Quality Assurance Project Plan

Project 14-017
Incorporating Space-borne Observations to Improve Biogenic Emission Estimates in Texas

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Summary of Project

QAPP Category Number: III
Type of Project: Secondary Data Project and Research or Development (Modeling)

QAPP Requirements: This QAPP includes descriptions of the project and objectives; organization and responsibilities; scientific approach; modeling procedures; quality metrics; data analysis, interpretation, and management; reporting; and references.

QAPP Requirements:
Audits of Data Quality: 10% Required
Report of QA Findings: Required in final report

May 29, 2014

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List of Acronyms

AQRP	Texas Air Quality Research Program
BDSNP	Berkeley-Dalhousie Soil NOx Parameterization
BVOC	Biogenic Volatile Organic Compound
CAMx	Comprehensive Air Quality Model with Extensions
CMAQ	Community Multi-Scale Air Quality model
DISCOVER-AQ	Deriving Information on Surface Conditions from Column and Vertically Resolved Observations Relevant to Air Quality.
GOES	Geostationary Operational Environmental Satellite
GPGS	GOES Product Generation System
IR	Infrared
LU/LC	Land Use/Land Cover
MEGAN	Model of Emissions of Gases and Aerosols from Nature
MPI	Message Passing Interface
MSFC	Marshall Space Flight Center
NASA	National Aeronautics and Space Administration
NO	Nitrogen monoxide
NO_2	Nitrogen dioxide
NO_x	Nitrogen Oxides (NO+NO2)
PAR	Photosynthetically Active Radiation
PI	Principal Investigator
PM	Particulate Matter
SMOKE	Sparse Matrix Operator Kernel Emissions model
TCEQ	Texas Commission on Environmental Quality
UC	University of California
UC-Berkley	University of California-Berkeley
UMD	University of Maryland
WRF	Weather Research and Forecasting (WRF) model
USCRN	U.S. Climate Reference Network
SURFRAD	Surface Radiation Network

1 PROJECT DESCRIPTION AND OBJECTIVES

1.1 Introduction

One of the challenges in understanding the Texas air quality has been the uncertainties in estimating the biogenic hydrocarbon emissions (Allen et al., AQRP State of the Science 2012 report). Biogenic volatile organic compounds (BVOCs) play a critical role in atmospheric chemistry, particularly in ozone and particulate matter (PM) formation. In southeast Texas, BVOCs (mostly as isoprene) are the dominant summertime source of reactive hydrocarbon (Wiedinmyer et al., 2001). Despite significant efforts by the State of Texas in improving BVOC estimates, the errors in emissions inventories remain a concern. This is partly due to the diversity of the land use/land cover (LU/LC) over southeast Texas coupled with a complex weather pattern (Song et al., 2008), and partly due to the fact that isoprene is highly reactive and relating atmospheric observations of isoprene to the emissions source (vegetation) relies on many meteorological factors that control the emission, chemistry, and atmospheric transport.

BVOC estimates depend on LU/LC, the amount of radiation reaching the canopy (Photosynthetically Active Radiation, PAR), and temperature. There have been many efforts in developing high resolution LU/LC data sets to better represent the diversity of vegetation over the State of Texas (Wiedinmyer et al., 2001; Byun et al., 2005). However, the treatment of temperature and PAR is not uniform across emission models and still poses a problem when evaluating the inventories. Guenther et al., 2012, argue that the largest uncertainty comes from the model solar radiation estimates and that using satellite-based PAR would be preferable.

Warneke et al., 2010, compared several BVOC emission models and showed that they agree within a factor of two. This was partly due to the differences in estimating the impact of light and temperature on emissions. Among the models used in their study, MEGAN (Model of Emissions of Gases and Aerosols from Nature) (Guenther *et al.*, 2006) produced higher estimates compared to measurements. Indirect evaluations of MEGAN by using satellite observation of formaldehyde also indicated that MEGAN over-estimates isoprene emissions (Palmer et al., 2006; Miller et al., 2008). But contrary to the above findings, a model study by Muller et al., 2008, showed that MEGAN under-estimated isoprene flux over Harvard forest site. Karl et al., 2007, also found MEGAN under-predicting isoprene flux when compared to the flux estimates derived from aircraft measurements.

This goes to show the difficulty of evaluating the estimated inventory. This difficulty is mostly due to the high reactivity of isoprene and the need to have a reasonable representation of the physical atmosphere when comparing modeled concentrations of isoprene (or related compounds) to the observations. The emission model estimate of isoprene is highly dependent on providing the correct PAR and temperature. But, relating the observed isoprene concentration (or derived flux) to the emissions inventory also depends on the atmospheric conditions that are regulated by radiation and temperature. The work proposed here is an attempt to improve emission estimates by using geostationary satellite observations to retrieve PAR for direct use in the biogenic emissions model. UAH also will perform a set of meteorological simulations using the Weather Research and Forecasting (WRF) Model to test the sensitivity of biogenic emissions to improved meteorological inputs. WRF simulations will take advantage of improved cloud simulation by applying a technique developed at UAH under a previous Texas Commission on Environmental Quality (TCEQ) funded project. The technique uses the Geostationary

Operational Environmental Satellite (GOES) cloud observations to dynamically correct cloud fields in WRF.

Emissions from soils also remain one of the most poorly quantified sources of NO_x (nitrogen oxides) in most air quality models. Soils can be the largest source of NO_x in rural regions where low-NO_x conditions make ozone production efficiency especially high, contributing to background ozone levels. A new soil NO_x scheme has been developed by University of California-Berkeley and Dalhousie University (Hudman *et al.*, 2012), which provides more mechanistic representation of how emissions respond to nitrogen deposition, fertilizer application, and changing meteorology. Previous studies (Hudman *et al.*, 2010; Hudman *et al.*, 2012) have shown the new scheme to more than double soil NO_x emission estimates in many regions and to greatly increase their episodic and interannual variability. We will be using this model for soil NO estimates in the current study.

1.2 Purpose of Study

The purpose of this activity is to advance our understanding of Texas Air Quality by utilizing satellite observations and the new advances in biogenic emissions modeling to improve biogenic emission estimates. In particular, University of Alabama in Huntsville (UAH) will be producing satellite-based Photosynthetically Active Radiation (PAR) for the Texas Discover-Air Quality (AQ) study period. The work also employs a new soil NO (nitrogen monoxide) emissions scheme. This work specifically addresses a priority area in Texas AQ studies by improving biogenic emission estimates. The project also contributes to several other priority areas as the improvements in radiation field not only impacts the biogenic emissions, it also improves the overall photochemical simulation and leads to better understanding of ozone and particulate matter (PM) formation.

1.3 Project Objectives

There are two principal objectives for this project:

(1) To provide satellite-based PAR estimates for Texas Discover-AQ period (September, 2013).

(2) To produce an improved biogenic emissions estimate for Texas and to help in the evaluation of biogenic emission inventories over Texas by providing the best model representation of the atmospheric condition during the observations used for evaluation.

2 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 Responsibilities of Project Participants

The University of Alabama-Huntsville (UAH) in collaboration with the Rice University will conduct this study under a grant from the Texas Air Quality Research Program (AQRP). UAH will be providing and evaluating satellite-based PAR while the Rice University will be providing/evaluating emission estimates utilizing UAH products. The key personnel working on this project and their specific responsibilities are listed below.

UAH currently generates a set of products from GOES that includes surface incident short-wave radiation as well as cloud albedo and cloud top temperature. Under the current activity, UAH will produce the PAR needed in the estimation of biogenic hydrocarbon emissions. Satellite-derived PAR will be evaluated against previous satellite-based products for the summer of 2006 as well as surface observations during 2013 Texas Discover-AQ campaign. Furthermore, the new PAR retrievals will be used in MEGAN to generate BVOC emissions. We will also implement Berkeley-Dalhousie Soil NOx Parameterization (BDSNP) within MEGAN. BDSNP provides a more mechanistic representation of how emissions respond to nitrogen deposition, fertilizer application, and changing meteorology. A series of sensitivity simulations will be performed and evaluated against Discover-AQ observations to test the impact of satellite-derived PAR and the new soil NOx emission model on emission estimates.

Dr. Pour-Biazar from UAH will be leading this project and will be responsible for coordinating all aspects of the work. Dr. McNider will help in data analysis and model evaluation. They will be assisted by a research associate and a graduate research assistant who will be helping the team in data preparation and model simulations. Dr. Cohan will be responsible for coordinating the work performed at Rice University. He will be responsible for incorporating BDSNP in MEGAN and performing emissions modeling and sensitivity calculations for biogenic emissions.

Table 1. Key project participants and their responsibilities.

Participant	Organization	Project Responsibility
Arastoo Pour Biazar	UAH	Project manager, generating satellite-based PAR, performing WRF simulations, coordinating different activities.
Richard T. McNider	UAH	Advise on the overall direction of the project.
Dan Cohen	Rice University	Biogenic emission estimates

In addition, we will be working closely with AQRP scientists and TCEQ staff to ensure the successful transition of data, models, and tools for their regulatory activities. TCEQ staff will participate in the review of the technical documentation generated during this project. TCEQ staff will also receive remote training on the use of satellite-based PAR estimates..

2.2 Project Schedule

The project is divided into three major tasks: (1) Generation and evaluation of satellite-based PAR for August 2006 and September 2013; (2) Improved biogenic emission estimates using satellite-based products in an offline version of MEGAN for the same periods; and (3) To examine the impact of different meteorological inputs on emission estimates and inventory evaluation (also for the same periods). The table below shows the overall schedule for completion of major tasks in this project including interim milestones. A more detailed schedule for deliverables, including responsibilities and timeline for interim reports is presented in section 8 under “Project Deliverables” sub-section.

Table 2. Summary of project schedule and milestones.

Deliverable	Deliverable Due Date
Generation and evaluation of satellite-based PAR.	October 31, 2014
Improved emission estimates.	November 30, 2014
Impact of meteorological inputs	March 31, 2015
Final report, delivering metadata and data files	June 30, 2015

3 FUNCTIONAL REQUIREMENTS

3.1 Required Functions

The functional requirements of the new satellite-based PAR and biogenic emission estimates are:

- To accept a set of currently retrieved GOES satellite products from UAH archives (http://satdas.nsstc.nasa.gov/) such as surface insolation and cloud albedo (UAH);
- Develop parameterizations to derive PAR from satellite observations (UAH);
- Evaluation of satellite-derived PAR against University of Maryland (UMD) products for August 2006 (UAH);
- Evaluation of satellite-derived PAR against surface observations during Texas Discover-AQ campaign (September 2013) (UAH);
- Implementation of BDSNP within MEGAN biogenic emission model (Rice University);
- Ingestion of satellite-derived PAR in MEGAN (Rice University);
- Performing WRF simulations (UAH);
- Producing emission estimates for different input parameters for Discover-AQ period (Rice University);
- Evaluation of emissions (UAH/Rice University);
- Model evaluation (UAH/Rice University).

3.2 Functionality, Interfacing, Performance, and Constraints

To remain consistent with MEGAN/WRF/CAMx (Comprehensive Air Quality Model with Extensions) code, all the codes will be written in the Fortran90 standard with extensions compatible with today's most widely used FORTRAN compiler in WRF user's community (i.e., Portland Group for Linux operating systems). Since this project comprises many complex components and functionalities, it is not possible to have the entire code contained in a single module. Shell scripts will be written to manage the processes, manage the flow of the data, and perform the calculations properly. The scripts for each major component will be constructed in a way that a single script will serve as the main script that manages the overall performance of the system, so that the users do not have to deal with multiple parts of the code separately. The codes and scripts will adhere to the MEGAN/WRF/CAMx coding/format style, including the use of appropriate in-code documentation (comment statements), loop indentation, and memory management techniques. The requirement for memory should be minimized. All variables will be type-declared using the FORTRAN "implicit none" statement at the top of each routine.

The PAR retrieval code will be designed as a stand-alone system that uses GOES raw observations and retrieved parameters. Biogenic emission estimates use MEGAN that is a well established and documented community model. The model will be modified to accept BDSNP. Minor modifications will allow MEGAN to accept satellite PAR as input (to replace model input). MEGAN will be used to generate biogenic emission estimates with different inputs. These estimates will be provided to the AQRP and TCEQ scientists to be used in CAMx simulations.

3.3 Hardware and Operating System Requirements

We expect to run all codes and scripts on a multi-core Linux cluster and supporting MPI (message Passing Interface) parallel processing directives. Model code will be compiled using Portland Group compiler for 64-bit architecture.

4 SYSTEM DESIGN

4.1 System Overview

PAR retrieval system will be constructed as a stand-alone system that will interact with the observational system through external files containing data and instructions. Currently, UAH collaborates with the Infrared (IR) group at the National Aeronautics and Space Administration (NASA) at Marshall Space Flight Center (MSFC) to generate and archive several GOES derived products. The retrieval system, GOES Product Generation System (GPGS), provides routine near real-time retrievals of skin temperature, total precipitable water, cloud top temperature/pressure, cloud albedo, surface albedo and surface insolation to be used in the meteorological and air quality models (Haines et al., 2003). Our PAR retrieval system will be designed around the current GPGS to ensure its integration within the system when finalized.

Our first attempt will use the proposed parameterization for PAR retrieval within a stand-alone code that interacts with GPGS through external files. During the evaluation phase of this project, some adjustments to the parameterization might be necessary. The first phase of evaluations will cover August 2006. For these evaluations UAH PAR product will be compared to the UMD products for the same period. After a satisfactory result from PAR evaluation, the PAR retrieval system will be integrated with GPGS. In the second phase of evaluation, UAH will be generating satellite-based PAR for September 2013 and will be evaluating them against surface observations. The final products will be used in MEGAN for biogenic emission estimates.

MEGAN will be modified to accept the satellite-based PAR retrievals. Furthermore, modifications to MEGAN will allow the use of BDSNP for soil NOx estimates. MEGAN will be used as an offline model to generate emissions under different atmospheric conditions and inputs. MEGAN will take meteorological inputs from the same WRF simulation that drives the CAMx run; satellite-based PAR data as an alternate input to test; and land use/land cover data from a source to be determined in consultation with TCEQ. In addition, MEGAN will also be tested with alternate meteorological inputs from UAH simulations. The resulting emissions will be provided to TCEQ and AQRP to be used in WRF/CAMx simulations. The modifications to MEGAN will follow standard development protocols used in the SMOKE (Sparse Matrix Operator Kernel Emissions model) and will be consistent with standard MEGAN code structure.

More information on the system constructs is provided in Section 3.2.

4.2 Component Description

Detailed information on the component description is provided in Section 3.2. Specific details about satellite PAR generation and MEGAN modifications will be provided in the final report.

4.3 Rationale for Selected Software/Hardware Tools

The software and hardware selected for this project are consistent with the current WRF/SMOKE/CAMx programming code, compilers and platforms used to develop, build and run these models, respectively. This will ensure compatibility with TCEQ's current computer system.

5 IMPLEMENTATION

5.1 Software System Development

We expect to develop the PAR retrieval system as a stand-alone code compatible with GPGS. Modifications to MEGAN will adhere to the current code structure. We will be making as little modifications as possible in MEGAN to be able to work within the constructs of the WRF/SMOKE/CAMx code. This will help to ensure that the modified system is used with as little manipulation as possible. All modifications within MEGAN will be well documented in the code and will be included in the final report.

The test bed will be based on the current MEGAN code, with additions for a user interface to allow user-defined choices such as satellite-based PAR option and subsequent control flags.

5.2 Verification and Validation

Functionality, interfacing, performance and design constraints for the new satellite-based PAR and MEGAN model will be verified mainly through the use of the test-bed program. Good Fortran coding practices (e.g., use of explicit type declarations) and Fortran compile-time checks will be employed to confirm that routine interfacing is working properly. Functionality, performance, and design constraints will be verified by applying the test-bed program to a case study. A simulation by modified MEGAN code in which no satellite data is used will be compared to the baseline MEGAN estimates to ensure consistent responses.

The initial satellite-based PAR estimates for August 2006 will be evaluated against the UMD products for the same period. Both UAH and UMD products for this period will be compared to surface observations from the U.S. Climate Reference Network (USCRN) for insolation evaluation and the Surface Radiation (SURFRAD) network to evaluate PAR. After a satisfactory result from PAR evaluation for this period, satellite-based PAR for September 2013 will be generated and evaluated against observations during Discover-AQ campaign. The evaluations will be based on standard statistical metrics such as error statistics and regression analysis with a focus on east/southeast Texas. In addition to the overall statistics, the spatial and temporal variability of error statistics will be examined to remove systematic bias if any. The final products will be used in MEGAN for biogenic emission estimates.

MEGAN functionality, performance, and design will be verified by applying the modified model to a case study for the summer of 2006 as well as September 2013 Texas Discover-AQ period. The resulting emission estimates will be evaluated independently and will be provided to AQRP and TCEQ scientists to be used in CAMx simulations for the September 2013 Discover-AQ field campaign. Previous studies have shown that east Texas is the dominant region of the state for biogenic VOC emissions, but the spatial distribution of east Texas BVOC emission estimates has varied widely across studies and even within studies as assumptions of land use/land cover and other conditions are varied (see, for example, Figure 6 of Gulden and Yang, Atmos. Envt 2006, at http://www.geo.utexas.edu/climate/Research/Reprints/GuldenYang.pdf). Comparisons will be made based on the emissions rate per unit surface area (for example, in ug C per m2 per hour). We will quantify both how the magnitudes of emissions rates vary with different assumptions in the MEGAN biogenic model, and also how temporal and spatial heterogeneity depend on those assumptions. In this project, the improved emissions estimates will be tested for the summers of 2006 and 2013.

5.3 Release and Delivery Management

The testing described in Section 5.2 above will encompass “alpha” testing of the new satellite-based PAR and MEGAN model. Once the system is verified to be working correctly, the revised MEGAN model code and the satellite data will be transferred to TCEQ for installation on their computer system. TCEQ will commence “beta” testing using one of their current ozone modeling applications. Any problems or issues will be reported back to the project team, who will promptly address them and provide a revised version to TCEQ for further testing if warranted. It should be noted, however, that this will be the first attempt at the implementation of such a system. TCEQ’s feedback together with the lessons learned during the evaluation of the system will be used to compile a list of recommendations for improving the system for operational use.

5.4 Version Control, Documentation, Archival

The satellite-based retrieval system is a new attempt and the final satisfactory outcome will be offered as version 1. For biogenic emissions, the latest MEGAN model as of May 2014 (MEGAN_v2.1) will be used in this project. All codes and modifications will use standard FORTRAN. Additional code checks will be applied to ensure that standard FORTRAN techniques are used throughout all model routines. The core model and all Probing Tools (if applicable) will be run in a systematic series of tests to ensure that all systems are working correctly. The new system and the modifications to MEGAN will be documented and communicated to AQRP and TCEQ.

All the source codes (including MEGAN) and documentations from this project will be compressed into a single Linux “tar” archive file and will be backed up at UAH and shared with AQRP and TCEQ.

5.5 Archiving Software

MEGAN source code and related tools will be compiled into a single Linux compressed tar file and archived as described in Section 5.4.

5.6 Audits of Data Quality

All data generated from this project or used in the evaluation work will undergo a rigorous data quality check to remove the outliers. Both USCRN and SURFRAD networks have an established quality control process. At each stage of the project, the data (both generated and used in the evaluation) along with a metadata will be released to AQRP and TCEQ. In the final stage of the project, a metadata describing the data files, along with a document describing the data quality will be compiled. The document, metadata, and the data files will be delivered to AQRP and TCEQ as part of the final report.

6 VALIDATION, VERIFICATION, AND TESTING

6.1 Testing Strategy

The testing strategy is presented in Section 5.2.

6.2 Checking Correctness of Outputs

The approach to checking correctness of outputs is described in Section 5.2.

6.3 Determining Conformance to Requirements

The Principal Investigator (PI) and his team will review all testing configurations, applications, and results from the stand-alone PAR retrieval system and the modified MEGAN model for the summers of 2006 and 2013. Results of all tests will be documented and submitted to AQRP and TCEQ as one of the deliverables in this project.

TCEQ modeling staff will also play a role in this quality assurance step through their “beta” testing of the revised MEGAN model. TCEQ staff will report back to the project team on any problems, unexpected results, or confirmation of appropriate outcomes from the use of the alternative PAR estimates.

7 DOCUMENTATION, MAINTENANCE, AND USER SUPPORT

7.1 Project Documentation Requirements

The project documentation requirements are listed in Section 2, Table 2. The required documentation includes this QAPP and the documentation listed in Table 2.

7.2 Maintenance and User Support

Code maintenance is detailed in Section 5.4. The Model of Emissions of Gases and Aerosols from Nature (MEGAN) (http://www.lar.wsu.edu/megan/guides.html) is a global emission model for estimating the net emission of gases and aerosols from terrestrial ecosystems into the atmosphere (Guenther et al., 2006, Sakulyanontvittaya et al. 2008, Millet et al. 2010, Stavrakou et al. 2011). MEGAN is designed for both global and regional emissions modeling and has global coverage with 1 km^2 or less spatial resolution. It can be also run at user defined spatial resolution. MEGAN is a semi-mechanistic model that accounts for the major known processes controlling biogenic emissions. MEGAN estimates only emissions of known compounds and includes additional compounds whenever they are identified as being of potential interest for the atmosphere. Emissions of 150 chemical species are included in MEGANv2.1 and the model can output individual compounds or categories associated with various atmospheric chemistry schemes. The MEGAN code and input files are available at no cost. User's Guides, models and input files can be obtained from http://www.lar.wsu.edu/megan/guides.html.

MEGAN is well documented and undergoes rigorous testing in each release. MEGAN has the flexibility of being used with different chemical mechanisms and have been used as the biogenic emission model in many air quality models. MEGAN enjoys a large user community and because of that bugs are reported, fixed, and communicated to the user community through the central website. It is anticipated that our modifications to MEGAN will be made available to the public through eventual inclusion in the official MEGAN model.

The MEGAN code modifications will conform to MEGAN code structure and will be thoroughly documented. The project team will archive all the source codes, scripts, and documentations for modified MEGAN and satellite PAR retrievals using Linux "tar" command. A backup will be kept at UAH and AQRP/TCEQ will be provided with a copy.

TCEQ staff may contact the project team directly for user support. Contact information is listed below:

- Arastoo Pour Biazar: **biazar@nsstc.uah.edu**, 256/961-7970.
- Dan Cohan : **cohan@rice.edu**, 713/348-5129.

7.3 Methods and Maintanance Facilities

The methods and facilities used to maintain, store, secure, and document code versions and related items are described in Sections 5.4, 5.5, and 7.2.

8 REPORTING

8.1 Project Deliverables

The project software deliverable will include a new version of MEGAN that includes BDSNP and satellite PAR input options. The documentation and training deliverables are described in Section 7.1. The schedule for major deliverables is presented in Section 2, Table 2. Here we present a detailed schedule of specific tasks and associated interim reports.

AQRP requires certain reports to be submitted on a timely basis and at regular intervals. A description of the specific reports to be submitted and their due dates are outlined below. UAH will be responsible for submitting the reports for this project (as a collaborator, Rice University will not submit separate reports). However, both UAH and Rice University will submit the Financial Status Reports (FSRs). The lead PI (Dr. Pour-Biazar) will submit the reports, unless that responsibility is otherwise delegated with the approval of the Project Manager. All reports will be written in third person and will follow the State of Texas accessibility requirements as set forth by the Texas State Department of Information Resources. Report templates and accessibility guidelines found on the AQRP website at http://aqrp.ceer.utexas.edu/ will be followed.

8.1.1 Executive Summary

At the beginning of the project, an Executive Summary will be submitted to the Project Manager for use on the AQRP website. The Executive Summary will provide a brief description of the planned project activities, and will be written for a non-technical audience.
Due Date: Friday, May 30, 2014

8.1.2 Quarterly Reports

The Quarterly Report will provide a summary of the project status for each reporting period. It will be submitted to the Project Manager as a Word doc file. It will not exceed 2 pages and will be text only. No cover page is required. This document will be inserted into an AQRP compiled report to the TCEQ.

Due Dates:

Report	Period Covered	Due Date
Quarterly Report #1	June, July, August 2014	Friday, August 30, 2014
Quarterly Report #2	September, October, November 2014	Monday, December 1, 2014
Quarterly Report #3	December 2015, January & February 2015	Friday, February 27, 2015
Quarterly Report #4	March, April, May 2015	Friday, May 29, 2015

8.1.3 Technical Reports

Technical Reports will be submitted monthly to the Project Manager and TCEQ Liaison as a Word doc using the AQRP FY14-15 MTR Template found on the AQRP website.

Due Dates:

Report	Period Covered	Due Date
Technical Report #1	Project Start - August 31, 2014	Monday, September 8, 2014
Technical Report #2	September 1 - 30, 2014	Wednesday, October 8, 2014
Technical Report #3	October 1 - 31, 2014	Monday, November 10, 2014
Technical Report #4	November 1 - 30 2014	Monday, December 8, 2014
Technical Report #5	December 1 - 31, 2014	Thursday, January 8, 2015
Technical Report #6	January 1 - 31, 2015	Monday, February 9, 2015
Technical Report #7	February 1 - 28, 2015	Monday, March 9, 2015
Technical Report #8	March 1 - 31, 2015	Wednesday, April 8, 2015
Technical Report #9	April 1 - 28, 2015	Friday, May 8, 2015
Technical Report #10	May 1 - 31, 2015	Monday, June 8, 2015

8.1.4 Financial Status Reports

Financial Status Reports will be submitted monthly to the AQRP Grant Manager (Maria Stanzione) by each institution on the project using the AQRP FY14-15 FSR Template found on the AQRP website.

Due Dates:

Report	Period Covered	Due Date
FSR #1	Project Start – August 31, 2014	Monday, September 15, 2014
FSR #2	September 1 - 30, 2014	Wednesday, October 15, 2014
FSR #3	October 1 - 31, 2014	Monday, November 17, 2014
FSR #4	November 1 - 30 2014	Monday, December 15, 2014
FSR #5	December 1 - 31, 2014	Thursday, January 15, 2015
FSR #6	January 1 - 31, 2015	Monday, February 16, 2015
FSR #7	February 1 - 28, 2015	Monday, March 16, 2015
FSR #8	March 1 - 31, 2015	Wednesday, April 15, 2015
FSR #9	April 1 - 28, 2015	Friday, May 15, 2015
FSR #10	May 1 - 31, 2015	Monday, June 15, 2015
FSR #11	June 1 - 30, 2015	Wednesday, July 15, 2015
FSR #12	Final FSR	Wednesday, August 15, 2015

8.1.5 Draft Final Report

A Draft Final Report will be submitted to the Project Manager and the TCEQ Liaison. It will include an Executive Summary. It will be written in third person and will follow the State of Texas accessibility requirements as set forth by the Texas State Department of Information Resources.

A document describing the data generated from this project and detailing the quality of the data will be provided in the final report. A metadata describing the data files will also be provided separately.
Due Date: Monday, May 18, 2015

8.1.6 Final Report
A Final Report incorporating comments from the AQRP and TCEQ review of the Draft Final Report will be submitted to the Project Manager and the TCEQ Liaison. It will be written in third person and will follow the State of Texas accessibility requirements as set forth by the Texas State Department of Information Resources.

The model, scripts, and tools developed under this project along with the data generated in this project will be delivered to AQRP and TCEQ.
Due Date: Tuesday, June 30, 2015

8.1.7 Project Data
All project data including but not limited to QA/QC measurement data, databases, modeling inputs and outputs, etc., will be submitted to the AQRP Project Manager within 30 days of project completion. The data will be submitted in a format that will allow AQRP or TCEQ or other outside parties to utilize the information.

The model, scripts, and tools developed under this project will also be delivered to AQRP and TCEQ. A document describing the data generated from this project and verifying the quality of the data will be provided in the final report. A metadata describing the data files will be provided separately. UAH will archive and maintain a copy of all the documents and data delivered to the AQRP as part of the final deliverable. The archive will be stored at UAH and will be maintained for at least three years.

8.1.8 AQRP Workshop
A representative from the project will present the findings of this project at the AQRP Workshop in June 2015.

References

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