OKLAHOMA CLIMATE
WINTER 2003-04

Oklahoma Climatological Survey

FROM THE EDITOR

Welcome to the second edition of "Oklahoma Climate," the Oklahoma Climatological Survey's new seasonal climate series, I hope you enjoyed the inaugural edition published during fall of 2003. As always, launching a new publication can be trying process, but this effort is devoted to allowing you, the citizens and decision-makers of Oklahoma, to tap into the extraordinary talent and expertise concentrated within OCS and the Oklahoma Weather Center.

The theme of this edition of the Oklahoma seasonal climate summary is "Ice Storm!" We felt this theme to be appropriate due to the unusual number of destructive ice storms which have visited our state recently. While these frozen phenomena are not welcome visitors, they do allow us to brag to our northern friends that, although we may not be able to drive in the snow, they would not fare any better in a good old fashioned Oklahoma ice storm!

This edition contains several great articles dealing with Oklahoma's winter weather, and the tools that the meteorological community of Oklahoma has at their disposal to help predict that weather. The historical perspective article "Ice Storm!" details the history of ice storms that have visited our state. Another article describes a groundbreaking meteorological display tool, developed right here at OCS: WeatherScope. This amazing piece of computer software already has proven its worth in the tornado outbreaks of May 3, 1999, and May 8-9, 2003. You also will read about the Oklahoma Mesonet's soil temperature network and how it's used in forecasting winter weather. Our classroom exercise is personalized for Oklahoma educators to help students learn how to use the Oklahoma Mesonet to pinpoint freezing rain – just in time for winter. Our friends from Oklahoma State University alert you about when to plant, spray, and just about any other type of information your might need to know about your gardens or lawns. Finally, we provide you with a few winter weather driving tips to help keep you and your loved ones safe as you travel during the holiday season.

We hope you will enjoy reading this chronicle of Oklahoma's varied and amazing climate as much as we did creating it. As always, we appreciate questions and comments concerning OCS and its publications. For more detailed accounts of Oklahoma's weather, be sure to check out the Oklahoma Monthly Climate Summary, published during the first week of each month.

Gary McManus, Editor

Oklahoma Climate Winter 2003-04

A heavily-damaged elm tree along a fence line in Kingfisher County bears witness to the destructive power of accumulated ice. Photo by Chris Fiebrich. 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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The Oklahoma Climatological Survey is the State Climate Office for Oklahoma

Dr. Kenneth C. Crawford, Director and State Climatologist

Editor
Gary McManus, Climatologist

Contributors
Derek Arndt
Dr. Renee McPherson
Billy McPherson
Michael Wolfinbarger
Chris Fiebrich
Dr. Kevin Kloesel
Gary McManus
Albert Sutherland

Design
Stdrovia Blackburn, Visual Communications Specialist

Editorial Board
Derek Arndt
Stdrovia Blackburn (advisor)
Brad Illston
Dr. Kevin Kloesel
Cerry Leffler
Gary McManus
Dr. Renee McPherson
Al Sutherland

Oklahoma Climatological Survey

Ice Storm!

Wintry weather is usually a short-term visitor in Oklahoma, but its consequences can be severe

By Derek Arndt
Assistant State Climatologist
Oklahoma Climatological Survey

Winter in the Sooner State is a season of struggle. Most often, the struggle is not man-versus-elements, but a battle between the elements themselves. At Oklahoma's southern latitudes, spring-like and autumn-like conditions can fight off winter for weeks at a time. The coldest months on the calendar may be best described as "crisp autumn blending into chilly spring, with intermittent periods of winter". Old Man Winter's reign over weather conditions isn't lasting, but one that comes for days at a time. Rarely will a snowy winterscape last more than a week in Oklahoma before sunny skies return and temperatures rise to more moderate values.

Wintry weather may be an intermittent visitor in our parts, but it still packs a punch. In fact, many of the same factors that help limit the duration of winter events actually make Oklahoma a bit more susceptible to winter's most destructive events: ice storms. These episodes of heavy or prolonged freezing rain can cripple transportation, communications, and energy networks.

Freezing precipitation events occur several times per year in the southern plains. Any given location in Oklahoma typically experiences between one and six events per winter, with an average somewhere between two and three. Freezing rain has occurred in Oklahoma as early as October and as late as April. January is the likeliest month for freezing rain events, followed by December and February.

Incursions of freezing precipitation are typically brief. In fact, the total number of freezing rain hours in Oklahoma City since the end of World War II wouldn't fill up three weeks (Tulsa has almost identical numbers). Accumulations are typically light, less than a tenth of an inch in most cases. However, transportation systems can be severely affected by even the lightest freezing rain events. During the week prior to Christmas in 1998, an intermittent freezing drizzle left just a few hundredths of an inch of glaze on roads, but the immediate impact was severe: more than 225 automobile accidents were reported in the state, 13 of those causing fatalities.

What causes freezing rain? Several factors need to occur in concert to produce freezing precipitation:

- First and foremost, the atmosphere must be able to produce the precipitation. This is an obvious statement, but this seemingly simple requirement is hard to come by during the winter, Oklahoma's driest season. A deep layer of sufficient moisture, a requirement for heavier precipitation, is even more uncommon during the cold months.

- A sufficient layer of warm air (greater than 32 degrees) aloft ensures that precipitation falls in liquid form.

A brilliant combination of sunlight and ice bathes the Kingfisher Mesonet station on February 1st, 2002. The ice observed on the guy wires (hanging below and to the left of the station) approached the diameter of a soft drink can. Photo by Chris Fiebrich.

- A layer of sub-freezing air at the surface causes rain to freeze on, or shortly after, contact. This surface cold layer must be shallow enough that rain doesn't freeze in the air and become sleet. If soil temperatures remain significantly above the 32 degrees mark, little or no freezing will occur on the ground, and icing will be limited to elevated, exposed structures such as limbs and power lines.

These conditions are not easily met. Additionally, when these conditions do materialize, it's usually in a limited area. In Oklahoma, a typical freezing rain event is confined to a belt, usually about 50-100 miles wide. The belt often is oriented roughly south-southwest to north-northeast. To its north, snowfall is reported; to its south, rain.

Laden with more than an inch of ice, a pine tree near the Noble Foundation in Ardmore bends to the ground following the Christmas 2000 ice storm. According to the Noble Foundation, many pine trees that bend in this manner survive an ice storm. Photo by Joe Lobell.

Thankfully, episodes of very heavy freezing precipitation are quite rare. Freezing rain events are usually too brief, or too light, to deposit massive quantities of ice on the surface. Accumulations of more than a quarter-inch of ice are typically observed only every few years. However uncommon, their impact can remain for days – even weeks – after the meteorological event has ended.

In defiance to the rarity of heavy icing in the historical record, winter delivered colossal ice storms in the back-to-back seasons of 2000-01 and 2001-02. Each of these featured very large accumulations of ice on trees and power lines, in some cases approaching four inches. And, while each was generated by ingredients common to all freezing precipitation events, they differed on three elements: location, coverage and soil temperature. These two subtle variations allowed each storm to take on a different characterization in Oklahoma's history.

The Christmas Ice Storm of 2000 might be the greatest ice storm since statehood, meteorologically speaking. A very deep layer of moisture fueled long-lasting heavy precipitation over much of the Arklatex and neighboring regions. More than four inches of ice were deposited on much of southern and eastern Oklahoma and western Arkansas. Because the pre-storm environment was very cold, soil temperatures were near or below freezing and ice accumulated on the ground and roadways throughout the event. Travel was next to impossible in the hours after the event, limiting emergency response. In the region, 26 people lost their lives. More than $200 million in damages were incurred in Oklahoma alone, much of it related to timber losses and damages from falling limbs in the heavily-forested southeast. More than 90 percent of the residents of Oklahoma's southeastern-most counties were without power for days. The storm was a standout in two ways: the sheer size of the area impacted by icing (parts of four states, including large portions of Oklahoma and Arkansas), and in the magnitude of accumulated ice in affected areas.

Just 13 months later, on January 28, 2002 a two-day ice storm occurred across much of central, western and northern Oklahoma. While the storm's footprint of two-inch-plus accumulations was smaller than the Christmas 2000 storm, local ice accumulations rivaled that of its predecessor. The severest icing occurred in more densely populated counties than the previous storm. Thus, the primary impact was

More than a day after it fell, more than an inch of ice covers the tower, instruments, and fence at the Kingfisher Mesonet station on February 1, 2002. The peculiar formations on the cup anemometer were created when centrifugal force related to the spinning cups caused drops to collect and freeze horizontally. When the instrument finally froze up, more familiar vertical icicles formed on these horizontal "arms". Photo by Chris Fiebrich.

Number of freezing precipitation events since World War II

	Oklahoma City	Tulsa
November	7	9
December	43	38
January	65	57
February	35	33
March	17	8
April	2	2

Average number of hours per year with freezing rain since World War II

	Oklahoma City	Tulsa
November	0.3	0.6
December	1.9	2.3
January	3.9	4.0
February	2.1	2.0
March	0.7	0.6
April	0.0	0.1

(Changnon Climatologist, Midwest Regional Climate Center and Oklahoma Climatological Survey)

catastrophic damage to electrical distribution lines. 40,000 poles and similar structures were lost by the rural electric cooperatives alone. The amount of electrical line downed by the storm would have stretched from Oklahoma City to New York – and back. Because the pre-storm environment was quite warm, soil temperatures were too high to support freezing of precipitation on the ground and roadways. This allowed a quick response by emergency personnel and by electric linemen from Oklahoma and many other states. Only a handful of weather-related traffic accidents occurred. Nine Oklahomans lost their lives in the storm and more than $100 million in damages was reported.

These aren't the only major ice storms to hit the state. Christmas of 1987 saw a two-day event in a narrow belt from Duncan to Miami, including the Oklahoma City and Tulsa metropolitan areas. Up to two inches of ice were reported, collapsing a 1,900-foot television transmission tower near Tulsa and causing two 737s to slide off the runway at Will Rogers International Airport in Oklahoma City. No injuries were reported with either of these events, but numerous traffic fatalities occurred. To the south of the narrow freezing belt, heavy rainfall caused river flooding. More than $10 million in damages (1987 dollars) were reported, two-thirds of which were incurred by the state's two largest electric companies.

Other notable storms struck Oklahoma in late November of 1919 and December 1937. The latter caused more than a quarter-million dollars in damages. This total is significant in two rights: 1) adjusted for inflation, the total represents $3.1 million dollars today, and 2) much of the electric infrastructure in Oklahoma was not yet built.

Extensive tree damage, like this seen in Kingfisher, was commonplace in the aftermath of the January 2002 ice storm. Photo by Chris Fiebrich.

Winter Soil Temperatures Across Oklahoma

Chris Fiebrich
Manager of the Oklahoma Mesonet
Oklahoma Climatological Survey

How often does the ground freeze across Oklahoma? It may surprise you to know that soil temperatures across the state rarely cool below 32 °F, and if they do, they usually stay frozen only for a few days.

Soil Temperature Measurements

The Oklahoma Mesonet has 550 soil temperature sensors deployed across the state. Figure 1 shows the locations where soil temperature measurements are taken. At most stations, soil temperature measurements are made below native vegetation at 5, 10 and 30 cm, and below bare soil at 5 and 10 cm. The bare soil temperature measurements imitate the temperature of a bare, agricultural field.

Ground temperatures are measured every 15 minutes (compared to atmospheric measurements which are taken every 5 minutes). Fewer soil temperature measurements are needed because the temperature of the soil changes more slowly than the temperature of the air. Figure 2 compares soil and air temperatures at the Norman Mesonet site during a 12-day period in January 2003. It can be seen that the soil temperature at 5 cm under bare soil (blue line) and under sod (pink line) does not change as much as the air temperature (brown line). For example, when the air temperature cooled into the low teens on January 17th (middle of the graph), soil temperatures stayed in the low-30s. Likewise, when the air temperature warmed to near 70 on January 20th (latter part of the graph), soil temperatures remained in the 40s.

Frozen Soils

Figure 3 shows the maximum number of days for which the soil temperature at 5 cm stayed below the freezing mark, 32 degrees, during the winter of 2002-2003. The southern half of the state rarely had more than a day or two with soil temperatures consistently below freezing. An exception was over central Oklahoma, where a snowstorm in late February caused soils to stay frozen for 2 to 4 days. A late January snowstorm caused soils in the far northeastern part of the state to stay below freezing for 4 to 6 days.

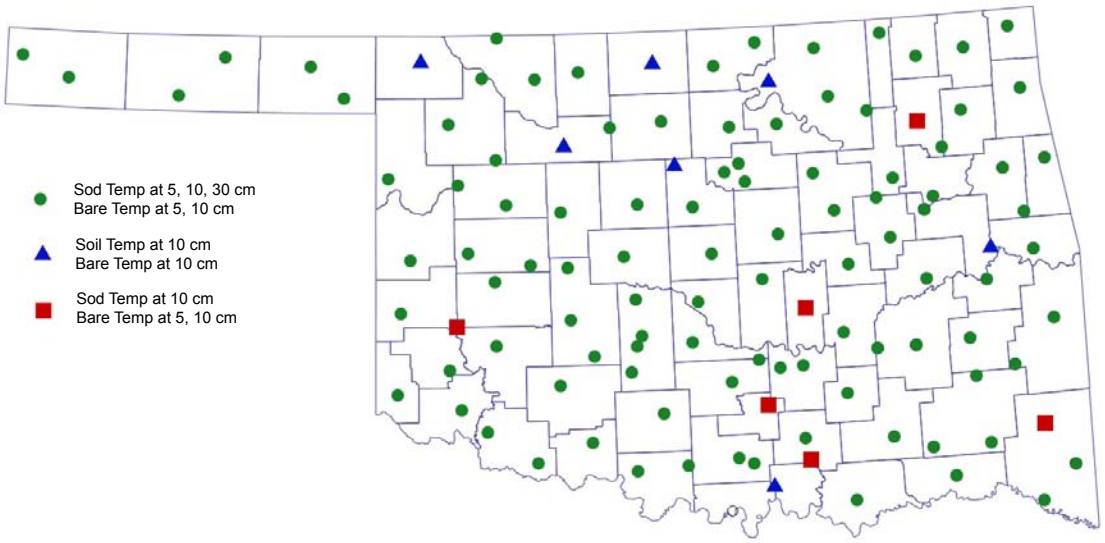


Figure 1. Soil Temperature sensor locations across the Oklahoma Mesonet.

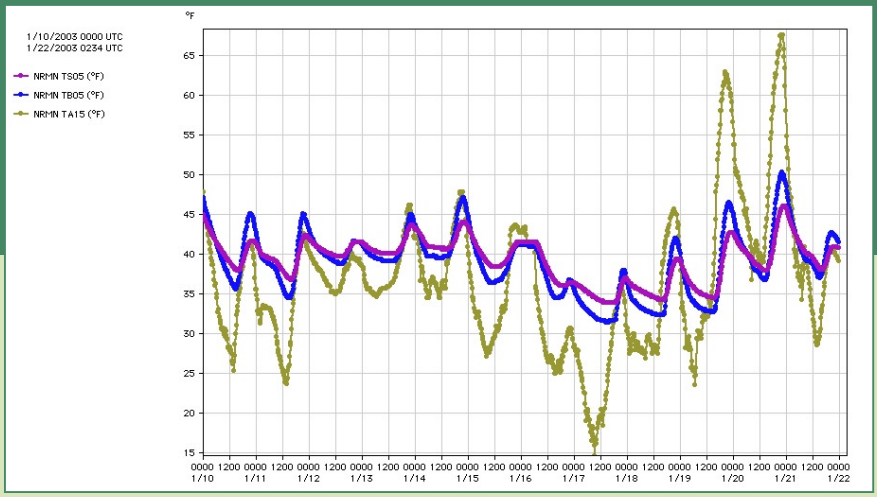


Figure 2. Time series plot of the 5 cm soil temperatures and air temperature at Norman, OK from January 10th - 22nd, 2003.

Soil Temperatures and Winter Precipitation

Meteorologists oftentimes use soil temperature data to aid in their prediction of ice accumulation across Oklahoma. According to National Weather Service forecaster Doug Speheger, "The soil temperatures can help to indicate when freezing rain might lead to travel problems. If the ground is warm, then we mention that the main problems will be on bridges and power lines. If the ground is cool, the problems can occur everywhere."

Using soil temperatures to help predict whether snowfall will accumulate can be more of a challenge since soils are rarely frozen before a snow event. A look back at the last 17 snow events in Oklahoma City revealed that soil temperatures of 45°F and cooler usually allow snow to accumulate. But many factors including snowfall intensity, air temperature, wind speed, and even soil moisture can be critical in determining whether snow will "stick" once it hits the ground. Rob Hale, meteorologist at the University of Oklahoma, studies and models the interaction of soils with snowfall. Hale says, "Snow accumulation on the ground is a very non-linear process. Even soil moisture can impact whether snow and ice can accumulate. If soils are moist, heat can transfer more readily from the ground to the earth's surface, inhibiting the accumulation of ice and snow."

To view real time soil temperature conditions across Oklahoma this winter, go to http://www.mesonet.org and click on "Mesonet Data".

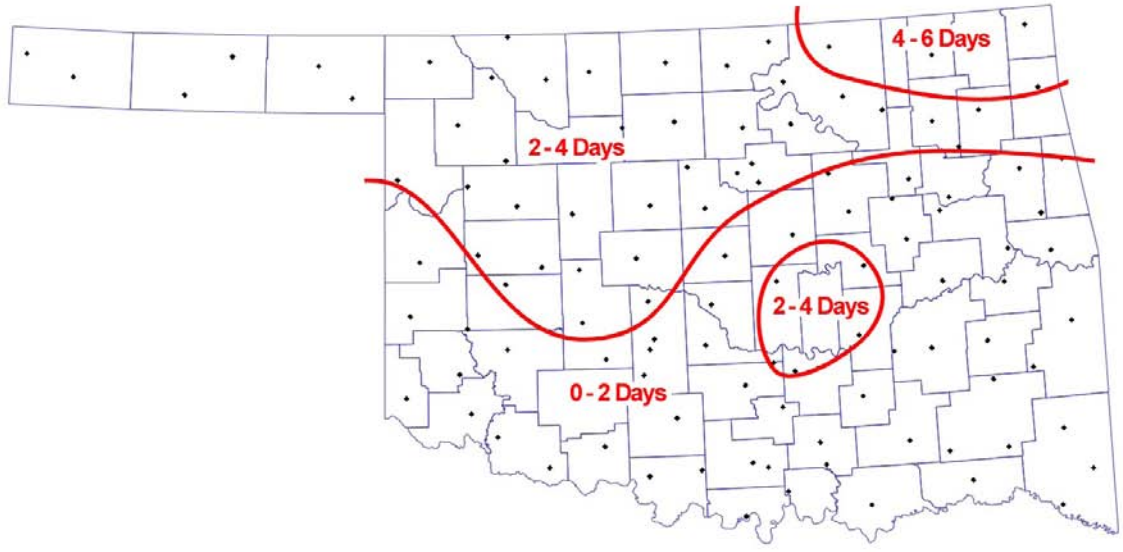


Figure 3. Maximum duration of Soil Temperatures at 5cm below freezing during Winter 2002-2003.

PHOTOS FROM THE FIELD

(above) Yikes, this is one visitor to stay away from! This rattlesnake was spotted by Senior Mesonet technician Ken Meyers. (photo courtesy of Ken Meyers)

(right) Who knew prairie dogs went to school (or used outhouses)? This prairie dog town between Blanchard and Chickasha comes equipped with just about everything except a miniature Mesonet tower. (Photo courtesy of Ken Meyers)

(background) A reminder of times long past, this stoic buffalo patrols the plains near Medicine Park. (Photo courtesy of J. Colin Caldwell & Stephen G. Bodrar)

Techs On the Trail

The Mesonet technicians and student personnel get to meet a lot of great folks from this fine state as they travel about maintaining the network. When they get out in the field, however, they generally don't get to do a lot of meetin' and greetin'. That's not to say they don't get a few visitors from time to time as they check out the Mesonet sites. Unfortunately (or fortunately, for the Crocodile Hunter fans out there), those visits are usually of the four-legged or creepy-crawly variety. Here are just a few of the friendly and not-so-friendly visitors our techs have become acquainted with.

(right) An inquisitive donkey adds his input on a visit to the Ringling Mesonet site. (Photo courtesy of J. Colin Caldwell & Stephen G. Bodrar)

(above) This eight-legged denizen of the Southwest, a tarantula, prepares for his close-up. (Photo courtesy of J. Colin Caldwell & Stephen G. Bodrar)

(left) A mouse declares squatter's rights and takes up residence in the instrument enclosure at Wynona. (Photo courtesy of Ken Meyers)

FALL 2003 SUMMARY

The lack of rainfall that has plagued Oklahoma during much of 2003 continued during the fall season. This running deficit, which began in the year's first month, was exacerbated by 3 straight months of below normal precipitation. Fortunately, the state's temperatures have not been as drastic, although the season did start out on a cool note, however. September, while a bit dry, was the 8th coolest the state has experienced since record-keeping began in 1892. That helped make bearable what could have been a miserably hot and arid month. October set a different tone with eight record-high temperatures and finishing as the 31st warmest in history. One theme remained consistent from September, as the lack of significant rainfall continued to make October the 26th driest on record. That premise held true throughout the entire season, actually, as November also fell below normal to the tune of the 27th driest in the last 112 years. The precipitation deficiency wasn't the season's only shortfall, as the state's secondary severe weather season during September and early October ended as one of the more benign in recent memory.

Precipitation

The precipitation story this fall was actually very simple: the eastern half of the state received rainfall, and the western half did not. There are obvious exceptions to that statement, of course. Far northeastern Oklahoma did not exceed 5 inches of accumulating precipitation for the season, and parts of the eastern panhandle and the far northwest received over 7 inches. That helped the panhandle region to fall just under an inch below normal. Southwestern portions of the state were much more unlucky, as their deficit of almost 6 inches earned that area the 7th driest autumn since 1895. In fact, the entire southern two-thirds of the state was at least 4 inches below normal, which helped the statewide-averaged rainfall deficit to come up nearly 4 inches below normal as well. The little over 6 inches of precipitation that did fall was the 26th driest fall season on record.

Temperature

Not surprisingly, those places that received significant rainfall during fall were also a bit cooler than the surrounding areas. Taken as a whole, however, the end result of the variations in temperature throughout the season is not significant. While the north central and northeast sections of the state were over half of a degree below normal, that shortfall was countered by the southern one-third of the state, which was warmer than normal.

September Daily Highlights

September 1-2: The month's beginning saw the first of several strong cold fronts sliding through the state, accompanied by strong northerly winds and abundant cloud cover. Temperatures dropped after the frontal passage from the 80s to the mid-60s on the 1st, and the temperatures remained below normal the following day as well.

September 3-9: An extended period of tranquil weather settled upon the state from the 3rd to the 9th. Temperatures started below normal during this period, slowly rising to near-normal on the 8th and 9th. What little rain that did fall was generally light, but a few heavy thunderstorms in the panhandle on the 6th and 7th brought 1.75 inches of rain to Boise City.

September 10-13: Torrential rainfall in Beckham County on the 11th is the highlight of this rainy and cool period. Radar estimates of 6-8 inches were indicated. Temperatures cooled once again to below normal, with more heavy rainfall occurring across the state through the 13th. Amounts in north-central Oklahoma exceeded 2.5 inches on that day.

September 14-17: Yet another cold front traversed the state early on the 14th. The surface high pressure system that took up residence over the state behind the cold front provided very pleasant weather through the 17th.

September 18-21: Much-needed precipitation returned on the 18th. A cold front had sagged into the panhandle, triggering showers and thunderstorms, before eventually passing through the entire state. The northwest received the bulk of the precipitation on the 20th.

September 22-28: A weak boundary sagged into northern Oklahoma on the 22nd, while cloudiness from the remnants of Hurricane Marty moved into southern Oklahoma. A stronger push of cold air moved across the state on the 24th, along with some much drier air. This remained the dominant pattern through the 28th.

September 29-30: A last bit of rainfall was in store for the state on the final two days of the month, accompanied by a bit of chilly weather. Much of northeastern Oklahoma fell into the 30s on the 29th, to go along with rainfall amounts of up to an inch. The month's epilogue was a typical fall day in Oklahoma, albeit with conditions normally seen in late October. Highs in the northwest struggled to reach 60 degrees, and strong northerly winds made the day feel much cooler.

October Daily Highlights

October 1-3:. Oklahoma City and Tulsa set coldest high temperature records on the 1st with 55 and 62 degrees, respectively. Tulsa then set a coldest low temperature record the next day with a chilly 39 degrees. Showers and thunderstorms moved into northern sections of the state overnight on the 3rd, but accumulations were generally light.

October 4-7: An upper-level disturbance in Colorado generated a few showers that affected the northwestern one-half of Oklahoma, but once again accumulations were generally light. In all, this was a very pleasant period with partly cloudy skies and seasonable temperatures.

October 8-9: The warm, moist air in place combined with an upper-level disturbance which moved over the state from Colorado to produce the month's most tumultuous period. The rain began on the 8th in northwestern Oklahoma and moved eastward across the state. The storms strengthened as they moved east, dropping 2-3 inches of rainfall over a large area of north central and northeastern Oklahoma.

October 10-11: Skies remained mostly cloudy throughout the period, but temperatures warmed up into the 70s and 80s on the 10th. A cold front entered the state from the northwest on the 11th, whipping up winds behind the front from the north at 40 mph. Light rain quickly followed, and highs behind the front never rose above the 60s, although they did reach the low-80s in the south prior to the frontal passage.

October 12-15: Highs in the 70s and 80s increased even further on the 13th into the upper-80s. A strong cold front entered the state on the same day. A few thunderstorms developed ahead of the front. Rainfall totals were light over most portions of the state, although a few stronger cells in the northeast dropped more than an inch of rain over select areas. The pleasant weather stretched into the 14th and 15th with sunny skies, light winds and highs in the 70s and 80s.

October 16-17: Another cold front spoiled the party on the 16th, but not before temperatures in the southern portions of the state rose into the upper-80s and lower-90s. Showers and thunderstorms formed along the front and dropped light rain in eastern Oklahoma.

October 18-24: Summer-like conditions returned to the state for the next seven days with lots of sunshine and record-breaking warmth. High temperatures in the 80s and 90s were common during this period.

October 25-26: The period started out cold in the post-frontal environment. Skies were overcast on the 25th with light rain falling in the north. Temperatures fell into the upper 50s and lower 60s for highs that day, ending in the 20s and 30s overnight on the 26th. Kenton felt a taste of winter with a low of 20 degrees that night.

October 27-29: The state was under the influence of a surface high pressure system on the 27th, signaling a pleasant afternoon. Southwesterly winds between 20 and 30 mph, combined with afternoon temperatures in the 70s and 80s and extremely dry vegetation, prompted the NWS to issue a fire weather watch for western and southern Oklahoma. Worsening conditions on the 29th brought the more serious red flag fire warning for the same areas.

October 30-31: A cold front moved through the state on the 30th. Temperatures behind the front cooled into the low-70s, and winds swung around to the north at 10-15 mph. Halloween day saw the frontal system stall in the south. Lows ranged from 27 degrees at Boise City to 73 degrees at Sallisaw and Talihina, although high temperatures cooled somewhat in southern sections compared to the previous day, reaching only into the mid-80s.

November Daily Highlights

November 1-4: This period was dominated by a warm front on the 2nd. Highs in southern sections were regularly in the 70s and 80s. McAlester achieved a record high temperature of 84 degrees on the 1st, while Oklahoma City experienced its warmest minimum temperature on record for the month of November with 68 degrees on the 3rd.

November 5-10: The cold front that moved across the state on the 4th was followed on the 5th by a reinforcing shot of cold air. Lows that night over much of the state were in the 20s and 30s. The cold weather continued to dominate deeper into the period, with the first freeze at many locations on the 7th.

November 11-16: Highs on the 11th were 5-15 degrees above normal across the state. A cold front quickly dashed the spring-like weather on the 12th for most of Oklahoma, dropping highs back into the 50s behind the front to go along with strong northerly winds. The temperatures slowly began warming throughout the remainder of the period, culminating with highs in the 60s at 70s on the 16th.

November 17-18: Stormy weather returned to the state on the 17th. Tornado watches were issued for the state as an upper-level storm system moved over the state. The storms did not become tornadic. Hail and strong winds, along with heavy rainfall, rattled Tulsa during the midday hours. The heavy rains hit again on the 18th; thankfully, devoid of the hail and strong winds.

November 19-22: The stormy period was replaced with pleasantly tranquil weather for a few days. Sunny skies, light winds, and highs in the mid-70s greeted the state on the 19th. A weak cold front interrupted the nice weather for some on the 21st, mainly the west and northwest, dropping highs back into the 50s.

November 23-30: The remaining 8 days of the month experienced very little in the way of measurable precipitation to go along with a wide range of temperatures due to frontal passages. The 24th saw the first freeze for much of southern Oklahoma. Lows on that day dropped into the lower teens across northern Oklahoma. The month ended with the same windy conditions of the previous few days, along with seasonable temperatures and sunny skies.

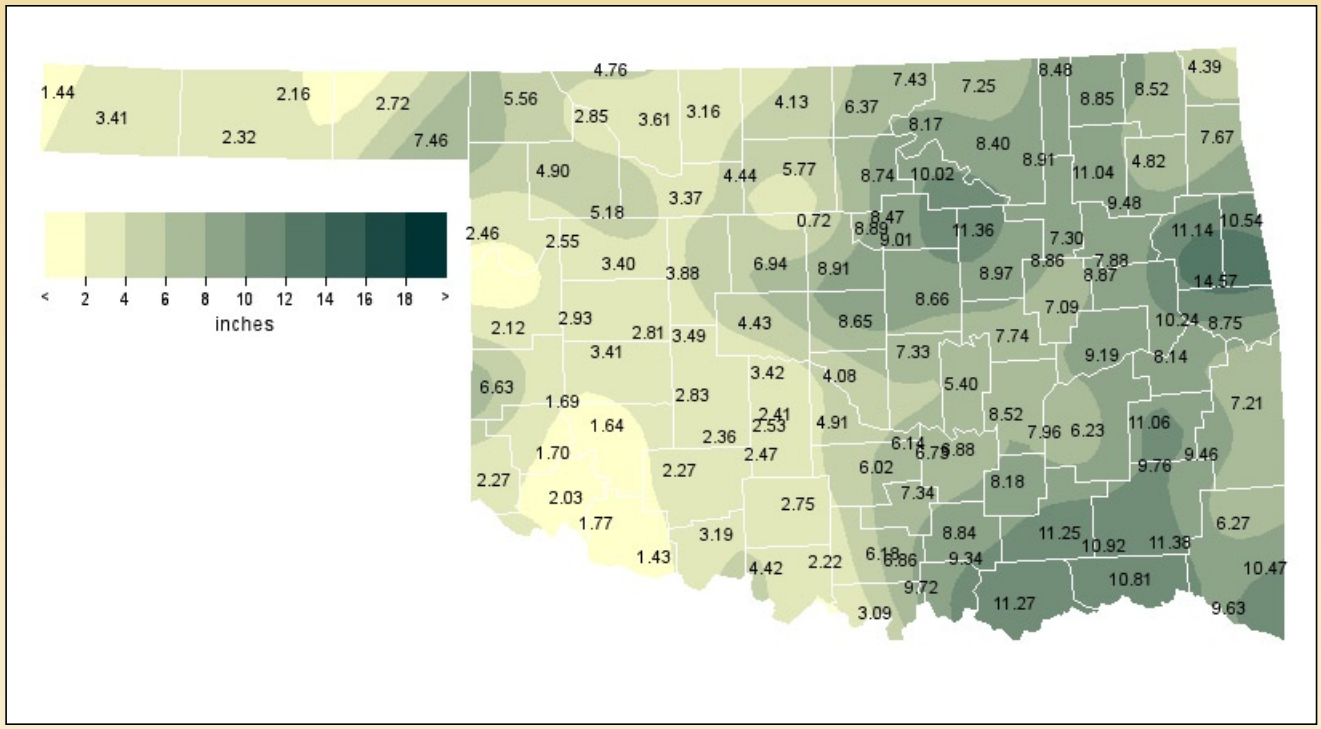
Fall 2003 Statewide Extremes

Description	Extreme	Station	Date
High Temperature	97ºF	Tipton	Septemper 10th
Low Temperature	7ºF	Kenton	November 24th
High Precipitation	14.57 in.	Cookson	
Low Precipitation	1.44 in.	Kenton	

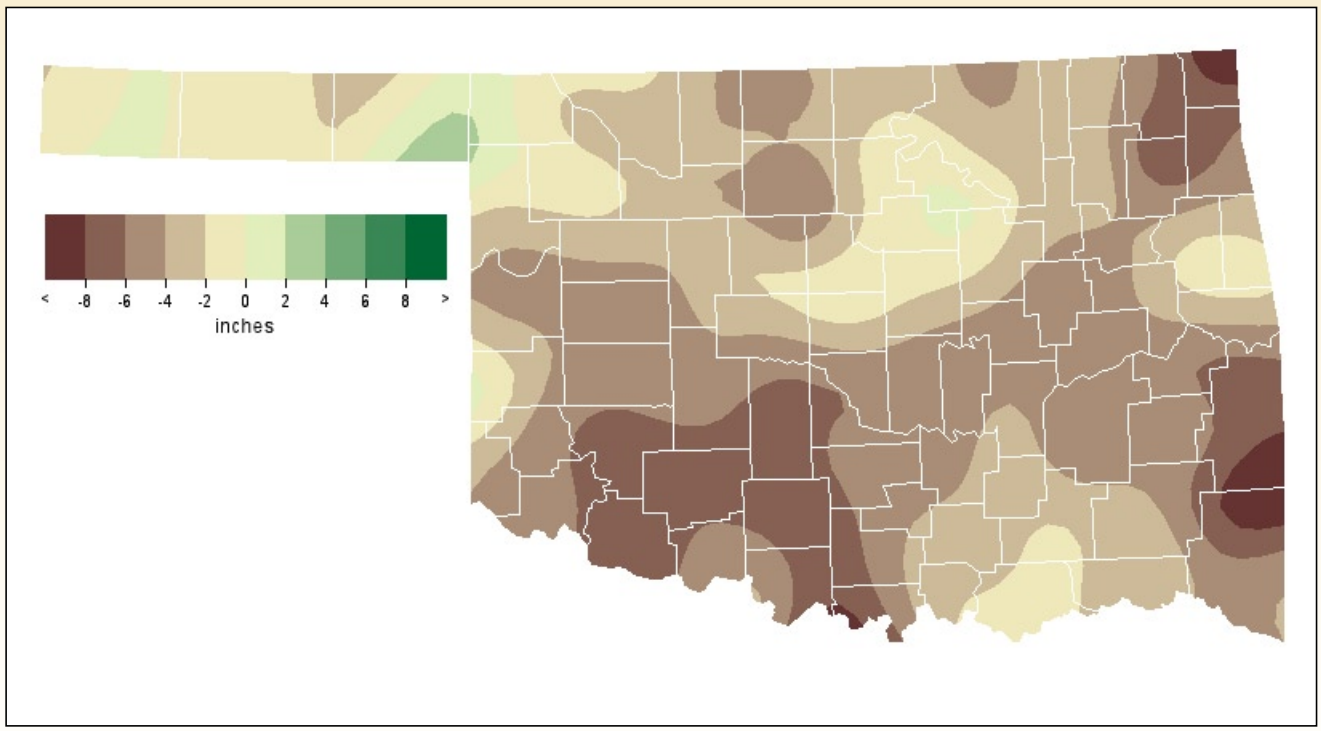
Fall 2003 Statewide Statistic

	Average	Depart.	Rank (1892-2003)
Temperature	60.8ºF	0.2ºF	54th Warmest
	Total	**Depart.**	**Rank (1892-2003)**
Precipitation	6.05 in.	-3.96 in.	26th Driest

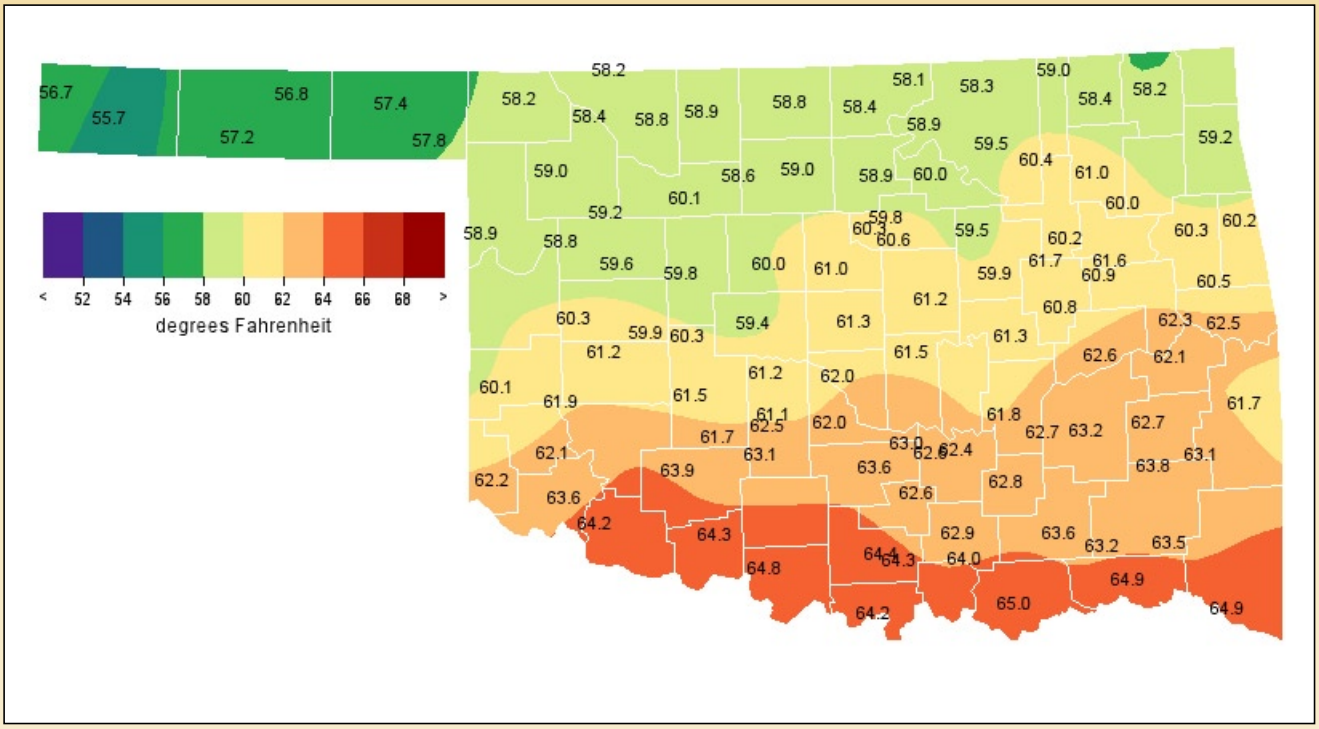
Observed Rainfall



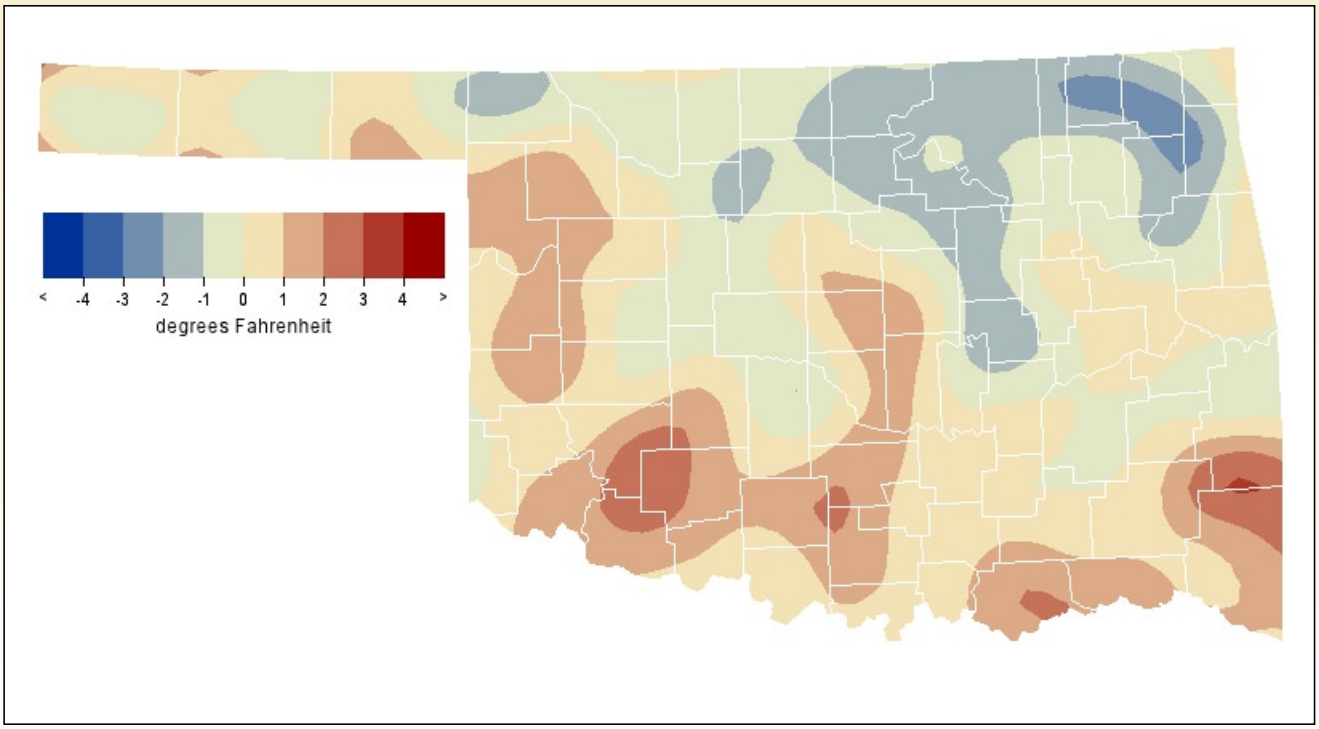
Rainfall Departure from Normal



Average Temperature



Temperature Departure from Normal



Fall 2003 Mesonet Precipitation Comparison

Climate Division	Precipitation (inches)	Departure from Normal (inches)	Rank since 1895	Wettest on Record (Year)	Driest on Record (Year)	2002
Panhandle	3.44	-0.99	42nd Driest	10.34 (1941)	0.70 (1956)	5.68
North Central	4.98	-2.89	31st Driest	17.19 (1986)	0.97 (1910)	10.55
Northeast	8.08	-3.95	36th Driest	27.94 (1941)	2.60 (1948)	6.14
West Central	3.27	-4.05	15th Driest	20.71 (1986)	1.01 (1954)	9.59
Central	6.27	-4.31	31st Driest	20.42 (1923)	2.11 (1910)	9.43
East Central	9.24	-4.29	42nd Driest	22.86 (1923)	2.40 (1948)	5.18
Southwest	2.27	-5.83	7th Driest	18.40 (1986)	0.95 (1910)	9.14
South Central	6.90	-4.79	29th Driest	24.03 (1923)	2.18 (1948)	9.24
Southeast	9.70	-4.90	35th Driest	25.15 (1984)	3.11 (1963)	9.79
Statewide	6.05	-3.96	26th Driest	18.15 (1923)	2.44 (1910)	8.29

Fall 2003 Mesonet Temperature Comparison

Climate Division	Average Temp (F)	Departure from Normal (F)	Rank since 1895	Hottest on Record (Year)	Coldest on Record (Year)	2002
Panhandle	57.3	0.3	54th Warmest	62.7 (1963)	53.6 (1976)	55.6
North Central	58.8	-0.8	31st Coolest	65.8 (1931)	56.0 (1976)	57.6
Northeast	59.6	-0.6	39th Coolest	66.6 (1931)	55.3 (1976)	59.0
West Central	60.2	0.5	53rd Warmest	65.7 (1931)	55.9 (1976)	58.1
Central	61.0	-0.2	51st Coolest	67.3 (1931)	56.9 (1976)	59.5
East Central	61.7	0.1	53rd Coolest	67.6 (1931)	56.7 (1976)	60.9
Southwest	62.6	0.8	40th Warmest	66.9 (1931)	57.1 (1976)	60.3
South Central	63.6	0.7	49th Warmest	68.3 (1931)	57.8 (1976)	61.2
Southeast	63.5	1.4	42nd Warmest	68.3 (1931)	56.8 (1976)	60.5
Statewide	60.8	0.2	54th Warmest	66.3 (1931)	56.2 (1976)	59.2

Fall 2003 Mesonet Extremes

Climate Division	High Temp (F)	Day	Station	Low Temp (F)	Day	Station	High Seasonal Rainfall	Station	Low Seasonal Rainfall	Station
Panhandle	96	Sep 16th	Goodwell	7	Nov 24th	Kenton	6.82	Slapout	1.44	Kenton
North Central	95	Oct 21st	Alva	12	Nov 24th	Freedom	8.32	Red Rock	2.65	Freedom
Northeast	91	Oct 21st	Pawnee	15	Nov 24th	Foraker	10.96	Claremore	7.19	Foraker
West Central	96	Oct 21st	Camargo	12	Nov 24th	Camargo	6.55	Erick	1.60	Retrop
Central	94	Oct 22nd	Acme	12	Nov 24th	El Reno	11.19	Oilton	2.20	Chickasha
East Central	92	Oct 22nd	Calvin	20	Nov 24th	Westville	14.57	Cookson	6.34	McAlester
Southwest	97	Sep 10th	Tipton	11	Nov 24th	Mangum	3.35	Hinton	1.63	Mangum
South Central	96	Oct 22nd	Waurika	20	Nov 24th	Ketchum Ranch	11.27	Durant	3.09	Burneyville
Southeast	92	Oct 22nd	Wister	18	Nov 29th	Wister	11.38	Cloudy	7.21	Wister
Statewide	97	Sep 10th	Tipton	7	Nov 24th	Kenton	14.57	Cookson	1.44	Kenton

Agriculture Weather Watch

By Albert Sutherland, CPH, CCA
Mesonet Assistant Extension Specialist
Oklahoma State University

"It's a mean time to put up fence." That observation from a long-time rancher sums up the current soil moisture conditions for the Western portion of Oklahoma. Rains that fell in mid-November were some of the first rains many places had seen in over a month.

The months of fall have continued in the pattern of below average rainfall from this summer. While every Mesonet tower recorded rainfall between November 12 and November 19, there are only a few Mesonet locations in the state that recorded near normal rainfall from September through November. The southwestern portion of the state is struggling with less then 50% of their normal rainfall through the fall months.

While soil moisture levels have recovered well in the eastern half of Oklahoma from rainfall in mid-November, soil moisture levels west of I-35 continue to be low. In southwest Oklahoma, Aaron Henson, Tillman County OSU Agriculture Educator, reported that the wheat seed planted in September waited in the ground, until rain in mid-November allowed seed germination to occur. This puts the wheat about 2 months behind on many southwest Oklahoma farms.

As one travels farther north to Custer County, they'll find that wheat is up, but suffering. Ron Wright, Custer County OSU Agriculture Educator, says the wheat in their area came up and gained good size early this fall from some light, timely rains. Unfortunately in November, the wheat began to show drought stress, just as producers needed it for wheat pasture. More moisture is needed soon or producers will have to turn to baled feed. Ron also noted that ponds in Custer County are dry and even some long used water wells have gone dry. This is due to 2 years of below average moisture in west-central Oklahoma.

The soil moisture maps of the state show the dramatic drop in soil moisture from eastern to western portions of Oklahoma. To view soil moisture charts on the Oklahoma AgWeather (http://agweather.mesonet.org) website, click on SOIL, and select Soil Moisture from the menu. The soil moisture is easiest to monitor by using the Fractional Water Index products. The Fractional Water Index is a 0-1 scale, with 0 being dry and 1 being saturated.

What Oklahoma agricultural producers need soon is more rain. They are hoping the probability of higher than normal winter rainfall becomes a reality. The National Weather Service extended forecasts indicate a 33% - 40% probability of above average rainfall for Oklahoma during November, December and January. You can get to the NWS extended forecasts on the Oklahoma AgWeather website by clicking on WEATHER and then going to the Forecasts section.

Lawn and Garden

December

- Complete yard clean-up. It is important to remove leaves from cool-season lawn areas to prevent grass die-out.
- Prune trees. Make proper pruning cuts on the outer edge of branch collars. This is a raised doughnut shaped area at the branch base. Do NOT use pruning paint; it slows growth that will cover over branch cuts.
- Clip holly or evergreen plants for Holiday Season decorations. Use florist foam and a container that can hold water to keep arrangements looking fresh.

January

- Spray dormant oil to control insect pests on ornamentals and fruit trees. Apply when the daytime temperature is above 50°F and the nighttime temperatures above freezing for 3-4 days. Use the summer rate for evergreen shrubs.
- Prune trees that are prone to excessive sap flow. These include pines, willows, elms, and maples. Do NOT apply pruning paint. It will not stop excessive sap flow and will slow callous growth over branch cuts.
- Plan spring landscape projects.
- Peruse plant and seed catalogs or websites. These colorful catalogs and websites will provide you many ideas for landscape projects.
- Collect seed trays, media, and seeds to start transplants. Start seeds for hardy herbs (cilantro, dill, parsley) and hardy vegetables (broccoli, cabbage, onion) to be transplanted after mid-March.

February

- Test lawn and garden soils. Contact your local County OSU Extension office for soil testing bags, pricing, and sampling information.
- Prune fruit trees.
- Spray peach trees with lime-sulfur soon after pruning and before bud swell to control peach leaf curl.
- Fertilize pecan and fruit trees based on soil test. In general, apply one tenth of a pound of actual nitrogen per year of tree age per tree, up to a maximum of 3 pounds of actual nitrogen per tree for pecan, 1 pound of actual nitrogen per tree for apple and plum, and 0.5 pound of actual nitrogen per tree for peach, pear, and cherry.
- Fertilize ornamental trees and shrubs. Use a quick release fertilizer at a rate of 1 pound of nitrogen per 1,000 square feet of root area. Tree and shrub roots extend out 2-3 times the distance from the trunk to the branch ends (tree dripline).
- Fertilize tall fescue after mid-February. Use a quick release fertilizer at a rate of 0.5 to 1 pound of nitrogen per 1,000 square feet.
- Start seeds for tomatoes and peppers to be transplanted in early April and flowers (wax begonia, seed geranium, impatiens, lobelia, salvia, verbena, and vinca) to be transplanted in late April.
- Shear evergreen shrubs and prune summer flowering shrubs. Wait to prune spring flowering shrubs until just after they bloom.

Wacky Water

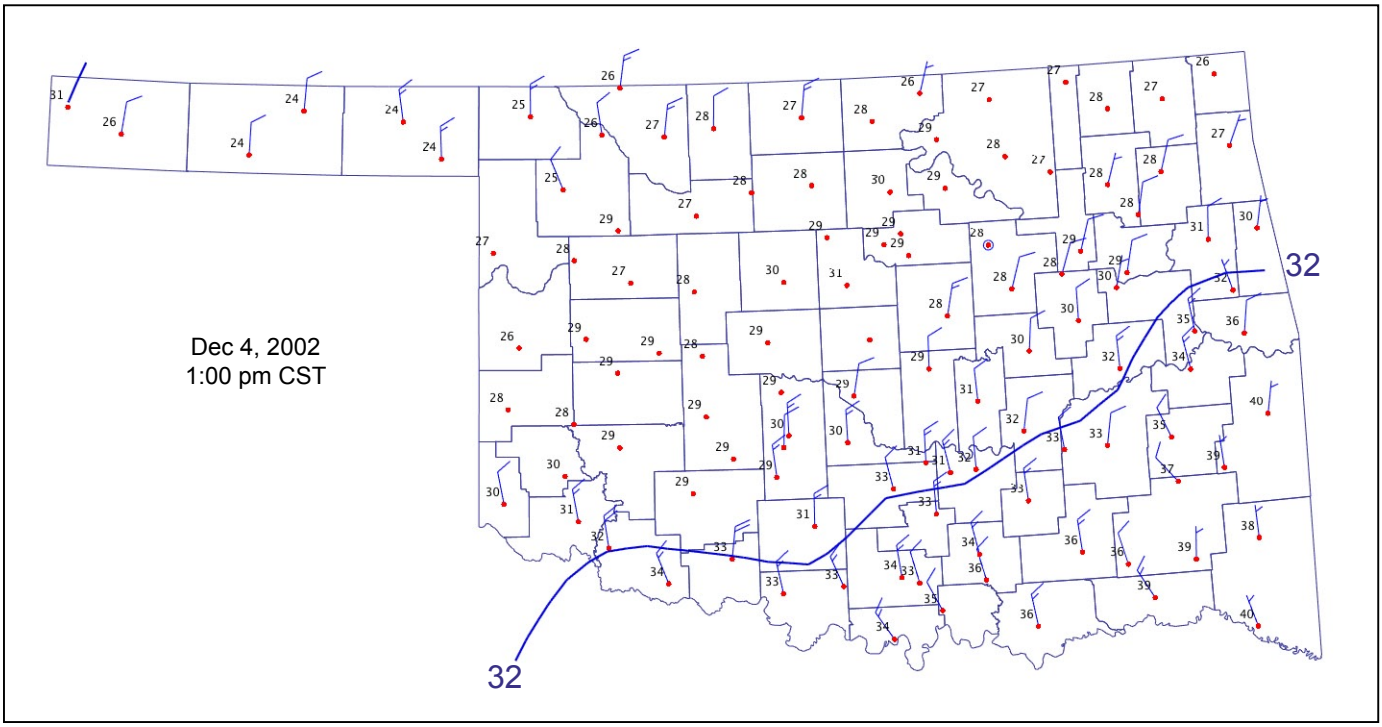
Freezing Precipitation and Instrumentation

The sensors on Oklahoma Mesonet towers are not immune to the harsh winter conditions that sometimes plague our state. When freezing rain or snow occurs, radiation sensors can be covered and the rain gauge may freeze over. One set of sensors that are particularly susceptible to freezing rain is the set that measures wind speed and direction. The cup anemometer, in particular, can be completely incased in ice and report “calm” wind conditions even in wind speeds of 20 miles per hour or more. The effect is similar to having your vehicle door frozen shut in freezing rain. Although the ability to retrieve accurate wind data is compromised in freezing rain events, a meteorologist can still use the calm wind reports to identify the areas that are receiving the frozen precipitation. It is a good bet that if the Mesonet towers are accumulating ice, the bridges, roads, and power lines in the vicinity of the site are as well. This information is very helpful to the State Department of Transportation, the electric utility companies, and National Weather Service.

In our previous seasonal summary, you learned how to interpret plotted winds. On the map below (December 4, 2002 at 1pm CST), notice that there is a large portion of northwestern and north central Oklahoma where the wind barbs are absent. In the panhandle, and in the south central and southeastern portions of the state, winds are from the north or northwest at ten to fifteen miles per hour. A meteorologist would look at the entire map and deduce that the winds are out of the north and northwest at ten to fifteen miles per hour over the entire state, but something is preventing winds from being reported in the swath extending from the southwest corner to the northeast corner of the state.

Notice that the temperatures in the region where the winds are missing are all below 32 F, the freezing point of water. But, also notice that there are many stations that are observing temperatures below freezing and are still reporting winds. Therefore, the freezing temperatures by themselves are not causing the wind data to be reported as “calm”. Something else is occurring in conjunction with the freezing temperatures. That ‘something else’ is rainfall. When liquid water falls and freezes on contact with power lines, roads, and Mesonet instruments, it is called “freezing rain”. The region where the winds are not being reported is evidence that the towers are incased in ice!

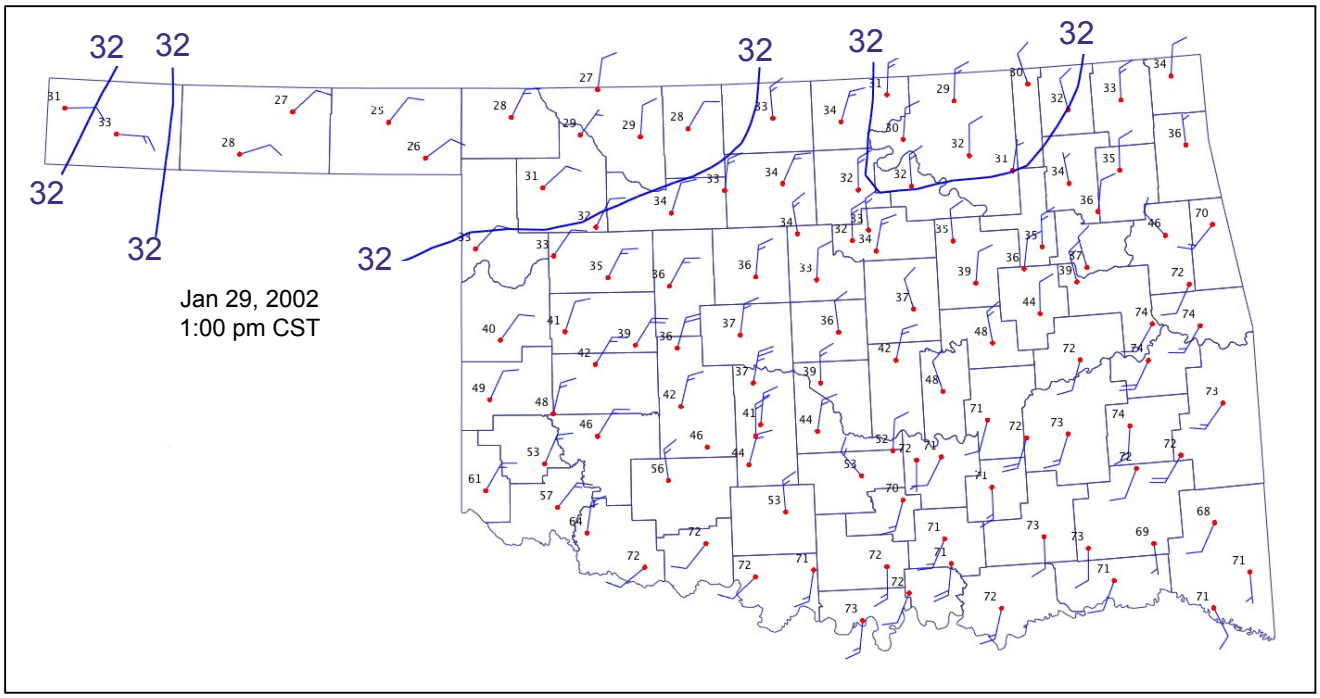
Oklahoma Mesonet Winds and Air Temperature

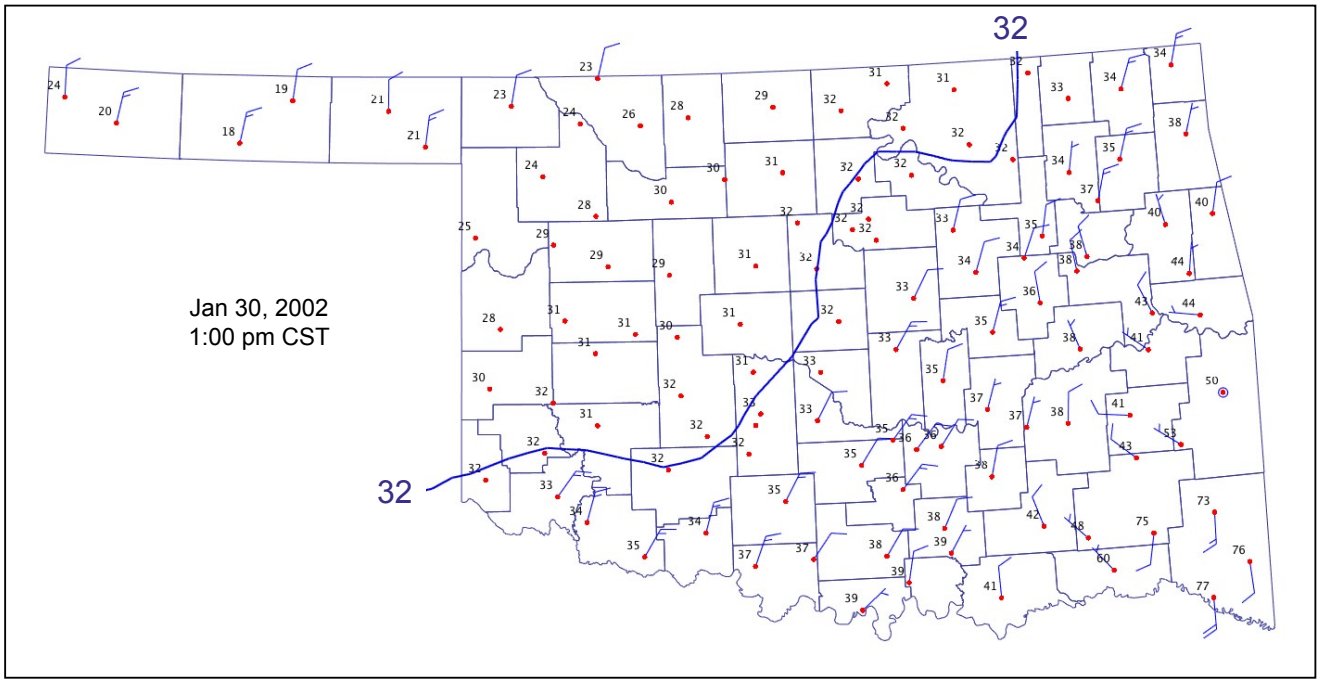


Below are two maps of temperature and winds. The first map shows data recorded at 1 pm CST on January 29, 2002. The second map is from 24 hours later – 1 pm CST on January 30, 2002.

1. On the January 29, 2002 map, shade the areas of Oklahoma that are experiencing temperatures below freezing (32ºF).
2. Are the areas that you identified in Question 1 experiencing freezing rain? (Remember that you can use the reporting of winds to help answer this question – See Interpretation Section.)
3. On the January 30, 2002 map, shade the areas of Oklahoma that are experiencing temperatures below freezing (32ºF).
4. Are any areas that you identified in Question 3 experiencing freezing rain? (Again, you may use the wind reports to help you.) If the answer to this question is yes, identify where the freezing rain is falling.
5. If freezing rain is falling over parts of Oklahoma, what is happening to the roads, bridges, power lines, trees, and Mesonet instruments in the region where the freezing rain is falling?

Oklahoma Mesonet Winds and Air Temperature

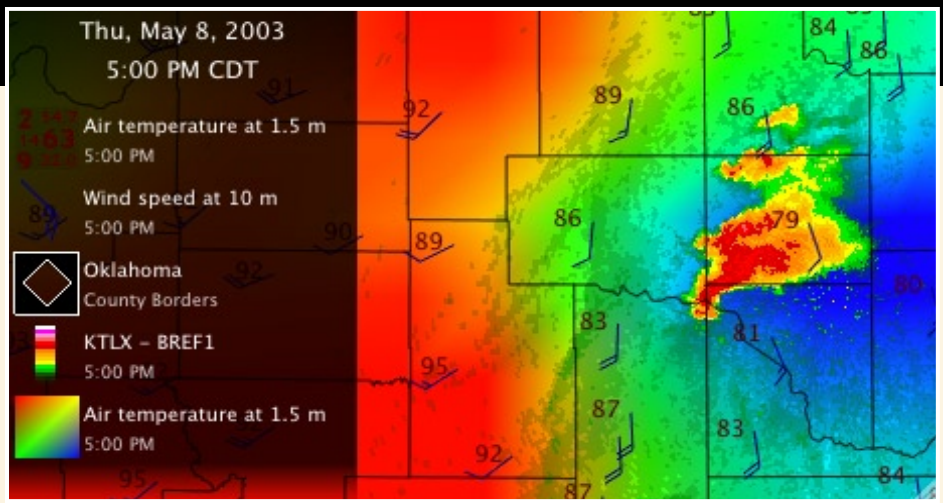




WeatherScope

Billy McPherson
Senior Scientific Programmer
Oklahoma Climatological Survey

Michael Wolfinbarger
Director of Technology
Oklahoma Climatological Survey



Central Oklahoma radar display for the 2003 May 8 tornadic storm. Air temperature and winds from the Oklahoma Mesonet are represented in a station model. Air temperature also is shown as a color gradient.

To aid state agencies, public safety officials, K-12 teachers and students, and other Oklahoma decision makers in viewing weather information in a timely fashion on their personal computers, the Oklahoma Climatological Survey develops easy-to-use visualization software and provides it for free for non-commercial use. OCS's most recent weather data display tool is called WeatherScope.

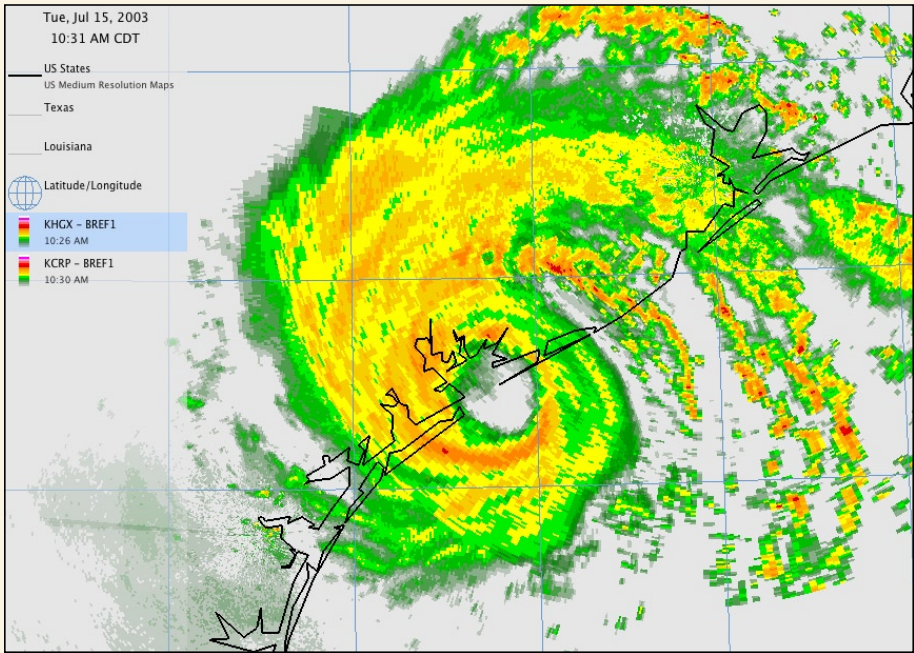
Designed to display Oklahoma weather information, WeatherScope can display weather and geographical information from sources both within and outside Oklahoma. As a result, decision makers can view weather conditions "upstream" — that is, before the weather moves into the state — and make necessary preparations ahead of time.

A primary design goal for the OCS Software Development Group is to generate the visual displays on the customer's machine rather than generating static images on a server. Once "raw" data are located on the user's personal computer, images are created on the fly. The images can be zoomed and panned, and data levels can be turned on or off. In addition, weather maps can be customized by the decision maker, allowing them to determine what information is pertinent to their needs.

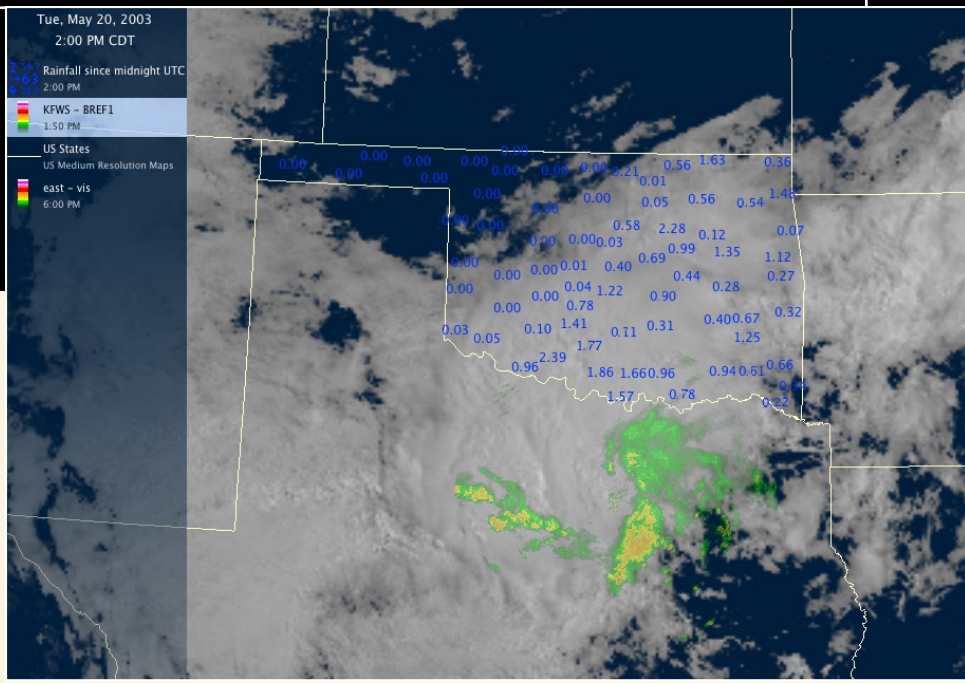
WeatherScope was created in the early to mid 1990's as a tool to visualize data from the Oklahoma Mesonet. At the time, the target audience was users of Oklahoma Mesonet data, particularly K-12 teachers in the EarthStorm project. The second incarnation of WeatherScope, developed in the latter 1990's, was in the form of a web-browser plugin called WxScope Plugin. The plugin was developed to work under Mac OS and MS Windows 95/98 in Netscape Communicator or Microsoft Explorer. The WxScope Plugin gave web developers the ability to embed weather data within any web page. The plugin was used extensively by the emergency management community, especially during the May 3, 1999 and the May 8 and 9, 2003 tornado outbreaks.

The present WeatherScope application is a stand-alone web-based display and analysis system. It is available for Windows 2000 and XP and Apple Mac OS X operating systems. WeatherScope can be used for many applications in meteorology, geosciences, and geography. WeatherScope allows the customer to produce weather maps according to individual needs.

Hurricane Claudette makes landfall near Port O'Connor, Texas in this image showing data from the Houston and Corpus Christi NEXRAD radar sites.



Renee McPherson
Associate Director
Oklahoma Climatological Survey



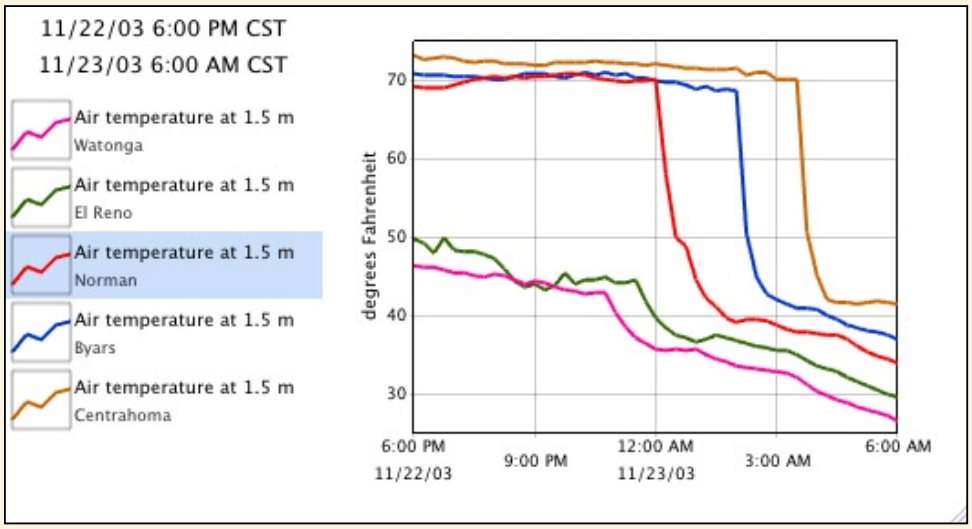
WeatherScope can display data in a variety of formats and differing scales in a single window, as illustrated by this example showing an infrared satellite image combined with NEXRAD radar data and rainfall measurements from the Oklahoma Mesonet.

WeatherScope can display weather data as maps or time-series graphs. The maps can include wind vectors (directional arrows with the length representing the wind speed), color contours, line contours, or simply the data themselves. Radar data can be displayed on the same map as other data, such as rainfall, wind, and air temperature.

Map overlays can be displayed as lines (e.g., highways, county boundaries) or points (e.g., cities, weather station locations) to provide a geographical context for the weather data. Overlays and data layers can be arranged in the legend such that a layer can be above or below another layer. Also, the translucency of layers is user configurable. For example, radar data may overlay point data (e.g., air temperatures), but if translucency is set to less than 100%, then the point data are allowed to show through.

WeatherScope has the ability to update data in real-time. Alternatively, the user may specify the date and time of the map. This feature allows users to view the data as they become available, without being concerned with manually downloading the most recent data.

Future releases of WeatherScope will include the ability to animate images and to view other data sources, such as satellite data. At this time, WeatherScope can be used by state employees and weather enthusiasts (for non-commercial use) to monitor the ever-changing conditions across Oklahoma. The software can be downloaded at http://sdg.ocs.ou.edu.



Time-series graph showing 12 hours of air temperature data for five Oklahoma Mesonet sites.

WINTER DRIVING TIPS

The winter combination of overcast skies, reduced visibilities, ice, snow, and rain leads to thousands of accidents and dozens of deaths every year. Remember, even experienced drivers can find their nerves and skills tested by winter road conditions. Motorists can avoid accidents if they observe a few winter weather driving tips.

- Before beginning your trip, know the current road conditions. For the latest conditions of Oklahoma roads, highways and Interstate highways, please call (405) 425-2385.
- Always wear your safety belt!
- Keep your car's windows, mirrors, and lights clear of snow and ice.
- Leave a few minutes early to allow extra time to get to your destination.
- Be aware of potentially icy areas such as shady spots and bridges and overpasses.
- Keep a safe distance of at least six seconds behind other vehicles and trucks that are plowing the road. You need at least three times more space to slow down on a slick road.
- Be deliberate in maneuvering your vehicle – most skidding is caused by sudden stops and turns.
- If your vehicle skids, don't hit the brakes. Ease off of the accelerator and gently steer into the direction of the skid.
- Don't pass a snowplow or spreader vehicle. Treat these as you would emergency response vehicles.
- Keep an emergency winter driving kit in your car.

More information is available from these sites:

FEMA Winter Weather Driving Site
http://www.fema.gov/hazards/winterstorms/winterf.shtm

Winter Storm Preparedness Kit:
http://www.srh.noaa.gov/oun/winterwx/okcpns3.php

Winter Weather Definitions:
http://www.srh.noaa.gov/oun/winterwx/okcpns2.php

Winter Weather Awareness:
http://www.srh.noaa.gov/oun/winterwx/okcpns1.php

Road Conditions:
http://www.srh.noaa.gov/oun/winterwx/roadconditions.php

Winter Weather Safety and Preparedness Information:
http://www.srh.noaa.gov/oun/winterwx/safety.php

Oklahoma Climatological Survey
100 East Boyd, Suite 1210
Norman, Ok 73019-1012
phone 405.325.2541 fax 405.325.2550
http://www.ocs.ou.edu
email ocs@ou.edu