites where peroxy radical concentrations were measured

In preparation for Task 3 (3-D air quality modeling with the CMAQ model), CMAQ version 5.2.1 has been installed on the Drexel high performance computing cluster and postdoc Daniel Anderson is being trained by Prof. Capps on its use.

FINANCIAL STATUS REPORT

Initial funding for fiscal years 2016 and 2017 was established at $1,000,000 each, for a total award of $2,000,000 for the FY 2016/2017 biennium. On September 4, 2017, the AQRP contract was renewed for the FY 2018/2019 biennium and additional funding of $750,000 per year was awarded. For each year, the funds were distributed across several different reporting categories as required under the contract with TCEQ. The reporting categories are:

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 will be 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.

During the reporting period 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. Maria Stanzione, AQRP Program Manager, assisted Dr. Allen in the program administration, while Maeve Cooney, Shannon Thorne, and Susan McCoy each provided assistance with program organization and financial management. Denzil Smith was responsible for the AQRP Web Page development and for data management.

Beginning September 1, 2018, The University of Texas at Austin switched to a federally negotiated fringe benefit rate. For fiscal year 2018/2019 the fringe rates will be:

Full-time/Benefits Eligible (including Graduate Students)	29%
Part-time/Benefits Eligible	39.60%
Part-time/Non-benefits Eligible	5.80%.

The contract between the TCEQ and The University of Texas at Austin was amended during this quarter to reflect this change in policy.

Table 1: Administration Budgets

Administration Budget (includes Council Expenses)
FY 2016/2017

Budget Category		FY16 Budget	FY17 Budget	Total	Expenses	Remaining Balance
Personnel/Salary		$74,376.95	$73,027.36	$147,404.31	$147,404.31	$0.00
Fringe Benefits		$18,118.37	$18,695.22	$36,813.59	$36,813.59	$0.00
Travel		$34.00	$0.00	$34.00	$34.00	$0.00
Supplies		$32.98	$974.69	$1,007.67	$1,007.67	$0.00
Equipment						
Total Direct Costs		$92,562.30	$92,697.27	$185,259.57	$185,259.57	$0.00
Authorized Indirect Costs		$7,437.70	$7,302.73	$14,740.43	$14,740.43	$0.00
10% of Salaries and Wages						
Total Costs		**$100,000.00**	**$100,000.00**	**$200,000.00**	**$200,000.00**	**$0.00**

Administration Budget (includes Council Expenses)
FY 2018/2019

Budget Category		FY18 Budget	FY19 Budget	Total	Expenses	Remaining Balance
Personnel/Salary		$53,700.00	$53,700.00	$107,400.00	$45,380.43	$62,019.57
Fringe Benefits		$12,930.00	$12,930.00	$25,860.00	$12,002.40	$13,857.60
Travel		$0.00	$0.00	$0.00	$0.00	$0.00
Supplies		$3,000.00	$3,000.00	$6,000.00	$680.18	$5,319.82
Equipment						
Total Direct Costs		$69,630.00	$69,630.00	$139,260.00	$58,063.01	$81,196.99
Authorized Indirect Costs		$5,370.00	$5,370.00	$10,740.00	$4,538.04	$6,201.96
10% of Salaries and Wages						
Total Costs		**$75,000.00**	**$75,000.00**	**$150,000.00**	**$34,542.30**	**$87,398.95**

ITAC

Table 2: ITAC Budgets

ITAC Budget
FY 2016/2017

Budget Category		FY16 Budget	FY17 Budget	Total	Expenses	Remaining Balance
Personnel/Salary						
Fringe Benefits						
Travel		$4,076.57	$0.00	$4,076.57	$4,076.57	$0.00
Supplies		$1,079.20	$0.00	$1,079.20	$1,079.20	$0.00
Total Direct Costs		$5,155.77	$0.00	$5,155.77	$5,155.77	$0.00
Authorized Indirect Costs						
10% of Salaries and Wages						
Total Costs		**$5,155.77**	**$0.00**	**$5,155.77**	**$5,155.77**	**$0.00**

ITAC Budget
FY 2018/2019

Budget Category		FY18 Budget	FY19 Budget	Total	Expenses	Remaining Balance
Personnel/Salary						
Fringe Benefits						
Travel		$7,500.00	$7,500.00	$15,000.00	$3,588.17	$11,411.83
Supplies		$1,500.00	$1,500.00	$3,000.00	$284.86	$2,715.14
Total Direct Costs		$9,000.00	$9,000.00	$18,000.00	$3,873.03	$14,126.97
Authorized Indirect Costs						
10% of Salaries and Wages						
Total Costs		**$9,000.00**	**$9,000.00**	**$18,000.00**	**$3,873.03**	**$14,126.97**

Project Management

Table 3: Project Management Budgets

Project Management Budget
FY 2016/2017

Budget Category		FY16 Budget	FY17 Budget	Total	Expenses	Remaining Balance
Personnel/Salary		$53,470.31	$51,727.58	$105,197.89	$105,197.89	$0.00
Fringe Benefits		$11,337.19	$12,236.62	$23,573.81	$23,573.81	$0.00
Travel		$0.00	$0.00	$0.00	$0.00	$0.00
Supplies		$0.00	$0.00	$176.36	$176.36	$0.00
Other		$0.00	$0.00	$0.00	$0.00	$0.00
Total Direct Costs		$64,938.86	$63,964.20	$128,948.06	$128,948.06	$0.00
Authorized Indirect Costs		$5,347.03	$5,172.76	$10,519.79	$10,519.79	$0.00
10% of Salaries and Wages						
Total Costs		**$70,330.89**	**$69,136.96**	**$139,467.85**	**$139,467.85**	**$0.00**

.00

Project Management Budget
FY 2018/2019

Budget Category		FY18 Budget	FY19 Budget	Total	Expenses	Remaining Balance
Personnel/Salary		$38,060.00	$38,060.00	$76,120.00	$20,601.09	$55,518.91
Fringe Benefits		$9,134.00	$9,134.00	$18,268.00	$7,430.50	$10,837.50
Travel		$0.00	$0.00	$0.00	$0.00	$0.00
Supplies		$1000.00	$1,000.00	$2,000.00	$0.00	$2,000.00
Other		$2,500.00	$2,500.00	$5,000.00	$0.00	$5,000.00
Total Direct Costs		$50,694.00	$50,694.00	$101,388.00	$28,031.59	$73,356.41
Authorized Indirect Costs		$3,806.00	$3,806.00	$7,612.00	$2,060.11	$5,551.89
10% of Salaries and Wages						
Total Costs		**$54,500.00**	**$54,500.00**	**$109,000.00**	**$30,091.70**	**$78,908.30**

Research Projects

A total of eight (8) projects requesting $1,231,101 in funding, were selected out of forty (40) proposals submitted to the AQRP RFP for the 2018-2019 biennium. Table 4 on the following page shows the distribution of the projects across the fiscal years for both FY 16-17 and FY 18-19.

The 2018 – 2019 budget allocates $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 will be expended first, so that all FY 2017 funds will be spent by Spring of 2019. That will leave 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, and we cannot move funds between fiscal years, so the FY 2019 shortfall is actually $782.)

Table 4: Contractual/Research Project Budget

FY 16-17

Contractual Expenses				
FY 16 Contractual Funding		**$815,000**		
FY 16 Contractual Funding Transfers		**$9,513**		
FY 16 Total Contractual Funding		**$824,513**		
Project Number		Amount Awarded (Budget)	Cumulative Expenditures	Remaining Balance
16-008	University of Houston	$191,366	$189,684.87	$1,681.13
16-010	Sonoma Technology, Inc.	$69,075	$69,075.00	$0.00
16-011	Ramboll Environ	$158,134	$158,127.36	$6.64
16-019	Univ. of Texas - Austin	$118,019	$117,551.39	$467.61
16-019	Ramboll Environ	$62,622	$62,618.81	$3.19
16-031	UNC - Chapel Hill	$225,000	$223,820.08	$1,179.92
FY 16 Total Contractual Funding Awarded		$824,216		
FY 16 Contractual Funds Expended (Init. Projects)			$820,877.51	
FY 16 Contractual Funds Remaining to be Spent				$3,635.83
FY 16 Additional Expenditures				
	State of the Science	$3,788.49	$3,635.83	$152.66
			$824,513.34	
FY 16 Contractual Funds Remaining to be Spent				$0.00

Table 4: Contractual/Research Project Budget (continued)

FY 16-17 (continued)

FY 17 Contractual Funding		**$815,000**		
FY 17 Contractual Funding Transfers		**$15,863**		
FY 17 Total Contractual Funding		**$830,863**		
Project Number		Amount Awarded (Budget)	Cumulative Expenditures	Remaining Balance
17-007	Univ. of Texas - Austin	$205,500	$202,348.20	$3,151.80
17-024	Atmospheric and Environmental Research, Inc.	$170,039	$170,039.00	$0.00
17-032	Drexel University	$59,000	$58,958.17	$41.83
17-039	Univ. of Alabama - Huntsville	$149,227	$149,226.81	$0.19
17-053	Aerodyne Research, Inc.	$185,193	$185,193.00	$0.00
17-SAFS	Univ. of Texas - Austin	$46,000	$35,999.96	$10,000.04
FY 17 Total Contractual Funding Awarded		$814,959		
FY 17 Contractual Funding Expended (Init. Projects)			$801,765.14	
FY 17 Contractual Funds Remaining to be Spent				$29,097.90
FY 17 Additional Expenditures				
	State of the Science	$22,211.51	$21,538.51	$673.00
19-023	UT Austin	$7,559.39	$0.00	$7,559.39
FY 17 Contractual Funds Expended			$823,303.65	
FY 17 Contractual Funds Remaining to be Spent				$7,559.39
Total Contractual Funding		$1,655,376		
Total Contractual Funding Awarded		$1,639,175		
Total Contractual Funding Remaining to be Awarded		$16,201		
Total Contractual Funds Expended to Date			$1,647,816.99	
Total Contractual Funds Remaining to be Spent				$7,559.39

Table 4: Contractual/Research Project Budget (continued)

FY 18-19

Contractual Expenses				
FY 18 Contractual Funding		**$611,500**		
FY 18 Contractual Funding Transfers		**$0**		
FY 18 Total Contractual Funding		**$611,500**		
Project Number		Amount Awarded (Budget)	Cumulative Expenditures	Remaining Balance
18-005	UC - Irvine	$139,193	$0.00	$139,193.00
18-005	Ramboll	$28,953	$0.00	$28,953.00
18-007	Ramboll	$150,000	$0.00	$150,000.00
18-010	TAMU	$121,000	$0.00	$121,000.00
18-022	UT Austin	$85,768	$0.00	$85,768.00
18-022	Sonoma Tech, Inc.	$86,346	$0.00	$86,346.00
FY 18 Total Contractual Funding Awarded		$611,260		
FY 18 Contractual Funds Expended (Init. Projects)			$0.00	
FY 18 Contractual Funds Remaining to be Spent				$611,500.00
FY 19 Contractual Funding		**$611,500**		
FY 19 Contractual Funding Transfers		**$0**		
FY 19 Total Contractual Funding		**$611,500**		
Project Number		Amount Awarded (Budget)	Cumulative Expenditures	Remaining Balance
19-023	UT Austin	$85,736.61	$0.00	$85,736.61
19-023	Ramboll	$65,013	$0.00	$65,013.00
19-025	Aerodyne Research, Inc.	$199,974	$0.00	$199,974.00
19-031	Baylor University	$98,087	$0.00	$98,087.00
19-031	University of Houston	$33,207	$0.00	$33,207.00
19-040	Drexel University	$130,264	$0.00	$130,264.00
FY 19 Total Contractual Funding Awarded		$612,282		
FY 19 Contractual Funding Expended (Init. Projects)			$0.00	
FY 19 Contractual Funds Remaining to be Spent				$611,500.00
Total Contractual Funding		$1,223,000		
Total Contractual Funding Awarded		$1,223,542		
Total Contractual Funding Remaining to be Awarded		($542)		
Total Contractual Funds Expended to Date			$0.00	
Total Contractual Funds Remaining to be Spent				$1,223,000