AQRP Monthly Technical Report

PROJECT TITLE	Incorporating Space-borne Observations to Improve Biogenic Emission Estimates in Texas	**PROJECT #**	14-017
PROJECT PARTICIPANTS	Arastoo Pour-Biazar; Richard McNider; Daniel Cohan, Rui Zhang	**DATE SUBMITTED**	8/11/2015
REPORTING PERIOD	**From:** July 1, 2015 **To:** July 31, 2015	**REPORT #**	15

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

<u>Progress Summary: CMAQ simulations</u>

Preparations for CMAQ simulations were completed. We are performing these simulations in addition to what was proposed originally, to evaluate the impact of our emission improvements on air quality simulations. A detailed report is attached below.

<u>Progress Summary: Preparation for final report</u>

The work on completing the final report is continuing.

Preliminary Analysis

Attached.

Data Collected

None for this period.

Identify Problems or Issues Encountered and Proposed Solutions or Adjustments

None.

Goals and Anticipated Issues for the Succeeding Reporting Period

Completing the final report.

Detailed Analysis of the Progress of the Task Order to Date

Attached.

Arastoo Pour Biazar

CMAQ simulation using different MEGAN outputs with satellite PAR

The preparation of the entire inputs files (MET, ICON/BCON, EMIS) needed for CMAQ simulations by using different MEGAN outputs with satellite data over the TCEQ SIP domains were completed. Two sets of meteorological fields are provided with the control case WRF run as default setting ('cntrl') and the cloud assimilation case as comparison ('analytical'). The initial conditions and boundary conditions at the D1 were extracted from NCAR's global MOZART model outputs with information at every 3 hour. The anthropogenic emissions are provided by TCEQ with the base year 2011 and CAMx Fortran binary format and has been transformed to the CMAQ compatible I/O API format using the CAMx inputs to CMAQ inputs converter utility CAMx2CMAQ developed by Ramboll-Environ (https://www.tceq.texas.gov/assets/public/implementation/air/am/contracts/reports/pm/5821110365FY1420-20130830-environ-camx2cmaq_source_code.tgz).

For biogenic emission, there are three sets of BVOC emission rates result which are generated by MEGAN model using the PAR data either from case 'cntrl' , case 'analytical' or directly from UAH's GOES satellite retrieval products ('UAH') respectively. Also there are four sets of soil NO emission rate results available which are estimated by either by YL95 or BDSNP algorithm using the meteorological field either from WRF run case 'cntrl' or 'analytical'. Due to the multiple combinations of those inputs for CMAQ run and time limitation, only three cases were finally chosen (see Table 1) to run to access the ozone impact due to different biogenic emissions during 2013 DISCOVER-AQ Houston campaign period. CB05 gas phase chemical mechanism as well as AERO6 aerosol module will be chosen for CMAQ simulation.

Figure 1 demonstrates the applicability of the ICON/BCON files for CMAQ from MOZART extraction. For ICON file at August 1, 2013, the spatial pattern for CO and ozone on the ground is reasonable with the peak values located at the Northeast of US and the magnitudes around 300ppb (for CO) and 100ppb (for ozone). Moreover, the cross-section plot for ozone at row 73 (with the location shown as the red line in ground plot Figure 1b) reflects the ozone intrusion by a tropopause fold (with maximum value 0.941 ppm at column 50 and layer 29), which is expected (The corresponding AGL height at the top vertical layer (layer 29) is around 13.6km).

Figure 2 shows the spatial distribution of daily of anthropogenic emissions (SO2, NOX, PM2.5 and VOC) at ground-level over the 12km Texas domain on August 1, 2013. Those ground emission are merged from the seven emission source categories, namely 'area', 'Canada', 'low_points', 'Mexico', 'nonroad', 'offroad', and 'onroad'. (ftp://amdaftp.tceq.texas.gov/pub/TX/camx/basecase/bc12_12jun.reg3a.2012_wrf361_p2a_i2_a/input/ei/Components/). For each source category, there are three individual versions to represent the temporal variation, namely weekdays, Saturday and Sunday. A run script has been created to find the corresponding day-of-the-week during the simulation period in 2013 and locate the correct files to merge. It can be seen that the spatial pattern of emission rate for the key pollutants is technical report), the comparison of the average soil NO emission rate over the different climate divisions using YL95 or BDSNP algorithm are shown as the histogram plot in Figure 5. For both YL95 and BDSNP cases, the top three emission regions are East Texas (1st for BDSNP case, 2nd for YL95 case), North Central Texas (2nd for BDSNP case and 1st for YL95 case) and High Plains (3rd place for both case). For BDSNP case, the emission is dominated over the East Texas region (674 moles/s, 2.3 times the corresponding YL95 case). The lowest emission region (South Texas) for the two different soil NO algorithms is also the same, even though the absolute value for YL95 case is almost three times higher than BDSNP case (34.8 moles/s for YL95 case versus 12.9 moles/s for BDSNP case by using the control case WRF run meteorology fields). Summing over the 10 climate divisions, the soil emission rate over Texas during the two-month predicted by BDSNP module is 21% higher using the base WRF inputs and 14% higher using the WRF run with cloud assimilation. Still, no significant difference (less than 5%) can by found by using the different meteorology inputs with the same soil NO algorithm.

The Rice team also finished a draft of the user manual of this standalone BDSNP module, which documented in detail the model structures and how to install and operate this soil NO emission model as the user specified applications. Further improvement directories such as replacing the default global fertilizer map from Potter et al. (2010) with more dynamic and up-to-date fertilizer fields from EPIC outputs by considering the different farming management scenarios were also mentioned in this user manual. This manual as well as the provided tested benchmark case and the 4km resolution soil biome map will be provided to TCEQ as part of final delivery.

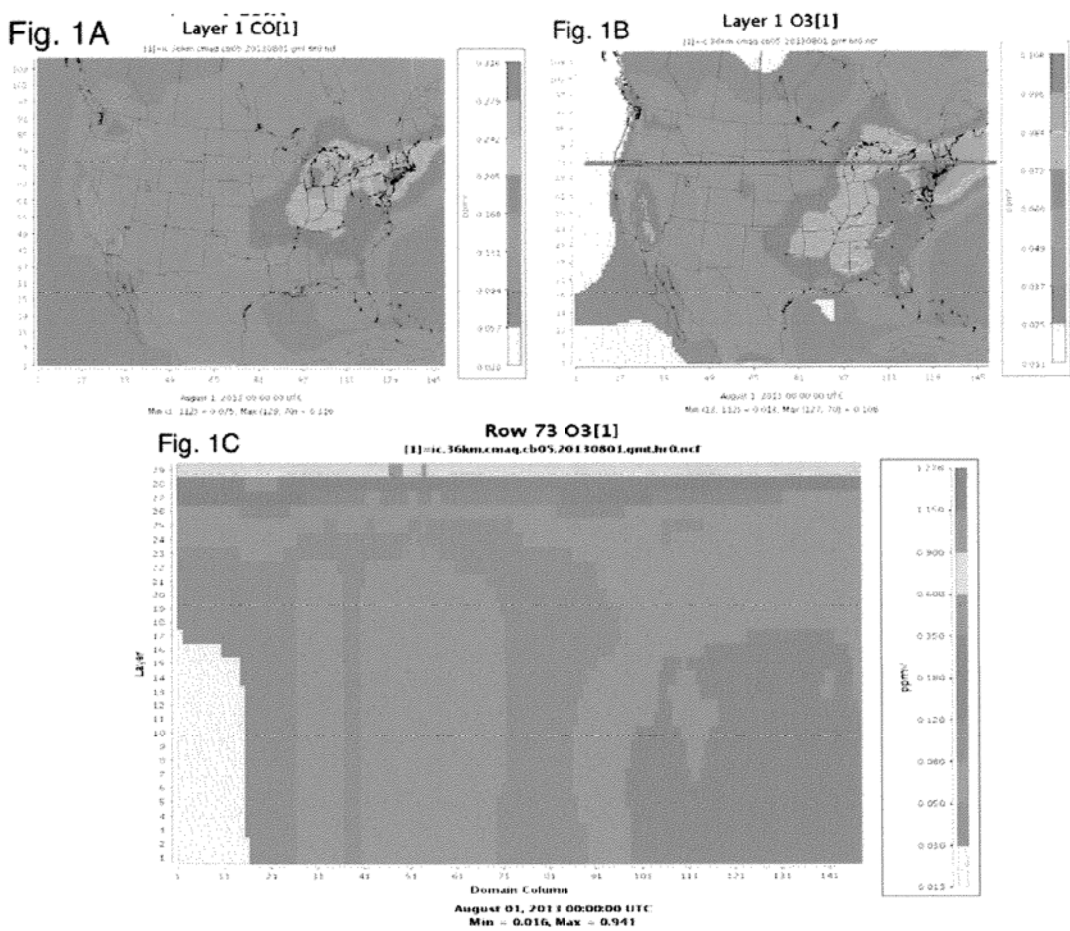


Figure 1. Initial conditions for CMAQ 36km CONUS domain extracted from MOZART simulation on August 1, 2013 as (a) ground CO concentration, (b) ground ozone concentration and (c) ozone vertical distribution at cross-section row 73 (as the red line locations in Fig. 1B)

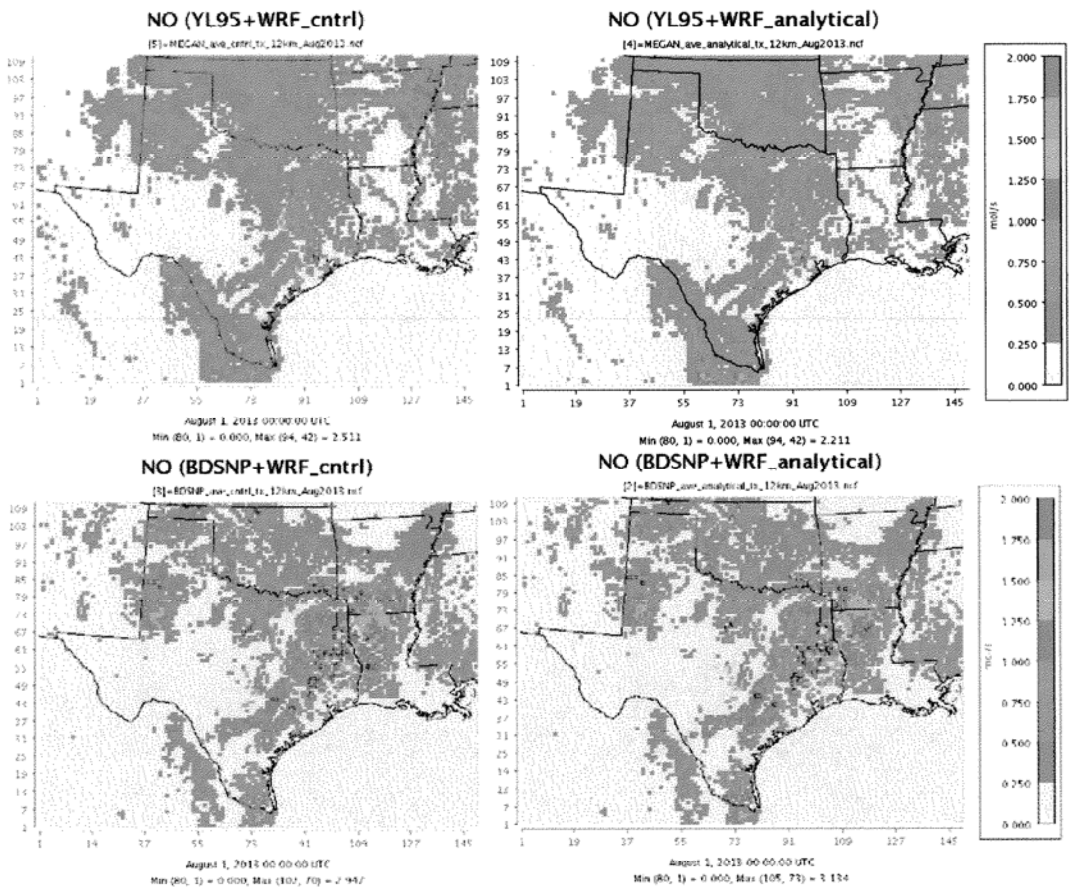
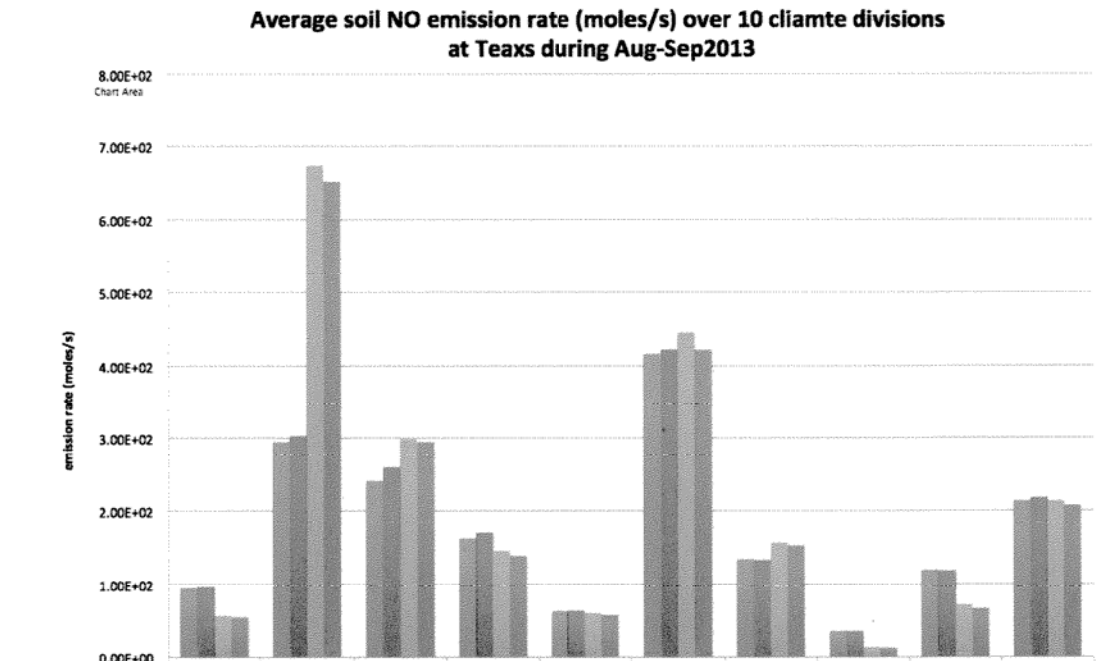


Figure 3. Comparison of the spatial patterns of the monthly mean soil NO emission rate using different meteorology inputs for WRF control case (cntrl) and WRF cloud assimilation case (analytical) and different algorithm YL95 and BDSNP over Texas domain during August 2013



	Edwards Plateau	East Texas	High Plains	Low Rolling Plains	Lower Valley	North Central Texas	South Central Texas	South Texas	Trans-Pecos	Upper Coast
YL95+WRF_cntrl	9.50E+01	2.95E+02	2.41E+02	1.63E+02	6.30E+01	4.16E+02	1.34E+02	3.48E+01	1.19E+02	2.14E+02
YL95+WRF_analytical	9.60E+01	3.03E+02	2.60E+02	1.71E+02	6.33E+01	4.22E+02	1.33E+02	3.47E+01	1.18E+02	2.18E+02
BDSNP+WRF_cntrl	5.64E+01	6.74E+02	2.99E+02	1.46E+02	6.00E+01	4.45E+02	1.57E+02	1.29E+01	7.13E+01	2.14E+02
BDSNP+WRF_analytical	5.41E+01	6.52E+02	2.95E+02	1.39E+02	5.72E+01	4.22E+02	1.53E+02	1.18E+01	6.61E+01	2.07E+02

Figure 5. Comparsion of average soil NO emission rate (moles/s) over the 10 climate divisions of Texas during August and September 2013 by different algorithms and meterological fields.