AQRP Monthly Technical Report

PROJECT TITLE	Improved Land Cover and Emission Factor Inputs for Estimating Biogenic Isoprene and Monoterpene Emissions for Texas Air Quality Simulations	**PROJECT #**	14-016
PROJECT PARTICIPANTS	Alex Guenther (Battelle/PNNL) Joost de Gouw (NOAA) Greg Yarwood, Sue Kemball-Cook (ENVIRON)	**DATE SUBMITTED**	2/9/2015
REPORTING PERIOD	**From:** January 1, 2015 **To:** January 31, 2015	**REPORT #**	9

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

Task 1: Estimation of Terpenoid Emission Fluxes from Aircraft Data

This month, we worked on the validation of one of the main assumptions in our work so far: what is the relation between isoprene and hydroxyl (OH) radical concentrations in the planetary boundary layer (PBL), and can isoprene concentration measurements be used to derive isoprene emissions? To answer this question, we used the results from a large eddy simulation (LES) model that were previously published [*Kim et al.*, 2012]. This model describes the turbulent mixing and chemical removal of isoprene in a planetary boundary layer capped by fair-weather cumulus clouds as is typical for Texas and the Southeast U.S. First, we verified that the variance in measured isoprene agrees with the modeled variance, and we found good agreement for different NOx regimes. Next, we studied the dependence of average isoprene mixing ratios in the model versus the average OH (Figure 1). It was found that there is a simple inverse relationship between mean isoprene and mean OH. Moreover, the factor between mean isoprene and the inverse of mean OH agrees within 10% with the assumed isoprene emissions in the model. This validates our use of measured isoprene mixing ratios ([ISOP]) to derive isoprene emissions $ISOP_{em}$, following the equation [*Warneke et al.*, 2010]:

$$[\mathrm{ISOP}] = \frac{\mathrm{ISOP_{em}}}{\mathrm{BL_{height}} \times \mathrm{k_{OH}} \times [\mathrm{OH}]} \quad (1)$$

where BL_{height} is the height of the PBL, [OH] is the OH radical concentration estimated according to a parameterization that includes measured NO_2, ozone and J-values [*Ehhalt and Rohrer*, 2000], and k_{OH} is the rate coefficient for the reaction between isoprene and OH.

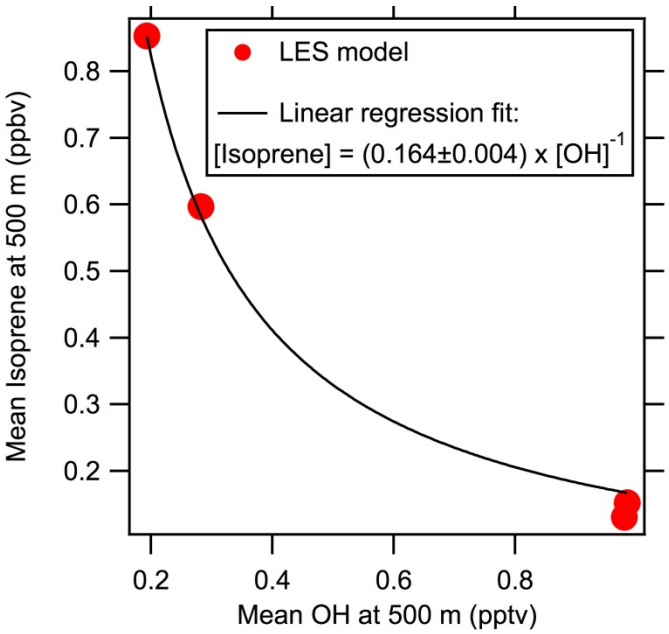

Figure 1: Mean isoprene as a function of mean OH at 500 m altitude in the mid-afternoon boundary layer calculated from the large eddy simulation (LES) results published previously

Task 2: Development of High Resolution Land Cover Data for MEGAN Modeling in Texas and the Southeastern U.S.

PNNL has updated LAIv dataset for the North America based on updated maximum fractional vegetation cover data from USGS.

Task 3: Emission Factor Database Development

PNNL has developed 30 meter resolution PFT dataset for the continental US by integrating MEGANv2.1 grass and shrub land cover, LandFire vegetation cover, National Land Cover Database 2011, Forest Inventory and Analysis (FIA) survey and USGS maximum vegetation cover data. In addition, PNNL has also developed an emission factor dataset for the continental US and evaluated the product against MEGANv2.1 dataset. Meanwhile, PNNL continues working on improving the emission factor dataset by incorporating aircraft observations.

Task 4: Development of MEGAN Biogenic Emission Inventories and Inventory Evaluation using Regional Photochemical Modeling

ENVIRON ran CAMx for the June 1-July 15, 2013 period using MEGAN emissions developed using default inputs and the final WRF run. We began evaluation of the model against surface observations from the CASTNet monitoring network and the TCEQ's CAMS network as well as against aircraft observations along the C-130 aircraft flight tracks.

Data Collected
None

Identify Problems or Issues Encountered and Proposed Solutions or Adjustments
None to date

Goals and Anticipated Issues for the Succeeding Reporting Period

Task 1: In the succeeding reporting period, we will work on these remaining points:

- We will compare CAMx modeled isoprene and OH along the C-130 and P3 flight tracks
- We will compare the modeled MEGAN v2.1 surface emissions along flight tracks with the emissions determined from the measurements
- We will work on the final report to summarize the findings from our research.

Task 3: Continue developing high resolution emission factor database by incorporating aircraft observations.

Task 4: Run CAMx for the period June 1 – July 15, 2013 using MEGAN emissions developed with updated inputs. Evaluate model performance against surface observations of ozone and compare modeled concentrations and aircraft measurements of isoprene, monoterpenes and other species of interest along aircraft flight tracks. Compare results of run with updated MEGAN inputs with results of CAMx run that used MEGAN emissions developed with default inputs. Begin work on final report.

Detailed Analysis of the Progress of the Task Order to Date

The project remains on schedule and budget for completion and delivery of the final AQRP-reviewed report by the AQRP contract end date of June 30, 2015.

References

Ehhalt, D. H., and F. Rohrer (2000), Dependence of the OH concentration on solar UV, *Journal of Geophysical Research, 105*, 3565–3571.

Kim, S. W., M. C. Barth, and M. Trainer (2012), Influence of fair-weather cumulus clouds on isoprene chemistry, *J. Geophys. Res.-Atmos.*, *117*(D10), D10302, doi:10.1029/2011JD017099.

Warneke, C. et al. (2010), Biogenic emission measurement and inventories determination of biogenic emissions in the eastern United States and Texas and comparison with biogenic emission inventories, *J. Geophys. Res.-Atmos.*, *115*, D00F18, doi:10.1029/2009JD012445.

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