

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	11/10/2014
REPORTING PERIOD	From: October 1, 2014 To: October 30, 2014	REPORT #	6

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

Aircraft measurement data, as well as PTR-MS VOC measurement data from the 2013 Southeast Atmosphere Study (SAS) field campaign (NCAR C-130 and NOAA P-3 aircraft), and the 2006 Texas Air Quality Study (NOAA P-3 aircraft), were collected. PNNL also developed, improved, and evaluated scripts that calculate biogenic VOC flux at given aircraft flight tracks using wavelet based techniques, based upon code and data provided by Dr. Thomas Karl (Karl et al, 2013) and Lisa Kaser (NCAR). Comparisons against flux results from traditional FFT (Fast Fourier transform) techniques show reasonable agreements. Preliminary flux results are available and PNNL is performing QA/QC tasks on the results.

Figure 1 shows an example racetrack in research flight # 1, and Figure 2 shows estimated isoprene flux for the example racetrack. The ratio of mean wavelet/FFT flux is 0.99 for the example racetrack. While FFT based flux analysis provide only one flux value for the entire racetrack, wavelet based analysis provides flux data in much higher resolution.



Figure 1. 3D plot of an example racetrack from research flight (RF) #1 of SAS campaign. The entire flight track of RF1 is shown in black line. The example racetrack is shown in red line.

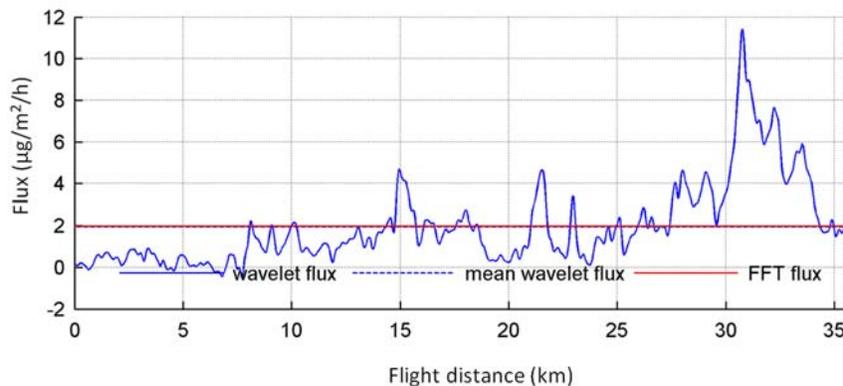


Figure 2. Estimated isoprene flux for the example racetrack shown in Figure 1. Mean wavelet/FFT flux is 0.99

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

PNNL compiled a database of LAI_v values at 1 km spatial resolution and 8 day temporal resolution, covering all of North America, for April to September of 2013. For this task, LAI data retrieved from the MODIS (MODerate Resolution Imaging Spectroradiometer) satellite (product MCD15A2.005) were used, and fractional vegetation land cover (f_c) data from MEGAN v2.1 database were applied. To efficiently handle MODIS LAI data, a Python script was written. This script will download MODIS data from a remote server, extract LAI data from the retrieved files, and merge the extracted data into a single file. Another Python script was written to calculate LAI_v data based on input LAI and f_c data, with an upper limit of 10 set for LAI_v to eliminate high values due to uncertainties in low f_c values in some grid cells.

Several alternative fractional vegetation land cover datasets were also tested for this project and compared with the existing MEGAN v2.1 f_c database, including vegetation cover data from the SPOT-VEGETATION satellite. It was determined that that SPOT data could be a useful data source for future efforts but there some data quality issues and it was decided that further examination was beyond the scope of this task and the existing MEGAN v2.1 f_c database for 2008 was used to quantify vegetation cover fraction for this project. The LAI_v data developed for

this project were compared against previously calculated MEGANv2.1 LAIv data, for previous years, for QA/QC purposes.

Figure 3 shows LAIv data for four selected time periods for 2013 (April 7th, June 10th, August 5th and September 30th). Progressively increasing LAIv were observed for the majority of North America from April to August, and decreasing LAIv was observed beyond August. The spatial pattern and temporal variations of LAIv follow expected patterns and are also consistent with previously calculated MEGAN v2.1 LAIv data.

It should be recognized that the fractional vegetation land cover data used here are based on satellite data for the year 2008, even though we are estimating LAIv for 2013. However we do not expect substantial changes in vegetation cover fraction from 2008 to 2013.

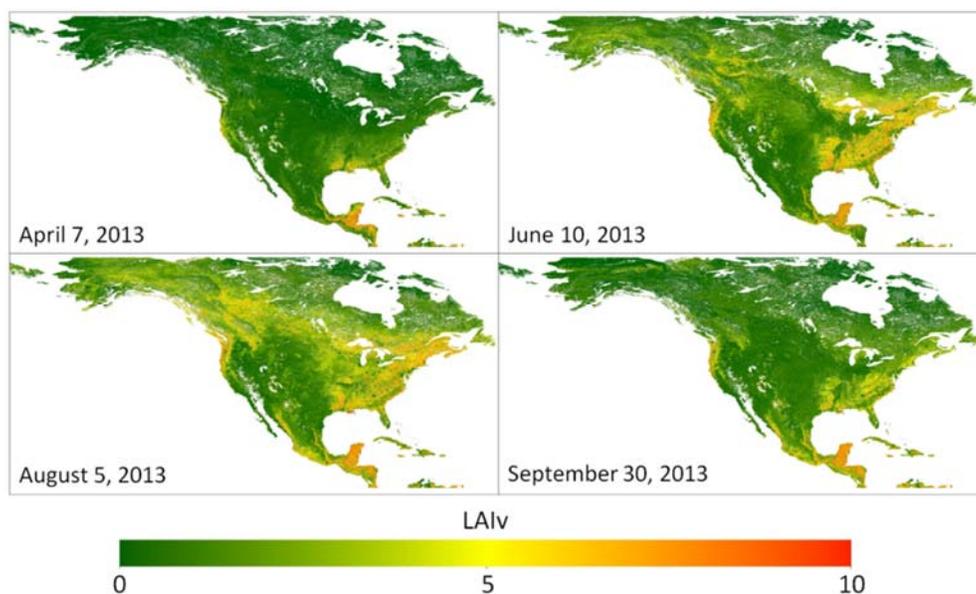


Figure 3. The calculated LAIv data for selected time periods from April to September 2013.

Task 3: Emission Factor Database Development

Several additional data sources that can be used to develop high resolution PFT database for Texas were identified. PNNL is evaluating these data for their applicability in this project.

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

ENVIRON completed evaluation of Weather Research and Forecast (WRF) Model (Skamarock et al. 2008) 12 km grid output fields for the period June 1-July 15, 2013 against CAMS station solar radiation data within Texas and ds472 wind, temperature and humidity data within and outside of Texas and the PRISM precipitation product. The precipitation evaluation showed the presence of an artifact around the 4 km grid focused on Houston. The 4 km grid was present in this WRF run so it could also be used by AQRP Project 14-024. The precipitation artifact was caused by the use of the 2-way nesting option on the 4 km grid. WRF was run a second time

without the nested 4 km grid, and the model performance evaluation was completed. No precipitation artifact was present in the second run.

ENVIRON continued development of software to perform CAMx model performance evaluation along aircraft flight tracks.

Data Collected

Aircraft data, and PTR-MS VOC measurement data from the 2013 Southeast Atmosphere Study (SAS) field campaign (NCAR C-130 and NOAA P-3 aircraft), and the 2006 Texas Air Quality Study (NOAA P-3 aircraft).

MODIS LAI remote sensing data

SPOT-VEGETATION Fraction of green Vegetation Cover (FCover) data

Land cover data collected: National Gap Analysis Program (GAP), LandFire, NatureServe Terrestrial Ecological Systems of the United States, National Land Cover Database 2011

Identify Problems or Issues Encountered and Proposed Solutions or Adjustments

None to date

Goals and Anticipated Issues for the Succeeding Reporting Period

Task 1: Continue working on calculation and assessment of flux estimation results.

Task 2: Complete compilation and assessment of LAIv data and provide final data to project partners.

Task 3: Collect, compare and evaluate high-resolution plant functional type (PFT) data from multiple sources for Texas and the surrounding regions. Develop scripts to process and map raw PFT scheme into scheme as used by the MEGAN model.

Task 4: Complete software to perform CAMx model performance evaluation along aircraft flight tracks. Rerun MEGAN with default inputs using new WRF run.

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

Karl, T., P. K. Misztal, H. H. Jonsson, S. Shertz, A. H. Goldstein, and A. B. Guenther. 2013. Airborne flux measurements of BVOCs above Californian oak forests: Experimental

investigation of surface and entrainment fluxes, OH densities and Damköhler numbers. *J. Atmos. Sci.*, 70, 3277–3287.

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