Oklahoma Climate

Spring 2006

Graphing History

Teleconnection

Hail Today
Gone Tomorrow

OCS attends AMS

MESSAGE FROM THE EDITOR

Folks that moved to the Sooner State in the late 1980s or 1990s are probably a bit shocked at the dry climate we have settled into the last few years. That period was abnormally wet, at least by Oklahoma's standards. In fact, precipitation was below normal only once (1988) between 1981 and 2000. That statistic is misleading, of course. Droughts still occurred during that period...they just managed to miss being caught by the annual precipitation data. The drought of 1996 is a prime example, which missed being sampled in an annual precipitation plot by spanning the end of 1995 and the beginning of 1996. That didn't hamper it from doing over a billion dollars in damage to the state's agriculture industry. Imagine the horror of those that moved into the state during the wet 1920s only to suffer through the Dust Bowl a decade later. OCS has long-term displays of both precipitation and temperature on its website, and acting State Climatologist Deke Arndt takes us through all their nuances and intricacies in this issue of "Oklahoma Climate."

What is the root cause of some of these climate cycles? Believe it or not, ocean temperatures in the equatorial Pacific are known to have a significant impact on our weather. El Nino and La Nina are probably the two most publicized of those phenomena, known as "teleconnections." You can read about those and other far-flung weather modifiers in this issue's feature article: "Teleconnections: Reach Out and Touch Someone." Another of our feature articles tracks severe hail storms in Oklahoma and the surrounding states using radar – one of the few studies to ever attempt this feat. OCS was well represented at the 2006 annual meeting of the American Meteorological Society, sending 22 faculty, research scientists, and staff. This is the pre-eminent meeting for the atmospheric sciences, and you can read about OCS' participation inside.

Our classroom activity explores extreme weather events using the climate trends data discussed earlier. In addition, be sure to read our regular features dealing with agricultural weather, weather safety, and a weather summary of the 2005-06 winter season.

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
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Cover Photo: Photo by John Humphrey. 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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OKLAHOMA CLIMATOLOGICAL SURVEY

Graphing History

Derek Arndt
Acting State Climatologist

A new OCS product helps provide some visual perspective on the state's climate cycles.

Earlier this year, the Oklahoma Climatological Survey's Climate Information Group produced a new suite of products that should help illustrate the nature of the state's climate cycles. These graphs, the fruit of OCS's collaboration with scientists from the USDA's Agricultural Research Service Grazinglands Research Laboratory (GRL) in El Reno, show the evolution of Oklahoma's climate history since the modern record began. Their graphical format helps bring forth details that can easily go unnoticed in the giant tables of numbers that compose the state's climate record.

Each graphic shows the modern history (since 1895) of precipitation or temperature for one of ten regions: Oklahoma's nine climate divisions, plus the statewide-averaged value. For example, the graphs in Figure 1 depict the average temperature and average precipitation across the state for each of the 111 spring seasons (Mar-Apr-May) spanning 1895-2005. The most recent years are on the right, and each complete decade is shaded for readability. The diamonds represent an individual observation; for example, the statewide average precipitation during very wet spring of 1990 was 18.41". The diamond that represents this value shows up as the leftmost diamond in the lighter-shaded 1990s decade.

The individual values are supplemented with two longer-term indicators. The first of these is simply the long-term average value for the dataset. For example, the average temperature of all 111 springs in Figure 1 is 58.7, represented by the heavy horizontal line. The second longer-term indicator is a five-year weighted average, which filters out some of the year-to-year "noise" in the climate signal and leaves a clearer picture of multi-year trends. These weighted values of temperature (precipitation) are colored red (green) when greater than the long-term average, and blue (brown) when less than it. The five-year filter was recommended by the GRL to help "tune" the product to the timescale in which certain decisions are made with regard to developing the most appropriate varieties of crops and the most appropriate land management practices.
The multi-year trends help to clarify several features within the data. Looking at the trends in annual precipitation and

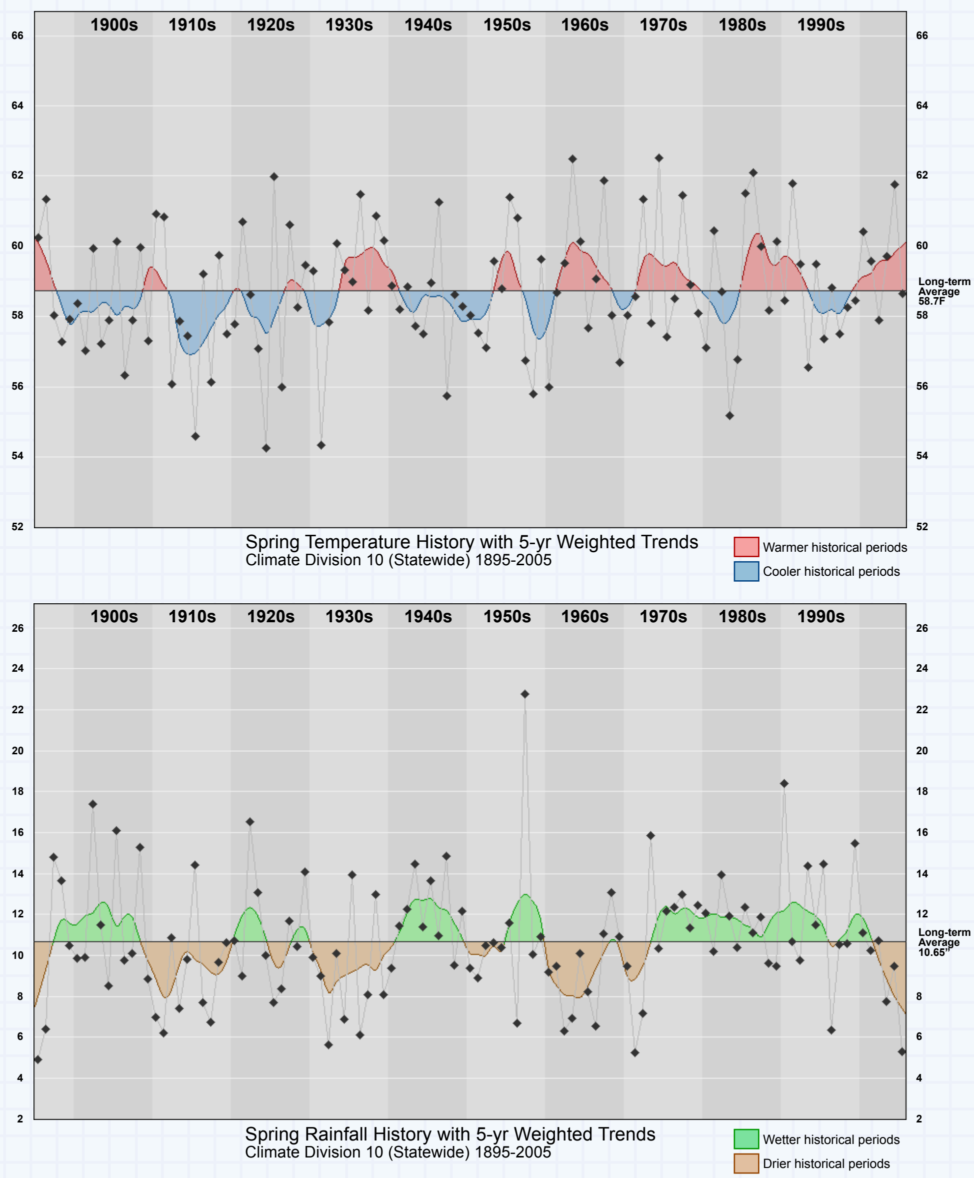
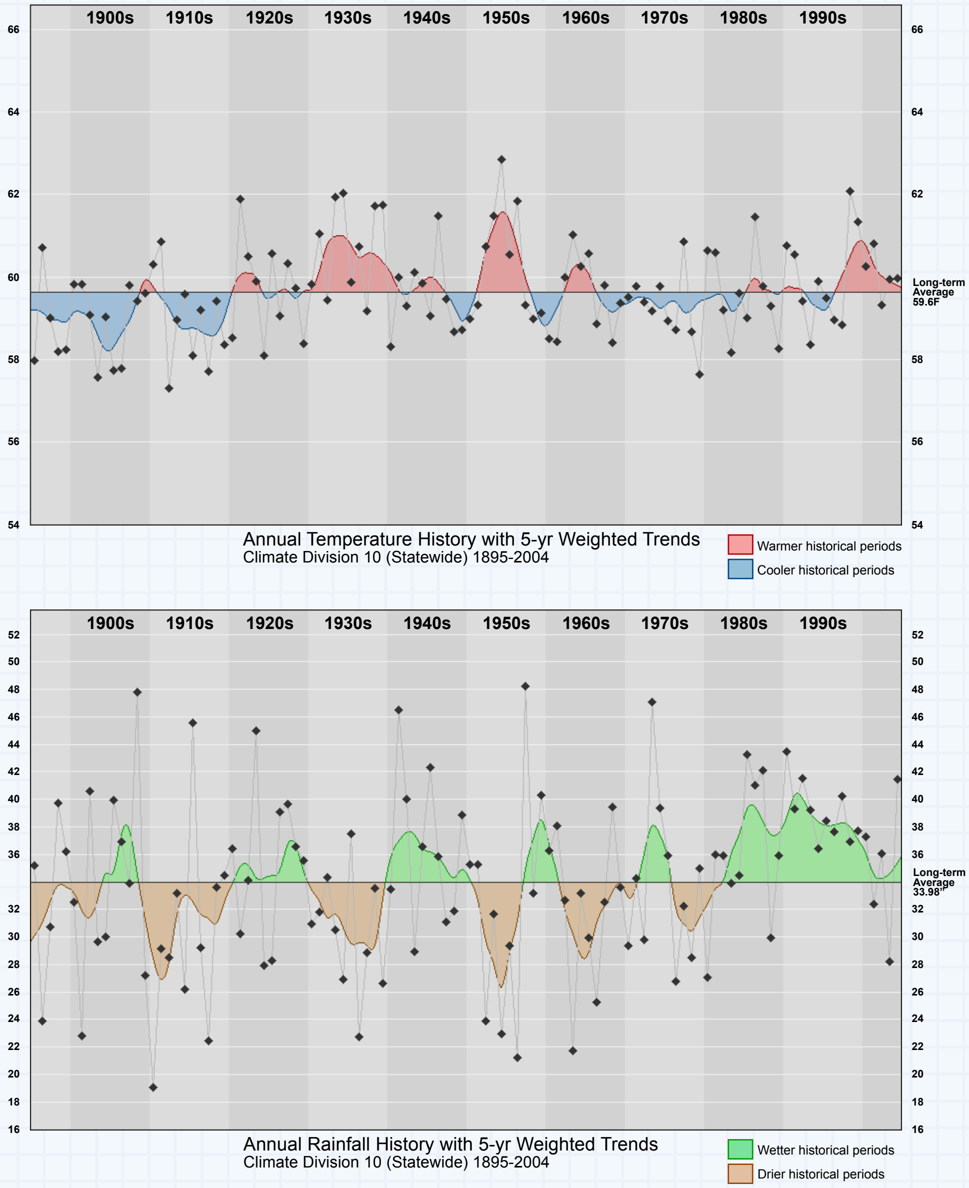


Figure 1 *- Statewide-averaged temperature (top) and precipitation (bottom) for the spring (March-May) seasons of 1895-2005.*

Figure 2 - *Statewide-averaged annual temperature (top) and precipitation (bottom) for 1895-2004.*

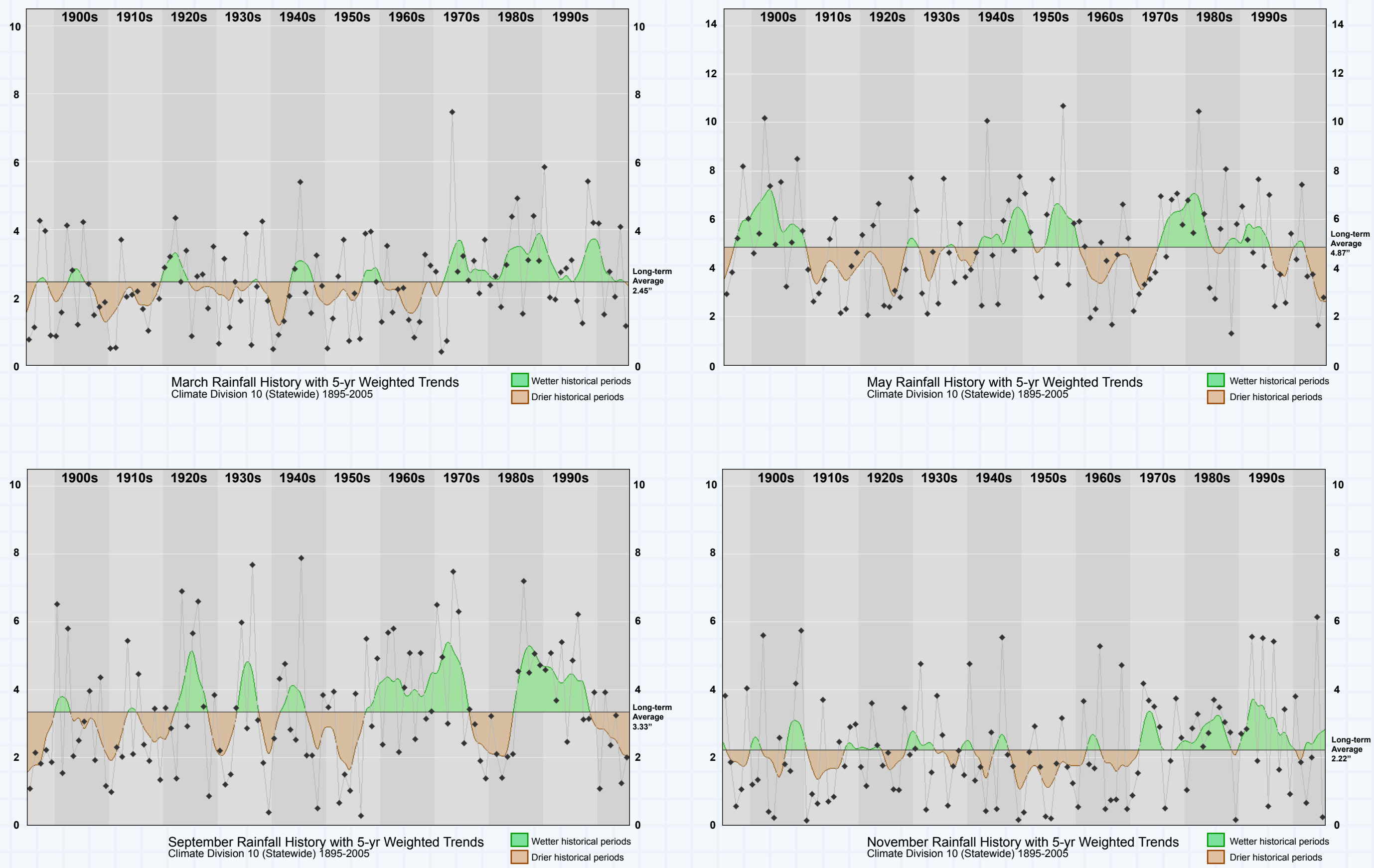


temperature (Figure 2), perhaps the most obvious pattern is the cyclic nature of each trace. The precipitation shows the near-decadal rhythm of Oklahoma's rainfall from the 1890s through the 1970s. With a few exceptions, dry periods and wet periods cycle through on a roughly twenty-year cycle (ten wet, ten dry).

Looking closer, you can also see that individual values aren't dictated by the nature of the longer-term pattern. Indeed, the wettest year in Oklahoma's modern climate record, 1957, came on the heels of an extended dry period.

Figure 2 also reveals that the droughts of the 1950s were more severe (on a statewide-averaged basis) than those of the 1930s. Admittedly, the dryness of the Dust Bowl era lasted a couple years longer than the mid-century droughts, but the magnitude of the precipitation and temperature spikes were greater in the 1950s. Another feature that leaps out of Figure 2 is the profound wetness of the 1980s and 1990s. This wetness not only bucked the established pattern, but its magnitude was unmatched at any time earlier in the period.

Figure 3 - Statewide-averaged precipitation for the months of (top to bottom) March, May, September and November.



However, not every month got in on the act. Figure 3 shows that the transition months of March and November actually began to "wetten" several years before the rest of the calendar. In contrast, the month of May, historically the wettest month of the calendar for most of the state, shows a marked downward precipitation trend. Finally, the month of September is oscillating dramatically, but to its own rhythm.

These graphs are all available at OCS's Climate Information website: http://climate.ocs.ou.edu/. Click on "Climate Trends" in the menu.

Teleconnection:
Reach Out and Touch Someone

When I was a child, I did not appreciate how simple games educated me about the workings of weather and climate. One example was the age-old experiment of creating a telephone out of two coffee cans attached by a string. When you talked into one can, the sound waves that you generated moved, or propagated along the string and were audible to the person holding the other end. A certain phone company created an advertising slogan built around this premise, and we were promptly asked to "reach out and touch someone". Nowadays, we have the ability to use all manner of technology to reach out and touch almost every part of the Earth from any place else. The ability to do this is called telecommunication.

Over the past 25 years, meteorologists have observed that our atmosphere behaves in the same way that our sound waves did in that homemade telephone. For example, changes in weather conditions and ocean water temperatures in far away places like the Tropical Pacific Ocean near Australia or South America, may have a ripple effect on weather patterns right here in Oklahoma, many thousands of miles away. The ability to link changes in weather patterns in one part of the world with weather pattern changes somewhere far away is called teleconnection.

By Kevin Kloesel
Assistant Dean, College of Atmospheric and Geographic Sciences

Two of the more newsworthy children that play this teleconnection game are El Niño and La Niña.

Most people have heard of El Niño. El Niño is the term used to describe the continual but irregular cycle of warmer than normal sea surface temperatures along the equator over the eastern and central Pacific Ocean. In the late 1800s, geographers in Peru noted that dramatic weather changes were occurring every three to six years. Peruvian fishermen claimed that when this switch in weather patterns occurred, the water near the Peruvian coast would warm dramatically. The shift toward warmer water that accompanied these weather changes tended to occur in December, and the fishermen named the phenomena “El Niño” because of its apparent correlation with the beginning of the Christmas season. In the 1960s, oceanographers realized that the warming and cooling of the waters off the coast of Peru was part of a larger phenomenon, one that spanned the entire tropical Pacific Ocean. In the 1980s, the term La Niña was created to describe the cooling of these same waters, or to designate the opposite of an El Niño.

El Niño is notorious for reaching out and touching everyone, but in dramatically different ways. The teleconnection effects of El Niño can result in severe droughts and deadly forest fires in Australia, Indonesia and southeastern Africa, but devastating floods in Ecuador, Peru and California. El Niño has also been linked to below-average numbers of hurricanes in the Atlantic basin, and milder than normal winters in the northeastern U.S. La Niña years tend to be associated with active Atlantic hurricane seasons, such as the devastating hurricane season of 2005.

El Niño is somewhat of a good-news, bad-news proposition for Oklahomans. While El Niño usually results in above-average winter season precipitation that may benefit farmers and ranchers, the aforementioned mild winters in the northeastern U.S. can mean reduced revenue for Oklahoma’s oil and gas industry. The most recent La Niña appears to be responsible for the current Oklahoma drought situation.

Just as you experienced the give and take of telecommunicating on that hand-made telephone with your friend, El Niño and La Niña take turns teleconnecting with both global and Oklahoma weather and climate patterns. Unfortunately, the ability to understand the mechanisms that cause this irregular shift between El Niño and La Niña is somewhat like attempting to unravel every conversation ongoing simultaneously on a party line. In addition, just like your cellular phone tends to have a different signal level in some areas than in others, so it is with El Niño and La Niña. No two El Niños or La Niñas are alike.

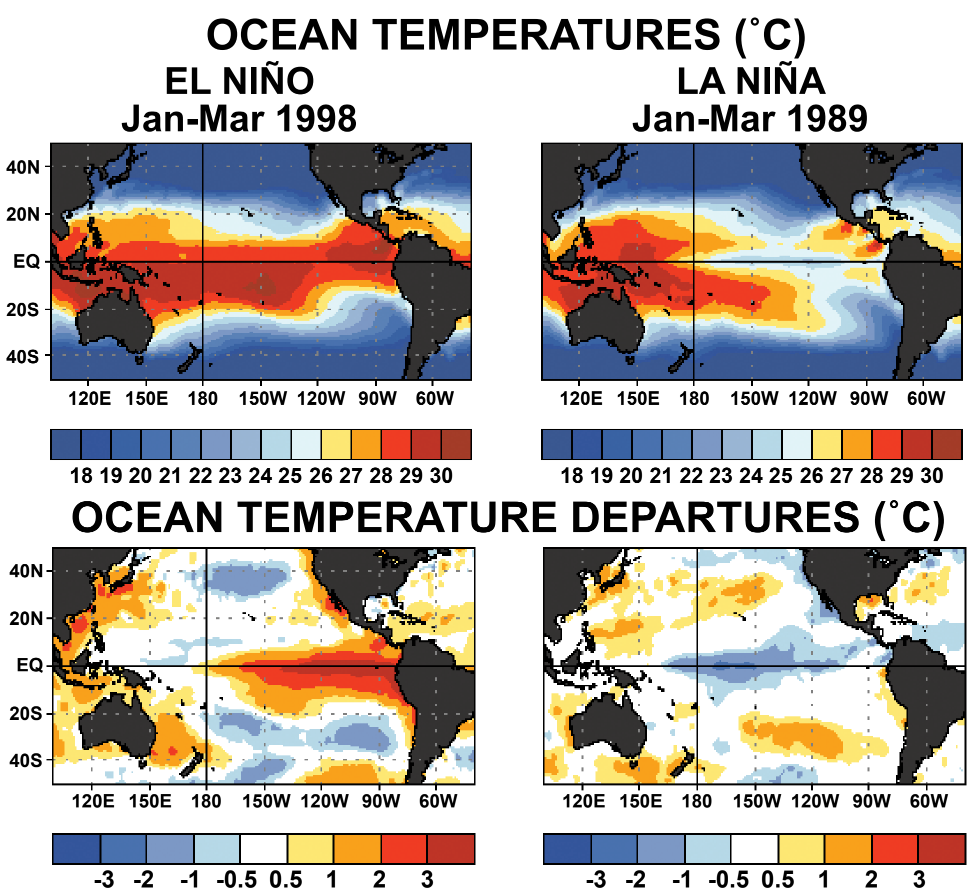


Figure 1 - *Sea surface temperature examples from El Niño and La Niña events (graphics courtesy of NOAA).*

The next time you pick up your phone to reach out and telecommunicate with someone, remember that your voice is not the only energy that can be transferred to some distant place. The atmosphere will also be teleconnecting, its energy roaming, providing an intricate balance of both expected and unexpected changes to our weather patterns and climate system.

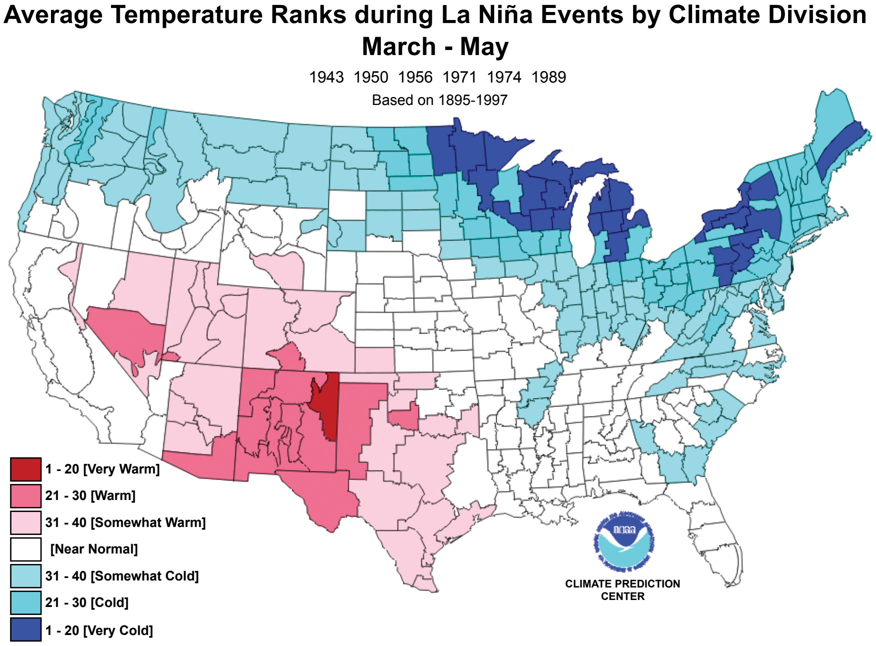


Figure 2 - *Climate division spring temperature rankings for previous strong La Niña events (figure courtesy of NOAA).*

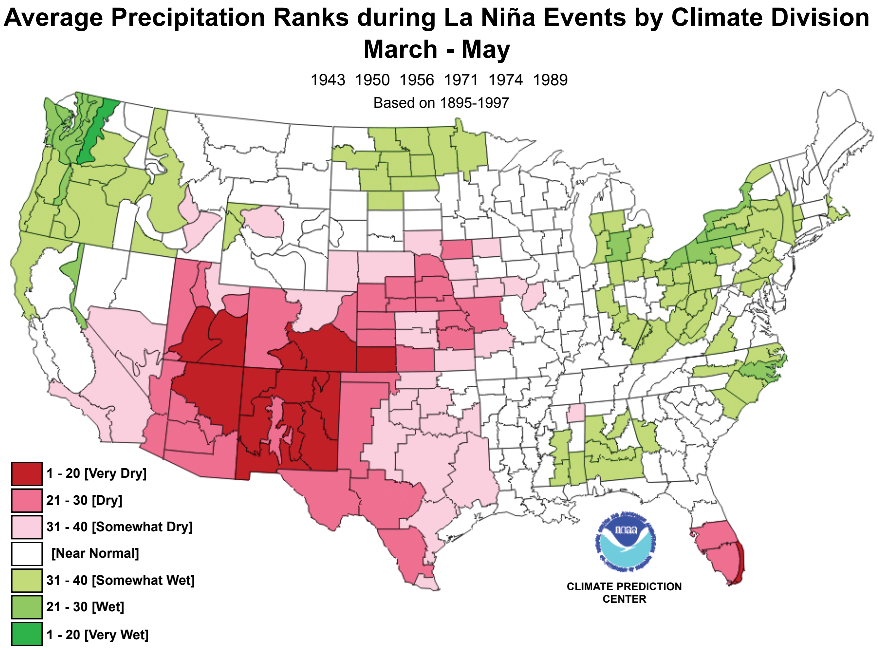
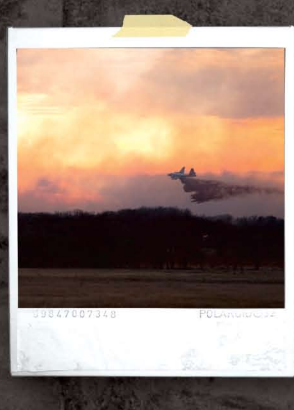
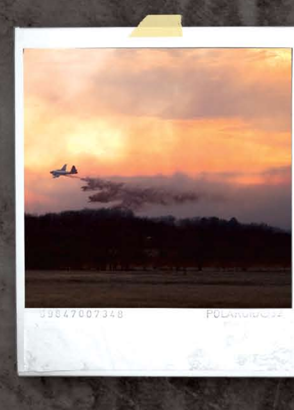


Figure 3 - *Climate division spring precipitation rankings for previous strong La Niña events (figure courtesy of NOAA).*

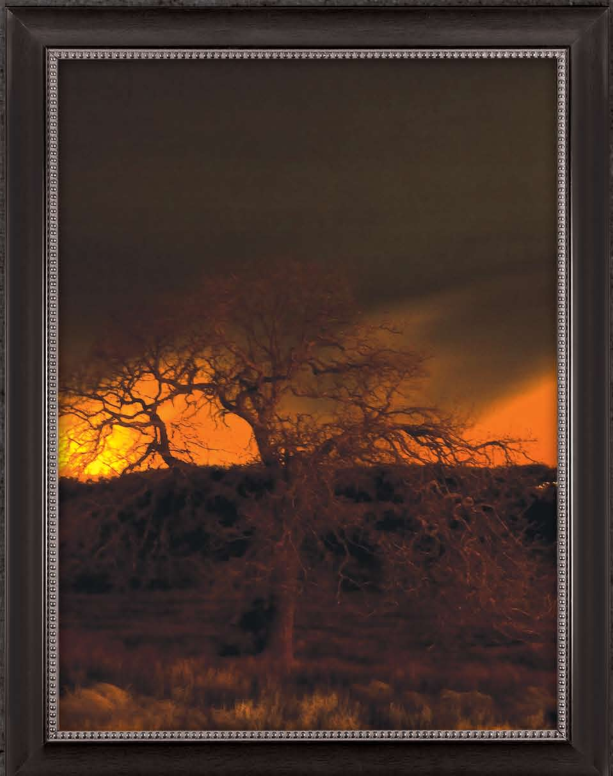
OKLAHOMA ABLAZE

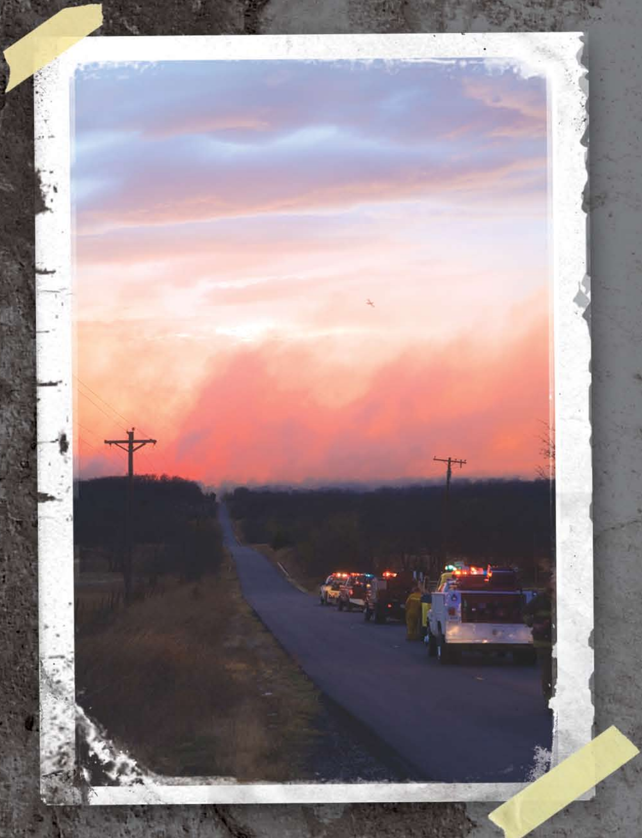
PHOTOS FROM THE FIELD





Photos By:
[top left] Ryan Davis
[all others] Bob Fritchie





Hail Today
Gone Tomorrow

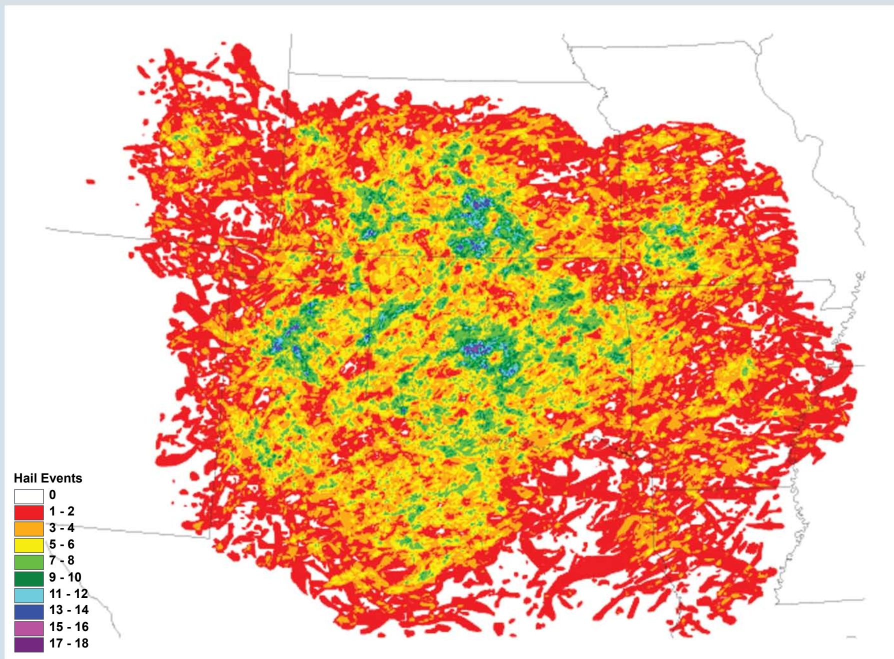


Figure 1 *- Analyzed severe hail occurrence for the period spanning 2001-2003.*

Severe hail is a common event in the Southern Plains of the United States. However, few studies have been conducted to quantitatively answer the question: how much hail occurs at any given location? Given the coverage of WSR-88D radars over the Southern Plains and recent technological advancements including hail detection algorithms, a compilation of severe hail swaths was completed for the period spanning 2001-2003 using data from 15 radar sites in portions of eight states.

Using software from Weather Decisions Technologies Inc. (WDT) and composite reflectivity radar data (CREF), all storms which occurred over the southern plains were investigated for potentially containing severe hail. Hail swaths were created for all storms which likely contained severe hail (0.75 inches or greater in diameter) during the three-year study period; a total of 390 days. The analysis was then repeated for what was defined as significant hail (2.0 inches or greater in diameter). The resultant hail swaths were then imported into ArcView, a geographic information systems (GIS) software, for visualization. The hail swaths were then overlaid for various time scales to produce climatological hail frequencies. The unique aspects of this analysis are the inclusion of GIS into a longer-term meteorological analysis and the use of radar detection of hail in place of observed severe hail reports. It serves as a demonstration study for the application of GIS techniques in meteorology.

Every severe hail swath from the three-year study period was plotted in a single image (Fig. 1). Several features were immediately apparent including a large concentration of severe hail events near three cities which contained radars: Amarillo, Oklahoma City, and Wichita. At the same time, other cities with radars revealed no significant relationship to severe hail (Tulsa; Dallas; Frederick, Oklahoma; Vance AFB; and Shreveport). In addition, compact areas of

By Danny Cheresnick, Research Associate, Oklahoma Climatological Survey

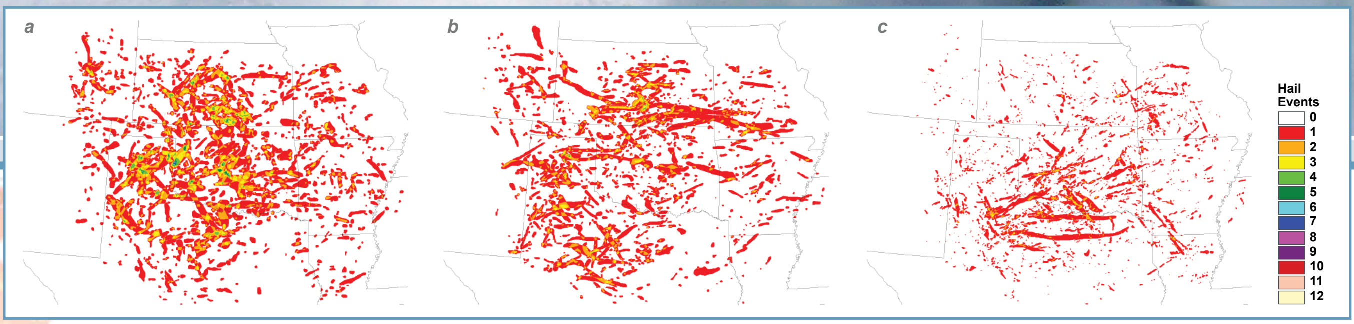


***Figure 2** - Analyzed significant hail occurrence for 2001 (a), 2002 (b), and 2003 (c).*

severe hail concentration were located large distances from any radar included in this study, such as near Shamrock, Texas, and Goodland, Kansas. Further, a relative minimum of hail swaths were noted in northeast Texas and southeast Colorado. This was a consistent trend throughout all analysis during the study. Finally, the maximum number of overlapping severe hail swaths at any location for the three-year period was 18 in central Oklahoma.

Annual composite analyses for significant hail were created for each of the three years (Fig. 2). The largest annual maximum of significant hail occurred in 2001, with eight events near Shamrock. In 2002, the maximum was five events near Wichita and Amarillo, while 2003 yielded a maximum of four events in multiple locations across southern Oklahoma and north Texas. Initial inspection of the annual composite analyses suggested that there were fewer hail swaths each successive year. However, the main differences from year to year were the characteristics of the swaths, particularly the decreasing mean area. The discrepancies between successive years can be explained by: (a) an increase in the resolution of the CREF data (and a significant subsequent increase in detail of the analysis, which is evident visually) in 2003 from four to one kilometer, (b) natural variation of hail occurrence, and (c) human inconsistencies in swath contouring.

When interpreting these figures, it is important to understand what the results actually mean. For example, for an area which was shown to have 10 severe hail swaths over the three-year study period, this does not guarantee exactly 10 severe hail events occurred at that location. However, it does mean that 10 times the radar detected a high probability of severe hail producing storms nearby. Thus, a given location may have only had severe hail five times, but there were likely other events within a short distance which did not effect that specific location. Additionally, there could have been other events which were below severe criteria.

This study sought an innovative and unique method for estimating hail occurrence across the Southern Plains of the United States. The combination of GIS and radar data made it possible to quantify likely hail occurrence in a new manner separate from human field observation. The application of this type of analysis has been demonstrated and the combination of GIS and radar data can be used to create long term observational studies for hail occurrence.

ANSWERS TO CLASSROOM ACTIVITY (pg. 23)

1. 4.45 inches. This is 1.11 inches greater than the long-term average.
2. Most climatologists would describe the Aprils of the 1940s as generally wet. No, the Aprils of 1944 and 1947 actually had below-average rainfall.
3. 3.29 inches. This is 0.05 inches less than the long-term average.
4. No, the 1950s decade featured several Aprils with below-average rainfall and an extremely wet April of 1957.
5. Without the 1957 value, the 1950s average rainfall drops to 2.74 inches. Most climatologists would describe this as a dry decade.
6. 47 Aprils had above-normal rainfall, which means 64 had below normal rainfall.
7. There are several months which feature very large rainfall values. These large values can have a strong influence on the overall average.

By: Gary McManus

The winter of 2005-06 will best be remembered for its dry weather, but it was undeniably warm as well. The season, which entered the record books as the 13th warmest and 2nd driest in state history, had only two significant bouts with frigid weather, in early December and mid-February. That is also a good accounting of the scant wintry precipitation during the December-February period. Other than those two distinct periods, the winter was exceptionally warm. Christmas day was the warmest in over 25 years, and January shattered its previous record for warmth at over 10 degrees above normal. With so little precipitation, severe weather was likewise severely limited. The true severe weather threat during winter came from wildfires, as the abundant warmth combined with low humidity and strong winds to burn hundreds of thousands of acres across the state.

Precipitation

The statewide-averaged precipitation for the state during winter was a paltry 1.46 inches, nearly four inches below normal. Most of the state's precipitation totals ranked in the top three driest, with only south central and southeastern Oklahoma bucking that trend with their 9th and 8th driest on record, respectively. The southeast led the way at nearly five inches of rainfall, on average, but they also had one of the greatest deficits as well at over five inches below normal. While the Panhandle received less than a half of an inch, on average, that is still only about an inch and a half below normal. Kenton recorded the lowest precipitation total in the state at just over a tenth of an inch, barely enough to wet the rain gauge. Idabel was lucky enough to receive well over six inches of precipitation to lead the state.

Temperature

The most provocative story of this winter season was the January that thought it was March. The overwhelming warmth of January, which came in at well over 10 degrees above normal, propelled the season to three degrees above average. Two extreme arctic outbreaks counteracted the warmth or the season would have ended much warmer. The cold snap in early December was by far the coldest of the season, and the season's lowest temperature of -15 degrees was recorded at Kenton during this outbreak. The end of February was the season's warmest period with Hollis reaching the season's highest temperature, 90 degrees on the 28th.

December Daily Highlights

December 1-5: A cold front passed through the state overnight on the 1st, supplying the month's first day with cool temperatures and northerly winds. The weather had warmed into the 60s by the following day, however. A warm start led to an even warmer day on the third. Highs in southern Oklahoma rose into the 80s, with the month's warmest temperature of 84 degrees being recorded at the Durant Mesonet site. McAlester tied its previous record high temperature on that day of 78 degrees. The cold front brought temperatures into a more winter-like area for the next couple of days, with lows from the teens to the 30s, and highs in the 30s and 40s.

December 6-9: An even stronger cold front brought a reinforcing blast of cold air on the 6th, ushering in some of the coldest weather of the last decade to the state of Oklahoma. High temperatures barely escaped the single digits in the Panhandle during this period, with Kenton and Boise City reaching a frigid 10 degrees on the 7th. Six locations tied or broke their record for minimum temperatures on the 8th and the 9th, while Kenton plunged to -15 degrees on the morning of the 8th. Much of northern Oklahoma dropped to below freezing from the 7th through the 9th with the help of clear skies, light winds, and snow cover of up to a couple of inches. The snow began falling on the 7th, but the cold airmass didn't allow for much melting. Temperatures finally rose above freezing for much of the area on the afternoon of the 9th, but remained in the 30s.

December 10-16: A shocking return to the 60s greeted the state for the next several days following the artic-like conditions of the past week. An upper-level disturbance moving through the Southern Plains brought a little moisture to the state on the 13th with temperatures moderating into the 50s and just a few 60s. Another cold front on the 14th dropped low temperatures in the Panhandle back into the single digits, with lows elsewhere remaining in the 20s and 30s.

December 17-21: The next five days could be considered the wet period of a month with very little precipitation, despite the scant amounts that actually fell. A weak upper-level disturbance moved through overnight on the 17th, bringing light rain and some snow to the west. The precipitation expanded and moved east during the day with snow in the north and rain elsewhere. Intermittent wintry precipitation continued for the next several days. Freezing drizzle and light freezing rain made for hazardous travel in the northwest, while Oklahoma City broke its record for daily snowfall on the 20th with 1.6 inches. Temperatures during this period rose into the 20s in the northwest, 30s in central sections, and low 40s in the south. The 21st combined cold temperatures with fog to form freezing fog, which once again created travel problems. The fog eventually burned off and temperatures warmed into the 60s under sunny skies.

December 22-31: The rest of the month was more spring-like than winter, with the warm temperatures, low humidities, and strong winds creating dangerous wildfire conditions. Temperatures managed to rise into the 70s in some portions of the state, and a weak cold front triggered a few showers on the 24th. Amounts were light, although about a third of an inch fell in northeastern sections. Record-breaking warmth was on tap for the next couple of days. The 25th was the warmest Christmas Day in over 25 years – the bright sunshine pushing temperatures into the 60s and 70s. The month's last day brought temperatures in the 60s and 70s and strong winds, igniting several fires across the state.

January Daily Highlights

January 1-3: The year's first day was unseasonably warm, which led to dangerous wildfire conditions. The warmth was accompanied by low humidity and winds gusting to 60 mph ahead of a cold front. Record high temperatures were set at McAlester, Oklahoma City and Tulsa. Low temperatures were incredibly in the 40s and 50s, very warm for early January. The weather cooled considerably the following day with lows in the 30s and 40s and highs in the 50s and 60s, but still above the seasonal normals. The winds calmed and the humidity increased, easing wildfire worries. Southerly winds kicked in again ahead of a weak cold front on the third, pumping up the strong southerly winds to gusts of over 40 mph. Record high temperatures occurred at Gage, Hobart and Lawton as temperatures rose into the 70s and 80s statewide. The month's high temperature of 87 degrees was set on the 3rd at Altus and Camargo.

January 4-8: The 4th was dominated by high pressure which had built in after the frontal passage of the 3rd. Although high temperatures rose into the 50s and 60s, strong northwesterly winds made the day feel cool. The period remained pleasant throughout with added warmth in the last two days. Record high temperatures were set once again on the 7th and 8th with highs in the 70s and 80s.

January 9-10: An upper-level storm approached from the west as a cold front dropped into the state from the north, bringing the state its first taste of winter weather since mid-December. The cold front dropped temperatures into more seasonable territory on the 9th, with highs in the 30s in the north. Most of the northwestern half of the state received at least some snow, but the heaviest band of 6-12 inches ran along Interstate 35 from Oklahoma City north to the Kansas border. Lamont led the state with 11 inches, while Braman had 9.5 inches. Another area of 3-4 inch snowfall occurred in west central Oklahoma. The front triggered severe storms in far eastern Oklahoma, with large hail being the main threat. Temperatures rose into the 50s in most areas on the 10th, except near the snow pack, where highs only reached the low 30s.

January 11-15: The 11th started cold, with lows in the 20s, but temperatures dropped into the teens where there was snow cover. Southerly winds helped temperatures to steadily increase over the next couple of days, eventually returning to 70s for highs. The winds gusted to over 40 mph on the 12th, once again raising the fire danger to extreme levels. A weak cold front dropped high temperatures down 10-20 degrees and triggered more severe storms in the far eastern portions of the state. Quarter-sized hail and winds of up to 60 mph were reported with those storms. High pressure moved in behind the front, allowing temperatures to rise once again into the 70s by the 15th.

January 16-21: The 16th-21st was marked by a couple of weak cold front passages on the 16th and 19th. Still, temperatures during this period were well above normal, and usually accompanied by strong gusty winds, adding to the risk of wildfires. Moisture surged northward on the strong southerly winds, making for a muggy night.

January 22-28: An upper-level storm moved toward the Southern Plains on the 22nd, creating a large area of heavy rain in south central and southeastern Oklahoma, as well as a lighter rain shield in the west. The extreme southeast received the most beneficial rainfall with a general area of nearly two inches. Amounts tapered off quickly to the northwest. Another light band from west central up through north central parts of the state provided little more than a third of an inch in spots. High pressure quickly filled in following the storm's passage, providing a pleasant day with light winds and highs in the 50s. High pressure dominated for the next several days until another upper-level storm approached from the west on the 27th. That disturbance kicked the winds up from the south, allowing another moisture surge from the Gulf of Mexico. More rain fell overnight and into the 28th, spreading over the eastern two-thirds of the state. The Mesonet site at Broken Bow recorded over two inches, with other amounts in the area exceeding an inch.

January 29-31: Light winds and clear skies greeted the state on the 29th before more clouds and strong winds returned that afternoon. The cloud cover kept temperatures in the 50s and 60s, but the gusty winds made it feel cool. The month's last day was much like its first, with strong winds, low humidity, and enough warmth to send the wildfire danger soaring.

February Daily Highlights

February 1-3: High temperatures rose into the 60s and 70s ahead of a weak cold front which had stalled in the northwest on the 1st. The front meandered north-south for a couple of days, its exact position determining whether highs were in the 50s and 60s or 60s and 70s. The front triggered a few rain showers on the 2nd in southern Oklahoma. The Mesonet site at Eufaula recorded more than a half of an inch on the 2nd. An upper-level disturbance on the 3rd brought enough cloudiness to drop high temperatures back down into the 50s and 60s as well as triggering light rain in the southeast.

February 4-9: Temperatures were more seasonable on the 4th with lows in the 20s and 30s and highs in the 40s and 50s. A cold front moved through the state on the 5th. Highs ahead of the front reached the 70s, but remained in the 50s behind the front. Cooler temperatures greeted the state on the 6th and 7th before warming a bit on the 8th and 9th.

February 10-15: A cold front and upper-level storm met over the state on the 10th, triggering light to moderate precipitation over the southeast. Totals were generally light, with a half of an inch reported at the Mt. Herman Mesonet site. Cool weather ensued for a couple of days with highs in the 40s and 50s and lows from the teens to the 30s. The weather warmed a bit after that with highs in the 60s and 70s. Strong winds and low humidity combined with the warmth to send wildfire potential skyrocketing during that period. A weak cold front moved into the state on the 15th and stalled, cooling northern Oklahoma to more seasonable weather.

February 16-20: A much stronger cold front entered the state early on the 15th. Temperatures quickly dropped 20-30 degrees after the frontal passage from the 40s and 50s into the 20s. Strong northerly winds gusting to over 45 mph dropped wind chills below zero. The cold air remained in place while an upper-level storm approached from the west on the 18th. Light freezing rain, sleet, and a bit of snow created traffic problems with very little accumulation. Single digit lows in the northwest combined with strong winds to produce wind chills of 10-15 degrees below zero. High temperatures didn't rise above freezing on the 18th. More light freezing rain and snow moved in on the 19th. Once again the precipitation was light, but the ice made travel treacherous. After a bit more freezing drizzle and freezing fog early on the 20th, skies slowly cleared and temperatures rose into the 30s and 40s.

February 21-25: This period accounted for the only significant wet weather during the month. The first couple of days were gray and cool with scattered drizzle and highs mostly in the 40s. A slight warm-up occurred the next two days with intermittent periods of light rain before an upper-level storm moved into the area on the 25th. Moisture was carried northward on strong southerly winds, providing sufficient moisture for a few heavy rain showers in the extreme south. The Mesonet sites at Antlers, Durant, Hugo, and Idabel all recorded more than an inch of rainfall.

February 26-28: The rainfall ended as high pressure settled over the state. Sunny skies and a significant warm up found temperatures rising into the 80s by the end of the month. Strong southerly winds and the low humidity combined to exacerbate the ongoing wildfire problem as February ended.

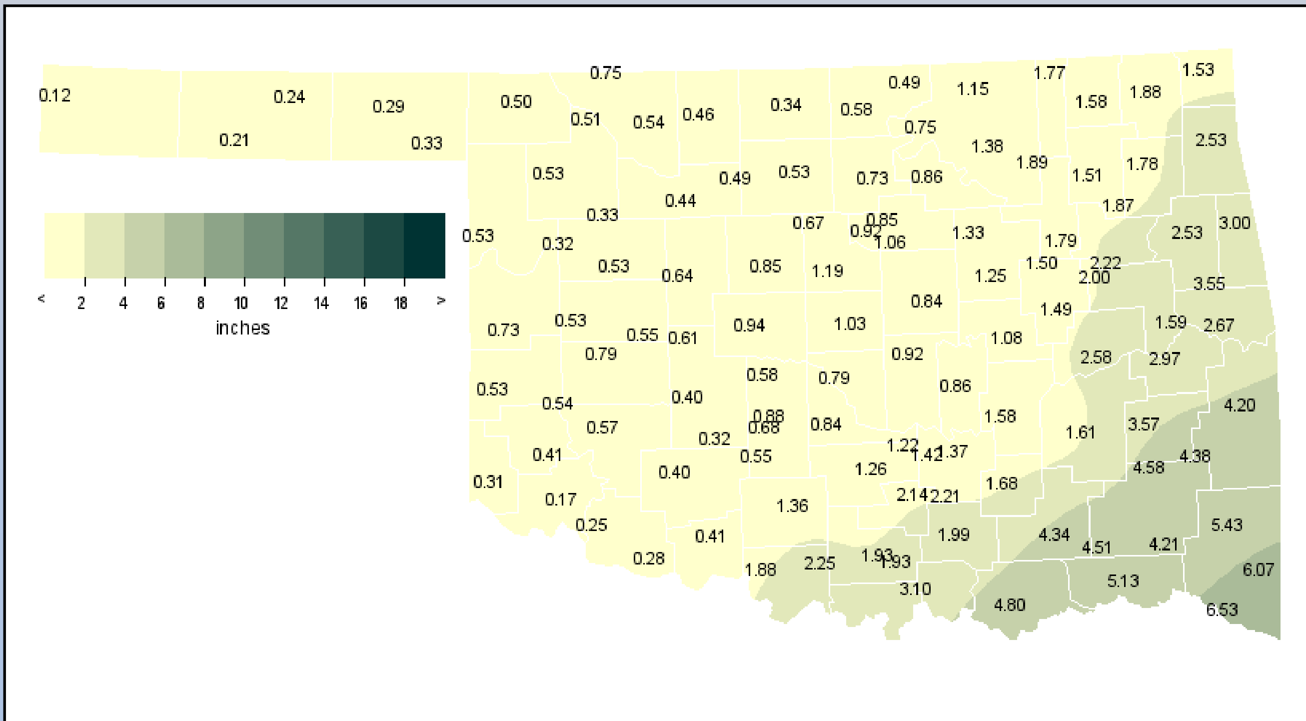
Winter 2005-2006 Statewide Extremes

Description	Extreme	Station	Date
High Temperature	90ºF	Hollis	Feb. 28th
Low Temperature	-15ºF	Kenton	Dec. 8th
High Precipitation	6.53 in.	Hooker	
Low Precipitation	0.12 in.	Kenton	

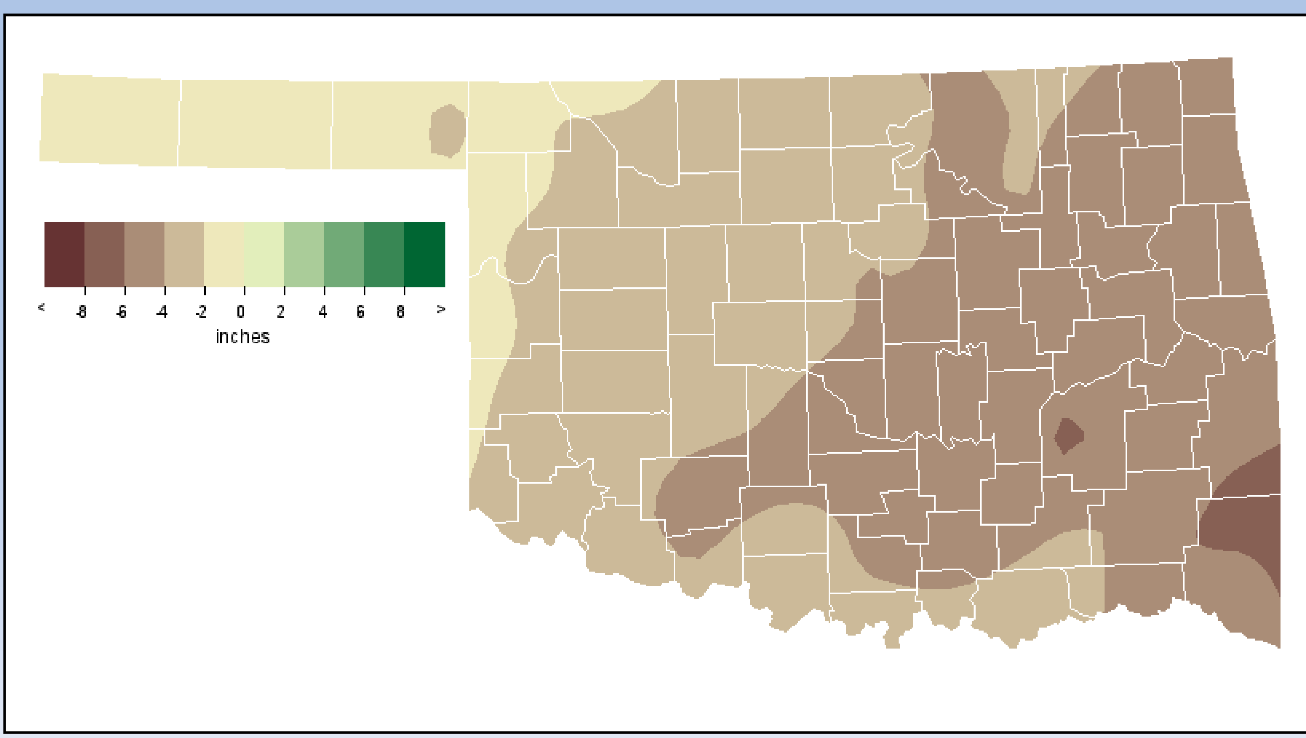
Winter 2005-2006 Statewide Statistics

	Average	Depart.	Rank (1892-2005)
Temperature	41.8ºF	3.0ºF	13th Warmest
	Total	Depart.	Rank (1892-2005)
Precipitation	1.46 in.	-3.77 in.	2nd Driest

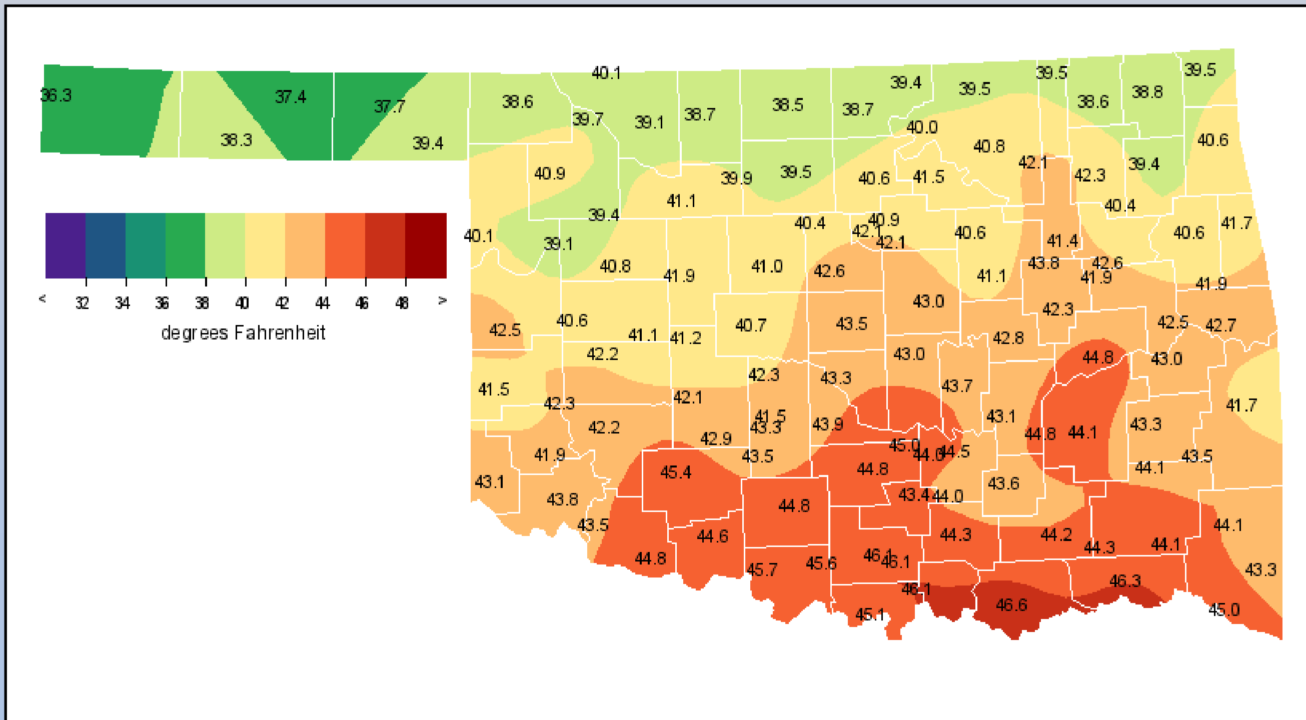
Observed Rainfall



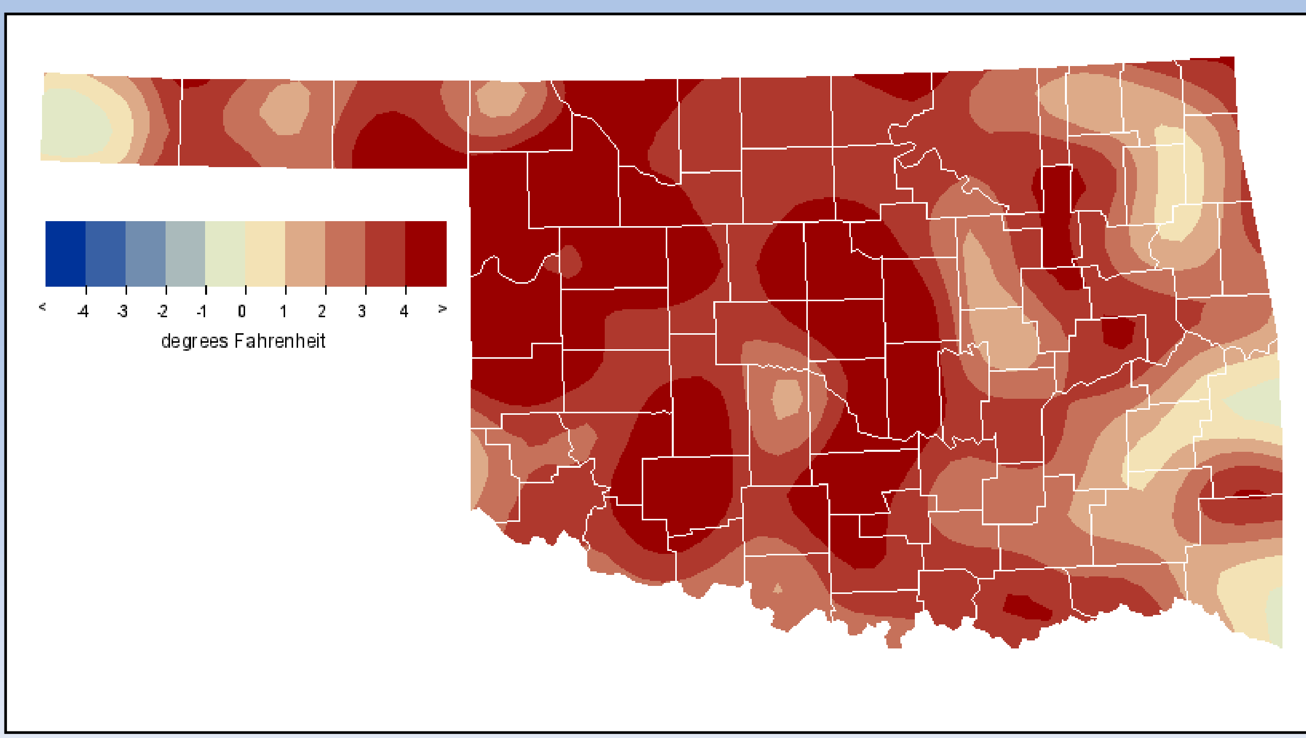
Rainfall Departure from Normal



Average Temperature



Temperature Departure from Normal



Winter 2005-2006 Mesonet Precipitation Comparison

Climate Division	Precipitation (inches)	Departure from Normal (inches)	Rank since 1895	Wettest on Record (Year)	Driest on Record (Year)	2005
Panhandle	0.32	-1.54	3rd Driest	5.13 (1960)	0.10 (1904)	2.38
North Central	0.52	-2.93	1st Driest	7.78 (1985)	0.55 (1909)	4.76
Northeast	1.63	-4.20	1st Driest	15.24 (1985)	1.94 (1918)	7.62
West Central	0.57	-2.59	3rd Driest	7.83 (1960)	0.21 (1909)	3.93
Central	0.91	-4.33	2nd Driest	13.80 (1985)	0.38 (1909)	5.65
East Central	2.26	-5.28	2nd Driest	14.59 (1938)	1.97 (1918)	9.00
Southwest	0.38	-3.39	2nd Driest	9.05 (1985)	0.14 (1909)	4.09
South Central	2.18	-4.46	9th Driest	13.36 (1998)	0.53 (1909)	6.89
Southeast	4.86	-5.16	8th Driest	20.47 (1932)	3.13 (1963)	10.22
Statewide	1.46	-3.77	2nd Driest	10.37 (1985)	1.24 (1909)	6.02

Winter 2005-2006 Mesonet Temperature Comparison

Climate Division	Average Temp (F)	Departure from Normal (F)	Rank since 1895	Hottest on Record (Year)	Coldest on Record (Year)	2005
Panhandle	38.3	2.9	14th Warmest	40.1 (2000)	27.1 (1899)	38.7
North Central	39.7	3.3	14th Warmest	43.0 (1992)	27.5 (1979)	38.7
Northeast	40.5	2.8	15th Warmest	43.9 (1932)	29.4 (1979)	41.0
West Central	41.3	3.8	9th Warmest	43.4 (1992)	29.5 (1979)	40.6
Central	42.3	3.2	10th Warmest	44.7 (1992)	30.8 (1905)	41.9
East Central	42.9	2.7	14th Warmest	45.6 (1932)	32.7 (1978)	43.3
Southwest	43.2	3.2	11th Warmest	44.9 (1952)	32.4 (1899)	42.5
South Central	44.9	3.0	13th Warmest	47.6 (1952)	34.7 (1905)	44.6
Southeast	44.0	1.8	28th Warmest	48.4 (1932)	35.3 (1978)	44.3
Statewide	41.8	3.0	13th Warmest	44.0 (1992)	31.2 (1905)	41.7

Winter 2005-2006 Mesonet Extremes

Climate Division	High Temp	Day	Station	Low Temp	Day	Station	High Monthly Rainfall	Station	High Daily Rainfall	Day	Station
Panhandle	87	Feb 28th	Buffalo	-8	Dec 8th	Hooker	0.53	Arnett	0.21	Jan 10th	Arnett
North Central	87	Feb 28th	Seiling	-4	Dec 8th	Newkirk	0.75	May Ranch	0.34	Dec 17th	Lahoma
Northeast	81	Feb 28th	Pawnee	-7	Dec 9th	Vinita	2.53	Jay	1.00	Jan 28th	Porter
West Central	87	Jan 3rd	Camargo	-4	Dec 8th	Camargo	0.79	Bessie	0.30	Dec 17th	Watonga
Central	84	Feb 28th	El Reno	-3	Dec 9th	Bristow	1.33	Oilton	0.56	Jan 28th	Okemah
East Central	80	Feb 16th	Webber Falls	-3	Dec 9th	Okmulgee	3.55	Cookson	1.82	Jan 28th	Cookson
Southwest	90	Feb 28th	Hollis	1	Dec 8th	Hinton	0.61	Hinton	0.23	Jan 22nd	Hinton
South Central	85	Feb 28th	Waurika	0	Dec 9th	Vanoss	4.80	Durant	1.67	Jan 28th	Lane
Southeast	82	Dec 3rd	Hugo	1	Dec 9th	Wister	6.53	Idabel	2.02	Jan 22nd	Broken Bow
Statewide	90	Feb 28th	Hollis	-15	Dec 8th	Kenton	6.53	Idabel	2.02	Jan 22nd	Broken Bow

AGRICULTURE WEATHER WATCH

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

A drought of historic proportions has settled in across Oklahoma. It has been so dry, for so long, folks are beginning to forget what rain looks like. Will it rain again? Yes, it will, but we appear to be in the midst of a long waiting game.

While sunny, warm days inspire us to look towards a new spring and summer growing season, passing by a wheat field can make one want to weep. Green plants can be seen in field after field, but the greenery is very sparse. Some wheat fields look like they did last October. They have narrow rows of green between large expanses of bare soil. Farmers have lost the pasture value of these fields. Now they face the possibility of so little grain, it may not pay to run a combine through the field.

Oklahoma farms and ranches are looking at moving into spring with no water in the soil profile. This makes planting any non-irrigated crop a gamble worse than the Oklahoma Lottery. Without any water in the soil,

there is no moisture to act as a buffer between rains. This means crops will only do as well as the rain that falls on the field will allow. If a crop goes through a stage where more moisture is needed than comes from recent rainfall, stress will occur quickly. Typically moisture collected during the winter is available for uptake to help crops through times of less than adequate rainfall. In a year like this one with no soil moisture to draw on, plants under water stress will fail. They may fail to pollinate, fail to fill grain, or fail to live.

This will be a year that tests the most stalwart farmer and rancher. Farm income will be low and expenses high. This is not a time for the feint of heart.

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.

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

MARCH

- Before you do any garden or yard tasks, WATER, WATER, WATER. Without watering first, planting a tree or trying to weed will only be an exercise in frustration. You won't be able to do the job right and you'll feel like your breaking rocks, instead of tilling soil.
- This is an excellent month to plant trees and deciduous shrubs. This can help you tame the "planting bug." You'll have something to plant that can handle those late March frosts and help you avoid planting your annual flowers too early.
- Fill in shady lawn areas by seeding with a blend of tall fescue and Kentucky bluegrass.
- Divide and replant summer-flowering perennials.
- Trim liriope, commonly referred to as monkey grass by hand clipping or with a high set mower in early March.
- Control weeds in flower beds.
- Spread compost or aged manure.
- Plant frost tolerant vegetables, such as beet, broccoli, cabbage, carrot, Swiss chard, kohlrabi, lettuce, onion, green peas, potato, radish, spinach, and turnip.
- Make plans for perennial and annual flower beds.

APRIL

- After mid-April, there is little danger of frost for most of Oklahoma. This is an excellent time to make a trip to your favorite nursery for perennial plants.
- This is the month for planting evergreen shrubs. Planting in April avoids March frosts that can damage young emerging shrub foliage.
- Apply a labeled fungicide to pine trees to control the devastating foliage disease, Diplodia Tip Blight. Make the first application when pine tip candles have expanded to half their full size. When the disease is severe, make three applications at 10-14 day intervals.
- In the garden, set out tomato, pepper, and eggplant transplants. Plant sweet corn during the last week of March or in early April. Lima bean, green bean, cucumber, and squash do better once warmer temperatures arrive, typically after April 10.
- In the later part of April, fertilize bermudagrass turf areas with one pound of actual nitrogen per 1,000 square feet of lawn area. For zoysiagrass, cut this rate in half.

MAY

- Early May is a super time to plant all of those heat loving annuals. These plants like the warmer soil temperatures that come with warmer May weather. While you're picking out flowering plants at your favorite nursery or garden center, remember to purchase some colorful foliage plants, too. Coleus is one of the most colorful foliage annuals. Coleus are easy to grow and there are varieties for sunny or shady locations.
- Vegetables that do best planted in May, when soil temperatures are close to 70∞F, include okra, southern pea, sweet potato, cantaloupe, and watermelon.
- Bermudagrass will be ready for its second fertilizer application in late May. Consider using a slow release material that will provide more uniform growth and color, while reducing the risk of nutrient runoff.
- After mid-May, soils typically are warm enough to seed bermudagrass or buffalograss.
- After warm-season lawns have "greened-up" and "filled-in," control broadleaf and grassy weeds with the appropriate weed control material.
- Clean out the water garden. Divide and repot water garden plants.

RAINFALL

Andrea Melvin

Rainfall is an extremely important variable for the farming communities of Oklahoma. They need to know whether or not they can expect too little rain or too much rain, which will affect their ability to produce a large crop. Generally, they are looking for trends or patterns in the data over the past few years. Weather is a cyclical process. We tend to experience a block of dry years followed by a block wet years. How long the “blocks” last can differ from decade to decade. But just because in the last 9 years an area experiences rainfall amounts of 20 inches doesn’t mean year number 10 also will be 20 inches.

How do you know if today’s weather is an extreme event? You must compare today’s weather to all recorded weather events or the climate record for your area. The longer the weather data has been collected the more values you have to compare. It is much easier to compare an average value, which represents the climate record to today’s weather value. The problem with averages is that they hide the extreme events.

Let’s work through a simple example before we tackle the entire rainfall record of Oklahoma. In your math class, you have five grades (i.e. your climate record). The values are 100, 80, 98, 90, and 65. You just received your final exam grade of 79. Will this final exam help or hinder your overall average?

First, calculate your average score for your five grades. Add up the five values. Divide by five (the total number of scores). Your average is 86.6. Don’t rely on my computations. Do the math yourself. It is math class after all.

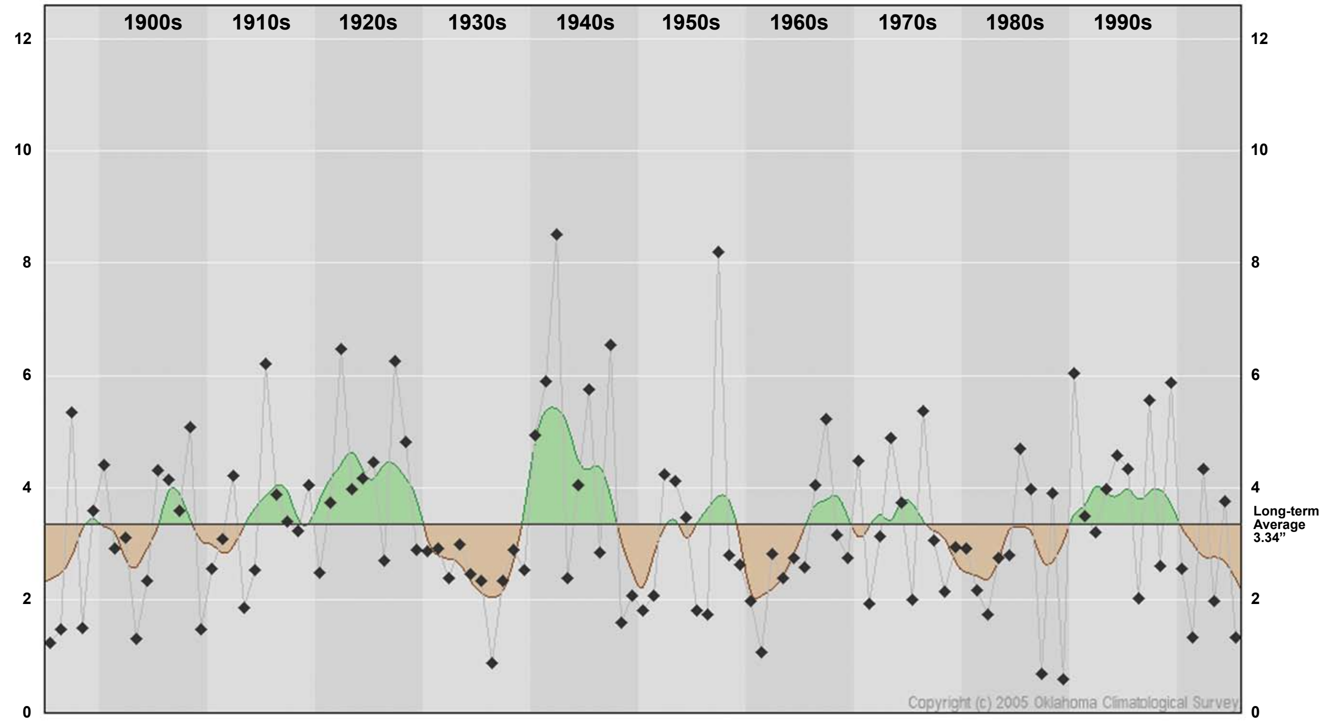
Your final grade of 79 is below your average. Would averaging in a grade of 79 increase of decrease your average? Quickly recalculate to find out.

What happens to your average if your score of 65 was 85 instead?

If all you knew about your scores was your average and your final exam score, what can you say about the two values? Did you score higher or lower than your average? Can you tell just from the average whether a score of 79 is the highest or lowest score you have ever received? No. You have to look at all of the values that make of the 86.6 average to see if 79 is an extreme values (highest or lowest) or if it fits right in the middle of your range of values.

Climate averages are a great tool. But they don’t tell the whole story. In the classroom activity, let’s look at the precipitation climate record for Oklahoma Aprils.

Figure 1



April Rainfall History with 5-yr Weighted Trends
Climate Division 10 (Statewide) 1895-2005

Table 1

Year	Apr	Year	Apr	Year	Apr	Year	Apr	Year	Apr	Year	Apr
1895	1.23	1900	4.4	1910	2.55	1920	2.5	1930	2.88	1940	4.94
1896	1.48	1901	2.93	1911	3.08	1921	3.73	1931	2.93	1941	5.9
1897	5.34	1902	3.12	1912	4.21	1922	6.46	1932	2.4	1942	8.5
1898	1.51	1903	1.31	1913	1.87	1923	3.97	1933	2.99	1943	2.39
1899	3.59	1904	2.34	1914	2.52	1924	4.17	1934	2.47	1944	4.03
		1905	4.32	1915	6.21	1925	4.46	1935	2.35	1945	5.74
		1906	4.14	1916	3.87	1926	2.71	1936	0.88	1946	2.85
		1907	3.58	1917	3.4	1927	6.25	1937	2.35	1947	6.53
		1908	5.07	1918	3.23	1928	4.82	1938	2.9	1948	1.6
		1909	1.48	1919	4.03	1929	2.89	1939	2.54	1949	2.06

Year	Apr	Year	Apr	Year	Apr	Year	Apr	Year	Apr	Year	Apr
1950	1.82	1960	1.98	1970	4.48	1980	2.93	1990	6.03	2000	2.56
1951	2.07	1961	1.07	1971	1.92	1981	2.17	1991	3.5	2001	1.32
1952	4.24	1962	2.83	1972	3.12	1982	1.75	1992	3.2	2002	4.32
1953	4.12	1963	2.39	1973	4.87	1983	2.74	1993	3.96	2003	1.99
1954	3.48	1964	2.75	1974	3.74	1984	2.8	1994	4.57	2004	3.75
1955	1.81	1965	2.57	1975	2	1985	4.69	1995	4.34	2005	1.33
1956	1.74	1966	4.04	1976	5.37	1986	3.97	1996	2.02		
1957	8.18	1967	5.22	1977	3.07	1987	0.69	1997	5.55		
1958	2.8	1968	3.17	1978	2.14	1988	3.91	1998	2.6		
1959	2.62	1969	2.76	1979	2.95	1989	0.58	1999	5.86		

CLIMATE TRENDS EXERCISES

The following table contains the statewide-averaged precipitation for each April from 1895-2005, a span of 111 years. The data are the same that make up the graph seen in Figure 1. The long-term average for April precipitation (the average value of these 111 values) is 3.34 inches.

Exercises:

1. What was the average April rainfall during the 1940s (1940-1949)? Is this above or below the long-term average? By how much?

2. Would you describe the 1940s as having generally wet Aprils, average Aprils, or dry Aprils? Did every individual April in this decade match this description?

3. What was the average April rainfall during the 1950s (1950-1959)? Is this above or below the long-term average? By how much?

4. At first glance, the average April rainfall during the 1950s is very close to the long-term average. Would you say this description fits all of the 1950s Aprils?

5. 1957 featured the second-wettest April on record. What happens to the decade's average April rainfall when the 1957 value is removed? Without the 1957 value to influence the average, would you still describe the decade's rainfall as "near average"?

6. Count the number of Aprils in the climate record with above-normal rainfall. Subtract this number from 111 to determine the number of Aprils with below-normal rainfall. Are these numbers equal?

7. ***(advanced)*** Well more than half of the Aprils in this record feature below-average rainfall. What does this say about rainfall patterns in April?

OCS ATTENDS AMS

The American Meteorological Societies 2006 Annual Meeting

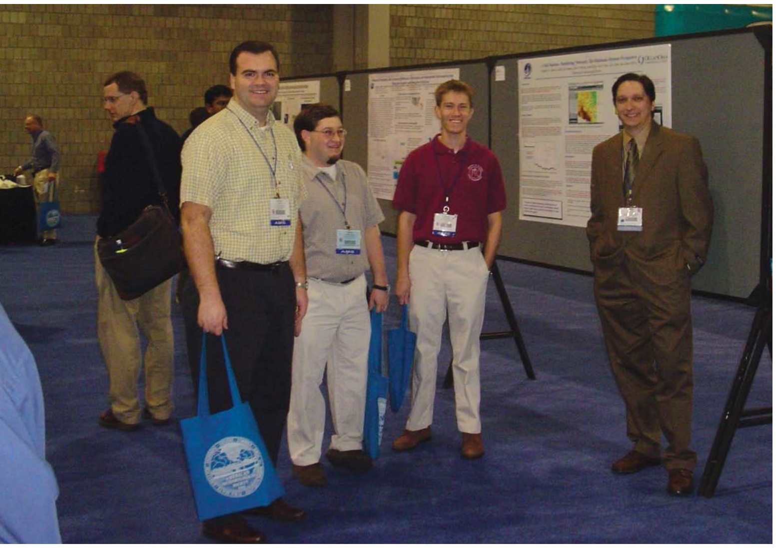
by Cerry Leffler PR Specialist
Oklahoma Climatological Survey

Faculty, staff, and students from the Oklahoma Climatological Survey (OCS) traveled in mass to the 2006 annual meeting of the American Meteorological Society. Twenty-two members of OCS descended upon Atlanta to present papers and posters in research areas ranging from K-12 science education to weather instrumentation.

Dr. Jeff Basara, Director of Research, traveled with nine staff and students currently under his direction. Analysis of soil moisture networks, impacts of controlled burns on the atmosphere, and the Oklahoma City Urban Micronet were just some of the topics presented by the OCS Research Team. Members of this group include Brad Illston, Peter Hall, Danny Cheresnick, Kodi Nemunaitis, Amanda Schroeder, Scott Stevens, James Hocker, and Justin Monroe. The Research Team made an impressive showing at this year's meeting.

Education was the other dominant session for OCS's participation. Such topics as effective approaches to adult learners, the challenges and successes of providing a national replication of honored programs, teaching the teachers (K-12 education), and demonstration of modern visualization tools for K-12 students, were welcomed and well-attended presentations. Andrew Reader, Andrea Melvin, Dale Morris, and Dr. Renee McPherson were on hand to deliver these insightful talks.

Besides education and research, OCS was represented in the Policy Forum and the 10th Symposium on Integrated and Assimilation Systems for the Atmosphere, Oceans, and Land Surface (IASA). In the IASA symposium, the OCS Portable Automated Research Micrometeorological Stations (PARMS) we introduced to a vast audience. PARMS are scaled down versions of Mesonet environmental observing sites to be used to gather more localized data. PARMS can be moved in standard pick-up trucks and can be stations on a relatively small area of land.



Kenny Tapp, Danny Cheresnick, and James Hocker stop to provide moral support for Brad Illston while he presented his poster titled "A Soil Moisture Network: The Oklahoma Mesonet Perspective".

Dr. Renee McPherson, Acting Director, OCS helps Boy Scout Troop 124 earn their weather badge.

WeatherFest 2005, held in conjunction with the AMS annual meeting, offers opportunities for the next generation of meteorologists scientists to interact with scientists. Dr. McPherson assisted a Boy Scout troop from Georgia with qualifying for their weather badge. Not only was she able to put together a few hands-on experiments for the scouts, but she was able to utilize WeatherFest to complete the learning experience.

The main social event (and becoming one of the most popular among AMS attendees) is the University of Oklahoma (OU) reception that is held each year. This offers a chance for OCS, OU, and Norman representatives to mix and mingle, cultivate new friends and partnerships, and show off all that is good in Oklahoma. After days of presenting papers and posters, recruiting new students, and bridging collaborative efforts, this is the perfect way to end the day.

In the end, it was a good week for OCS professionally, intellectually, and socially. For more information about AMS, and a list of dates for other meetings hosted throughout the year, you can go to www.ametsoc.org.

Dan Sutter, Professor of Economics at OU, Dr. Mark Shafer, and Dale Morris relax and enjoy refreshments at the OU reception in Atlanta.

John Ritz, Development Office for College of Earth and Energy, and Dr. John Snow, Dean of the College of Atmospheric and Geographic Sciences enjoy the fun for which they have created.

OCS, College of A&GS students, and friends meet up at the annual event for food, drink and interesting conversation.

FLASH FLOOD
SAFETY • TIPS

STOP

From the Norman National Weather Service Forecast Office:

- Flash Floods develop quickly.
- They can occur anywhere, along rivers or creeks, in low water crossings or in a dry stream bed.
- They can occur during any month and at any time during the day. In fact, flash floods often occur at night when it is difficult to find an escape route.
- Flash floods can be deceptive. Flood waters are likely deeper and moving faster than you think.

When driving:

- Avoid low water crossings.
- Use alternate routes to avoid flood prone areas.
- Leave your vehicle immediately if it stalls in flood waters.
- Move to higher ground if you can do so safely.
- Most cars and light trucks will begin to float in as little as 12to 2 feet of water.

- **Act quickly: Rising waters make vehicle doors difficult if not impossible to open.**

If you are outside:

- Everyone, especially children, should stay away from flooded creeks, streams or drainage ditches.
- Swiftly flowing water can quickly sweep away even the strongest swimmers.
- Soggy banks can collapse, dumping you into flood waters.

OKLAHOMA
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