2025 TEXMESONET ADVISORY COMMITTEE RECOMMENDATIONS REPORT

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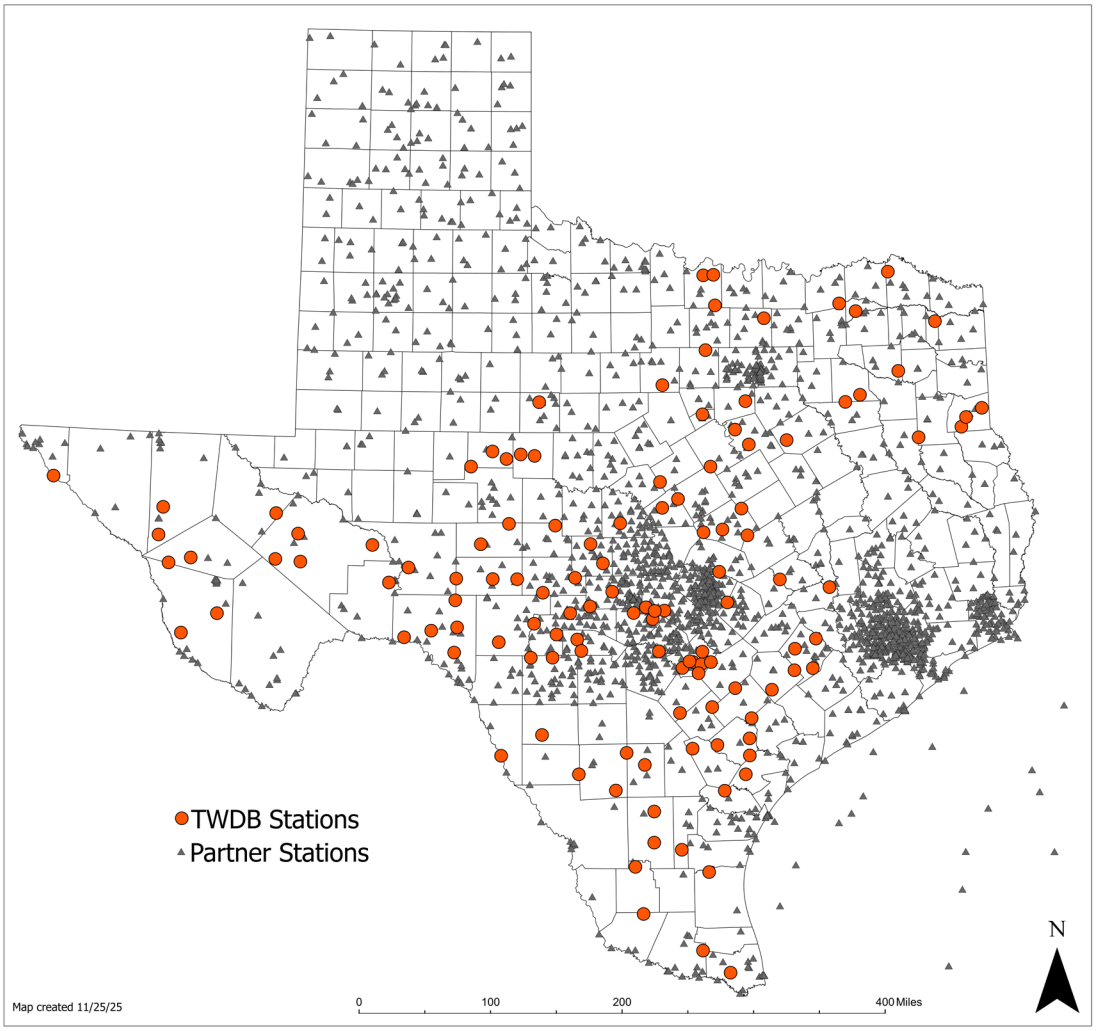
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Introduction

The TexMesonet, operated by the Texas Water Development Board (TWDB), is a system for collecting and analyzing surface meteorological and soil conditions throughout the state of Texas (Wyatt et al., 2023). It consists of two primary components: (1) a network of over 100 automated weather stations located throughout the state of Texas, designed to fill gaps in existing observing networks and provide valuable real-time information on weather and its potential impacts; (2) a system for aggregating and displaying observations from numerous observing networks throughout and adjacent to the state of Texas in addition to those operated directly by the TWDB.

The TexMesonet system includes the observing equipment as well as the personnel, hardware, software, procedures, and documentation for quality assurance, data archival and dissemination, and product and service generation and delivery. The first TWDB TexMesonet station was installed in Blanco County on April 28, 2016, and the most recent station as of this writing was installed in Lampasas County on November 6, 2025. Currently, the TWDB manages 123 weather stations across the state.



To support the expansion of the network, the Executive Administrator of the TWDB created the TexMesonet Advisory Committee (Committee) in 2021. The Committee was later codified by the 88th Texas Legislature in Texas Water Code § 16.028 and formalized with a set of bylaws in 2024. The purpose of the Committee is to advise and make recommendations to the TWDB on ensuring data quality and optimizing the efficiency and effectiveness of hydrometeorological data collection, product development, and dissemination of data and information.

Members of the Committee represent various interest groups and technical expertise relevant to the TexMesonet and serve staggered, renewable three-year terms. Current members are:

- John Nielsen-Gammon (Presiding Officer), Texas A&M University
- Briana Wyatt (Vice Presiding Officer), Texas A&M University
- Bryan Anderson, Edwards Aquifer Authority
- Alan Barraza, Texas Commission on Environmental Quality
- Guy Fipps, Texas A&M University
- Bradley Illston, University of Oklahoma
- Luke Kanclerz, Texas A&M Forest Service
- David Murdoch, Lower Colorado River Authority
- John Schroeder, Texas Tech University
- Greg Waller, National Oceanic and Atmospheric Administration

In February 2025, the Committee welcomed the two newest members: Bradley Illston and Luke Kanclerz. They were nominated by the Committee in recognition of their respective expertise in mesonet operations and wildfire and public safety.

The Committee meets at least quarterly to stay abreast of TexMesonet operational status and relevant issues and to exchange information regarding stakeholder needs, best practices, and ideas for improvements. In keeping with its mission, the Committee also provides a formal set of recommendations biennially to the TWDB for enhancing the value and benefit of the TexMesonet to the State of Texas. This document is the first Recommendations Report, marking a significant milestone in the Committee's efforts to formalize and advance communication between them and the TWDB.

To inform and inspire the development of the 2025 recommendations, the Committee hosted presenters from both internal and external partners. In February, Dr. Jerry Brotzge presented on *Creating Value: Mesonet Partnerships and Products*. Dr. Brotzge serves as the State Climatologist of Kentucky, the Director of the Kentucky Climate Center, and Director of the Kentucky Mesonet. He has also worked with both the New York Mesonet and the Oklahoma Mesonet. His presentation provided insights on mesonet operations, from funding and data products, to garnering public buy-in and the usefulness of advisory groups. In May, Dr. Ali Mousavinezhad, TexMesonet's Data Team Lead, presented on *TexMesonet Data Products: Past, Current, Future*. In his presentation, he reviewed the team's progress regarding data quality control; findings of an assessment of existing data products and dissemination methods used by 28 other mesonets; and cloud computing investments made by the TWDB.

To facilitate focused discussion and efficient drafting of recommendations, the Committee established three subcommittees. Members joined the subcommittee most aligned with their interests, and each was led by a volunteer chair responsible for coordinating meetings and managing writing assignments.

- Infrastructure/Network Subcommittee, chaired by Bryan Anderson
- Data/Products Subcommittee, chaired by Briana Wyatt
- Dissemination/Outreach/Stakeholder Partnerships Subcommittee, Chaired by John Nielsen-Gammon

The Committee recommendations fall into five general categories:

- Recommendations for monitoring sites owned by the TWDB
- Recommendations for monitoring sites owned by partner networks
- Recommendation for improving data availability via an application programming interface (API)
- Recommendation for developing a partnership with the Texas Division of Emergency Management (TDEM)
- Recommendations related to TexMesonet product dissemination

Each of these categories are further described below, with recommendations in bold text.

Recommendations for monitoring sites owned by the TWDB

Standardize, document, and publish online all sensor calibration and installation procedures to result in a Level 4 or 5 rating on all Sensor Performance and Maintenance categories in the American Association of State Climatologists (AASC) Mesonet Recognition Program Requirements and Procedures.

In the context of the TexMesonet, quality assurance (QA) procedures are those performed on instrumentation (such as recalibrations, rotation of sensors, etc.) to ensure the measurement and collection of quality data. Included within QA procedures is quality control (QC), which is related to data processing after collection and is described in the next recommendation. This follows the standardized definitions used by the World Meteorological Organization (WMO, 2021). We recommend that all QA procedures should be at minimum Level 4 based on AASC recommendations (link). Two primary actions are needed to meet this recommendation:

- Standardize, document, and make publicly available the results of all sensor tests or calibrations done prior to installation for TWDB sites.
- Standardize, document, and publicly disseminate all installation procedures for TWDB sites.

These steps will build user trust in data provided by the TexMesonet and improve the proper application of data of various levels of quality.

Implement a series of quality assurance procedures, tests, notifications, and reports on all data (including both internal and external data sources) disseminated by the TexMesonet to result in Level 4 or 5 rating on all Quality Assurance and Control categories in the AASC Mesonet Recognition Program Requirements and Procedures.

Trust in data is paramount to the growth and success of any meteorological and/or climatological observation network. If untrusted data are disseminated to the public, shareholders, and end users, then doubts on the professionalism, validity, and usefulness of the network will result and cause immense reputation hardships. Through implementing a variety of QA/QC procedures, the ability to provide high-quality datasets and products is maintained.

Quality control procedures are performed on the data collected from instrumentation to ensure the data are not in error before making the data available to users. Quality control staff should be hired and trained to lead the efforts to process all data handled and disseminated by the TexMesonet. This staff would be responsible for the following key components:

- Automated Tests: With the ingestion of hundreds of thousands of data points every day, automation of QC is paramount. Before ingested data from TWDB and partner networks are disseminated publicly, a series of tests should be performed on each data value. These tests can include range tests (e.g., a relative humidity of 120% would be flagged as erroneous), step tests (e.g., a change in soil moisture from 90% to 5% in 5 minutes would be flagged as erroneous), a climatological test (e.g., a temperature of 110°F in February would be flagged as suspicious in most locations), and many more. Each test would have different parameters per variable and could be adjusted as needed. Over time, additional QC tests could be implemented when warranted. The tests can have multiple values of quality values such as “good”, “suspect”, or “bad” to allow a more precise first pass analysis of the data.
- Manual Analysis: Routine analysis of data should be performed by a human to investigate all automated flagged observations and to seek out potential sensor issues that automation may not discover. For each automated flagged observation, the staff should determine the cause of the error to see if that sensor needs to be replaced before additional issues (and loss of data) occur. The staff should also manually look at time series graphs and spatial plots of data to determine any drift or bias issues and/or nearby outliers in instrument measurements.
- Flagged Files: Raw data files are to never be altered. Thus, flagged files would be created consisting of the results of the automated tests and cross-referenced via site specific identification and date and time of observation. These flagged files could be changed if a determination is made by a human that the automated tests either missed edge cases or flagged actual rare phenomena (e.g., heat burst). Through a combination of raw data files and flagged files, public data files would be created. These public data files should be regenerated routinely to allow for changes to quality assurance flags to be applied as error modes emerge and QA/QC techniques improve.

- Reporting: Daily reports of automated tests should be sent to staff for review and further investigation of issues. Monthly, quarterly, and annual reports should be generated and shared with the Committee, who can provide troubleshooting, sensor recommendations, and expert advice.

Through this implementation of QC procedures, the TexMesonet would maintain a high level of data quality available to end-users, enable increased funding available from federal sources (e.g., National Mesonet), and allow easier growth of the network from support via quality recognition of the network's operations.

Recommendations for monitoring sites owned by partner networks

Establish criteria for partner networks to standardize station and sensor metadata required for inclusion in TexMesonet and provide that information to the public.

Approximately 3% of stations providing data to the TexMesonet are operated and maintained by the TWDB, while the other 97% are managed by partner networks. Information on TWDB stations is available to the public, but station and sensor information for partner networks is not consistent or available to users via the TexMesonet viewer.

In order to maintain the integrity of the data collection sites, certain metadata should be required before including partner network data in the TexMesonet.

At a minimum, the partner networks should provide:

Site Information:

- latitude and longitude of station with datum
- land surface elevation of station with datum
- general description of the site
- site transmission interval/data availability interval
- site maintenance schedule

Sensor Information:

- type of instrument used for each sensor, including manufacturer and model
- list of parameters with the units of measure
- collection interval of measured parameters
- sensor maintenance schedule

Partner networks should be required to confirm and/or update site metadata on an annual basis. Once reviewed by TexMesonet staff, this information should be included on the TexMesonet website.

Establish criteria to standardize a tiered grading system of partner networks and to assist in upgrading partner networks sites to the highest tier.

In order to better identify the status of partner networks, each should identify the “Level” of their networks/sites for each “Category” according to the AASC Recommendation and Best Practices for Mesonets document (AASC, 2019). Based on those results, TexMesonet staff should create a tiered grading system for the existing networks/sites. TWDB installed TexMesonet stations are categorized as the highest tier. Any new partner networks should be required to perform the same analysis and assigned the appropriate tier.

Because of the varying networks that contribute to the TexMesonet, it can be difficult to distinguish between sites displaying data in real-time and those with delayed updates. These network/site specific tiers will make it easier to quickly view only those stations with the most current data.

The TexMesonet program should assist in upgrading existing partner network sites to the highest tier in any way possible, either through financial/equipment assistance or any other appropriate means. This includes sharing all protocol documents and recommending QA/QC protocols for partner networks to improve consistency of data across networks. Priority should be given to sites located in data gaps.

Recommendation for improving data availability via an API

Make all variables accessible via the Application Programming Interface (API), and remove limits on the API of a single station and specified time period such that all data collected from all sites at all times be easily accessible for those who desire to use it.

Currently, only the following information is openly available for direct download for research and applications using the TexMesonet API:

- List of stations and locations
- Most recent record from each station
- All charting fields for a single site
- Time series of air temperature for one site and a specified time period
- Time series of relative humidity for one site and a specified time period
- Time series of barometric pressure for one site and a specified time period
- Time series of precipitation for one site and a specified time period
- Time series of wind speed for one site and a specified time period

Many other variables and derived variables exist, but presently can only be downloaded manually using the “Custom Datasets” web request page, which enforces limits on how many stations and how much data may be downloaded at a time. This system is overly cumbersome and restricts the utility of data collected by the network, especially for long-term studies, studies

with a broad geographic focus (i.e., regional or statewide), or development of applications using machine learning, all of which require the use of data from multiple sites and years.

Recommendation for developing partnership with TDEM

Establish a formal partnership with Texas Department of Emergency Management (TDEM) to support TexMesonet design, operations, product development, and decision support.

While discussions regarding a statewide network of automated weather stations had been taking place for many years, the impetus for the TexMesonet program was the Wimberley flood in 2015. Other mesonets around the country, such as the Kentucky Mesonet and the New York Mesonet, were created primarily to serve public safety. Like most statewide mesonets, the TexMesonet has many uses, but public safety during weather emergencies is a core application. A formal partnership with TDEM would increase the value of the TexMesonet to the State of Texas and its citizens.

Such a partnership should involve many aspects of the TexMesonet program. Station siting should be informed by the potential to fill critical weather monitoring and information gaps during weather emergencies, as identified by state and local officials. Such stations may typically be comprehensive mesonet stations, but the possibility of denser subnetworks with focused instrumentation might also be considered. Product development specifications and prioritizations would involve considerations of their use within the State Operations Center and by local emergency managers and public safety officials.

As the TexMesonet product suite becomes more extensive and includes products designed specifically for emergency management, the TWDB may come to play a larger supporting role in emergency operations, providing expert training, guidance, and interpretation of TexMesonet data.

The Committee believes that this would be a critical partnership worthy of special treatment and attention, fundamentally different from interaction with other state agencies. By increasing both the actual and perceived value of the TexMesonet, it would help ensure the TexMesonet's continued existence and support, including upholding its high standards of reliability.

Recommendations related to TexMesonet product dissemination

Improve availability, usability, and resolution of mapped products.

This should be done by implementing the following changes:

- Producing basic near real-time and historical maps of all variables statewide (currently only temperature and precipitation are available) at multiple times (i.e., 24-hr, 48-hr, one week, two weeks, etc.). See Oklahoma Mesonet webpage for additional examples.
- Use a more user-friendly image format: We recommend *.png or *.jpg, which are easily shareable. Current PDFs are difficult to use and share. Additionally, PDFs will require additional ADA compliance by April 2026 (Web Content Accessibility Guidelines (WCAG) two requirements). The interactive map is not shareable.
- Improve spatial resolution, create regional maps: End users would likely appreciate regional maps that provide higher resolution over a smaller area. This could be done using the climate zones of Texas, or other already-established regional boundary systems. The addition of county outlines in all map products would also provide additional geographical reference.

Improve the accessibility of online interactive maps to facilitate the use of TexMesonet data by the public and first responders.

Presently, the only way for the public to access near real-time maps of TexMesonet data is by using an internet browser to visit texmesonet.org. While the interactive map found at the site is helpful when using a desktop computer, it is quite difficult to use on a mobile device and is not optimized for small screens. The creation and hosting of mobile-friendly maps should be a straightforward short-term improvement and can serve as a stepping stone to the app development in the following recommendation below.

Develop an app incorporating TexMesonet data and other weather safety information. The app should be inspired by the very successful Oklahoma Mesonet app.

The TexMesonet has an interactive website with many maps, graphs, and other products. However, most people use smartphones as their primary devices over the course of a typical day. Creating a comprehensive and reliable TexMesonet app for iOS and Android would bring TexMesonet data and products into the hands of many more potential users of weather information.

The Oklahoma Mesonet app primarily delivers graphical products that are already available on the Oklahoma Mesonet website. Such products include maps, graphs, and current data. The TexMesonet app could do the same, and additional app-based products could also be added to the website.

The TexMesonet website delivers near real-time radar data from the National Weather Service. The Oklahoma Mesonet app does the same, and also delivers real-time weather warnings, making the app a comprehensive public safety tool. The delivery of weather warnings would greatly enhance the value of a TexMesonet app, potentially making it the go-to app for Texans interested in the weather while enhancing public safety. However, the development of a tool with incorporation of weather warnings must be done with great care, ensuring accurate and timely delivery of weather warning information.

The Oklahoma Mesonet app also includes a “Ticker” feature, a lighthearted daily weather discussion regarding recent or upcoming weather events. Such a daily discussion enhances engagement with the app as well as improving overall weather awareness and understanding, paying dividends when severe weather strikes.

Produce a regular weather newsletter with daily and weekly information and updates.

Data and information delivery by the TexMesonet is presently modeled on a “pull” mechanism, whereby individuals must go and access the data or utilize computer software to retrieve the data. This mode of data and information delivery works well for extremely knowledgeable users who already know what they want and need, but it is not well suited for expanding the TexMesonet’s utilization and value.

A daily or weekly newsletter would provide a means of pushing information out to stakeholders regarding Texas weather as monitored by the TexMesonet. Such a newsletter would serve an educational purpose, helping make people aware of weather hazards and risks while also conveying an accurate picture of their prevalence. It would highlight upcoming potential weather hazards and place recent weather and climate events into a historical context.

One potential model for such a newsletter is the Oklahoma Mesonet “Ticker”, mentioned above and produced by the Oklahoma State Climatologist, but the newsletter would need to be distinctly Texan. The newsletter would be of service as well to Texas legislators, highlighting weather issues such as drought and water supplies of concern in their districts.

The newsletter would also increase the visibility of the TexMesonet among the citizens of Texas. The newsletter can be a medium for announcing new stations and products as well as other issues arising from the TWDB and its operations.

We envision an email subscription service, but there are other communication media that could serve a similar function.

Conclusion

This document summarizes the short- and long-term recommendations developed by the TexMesonet Advisory Committee. These recommendations are intended to guide the TWDB in the improvement of data availability, data quality, and public awareness of the TexMesonet, with the ultimate goal of making the TexMesonet a world-class environmental monitoring network providing improved safety and water security for the people of the State of Texas.

References

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