# Monthly Technical Report

*(Due to AQRP Project Manager on the 8th day of the month following the last day of the reporting period.)*

| | | | |
|---|---|---|---|
| **PROJECT TITLE** | Soil Moisture Characterization for Biogenic Emissions Modeling in Texas | **PROJECT #** | 14-008 |
| **PROJECT PARTICIPANTS** **(Enter all institutions with Task Orders for this Project)** | The University of Texas at Austin | **DATE SUBMITTED** | 2/5/15 |
| **REPORTING PERIOD** | **From:** 1/1/2015 **To:** 1/31/2015 | **REPORT #** | 8 |

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** *(Include all Task actions conducted during the reporting month.)*

A conference call was held on January 12, 2015 between Barry Exum, Dave Sullivan, Elena McDonald-Buller, and Gary McGaughey. The University of Texas (UT) team communicated progress to-date on project activities and requested a recommendation from TCEQ on the spatial and temporal focus for MEGAN simulations to predict isoprene.

Technical activities during 2014 focused on analysis of in-situ soil moisture measurements and NLDAS-2 predictions of soil moisture within the TCEQ 4km and 12km grid domains as summarized in previous monthly reports. On the conference call, UT reported that the UT team was ready to initiate MEGAN simulations to predict isoprene emissions during representative periods of drought and requested guidance on the geographic areas and time periods of interest to TCEQ. Barry stated that TCEQ is interested in MEGAN simulations performed at 1km horizontal resolution for the 4km grid domain (with a focus on eastern Texas regions) for drought years such as 2011.

Therefore, Elena stated that UT will commence with MEGAN simulations targeting the prediction of isoprene emissions for the growing season (March-October) for years 2006 (drought), 2007 (average to wet) and 2011 (record drought in Texas) on the 4km grid domain with analysis targeted towards eastern Texas regions.

During January 2015, MEGAN simulations were performed by UT to estimate area-averaged isoprene emissions during the summer of year 2011 for eastern Texas climate divisions (North Central, South Central, East, Upper Coast: ref. Fig. 1). MEGAN simulations were performed for a BaseCase (impact of soil moisture not considered) as well as simulations that utilized the

NLDAS-2 soil moisture databases (described in previous monthly reports): Noah, NoahMP, Mosaic, and VIC.

Fig. 2 (also ref. Table 1) shows preliminary predicted isoprene emissions for the summer (June-July-August) of 2011 for each of the five MEGAN scenarios (i.e., BaseCase, Noah, NoahMP, Mosaic, VIC) and four eastern Texas regions. The BaseCase daily averaged isoprene emissions range from 38.2 kg/km$^2$ for Upper Coast to 103.9 kg/km2 for East Texas.

As demonstrated in Fig. 2 and Table 1, the Mosaic and VIC simulations for the all-time record drought year 2011 predicted dramatically lower summer isoprene emissions compared to those for the BaseCase (i.e., impact of soil moisture not considered) and Noah runs. The Noah simulation has relatively small reductions in predicted isoprene emissions relative to the BaseCase ranging from -3.5% for East Texas and Upper Coast to -6.9% for North Central; NoahMP has slight larger reductions with a maximum of -12.2% for South Central.

Employing the Mosaic and (especially) VIC soil moisture databases resulted in dramatically reduced isoprene emissions relative to the BaseCase. For the Mosaic simulation, reductions vary from -42.8% for East to -70.4% for Upper Coast; VIC has a maximum reduction of -92.9% for Upper Coast.

Clearly the predicted emissions during the summer of 2011 are highly sensitive to the specific soil moisture database employed. A preliminary investigation of upper-level soil moisture values revealed that Mosaic tends to predict lower moisture availability compared to Noah MP; crucially, the Mosaic and VIC wilting point values are a factor of two or greater than those for Noah/NoahMP. The difference in wilting points between the NLDAS-2 databases is significant because the wilting point value is the threshold value below which isoprene emissions are set to zero. Analysis of isoprene results and sensitivity to the underlying soil moisture availability and wilting point databases will continue during February 2015.

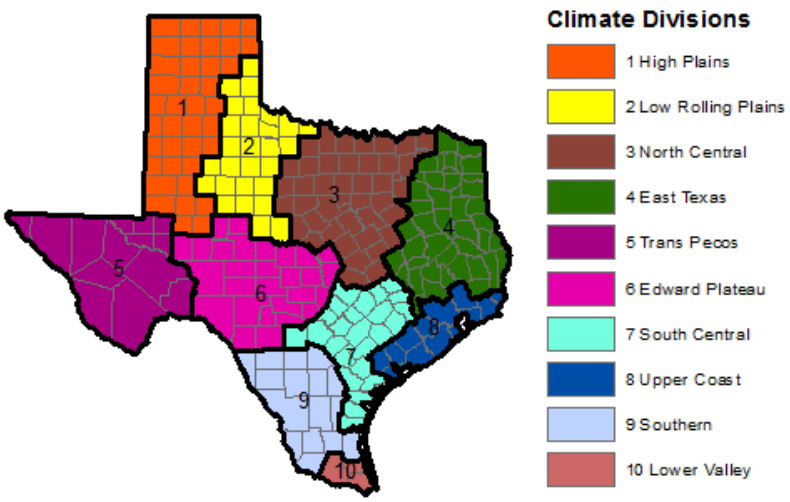


**Fig. 1** Texas climate divisions including North Central (3), East (4), South Central (7) and Upper Coast (8).

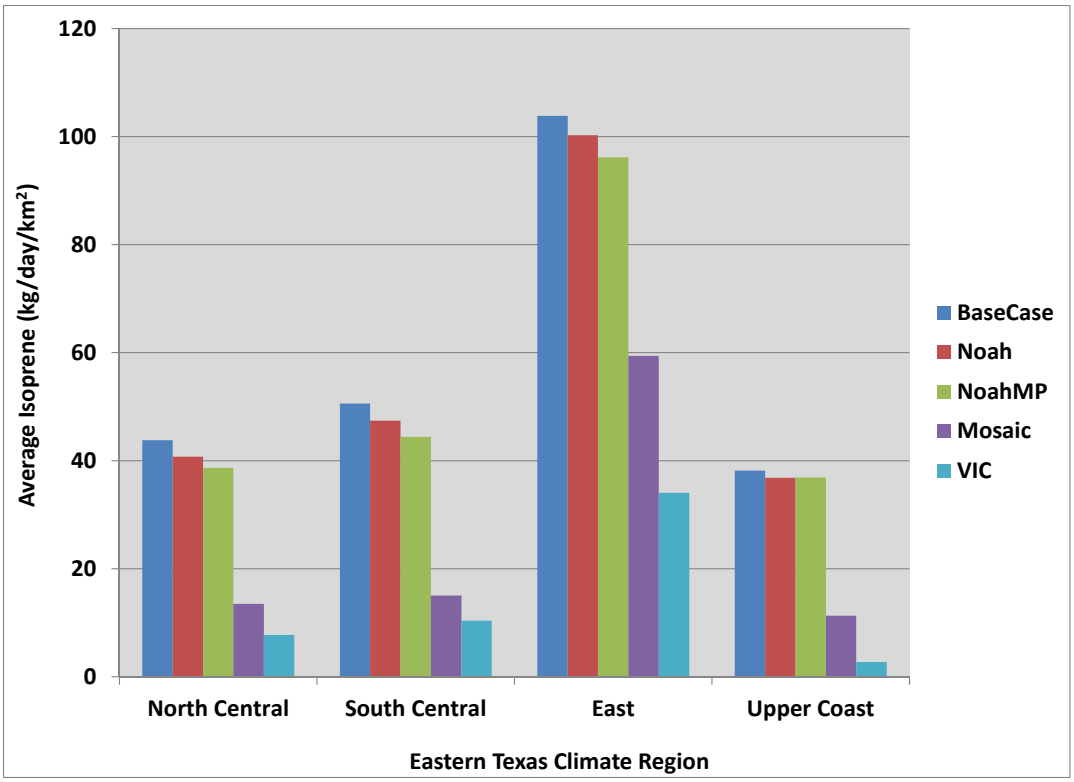


**Fig. 2** MEGAN region-averaged daily isoprene emissions (kg/day/km$^2$) during the summer of 2011 for eastern Texas climate divisions. Results are shown for BaseCase (impact of soil moisture not considered) and simulations that utilized the NLDAS-2 (e.g., Noah, NoahMP, Mosaic, VIC) soil moisture databases.

**Table 1.** Area-averaged isoprene emissions by eastern Texas climate division during the summer of 2011 for five MEGAN simulations: (1) BaseCase (impact of soil moisture not considered) and BaseCase utilizing each of the NLDAS-2 soil moisture databases: (2) Noah, (3) Noah MP, (4), Mosaic, and (5) VIC.

| | **Area-Averaged Daily Total Isoprene Emissions (kg/km$^2$/day)** | | | | | **Percentage Change Relative to BaseCase** | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Region** | **BaseCase** | **Noah** | **NoahMP** | **Mosaic** | **VIC** | **Noah** | **NoahMP** | **Mosaic** | **VIC** |
| **North Central** | 43.8 | 40.8 | 38.7 | 13.5 | 7.7 | -6.9% | -11.7% | -69.2% | -82.4% |
| **South Central** | 50.6 | 47.4 | 44.4 | 15.0 | 10.4 | -6.3% | -12.2% | -70.3% | -79.5% |
| **East** | 103.9 | 100.2 | 96.2 | 59.4 | 34.0 | -3.5% | -7.4% | -42.8% | -67.2% |
| **Upper Coast** | 38.2 | 36.8 | 36.9 | 11.3 | 2.7 | -3.5% | -3.4% | -70.4% | -92.9% |

**Preliminary Analysis** (*Include graphs and tables as necessary.)*
A comparison of predicted isoprene concentrations from MEGAN simulations for eastern Texas regions during summer of 2011 is summarized in the previous section. Efforts to extend this analysis to other seasons (spring/fall) and years 2006 and 2007 is on-going.

**Data Collected** *(Include raw and refine data.)*
In parallel with the analysis of the NLDAS-2 soil moisture datasets, our team is moving forward to process additional input datasets (e.g., land cover, LAI, PAR, other meteorological inputs such as temperature and winds) as required for MEGAN for Mar-Oct for years 2006, 2007, and 2011.

**Identify Problems or Issues Encountered and Proposed Solutions or Adjustments**
None this period.

**Goals and Anticipated Issues for the Succeeding Reporting Period**
We completed initial testing of MEGAN for summer of 2011 that utilized the NLDAS-2 datasets to predict hourly isoprene emissions for the 4km grid domain including the four eastern Texas climate divisions North Central, East, South Central, and Upper Coast. We are currently expanding the MEGAN simulations to include additional seasons and years.

**Detailed Analysis of the Progress of the Task Order to Date** *(Discuss the Task Order schedule, progress being made toward goals of the Work Plan, explanation for any delays in completing tasks and/or project goals. Provide justification for any milestones completed more than one (1) month later than projected.)*
Ongoing.

---

Submitted to AQRP by:

Principal Investigator: Elena McDonald-Buller

*(Printed or Typed)*