4.1 THE CROSSTIMBER MICRONET:
AN AUTOMATED MICROSCALE SURFACE OBSERVATION NETWORK

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1. INTRODUCTION

The Crosstimber Micronet is a 5-acre automated surface observation network for the study of microscale meteorological phenomena. It was designed for direct comparison of observations with nearby Oklahoma Mesonet stations (Brock et al. 1995), and for testing of new equipment for potential use on the Mesonet.

2. LOCATION

The Micronet is located in central Oklahoma, approximately 40 km southeast of Oklahoma City. It is encircled by five Oklahoma Mesonet stations. Each of those Mesonet stations is located approximately 30 km from the Micronet (Fig. 2.1).

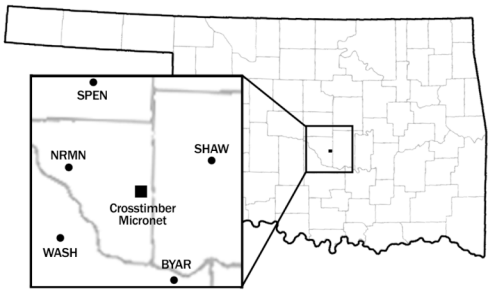

Figure 2.1. Map of Oklahoma showing the location of the Crosstimber Micronet and surrounding Oklahoma Mesonet sites.

The Micronet is located in the Crosstimbers ecoregion of Oklahoma, also called the "Cross Timber" (Fig. 2.2).

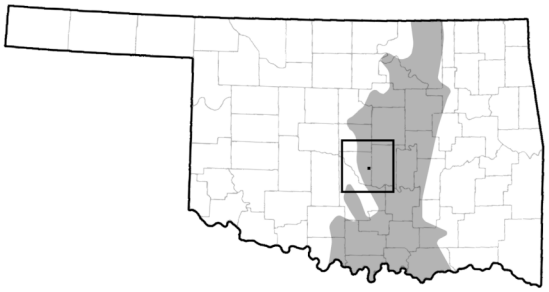

Figure 2.2. Map of Oklahoma showing the Crosstimbers ecoregion.

The Cross Timber extends from southeastern Kansas to central Texas. It is a transition zone between the prairie toward the west and eastern hardwood forests toward the east. Thus, the Cross Timber shares characteristics with both regions. It is distinguished by the dominance of short oaks, mostly post oak and blackjack oak. These oaks are ragged and dense compared to other trees in Oklahoma. Hence, the "Cross Timber" was named for the difficulty faced by early settlers who attempted to cross it.

The ragged trees of the Cross Timber were not ideal for lumber production. Consequently, the Cross Timber is one of the least disturbed forest types east of the Rocky Mountains. Many ancient oaks still survive there, especially in areas that are too steep for grazing or farming.

The Cross Timber is a region of rolling hills and narrow valleys. The terrain generally is more complex than other parts of central Oklahoma. The complex terrain and undisturbed vegetation of the Cross Timber make it an excellent region for the study of land-atmosphere interactions.

The Crosstimber Micronet is located on a 200 m x 100 m parcel of land in a relatively undisturbed part of the Cross Timber. The vegetation and terrain are typical of the region. The parcel was selected because it was considered an ideal location for micrometeorological research.

The northern 80% of the Micronet lies on the southern slope of a hill that rises 15 m above a small creek valley. The slope is covered by post oak, blackjack oak, and black hickory trees, which are 5-15 m tall. The southern 20% of the Micronet is flat and is covered by tall grasses.

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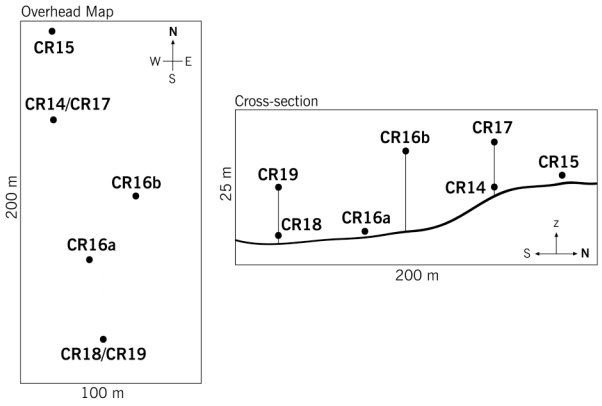

Figure 2.3. Map (overhead and cross-section) showing Crosstimber Micronet sites.

Six permanent meteorological stations are located at the Crosstimber Micronet: CR14, CR15, CR16b, CR17, CR18, and CR19 (Fig. 2.3). CR18 and CR19 are co-located in the creek valley at the southern end of the Micronet. CR15 is located at the top of a ridge on the northern edge of the Micronet. CR14 and CR17 are co-located 50 m south of CR15. CR16b is located on the slope, between CR18/19 and CR14/17. From 2002-2004, CR16a was located 50 m north of CR18. During April 2004, it was moved to the top of a 15 m tower approximately 30 m northeast of its previous location.

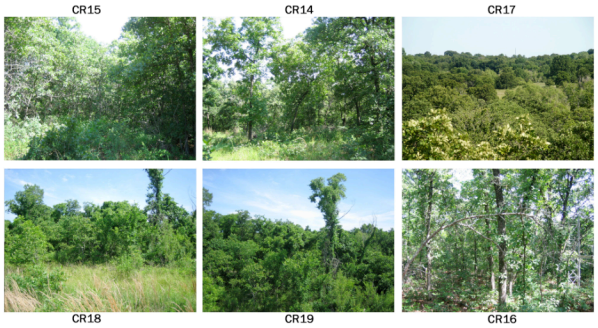

Figure 2.4. Photos at six Crosstimber Micronet sites. The view is toward the southeast, the prevailing wind direction at the Micronet.

3. DATA COLLECTION & TRANSMISION

The instruments and parameters measured at the Crosstimber Micronet generally are the same as those by the Oklahoma Mesonet (Brock et al. 1995). However, most Micronet stations are not equipped with the full suite of Mesonet sensors, and some stations contain additional instruments and measurement levels that are not used on the Mesonet (Table 3.1).

Station	Parameter	Height (AGL)	Sensor
CR14	Data logging		Campbell Sci. CR10X
	Air temp./humidity	1.5 m	Vaisala HMP45C
	Air temperature	4.5	Thermometrics thermistor
	Air pressure	1.0	Vaisala CS105*
CR15	Data logging		Campbell Sci. CR205
	Air temp./humidity	1.5	Vaisala HMP45C
CR16	Data logging		C. Sci. CR205, CR10T
	Air temp./humidity	1.5	Vaisala HMP35C*
		4.5 +	Vaisala HMP35C*
		11 +	Vaisala HMP45C
	Wind speed/direction	14 +	RM Young Wind Monitor
CR17	Data logging		Campbell Sci. CR205
	Air temp./humidity +	9	Vaisala HMP45C
	Wind speed/direction	10	RM Young Wind Monitor
CR18	Data logging		C. Sci. CR205, CR10T
	Air temp./humidity	1.5	Vaisala HMP45C
	Air temperature	0.5 +	Thermometrics thermistor
	Rainfall	0	MetOne tipping bucket*
	Soil temperature	-0.05	Fenwall NTC Thermistor
	Net radiation	2	REBS net radiometer*
	Wind speed	2	RM Young Wind Sentry
	Ground heat flux	-0.05	REBS HFT-3.1
	CO2 concentration +	2	Vaisala GMP343
CR19	Data logging		C. Sci. CR205, CR10T
	Air temp./humidity +	9	Vaisala HMP45C
	Air temperature	2 +	Thermometrics thermistor
	Air temperature	3.5 +	Thermometrics thermistor
	Air temperature	5 +	Thermometrics thermistor
	Air temperature	6.5 +	Thermometrics thermistor
	Air temperature	8 +	Thermometrics thermistor
	Wind speed/direction	10	RM Young Wind Monitor

* different instrument from its counterpart on the Oklahoma Mesonet
+ not measured by the Oklahoma Mesonet

Table 3.1. Instruments and parameters measured by the Crosstimber Micronet.

Figure 3.1. Photo of the CR18/CR19 site, located in the Micronet's valley.

Like Oklahoma Mesonet stations, the Crosstimber Micronet stations sample observations every three seconds and average those samples over a period of five minutes. The five-minute averages of each parameter from each site are transmitted via 900 MHz radio link to CR14, where data from the entire network are stored. The data are later retrieved via phone line from the Crosstimber Micronet office in Norman, Oklahoma.

Quality assurance of data from the Crosstimber Micronet is relatively simple because of the high density of observations there. First, observations are processed though an automated quality control program, which flags all missing and obviously erroneous observations. Later, the remaining observations are plotted and compared with corresponding observations at adjacent Micronet sites and surrounding Mesonet sites. All suspect data is flagged. Finally, the observations are classified into the following categories: good, suspect, missing, instrument error, and radio/transmission error.

4. OBSERVED SPATIAL VARIABILITY

Large gradients of meteorological parameters are routinely observed within the Micronet's 0.02 km^2 area. For example, the temperature at CR18 is up to 1.6-2.9°C lower than the temperature observed at CR15 on an average clear night. Temperature differences of 9°C or greater across the Micronet have been observed during each month from November to April (Table 4.1).

Month	Average ΔT	Clear night ΔT	Largest ΔT observed
Jan	1.5°C	2.3°C	9.6°C
Feb	1.3	2.3	9.0
Mar	1.7	2.6	9.7
Apr	1.6	2.2	10.7
May	1.4	1.8	7.5
Jun	1.2	1.6	5.0
Jul	1.5	1.7	5.4
Aug	1.4	1.6	6.2
Sep	1.8	2.1	6.0
Oct	1.7	2.1	8.0
Nov	1.5	2.9	11.3
Dec	2.3	2.8	10.4

Table 4.1. Average largest nightly temperature difference (ΔT; °C) across the Micronet (i.e., between CR18 and CR15) and largest observed temperature difference observed across the Micronet.

Temporal variability also can be large at the Micronet, and sharp changes can occur at some sites while not at others (Fig. 4.1).

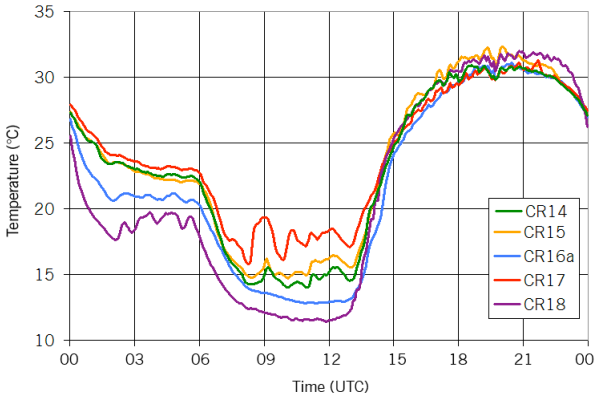

Figure 4.1. Temperature at various Micronet sites on 29 September 2002.

5. SUMMARY

The Crosstimber Micronet is ideally located and equipped for the study of microscale meteorological phenomena. The Micronet's vegetation, terrain, density of observations, unique microclimates, and proximity to five Oklahoma Mesonet sites make it a valuable tool for studying microclimates and microscale land-atmosphere interactions.

6. ACKNOWLEDGEMENTS

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7. REFERENECS

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