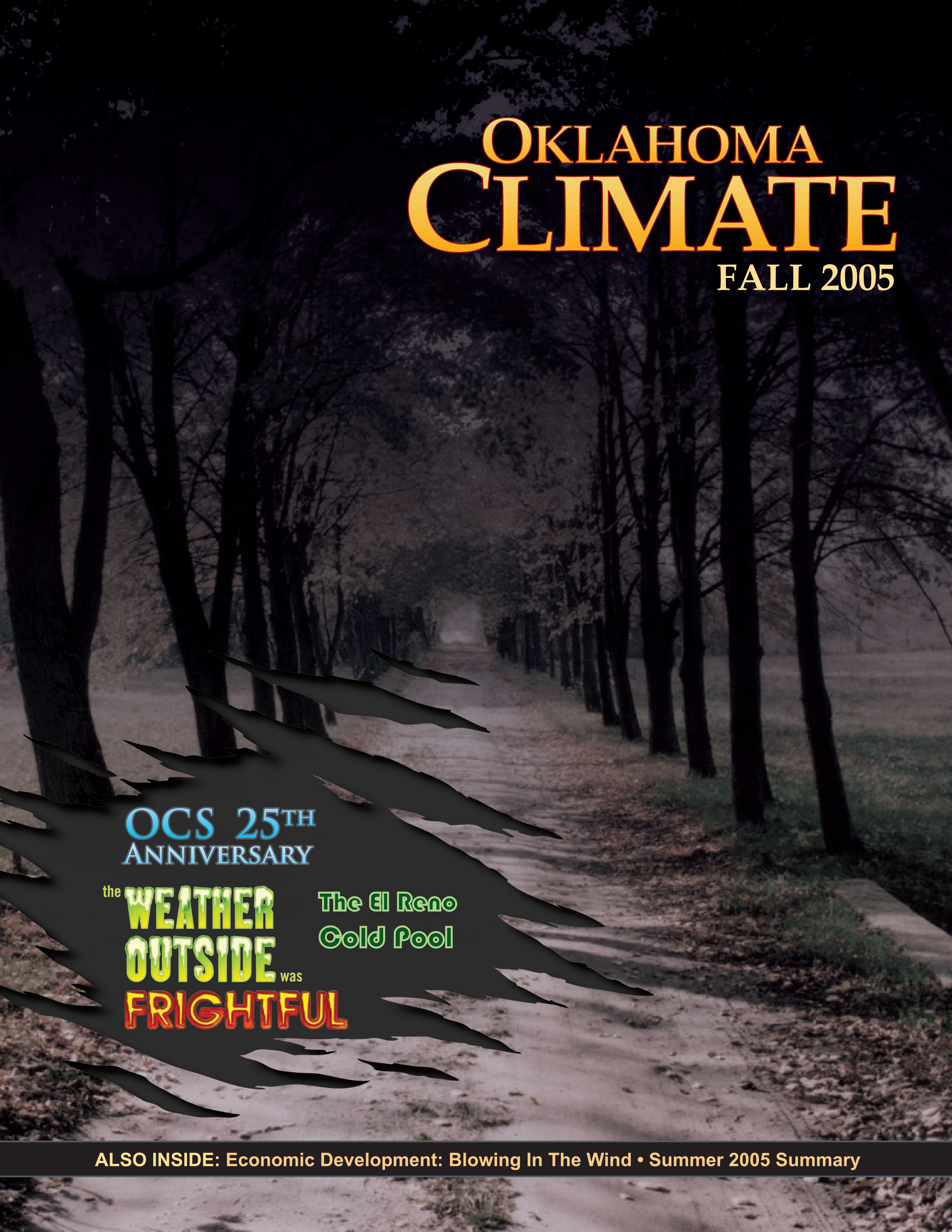
OKLAHOMA CLIMATE

FALL 2005



OCS 25TH ANNIVERSARY

the WEATHER OUTSIDE was FRIGHTFUL

The El Reno Cold Pool

ALSO INSIDE: Economic Development: Blowing In The Wind • Summer 2005 Summary

MESSAGE FROM THE EDITOR

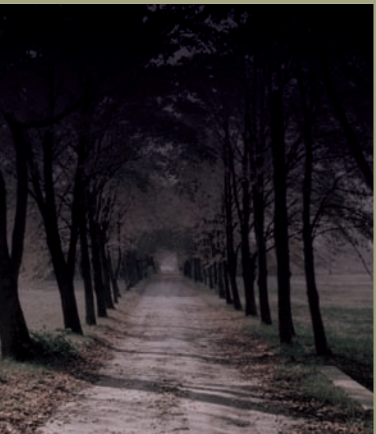
Let's face it, kids don't care what the weather is like on Halloween. All they care about is getting their sugary haul home as quickly as possible and begin another week or two of accelerated tooth decay. Parents, on the other hand, don't want their kids to be out in cold or rainy weather. More importantly, they don't want to be the ones out with their kids in the inclement weather. Fortunately, parents in Oklahoma usually don't have to worry about their little Frankensteins and ballerinas returning home with frostbite. The state's weather is normally in transition phase at that point between the warm weather of early fall to the cooler weather of Thanksgiving. Mother Nature is not that constant, as Oklahomans are well aware of, so one year might bring highs in the 70s, while the next year the temperatures might not climb above 40 degrees. The Halloween of 1991 was just such a year. A frigid blast of air with origins in the Arctic Circle barreled into the state just before Halloween, plunging the state into a frightening frozen holiday. Our historical perspective recalls that frigid Halloween, and also provides the weather of Halloweens' past.

We also commemorate a very special occasion in this issue: the 25th anniversary of the creation of the Oklahoma Climatological Survey, from which this publication originates. In its quarter-century lifespan, the state climate office of Oklahoma has become a national leader in many areas. Read about the people and events that have shaped this groundbreaking and exceptional office. Many of us watch the weather on television and see temperature forecasts for a generalized area, but forecasting down to your location is not that simple. Varying conditions from city to city, and even field to field, due to small changes in geography can be significant. One of those instances is examined inside in an article detailing the seeming cold pool of air that surrounds El Reno at night. Energy prices are higher now than anytime in history, making renewable energy more important than ever. Read about wind power in Oklahoma, and what it means for the state's residents and customers.

Also in this issue, you'll find our normal feature articles: a classroom exercise dealing with the Oklahoma wind power industry, a summary of the summer's agricultural conditions, horticulture tips from our resident agricultural expert, and our pictorial section. In this issue, that pictorial subjects are near and dear to our hearts here at the climate survey – the children of OCS employees in their Halloween costumes.

I sincerely hope you enjoy this issue of "Oklahoma Climate." If you have any questions or comments, please feel free to contact me at gmcmanus@ou.edu.

Gary McManus – Editor



Oklahoma Climate
Fall - 2005

Cover Photo: Photo by Adriana Herbut. If you have a photo that you would like to be considered for the cover of Oklahoma Climate, please contact Gary McManus at gmcmanus@ou.edu.

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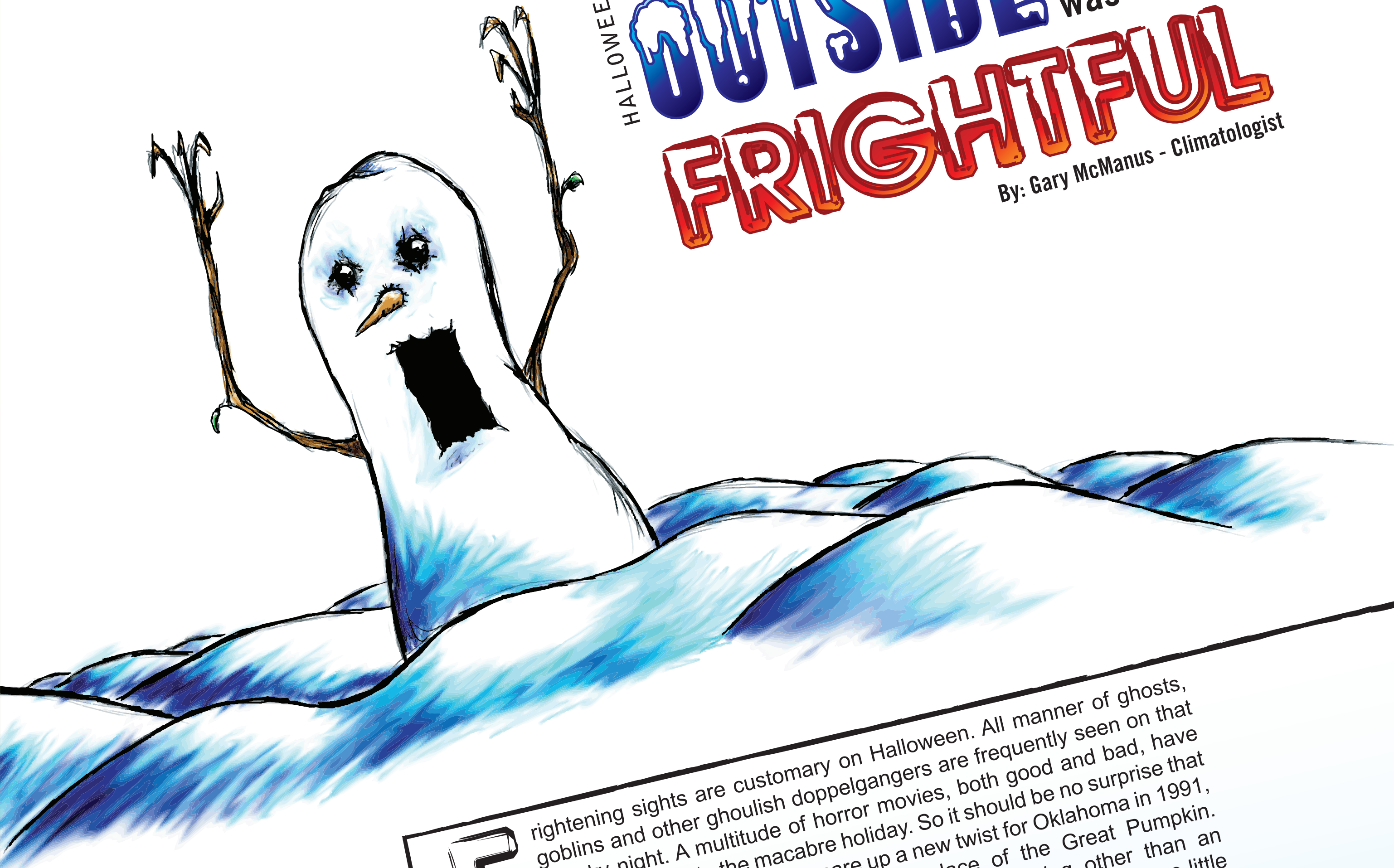
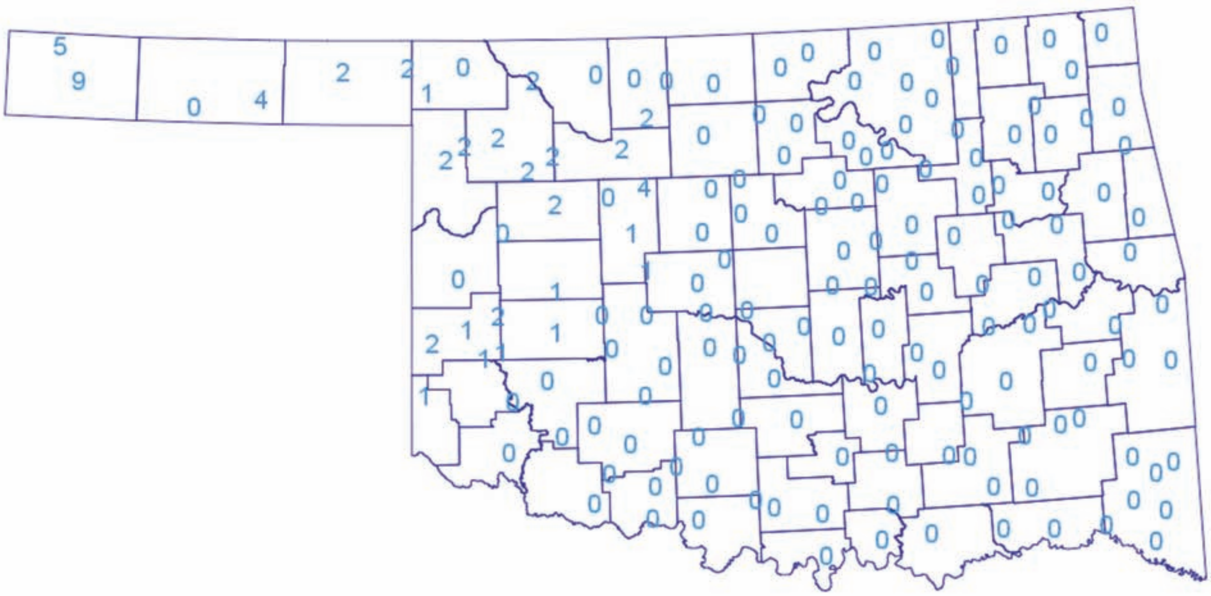
Halloween 1991: the Weather Outside was Frightful

By: Gary McManus - Climatologist



Frightening sights are customary on Halloween. All manner of ghosts, goblins and other ghoulish doppelgangers are frequently seen on that spooky night. A multitude of horror movies, both good and bad, have been dedicated to the macabre holiday. So it should be no surprise that Mother Nature managed to scare up a new twist for Oklahoma in 1991, as Jack Frost and Old Man Winter took the place of the Great Pumpkin. Unfortunately, for those trick-or-treaters dressed as anything other than an Eskimo or Wolfman, frozen caramel apples and soggy popcorn balls were little comfort against the wintry chill.

Snowfall, in inches, on October 30, 1991



The week started on a pleasant note with sunny skies heralding temperatures in the 60s and 70s on the 28th. An unusually strong arctic cold front was barreling down from the north, however, reaching Oklahoma early on the 29th. Temperatures dropped immediately into the 20s in the northwest behind the front as snow began to fall. Twelve inches accumulated in Boise City by the 30th as the rest of northwest Oklahoma garnered between two and five inches. Temperatures struggled to eclipse the 20s and 30s for the next several days, culminating in a dreary, miserable Halloween weekend.

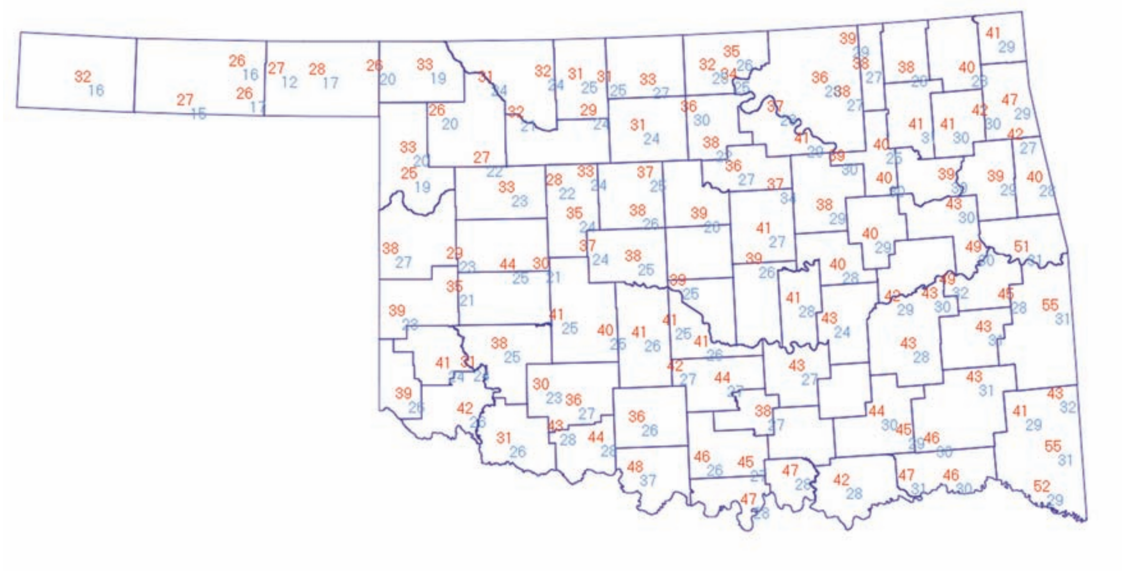
A combination of snow, sleet, freezing rain, and just plain old torrential rainfall made for treacherous conditions on Halloween day. Most of the state was placed under some type of winter weather advisory by the National Weather Service, while the southeast was under alert for flash flooding. For the most part, the precipitation had ended by dusk, but by then the damage was done. By the time trick-or-treating was to have begun in earnest, temperatures in the 20s and strong northerly winds combined to drop wind chill temperatures down to single digits.

Winter storm warnings were posted for the Panhandle and western Oklahoma with localized reports of up to five inches of snow having fallen. Ice and sleet covered the ground farther east. Much of Weatherford was without power in the early morning due to ice-coated tree limbs disrupting power lines. Sleet was reported to have covered the ground in that area as well. Interstate 40 in western Oklahoma was down to one lane from Oklahoma City to the Texas state line due to deteriorating travel conditions.

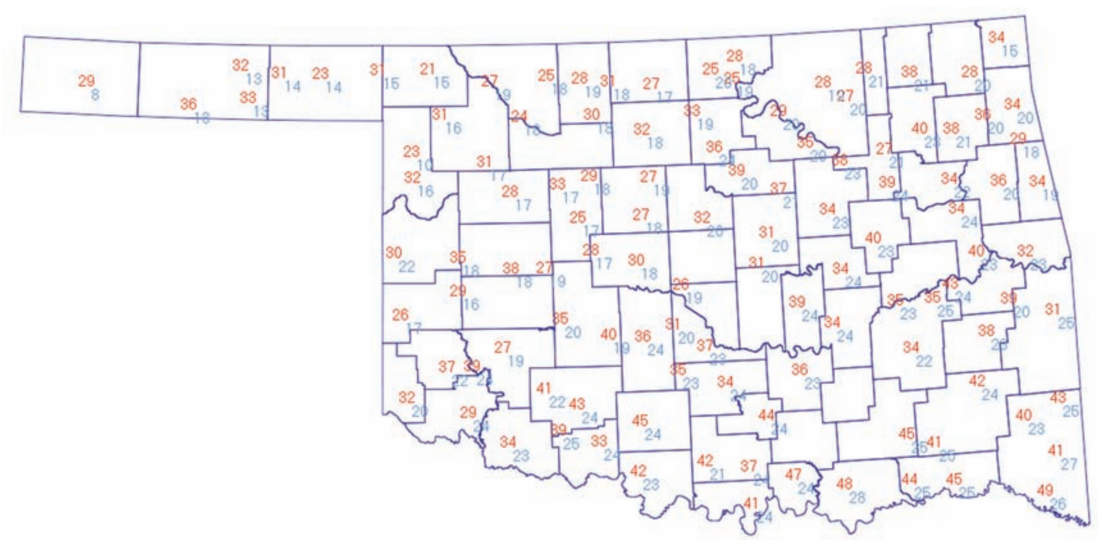
And the Cold Played On

The cold lingered for several more days as the center of the arctic high moved south, finally settling over Oklahoma on Saturday, November 2. The state's college football fans were as dismayed as the erstwhile trick-or-treaters from two nights past as they stayed away in droves from home football games in Norman and Stillwater. Only 37,000 showed up for the Sooners' game versus Kansas State, and half of those left at halftime as snow began to fall. The story was much the same for the Cowboys game against Kansas. Only 18,000 fans braved the 24 degree temperature at kickoff, and only a few hundred stayed through the snow until the final gun sounded. Oklahoma City's high temperature of 26 degrees was the coldest maximum temperature on record for that day and location, and also the coldest high temperature for that early in the season.

High (red) and low (blue) temperatures on October 31, 1991



High (red) and low (blue) temperatures on November 1, 1991



The Weather of Halloweens Past

Overall, about one out of five years has recorded significant precipitation during Halloween. Years with precipitation range from six percent of the years out in the Panhandle to just over a quarter of years in the east. The wettest year at many locations across the state occurred in 1998, although Durant, which holds the state record for the wettest Halloween with 5.35 inches, set its record in 1974.

Typical temperatures for Halloween are the upper-60s to low-70s for daytime highs and mid- to upper-40s for nighttime lows. The warmest Halloween temperature on record was 90 degrees, set at both Durant and Ardmore in 1934. Most places in Oklahoma, however, set their records in 1950, when upper 80s were commonplace across the state. The coolest temperature on record for Halloween is 15 degrees, set at Goodwell in 1991 and at Clinton and Ponca City in 1993. Young trick-or-treaters need jackets about half of the time across most of the state, but those in the northwestern parts could use a jacket almost every year.

Oklahoma Climatological Survey 25 Years 1980-2005

By: Cerry Leffler
Administrative Manager

The Oklahoma Climatological Survey (OCS), currently the nation's largest state climate office with 68 employees, is celebrating its 25th anniversary this month. OCS, a state agency housed at the University of Oklahoma, is charged with archiving and disseminating weather and climate information for the citizens and leaders of Oklahoma. In addition, OCS is the operational home of the Oklahoma Mesonet, Oklahoma's world-renowned weather observing network.

Much like a human being, an organization has a life of its own. It begins in infancy and grows, changing and maturing along the way, all the while collecting memories and knowledge. OCS has many incredible accomplishments in its first 25 years, and continues to serve the people of Oklahoma.

Established in 1980 by its founder, Dr. Amos Eddy, Professor of Meteorology at the University of Oklahoma, the organization was to address the need for accurate and timely weather observations for state agencies and individuals alike. Governor David L. Boren and OU President Paul Sharp appointed Dr. Eddy as State Climatologist in June 1978, and established the state climate office on the OU campus in July 1980. The office's genesis was the result of the need to establish climate research and applications for the state due to the dismantling of the climate programs by the National Weather Service (NWS). While the NWS recognized the need for such information, it turned its resources and attention to creating new technologies to improve forecasting of severe weather. This left over half of the nation without state climatologists.

One of the first products produced by OCS was a monthly summary, simply titled, The Oklahoma Monthly Climate Summary, which provided the previous month's weather observations and yielded many tables and graphs of average temperature and precipitation, as well as long-term forecasts. Dr. Eddy's goal for this summary was to have it produced, printed, and mailed by the 15th day of the following month. This was exceptional in the 1980's due to the length of time it took for the observations to travel from the human observer to the state climate office; each piece of datum's circuitous route taking it from the observer to the local NWS office, then off to the National Climatic Data Center (NCDC), finally arriving at OCS after three months time. The first monthly summary was published in September of 1980, and is still published today. You can find the most recent summary, with many other free publications, at http://www.ocs.ou.edu. While the summary has changed and improved over the years, it still boasts thousands of readers annually.

Amos Eddy established a unique relationship with the NCDC early on, and OCS became the only other agency in the nation to possess the entire dataset of the nation's NWS National Cooperative Observing Network weather observations. It was the most comprehensive database for any state climate office. This awarded OCS the ability to generate many collaborative research alliances and opportunities. OCS created a consortium to collect data from other states and to share the national archive for unified climate research interests. Today, Dr. Ken Crawford, Director of OCS since 1989, is working with the NWS to build a network infrastructure to collect and quality assure data from many sources nationwide and to continue Oklahoma's legacy as a national data resource.

In the early years, research influence was directed toward economic assessment and impact of climate in several areas of the state's resources, such as agri-business, water resources management, and climate impact on energy demand. Today, this theme remains with scientists at OCS with continued research in drought mitigation and urban meteorology, advances in agricultural models, and energy resource management. However, OCS has expanded its services to include the operation of Oklahoma's real-time weather observing network, the Oklahoma Mesonet (www.mesonet.org), and hands-on training in the use of weather data and products by such industries as Oklahoma's first responders, K-12 education, electric cooperatives, and transportation.

Each director of the OCS has left a legacy in his or her name. Dr. Amos Eddy created OCS and reinvigorated the climate research and application initiative in Oklahoma. Dr. Claude Duchon, interim director from 1987-1989, co-authored a book with Howard L. Johnson, retired Assistant State Climatologist for Service, titled: The Weather and Climate of Oklahoma. The book presented a comprehensive overview of Oklahoma and its natural resources including atmospheric contributions.

Dr. Kenneth C. Crawford, Director from 1989-2004 (who will return from sabbatical in 2006), brought the vision of the Oklahoma Mesonet and carried it through to fruition with counterparts from Oklahoma State University. The Oklahoma Mesonet is the premier network of its kind in the nation and has brought tremendous respect and millions of research dollars to Oklahoma. Finally, Dr. Renee A. McPherson, Acting Director (2004-2006), shaped OCS's current K-12 outreach program to the award-winning curriculum that it is today, and has expanded the research enterprise to include transportation – of which OCS is fast becoming a nationwide leader.

All of these individuals have made contributions to the growing entity known as OCS, providing gentle guidance and nurturing where needed, culminating in one of the most prestigious and respected state climate offices in the nation. As OCS joyfully celebrates 25 years of serving Oklahomans, its employees stand in awe of what has been accomplished, and look to the next 25 years with bright ideas and enthusiasm for the future. Thank you, Oklahoma, for letting us serve you.


OCS CHILDREN

PHOTOS FROM THE FRIDGE

The El Reno Cold Pool

By: Cindy Morgan
NERON Quality Assurance Manager

Nothing is more enjoyable than sitting outside on a clear autumn night and watching the stars. All you need are clear skies, calm winds, open terrain, and an area far away from lights. The forecast calls for a warm evening, but if you are watching stars from the El Reno Mesonet site, you will need a blanket!

The El Reno Mesonet site (ELRE) is located approximately five miles west-northwest of El Reno, Oklahoma, on open, gently sloped terrain (see Figure 1). Like most Oklahoma Mesonet sites, this site is equipped with air temperature sensors at both 1.5 m and 9 m. ELRE is frequently impacted by strong low-level inversions (temperature differences of at least 5°C between 1.5 m and 9 m) shortly after sunset on nights with clear skies and calm winds. Furthermore, the cooling rate at ELRE is much greater than any of its surrounding sites (see Figure 2), begins just before sunset, and lasts for several hours. By sunrise, the inversions are minimal and ELRE is approximately the same temperature as the other sites in the immediate area. Because inversions at ELRE have been as strong as 11°C while inversions at surrounding sites were minimal, this phenomenon is believed to be the result of a microscale feature.

Normally, the ground begins to cool as the sun sets due to radiational cooling. The cool ground chills the air immediately above it in a process called conduction. In addition, air aloft cools as a result of wind mixing the cooler air that is near the ground with the air aloft. This continues until sunrise the following day. However, if the wind is calm, mixing does not occur and the air aloft cools slowly while the air just above the ground continues to cool rapidly. This causes a large temperature difference between the air near the ground and the air aloft. Another factor needed for rapid surface cooling is clear skies. If clouds are present, radiation emitted by the ground will be absorbed and re-emitted by the clouds. Some of the radiation emitted by the clouds will reach the ground and will prevent it from cooling as quickly.

Figure 1
Photograph of ELRE. The site is located in an open field with gently sloping terrain. Pictures provided by the Oklahoma Climatological Survey.

There are many different factors that can cause a site to cool more than its surroundings. ELRE is affected by a method of cooling call in-situ cooling; cooling that occurs when the air near the ground does not mix with the surrounding air. Since the air very near the surface cools by conduction with the ground and the air aloft cools by mixing with the air near the surface, this allows the air near the surface to cool a large amount compared to its surroundings when there is little or no wind. In-situ cooling is normally associated with wind obstructions such as hills and trees. These obstructions block the wind during evenings with clear skies and light winds and can create large horizontal temperature gradients. A study by Gustavvson et al. (1998) found that very large temperature variations are possible within one hour of cooling and that the fastest cooling was during the first two hours after sunset, while the rate slowed during the remainder of the night.

At first glance, ELRE does not have any unusual features that would warrant in-situ cooling. The site is located on gently sloped terrain and there are no nearby trees or other obvious obstructions. A study was completed during the first 3 months of 2005 using Portable Atmospheric Research Micrometeorological Stations (PARMS) to study the wind speed and temperature profile surrounding the site to get a better understanding of why ELRE gets so much cooler than its surrounding sites. The measurements obtained showed that the slope of the land where ELRE is located is just enough to act as a wind obstruction, which would cause in-situ cooling. Of the 100 Mesonet stations that collect air temperature measurements at 1.5 m and 9 m, strong inversions are rare at most sites. Including ELRE, only 8 Oklahoma Mesonet sites with sensors at both levels have recorded temperature inversions of at least 10°C between January 2000 and March 2005.

To most people, the El Reno Mesonet site appears to be just a normal location. However, on dry, clear, calm evenings, the air temperature near the ground cools at a much faster rate just after sunset than the surrounding areas due to in-situ cooling. The lack of wind mixing the air also causes the air temperature aloft to cool very slowly. So, the next time you decide to watch the stars on a beautiful autumn evening just after dusk, be sure to steer clear of the El Reno Mesonet site!

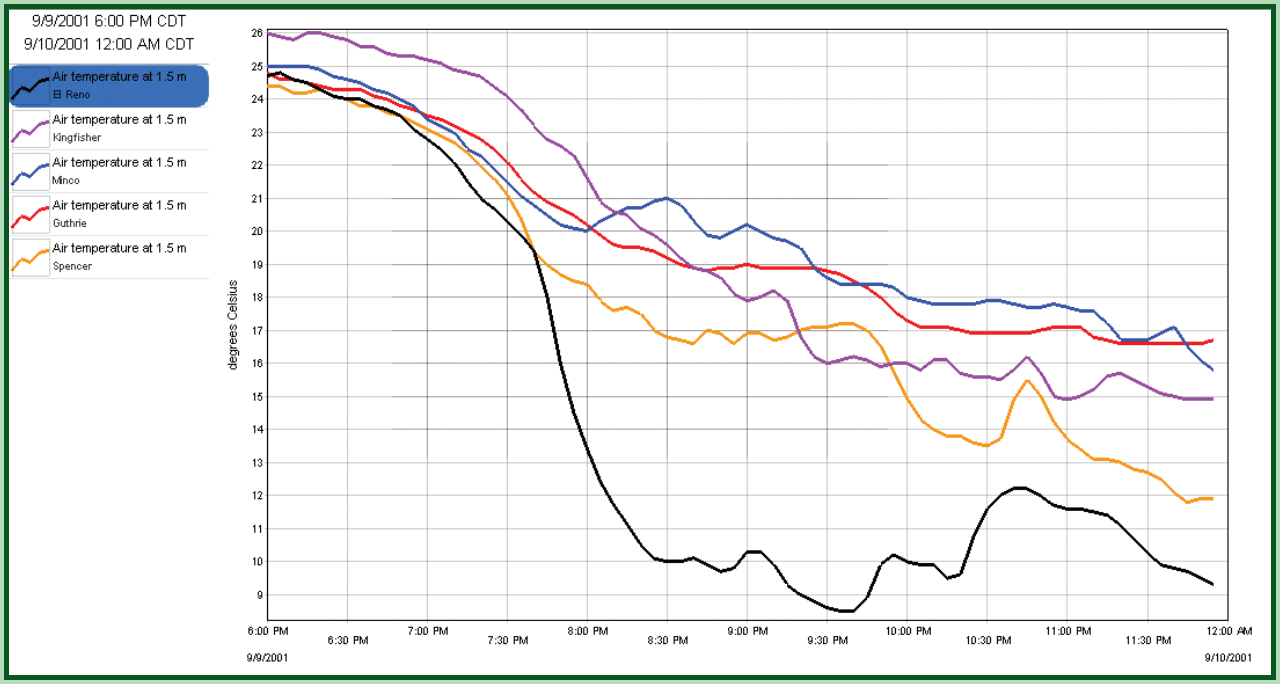


Figure 2
Air temperature (in °C) for ELRE and its surrounding sites during the afternoon and evening of September 9, 2001. During evenings with calm winds, low humidity, and clear skies ELRE often cools at a much faster rate than any of its surrounding sites.

SUMMER 2005 SUMMARY

By: Gary McManus

Droughty conditions which began in the spring were eradicated in most areas by summer deluges as the state experienced its 28th wettest summer on record. The exception to the rule lay with the far southeastern corner of Oklahoma, which suffered through its 12th driest summer on record. Meanwhile, a swath of the state from southwestern up through central and north central Oklahoma enjoyed rainfall surpluses of over five inches. The excessive rainfall and associated cloud cover helped the state finish a bit on the cool side for the season; the 47th coolest on record, to be exact. Severe weather entertained the state on several occasions, including eight tornadoes during June. Most of the stormy weather brought high winds and heavy rainfall, however, as the tornado sightings ended early in the summer on June 9th.

Precipitation

Oklahoma was blessed with a drought-quenching summer rainy season in 2005. The statewide-averaged precipitation total was over 12 inches, more than two inches above normal. The area from southwestern and west central Oklahoma up through the central and north central sections experienced robust precipitation totals. Those areas finished with average rainfall totals within the top-14 on record. Meanwhile, the southeastern corner of the state was the only area which finished less than normal, and their total was nearly five inches below normal. The Panhandle, whose rainy season occurs in the summer months, was over an inch above normal, good enough for the 36th wettest summer on record for that section of the state.

Temperature

The areas that received a lot of rain were generally cooler than those areas that received less. Most of the eastern one-third of the state was generally above normal temperature-wise, but none more so than the southeast. The average temperature finished well over a degree above normal, the 30th warmest such period on record for that section of the state. Southwestern Oklahoma was the coolest compared to normal, and enjoyed its 25th coolest summer on record. As a whole, the state finished just a tad below normal.

June Daily Highlights

June 1-5: The storminess of June began early on the 1st. After another warm day on the 2nd, successive bouts with severe thunderstorms occurred each day through the 5th. The storms started early on the 3rd in central and southwestern Oklahoma. A small tornado touched down near Hardy, in Kay County, late that evening. No damage was reported with the twister, however. The storms, which had been firing along a cold front and dry line that had pushed into the northwest returned on the 4th. A rain-wrapped tornado was spotted near Pumpkin Center, and hail covered the ground in Yukon. Other tornadoes struck near Marlow and McCord, according to preliminary reports. Straight-line winds were the most dangerous severe threat on the 4th, however. Damaging winds of over 90 mph were reported in Tulsa, and numerous wind gusts greater than 70 mph were scattered across the state, associated with the storms. Yet another line of storms formed on the 5th and pushed across central and south central sections of the state. Although not as widespread as on the previous day, more severe wind and hail reports occurred with these storms. A large supercell in southwestern Oklahoma dropped two confirmed tornadoes in Kiowa County, the second of which – rated an F1 on the Fujita Scale – damaged several structures near Mountain Park and Snyder.

June 6-8: The weather calmed for the next three days other than a few isolated severe storms which cropped up across the state. A warm period, the high pressure which moved over the state allowed for sunny skies and rising temperatures. Lows were mainly in the 70s during this time, and highs reached into the upper 90s. Heat indices had risen above 100 by the 8th.

June 9-12: Widespread severe weather returned once again during this five-day period. The Cimarron River overflowed its banks near Waynoka on the 11th as the storms continued through the 13th. Some locations in Woods and Woodward counties received over eight inches of rainfall through this period. A 92 mph wind gust was recorded by the Bessie Mesonet site on the 12th, with several reports of 80 mph winds occurring during the same period in Washita and Caddo counties.

June 13-17: The 13th was a tranquil day with lows dropping into the upper-50s in the northwest to the mid-70s in the southeast. The weather remained rather passive for the next couple of days with lows in the 50s and 60s and highs in the 80s and 90s. Finally, late on the 15th and into the 16th, storms raced across the state from the Panhandle southeastward. Strong straight-line winds were the main culprit of this outbreak, which saw winds of up to 100 mph measured by the Oklahoma Mesonet site at Marshall. Winds of 90 mph were reported near Coyle and Minco, with winds greater than 60 mph being too numerous to mention. The winds left significant damage in their wake. A car wash collapsed on a vehicle in Ringwood, and a nearby trailer home was thrown onto a county road. Several businesses in Hennessey were damaged by high winds in that area, estimated at 90 mph. The storms knocked out power to 42,500 homes across the state, and a utility worker was killed in the restoration efforts when he touched a live power line. The storms eventually exited the state on the 17th, making for a calmer afternoon.

June 18-26: The transition to summer from the spring-like weather began in earnest on the 18th as a large area of high pressure in the upper-levels settled over the southwestern U.S. The sinking air stifled any precipitation chances, and the temperatures settled into the 90s for the most part. The northern half of the state made a slower transition to the warm weather than the south due to the excessive rainfall that occurred previously, but eventually it, too, warmed up to summertime levels.

June 27-30: Triple-digit temperatures arrived with the end of the winter wheat harvest, as the late-June sun heated up the bare ground of the wheat belt across southwestern and north central Oklahoma more effectively. The month ended with its hottest temperature, 102 degrees, being recorded on the 30th at Cherokee and Grandfield.

July Daily Highlights

July 1-5: July was greeted with violent weather early as a round of severe storms struck in the northwest on the 1st. Winds of up to 70 mph and quarter-sized hail were reported with the storms. More storms occurred overnight on the 2nd due to an outflow boundary in the southwest, a remnant of the previous day's storms. Severe storm winds overturned and sank a boat on Tom Steed Lake in Kiowa County. Conditions quieted down on the 2nd after the storms exited the state, and temperatures warmed into the 80s and 90s. More severe storms moved across the state that night and into the early morning hours on the 4th. All areas of the state experienced storms except for the extreme southwest. Winds from 60-80 mph were reported in many areas, peaking with a 102 mph wind gust at Blackwell. Widespread wind damage was reported with these storms, including downed power lines, tree damage, and damage to structures. Yet another night of storms awaited residents on the

5th. Temperatures throughout this period were seasonable, with the exception of the exceedingly hot day on the 3rd.

July 6-9: The widespread storms ended on the 6th with just a few intense storms confined to the southwest. Rainfall amounts were light in that area, generally less than one-half of an inch. The weather for the rest of the period was pleasant and seasonable with plenty of sunshine, highs in the 80s and 90s, and lows in the 60s and 70s.

July 10-15: Tropical moisture from the remnants of Hurricane Dennis crept into eastern Oklahoma on the 10th, providing the fuel for a few showers and storms. More storms on the 11th brought rain to the west, and cooled that area down enough to keep high temperatures in the 80s, while the rest of the state suffered in the upper 90s and 100s. Severe storms were on tap for the 12th as well. A complex of severe storms moved south into north central Oklahoma from Kansas. Strong winds of up to 69 mph and quarter-sized hail were the main severe threats from these storms. The Marshall Mesonet site reported nearly 1.5 inches of rainfall that afternoon. Scattered showers and storms occasionally popped up through the next three days, with daytime highs remaining summer-like; upper-90s and 100s were common across the state.

July 16-18: This three-day period was marked by lots of sunshine and warm weather. A cold front approached from the north on the 18th and acted as a focus for showers and storms late that night.

July 19-25: A fairly innocuous period, the next seven days were marked by lots of sultry weather. High temperatures soared into the triple digits across the state, and heat indices outpaced even those readings. Oklahoma City reached 100 degrees on the 22nd for the first time since August 28th of the previous year.

July 26-27: Welcome relief came in the form of a cold front early on the 26th. The cooler weather came complete with showers and storms as winds shifted to the north. Highs only reached the 70s and 80s in the northwest, although temperatures still soared into the 90s in the southeast, ahead of the front. The cold front lingered in the southeast on the 27th, and the storm activity was restricted to south central and southeast Oklahoma. Waurika received over two inches of rainfall with the storms.

July 28-31: Remaining dry, the month's final four days saw a gradual warm-up as high pressure began to dominate once again. Gage reported a low temperature of 51 degrees on the 29th, while Erick and Arnett fell to 52 degrees. By the month's final day, however, summer was in full bloom again with highs in the 90s and 100s under abundant sunshine.

August Daily Highlights

August 1-3: A dome of high pressure settled over the state for the month's first three days, providing seasonable temperatures. Partly cloudy skies and warm conditions – typical summer fare – were on hand throughout the period, with highs in the 90s and 100s, and lows in the 70s.

August 4-8: An approaching cold front triggered showers and thunderstorms before sunrise on the 4th and continued through the rest of the afternoon. Several of the storms exceeded severe limits, with winds of up to 66 mph recorded by the Mesonet site at Woodward. More storms on the proceeding four days brought much-needed rainfall to the state, and the cold front dropped temperatures below normal.

August 9-11: A much quieter period after the previous few days of storms, only a few showers along the Red River broke up the monotony of sunny skies and high temperatures in the 90s.

August 12-17: Another fairly strong cold front entered the state on the 12th and stalled, setting up another wet weather scenario for the next several days. These storms were a bit more significant than those that cropped up earlier in the month, with many associated reports of severe weather. High winds and flooding were the main culprits. Strong storms struck once again on the 13th along the stalled cold front. Similar to the previous day, strong winds were the main severe threat. The weather behind the stalled front was considerably un-summer like. Temperatures in northern Oklahoma only climbed into the upper-70s. The weather south of the front remained hot and humid. The front sagged further to the south over the next several days, spreading more heavy rain and severe weather. There were several locations with rainfall totals over five inches for the period, including Sulphur and Bowlegs, which both exceeded six inches.

August 18-19: The ensuing two days were replete with clear skies and warm temperatures. Triple-digit high temperatures returned, and the moist soil caused heat indices to soar close to the 110-degree mark in northwestern Oklahoma.

August 20-24: An upper-level storm system approached the state from the west, triggering another extended period of showers and thunderstorms. Heavy rains fell over much of the state, with the highest totals occurring in west central and north central Oklahoma. Several totals once again exceeded five inches, with the Mesonet sites at Breckenridge and Watonga topping the six-inch mark from the 20th through the 24th. With each round of storms, more outflow boundaries were created which would later trigger more showers. The storms and various boundaries kept temperatures quite pleasant compared to normal with a mixture of 80s and 90s.

August 25-31: Weather on the 25th was quiet with light winds and high humidity. Heat indices across the state rose easily into the 100s. Showers formed again in the northwest along an outflow boundary from storms in Kansas, bringing rains of near an inch to Cheyenne and Leedey. A brief cool down occurred due to a frontal passage on the 27th, with the cooler weather extending into the 28th. Lows dropped to as low as 49 degrees in Kenton in the far western Panhandle on the 29th. Northeasterly winds and cloudiness across eastern Oklahoma were due to the influence of Hurricane Katrina, at that point a tropical depression moving across Tennessee.

Summer 2005 Statewide Extremes

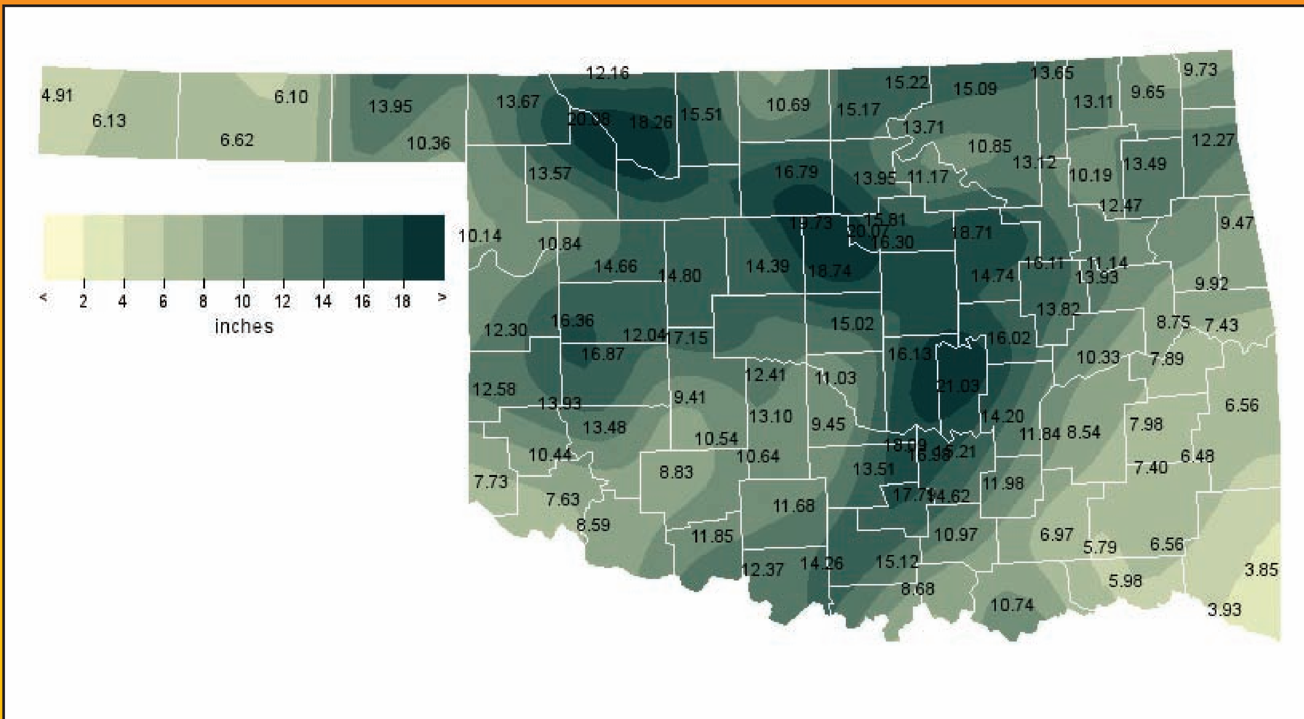
Description	Extreme	Station	Date
High Temperature	106ºF	Claremore, Grandfield	July 23rd, 3rd
Low Temperature	42ºF	Kenton	June 5th
High Precipitation	21.03 in.	Bowlegs	
Low Precipitation	1.93 in.	Broken Bow	

Summer 2005 Statewide Statistics

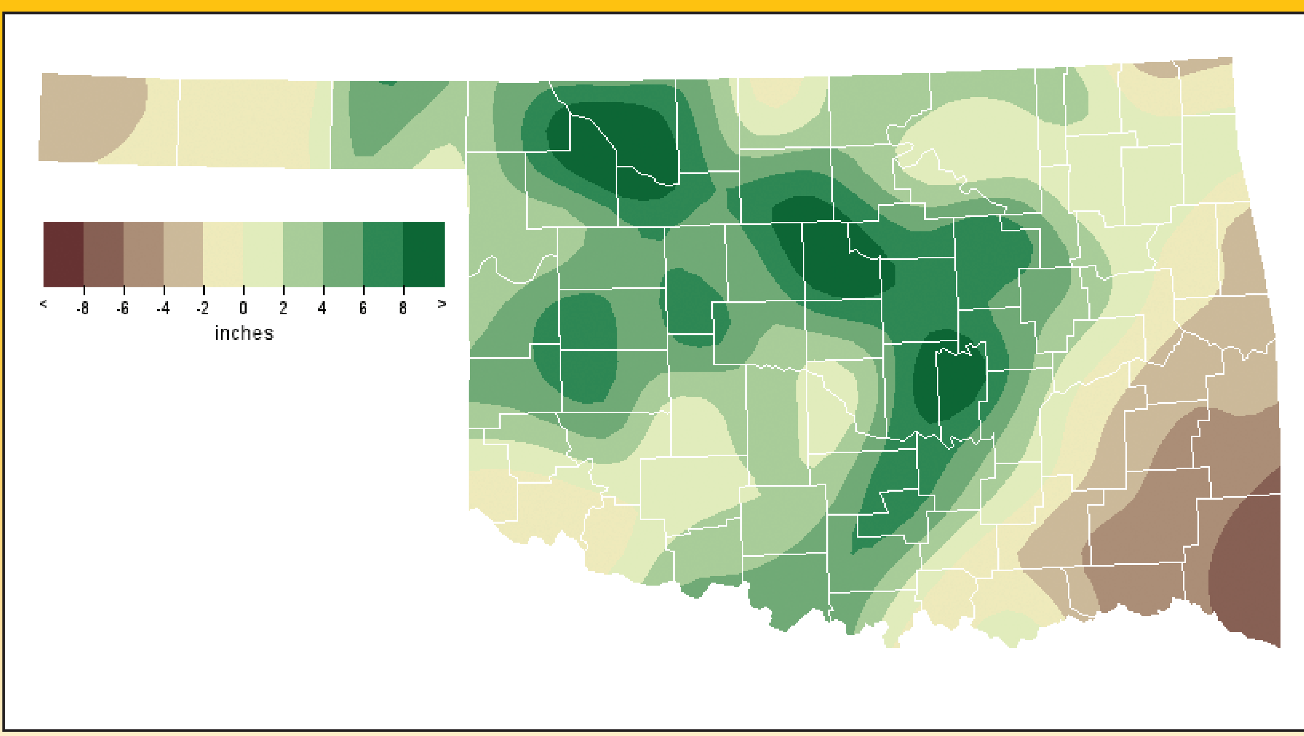
	Average	Depart.	Rank (1892-2005)
Temperature	79.2ºF	-0.3ºF	47th Coolest
	Total	**Depart.**	**Rank (1892-2005)**
Precipitation	12.06 in.	-2.29 in.	28th Wettest

SUMMER 2005 SUMMARY

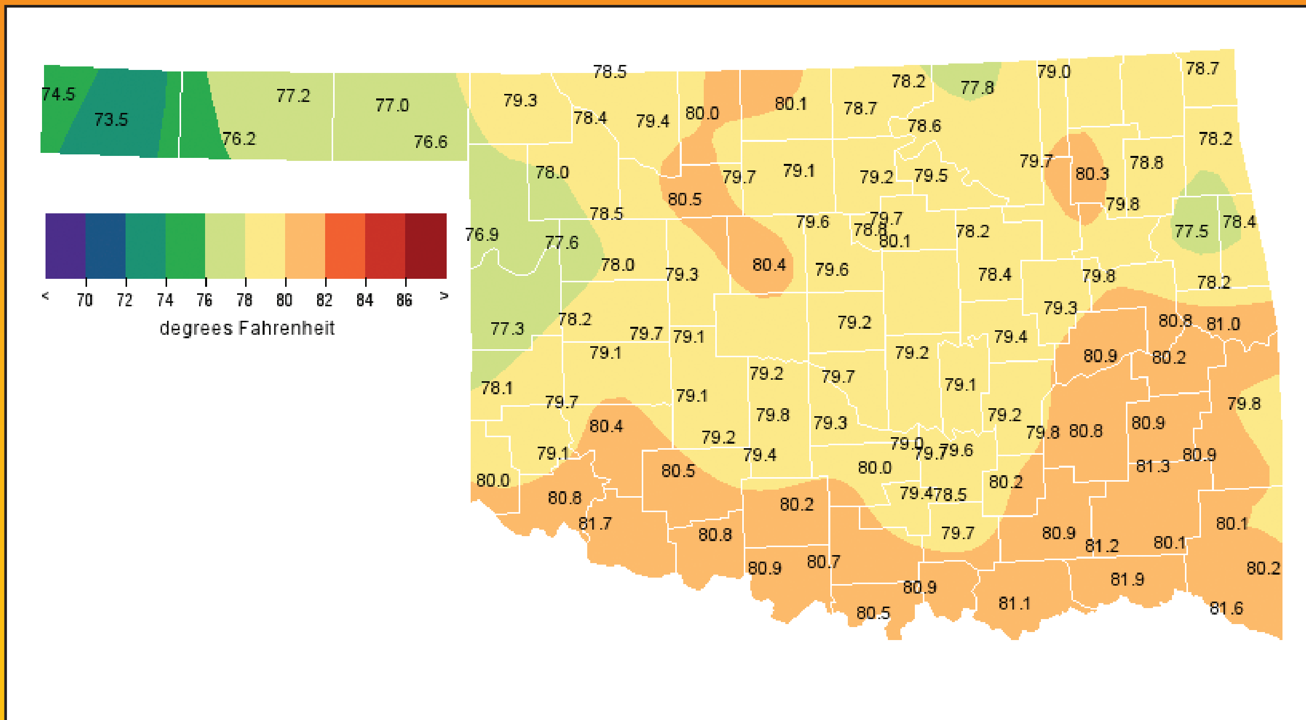
Observed Rainfall



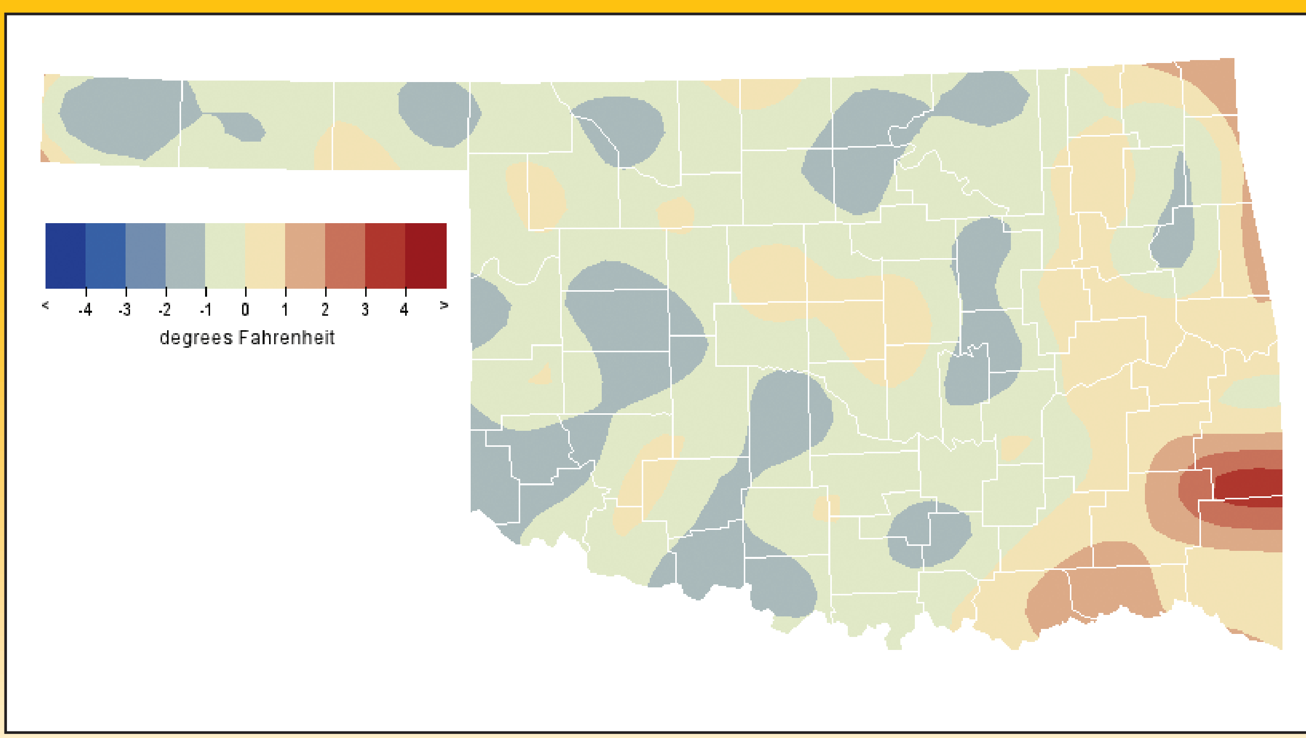
Rainfall Departure from Normal



Average Temperature



Temperature Departure from Normal



Summer 2005 Mesonet Precipitation Comparison

Climate Division	Precipitation (inches)	Departure from Normal (inches)	Rank since 1895	Wettest on Record (Year)	Driest on Record (Year)	2004
Panhandle	8.98	1.02	36th Wettest	17.32 (1950)	2.66 (1936)	12.27
North Central	15.14	5.17	11th Wettest	16.95 (1995)	3.73 (1936)	13.70
Northeast	12.12	1.16	48th Wettest	23.78 (1948)	2.97 (1936)	15.19
West Central	13.82	5.11	10th Wettest	16.53 (1995)	2.79 (1980)	13.01
Central	15.49	5.72	14th Wettest	17.61 (1992)	1.97 (1936)	15.80
East Central	11.02	0.31	51st Wettest	20.53 (1958)	1.54 (1936)	16.49
Southwest	10.56	1.54	29th Wettest	16.22 (1996)	2.15 (1980)	14.05
South Central	13.26	3.54	17th Wettest	19.72 (1950)	2.58 (1980)	16.79
Southeast	6.06	-4.93	12th Driest	21.23 (1945)	3.50 (1934)	14.92
Statewide	12.06	2.29	28th Wettest	17.26 (1950)	2.79 (1936)	14.77

Summer 2005 Mesonet Temperature Comparison

Climate Division	Average Temp (F)	Departure from Normal (F)	Rank since 1895	Hottest on Record (Year)	Coldest on Record (Year)	2004
Panhandle	76.4	-0.9	35th Coolest	81.9 (1934)	71.5 (1915)	74.5
North Central	79.1	-0.8	33rd Coolest	86.2 (1934)	74.3 (1915)	76.2
Northeast	79.0	0.2	54th Warmest	85.4 (1934)	73.8 (1915)	75.4
West Central	78.6	-0.9	34th Coolest	85.4 (1934)	74.6 (1915)	76.5
Central	79.4	-0.6	41st Coolest	85.6 (1934)	75.0 (1915)	76.2
East Central	79.6	0.3	54th Warmest	85.4 (1934)	75.0 (1915)	76.6
Southwest	80.1	-1.1	26th Coolest	86.0 (1980)	77.1 (1915)	78.0
South Central	80.1	-0.7	38th Coolest	86.2 (1934)	77.0 (1906)	77.0
Southeast	80.8	1.6	30th Warmest	84.8 (1934)	75.3 (2004)	75.3
Statewide	79.2	-0.3	47th Coolest	85.2 (1934)	74.9 (1915)	76.2

Summer 2005 Mesonet Extremes

Climate Division	High Temp	Day	Station	Low Temp	Day	Station	High Monthly Rainfall	Station	High Daily Rainfall	Day	Station
Panhandle	105	Jul 24th	Hooker	42	Jun 5th	Kenton	13.95	Beaver	2.39	Jun 16th	Buffalo
North Central	104	Jul 23rd	Lahoma	51	Jun 1st	Freedom	20.08	Freedom	4.59	Jun 10th	Alva
Northeast	106	Jul 23rd	Claremore	53	Jun 28th	Nowata	15.09	Foraker	2.67	Aug 15th	Miami
West Central	102	Jul 3rd	Retrop	49	Jun 28th	Butler	16.87	Bessie	3.45	Aug 20th	Retrop
Central	104	Jul 22nd	Kingfisher	49	Jun 28th	Kingfisher	21.03	Bowlegs	5.37	Aug 14th	Bowlegs
East Central	104	Jul 23rd	Sallisaw	55	Jun 2nd	Cookson	16.11	Hectorville	2.65	Aug 14th	Calvin
Southwest	106	Jul 3rd	Grandfield	47	Jun 28th	Mangum	17.15	Hinton	4.07	Aug 21st	Hobart
South Central	103	Jul 3rd	Ringling	56	Jun 21st	Burneyville	18.09	Byars	4.63	Aug 14th	Ringling
Southeast	105	Jul 22nd	Talihina	56	Jun 19th	Broken Bow	7.98	Wilburton	1.95	Jun 17th	Wister
Statewide	106	Jul 23rd	Claremore	42	Jun 5th	Kenton	21.03	Bowlegs	5.37	Aug 14th	Bowlegs

AGRICULTURE WEATHER WATCH

BY: ALBERT SUTHERLAND, CPA, CCA
MESONET ASSISTANT EXTENSION SPECIALIST
OKLAHOMA STATE UNIVERSITY

The summer of 2005 started off dry and ended up wet for the vast part of Oklahoma. The exception to this has been in southeastern Oklahoma, where rainfall has been in short supply. According to the Oklahoma Climatological Survey Regional Rainfall Table over the last 90 days, the state has had 105% of its normal rainfall. During this same 90 days, the southeastern region of the state has only received 59% of its normal rainfall. That leaves this important forestry area with a rain deficit of close to 4.5 inches. This lack of rainfall has made this a very active fire season in the forests of southeastern Oklahoma. Crews from a number of other states have joined Oklahoma fire fighters to keep forest fires in check. Dry years in the forest mean slow tree growth and a higher potential for disease and insect attack in the years ahead, in addition to the greatly increased fire danger.

September gave us the same pattern as summer, with the first half of the month hot and dry. Then the rain of September 15 fell from the skies. You can see how important this rain was by comparing the statewide 2-inch Fractional Water Index Maps for September 14 and September 15. We went from very dry upper soil moisture to wonderfully wet conditions for much of the state. In the Oklahoma Crop Weather report, compiled weekly by the Oklahoma Department of Agriculture and Forestry (ODA) from information submitted by OSU County Extension Educators, 74% of the counties were judged to have adequate or surplus upper soil moisture at week's end on September 18. In last year's report for the same week, only 29% of the counties were considered to have adequate or surplus upper soil moisture.

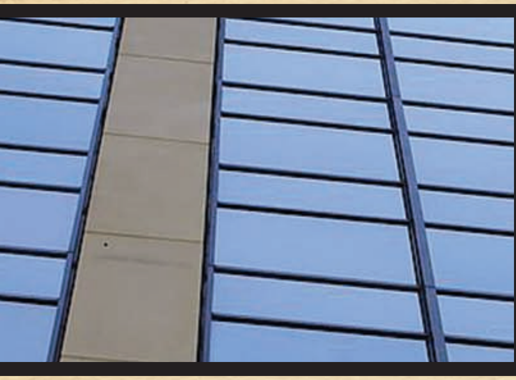
On the western side of the state, August rainfall spurred wheat planting. While much of the wheat for grain has yet to be planted, the wheat planted for grazing cattle is close to being completed as the end of September nears. As of mid-September, the earliest planted wheat was starting to emerge. Growers will try to make the most of the rain on September 15 and any future rainfall by cranking up their tractors and drilling more wheat.

This summer was a good one for livestock producers. With only a few days above 100 degrees, the summer heat stress was less than usual. While a few days saw heat indexes climb over 105 degrees, these were few and far between.

Vegetable producers will remember the summer of 2005 as the year they fought a lot of disease problems. The higher humidity left them scrambling to stay ahead of foliar fungi. Vegetable producers were not the only ones to find themselves spending more money on fungicides this summer. The early summer looked like we were heading into a season of little pecan scab disease. Then as the summer progressed, pecan scab took off as we experienced higher humidity and lower than normal air temperatures.

For corn, cotton, peanut and sorghum, this summer has turned out to be a good one with 60-70% of these crops rated either good or excellent as of September 18. Soybean is the crop exception, with only 42% rated good or excellent. As the heat of summer fades, agricultural producers are anticipating a happy, bin-filling harvest.

To access the products mentioned previously and connect to the latest agricultural weather information, go to Oklahoma AgWeather at http://agweather.mesonet.org. This web site is a joint project of the University of Oklahoma and Oklahoma State University. It uses the latest information from the Oklahoma Mesonet and the Oklahoma Climatological Survey. If you have any questions or comments about the Oklahoma AgWeather site, please, contact Albert Sutherland by phone at 405-224-2216 or by email at albert.sutherland@okstate.edu.



URBAN FARMER

by: Albert Sutherland

September

- Apply a fall lawn preemergent for winter annual weed control, popular products include Princep, Barricade, Balan, Surflan or Team.
- Fertilize tall fescue in late September to stimulate growth as air temperatures cool, use a quick release fertilizer at a rate of 1 pound of actual nitrogen per 1,000 square feet.
- Seed tall fescue for new shady lawn areas or to thicken existing stands. Mix some Kentucky bluegrass with the tall fescue to improve summer turf appearance.
- Plant pansies for fall, winter and spring color. Pansies will produce new blooms whenever the air temperature goes above 40º F.
- Divide and replant spring-flowering perennials.
- In the garden, plant garlic, radish, rutabaga, spinach, Swiss chard, radish, and turnip.
- To increase garden soil organic matter, plant Austrian winter peas, vetch, wheat or rye as a winter cover crop. Till green plants into the soil a couple of weeks before you want to plant next spring.

October

- Plant deciduous trees and shrubs.
- Plant most bulbs. Wait until November to plant tulips.
- Take a soil test to determine the nutrient status of your soil. Collected soil can be dropped off at your county OSU Cooperative Extension Service Office for analysis.

November

- Once the 4-inch average soil temperature under sod drops below 55º F, plant tulip bulbs 6 inches deep.
- Fertilize tall fescue in early November. Use a quick release fertilizer at a rate of 1 pound of actual nitrogen per 1,000 square feet.
- Rake leaves, clean up flower beds, and build a compost pile. A simple recipe for making a compost pile is to use 50% green and 50% dry plant material in alternating layers 3-4 inches thick.
- Prune trees after the majority of its leaves have turned color or dropped to the ground.
- Dig and transplant young trees or deciduous shrubs that need to be moved.

Economic Development:

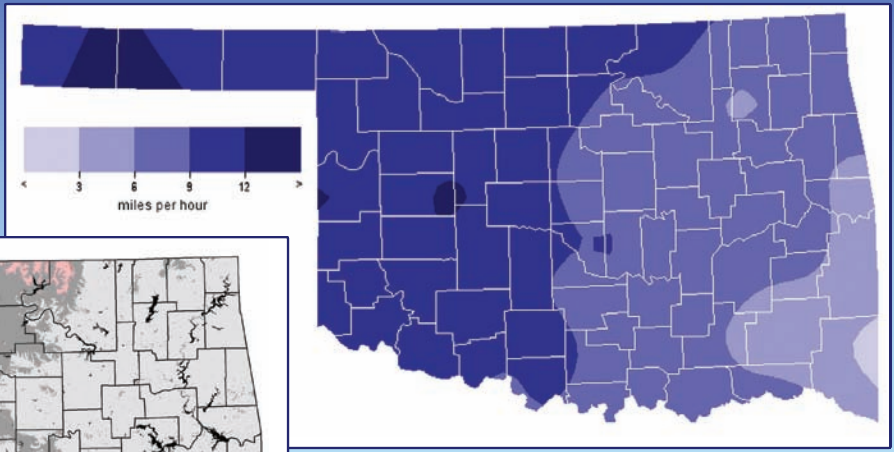
Blowing in the Wind

Mark Shafer
Director, Climate Information Group
Oklahoma Climatological Survey

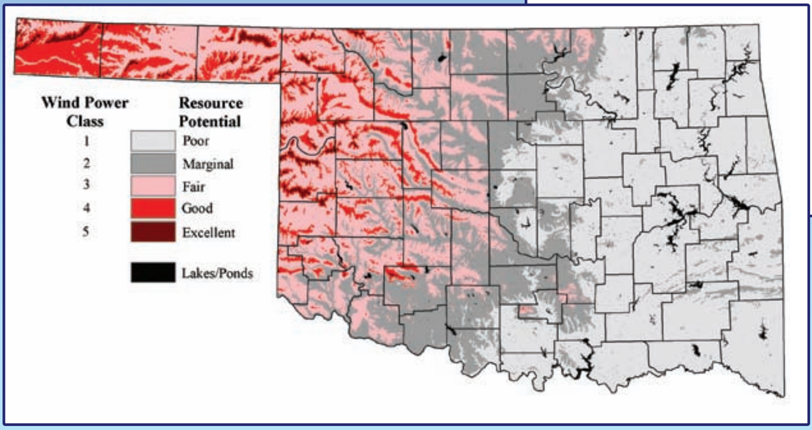
Kylah McNabb
Outreach Coordinator
Oklahoma Wind Power Initiative

Oklahoma is known for being "where the wind comes sweepin' down the plain". Over the past several years that wind has begun to be harnessed to the benefit of Oklahoma's citizens. In both utility-scale and home-scale, wind power has emerged in Oklahoma as a viable energy source and an economic force.

One reason that Oklahoma is so attractive for wind power is its location. All along the east side of the Rocky Mountains, from Texas to North Dakota, the wind blows strongly. These states are home to the best wind resources in the nation, aside from mountain passes that channel wind flow into narrow areas. You can put a wind turbine just about anywhere in Oklahoma and reap the benefits of this geography.



Average Wind Speed



Wind Power Density Map

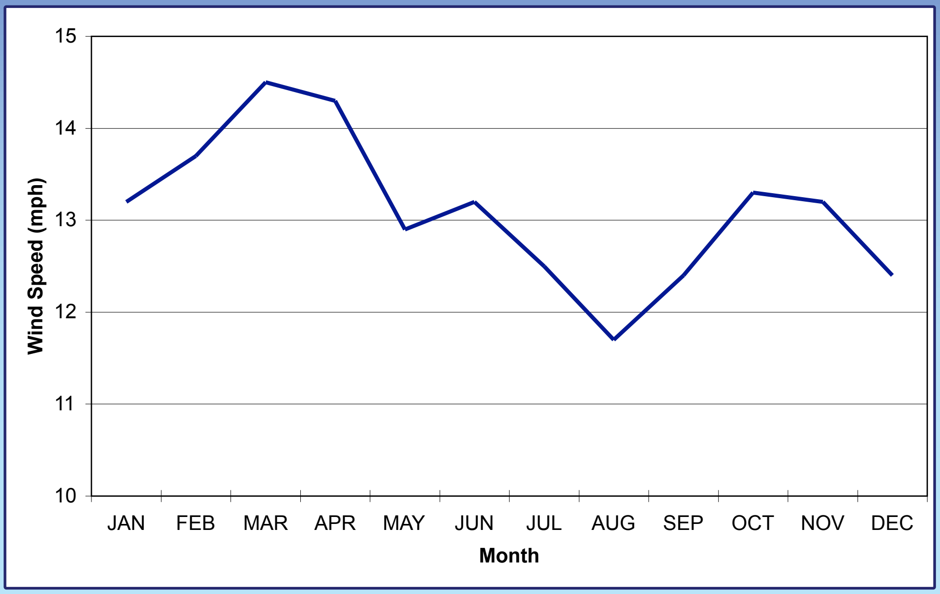
Map: Oklahoma Wind Power Initiative

Another factor that helps make Oklahoma windy is its location near the Gulf of Mexico. Warm, moist air flows northward across Texas, especially in the springtime. As it interacts with the dry air coming from the west across the Rocky Mountains and cold fronts coming down from the north, the wind really picks up.

All of this creates wind energy potential – a source of power that can be tapped merely by putting a turbine into the wind flow. In fact, Oklahoma could theoretically produce 725 billion kilowatt-hours of energy from wind power each year – approximately 13 times the total energy produced within the state now. Realistically, every square inch of Oklahoma is not going to be covered with wind turbines, but 'wind farms' have sprung up to harness some of this energy.

Wind power developers look at something called 'wind power density' to calculate how much energy could be harnessed from any parcel of land. To calculate WPD, each wind speed observation is cubed (speed * speed * speed), meaning that doubling the wind speed would produce 8 times as much energy. Other factors, such as air density, terrain, and capabilities of the turbines are taken into account as well. The Oklahoma Wind Power Initiative (http://www.ocgi.okstate.edu/owpi/) has maps like the one shown that estimate WPD for all of Oklahoma.

An important feature demonstrated by the map is ridge lines. Locally higher elevations are usually windier than more sheltered low-lying areas. Another feature of the map is that western Oklahoma has much higher potential than eastern Oklahoma. This is because of an east-to-west increase in average wind speed across Oklahoma. The lower elevations and tree-covered regions of eastern Oklahoma reduce wind speeds below critical thresholds for operation of many utility-scale wind turbines. New technology is working to take advantage of lower wind speeds so that some areas in eastern Oklahoma may eventually be home to wind farms too.



Monthly Wind Speed, Weatherford

Two factors, other than available land, that constrain wind power development are how strong the wind has to be to turn the turbines and seasonal variations. It takes a wind speed of approximately 12 miles-per-hour to turn the enormous utility-scale wind turbine blades. One way that utility-scale developers have compensated for this is to build higher towers. Wind speeds above ground level usually increase, such that a wind speed of 10 mph near the ground may be nearly 15 mph at 250 feet – the height at which new utility-scale wind turbines are being installed. For home-scale turbines, much closer to the ground where the winds are weaker, a wind speed of as low as 6 mph may be enough to generate electricity.

Another factor constraining development is the seasonal variation in wind speed. While places in Oklahoma may average more than 12 mph, it does not mean that every day has wind speeds strong enough to turn the blades. Monthly average wind speed for Weatherford – the windiest of the Mesonet sites – shows that wind speeds peak in the spring time and fall to an average of less than 12 mph during summer. The minimum comes during the period when energy is most needed.

Even with the seasonal wind patterns in Oklahoma, utilities have found it profitable to develop wind farms. Three are currently in operation in Oklahoma: Blue Canyon near Lawton, the Oklahoma Wind Energy Center near Woodward, and the newest one – the Weatherford Wind Energy Center. These wind farms are also profitable for those who own the land on which they sit. A large wind farm may produce more than $250,000 in annual royalty payments to the landowners, or about $4,000-5,000 per turbine. Schools are beneficiaries as well, receiving anywhere from $150,000 to $400,000 annually in ad valorem taxes. After a five-year exemption period, additional property taxes will produce similar revenue sources for county governments. Horizon Energy, developer of the Blue Canyon facility, estimates that the net economic impact to local communities is $17 million over 20 years. All of this comes from just letting nature be nature, and letting the wind come sweeping down the plain.

WIND POWER by Andrea Melvin

Several states in the U.S. have good resources for wind energy. Oklahoma is ranked 8th in the country for potential wind energy resource. To even be considered, a wind farm site must have a minimum annual average wind speed around 11 to 13 mph (approximaely 5 m/s to 5.8 m/s).

Wind turbines are sophisticated machines with computer controls. On a calm day, the turbine sits idle with its blades not spinning. As the wind picks up, it eventually reaches the cut-in speed of the turbine, which is around 10 mph. At this wind speed, the turbine blades spin up to operating speed, usually around 14 to 29 revolutions per minute, and the turbine starts generating electricity. As the wind speed increases, the generator output increases. When the wind speed increases to the rated wind speed, usually around 30 to 35 mph (~13.4 m/s to 15.6 m/s), the generator will be outputting its nameplate-rated capacity. For example, a 750 kilowatt (kW) turbine will be outputting 750 kilowatts of electricity.

As the wind speed continues to increase, the generator output will remain at the rated capacity (i.e., 75 kW) until such time as the wind speed reaches the cut-out speed, usually around 55 to 65 mph (~24.6 m/s to 29 m/s). At this wind speed, the turbine will activate a disk brake, stopping the blades in a few revolutions, and then rotate itself 90 degrees out of the wind and park itself. This way the turbine has less surface area in the wind, thereby reducing the risk of damage to the turbine. If the wind speed drops to a level below the cut-out speed for a sufficient length of time, the turbine will point itself back into the wind, release the brake, and the blades will spin back up to operating speed, and the turbine will resume producing power.

Wind power is a clean, renewable alternative fuel source. A single 1.5 megawatt (mW) wind turbine powers about 500 average American homes, year after year. This offsets 13 tons of sulfur dioxide and 6 tons of nitrogen oxide emissions each year. It also displaces 2,700 tons of carbon dioxide a year – that's the equivalent of planting 1.5 square miles of forest.

References

Visit the Oklahoma Wind Power Initiative at:
http://www.seic.okstate.edu/owpi/ .

CLASSROOM ACTIVITY

Wind energy is becoming a popular resource. In Oklahoma, the wind "comes sweeping down the plains", but is it profitable to build a wind farm anywhere in Oklahoma? Your job is to determine the best location to set up a wind farm. You have been given data from two Oklahoma Mesonet sites. Keep in mind the height of a Mesonet tower is 10 meters. Wind turbines are generally 50 meters where winds are even higher than near the surface.

1. Which location has a higher mean wind speed, Tahlequah or Weatherford?

2. For each location, which month has a higher mean wind speed?

3. What time of day does the highest mean wind occur at each site?

4. You have four graphs of mean wind speeds from 1994 to 2005 [Figures 1-4 (page 26-27)]. Place them in order from highest to lowest. Which month/site combination will produce the most potential wind energy?

5. Divide into four groups. Have each group create a graph from the table of 2005 mean wind speeds. Compare the 2005 graphs to the 11-year means in Figures 1-4. Do the 2005 graphs follow the same pattern as the 11-year mean graphs?

6. Research the terrain near each of the sites. Let's say that Tahlequah is a good representative of eastern Oklahoma and Weatherford is a good representative of western Oklahoma. How does terrain influence the mean wind speeds?

7. Select a site/month combination. Write a paragraph or two explaining where you would locate a wind farm. Provide reasons based on terrain and mean wind speeds to support your choice.

Table 1 - 2005 Mean Wind Speeds

2005 Mean Wind Speeds				
	Tahlequah		Weatherford	
	March	August	March	August
Hour of Day	Mean Wind (m/s)	Mean Wind (m/s)	Mean Wind (m/s)	Mean Wind (m/s)
1	6.9	4.0	12.3	10.0
2	7.0	3.8	12.5	9.8
3	6.9	3.9	12.8	9.4
4	6.9	3.8	13.1	9.6
5	7.1	4.2	13.3	9.5
6	6.3	4.3	12.7	9.4
7	6.5	4.2	11.9	9.1
8	7.3	5.2	12.1	9.3
9	8.9	5.9	13.6	10.4
10	9.9	5.9	15.1	10.9
11	10.6	5.8	16.1	11.4
12	10.4	5.8	15.6	10.6
13	10.3	6.0	15.8	10.9
14	10.6	6.2	15.8	11.2
15	10.6	7.1	15.4	11.5
16	10.3	6.0	15.7	12.2
17	9.7	5.7	15.4	11.7
18	8.6	5.1	13.8	11.1
19	6.8	3.5	12.5	10.6
20	6.0	3.3	12.5	9.8
21	6.2	3.2	13.0	10.2
22	7.2	3.4	13.1	10.9
23	7.3	3.7	13.2	10.5
24	7.3	4.2	12.9	10.2

Figure 1 - March Mean Wind Speed (1994-2005) for the Tahlequah Mesonet Site

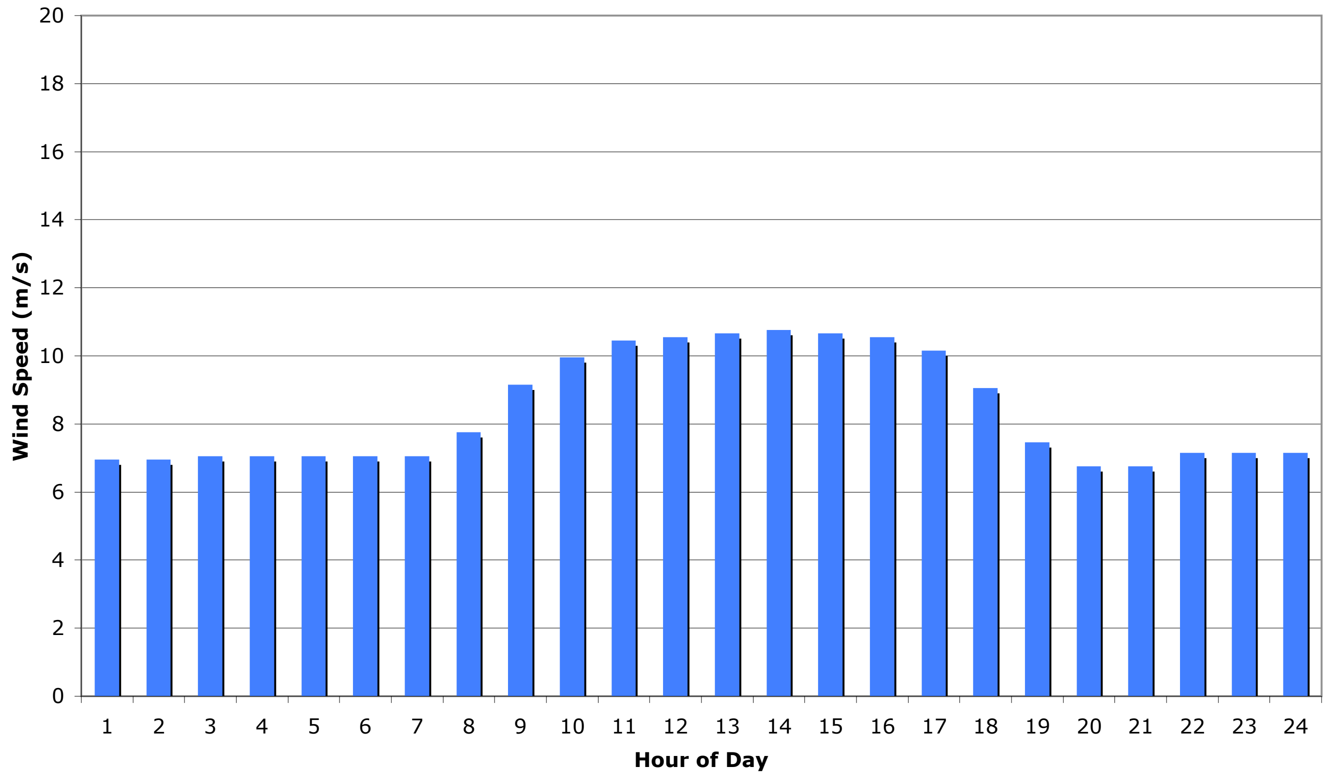


Figure 2 - August Mean Wind Speed (1994-2005) for the Tahlequah Mesonet Site

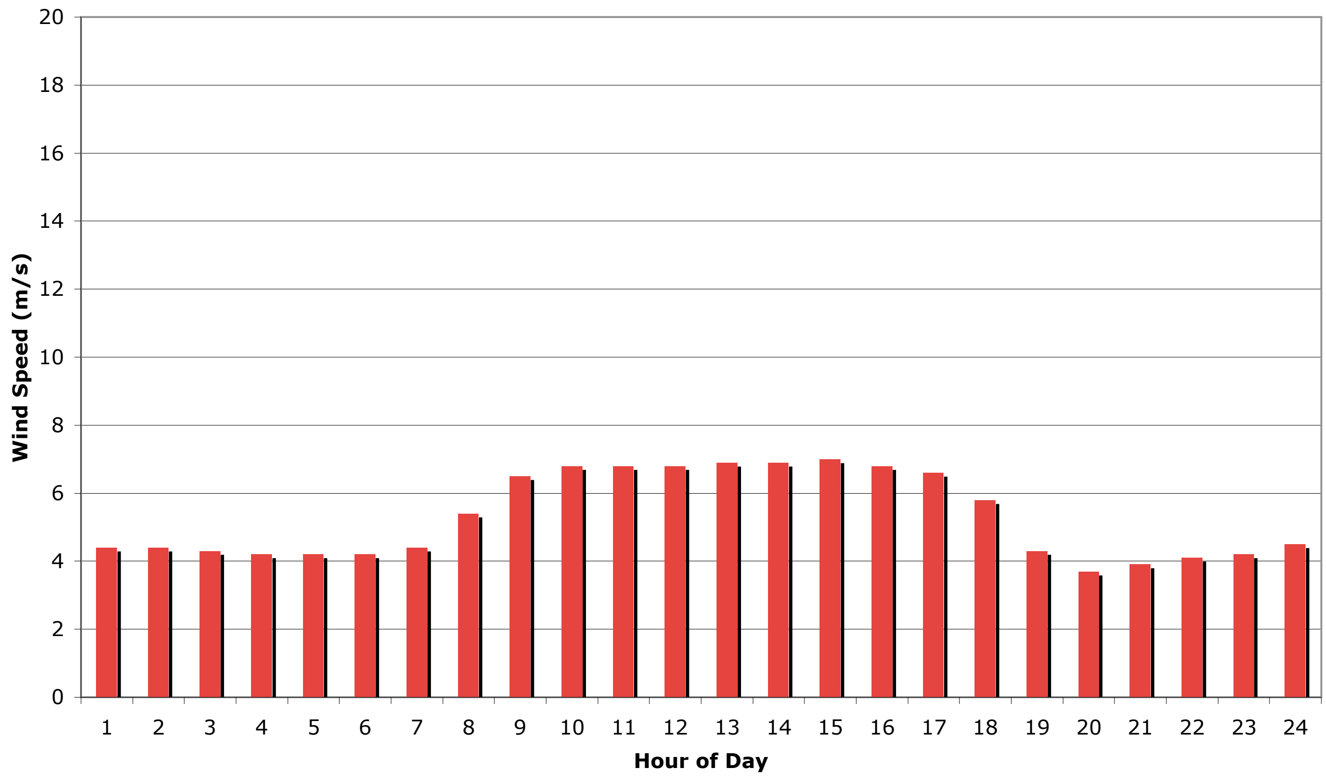


Figure 3 - March Mean Wind Speed (1994-2005) for the Weatherford Mesonet Site

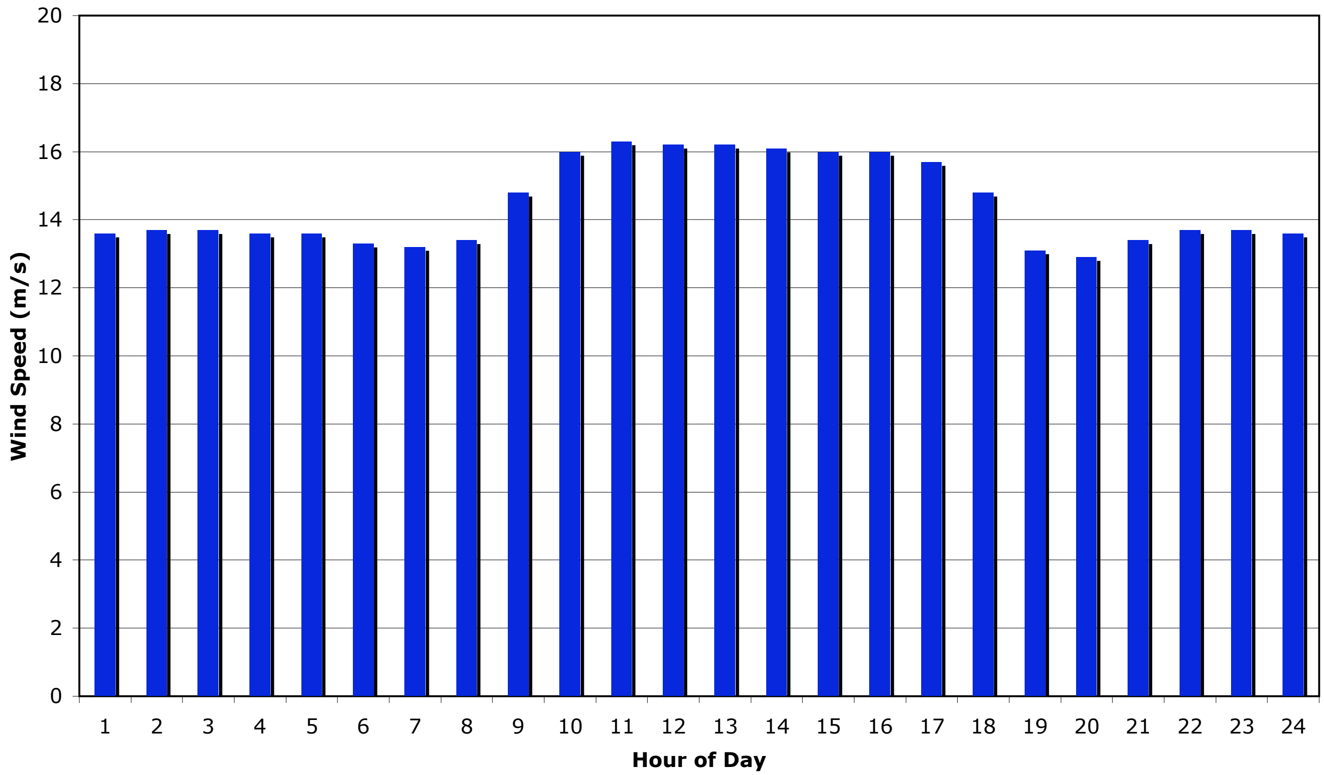
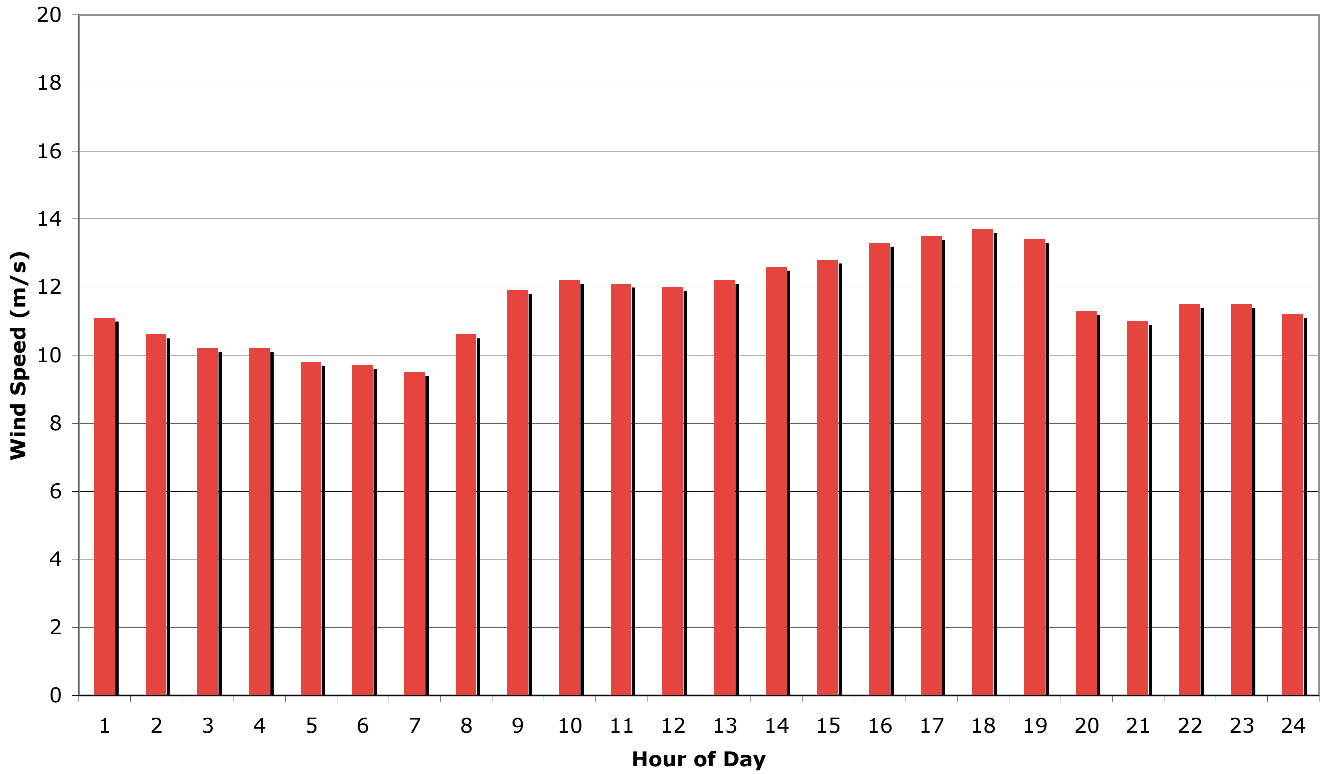


Figure 4 - August Mean Wind Speed (1994-2005) for the Weatherford Mesonet Site



TRICK OR TREAT

SAFETY TIPS

- Children should go out during daylight hours unless accompanied by a responsible adult.
- Plan a safe route so parents know where their older kids will be at all times.
- Set a time for their return home. Make sure that your child is old enough and responsible enough to go out by themselves.
- Let your children know not to cut through back alleys and fields. Make sure they know to stay in populated places and don't go off the beaten track. Stay in well lighted areas.
- Stop only at familiar houses in your own neighborhood unless they are accompanied by an adult.
- Small children should never be allowed to go out alone on Halloween. Make sure an older sibling or adult is with them.
- Instruct your children not to eat any treats until they bring them home to be examined by you.
- Instruct your child to never go into the home of a stranger or get into their car.
- Make sure your child carries a flashlight, glow stick or has reflective tape on their costume to make them more visible to cars.
- Let them know that they should stay together as a group if going out to Trick or Treat without an adult.
- Make sure your child is properly dressed for the cold or warm weather.

For more information visit: http://www.halloween-safety.com

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