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# THE MISSISSIPPI MESONET: PHASE 2

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## 1. INTRODUCTION AND OBJECTIVES

Following the Mesonet 2002 conference in Norman, OK and a stakeholders workshop held in Jackson in October 2002, plans were made for Jackson State University to take a leading role in developing a world-class mesoscale observing network in Mississippi for research, education, and operational use: The Mississippi Mesonet (White and Matlack 2005).

In partnership with the National Weather Service, a multi-institution steering committee has promoted the anticipated benefits for Mississippi of a statewide mesonet:

- •Improved weather forecasts
- •Improved hydrologic forecasts
- •Emergency management
- •Weather research and modeling
- •Agriculture
- •K-12 and higher education

In particular, special attention has been focused recently on the impacts of severe weather for public safety and the economy, as exemplified by the Central Mississippi outbreak of F3 tornadoes in April 2005 and the catastrophic devastation of Hurricane Katrina in 2006. Strong partnerships have naturally resulted with local and state emergency managers.

Significantly for NOAA, the mesonet has been promoted as a testbed and prototype for modernization of the cooperative observing system ("COOP") within NERON. By incorporating Mississippi Mesonet data into MADIS, data are made routinely available for NWS forecasters and for potential assimilation into NOAA operational models. The mesonet also benefits NOAA by providing quality data for atmospheric research and as an opportunity for minority undergraduate students at JSU to gain experience with research instrumentation and data analysis.

## 2. STRATEGIES

Using seed money from the NOAA Center for Atmospheric Studies (NCAS), JSU has been able to leverage various local, state, university, and federal funding sources over a three year period to design and build the initial prototype network. During this Phase 1 of what is planned to be a comprehensive statewide network, an exhaustive survey of existing observing platforms within the state was made (White and Finney 2005), to consider the complementary roles of multiple networks and implications for modernization of the COOP network.

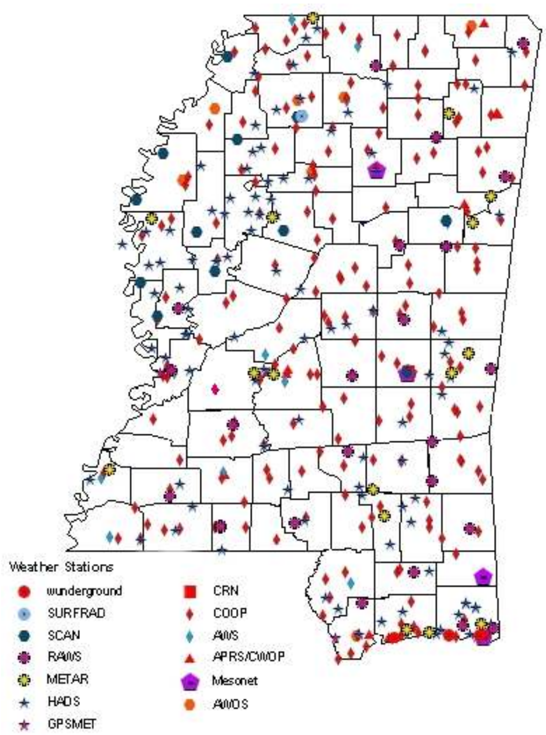


Figure 1: Survey of observing networks in Mississippi.

The observing system that was selected blends the instrumentation and protocols of the Oklahoma Mesonet (Brock *et al.* 1995) and the Louisiana

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Agriclimatic Information System (LAIS) (Greenland 2005), with one-minute temporal resolution and sensor redundancy. Real-time two-way communications are currently provided by spread spectrum radio, with consideration that the law enforcement telecommunications system (LETS) and/or MeteorBurst may be used at some sites in the future.

Following the guidance of the NWS ISOS team, a 20 mile grid was projected onto the state as a tool to plan for an eventual network of 120 stations evenly distributed around the state.

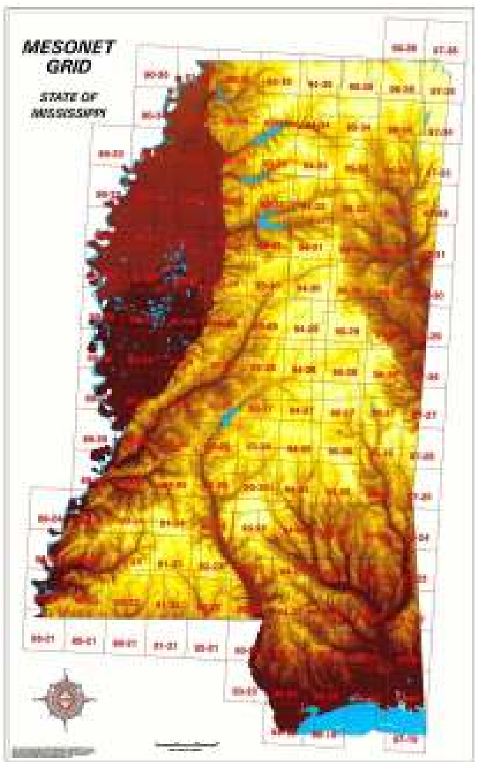


Figure 2: Overlay of 20 mile grid on topography.

Installation of the first five stations commenced from 2004 to 2006, to form the Phase 1 prototype network. During this time a critical partnership was formed with the National Center for Biodefense Communications at JSU. Also, extensive documentation describing site selection and installation procedures has been developed in order to strive for consistency and efficiency.

Figure 3: Mesonet station at Calhoun City shortly after installation.

Figure 4: Undergraduate Meteorology student assisting with installation of mesonet station.

The general categories of measurements being made include:

- Air temperature
- Wind
- Humidity
- Precipitation
- Pressure
- Solar radiation
- Soil moisture and temperature

## 3. NETWORK STATUS

The recent renewal of JSU's funding under NCAS will ensure continued operation of the network through 2011. By early 2007, the mesonet is expected grow to about 10 stations, about half of which will be in the coastal region. Recent efforts to develop a comprehensive website (http://jsumesonet.jsums.edu/index.htm) and data management scheme are continuing.

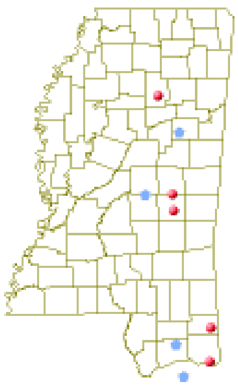

Figure 5: Mesonet sites active as of October 2006 (Red); new sites to be installed by January 2007 (Blue).


Figure 6: Snapshot of website under development.

## 4. CHALLENGES

The greatest challenges during Phase 1 were how to make progress with the limited resources available and the need to gradually build up institutional support for the concept of the Mesonet. The constraints of obtaining long-term access to sites with sufficient exposure that could provide spread spectrum radio transmission to a static internet site (such as public schools) was another obstacle within the rural forested environment of much of Mississippi.

Although the state has been subjected to a large share of tropical cyclones and severe weather over the last two years, observing equipment failures have been extremely rare. Most data interruptions have been due to internet connection problems and software issues. There has been a significant spin-up process for development of software, data management tools, and World Wide Web products.

Moving into Phase 2, the looming challenge is to develop more comprehensive funding mechanisms for growth and maintenance of the network.

## 5. CURRENT APPLICATIONS

Currently the data are used by NWS Weather Forecast Offices (WFOs) for forecasting and storm reports. On an hourly basis, data are integrated with NWS/FAA synoptic data to produce contour and streamline maps that are served via the website. Emergency managers use the data to

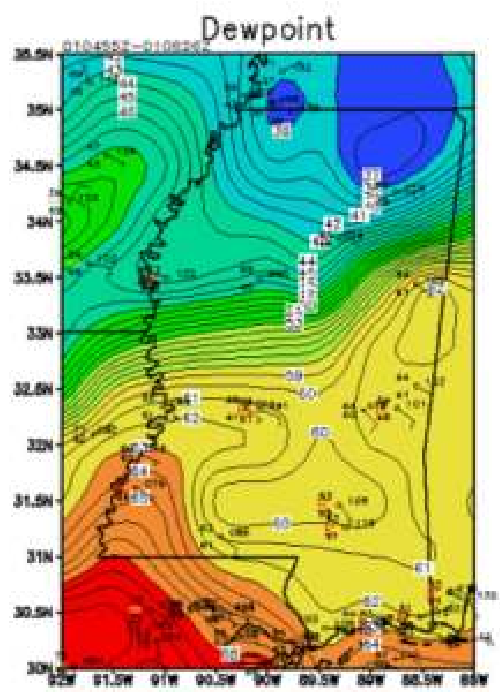


Figure 7: Example of synoptic contour map of dewpoint for 4 April 2005.

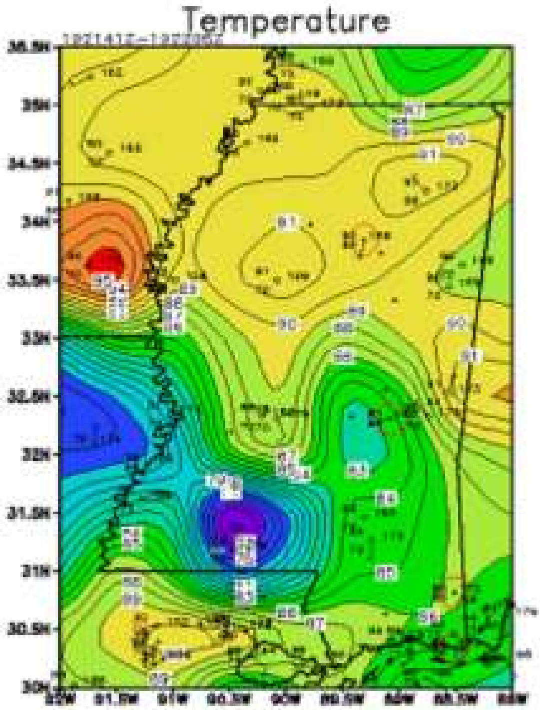


Figure 8: Example of synoptic contour map of temperature from 19 June 2006, with mesonet stations circled in red.

provide local weather support in areas underserved by other networks. Recently, wind data from the Pascagoula site was used in a highly publicized legal case to settle hurricane insurance coverage issues arising from damage by Hurricane Katrina. Development of time series plots is underway, along with initiatives for data use in K-12 education.

Mississippi Mesonet data are currently being employed in research projects led by university and agency investigators. USDA scientists at the National Sedimentation Lab in Oxford and at the Plant Materials Lab in Coffeeville use the data for hydrology and crop studies. At JSU, various projects make use of the mesonet for studies on mesoscale modeling, the land/sea breeze circulation, nocturnal warming, and atmospheric dispersion. The University of South Alabama has supported the Mississippi Mesonet to provide in situ data for studies on interactions during hurricane landfall. And Mississippi State University will soon be applying mesonet data to studies on land-surface interaction in severe storm environments.

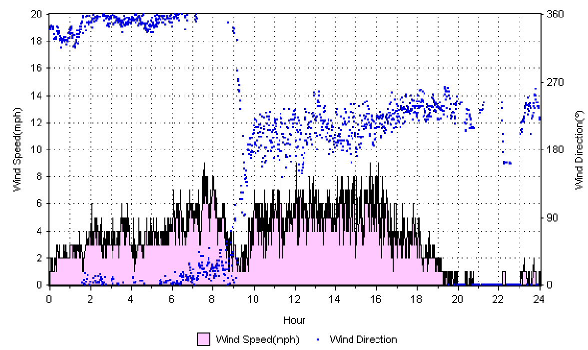


Figure 9: Time series of 10 m wind speed and direction at Pascagoula on 2 September 2006, showing transition between land breeze and sea breeze.

Shortly after the first mesonet station was installed at Newton, surprisingly dramatic cases of nocturnal warming were noted that were not associated with frontal passages or convective activity. These “nocturnal warming events” (White 2005) are being investigated in the context of regime transitions within the nocturnal boundary layer. Typically the temperature will increase 2 to 5 degrees Celsius within a 15 to 30 minute period, and then remain nearly constant for 1 or 2 hours before suddenly returning to the expected regime of gradual nocturnal cooling. In most cases the warming is accompanied by a sudden decrease in dewpoint, presumably by mixing of warm dry air from the nocturnal inversion. Antecedent conditions have nearly calm winds, which increase to speeds of 2 to 3 m/s during the warming.

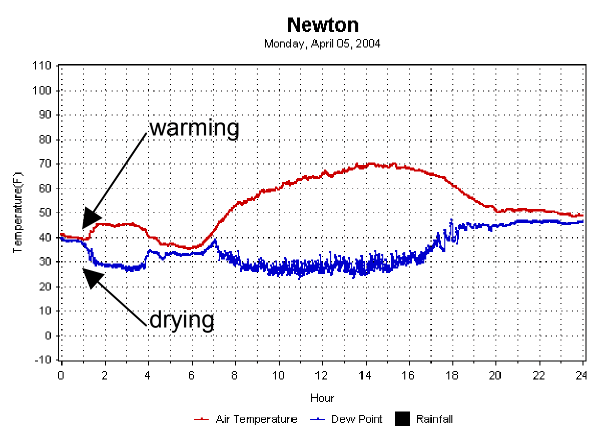


Figure 10: Time series of temperature and dewpoint at Newton on 5 April 2004, showing example of nocturnal warming event.

## 6. FUTURE DIRECTIONS

As the mesonet expands, applications of the data to mesoscale modeling and phenomenological studies will grow. There are also initiatives for integration with GIS for emergency management, water quality applications, and atmospheric dispersion studies. Temporary collocation of micrometeorological flux towers will provide opportunities for calibration and comparison of bulk turbulent energy fluxes. There will also be coordination under the umbrella of NCAS with coastal zone observations (CoZobs) made by the University of Puerto Rico at Mayaguez to look at processes affecting coastal environments.

Consistent with a coastal zone emphasis, the mesonet data will increasingly help to support modeling studies of landfalling tropical cyclones. Numerical modeling of the coastal zone will also be crucial to studies of atmospheric dispersion and air quality interactions with the land/sea breeze system. Collaboration with Howard University and NCAR MMM is expected to consider approaches to use of three-dimensional variational (3dvar) assimilation of mesonet data into WRF, in particular to address short-term mesoscale weather impacts.

We expect the mesonet to serve as a validation testbed for the 3D Volume Averaged Soil Moisture Transport (VAST) model being developed for the Climate WRF (CWRF) model (Liang *et al.* 2005a; Xu *et al.* 2004). This surface model will include 11 soil layers and include terrain effects on drainage (Liang *et al.* 2005b). It has been proposed that there could be a possibility of using VAST to couple WRF with a hydrologic river routing scheme.

JSU will also be expanding its outreach to K-12 students and teachers and its training of undergraduate students in working with research instrumentation and data analysis.

Some new directions to consider include the possibility of adding boundary layer towers or profilers. There is also interest in investigating application of a consensus approach to provide multi-sensor determination of proxy parameters for specialized applications (such as visibility for aviation or fire weather indices).

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