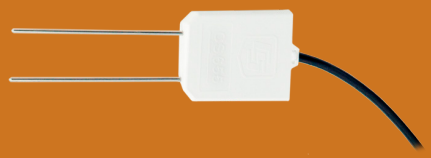
Texas Soil Observation Network (TxSON)

Courtesy Texas Tribune

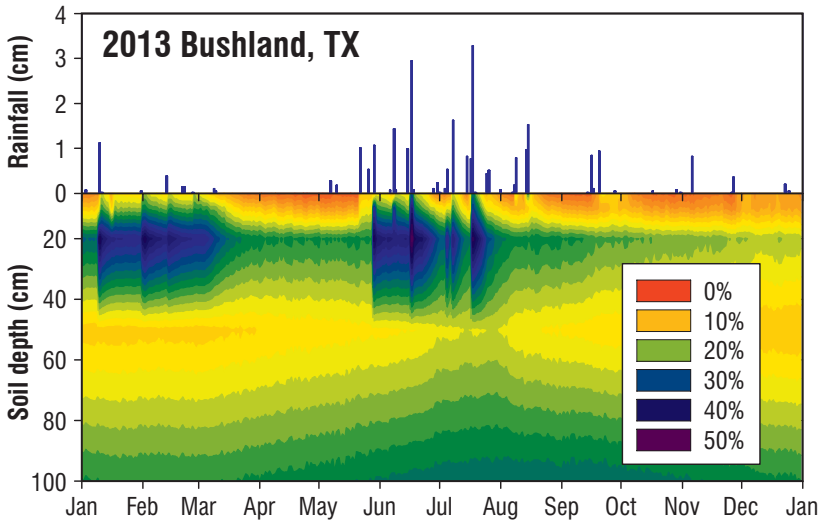
Our Vision and its Benefit



A Program for Monitoring
SOIL MOISTURE
Across the State of Texas

Accounting for all the water in Texas is no small task. We can observe stream flow, reservoir capacity and groundwater levels, but soil moisture is more subtle. As drought continues in Texas, water managers are becoming aware of the soil moisture deficit and its linkage to reservoir and groundwater levels. Yet soil moisture networks are currently sparse across Texas. We need an effective water accounting system to track increasing demands on Texas' water supply. In collaboration with NASA, researchers at the University of Texas at Austin are designing a state-of-the-art soil moisture monitoring network in the Texas Hill country to provide:

- Refined soil moisture satellite data products for operational use and improved forecasting
- Improved drought management monitoring and irrigation requirements
- Data for utilities and industry to meet water, wind, and energy demands
- Real-time emergency response data for natural disasters and environmental emergencies
- Collaboration and outreach to enrich educational resources and promote conservation

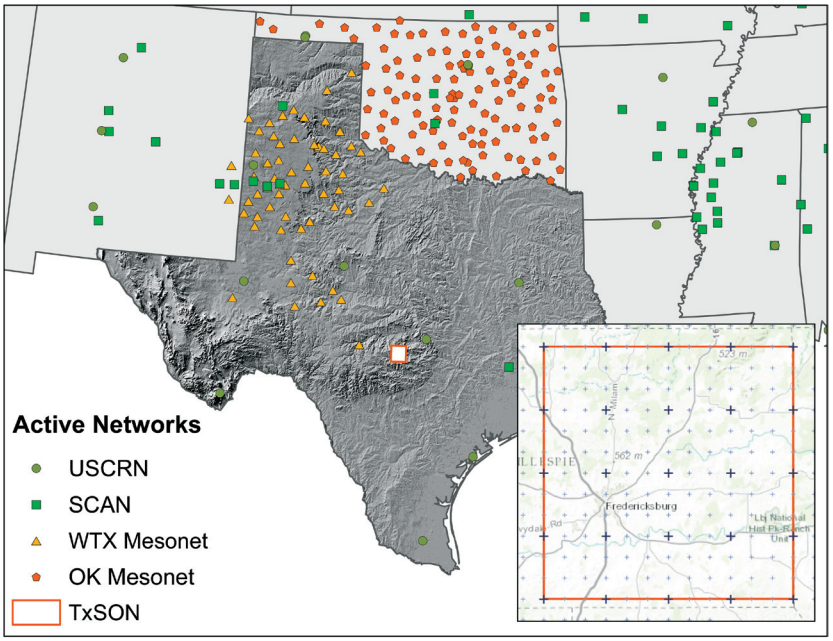


Soil moisture responds directly to rainfall data at the surface by quickly wetting (blue) and slowly drying out (red). Note an increase in soil moisture at depth (50-100 cm) following some heavy summer rains.

Sponsored by: JACKSON SCHOOL OF GEOSCIENCES — BUREAU OF ECONOMIC GEOLOGY

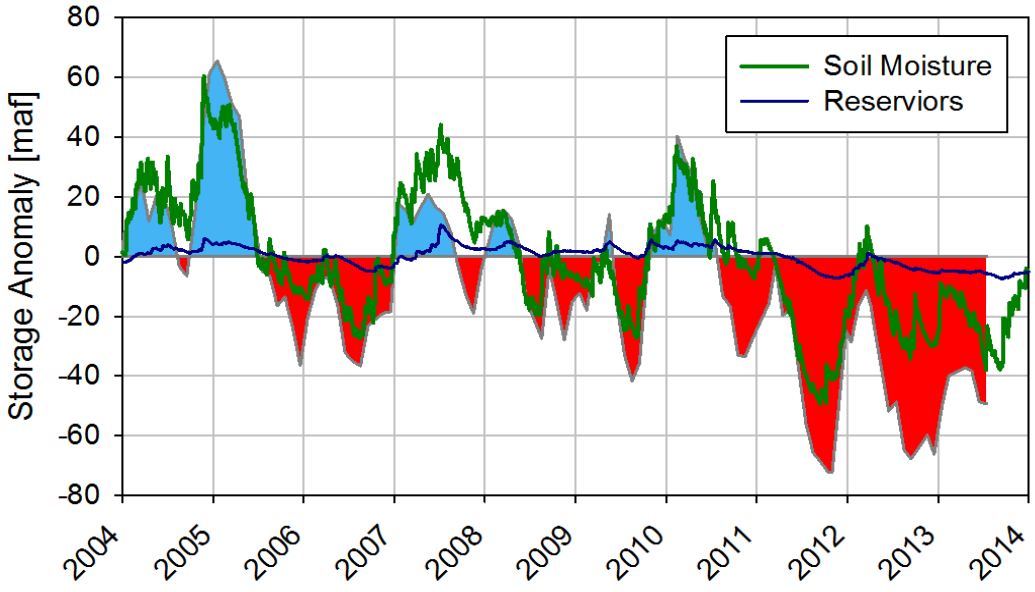
Where is the water in Texas?

Though droughts and floods are inevitable in Texas, the impacts are inherently linked to antecedent soil moisture conditions. When saturated, soils are prone to flood. When dry, a lack of consistent rainfall affects crop and rangeland production resulting in meteorological drought. Prolonged dry conditions result in hydrological drought impacting deeper soil moisture storage which must be replenished before waters can enter reservoirs or recharge aquifers. A time lag exists between these two types of droughts, leaving the public wondering why a "drought" persists even after normal rainfall resumes.



In comparison to other states, soil moisture and meteorological networks are sparse in Texas. The forthcoming Texas Soil Observation Network (TxSON) located near Fredericksburg, TX will serve as our State's first intensively monitoring region (inset).

During the 2011 drought in Texas, researchers at UT estimate a total water deficit of 50 million acre-feet (maf) with soil moisture accounting for 20-100 percent of this shortage. This amounts to a lot of water considering Texans currently consumes 18 maf annually. However, without on-ground data, we can't predict where these losses have occurred, nor can we estimate the amount of precipitation needed to overcome a drought or conversely, produce flooding. The 2011 drought has shown us that neither satellites nor numerical models alone can accurately determine "where" the water is without ground-truth points. The goal of this project is to build a reliable measurement system that connects soil water to surface water and groundwater resources, providing water managers and stakeholders with a more comprehensive ability to meet the future water needs of Texas. A state-of-the-science Texas Soil Observation Network (TxSON) will meet that goal.

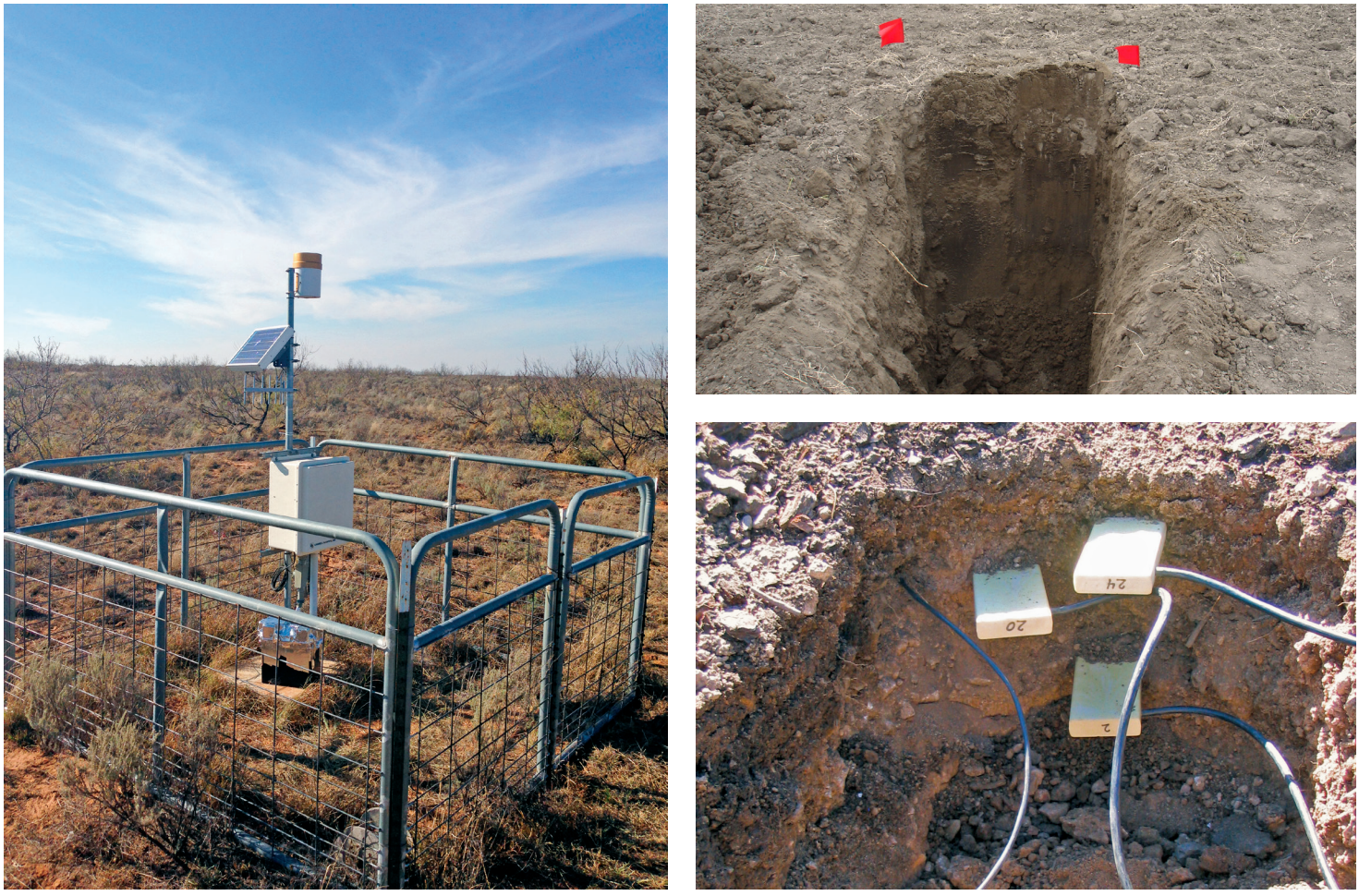


Total terrestrial water storage measured by NASA's GRACE satellite over Texas can tell us changes on the Earth's gravity resulting from gains (blue) and losses (red) of water weight. Change in soil moisture estimated from models is illustrated by the green line and reservoir storage by the dark blue line. The 2011 drought resulted in nearly 80 maf of total loss, with nearly 50 maf being from soil moisture alone, considerably more than the change seen in reservoir storage.

Texas Soil Observation Network (TxSON)

The TxSON will be an intensively monitored area (500 square miles) located near Fredericksburg, Texas, along the Pedernales River and within the middle reaches of the Colorado River. The TxSON will consist of 39 new monitoring stations along with 7 existing stations of the LCRA Hydromet network. Data will be made available to anybody with access to the internet, allowing near real-time decisions to be made by water managers, irrigation districts, and educators. The TxSON will also support NASA's Soil Moisture Active Passive (SMAP) program, which will produce maps of soil moisture across the entire State of Texas. The network will help residents, and local and State agencies of Texas recognize the linkages between soil moisture, crop/rangeland production and water resources while generating high quality data for the NASA mission. This unique network will produce:

1. A focal point for hydrologic monitoring in a vital area for Texas water resources
2. An important first step in building a monitoring network across Texas, one of the most under-monitored areas in the country
3. A unique opportunity for educational outreach, both for K-12 and the University of Texas at Austin, by enlisting students and teachers in field activities and long-term maintenance



Typical layout of a TxSON soil moisture monitoring station (left). The soil pit (top right) is excavated and soil moisture sensor are inserted into the trench face (bottom right). The wires are routed below ground to a tripod containing additional meteorological sensors, a solar panel, and a data logger.

What do we need and what can you do?

Perhaps the biggest challenge to monitoring soil water across Texas is a lack of available land for the monitoring stations. The footprint of a single station is about 10 x 10 feet fenced if necessary to protect it from livestock. To install a station, we dig a small trench, install soil moisture sensors at different depths, and backfill. Meteorological sensors, a data logger and a cellular modem are added to a tripod on the surface. The system is self-contained and powered by a solar panel. Data (soil moisture and temperature, rainfall, air temperature and humidity) are automatically transmitted to an external server using and will be available over the internet in near real-time at the www.centraltexashub.org website. Our initial focus will be to find locations in the area near Fredericksburg (see map above), but expansion will depend on our donations and accessible acreage. Ultimately, we envision a soil monitoring network serving the entire State of Texas. Your financial support, or the contribution of access to small tracts of land, will aid us in accomplishing our objective of informing Texans about its water use and requirements for many years to come.

The Jackson School of Geosciences is investing $48,000 in this collaborative research initiative and requests a donation of $140,000 to fund and name the TxSON research project. This collaboration will result in ground breaking research that will accurately measure soil moisture in the State of Texas, which is critical for our future. The research will be conducted by experienced scientists at the Bureau of Economic Geology who have excellent academic credentials and a proven history of producing stellar research. We ask you to help us collaborate with The University of Texas at Austin on this unique opportunity to partner with NASA.

Texas Soil Observation Network (TxSON)

www.beg.utexas.edu/soilmoisture

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