The University of South Alabama Mesonet: Challenges and Opportunities for the Future

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History
The University of South Alabama (USA) built its first mesonet station in January 2000. By October 2009 four stations existed. A grant from the National Science Foundation allowed for the installation of these first four stations. Funding for more stations was received in 2006 through NOAA. Currently the network consists of 26 research quality weather stations (Figure 1) and is the only network of its kind on the north-central U.S. Gulf Coast. The USA Mesonet stretches about 325 km in an east-west direction, across three states. The north-south dimension ranges from about 100 km at the western end to about 35 km in southeast Alabama north of the Florida Panhandle. The spacing between stations ranges from 5.4 to 55.6 km with an average of about 30 km.

Station Configuration
All USA Mesonet stations are enclosed by a 9.14 by 9.14 m fence (Figures 2 and 3). The fence is 2.44 m tall including three strands of barbed wire at the top of a chain-link base. A 3.05 m wide gate is located on the north side of the enclosure. In the center of the enclosure is a 1.22 by 1.22 m concrete foundation that anchors the tower base plate (Figure 4). The concrete foundation is 0.61 m deep. Two smaller concrete pads measuring 0.46 by 0.46 m are located to the north of the tower foundation and form the base of the rain gauge supports. The tops of the rain gauge funnels are 82.5 cm above the ground. At a distance of 1.12 m south with a 0.46 m tower foundation is a "tower lift anchor pipe" that supports a winch used to raise and lower the towers (Figures 5 and 6) which are hinged at the northern end of the base plate. The towers are secured with three heavy duty (4.76 mm diameter) guy wires secured into the ground with 15.86 mm wide, 1.22 m tall anchor plates. This robust construction was chosen due to the relatively frequent occurrence of severe weather in the area, including tropical storms and hurricanes.

Instruments
Table 1 lists the instruments installed at USA Mesonet stations. Sensor redundancy exists to maximize data collection during severe weather events. World Meteorological Organization (WMO) instrument siting standards are followed as closely as possible. In some cases, minor compromises were necessary such as putting nearby obstructions in order to secure a safe, no-chance lease of land with free Internet access.

Data
Data are collected at 1-minute intervals using a Campbell Scientific CR 3000 datalogger. A Campbell Scientific AM16/32 multiplexer is used to accommodate the large suite of sensors. All stations are powered by solar energy using a BP Solar SX30U solar panel which charges a 12 V battery. A fully charged battery will power the station for approximately six days before discharging to the critical dysfunctional level of 10 volts. Data is sent to a nearby building using line of sight transmission via 900-MHz bidirectional spread-spectrum radio. An antenna inside the datalogger enclosure communicates with a directional glass-mount dipole antenna on the inside of a window in clear line of sight view of the tower. These antennas have a range of 1 mile. At some sites two 10-mile range antennas were needed; an Omni-directional antenna was placed on the tower and a directional Yagi antenna was mounted at the building. Both of these antennas are placed outside. The data flow to the Internet via a Lantronix SSL 301 Ethernet/IP gateway.

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Data Access:
Data are available online at: http://chillweb.southalabama.edu/

Figure 1: Map of USA Mesonet stations

The majority of station hosts are public schools which provide a safe, well maintained environment with minimal vandalism and free access to the Internet. Additionally, they offer an important link for community outreach and K-12 education. Many stations are located in counties where previously no data were available at all. This is crucial to the Mobile National Weather Service Forecasting Office and local TV stations in fulfilling their mission of forecasting and issuing severe weather warnings.

Figure 2: Bird’s-eye view of USA Mesonet weather station layout. Components are not drawn to scale.

Figure 3: North facing photo of USA Mesonet station

Two 3 m long, east-west oriented cross-arms are mounted on the tower to support instruments at 1.5, 2.9, and 10 m elevation (Figure 7). Additionally, a 1.5 m long, north-south oriented cross-arm is mounted at the 15 m level. A solar panel is mounted on the tower at about 7.1 m AGL. All stations are grounded using a 2.44 m copper ground rod attached to the tower base by a copper wire.

Figure 4: Rebar for concrete foundation.

Figure 5: Winch mechanism secured on tower lift anchor pipe.

Figure 6: Raising and lowering of towers occurs with an electric winch mechanism.

Figure 7: Schematic of USA Mesonet station layout (components not drawn to scale).

Figure 8a and b: Kudzu at Atmore AL – the insect pests impales dead animals on the station fence (a) including birds its own size.

Figure 9: Bird’s nest under datalogger enclosure

Figure 10: The Loggerhead shrike (a) impales dead animals on the station fence (b) including birds its own size.

Challenge 1: Funding
Currently, the biggest challenge facing the USA Mesonet is securing reliable, long term funding. Federal appropriations have kept the project going for the past 4 years, but this funding source remains uncertain for the future. Unfortunately, traditional research funding avenues such as the National Science Foundation do not support operation and maintenance of existing observing systems or research equipment. It costs approximately $12,000 per year to keep one weather station operational. This includes staff salaries, operation and maintenance of a service vehicle, building rental, calibration and replacement of sensors, and maintenance/replacement of computer equipment. Several avenues of funding are actively being pursued.

Figure 11: Wasp nest under TB3 tipping bucket rain gauge.

Challenge 3: Weather
In August 2005 Hurricane Katrina’s outer eyewall directly hit the Pascagoula, MS station (Figure 12). The storm surge brought in debris that can be seen on the south-facing side of the fence, but fortunately did not reach as high as the datalogger enclosure. Shortly after the peak 10 m wind speeds were measured, the tower leaned over, causing the 10 m anemometer wires to become unplugged (Figure 13). At 0412 CST on 27 March 2009 a wind gust of 38.25 m s⁻¹ was recorded at Robertsdale, AL. An outbreak of severe weather and associated tornadoes passed directly over the station. A house about 1300 m to the west-southwest of the tower incurred significant roof damage (Figure 14) with debris strewn to the east and northeast of the house. The station tower incurred no damage.

Figure 12: Leaning tower and debris at Pascagoula MS after Hurricane Katrina

Figure 13: Hurricane Katrina measurements at Pascagoula, MS.

Figure 14: Damage to home at Robertsdale AL in March 2009.

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