

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	The University of Texas at Austin	DATE SUBMITTED	4/8/15
REPORTING PERIOD	From: March 1, 2015 To: March 31, 2015	REPORT #	10

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.)*

During March 2015, the team continued performing technical analyses towards developing draft final reporting sections as follows:

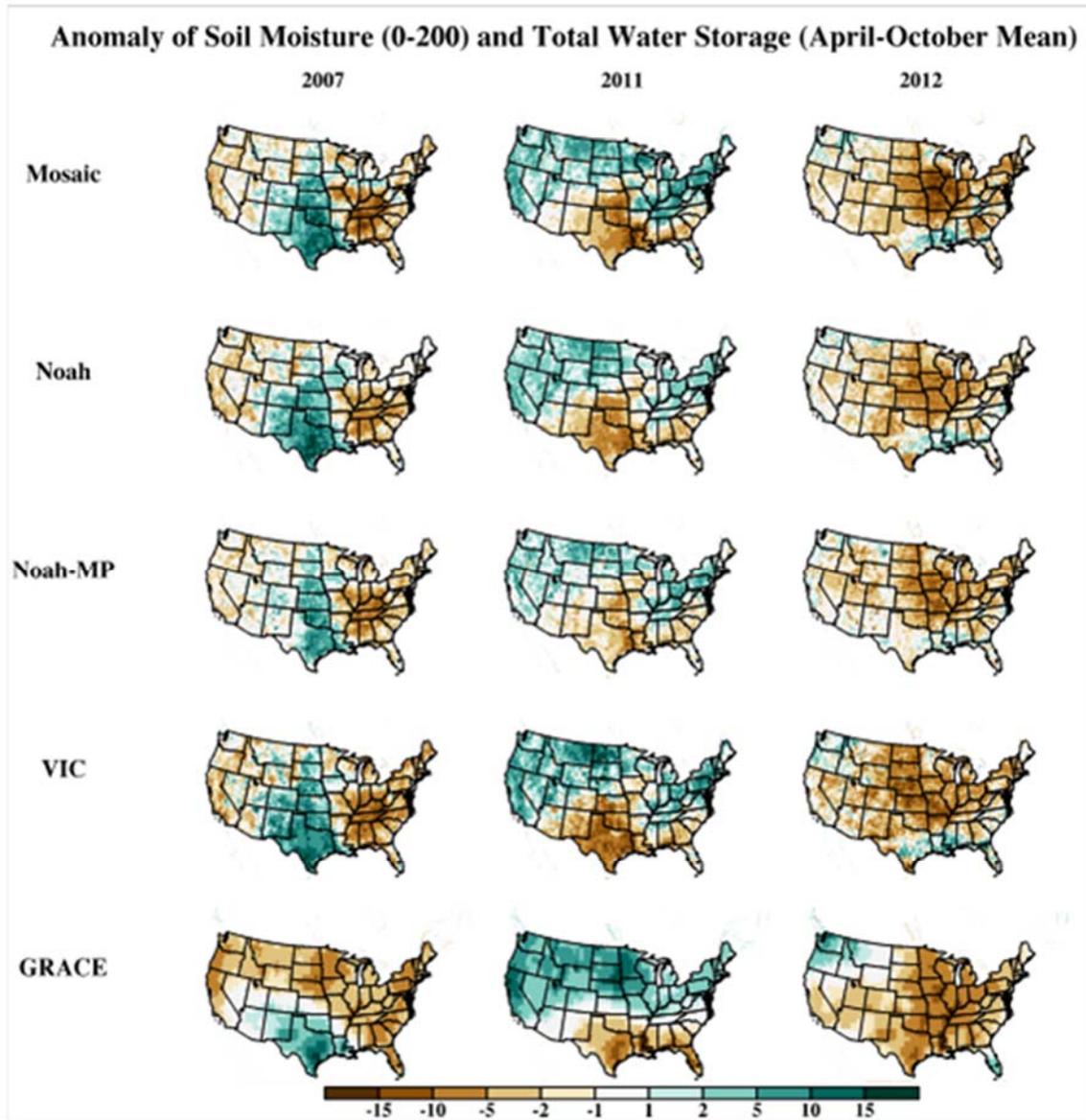
- 1.) Overview of in-situ monitoring networks in Texas
- 2.) Overview of NLDAS-2 soil moisture datasets
- 3.) Comparison of in-situ observations to NLDAS-2 predictions
- 4.) Comparison of NLDAS-2 predictions and GRACE observations
- 5.) MEGAN simulations to predict isoprene on the 4km grid domain using the NLDAS-2 LSM soil moisture databases

Preliminary Analysis *(Include graphs and tables as necessary.)*

The Gravity Recovery and Climate Experiment (GRACE) consists of two NASA satellites that use a precise microwave ranging system to measure the distance between themselves due to gravitational acceleration (<https://climatedataguide.ucar.edu/climate-data/grace-gravity-recovery-and-climate-experiment-surface-mass-total-water-storage-and>). Changes in Earth's gravity field are directly related to changes in surface mass. The surface mass signal largely reflects total water storage (TWS), which is the sum of groundwater, soil moisture, surface water, snow and ice.

Preliminary results are shown below that contrast GRACE-observed TWS with NLDAS-2 soil moisture predictions. Anomalies for years 2007, 2011, and 2012 (April-October totals relative to the 2006-2013 averages) for NLDAS-2 soil moisture (integrated over 0-200cm) and GRACE-observed TWS are shown in Figure 1.

Figure 1. Comparison of April-October anomalies for years 2007, 2011, and 2012 for 0-200cm NLDAS-2 (Mosaic, Noah, Noah-MP, and VIC LSMs) soil moisture and GRACE total water storage. Units are cm.



GRACE tracks the temporal changes of TWS by monitoring the distances between the two satellites. TWS includes changes of soil moisture storage and groundwater storage as well as surface reservoir water storage. The contribution of changes of surface water reservoir to TWS change is typically small compared to soil moisture and groundwater storage. Long et al. (2013) found that the temporal variations of soil moisture and GRACE TWS were in general agreement during the 2011 Texas drought and that the deficit in soil moisture dominated the depletion of TWS.

As shown in Figure 1, the large-scale gradients between the NLDAS-2 soil moisture and GRACE TWS anomalies have similar spatial patterns. For example, both NLDAS-2 and GRACE indicate relatively wet values in the South Central US during 2007 and very dry conditions in the South Central US for 2011 and Great Plains and Ohio River Valley for 2012. In Texas during 2011, Noah-MP shows the lowest magnitude dry anomalies; this may be due, in part, to the relatively weak response of Noah-MP to interannual variations of deep layer soil moisture shown by our previous investigations.

Although the NLDAS-2 soil moisture and GRACE TWS anomalies are directionally similar, the spatial extents of wet/dry patterns are different. For example, the relatively wet TWS values for 2007 are limited to Texas and portions of surrounding states whereas the NLDAS-2 wet anomalies extend north and northwest into portions of the southwestern US and the Central Plains states of Kansas, Nebraska, and Dakotas. During 2011, GRACE indicates drier than normal conditions throughout Texas and the Gulf Coast states; the magnitude of drought in the Gulf Coast regions (outside of Texas) is often lower (especially for Florida) and extends farther north into the South Central Plains (i.e., Oklahoma and Nebraska) compared to GRACE.

During 2012, GRACE indicates that most of the US is relatively dry with the exception of the northwestern US and Florida; the spatial extent of predicted NLDAS-2 soil moisture drought covers much of the US but predicts average-to-wet conditions over portions of Texas and the Gulf and Atlantic coastal regions. Combined, the NLDAS-2 and GRACE results might indicate that late 2011/early 2012 rainfall mostly replenished soil moisture throughout Texas but that these rains were insufficient to recharge groundwater storage to pre-drought levels.

Long, D., B. R. Scanlon, L. Longuevergne, A.-Y. Sun, D. N. Fernando, and H. Save (2013), GRACE satellites monitor large depletion in water storage in response to the 2011 drought in Texas, *Geophys. Res. Lett.*, 40, 3395–3401, doi:10.1002/grl.50655.

Data Collected (*Include raw and refine data.*)

No additional data were collected for this project during March 2015.

Identify Problems or Issues Encountered and Proposed Solutions or Adjustments

A quality assurance review of the wilting point data used for the MEGAN simulations suggested an inaccuracy in the VIC dataset. Although we have verified that the MEGAN inputs are consistent with the original wilting point values retrieved from NLDAS-2 for VIC, we are conferring with NLDAS-2 experts for additional confirmation. We do not anticipate delays in completing any additional MEGAN runs, if needed, for the March 20, 2015 draft final report.

Goals and Anticipated Issues for the Succeeding Reporting Period

Work will continue on the development of the draft final report. Additional MEGAN runs will be performed, as needed, to refine the analyses.

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)