AIR QUALITY RESEARCH PROGRAM

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

Annual Report

July 29, 2015 through August 31, 2016

Submitted to

David Brymer
Texas Commission on Environmental Quality
12100 Park 35 Circle
Austin, TX 78753

Prepared by

David T. Allen, Principal Investigator
The University of Texas at Austin
10100 Burnet Rd. MC R7100
Austin, TX 78758

October 5, 2016

The preparation of this report was financed through a grant from the Texas Commission on Environmental Quality (TCEQ), administered by The University of Texas at Austin through the Air Quality Research Program (AQRP). The contents, findings, opinions, and conclusions are the work of the author(s) and do not necessarily represent findings, opinions, or conclusions of the TCEQ.

Texas Air Quality Research Program

Annual Report

July 29, 2015 – August 31, 2016

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

On July 29, 2015, the Texas Commission on Environmental Quality (TCEQ) contracted with the University of Texas at Austin to administer the AQRP. During the first quarter of operations, the AQRP established the membership of the Independent Technical Advisory Committee (ITAC) and the Advisory Council. Also, the AQRP developed the Strategic Research Plan to identify research priorities in preparation for the issuance of the Request For Proposals (RFP). These priorities built on the research findings from the previous AQRP contract (582-10-94300) as described in the State of the Science Assessment for the 2014-2015 biennium. The Strategic Research Plan was submitted to the TCEQ for review and comment.

On February 8, 2016, the AQRP Advisory Council held its first meeting. The purpose of the meeting was to introduce the members to the AQRP administration, to instruct the Council on its roles and responsibilities, to share the research findings from the previous AQRP projects as described in the State of the Science assessment, and to meet jointly with the Texas Commission on Environmental Quality (TCEQ) management to discuss the research priorities for the FY 16-17 funding cycle.

Following the meeting, the Strategic Research Plan document was finalized, and submitted to the TCEQ for final review. On Monday, February 22, the Strategic Research Plan and the State of the Science Assessment were both approved by the TCEQ for release.

The RFP for the FY 16-17 funding cycle, was issued on Tuesday, February 23, 2016, and closed on April 20, 2016 at 5:00 pm central time. An extension was granted to investigators from institutions which were closed due to severe weather that occurred on April 15 through April 18, 2016. The extension was equal in length to the period of time that the investigator's institution was closed and required substantiation from the institution announcing the closure.

In total the AQRP received 54 proposals requesting a total of $9,549,443.00 in funding with approximately $1,630,000.00 available for projects in FY 16-17.

The technical review and ranking of the proposals began on Friday, April 22, with each proposal assigned to 3 primary reviewers on the ITAC. Efforts were made to ensure that no conflicts of interest existed between the proposer(s) and the reviewer(s) assigned to the proposal. Prior to beginning the review process, each ITAC member agreed to abide by both a Conflict of Interest Policy and a Confidentiality Policy. The primary reviewers scored the proposals they were assigned and returned the scores to the AQRP. The AQRP then compiled those scores to determine a preliminary average score for each proposal.

The ITAC met in Austin, Texas, on May 12 and 13, 2016. At the meeting, the preliminary average scores were evaluated to determine whether the proposals that failed to rank in the top half of the scoring should undergo additional review. The primary reviewers briefly discussed each proposal. At this stage, if any ITAC member called for additional consideration, the proposal advanced to the next stage. Otherwise, proposals that failed to rank in the top half of submissions, based on technical merit, were not advanced to the next stage. In the second stage of review, proposals were described by the three primary reviewers, and the entire ITAC discussed the strengths and weaknesses of each proposal. Based on the discussion, every ITAC member provided a technical score for each proposal for which they did not have a conflict. After the initial round of discussion, the proposals that advanced to this round were rated in an upper group, a lower group and a middle group. The ITAC went through a second round of discussion concerning proposals that appeared, based on technical ranking alone, to be near the limits of the AQRP's ability to fund proposals. Informed by that discussion, ITAC members had the opportunity to change their scoring for proposals ranked in the middle and lower groups. At this stage, the scoring for the technical rankings was final. This process is similar to the processes that AQRP has utilized in past solicitations.

The ranked proposals were then submitted to the TCEQ as follows:

> Highly Recommended/Recommended – 7 proposals receiving the highest peer review scores, totaling $1,299,951 in funding requested, and 11 proposals that went through a second round of review by the ITAC, totaling $2,216,738 in funding requested were collectively rated as highly recommended/recommended. A rank ordering of the proposals, based on technical merit was developed.
>
> Recommended if funding is available – 11 proposals had lower technical merit scores, but still could be considered for funding, if resources were available; these proposals totaled $1,753,238 in funding requested.
>
> Not recommended – 25 proposals with significant technical concerns, were not recommended for funding.

TCEQ performed a relevancy review of these proposals and returned a ranked list to the AQRP on June 13, 2016. The AQRP then convened a meeting of the Advisory Council on June 27, 2016, in Austin, Texas. During this meeting, Dr. David Allen presented the results of both the ITAC review results and the TCEQ relevancy review. After discussing the projects that ranked

highest from both reviews, the Advisory Council then selected nine (9) projects to receive funding. The Advisory Council also expressed a strong desire to fund additional work that would have relevance to air quality in the Eagle Ford Shale region, and directed the AQRP to request the TCEQ to re-examine two specific projects to determine whether or not individual tasks, relevant to that region, could be funded.

The AQRP assigned Project Managers to the projects that were selected for funding. It then notified the TCEQ which projects were funded and the Project Manager for those projects, and conveyed the Council's request to re-examine the two projects for possible partial funding.

While the TCEQ considered the Council's request, the AQRP sent notifications to the awardees and to the investigators of the 25 proposals that were not recommended for funding by the ITAC. The TCEQ assigned Project Liaisons for each of the nine awarded projects. The Project Managers held kick-off meetings with the project investigators and the TCEQ Liaisons, and work began on the project Work Plans. The AQRP also initiated the contracting process.

In late July, the TCEQ completed its review of the two (2) projects that was requested by the Advisory Council, and declined to change the relevancy ranking or split out specific tasks for funding. TCEQ stated that a component of the relevancy review was to ensure that the TCEQ and the AQRP were not paying for redundant research, and detailed work TCEQ is currently funding in the region.

As a result of that response, the AQRP notified the Advisory Council via email and requested a vote on one additional project that had been placed on hold pending the TCEQ review of the other projects. A majority of the Council approved the final project. The lead investigator was notified, a Project Manager and TCEQ Liaison were assigned, and work began on the Work Plan. At this time, notifications that their proposals were not selected for funding were sent to the remainder of the RFP respondents.

Upon notification of award, the lead investigators for two of the projects, 16-008 and 16-032, advised the AQRP that they had moved to new universities. Arrangements were made to move the awarded projects to the new universities and new budgets were submitted to the AQRP to reflect changes in pay rates (though effort stayed the same), tuition rates, and indirect cost rates. In one instance, project 16-008, this resulted in a decrease to the budget and in the other it resulted in a small increase.

One other project requested an increase to the budget that had been approved by the Advisory Council. Upon review of Project 16-019, the ITAC recommended that a Task be removed and the budget be reduced accordingly. The TCEQ concurred with this assessment and the AQRP estimated the amount of the reduction. The Advisory Council approved the project and upon award, the lead investigator was asked to rebudget the project to reflect the removal of the Task. The rebudgeted project cost was greater than the amount estimated by the AQRP.

The AQRP submitted an email request to the Advisory Council to increase the budgets for 16-019 and 16-032, along with justification for the request. This was approved by a majority vote by the Council.

As of August 31, 2016, the end of the fiscal year, all project Work Plans were under development. None have been approved to date. A list of all funded projects and a brief abstract for each project is included in Research Project section of this report.

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).

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 year the AQRP performed Steps 1 – 7. Step 7 is in progress for the 2016-2017 biennium.

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), 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 conflict 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	The University of Texas at Austin
William Carter	Emeritus Research Chemist, Center for Environmental Research and Technology	University of California - Riverside
Don Collins	Professor and Director of the Center for Atmospheric Chemistry and the Environment	Texas A&M University
James Crawford	Research Scientist, Chemistry & Dynamics Science Directorate	NASA
Peter Daum	Head, Atmospheric Science Division	Brookhaven National Lab
Mark Estes	Senior Air Quality Scientist Air Modeling and Data Analysis Section	Texas Commission on Environmental Quality
Fred Fehsenfeld	Senior Scientist, Cooperative Institute for Research in Environmental Sciences	University of Colorado – Boulder (Retired)
Joost de Gouw	Research Physicist, Earth System Research Lab	NOAA
Robert Griffin	Associate 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
Bryan Lambeth	Meteorologist	TCEQ (Retired)
Golam Sarwar		EPA ORD
Christine Wiedinmyer	Scientist III, Atmospheric Chemistry Division	Nation Center for Atmospheric Research
Greg Yarwood	Principal	Ramboll Environ, Inc.

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 serves as a Board of Directors for the Program and consists of between 7 and 11 members, all residents of the State of Texas. 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
Ramon Alvarez	Senior Scientist	Environmental Defense Fund
Daniel Baker	Senior Consultant in Air Quality	Shell Global Solutions
Omar Garcia	President & CEO	South Texas Energy & Economic Roundtable
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
Kim Herndon	Assistant Director Air Quality Division	Texas Commission on Environmental Quality
Keith Sheedy	Technical Advisor to the Deputy Director for the Office of Air	Texas Commission on Environmental Quality

RESEARCH PROJECTS

FY 2016 – 2017 Projects

Final funding amount for each project to be reported after Work Plan approval.

Project 16-007 **STATUS: Work Plan Under Review**

Evaluating Methods for Determining the Vapor Pressure of Heavy Refinery Liquids

University of Texas at Austin – Vincent Torres

AQRP Project Manager – Gary McGaughey
TCEQ Project Liaison – Russell Nettles

Funding Amount Approved by Advisory Council: $205,500

Abstract

During the last five years, crude oil and natural gas production and petroleum refinery operations have seen an increased focus on their emissions of volatile organic compounds (VOCs), hazardous air pollutants (HAPS) and greenhouse gases (GHGs), especially those from storage tanks. These actions have been taken by the United States Environmental Protection Agency (US EPA) "because EPA and state investigations have identified Clean Air Act compliance concerns regarding significant emissions from storage vessels, such as tanks or containers at onshore oil and natural gas production facilities" and to "collect information on processing characteristics, crude slate, emission inventories, and limited source testing to fill information gaps". State and federal laws require certain facilities to design, install, operate and maintain effective pollution control measures to minimize the emissions of VOCs and HAPs. For example, the federal New Source Performance Standards for Crude Oil and Natural Gas Production "requires that new, reconstructed or modified storage vessels with the potential for VOC emissions of equal to or greater than six tons per year reduce VOC emissions by at least 95%." The Texas Commission on Environmental Quality (TCEQ) funded two projects recently to better understand the composition and properties of heavy refinery liquids and the most appropriate method of determining their true vapor pressure (TVP).

The purpose of this research is to improve the estimates of VOC emissions from storage tanks holding heavy refinery liquids. These tanks are found at storage terminals and refineries and are frequently heated in order to reduce the viscosity of their contents and make them pumpable. Evidence is mounting that the emissions from these tanks are underreported and may explain some of the VOC inventory gap in parts of Texas.

During the course of this project, the most accurate, reliable, convenient, and reasonably priced means of measuring the TVP of heavy refinery liquids stored in tanks will be identified. Identifying an appropriate means of measuring the TVP of these heavy refinery liquids is important because direct measurement of VOC emissions from storage tanks is inherently inexact and expensive, so equations are used to estimate emissions from storage tanks. The value used for the TVP in these equations has a profound impact on the results. The results of this research will facilitate efforts being made by the US EPA, TCEQ, and agencies in other states to better understand, more accurately estimate, and manage emissions from tanks holding heavy refinery liquids.

Project 16-008 **STATUS: Work Plan Under Review**

High Background Ozone Events in the Houston-Galveston-Brazoria Area: Causes, Effects, and Case Studies of Central American Fires

University of Houston – Yuxuan Wang

AQRP Project Manager – Elena McDonald-Buller
TCEQ Project Liaison – Doug Boyer

Funding Amount Approved by Advisory Council: $191,366

Abstract
A significant fraction of surface ozone in Texas comes from regional background originating from outside the state. Background ozone is particularly variable over the Houston-Galveston-Brazoria (HGB) region due to its unique geographical location and meteorology. Prior analyses of the HGB background ozone have focused predominantly upon averages, not high concentration days or exceptional events. To bridge this gap, the objectives of this project are to identify high background ozone events across the HGB area over the past 16 years (2000-2015), characterize meteorological conditions and anomalous emissions that cause these events, and understand their effects on ozone exceedances. With regard to emission anomalies, the focus will be on fire events from Mexico and Central America, a large fire region globally of unique importance to Texas air quality in springtime and summer whose impact on Texas background ozone has not been quantified.

Integrated analyses of observations and modeling will be conducted to achieve the project objectives. Daily HGB background ozone estimated by researchers at the Texas Commission on Environmental Quality (TCEQ) will be used as the data source to identify high background ozone days. Different types of meteorological events which may be potentially associated with high background ozone (e.g., cold fronts and thunderstorms) or high local photochemical production (e.g., heat waves and stagnation) will be identified based on the analysis of meteorology data. The relationship between high background ozone days and the meteorological 'event days' will be characterized, e.g., in terms of their overlapping (or the lack of it), and background ozone difference between meteorological 'event days' and 'non-event days' will be evaluated. Anomalies in fire emissions leading to high background ozone will be mapped through spatiotemporal sampling of the Fire INventory from NCAR (FINN) along background trajectories of air masses affecting the HGB area prior to and during the selected high background ozone days. The GEOS-Chem global chemistry transport model, with the FINN inventory implemented, will be used to simulate a number of case studies of large Central American fires and estimate the perturbations caused by ozone precursor emissions from those fires on background ozone concentrations in Texas and the HGB area. Finally, we will develop a quantitative estimate of the effects of background ozone versus local production on ozone exceedance cases in the HGB area and the dependence of such effects on meteorology and Central America fire emissions.

Project 16-010 **STATUS: Work Plan Under Review**

MOVES-Based NOx Analyses for Urban Case Studies in Texas

Sonoma Technology, Inc. – Stephen Reid

AQRP Project Manager – Gary McGaughey
TCEQ Project Liaison – Chris Kite

Funding Amount Approved by Advisory Council: $69,075

Abstract
Emissions inventories are an important component of air quality planning and a key input to photochemical grid models that support air quality assessments. Findings from recent studies suggest that nitrogen oxides (NOx) emissions may be overestimated in the U.S. Environmental Protection Agency's (EPA) National Emissions Inventory (NEI), perhaps by as much as a factor of two. This overestimate has generally been attributed to the mobile source sector (e.g., on-road motor vehicles), for which emission estimates are prepared using EPA's MOVES model. A number of potential issues have been identified with MOVES, including reliance on the model's default input data rather than more representative local inputs.

The overall goals of this project are to examine MOVES emission estimates at the local scale and identify which input parameters have the greatest influence on NOx emission estimates. Specifically, we will use a well-established emissions reconciliation technique to quantitatively compare MOVES emission results with ambient near-road monitoring data. These analyses will be performed for case studies in three Texas metropolitan areas: Dallas-Fort Worth, Houston, and El Paso. In addition, we will perform sensitivity analyses comparing MOVES emission results using default vs. local data to identify key parameters that have substantial influence on NOx emissions. The results of this work will support emissions inventory development and air quality management efforts in Texas by providing information on the accuracy of current MOVES emission estimates and MOVES input parameters, for which local data are critical.

Project 16-011 **STATUS: Work Plan Under Review**

A Next Generation Modeling System for Estimating Texas Biogenic VOC Emissions

Ramboll Environ US Corporation – Gregory Yarwood

AQRP Project Manager – Elena McDonald-Buller
TCEQ Project Liaison – Doug Boyer

Funding Amount Approved by Advisory Council: $158,134

Abstract
The exchange of gases and aerosols between the Earth's surface and the atmosphere is an important factor in determining atmospheric composition and regional air quality. Emissions of reactive gases from the earth's surface drive the production of ozone and aerosol and other atmospheric constituents relevant for regional air quality. Emissions of some compounds, including biogenic volatile organic compounds (BVOCs), are highly variable and can vary more than an order of magnitude over spatial scales of a few kilometers and time scales of less than a day. This makes estimation of these emissions especially challenging and yet accurate quantification and simulation of these fluxes is a necessary step towards developing air pollution control strategies and for attributing observed atmospheric composition changes to their causes.

The overall goal of Project 16-011 is to improve numerical model predictions of regional ozone and aerosol distributions in Texas by reducing uncertainties associated with quantitative estimates of BVOC emissions from Texas and the surrounding region. Although there have been significant advancements in the procedures used to simulate BVOC emissions, there are still major uncertainties that affect the reliability of Texas air quality simulations. This includes significant gaps in our understanding of BVOC emissions and their implementation in numerical models including 1) isoprene emission factors, 2) missing compounds, and 3) and unrepresented processes including canopy heterogeneity and stress induced emissions. In this project, we will develop new emission factors and incorporate missing BVOC compounds and unrepresented BVOC emission processes into the Model of Emissions of Gases and Aerosols from Nature (MEGAN) framework. To accomplish this, we will develop a transparent and comprehensive approach to assigning isoprene and monoterpene emission factors and will update MEGAN to include additional BVOC and processes including stress induced emissions and canopy heterogeneity. We will evaluate MEGAN BVOC emission inventories for Texas and surrounding regions using surface and aircraft observations and a photochemical model.

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 16-019 **STATUS: Work Plan Under Review**

The Influence of Alkyl Nitrates from Anthropogenic and Biogenic Precursors on Regional Air Quality in Eastern Texas

University of Texas at Austin – Elena McDonald-Buller
Ramboll Environ US Corporation – Gregory Yarwood

AQRP Project Manager – David Sullivan
TCEQ Project Liaison – Jim Smith

Funding Amount Approved by Advisory Council: $180,642

Abstract
Mono and multifunctional alkyl nitrates (ANs) are formed from the oxidation of biogenic or anthropogenic volatile organic compound (VOC) precursors and serve as a reservoir or sink of nitrogen oxides (NO_x). Alkyl nitrates have sufficiently long atmospheric chemical lifetimes (hours to days), such that they can influence tropospheric ozone and secondary organic aerosol (SOA) formation over regional to global spatial scales. Their functionalities, yields, and fates are known to depend upon the size and structure of the VOC. Depending on their structure, ANs can be transported, chemically processed, removed by deposition to vegetation and other surfaces, or undergo partitioning to and from the aerosol phase where hydrolysis is thought to be a loss mechanism. Although knowledge gaps still exist, recent laboratory and field studies have provided new insights on these processes for ANs formed from biogenic and anthropogenic hydrocarbon precursors. An ongoing need will be to incorporate these findings into the chemical mechanisms of photochemical models used to assess regional air quality. The objectives of this work are to apply the findings of ongoing experimental studies examining alkyl nitrates formed from the OH-initiated oxidation of C8-C11 alkanes at the University of Texas at Austin in addition to those of new publications that have focused on other hydrocarbon precursor classes relevant to Texas emissions inventories to improve how ANs are represented in the version 6 of the Carbon Bond mechanism (CB6). Revision 4 of CB6 (CB6r4) will soon be available in version 6.32 of the Comprehensive Air quality Model with extensions (CAMx v6.32). Sensitivity tests with CAMx will evaluate the formation and fate of ANs in central and southeastern Texas, the influence of ANs on regional ozone by recycling NO_x, and dependencies on organic aerosol concentrations.

Project 16-024 **STATUS: Work Plan Under Review**

Improving the Modeling of Wildfire Impacts on Ozone and Particulate Matter for Texas Air Quality Planning

Atmospheric and Environmental Research, Inc. – Matthew Alvarado

AQRP Project Manager – Elena McDonald-Buller
TCEQ Project Liaison – Erik Gribbin

Funding Amount Approved by Advisory Council: $170,039

Abstract
Fires can have a large impact on ozone and particulate matter concentrations, and thus air quality, in Texas. Current air quality models (also called chemical transport models) take estimates of the primary emissions from biomass burning (such as forest and grass fires) and unphysically dilute them, which can lead to incorrect estimates of the impact of biomass burning on air quality. Smaller scale models like AER's Aerosol Simulation Program allow us to examine the chemical and physical transformations of trace gases and aerosols within biomass burning plumes and to develop new methods for accurately including this aging process in standard air quality models. In this project, we will improve our understanding of the impacts of local and out-of-state fires on air quality in Texas by implementing an improved approach for modeling the near-source chemistry of biomass burning plumes into the CAMx (Comprehensive Air Quality Model with Extensions) model used in Texas air quality planning. This improved approach will allow CAMx to better represent the impact of forest and grass fires on air pollutants such as ozone and fine particulate matter ($PM_{2.5}$). We will also investigate the impact that long-range transport of wildfire smoke has on air quality in Texas. This project thus addresses two strategic topics of the Texas Air Quality Research Program: "Improving the understanding of ozone and particulate matter (PM) formation [and] the interactions of ozone and PM precursors" and "Investigating global, international, and regional transport of pollutants using data and modeling analyses."

Project 16-031 **STATUS: Work Plan Under Review**

Condensed Chemical Mechanisms for Ozone and Particulate Matter Incorporating the Latest in Isoprene Chemistry

University of North Carolina – Chapel Hill – William Vizuete

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

Funding Amount Approved by Advisory Council: $225,000

Abstract
Isoprene, the most emitted non-methane hydrocarbon on the planet, is known to influence ozone (O_3) formation in Houston, Texas. Eastern Texas and northern Louisiana feature some of the largest biogenic emission sources of isoprene in the United States. It is also now known that the photochemical oxidation of isoprene, when mixed with anthropogenic emissions from urban areas like those found in Houston, can produce significant yields of fine particulate matter ($PM_{2.5}$) through acid-catalyzed multiphase chemistry of isoprene epoxydiols (IEPOX) that leads to secondary organic aerosol (SOA) formation. Next-generation regulatory models in Houston will attempt to capture this recent discovery even though there exists great uncertainty in both gas-phase isoprene oxidation and SOA formation chemistry. This work will produce a fully updated condensed gas-phase mechanism based on SAPRC-07 and PM formation parameters suitable for use in a regulatory air quality model. The updated parameters will be evaluated against an archive of UNC smog chamber experiments, including new isoprene SOA experiments that investigate the effect of organic coatings/mixtures on the acid-catalyzed multiphase chemistry of IEPOX.

Our previously funded Air Quality Research Program (AQRP) work has directly derived the multiphase kinetics of IEPOX only on pure inorganic aerosols. In the atmosphere, however, IEPOX will more likely encounter mixed particles containing both pre-existing organics and acidic sulfate. As a result, there is a need to constrain the impact of pre-existing organics within acidic sulfate aerosol on the kinetics of IEPOX multiphase chemistry. We will also produce a regulatory air quality modeling episode focused on Houston to test these new updates in a simulated urban environment. This work directly addresses the stated priority area of improving the understanding of O_3 and PM formation and the interaction with PM precursors. Further, the regulatory air quality modeling system developed by this work can begin to address the stated priority of quantifying the impacts of uncertainty due to the treatment of atmospheric chemical processes by condensed models.

Project 16-032 **STATUS: Work Plan Under Review**

Spatial Mapping of Ozone Formation near San Antonio

Drexel University – Ezra Wood

AQRP Project Manager – Gary McGaughey
TCEQ Project Liaison – Mark Estes

Funding Amount Approved by Advisory Council: $59,000

Abstract
Ozone (O_3) is the main component of smog and causes adverse effects on human health, especially to sensitive groups such as children and the elderly. Unlike "primary" pollutants which are emitted directly from vehicles and industrial processes, ozone is formed in the atmosphere from photochemical reactions involving volatile organic compounds (VOCs) and nitrogen oxides ("NO_x"). In order for San Antonio to comply with the new National Ambient Air Quality Standard for ozone of 70 ppb, regulators will need to make science-based decisions on effective mitigation strategies, including emission reduction programs. Such decisions will require knowledge of the amount of ozone that is transported into the city from upwind regions (usually located southeast of San Antonio), the absolute rates of ozone formation in and around San Antonio, the relative importance and interaction of emissions from various sources (e.g., upwind oil and gas activity and urban emissions from the city itself), and when and where ozone formation occurs under "NO_x-limited" or "VOC-limited" conditions. In contrast to Houston and Dallas, little is known about ozone formation in San Antonio. This research project will address this major shortcoming and elucidate the mechanisms and rates of ozone formation that affect air quality in San Antonio using novel measurements of peroxy radicals aboard a mobile supersite during a 3-week field project during late spring of 2017. Instantaneous ozone production rates $P(O_3)$ will be quantified aboard the Aerodyne Mobile Laboratory using new but tested measurements of total peroxy radicals. These measurements will be used to "map" the rate of ozone formation upwind, downwind, and inside of the urban core of San Antonio. Measurements of organic nitrates will also be used to investigate the role of alkanes and organic nitrate formation as a terminator of ozone chemistry.

The main goals of the project are to quantify how much ozone is produced inside the city compared to upwind, and to quantify the role of alkanes in ozone formation.

Project 16-039 **STATUS: Work Plan Under Review**

Use of Satellite Data to Improve Specifications of Land Surface Parameters

University of Alabama - Huntsville – Richard McNider

AQRP Project Manager – Elena McDonald-Buller
TCEQ Project Liaison – Bright Dornblaser

Funding Amount Approved by Advisory Council: $149,227

Abstract
It is the purpose of this proposal to continue a process to evaluate and improve the performance of the land surface models used in WRF by the use of satellite skin temperatures to better specify physical parameters associated with land use classes. Improved temperature performance impacts biogenic emissions, thermal decomposition (chemical chain lengths and slopes of ozone/NOy curves) and thermally driven winds. Also, land surface parameters control surface deposition which impacts the efficacy of long-range transport. Physical parameters such as heat capacity, thermal resistance, roughness, surface moisture availability, albedo etc. associated with a land use class are actually used in the land surface model. Many of the land use class associated parameters such as surface moisture availability are dynamic and ill-observed depending on antecedent precipitation and evaporation, soil transport, the phenological state of the vegetation, irrigation applications etc. Other parameters such as heat capacity, thermal resistance or deep soil temperature are not only difficult to observe they are often unknowable *a priori*. Despite the difficulty in specifying these parameters they are incredibly important to model predictions of turbulence, temperature, boundary layer heights and winds.

This proposal is directed toward the Meteorology and Air Quality Modeling and Biogenic Emissions Priority. Biogenic emissions are highly sensitive to temperature. Improvement in temperature predictions in conjunction with improved radiation inputs into biogenic emission model (MEGAN or BEIS) should increase the quality of biogenic emissions. The proposal is responsive to three areas in the Meteorology and Air Quality Modeling Priority- (1) boundary layer performance can impact local circulations driven by thermal gradients and the strength of low level jets is controlled by nighttime surface cooling rates; (2) boundary layers can impact clouds both boundary layer topped cumulus and clouds in sea breeze convergence zones; (3) dry deposition of ozone and nitrogen species is often controlled by stomatal uptake which depends on soil moisture.

The proposal will continue and expand activities under a 2015 funded AQRP project using satellite observed skin temperatures. That project was a late selected reduced scope project. Despite some initial issues with a NOAA skin temperature data set, the project ended up showing improvement in model performance for skin temperatures and in wind performance. However, the improvements were not as large as in previous uses of skin temperature data. Part of this may be due to following the Pleim-Xiu air temperature approach in the project, in which absolute differences between model and observed skin temperatures were used rather than skin temperature tendencies. Differences between the model and satellite skin temperatures not related to the boundary layer parameters such as emissivity or atmospheric correction in the satellite product might be an issue. Under this proposed activity skin temperature tendencies will

be tested instead which avoids such problems. The DISCOVER AQ period of 2013 was an unusually cloudy and windy period over most of the Eastern U.S. and not characteristic of the conditions usually associated with ozone episodes in Texas. While significant effort went into QA for the skin temperature data set, cloud contamination in the skin temperatures may still be an issue. Under the proposed activity alternative skin temperature products such as MODIS data will used in conjunction with the tendency method that may reduce cloud contamination issues. Also, in consultation with TCEQ additional periods such as TEXAQS 2006 or the 2012 SIP period will be examined. Finally, the work on the previous project included emphasis on the large 12-km domain. Under, this proposed activity a greater emphasis will be given to fine scale model performance around Houston and Dallas. Particular attention will be given to wind changes due to changes in boundary layer parameters including changes in sea breezes and low level jets.

Project 16-053 **STATUS: Work Plan Under Review**

Identifying and Apportioning Ozone Producing VOCs in Central American Fires

Aerodyne Research, Inc. – Scott Herndon

AQRP Project Manager – Gary McGaughey
TCEQ Project Liaison – Mark Estes

Funding Amount Approved by Advisory Council: $185,193

Abstract
Aerodyne Research, Inc. will conduct measurements using a mobile laboratory as a portable photochemistry super site to study ozone production and the emission sources that ultimately impact air quality in central Texas. We envision working at locations upwind, downwind and lateral to San Antonio. The suite of instrumentation has been selected to quantify key oxygenated volatile organic carbon species (OVOC) and nitrogen containing species (e.g. alkyl nitrates) to pinpoint and apportion ozone within broad categories of VOC emission sectors. The instrument payload will also directly quantify the instantaneous production rate of ozone to determine whether the chemical regime is NOx limited or VOC limited. An additional component of this research project will be to characterize emission sources associated with oil and natural gas production in the Eagle Ford Shale play, including active medium to large processing flares, as well as oil and condensate tanks at wellpads.

The project will provide scientific insight into the VOCs that are contributing to the ozone in central Texas. The effectiveness of mitigation strategies will be informed by these results. This work will isolate ozone production due to VOC oxidation from biogenic sources, refinery emissions, emissions from oil producing well pads and emissions from natural gas production. The dataset will inherently contain regional transport of emissions and processed air. The project will quantify local ozone production rates and evaluate the ozone sensitivity regime.

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. 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. James Thomas, AQRP Manager, was responsible, through the project review period, for assisting Dr. Allen in the program administration. Maria Stanzione, AQRP Program Manager, with Rachael Bushn, Melanie Allbritton, and Susan McCoy each provided assistance with program organization and financial management. Denzil Smith is responsible for the AQRP Web Page development and for data management, with Gina Palacios providing assistance as needed.

Fringe benefits for the administration of the AQRP were initially budgeted to be 24% of salaries and wages across the term of the project. It should be noted that this was an estimate, and actual fringe benefit expenses are reported for each month. The fringe benefit amount and percentage fluctuate each month depending on the individuals being paid from the account, their salary, their FTE percentage, the selected benefit package, and other variables. For example, the amount of fringe benefits is greater for a person with family medical insurance versus a person with individual medical insurance. Actual fringe benefit expenses to date are included in the spreadsheets below.

Table 3: Administration Budget

Administration Budget (includes Council Expenses)
FY 2016/2017

Budget Category		FY16 Budget	FY17 Budget	Total	Expenses	Remaining Balance
Personnel/Salary		$70,040.00	$70,040.00	$140,080.00	$47,226.28	$92,853.72
Fringe Benefits		$16,806.00	$16,806.00	$33,612.00	$10,802.68	$22,809.32
Travel		$150.00	$150.00	$300.00	$0.00	$300.00
Supplies		$6,000.00	$6,000.00	$12,000.00	$11.78	$11,988.22
Equipment						
Total Direct Costs		$92,996.00	$92,996.00	$185,992.00	$58,040.74	$127,951.26
Authorized Indirect Costs		$7,004.00	$7,004.00	$14,008.00	$4,722.63	$9,285.37
10% of Salaries and Wages						
Total Costs		**$100,000.00**	**$100,000.00**	**$200,000.00**	**$62,763.37**	**$137,236.63**

ITAC

Travel and meeting expenses have been paid for the ITAC members who attended the ITAC meeting held in Austin, Texas on May 12 and 13, 2016.

Table 4: ITAC Budget

ITAC Budget
FY 2016/2017

Budget Category		FY16 Budget	FY17 Budget	Total	Expenses	Remaining Balance
Personnel/Salary						
Fringe Benefits						
Travel		$10,000.00	$10,000.00	$20,000.00	$4,076.57	$15,923.43
Supplies		$5,000.00	$5,000.00	$10,000.00	$1,079.20	$8,920.80
Equipment						
Total Direct Costs		$15,000.00	$15,000.00	$30,000.00	$5,155.77	$24,844.23
Authorized Indirect Costs						
10% of Salaries and Wages						
Total Costs		**$15,000.00**	**$15,000.00**	**$30,000.00**	**$5,155.77**	**$24,844.23**

Project Management

Project Managers held kick-off calls for each project selected for funding and are currently working with project investigators to develop the project Work Plans (Scope, Budget, and QAPP).

Table 5: Project Management Budget

Project Management Budget
FY 2016/2017

Budget Category		FY16 Budget	FY17 Budget	Total	Expenses	Remaining Balance
Personnel/Salary		$44,000.00	$44,000.00	$88,000.00	$14,087.25	$73,912.75
Fringe Benefits		$10,600.00	$10,600.00	$21,200.00	$3,080.11	$18,119.89
Travel		$500.00	$500.00	$1,000.00	$0.00	$1,000.00
Supplies		$5,500.00	$5,500.00	$11,000.00	$0.00	$11,000.00
Other		$5,000.00	$5,000.00	$10,000.00	$0.00	$10,000.00
Total Direct Costs		$65,600.00	$65,600.00	$131,200.00	$17,167.36	$114,032.64
Authorized Indirect Costs		$4,400.00	$4,400.00	$8,800.00	$1,408.73	$7,391.27
10% of Salaries and Wages						
Total Costs		**$70,000.00**	**$70,000.00**	**$140,000.00**	**$18,576.09**	**$121,423.91**

Research Projects

A total of $1,630,000.00 is available for research projects. A total of ten (10) projects were selected for funding out of fifty four (54) proposals submitted to the AQRP RFP for the 2016-2017 biennium. It is anticipated that $1,593,176.00 will be allocated to the 2016-2017 projects, pending final approval of project budgets. As of August 31, 2016, none of the projects were active and no research project funds were expended.