5.8 CREATING COUNTY CLIMATE SUMMARIES FOR OKLAHOMA

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To paraphrase Tip O'Neil: all weather is local. Whether people are looking for forecasts or climate information, they usually want to know what is happening in their backyard. Although technology does not exist to give an accurate assessment at that scale, there are abundant data sources that allow climatologists to address questions at least at a county-level scale. To fulfill this need, and to supplement statewide-level information included in *The Atlas of Oklahoma Climate* (Johnson and Duchon 1995) and the state climate office's website, the the Oklahoma Climatological Survey (OCS) developed a CD publication containing county-level climate information.

The effort grew out of collaboration with local offices of the Natural Resources Conservation Service (NRCS), dating back more than ten years. Each county-level NRCS office is required to prepare a five-year plan. Part of these plans includes a section on weather. Some of the more progressive offices approached OCS for information that could be used in agricultural planning decisions. It quickly became apparent that off-the-shelf information from the website or OCS publications lacked the detail needed to serve this clientele.

Through an iterative process, a framework was developed for a document that summarized the climate for a specific county. The document drew upon two principal sources of information available in Oklahoma: the National Weather Service (NWS) Cooperative Observer Network and the Oklahoma Mesonet (Brock et al. 1995). A document was developed that built upon the long-term temperature and precipitation records from the cooperative observer network and was supplemented with humidity, wind, solar radiation and soil temperature data from the Mesonet.

Preparing the documents for the NRCS strategic plans launched an intensive effort to provide a complete set of county-level information for the entire state. The result is a CD publication that consists of three major elements: a 'Quick Climate Facts' summary of means and extremes, detailed assessments, and station summaries. The detailed assessments include a written overview of the climate; charts of annual temperature and precipitation, tables of temperature and precipitation means, extremes and variability; freeze and frost information; wind roses; summarized humidity and soil temperatures; and a listing of historically significant tornadoes in the county. Station summaries contain similar tables for each long-term Cooperative Observer and Oklahoma Mesonet station. In addition, an overview of Oklahoma's climate is provided. These elements are combined through a web-based interface on the CD-ROM that allows individuals to select information by county or by observing station.

As the clientele list expanded, the development team realized that many people want a sense of their county's climate without having to wade through a multi-page document full of tables. This inspired the development of a one-page 'Quick Climate Facts' overview. The overview is suitable for a general audience, is visually appealing, and may have great benefits to local economic development coalitions and chambers of commerce.

Development of the products was iterative, both with the NRCS offices and internally to OCS. During the 2004 planning cycle, 14 county NRCS offices requested the assessment for their counties. While most accepted the information without revision, dialogue with several county officials sparked new ideas that improved the document.

Internally, collaboration with our Visual Communications specialist helped to make the overall documents more applicable to target audiences. In particular, the collaboration generated the idea to create two documents for each county: one a detailed assessment for target audiences such as the county NRCS offices and a second document designed for those with only a casual interest in weather and climate. This highlights an underlying theme of climate services: *presenting technically-correct information is a necessary, but not sufficient condition for use of that information*. A good product requires a good design in order to encourage widespread use.

1. County Climate webpages

The goal of the county climate summaries was to package climate information in a useful fashion for those who could benefit from the use of climate information but were not necessarily literate in the details of climatology. In order to make access easy, the development team settled upon a CD-ROM format, driven by HTML and PDF files. This allows individuals to access the information through familiar formats, namely whatever web browser they use for other applications. No specialized software is required for access to this information.

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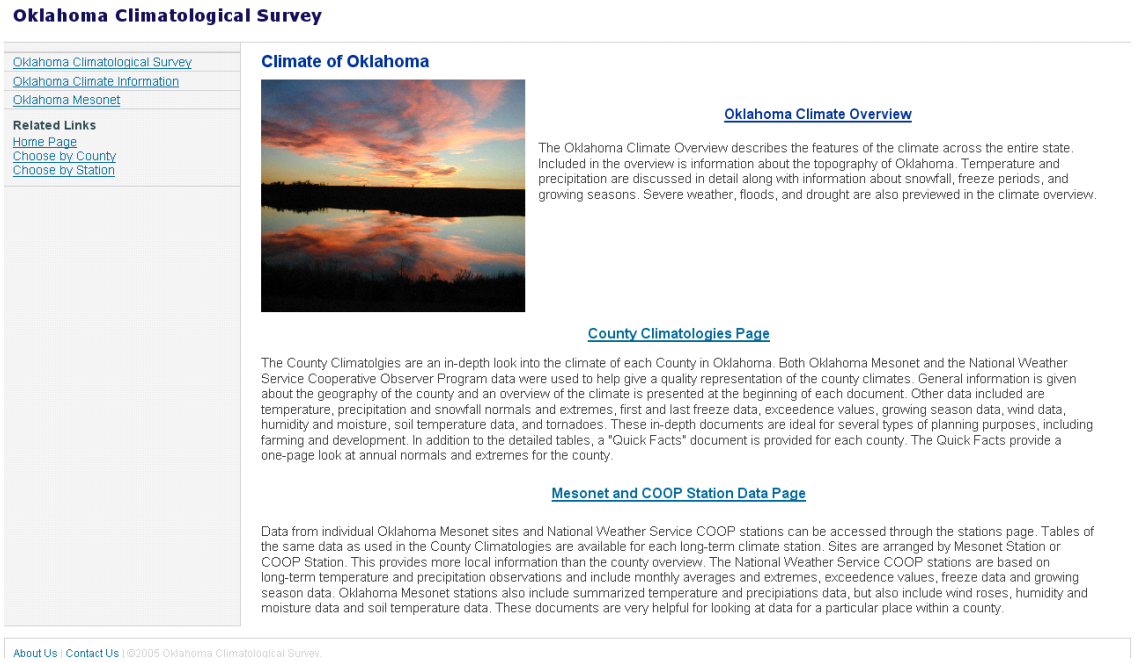


Figure 1. Homepage for the county climate summaries CD.

The CD starts with a file labeled 'StartHere.html', which loads the county climate CD homepage (Figure 1). The only other file visible at start-up is a folder labeled 'Products' which contains all the other HTML and PDF files and related images.

The Homepage contains three links to information from the CD: a statewide climate overview, documents listing by county, and summarized data for individual Cooperative Observer or Oklahoma Mesonet stations. The statewide climate overview combines text submitted by OCS staff for the National Climatic Data Center's (NCDC) update to its Climatography of the U.S. No. 60 publication (NCDC 1978) with related maps and graphs of 30-year averages and historical records. In addition to the information directly included on the CD, the CD contains live links to the OCS homepage, The OCS climate data page, the Oklahoma Mesonet homepage, and the 'how to contact OCS' information from the OCS homepage.

The heart of the publication is the choose-by-county option. Clicking on a county from the list retrieves an HTML file that provides documents and links to stations for only that county. This makes it easy to view information for local areas without having to look through an extensive list. To assure that the pages are uniform, the HTML code is generated from a program that matches stations to their respective counties and automatically inserts the appropriate links. All documents and HTML files included in the county webpage reside on the CD.

Options provided on the county pages include links to the 'Quick Climate Facts' PDF document, the 'Detailed Climate Information' PDF document, and a list of stations for the county. The PDF documents are discussed in more detail below. Because more than one station may be available in any given county, it was decided to include all long-term Cooperative Observer stations with established normals and all Oklahoma Mesonet sites with at least ten years of data. For each qualifying site, the observation network, station ID, station name, variables observed, and period-of-record is provided. More details on the content of the pages are provided in Section 4 below.

2. Quick Climate Facts

An example of a Quick Climate Facts PDF document is shown in Figure 2. The document is designed to provide a representative overview of each county, for easy comparison between the counties and to place the county's climate within the context of the state's climate. To facilitate comparison, each document includes statewide maps of average annual temperature and precipitation for the most recent normals period (1971-2000). The addition of an image from the county customizes each document and encapsulates the variety of Oklahoma's landscape. Images are taken from Mesonet sites, but more scenic images will be substituted as they come available.

NCDC cooperative data from combined TD-3200 and TD-3206 data sets were used to calculate county

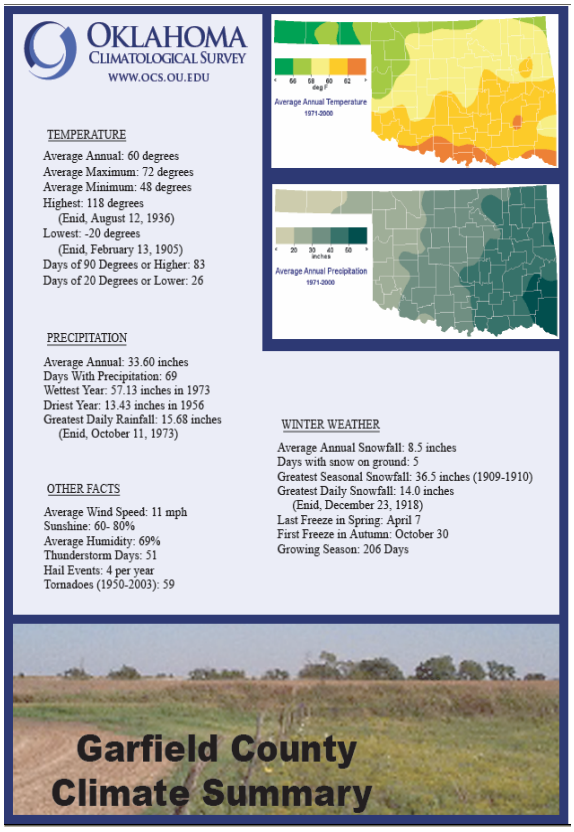


Figure 2. Quick Climate Facts summary for Garfield County, Oklahoma.

averages and extremes. Period-of-Record extremes were calculated for each station, regardless of whether it had only one year or 100 years of data. In this way, any value recorded in the county could establish the county record. For computing averages, only stations having at least 25 years of observations during the period 1971-2000, with each year having no more than 30 days of missing observations, were included. Qualifying long-term averages were then used in a Barnes (1964) objective analysis routine to determine a value at the centroid of each county. The use of an objective analysis routine allowed for inclusion of stations outside the county borders in determining the means. For extremes, only stations within the county borders were included. In one case, no long-term temperature stations existed within a county, so an immediately-adjacent station was used to determine the county's records.

Cooperative observer data were supplemented with other sources to yield a more complete representation of the county. Average wind speed and relative humidity were determined for each county using eleven years (1994-2004) of data from a single Oklahoma Mesonet station. If more than one station were available, the station nearest the county centroid was used. Because the means of these fields are fairly homogeneous across the state (local topographic considerations aside), a single station was sufficiently representative for the means. More localized information is included in the station summaries on the CD.

The percentage of sunshine listed in the Quick Climate Facts sheets was extracted from maps in the *Climatic Atlas of the United States* (Environmental Data Service 1968). The range represents percentage of possible sunshine from a minimum in January to a maximum in July. Thunderstorm days were estimated from Changnon (2001). Hail events were determined by averaging the number of days from 1991-2000 with severe hail (3/4-inch or greater) listed in NCDC's Storm Events data base. Multiple reports on a single day were counted as a single occurrence. The number of tornadoes in the county came from the NWS Forecast Office in Norman,OK (NWS http://www.srh.noaa.gov/oun/tornadodata/county/).

3. Detailed Climate Information

For those wanting more than an overview of the county's climate, a set of detailed tables are included in the Detailed Climate Information PDF document. Each document includes:

- a one-page text narrative describing the overall climate for the county (Figure 3);
- graphs of annual temperatures and precipitation;

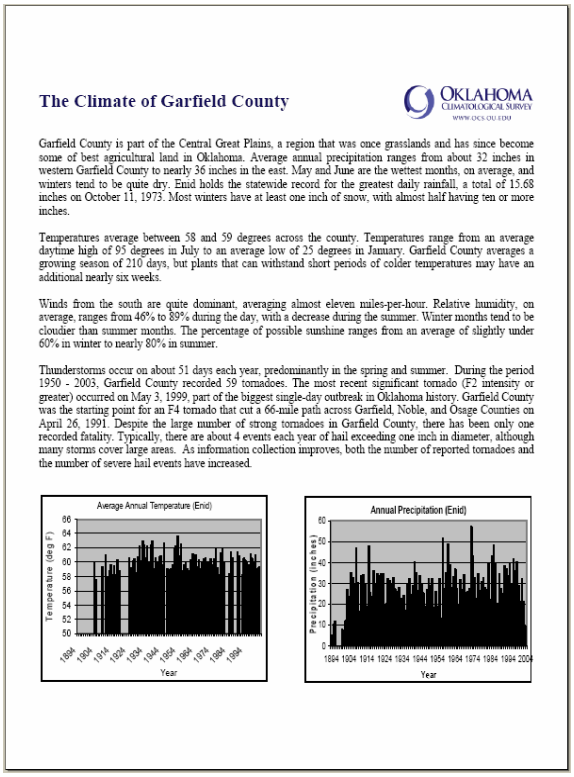


Figure 3. Front page of detailed climate summary for Garfield County, Oklahoma.

Temperature (deg Fahrenheit)												
	AVERAGES (1971-2000)			EXTREMES (1894-2003)				AVG # DAYS PER MONTH (1971-2000)				
	Daily Max	Daily Min	Daily Avg	Record High		Record Low		Max>100	Max>90	Max<32	Min<32	Min<0
Jan	45.5	25.2	35.3	84	(22nd, 1943)	-14	(15th, 1905)			6	24	*
Feb	52.5	30.1	41.3	92	(24th, 1918)	-20	(13th, 1905)		*	3	16	*
Mar	61.7	38.2	49.9	100	(19th, 1907)	0	(3rd, 1960)		*	1	9	
Apr	71.3	47.6	59.5	101	(11th, 1972)	18	(2nd, 1936)	*	*		1	
May	79.8	57.6	68.7	104	(30th, 1985)	28	(1st, 1909)	*	3			
Jun	89.5	66.5	78.0	111	(24th, 1918)	43	(12th, 1903)	1	16			
Jul	95.0	71.5	83.3	115	(18th, 1936)	50	(4th, 1915)	8	25			
Aug	93.6	70.1	81.9	118	(12th, 1936)	45	(31st, 1915)	6	23			
Sep	85.2	62.4	73.8	109	(13th, 1918)	33	(30th, 1985)	1	11			
Oct	73.9	50.4	62.2	100	(1st, 1910)	17	(30th, 1917)		1		1	
Nov	58.3	37.7	48.0	92	(5th, 1915)	9	(29th, 1911)			*	9	
Dec	48.4	28.8	38.6	85	(24th, 1955)	-10	(22nd, 1989)			3	20	*
Annual	71.3	48.9	60.1	118	(Aug 12, 1936)	-20	(Feb 13, 1905)	17	81	12	80	1

Precipitation (inches)										
	AVERAGE	EXTREMES (1894-2003)			AVG # DAYS PER MONTH (1971-2000)					
	1971-2000	Monthly Max	Daily Max		any	meas	0.10"+	0.25"+	0.50"+	1.00"+
Jan	1.15"	4.84" (1907)	2.67"	(22nd, 1921)	6	5	2	1	1	*
Feb	1.64"	4.56" (1915)	3.14"	(21st, 1997)	6	5	3	2	1	1
Mar	2.59"	8.75" (1973)	2.76"	(10th, 1974)	8	7	5	3	2	1
Apr	3.25"	10.01" (1912)	8.30"	(28th, 1912)	8	8	5	4	2	1
May	4.87"	14.36" (1957)	8.15"	(16th, 1957)	10	10	7	5	3	1
Jun	4.40"	12.11" (1915)	4.90"	(5th, 1916)	9	9	6	4	3	2
Jul	2.75"	12.97" (1960)	8.30"	(4th, 1960)	7	7	4	3	2	1
Aug	3.37"	10.47" (1906)	4.40"	(8th, 1906)	7	7	4	3	2	1
Sep	3.13"	9.72" (1913)	5.50"	(12th, 1913)	8	7	4	3	2	1
Oct	3.34"	15.84" (1973)	15.68"	(11th, 1973)	6	6	4	3	2	1
Nov	2.26"	9.49" (1964)	4.34"	(20th, 1994)	7	7	4	3	2	1
Dec	1.44"	4.33" (1911)	2.31"	(4th, 1944)	6	6	3	2	1	*
Annual	34.18"	15.84" (Oct 1973)	15.68"	(Oct 11, 1973)	89	83	52	36	23	10

Snow and Sleet (inches)											
	AVERAGE	EXTREMES (1894-2003)				AVG # DAYS PER MONTH (1971-2000)					
	1971-2000	Monthly Max	Daily Max		Greatest Depth		any	meas	0.50"+	1.00"+	Pot. Glazing
Jan	2.2"	23.5" (1918)	9.5"	(6th, 1988)	65.0"	(30th, 1942)	1	1	1	1	2
Feb	2.2"	23.0" (1910)	12.0"	(23rd, 1971)	60.0"	(18th, 1940)	1	1	1	1	1
Mar	1.2"	15.5" (1931)	10.0"	(30th, 1931)	13.0"	(14th, 1999)	1	1	*	*	1
Apr	0.0"	8.3" (1938)	8.0"	(8th, 1938)	8.0"	(8th, 1938)	*	*			
May		0.0" (1894)	0.0"	(21st, 1894)							
Jun		0.0" (1950)	0.0"	(28th, 1950)							
Jul											
Aug		0.0" (1952)	0.0"	(5th, 1952)							
Sep		0.0" (1942)	0.0"	(26th, 1942)							
Oct	0.0"	5.0" (1913)	5.0"	(28th, 1913)			*				*
Nov	0.5"	6.0" (1919)	6.0"	(20th, 1988)	4.0"	(28th, 1948)	*	*	*	*	*
Dec	1.2"	16.0" (1918)	14.0"	(23rd, 1918)	15.0"	(18th, 1945)	1	1	1	*	1
Annual	7.3"	23.5" (Jan 1918)	14.0"	(Dec 23, 1918)	65.0"	(Jan 30, 1942)	4	4	3	2	6

Figure 4. Climate overview tables for Enid, Oklahoma, based on TD-3200 and TD-3206 Cooperative Observer Data. Extremes are based on the station period-of-record and averages based on the most recent 30-year normal period (1971-2000).

- monthly averages and extremes of temperature, precipitation, and snowfall;
- probable ranges of monthly temperatures and precipitation;
- probable dates of first and last freeze and growing-season length;
- prevailing wind direction and speed;
- monthly average humidity and moisture measurements;
- monthly average soil temperatures;
- history of significant tornadoes; and
- recommendations for further information.

The written description of the climate provides general features in a narrative format, which some people prefer to look-up tables. For each county a long-term station with temperature and precipitation were selected to capture the annual variability in the graphs. Where possible, the temperature and precipitation graphs are derived from the same station, but in some cases temperature data were not available for an extended period. In those cases, the longest available good-quality record was substituted for the temperature graph. The sources are listed in the 'additional information' section at the end of the document.

The first set of tables (Figure 4) for the county provides averages and extremes for the 'standard' climate variables: temperature, precipitation, and snowfall. Data are based on the combined TD-3200 and TD-3206 data sets. Data for a single station in the county are used, based upon the station's period-of-record, quality of the observations, geographical location and whether it is representative of the region. Averages computed directly from the data were used instead of the published normal values to assure consistency with the average number of days per month calculations, for which no published normal values are available.

Because of tremendous annual and inter-annual climate variability in Oklahoma, means and extremes do not necessarily make good planning guides. In order to capture most of the variability without having to plan for a worst-case scenario, exceedence values were used. These were based upon feedback from staff at the local NRCS offices, who suggested "2 in 10 years" upper and lower bounds as useful planning measures. A table of monthly and annual temperature and precipitation values, based on the 20th and 80th percentiles of the period-of-record distribution was created (Figure 5).

A comparison to normal and extreme values provides an example of the utility of the exceedence table. For example, the mean annual rainfall in October for Enid is 3.34 inches, with a maximum occurrence of 15.84 inches. The 20th – 80th percentile range is 0.70 to 4.18 inches, or a midpoint of 2.44 inches. Taken together, it can be anticipated that in any given October, Enid would receive about two or three inches of rainfall, but it would not be unreasonable to expect less than in inch or a bit more than four inches. However, planning for five or more inches or less than a half-inch may not be worthwhile, unless a seasonal forecast exhibits sufficient confidence to shade toward one end of the distribution.

Recognizing that some crops are more tolerant to brief periods of sub-freezing temperatures, freeze data are provided for several thresholds (Figure 6). The freeze calculations are based on a ranked distribution of

Exceedence values (2 in 10 years)				
Month:	Maximum Temperature Higher Than:	Minimum Temperature Lower Than:	Precipitation Less Than:	Precipitation More Than:
January	74	-2	0.13	1.56
February	80	4	0.27	2.40
March	87	13	0.51	3.06
April	92	27	1.46	4.39
May	97	38	2.01	6.25
June	103	50	1.85	6.06
July	107	57	1.00	3.84
August	108	55	1.04	5.25
September	103	40	1.30	5.20
October	95	29	0.70	4.18
November	82	16	0.08	3.15
December	73	4	0.20	1.96
Annual	**109**	**-2**	**24.26**	**35.04**

Figure 5. 'Exceedence Values' for Enid, Oklahoma. Thresholds are based upon the 20th and 80th percentiles of the historical monthly maximum and minimum temperature and precipitation values, based on all available data from 1894-2003.

First Freezing Temperature in Fall			
Probability	24 F or Lower	28 F or Lower	32 F or Lower
1 Year in 10 Earlier Than –	November 3	October 27	October 20
2 Years in 10 Earlier Than –	November 10	November 2	October 25
5 Years in 10 Earlier Than –	November 21	November 11	November 2
Last Freezing Temperature in Spring			
Probability	24 F or Lower	28 F or Lower	32 F or Lower
1 Year in 10 Later Than –	March 30	April 8	April 18
2 Years in 10 Later Than –	March 25	April 5	April 13
5 Years in 10 Later Than –	March 15	March 25	April 4

Number of Days in Growing Season			
Probability	Higher than 24 F	Higher than 28 F	Higher than 32 F
9 Years in 10	227	210	194
8 Years in 10	234	218	197
5 Years in 10	250	233	210
2 Years in 10	269	248	225
1 Year in 10	273	253	235

Figure 6. Freeze/Frost dates for Enid, Oklahoma based upon Cooperative Observer Data from 1894-2003.

period-of-record temperatures for the combined TD-3200 and TD-3600 cooperative observer record for the same station used in the averages and extremes tables. For each year, the date of the last freeze in spring, first freeze in fall, and number of days between freezes (growing season) were calculated. If the station had missing temperature observations for the period January through April, subsequent to the date of occurrence for the last freeze in spring, the year was excluded from the analysis. Similarly, years with missing observations from October through December prior to the date of occurrence for the first freeze in fall were excluded. The length of growing season was then computed based on the year's freeze dates. The process was repeated for threshold of 24 and 28 degrees Fahrenheit.

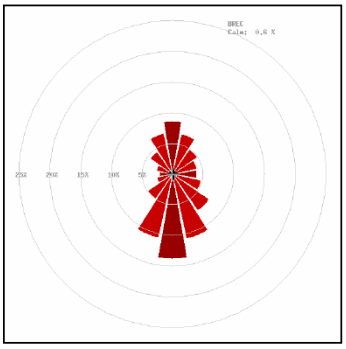
Dates of occurrence were ranked to determine percentile distributions for each of the dates and thresholds. At the request of NRCS staff, this was displayed as 'x years in 10' rather than a percentage frequency of occurrence. Thus, the mean of the distribution would be 5 years in 10 with other thresholds giving some measure of variability to the distribution.

The Oklahoma Mesonet provides an opportunity to add wind, moisture and soil temperature information at a county level. Although the Mesonet has not been operational for a 30-year period, the eleven years of available information appears to provide stable means, even though it is unlikely that the eleven-year period has captured the tail ends of the distribution. Therefore, the development team chose not to include extremes or frequency distribution measures in these tables.

Wind observations are presented using a wind rose and frequency distribution table (Figure 7). Both were generated using the 5-minute observations of wind speed and direction recorded at 10 meters above ground level. The maximum gust and maximum sustained (5-minute average) are listed for reference. Wind roses capture the prevailing southerly component of wind direction common to Oklahoma, with a secondary northerly component frequently recorded during the winter months. Wind data were only presented in aggregate form in the county document, but monthly averages are provided for individual Mesonet stations.

The documents include summaries of moisture and soil temperature as well (not shown). The moisture table includes daily maximum, minimum and average relative humidity, daily average dewpoint, and daily average vapor pressure deficit, listed by month and annually. People frequently ask for humidity values, so those are included, but OCS encourages people to use measures

WINDS
From Breckenridge Mesonet Site (BREC); Jan 1994 – Dec 2001
Latitude: 3625N Longitude: 09742W Elevation: 1155 ft



Wind Roses show the prevailing direction from which the wind is blowing. North is up in the image. The circles show the percentage of time from which the wind is blowing in that direction. For example, Breckenridge records a south wind about 14 percent of the time, with northerly winds just under 9 percent of the time.

The table below shows the percentage of time the wind is blowing from each of the 16-point compass headings, and the percent of time the prevailing wind is recorded in each speed bin.

Maximum Gust: 66.5 mph
Maximum Sustained: 49.2 mph
Overall Average Speed: 10.7 mph

BREC	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Totals
Calm																	0.6%
1- 5 mph	0.6	0.7	0.8	0.8	1.0	1.0	1.1	0.9	0.8	0.8	0.8	0.8	0.8	0.6	0.5	0.5	12.5%
6-10 mph	2.4	2.3	2.2	1.9	2.1	2.6	3.4	4.1	4.0	2.5	1.4	1.0	0.9	1.1	1.5	2.1	35.6%
11-15 mph	2.4	2.1	1.4	1.0	0.8	1.0	2.2	3.9	4.6	3.0	1.3	0.5	0.3	0.5	1.3	2.0	28.2%
16-20 mph	1.8	1.2	0.5	0.2	0.2	0.2	0.5	1.5	2.9	2.4	0.9	0.2	0.1	0.3	0.7	1.1	14.6%
21-25 mph	1.0	0.4	0.1	0.0	0.0	0.0	0.1	0.3	1.2	1.4	0.4	0.1	0.0	0.1	0.3	0.7	6.2%
26-30 mph	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.5	0.1	0.0	0.0	0.0	0.1	0.2	1.8%
31-35 mph	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.4%
35+ mph	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1%
Totals	8.6	6.7	5.0	4.1	4.0	4.9	7.3	10.8	13.8	10.6	4.9	2.6	2.1	2.7	4.5	6.8	100.0%

BREC	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Max Gust	61	67	56	51	56	46	59	59	56	66	54	55	58	57	66	63
Max 5 Min	46	49	38	34	35	40	44	44	38	42	43	43	44	40	47	49
Avg Speed	13.0	11.1	8.9	8.1	7.3	7.5	8.6	10.3	12.2	13.5	11.3	8.1	7.2	8.8	11.0	12.4

Due to rounding, column and row totals may not sum to exactly 100.0%.

Figure 7. Wind rose and wind speed frequency distribution for the Oklahoma Mesonet site near Breckenridge (Enid), Oklahoma, based on data from 1994-2003.

such as dewpoint or vapor pressure deficit, which are more relevant for crop growth and stresses. Five-minute observations were used to calculate daily values for each of the variables, which were then used to compute monthly variables. Only stations having 90% or more of possible observations were used in the analysis.

The Mesonet measures soil temperatures at 5, 10 and 30 cm below ground. The 5 and 10 cm depths are measured under natural vegetation and exposed soil. The near-surface measurements are highly variable; therefore the 10-cm depth was chosen to represent soil temperature climatology. The soil temperature table shows averages beneath both natural vegetation (sod) and exposed soil, to provide representative measures for both tilled fields and ground cover. The average daily range is given for the bare soil, because it exhibits more variability than does its natural vegetation counterpart.

Severe weather is an important consideration in Oklahoma. Therefore, it was decided to include information about significant tornadoes (Figure 8) within the document. The development staff researched historical occurrences, for each county, of tornadoes rated F2 or higher on the Fujita Scale. Tornado occurrences from 1880-1989 were obtained from Grazulis (1991). The NWS Forecast Office located in Norman, Oklahoma provided county-based lists for more recent occurrences (NWS http://www.srh.noaa.gov/oun/tornadodata/county).

4. Station Summaries

Because a single station within a county is not necessarily representative of conditions across the entire county, an option is provided on the CD to select specific Cooperative Observer or Mesonet stations. The station summary option lists each Cooperative Observer station that was open during the entire period 1971-2000 and had sufficient data to produce long-term averages and extremes. Stations are listed based on the station number assigned by NCDC. Mesonet stations that were operational (or short-distance moves)

Date	Path	Deaths	Injuries	Rating	Counties Affected
May 27, 1896	10 miles	0	1	F3	Kingfisher, Logan, Garfield
March 17, 1905	unknown	0	0	F2	Garfield
March 17, 1905	2 miles	0	4	F2	Garfield
March 17, 1905	20 miles	0	4	F2	Garfield
March 31, 1914	5 miles	0	1	F2	Garfield
March 18, 1927	35 miles	0	3	F3	Garfield, Grant, Kay
November 19, 1930	5 miles	0	4	F3	Garfield
November 19, 1930	4 miles	0	1	F2	Garfield
April 24, 1935	11 miles	0	1	F2	Garfield, Noble
January 26, 1944	20 miles	0	2	F2	Garfield, Noble
March 30, 1949	40 miles	0	7	F3	Garfield, Grant, Kay
April 2, 1956	18 miles	0	4	F3	Garfield, Grant
April 8, 1956	8 miles	0	4	F3	Garfield
November 17, 1958	35 miles	0	0	F2	Garfield, Grant, Kay
October 20, 1963	5 miles	0	0	F2	Kingfisher, Garfield
April 22, 1964	8 miles	0	0	F3	Garfield
June 5, 1966	8 miles	0	6	F2	Garfield
April 26, 1970	4 miles	0	0	F2	Garfield
May 20, 1977	5 miles	0	0	F2	Logan, Garfield
May 2, 1979	24 miles	1	25	F4	Major, Garfield
May 2, 1979	8 miles	0	0	F3	Garfield
April 12, 1991	6 miles	0	0	F2	Garfield
April 12, 1991	9 miles	0	0	F3	Garfield, Grant
April 26, 1991	6 miles	0	0	F3	Garfield
April 26, 1991	66 miles	0	0	F4	Garfield, Noble, Osage
April 21, 1999	8.5 miles	0	0	F2	Garfield
May 3, 1999	8 miles	0	0	F2	Logan, Garfield

Figure 8. Significant Tornadoes (F2 intensity or greater) affecting Garfield County, 1880 – 2003. Source: *Significant Tornadoes, 1880-1989: Volume I* and National Weather Service, Norman office.

during 1994-2004 were included.

Cooperative Observer station summaries include monthly averages, 1971-2000, the average number of days per month of occurrence of certain climatic features, monthly and annual exceedence values, monthly extremes, and freeze/frost information. The information is identical to that included in the county document, but the layout was changed somewhat during the design process. Future revisions of the county documents may include re-formatting the PDF documents to follow the new station layout.

Mesonet station summaries include monthly averages, extremes and wind roses for the period-of-record 1994-2004. Each summary includes temperature and precipitation averages and extremes, but the real climatological value of the Mesonet lies in the wind, humidity, and solar radiation information. The monthly averages include prevailing wind speed and direction and average daily solar radiation accumulation. The humidity and soil temperature tables, as presented in the county documents, are included as separate tables. The extremes table includes peak wind gust with date of occurrence and the greatest rain rate for the month, determined from the Mesonet's 5-minute observations. The wind rose image for the site is also included.

Because of the short duration of the Mesonet as compared to the cooperative observer data, the following disclaimer is listed on each Mesonet station summary:

> *CAUTION: Mesonet data are only available since 1994, a period considered too short to give reliable climate statistics for temperature and precipitation. Cooperative observer sites are strongly recommended for these purposes. Other variables, such as humidity, soil temperatures, and winds, are not available from cooperative observer sites and Mesonet represents the best available information.*

This is not meant to imply that the Mesonet data are of poor quality; rather the purpose is to encourage people not to disregard the Cooperative Observer data simply because it does not provide as much temporal detail or variables as compared to the Mesonet. In the opinion of the development team, the length of record of the Cooperative Observer data supercedes the extensive quality-assurance applied to the Oklahoma Mesonet (Shafer et al. 2000).

5. Designing the county climate CD

The process of designing all of the documents and layout for the CD took more than a year. While representing a tremendous effort, the active collaboration of climatologists, artists, and users provides a set of documents that will enable individuals at the local levels to make more informed decisions with regards to weather and climate issues.

The addition of the one-page Quick Climate Facts sheets promises to be a valuable resource for local economic development coalitions and chambers of commerce, who frequently call and request such information from OCS. The attractive layout is sure to add to any information sent to prospective businesses.

The end result of the process is the development of localized, meaningful climate information that serves a variety of applications. Packaging the information on a CD enables easy access, without having to surf through websites to find documents. Furthermore, the CDs make the information easily accessible to county offices, libraries and schools.

We believe that the county climate summaries CD is an important step forward in bringing relevant information to the local levels. It furthers the OCS mission of providing weather and climate information to the citizens of Oklahoma and increases OCS' visibility within our communities.

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