# Monthly Technical Report

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

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| **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** | 8/7/14 |
| **REPORTING PERIOD** | **From:** July 1, 2014 **To:** July 31, 2014 | **REPORT #** | 2 |

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.

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

Work during July focused on an overview description of the networks [West Texas Mesonet, Climate Research Network (CRN), Soil Climate Analysis Network (SCAN), Cosmic Ray Soil Moisture Observing System (COSMOS)] that operate soil moisture observation stations in Texas (not provided here) as well as an analysis of data collected during 2006-2013 at selected stations (including two in the Oklahoma Mesonet representative of soil moisture conditions for northeast Texas) labeled in Figure 1.

Figure 1 also shows the spatial distribution of NRCS (1999) soil types found in Texas. The map was constructed using datasets provided by the National Resource Conservation Service (NRCS) of the U.S. Department of Agriculture (USDA) distributed in U.S. Geological Survey (USGS) Digital Line Graph (DLG-3) Optional Distribution Format (http://www.ctre.iastate.edu/research/bts_wb/cd-rom/spatial/dlg.htm). The Soil Survey Geographic Data Base (SSURGO), which is created using field methods and aerial photos, provides the most detailed level of soil information. The detailed SSURGO soil survey maps, or if unavailable data on geology, topography, vegetation, and climate together with satellite images, are generalized to create the State Soil Geographic Data Base (STATSGO). STATSGO is mapped on USGS 1:250,000-scale topographic quadrangle series and is the source of the USDA soil taxonomy classification (order) mapping shown in Figure 1. Table 1 provides technical summaries of selected chemical and physical soil characteristics for the seven Texas soil types according to NRCS (1999).

Figure 1. Locations of soil moisture observation stations in Texas overlain on a soils type map. The boundaries show the ten Texas climate divisions. Measurement data collected at the labeled sites in eastern Texas and southeastern Oklahoma during 2006-2013 are currently being investigated.

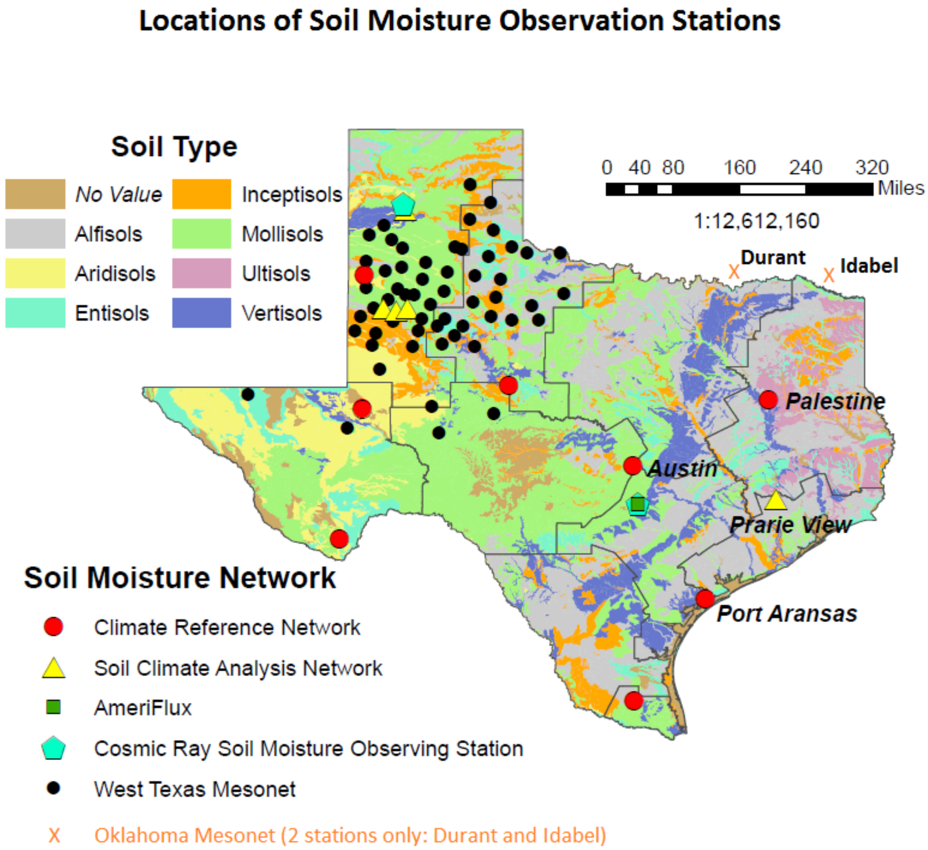


Table 1. Abbreviated descriptions from Chapter *6 The Categories of Soil Taxonomy* from "Soil Taxonomy A Basic System of Soil Classification for Making and Interpreting Soil Surveys" (NRCS, 1999**) for the chemical and physical properties of the seven Texas soil types (ref. Figure 1).

| Soil Type | Description (abbreviated from NRCS, 1999) |
|---|---|
| Alfisols | Properties include a combination of ochric or umbric epipedon, an argillic or natric horizon, a medium to high supply of bases in the soils, and water available to mesophytic plants more than half the year or more than 3 consecutive months. Because these soils have water and bases, they are, as a whole, intensively used. |
| Aridsols | Properties include one or more pedogenic horizons, a surface horizon or horizons not significantly darkened by humus, and an absence of deep, wide cracks (see Vertisols) and andic soil properties. Aridols are primarily soils of arid areas; if irrigated, many are suitable for a wide variety of crops. |
| Entisols | Properties include dominance of mineral soil materials and absence of distinct pedogenic horizons. Entisols support plants and may occur in any climate and under any vegetation. |
| Inceptisols | Inceptisols have a wide range in characteristics and occur in a wide variety of climates formed in any environment except arid, with comparable differences in vegetation. Properties include a combination of water available to plants for more than half the year or more than 3 consecutive months and one or more pedogenic horizons of alteration or concentration with little accumulation of translocated materials other than carbonates or amorphous silica. |
| Mollisols | Mollisols have a combination of very dark brown to black surface horizon (mollic epidedon), a dominance of calcium, crystalline clay minerals, and <30% clay in some horizon above 50 cm if the soils have deep wide cracks (>1 cm). Mollisols typically form under grass in climates that have a moderate to pronounced |

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| | soil moisture deficit, but can also form under a forest ecosystem and sometimes in marshes or in mals in humid climates. |
| Ultisols | Utisols have markers of clay translocation like Alifols but have markers of intensive leaching absent in Alfisols. Properties include argillic horizon and a low supply of bases, particularly in the lower horizons. Cation exchange is moderate or low; in uncultivated soils the highest base saturation is a few cm beneath the surface. Because they are commonly warm and most, they can be made highly productive if fertilizer is applied. |
| Vertisols | Properties include a high bulk density when the soils are dry, low or very low hydraulic conductivity when soils are moist, an appreciable rise and fall of the soil when the soils are moist, and then dry and rapid drying as a result of open cracks. Unique preopertys are high content of clay, cracks that open and close periodically, and evidence of soil movement in the form of slickensides and of wedge-shaped structural aggregates that are tilted at an angle from the horizontal. |

**NRCS Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service. U.S. Department of Agriculture Handbook 436.

Season-Averaged Soil Moisture Observations in Texas

Because this project investigates the impact of soil moisture variability on the prediction of biogenic emissions within eastern portions of Texas, initial analyses of observational soil moisture data are focused on the four labeled sites in Texas in Figure 1 (i.e., “Palestine”, “Austin”, “Prairie View”, “Port Aransas”) in addition to two Oklahoma Mesonet stations (representative of conditions in northeastern Texas) adjacent to the Red River in southeastern Oklahoma (“Durant” and “Idabel”). The hourly data for Texas stations were retrieved directly from the SCAN and CRN websites; summary daily data for the Oklahoma Mesonet stations were accessed via the North American Soil Moisture Database (NASMD) and were only available (at this time) through September 2012. The NASMD was described in the previous monthly technical report.

Figure 2 shows the season-averaged soil moisture values for the Prairie View SCAN location using all available hourly data collected during 2006-2013. A completeness criteria of 70% for individual annual seasons was applied. (For our purposes: winter=Dec/Jan/Feb, spring=Mar/Apr/May, summer=Jun/Jul/Aug, fall=Sep/Oct/Nov). On average across all years, seasonal soil moisture increases with increasing depth at the Prairie View location, varying from a minimum of 0.06 $m^3/m^3$ during summer (5.1 cm) to a maximum of 0.35 $m^3/m^3$ (101.7 cm) during winter. All depths show a similar seasonality with lowest soil moisture values during summer (and fall at 101.7 cm) and relatively higher values during spring and, especially, winter.

To inter-compare the measurements throughout eastern Texas and far southeastern Oklahoma, Figures 3 and 4 compare the 5 cm and 100 cm (when available) seasonal results across the six stations summarized in Table 2. At 5 cm, the lowest soil moisture values were observed at Port Aransas with highest values at Idabel; all locations are characterized by a similar seasonality.  Results at each available location at 100 cm also show strong seasonality (though with less consistency) and increased soil moisture compared to 5 cm; values at Port Aransas are substantially lower compared to the other locations.

The investigation of observed soil moisture at these stations (hourly, daily, and seasonal), including an analysis of inter-annual variability with particular attention to drought year 2011, is on-going.

Figure 2. Season-averaged observed soil moisture using all available measurements during 2006-2013 at the Prairie View SCAN station.

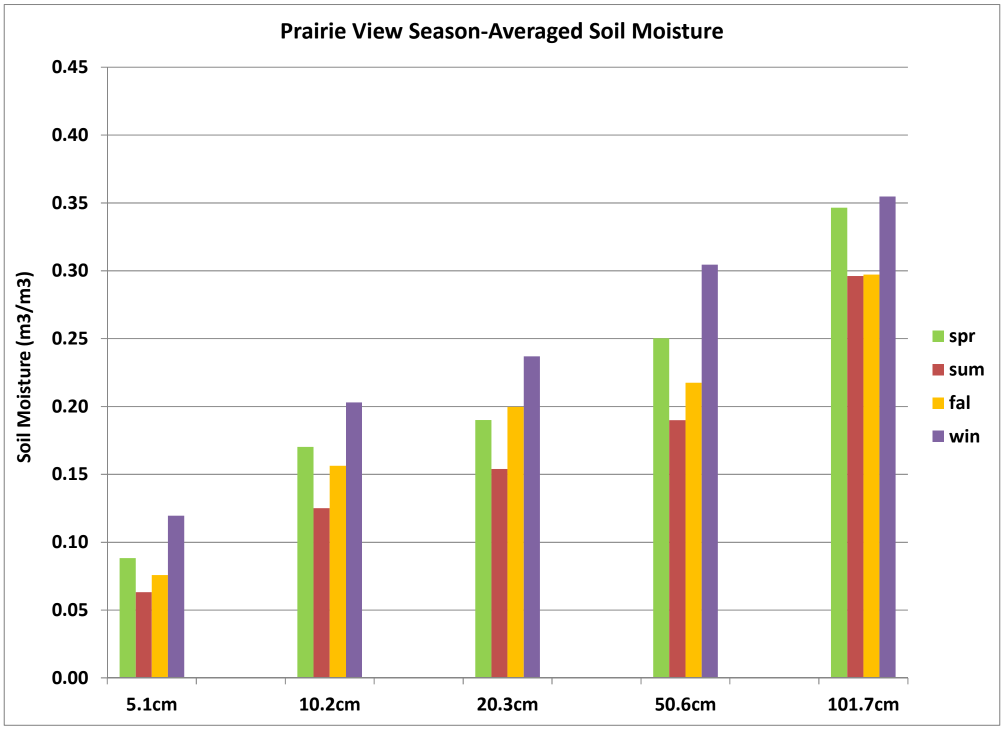



Figure 3. Season-averaged observed soil moisture using all available 5-cm measurements during 2006-2013 at selected stations in eastern Texas and southeastern Oklahoma.

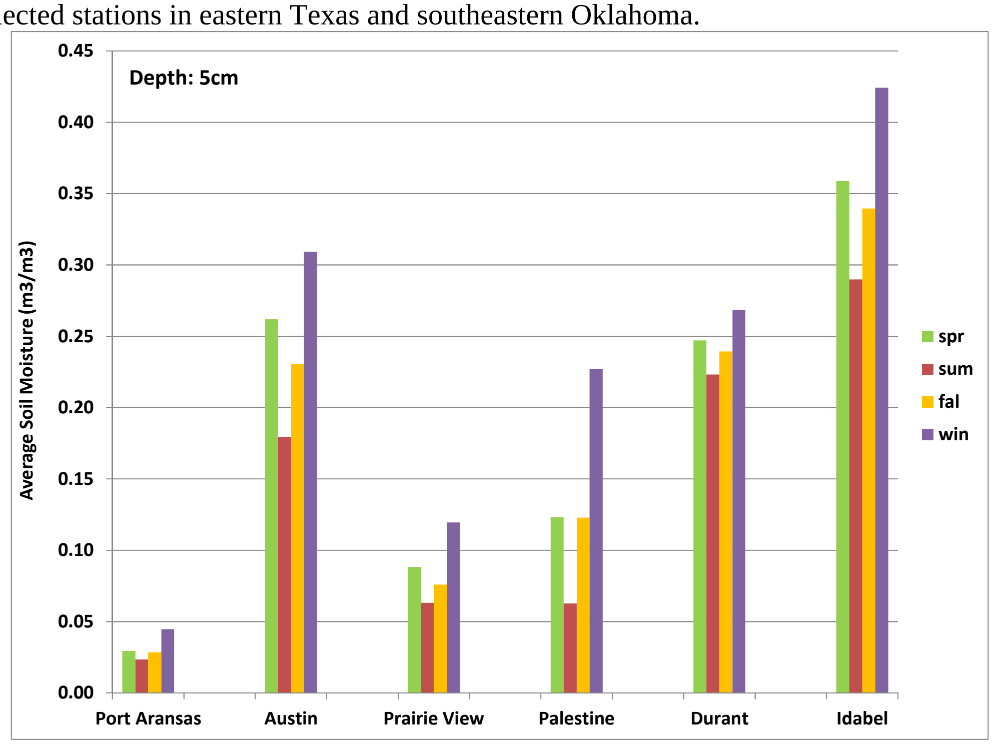
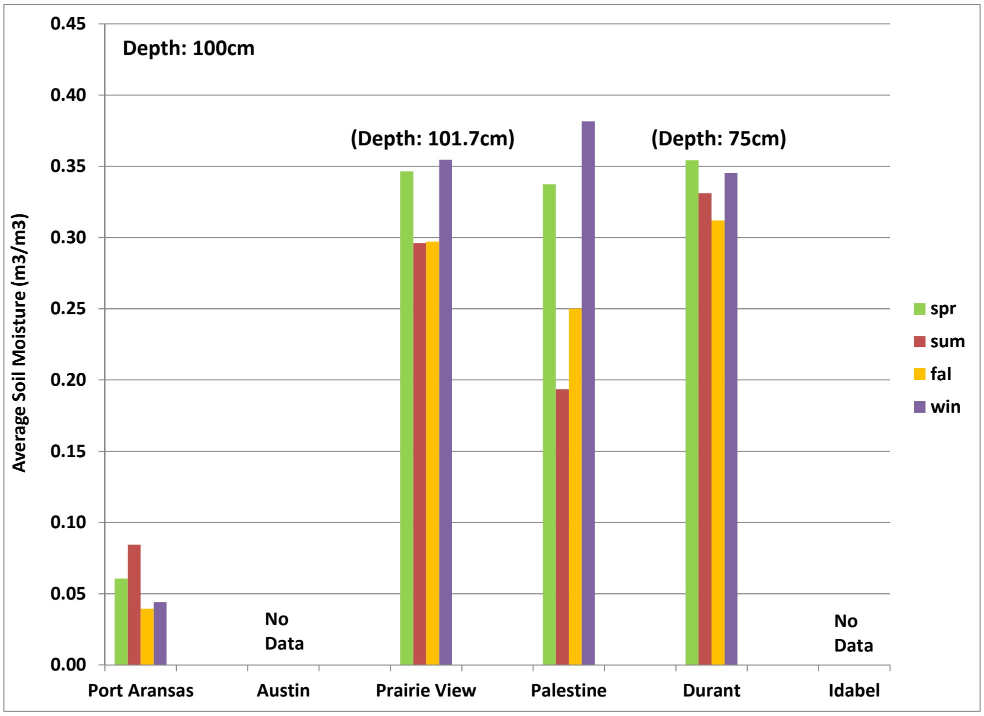


Figure 4. Season-averaged observed soil moisture using all available 100-cm measurements during 2006-2013 at selected stations in eastern Texas and southeastern Oklahoma.




**Preliminary Analysis** (*Include graphs and tables as necessary.)*
Initial analysis of soil moisture datasets for Texas as described above.

**Data Collected** *(Include raw and refine data.)*
On-going collection of relevant soil moisture datasets as described above.

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

**Goals and Anticipated Issues for the Succeeding Reporting Period**
The team will continue to focus on fully investigating and summarizing all available soil moisture databases (observations and predictions) for Texas, focusing on the 2006-2013 time period.

**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.

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Submitted to AQRP by:
Principal Investigator: <u>Elena McDonald-Buller</u>

*(Printed or Typed)*