AQRP Monthly Technical Report

PROJECT TITLE	Detecting events and seasonal trends in biomass burning plumes using black and brown carbon: (BC)2 El Paso	**PROJECT #**	18-031
PROJECT PARTICIPANTS	Rebecca J. Sheesley (Baylor) Sascha Usenko (Baylor) James Flynn (UH)	**DATE SUBMITTED**	April 8, 2019
REPORTING PERIOD	**From:** March 1, 2019 **To:** March 31, 2019	**REPORT #**	5

A Financial Status Report (FSR) and Invoice will be submitted separately from each of the Project Participants reflecting charges for this Reporting Period. I understand that the FSR and Invoice are due to the AQRP by the 15th of the month following the reporting period shown above.

Detailed Accomplishments by Task

Travel to and site preparation of the BC^2 El Paso site

- Travel to and site preparation of the air monitoring site located on the University of Texas El Paso (UTEP) campus adjacent to TCEQ. The research team drove the Baylor Air Quality Trailer to El Paso for deployment. The research team was on site for four days (March 18 -22).
    - Prior to traveling to El Paso, the research team prepared the trail, instrumentation, and supplies for transport.
    - Drove the trailer to El Paso from Waco.
    - Help oversee addition site setup including security fencing and power upgrades.
    - Placed the trailer at designated pad located adjunct to the UTEP TCEQ sites
    - Met with TCEQ scientist and with UTEP facilities personnel.
    - Emergency access to the trailer was give via pad lock combinations to campus facilities personnel, campus police, and the local fire department as well as a list of approved names.

Baylor Air Quality Trailer – Instrument setup and deployment

- Conducted a setup and configuration of instrumentation inside trailer in El Paso
    - Installed instruments and completed mass flow controller and valve connections
    - Configured DAQ for aethalometer data streaming
    - Completed pressure checks on all the gas cylinders
    - Completed leak test on all the connections
    - Upgraded electrical outlet to supply 240V AC for full power to the trailer
    - Acquired the necessary electrical supplies, tubes, fittings and connections
    - Secured outer inlet for long-term sampling (strongly encourage by the local TCEQ scientist).
    - Installed Nest cameras for continued video monitoring of the interior. Note this will help monitor the instrumentation, gas pressures (cylinders) and flowrates. These cameras also allow for real-time training or assistance during filter changes.

    - Installed the mid-volume sampler for event filer collection
    - Secured all the outer ports to mitigate dust and insect intrusion to the interior (again, strongly encourage by the local TCEQ scientist).

- Field experiment activities
    - Performed nephelometer CO_2 calibration and zeroing.
    - Performed zeroing and colocation tests on TAPs. Results of the TAP colocation tests showed that the readings on the TAPS were in good agreement with each other (see plots below).
    - The flows on both TAPs were set at ~1.8 lpm, nephelometer flow at 21 lpm and the bypass flow to 17 lpm to maintain the required ~42 lpm on the main inlet.
    - Communicated with Dr. Fitzgerald regarding essential maintenance and upkeep of trailer.
    - Trained UTEP staff to change TAP filters and developed training videos.
    - Facilitated TAP filter change over the phone.
    - Confirmed that data is being stored on the UH H-net server.
    - Confirmed and finalized daily checks via TeamViewer, data servers, and video cameras.

Daily Checks – BC^2 El Paso

- Routinely checking on instrumentation and data acquisition. Completing the daily checklist.
- Began the development of a MATLAB program to compile daily data and perform preliminary data analysis
- Developed an analysis scheme to filter negative values and abnormally high outlier values, average the data over five minutes and calculate absorption angstrom exponent, scattering angstrom exponent and single scattering albedo (see graph below).
- Daily graphing a time series plots of absorption and scattering coefficients, AAE, SAE and SSA (see graph below).

Preliminary Analysis

- Continued monitoring of the instrumentation and data from the BC^2 El Paso site
    - Routinely checking on instrumentation and data acquisition. Completing the daily checklist.
    - Began the development of a Matlab program to compile daily data and perform preliminary data analysis.
    - Developed an analysis scheme to filter negative values and abnormally high outlier values, average the data over five minutes and calculate absorption angstrom exponent, scattering angstrom exponent and single scattering albedo.
    - Daily graphing a time series plots of absorption and scattering coefficients: Absorption Angstrom Exponent (AAE), Scattering Angstrom Exponent (SAE), and Single Scattering Albedo (SSA).
    - Routinely check UTEP and Chamizal sites for local meteorological data (RH, temperature, wind parameters and atmospheric pressure) and particulate matter, trace gases and chemical speciation data.
    - Routinely monitoring of MODIS satellite data for potential biomass burning events. If fires are detected, NOAA HYSPLT forward trajectories will be used to predict any potential influence of biomass burning on the site.

Data Collected

Preliminary data from the BC^2 El Paso site was collected during the last week of March 2019. Raw data from the TAP, nephelometer, aethalometer, and trace gases are stored on the h-net server. The research team will have access to all data via the computer (TeamViewer) or h-net server. Representative absorption and scattering data from March 26 is presented in Figure 1. AAE, SAE, and SSA will be derived from the absorption and scattering data using the equations 1-3, respectively (see Figure 2). The preliminary analysis shows that the site is mostly dominated by black carbon or black carbon mix aerosol from fossil fuel combustion.

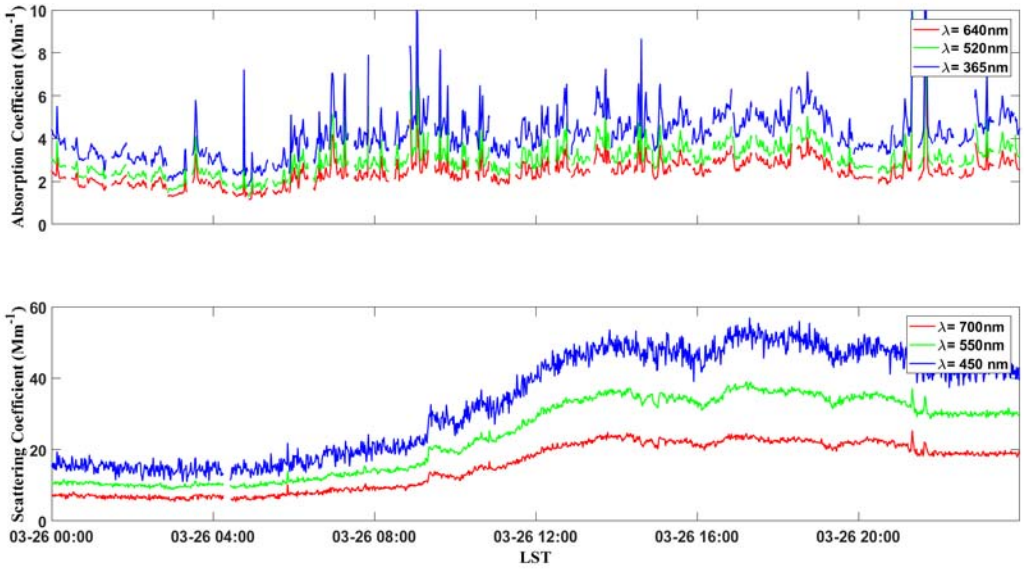

Figure 1. Particle-based optical measurements using the Tricolor Absorption Photometer (TAP, top) and nephelometer (i.e. scattering, bottom) from the BC^2 El Paso site. Twenty-four hour absorption and scattering profile (5 min averages) of blue, red, and green wavelengths.

Absorption Angstrom Exponent Eq 1

$$AAE_{\lambda 1/\lambda 2} = \frac{-\log(\frac{\sigma\, ap,\lambda 1}{\sigma\, ap,\lambda 2})}{\log(\frac{\lambda 1}{\lambda 2})}$$

Scattering Angstrom Exponent Eq 2

$$SAE_{\lambda 1/\lambda 2} = \frac{-\log(\frac{\sigma\, sp,\lambda 1}{\sigma\, sp,\lambda 2})}{\log(\frac{\lambda 1}{\lambda 2})}$$

Single Scattering Albedo Eq 3

$$SSA_{\lambda 1} = \frac{\sigma\, sp,\lambda 1}{\sigma\, sp,\lambda 1 + \sigma\, ap,\lambda 1}$$

Where $\sigma_{ap,\lambda 1}$ represents absorption coefficient at wavelength λ_1 and $\sigma_{ap,\lambda 2}$ represents absorption coefficient at wavelength λ_2. Similarly, $\sigma_{sp,\lambda 1}$ and $\sigma_{sp,\lambda 2}$ represent scattering coefficients at wavelengths λ_1 and λ_2, respectively.

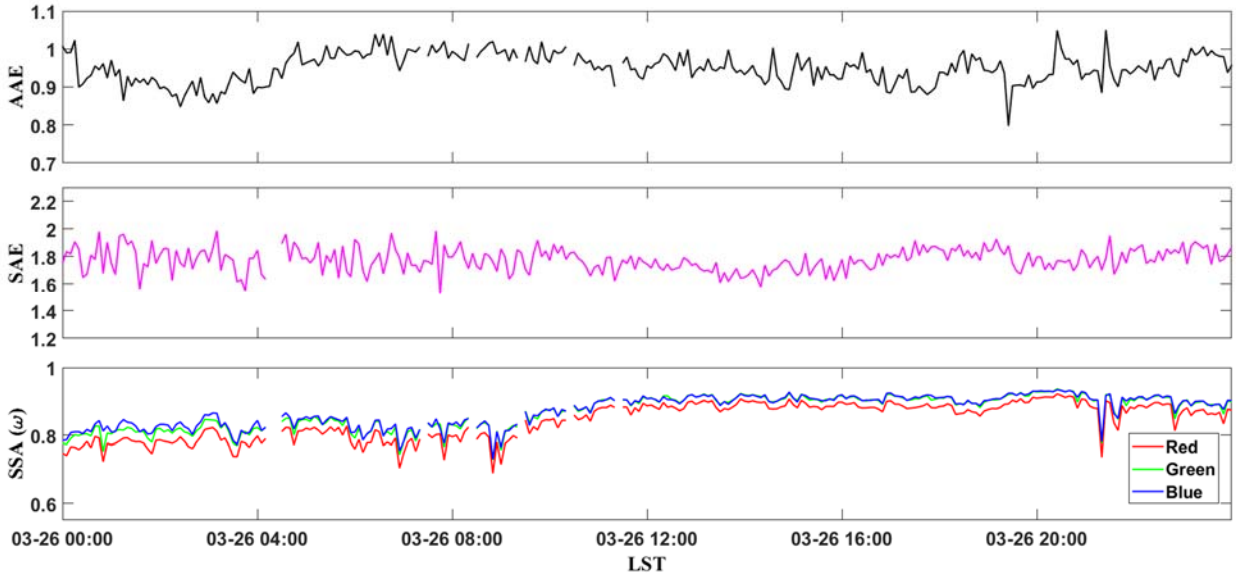

Figure 1. AAE, SAE, and SSA calculated from optical TAP and nephelometer measurements from the BC^2 El Paso site. Twenty-four hour AAE, SAE, and SSA profile for blue, red, and green wavelengths with 5 min averages.

Identify Problems or Issues Encountered and Proposed Solutions or Adjustments

There were a few problems/issues encountered during the month of March. All issues have been corrected or will be corrected in April.

- After the initial setup the research team was not able to reobtain the data stream the NO_x instrument without a manual reboot. The research team identified the problem remotely and request that a UTEP group manually reboot the instrument. The reboot was performed and the issue was resolved.
- During the initial setup, the Baylor Air Quality Trailer was scheduled to be secured to the ground via tie downs. This securing mechanisms will be provided by UTEP facilities. This was the last step after the security fence was installed. The fence has been installed but the tie downs have not. The trailer will be secured to the ground via tie downs in April. Sujan will help oversee this final step during April's monthly site visit. We are anticipating no problem with this step.
- There may be an opportunity to optimize the flowrate to the TAPs one more time. This optimization will occur by Sujan Shrestha during April's monthly visit.

Goals and Anticipated Issues for the Succeeding Reporting Period

There are no anticipated issues for April. The overarching goal for April is to continuously collect TAP, nephelometer, aethalometer, and trace gases data from the BC^2 El Paso site. Working with the UH IT to get remote login access via LogMeIn. Currently Baylor students are using TeamViewer to remotely access the computer at El Paso.

The goal for the April site visit will be to optimize the TAP flowrate and to physically secure the trail to the ground using tie downs. Note: Airline tickets for April and May site visits have been purchased. Meeting with Dr. Fitzgerald's graduate students to answer any questions regarding filter changing techniques.

Detailed Analysis of the Progress of the Task Order to Date

The project is still in its initial stages. The research team did perform a co-location experiment between the two TAPs. This was done prior to (at Baylor) and after deployment at the BC^2 El Paso site (figure 3). Results from the co-location experiment show that the two TAPs are performing similar to each other and prior to deployment.

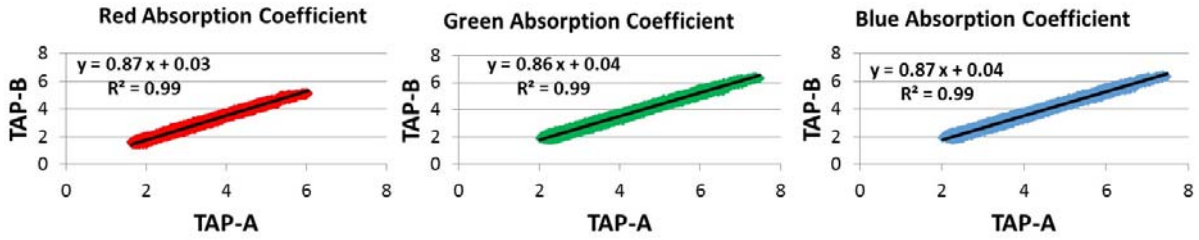

Figure 3. TAP co-location experiments from the BC^2 El Paso site. Twenty-four hour absorption and scattering profile (5 min averages) of blue, red, and green wavelengths.

Do you have any publications related to this project currently under development? If so, please provide a working title, and the journals you plan to submit to.

___Yes _x_No

Do you have any publications related to this project currently under review by a journal? If so, what is the working title and the journal name? Have you sent a copy of the article to your AQRP Project Manager and your TCEQ Liaison?

___Yes _x__No

Do you have any bibliographic publications related to this project that have been published? If so, please list the reference information. List all items for the lifetime of the project.

___Yes _x__No

Do you have any presentations related to this project currently under development? If so, please provide working title, and the conference you plan to present it (this does not include presentations for the AQRP Workshop).

___Yes _x__No

Do you have any presentations related to this project that have been published? If so, please list reference information. List all items for the lifetime of the project.

___Yes _x__No

Submitted to AQRP by

Principal Investigator