A Micronet technician deploys a traffic light station on 8 May 2008. The Vaisala Weather Transmitter WXT510 is a key component of the Oklahoma City Micronet.

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Atmospheric monitoring across Oklahoma City

The Oklahoma City Micronet (OKCNET) is a project designed to improve the atmospheric monitoring across the Oklahoma City metropolitan area. The project includes two main phases of implementation including (1) the deployment of three new Oklahoma Mesonet sites within Oklahoma City and (2) the installation of a dense network of sites mounted on traffic signals. As of 1 June 2008 all stations have been deployed.

Mesonet stations

As part of a joint effort between the OKCNET project and the Oklahoma Mesonet (Brock et al. 1995, McPherson et al. 2007), three new Mesonet sites were installed within Oklahoma City in early 2007 (Fig. 1). The first site (OKCN) was installed in February 2007 on the campus of the Daily Oklahoman, approximately 7 miles north of the central business district. In April 2007, two additional sites were deployed including one on the campus of Oklahoma State University in Oklahoma City, approximately 4 miles west of the central business district (OKCW), and one approximately 4 miles east of the central business district (OKCE) on Oklahoma City municipal property.

Traffic signal stations

The design, testing, and deployment of stations mounted on traffic signals would not be possible or successful without the extensive assistance and collaboration provided by Oklahoma City officials. Oklahoma City boasts the world's largest wifi mesh network (communications network made up of radio nodes), and with the assistance of Oklahoma City personnel, the traffic signal sites were designed to utilize the network of wireless access points across the metropolitan area.

Each traffic light station consists of a Vaisala Weather Transmitter WXT510 sensor, a datalogger, an enclosure specifically designed for the traffic signals, and hardware to facilitate power and communications across the OKC wifi network.

In December 2007, a working prototype station was completed and installed at the intersection of two streets in the central business district of Oklahoma

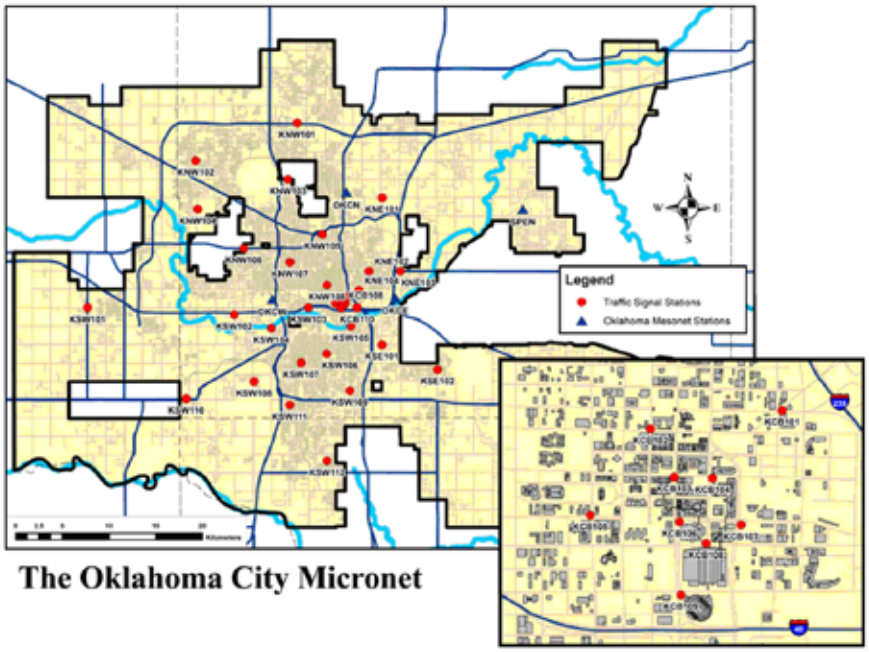

Figure 1. Locations of Oklahoma City Micronet stations. The window in the lower right corner of the graphic shows the locations of traffic signal stations within the central business district of Oklahoma City with respect to the primary building structures and streets.

A mesonet is a network of automated weather stations designed to observe mesoscale meteorological phenomena (atmospheric phenomena having horizontal scales ranging from a few to several hundred kilometers).

Oklahoma City Micronet has already shed new insights regarding atmospheric processes across the metropolitan area.

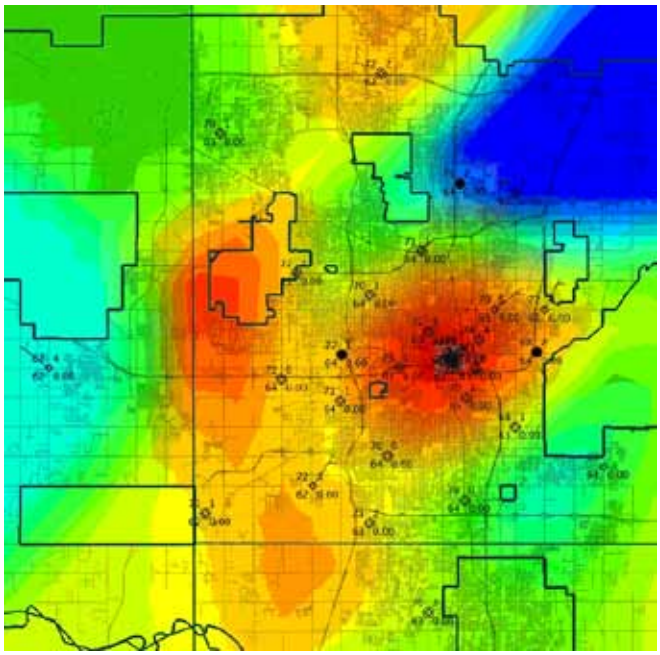

Figure 2. An example of the Oklahoma City urban heat island at 11:00 UTC (6:00 am CDT) on 21 June 2008.

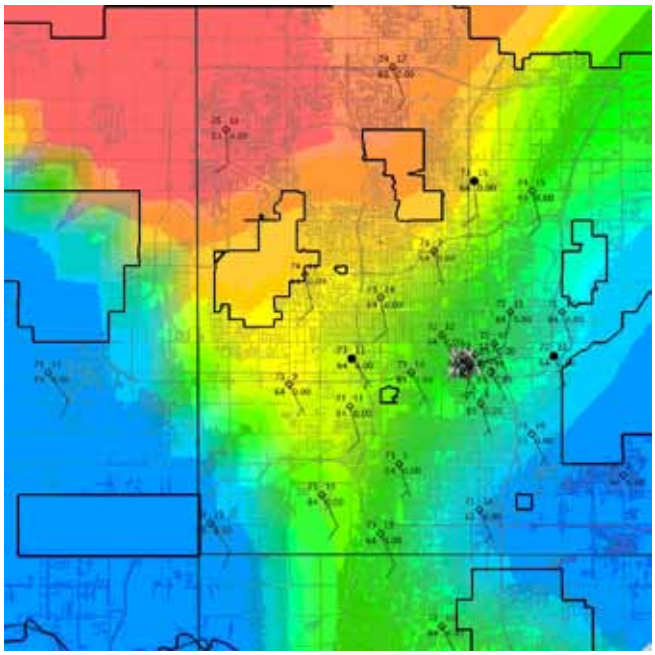

Figure 3. An example of the Oklahoma City urban heat island at 10:28 UTC (5:28 am CDT) on 31 May 2008.

City. A series of tests were completed and all subsequent approvals were acquired from Oklahoma City officials. Given the final approval from Oklahoma City, all remaining sites were fabricated during the spring of 2008.

The installation of the remaining 35 traffic signal stations began in the central business district of Oklahoma City and, by 30 May, all sites had been deployed across the metropolitan area (Fig. 1). The deployment of the traffic signal stations was accomplished via a truck rental agreement whereby a trained Oklahoma City technician operated the lift as a Micronet technician installed each station.

Next, each site was secured to the pole via stainless steel straps and the station linked to an Oklahoma City wireless access point via an Ethernet cable. The link to the access point established both communications and the power needed to operate the station. Once secured and connected, the technician verified communications with Oklahoma Mesonet personnel and panoramic site photos were collected. The deployment of each station spanned approximately one hour, which allowed for multiple stations to be deployed in a single day. The compact design and functionality of the WXT510 was critical to the success of the traffic signal stations deployed across Oklahoma City.

New insights into atmospheric processes

The spatial and temporal density of observations collected by the Oklahoma City

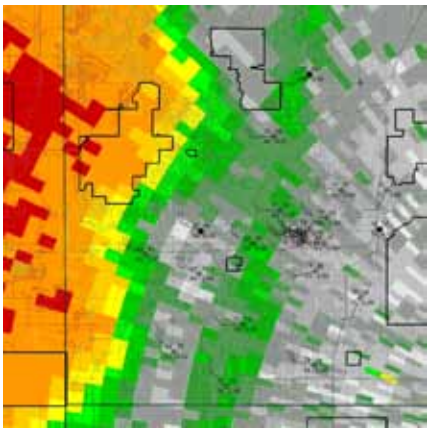

Figure 4. The leading edge of an intense squall line with a bow echo as it propagates through Oklahoma City at 2:02 am CDT on 27 May 2008. Intense precipitation is highlighted as yellow/orange/red. In addition, Oklahoma City Micronet observations include wind barbs, air temperature (oF – upper left), dew point temperature (oF – lower left), precipitation since 0000 UTC (in – lower right), and maximum wind gust during the previous minute (mph – upper right).

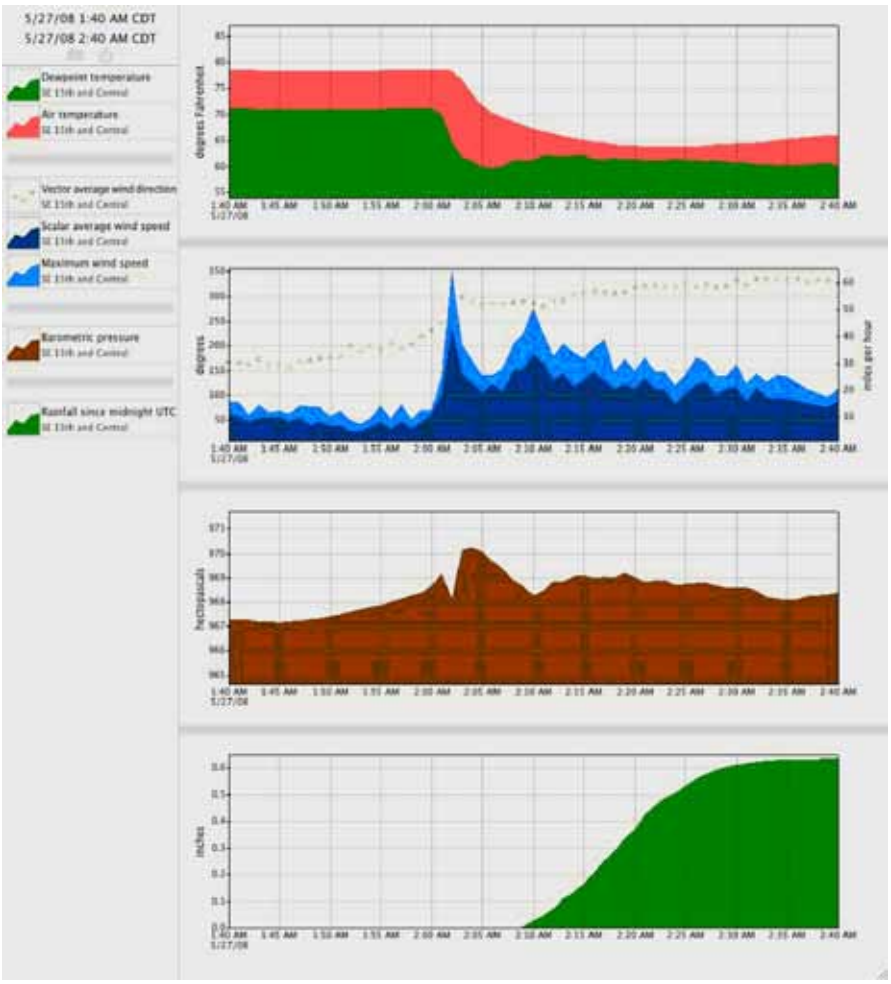

Figure 5. Time series observations from KSW105 at 2:02 am CDT on 31 May 2008. The KSW105 site is located approximately 1.2 miles southeast of the Oklahoma City central business district.

Micronet has already shed new insights regarding atmospheric processes across the metropolitan area. For example, because the Micronet spans the gradient from quasi-rural to urban land use conditions, the Micronet has consistently detected an urban heat island as great as 11°F and associated gradient of air temperature due to the varying surface conditions (Fig. 2). However, the air temperature gradient (and associated maximum/minimum values) is often impacted by the magnitude and direction of the near-surface wind conditions as shown in Figure 3, in which temperature values in the northwest portion of the Oklahoma City metropolitan area (downstream of the urban core) were as much as 5°F warmer than locations upstream of the highly populated areas in southeast (and southwest) Oklahoma City.

The network has also captured the impacts of severe weather across Oklahoma City. Figure 4 shows Micronet observations as a severe thunderstorm complex with a bow echo began propagating through the metropolitan area during the early morning hours on 27 May 2008. Severe winds were observed along the leading edge of the gust front in advance of the heavy precipitation including a gust to 65 mph at the Micronet site located at SE 15th St. and Central Blvd. (KSW105). The time series data from KSW105 (Fig. 5) also confirm that the strongest winds were observed approximately 6 minutes prior to the onset of precipitation and approximately two minutes prior to the decrease in air temperature that occurred during the event. Further, there was a slight decrease in station pressure as the gust front passed followed by a rapid increase (approximately 2 mb) over the following two minutes.

Enhanced observing capabilities

With an average station spacing of approximately 3 km, the Oklahoma City Micronet observes atmospheric conditions across the metropolitan area at fine spatial resolution. Additionally, a key component of the Oklahoma City Micronet is rapid data collection of research quality observations. At each traffic signal site atmospheric conditions are measured and transmitted every minute to a central facility 24/7. Similarly, the observations at the Oklahoma City Mesonet sites are collected every 5 minutes and transmitted to a central facility. All observations receive real-time and archived quality assurance prior to distribution or display. As a result, approximately 600,000 research quality observations are collected each day across Oklahoma City. ■

Further information:
okc.mesonet.org/
www.vaisala.com/wxt520

References

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