OKLAHOMA CLIMATE

Summer 2007

Historical Perspective

Sweltering

BUT IN A UNIQUE WAY

Feature Stories

OKLAHOMA SQUALL LINES

Extreme Weather

Myths and Myth-Conceptions

Goldie Locks Doesn't Have Anything on Oklahoma Wheat Producers

Also Inside

- Spring 2007 Summary
- Agweather Watch and Urban Farmer
- Classroom Activities

Oklahoma Climate Spring 2007

Cover Photo: by Stdrovia Blackburn. If you have a photo that you would like to be considered for the cover of Oklahoma Climate, please contact Gary McManus at gmcmanus@mesonet.org.

MESSAGE FROM THE EDITOR

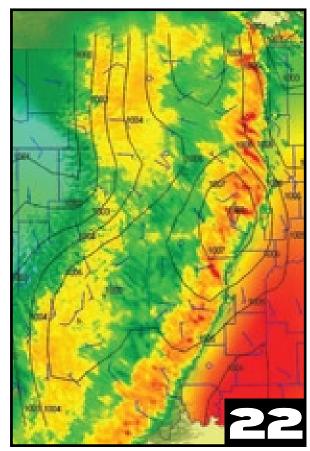
Gary McManus

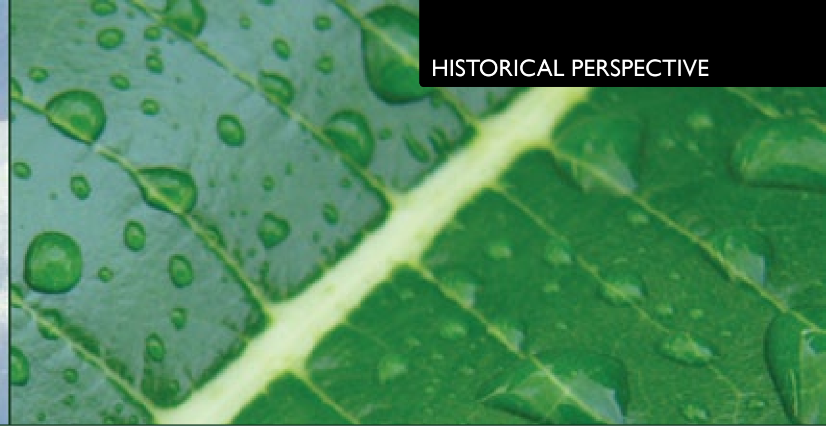
As an agricultural state, Oklahoma understands the difficult row hoed by the American farmer, whose livelihood depends almost entirely upon something that is, in its very essence, unreliable. I'm speaking of course about the weather. We invited Mark Hodges, Executive Director of the Oklahoma Wheat Commission, to illustrate this point by comparing the 2006 and 2007 winter wheat harvests. Winter wheat is Oklahoma's most important crop, and its success relies heavily on the precipitation it receives throughout its life cycle. Obviously drought can be disastrous, as shown by the 2006 harvest which has been deemed the state's worst in the last 50 years. Fast-forward to 2007 and the heavy rains that fell through the first six months – a boon to this year's crop? Well, not quite. As it turns out, it's all in the timing. Read the feature article to learn more about how these two climate extremes managed to produce somewhat similar results.

We also continue our centennial weather series with a look back at 100 years of Oklahoma summers. Most of us probably think summers come in two varieties – hot or hotter. That's not entirely the case, however. Believe it or not, cool and wet summers have happened on occasion in our state's past. Another feature article details the climatology of Oklahoma squall lines. This is a fascinating look at this particular severe-weather producer, a necessary component of our hydrologic cycle. Finally, our third feature article tries to tackle some of the more common summer weather myths flying around out there. Remember to think twice before you grab that Gatorade this summer!

Our classroom exercise allows students to play in the mud as they investigate soil moisture values from the Oklahoma Mesonet. In addition, be sure to read our regular features dealing with agricultural weather, weather safety, a weather summary of the previous three months, and a photo section portraying the flood conditions found across Oklahoma this summer.

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@mesonet.org.





Sweltering

BUT IN A UNIQUE WAY

A century of Oklahoma summers marched to their own (usually very hot) drummer

Derek Arndt Assistant State Climatologist

Ahhhh, summer in Oklahoma: it brings to mind gentle breezes, cool nights, pleasant picnics and babbling brooks … until the oven-hot blast of July wind wakes you up from the daydream. Let's face it: during summer's peak, life can be an endurance test in the Sooner State. But it's not all hot and dry. Sometimes, it's hot and humid. And when it's relatively cool, you can bet that it's downright wet outside. That's the summer life in the middle of a continent.

To describe Oklahoma's summer with one word (besides "hot"), perhaps the most accurate choice is "different". It's true: even beyond the obvious temperature differences, Oklahoma's summer climate patterns are unique. In previous installments of this series, we've highlighted the state's mercurial winters, which are capable of delivering almost anything. And we've visited the famously active patterns of the Sooner Spring. But summer here is altogether different, in that it is typically a one-note tune, repeated for weeks.

The Big Picture

The climatologist's summer comprises the months of June through August. Obviously, these months are the warmest on the calendar. And it's safe to claim that it can get quite hot. Temperatures during summer average around 80 degrees, which may not sound so uncomfortable until we're reminded that the average temperature is just that: the average of the high and low temperature. East of I-35, it's probable, by about 4-to-1 odds, that temperatures will top the century mark during any given summer. In western Oklahoma, triple-digit temperatures are a near certainty. Along the Red River south and west of Lawton, temperatures top 100 degrees more than 30 times per year, on average.

Summer is again different from winter and spring in that it isn't getting any warmer. Figure 1 portrays a fairly level temperature trace; if anything, the season has cooled slightly during recent decades. This tendency is much more pronounced in the southeastern fetches of the state.

Precipitation during summer behaves much differently as well. Rainfall events typically come in large doses, often separated by long periods of time (summer 2007 notwithstanding). For the vast majority of the state, summer precipitation is fleeting, unreliable, and lower in magnitude than that which we receive during spring and fall. The exception to this pattern is the western panhandle – roughly west of Guymon – which is loosely tied to the summer monsoon patterns that pump moisture into the southwest United States. In fact, Cimarron County's three wettest months are June, July and August, unique among Oklahoma's 77 counties.

Persistence and Memory

What makes summer so different? Quite simply, the rules change. Or, maybe it's more accurate to say the rules just go away. During summer, the jet stream, which shepherds the large-scale systems that bring autumn, winter, and spring storms, shifts northward toward the Canadian border. This leaves a vacuum of atmospheric direction that often leaves Oklahoma locked into persistent patterns. When this happens, the configuration of conditions that bring rain or drought take longer to evolve and much, much longer to dissipate. The record-breaking rains of early summer 2007 were an obvious consequence of this tendency for persistence, as were the prolific drought patterns of the previous summer.

Speaking of drought, it is exacerbated by another unique summer characteristic: summer is the only Oklahoma season that shows a strong correlation between temperature and precipitation. In other words, when one changes, so does the other. Wet summers are usually cool summers, and hot summers are almost certainly dry summers. Drought can happen at any time in Oklahoma, but summer droughts bring extreme heat. This correlation was brutally apparent during the cruel summertime conditions of mid-1930s and the mid-1950s, when drought conditions helped thermometers to run amok. On the flip side, it's no coincidence that the coolest July and August of statehood (1950 and 1915, respectively), were also the wettest.

Another unique summer characteristic is the development of a "memory" of sorts over the season. Statistically speaking, throughout the rest of the year, weather during one month doesn't noticeably impact the weather of the next. However, this changes in June, when temperatures are somewhat sensitive to May precipitation. July "listens" to June in the same way, but more acutely. This behavior reaches a peak during August. In fact, the best historical indicator for August temperatures is July precipitation. Bottom line: if July was dry, August will be even hotter than usual.

The Big Events

It goes without saying that the biggest summer events in Oklahoma were non-events, at least from a precipitation perspective. The summers of the mid-1930s and mid-1950s were dominated by drought, and were therefore dominated by heat. The 1934 summer was the hottest overall (average temp: 85.2 F), and 1954 featured the hottest month (July, 88.1 F). However, the most intense heat waves occurred during the

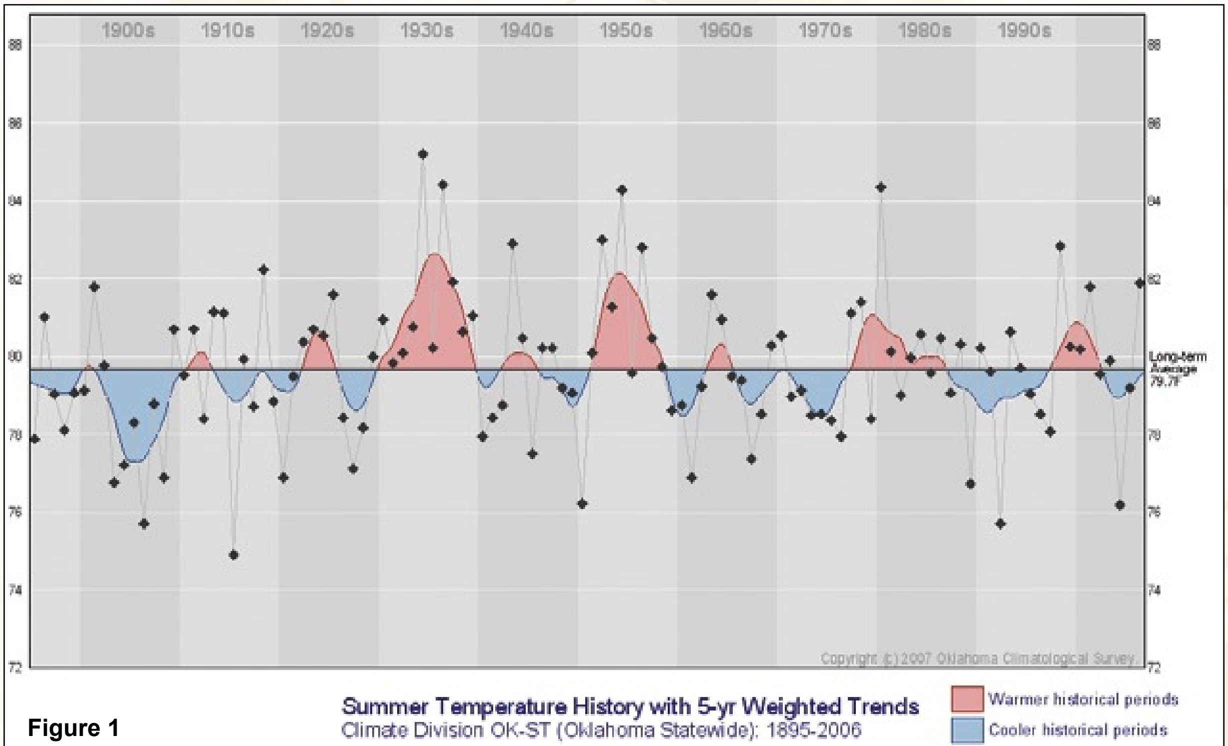


Figure 1

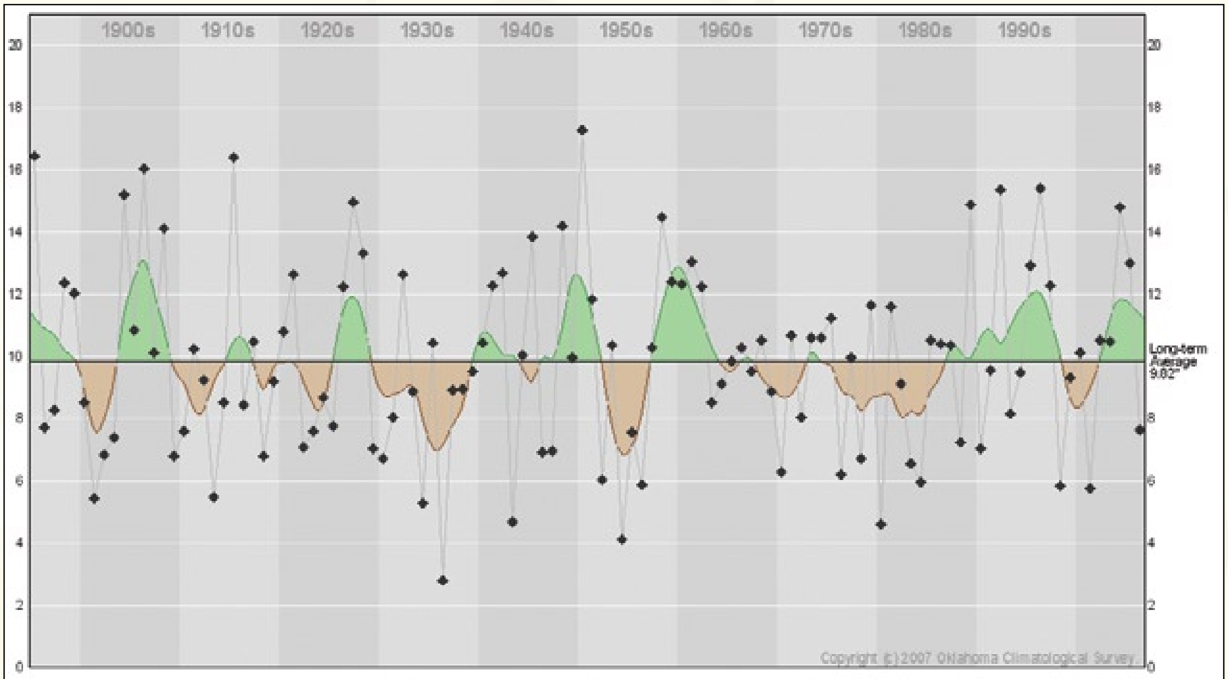


Figure 2 Summer Rainfall History with 5-yr Weighted Trends
Climate Division OK-ST (Oklahoma Statewide): 1895-2006

summer of 1936, when the state's all-time record temperature of 120 F was set ... four times. This mark still stands, having been tied only twice during the 70 subsequent years.

For the state's I-35 corridor, the summer of 1980 might be the most brutal on record. While it never peaked with the extreme heat of 1936, the season was relentless. Healdton recorded high temperatures of 100 or more on 83 days that year. Oklahoma City's summer records are littered with "1980", more so than any other year.

During summer, the danger of severe weather is much lower than during spring, but the season is not immune to local downpours, downbursts and even tornadoes. The state's deadliest summer tornadoes occurred during each of the century's World Wars. On June 1, 1917, much of Coalgate was destroyed by a tornado that claimed 14 lives. June 12, 1942, brought a violent tornado (later estimated to be F4 strength) through southwest Oklahoma City, killing 35. This was the metropolitan area's deadliest tornado for nearly 60 years, until the storm of May 3, 1999, took its place. The 22 tornadoes spawned in nine short hours on June 8, 1974, was the outbreak of record for a quarter-century, until eclipsed by the May 1999 event.

When rainfall comes in heavy summer doses, flooding is a real threat. June has twice delivered calamity to urban Oklahoma City in the form of a swollen North Canadian River, first in 1915 and again in 1923. Engorged by more than a foot of rainfall, the Canadian rose out of its banks near Hydro on June 23-24, 1948, killing 11 along a stretch of U.S. Highway 66.

Summer's most prevalent severe weather threat might just be good, old-fashioned straight-line winds. Downbursts and microbursts are a tangible possibility, even in relatively weak storms. Supercells, while not prolific during summer, are a viable threat. On August 17, 1994, a supercell thunderstorm produced three-inch hailstones driven by 113-mph winds. Several people in Garfield County were treated for hypothermia after being trapped waist-deep in hail ... inside their cars.

The Details

Summer (JJA)	Year	Statistics
Warmest	1934	85.2°F
Coolest	1915	74.9°F
Wettest	1950	17.25 in.
Driest	1936	2.79 in.

June	Year	Statistics
Warmest	1953	84.6°F
Coolest	1982*	72.6°F
Wettest	1908	8.73 in.
Driest	1933	0.46 in.

July	Year	Statistics
Warmest	1954	88.1°F
Coolest	1950*	76.2°F
Wettest	1950	9.26 in.
Driest	1980	0.41 in.

August	Year	Statistics
Warmest	1936	87.2°F
Coolest	1915	73.2°F
Wettest	1915*	6.39 in.
Driest	2000	0.14 in.

* more extreme values were observed during pre-statehood summers

Goldie Locks Doesn't Have Anything on Oklahoma Wheat Producers

Mark Hodges, Executive Director
Oklahoma Wheat Commission

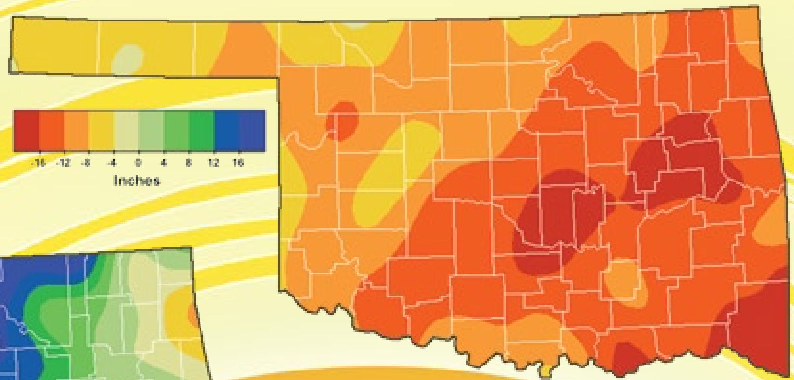
If you are a wheat producer in Oklahoma you certainly could relate to the too hard, too soft, and just right bed analogy in "Goldie Locks and the Three Bears" when it came to precipitation timing and other maladies suffered over the last two years. Of course, depending on where you are located in the state, and the time frame, determined what kind of bed you were sleeping in. During crop year 2006, if you were generally south of I-40 and west of I-35 you had a really "hard bed" in producing 10%-15% of a normal crop with many producers feeling lucky to harvest enough grain for seeding the 2007 crop. Root systems were confined to the upper few inches of the soil profile with little or no secondary root development. Consequently, that already hard bed got even harder when not enough forage was produced or plants weren't anchored sufficiently to allow grazing.

While the situation improved somewhat as one moved northward of I-40 in 2006, there really never was an area we would have called "just right". As harvest arrived (what little there was) we were concerned the toll the climatic conditions might have played on quality. It was a pleasant surprise to see the crop be reported as one of the best milling crops in several years by flour mills (just not enough of it). I have always heard wheat was a dry weather crop, well, maybe not quite this dry!

Enter 2007, if the 2006 crop year was "much too hard" then the 2007 crop could be easily called the crop which was "much too soft", at least in the body of the state. We started with outstanding conditions "just right" for forage production in the Southwest part of the state (where the bed was much too hard in 2006). Contrast that with the top two tiers of Oklahoma counties on the Kansas border not being as lucky with only about a 20% stand as late as early January. Add to that a major ice/snow event in the western Panhandle and things were still a little iffy north of I-40 into the Panhandle. By late March though, the state as a whole was really looking "just right" with good stands in the northern counties and abundant tillering in the Southwest. That bed that now seemed to be shaping up "just right", acquired some major lumps in the first two weekends of April as temperatures dipped well below freezing for several hours, especially in the northern part of the state.

Still reeling from the freeze, many areas of the state were covered with leaf rust (disease) at one of the most vulnerable times in the wheat plants life, and it seemed to happen overnight. Those varieties (Jagger and Jagalene) that were early in maturity or early in breaking winter dormancy and/or were susceptible to leaf rust suffered major damage (created the hardest bed). The further north (with the exception of the Panhandle) one traveled in the state the more pronounced (harder the bed) the problem was expressed. If this weren't enough, Army Head Worms started attacking the crop in isolated areas (unless it was on your farm).

Figure 1 - Departure from normal precipitation from Oct. 1, 2005-June 30, 2006. Note the deficits between 4-16 inches across the wheat-growing areas in the western half of Oklahoma.



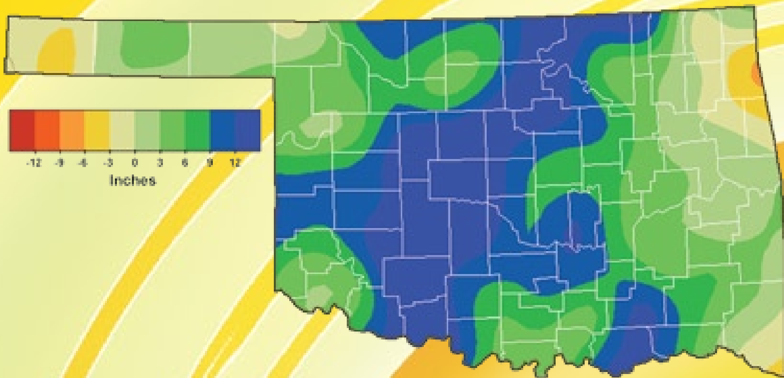
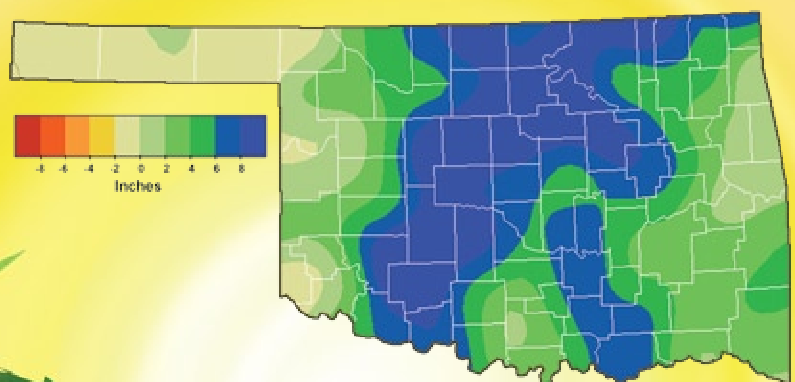


Figure 2 - Departure from normal precipitation from Oct. 1, 2006-June 30, 2007. Surpluses of greater than 12 inches exist across Oklahoma's wheat belt.

Figure 3 - June 2007 departure from normal rainfall. The month was the wettest June on record for Oklahoma and brought the 2007 wheat harvest to a slow crawl.



The final event that really turned the crop of 2007 (with the exception of the Panhandle) into a bed of pure concrete was the relentless rain following the maturity of the crop. The first load of wheat reportedly cut in Oklahoma came from the Grandfield area (Devol) in mid-May. After that forty acre field was cut not much more has been cut in that area and to the east in the following eight weeks. In fact, there has not been much wheat cut in the state (with the exception of the Panhandle) since early June, nor will there be in 2007. To add insult to injury, with a few exceptions in Southwest Oklahoma, test weights and general quality has not been good and won't be on the acres that will be harvested.

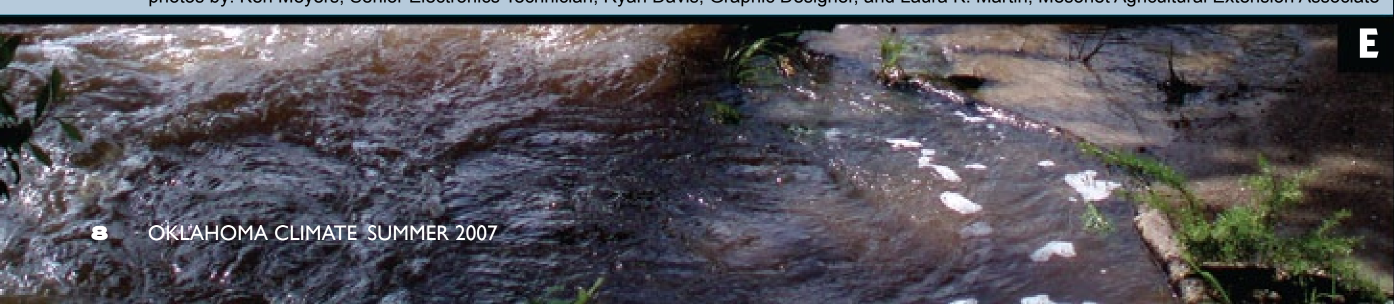
Then there is the Panhandle "JUST RIGHT"; many say a crop of a life-time. High yields and high test weights were very common. Most producers or elevators were not prepared for the kind of crop that emerged, but what a problem to have! The quality of the Panhandle crop was also amazing (with some exceptions in protein), but who would have fertilized for twice a normal yield on so many acres.

So Oklahoma wheat producers (depending on where they live) have experienced the full range of possibilities over the last two years. They will have to depend on the faith and hope many wheat producers have after experiencing the kind of harvest of the last two years…there is "next year", and if the 2008 crop will be "too hard, too soft or just right".

The Mesonet and Oklahoma Climatological Survey are irreplaceable tools in allowing us better understand, assess and respond to our ever changing production environment. The service these organizations provide is an integral part of our relationship and informational network with wheat customers worldwide. The information provided also helps us develop strategies in our marketing plan every year when working with customers.

PHOTOS FROM THE FIELD
Oklahoma Flooded

photos by: Ken Meyers, Senior Electronics Technician, Ryan Davis, Graphic Designer, and Laura K. Martin, Mesonet Agricultural Extension Associate



F

H

G

A: Grady County

B: Grady County

C: Washita River

D: Blue River

E: Blue River

F: Grady County

G: Flooded street in Claremore

H: Flooded street in Claremore

Extreme Weather

Myths and Myth-Conceptions

Andrea Melvin: Outreach Programs Coordinator • Gary McManus: Assistant State Climatologist

As with any type of myth or legend, those of the weather variety can be quite entertaining. Who knew that sticking a knife in the ground in front of a tornado would cause it to split and bypass your area? Of course, with Oklahoma's proclivity for weather extremes, some of those myths can lead to disaster if taken at face value. When it comes to weather safety, it's always important to separate fact from fiction. Since we're in the dog days of summer, let's concentrate on some of the factoids you may have heard about our dreaded summer heat. And remember, if a tornado hits while you are reading this, don't bother opening any windows...**TAKE COVER IMMEDIATELY!**

True or False:

Grab a sports drink to beat the heat.

- **True!** But only if you are an athlete. Sports drinks are made for athletes who sweat a lot in hot weather. Most people don't need the special electrolyte balance, and the sugar in the drinks might make you feel thirstier. Your best bet is chilled water.

True or False:

Don't worry about the medicines you normally take.

- **False!** According to the American Academy of Family Physicians, there are quite a few medications that can make it more difficult to control body temperature. Before spending a lot of time in the heat, be sure to ask your doctor or pharmacist about this possible side effect.

True or False:

During a heat wave, Oklahomans cope better than New Yorkers.

- **True!** After spending a lot of time in hot weather, people acclimate to it and find it less bothersome. This is why more people die in heat waves in Northern cities – they simply aren't accustomed to the blistering temperatures (Oklahomans probably wouldn't want to experience a Northern winter, either).

True or False:

If a person is still urinating, they have nothing to worry about.

- **False!** It's a common misconception that heat exhaustion and heat stroke are only serious when the kidneys stop producing urine. Waiting for that to happen can be a deadly mistake. Instead, be on the lookout for the early warning signs – dizziness, exhaustion, confusion, lack of appetite, headache, and excessive thirst.

True or False:

Dry heat is better than humid heat.

- **True (sort of)!** When sweating in a dry heat, the moisture on skin will evaporate and help cool the body. In humid air, it gathers on the skin and contributes to that sticky feeling. However, perspiring a lot in dry air still means you are losing a lot of fluid, and you need to replace it quickly.

True or False:

If I feel like I'm about to pass out from the heat, I should find the nearest body of water and jump in.

- **False!** This may be tempting, but if you have any of the signs of heat stroke, don't try to self-treat. Get medical treatment. Heat stroke often causes neurological symptoms that lead to poor decisions.

SPRING 2007 SUMMARY

By: Gary McManus

Prodigious rainfall amounts propelled the spring to the 20th wettest since 1895. That lofty ranking comes despite dry conditions in eastern Oklahoma. The season finished similarly above normal in temperature, ranked as the 21st warmest, due mainly to the 2nd warmest March on record. That early warmth had disastrous consequences for parts of the agricultural community. The warm weather meant early maturation for many of the state's crops, including winter wheat and grapes. A fierce stretch of cold weather in April dropped temperatures into the mid-20s in the northern half of the state, significantly damaging portions of those crops. Preliminary reports indicate 22 tornadoes touched down in the state during spring, well below the seasonal average of 35. The most powerful of those twisters was rated as an EF-3 on the Enhanced Fujita scale, striking and destroying the local school in the small town of Sweetwater. Unfortunately, the state's first tornado fatalities since April 2001 occurred on March 28 near the small town of Elmwood in Beaver County. A tornado struck a residence in that area, killing both people inside. May was the most active month for severe weather, which is normal for Oklahoma. Tornadoes, large hail and widespread flash- and river-flooding were common throughout the month.

Precipitation

The central areas of the state, from the western border to the northeast, were the wettest regions during spring. Central Oklahoma itself averaged over 17 inches of rain during the three-month period, nearly five inches above normal, ranking as its 4th wettest spring on record. West central and north central Oklahoma also enjoyed abundant surpluses, ranking as the 4th- and 8th-wettest springs, respectively. Not all areas of the state were as fortunate, however. The southeast and east central portions of the state had deficits of several inches for the season and ranked as the 34th- and 23rd-driest on record. The Oklahoma Mesonet site at Burbank recorded the most precipitation for the spring at nearly 23 inches. In contrast, Boise City had a meager 3.5 inches in comparison.

Temperature

For only the second time since records began in 1895, the statewide average temperature during March was warmer than that of the following April. March was nearly eight degrees above normal, which was followed by an April nearly four degrees below normal. Combined with a mildly warm May, the season finished between 1-2 degrees above normal. The highest temperature during the spring, 93 degrees, was reported by the Oklahoma Mesonet site at Altus on May 4. The lowest temperature of 11 degrees came in from Oilton on March 4.

March Daily Highlights

March 1-3: The month's beginnings found the state clear and cool following a cold front on the previous day. Lows were mainly in the 30s with a few 40s. A cold dry air mass in the afternoon produced brisk northerly winds and high temperatures in the 50s and 60s. The next two days were similar with gusty northerly winds and seasonal temperatures. Highs on the 3rd were a bit cooler, remaining in the 40s.

March 4-8: A nice warm up over the next five days meant for very pleasant weather. Lows were cool on the 4th, dropping into the teens and 20s, but the rest of the period found high temperatures in the 70s and lows generally in the 30s and 40s. A weak cold front on the 7th did little to cool temperatures as highs were in the 60s in the front's wake.

March 9-13: The first rainy period of the month, an upper-level disturbance moved across Oklahoma on the 9th bringing thunderstorms with light rain to southeastern Oklahoma. Clear skies and light winds followed the front on the morning of the 10th with temperatures in the 30s and 40s. Another approaching upper-level storm brought cloudiness and southeasterly winds of 10-15 mph which helped to warm temperatures into the 70s. Storms erupted in the west that evening and moved east. Areas with rain struggled to reach high temperatures in the 60s, while other areas were in the 70s. The next two days found mostly cloudy skies and highs in the 60s and 70s to go along with a few scattered storms. High temperatures remained in the 60s and 70s.

March 14-18: Quiet conditions returned on the 14th with low temperatures in the 50s to go along with light winds. A cold front entered the northwest later that afternoon. Highs reached the 80s ahead of the front but remained in the 60s behind the boundary. Very light rain fell on the morning of the 16th in southern Oklahoma, which gave way to clear skies and chilly north winds. Lows were in the 30s and 40s and rose into the 50s and 60s in the afternoon. The surface high pressure system that followed behind the front moved east on the 17th, allowing a return of southerly winds which gusted to over 25 mph. Highs reached into the 70s and 80s on the strength of those winds. High temperatures were in the 70s and 80s across the state. Slapout reached 90 degrees, tying for the state's highest temperature of the month.

March 19-21: The moisture interacting with the stalled cold front in northern Oklahoma meant rain for that part of the state. The 19th was merely a prelude with light showers in the area to go along with strong southerly winds and highs in the 60s. South of the front, the high temperatures in the humid air mass rose into the 70s and 80s. The 20th was the breakout day for the precipitation. Storms fired along the cold front and continued to move east over the same area. The Oklahoma Mesonet site at Foraker recorded over five inches of rain, with an unofficial report of nearly seven inches by a spotter in Newkirk. Flash flooding was widespread in Kay County. The warm southerly flow continued on the 21st. Winds gusted to 45 mph in the west associated with a dryline. Clouds decreased in the afternoon and high temperatures rose into the 80s.

March 22-25: Another round of showers and storms moved over the state from the southwest, fueled by the continuing moist flow from the south. The storms dumped between 1-3 inches from west central through northeast Oklahoma. The showers and storms continued into the 23rd with over an inch of rain falling in the western Panhandle. Highs were in the 70s and 80s during this period with low temperatures remaining well above normal in the 60s. More storms formed across the northwest in the pre-dawn hours of the 24th. The Oklahoma Mesonet site at Woodward recorded a wind gust of 82 mph to go along with reports of power line and roof damage. The 25th brought a lull in the precipitation. Lows were in the 50s and 60s throughout this period and high temperatures were in the 70s and 80s as the warm and moist air flow from the south continued unabated.

March 26-27: An upper-level storm moved over the state during the 26th and 27th, bringing more showers and thunderstorms. Most amounts were less than an inch with very little severe weather reported. The strong southerly winds continued with temperatures rising from the 50s and 60s in the morning to the 60s and 70s during the day.

March 28-31: One of the wettest and stormiest periods in quite some time saw the return of deadly tornadoes to Oklahoma to go along with significant drought-busting rainfall. A powerful upper-level storm approached the state from the Four Corners area, setting up a classic springtime system. The storms struck the west on the 28th. A supercell moving north out of the Texas Panhandle slammed into the Oklahoma Panhandle, producing two EF2 (Enhanced Fujita) tornadoes in Beaver County. One of those tornadoes struck a home near Elmwood, killing both residents inside. Storms popped up in southwestern Oklahoma on the 29th, moving northeast over central Oklahoma. A thunderstorm dropped an EF2 tornado along the Canadian/Oklahoma County line, doing extensive damage to areas of west and northwest Oklahoma City. Two more tornadoes were reported on the 29th. An EF1 tornado touched down in Blaine County near Okeene while a weak EF0 twister struck in Garfield and Grant counties. The storms on the 30th into the early morning hours of the 31st dropped more heavy rain in Oklahoma creating extensive river- and flash-flooding. Flooding was reported in nearly all the state save the eastern one-third. A cold front swept through the state on the 31st as the upper-level storm exited the area. Lows on the month's final day were in the 40s and 50s, and highs were in the 60s.

April Daily Highlights

April 1-2: Near-perfect weather graced the month's first two days with sunny skies, light winds and unseasonably warm temperatures as highs rose into the 70s and 80s.

April 3-9: A cold front entered northwestern Oklahoma on the 3rd, vanquishing the pleasant weather as it passed. Lows in the 50s and 60s failed to rebound much after the front's passage, but areas south of the boundary rose into the 80s once again. Skies remained clear for the first two days, finally clouding up on the 5th with the arrival of an upper-level storm system. Temperatures remained unseasonably cool for the next few days, some 20-25 degrees below normal. More light snow fell on the 6th and 7th with little accumulation, and widespread freezing temperatures were recorded throughout the period. The state's lowest temperature of the month, 17 degrees, occurred at the Jay Mesonet site on the 8th.

April 10-14: Another storm system approached the state and triggered a round of storms on the 10th along an associated cold front and dryline. The heaviest rain fell in southeastern Oklahoma where close to two inches was reported in localized areas. Fierce northerly winds assaulted the state on the 11th with gusts up to 50 mph in northern Oklahoma. Highs reached the 60s and 70s but the day felt much cooler due to the wind. More storms formed on the 12th and 13th along a cold front. The strongest of the storms occurred on the 13th in southwestern Oklahoma. Hail to the size of golf balls and strong winds were the main severe threat. Snow fell in the extreme northwest with nearly six inches being reported in Boise City.

April 15-18: Surface high pressure following a cold front left a clear, cool morning on the 15th. Temperatures rose into the 60s and 70s as the high pressure dome moved to the east. Southerly winds returned on the 16th and temperatures were a bit warmer, mainly in the 70s. An upper-level storm provided the impetus for rain and a few storms during the next couple of days. Light rain continued into the early morning on the 18th. Lows fell into the 40s and 50s and rebounded into the 60s and 70s as surface high pressure moved over the state.

April 19-23: The 19th was seasonably cool with fog early, giving way to high clouds in the afternoon along with temperatures in the 70s. The temperatures and the southerly winds both increased the next few days in response to an upper-level storm. High temperatures in the 80s along with southerly winds gusting to near 50 mph culminated with a line of showers and storms on the 22nd. The storm formed along a dryline late on the 22nd and diminished quickly as they moved to the east, but not before spawning a couple of tornadoes and tennis ball size hail in Harper County.

April 24-26: Very heavy rainfall was reported in far southeastern Oklahoma on the 24th from storms which fired along a dryline. A cold front began to move through late on the 24th and pushed through the state on the 25th. Northwesterly winds gusting to over 30 mph followed along behind the front, combining with temperatures in the 50s and 60s to make for a cold, blustery day. The 26th began cool and overcast with lows in the 40s and 50s and northerly winds. Temperatures managed to reach the 60s and 70s that afternoon.

April 27-29: Pleasant weather returned to the state for the next three days. Highs in the 70s and 80s made for nice spring days, with lows in the 40s and 50s cooling things off at night. An upper-level disturbance approached the state on the 29th, increasing the southerly winds and high temperatures.

April 30: Showers and thunderstorms associated with an upper-level storm dumped up to two inches of rainfall across southeastern Oklahoma on the month's last day. Severe weather was at a minimum for a springtime event, although some hail and high winds were reported. High temperatures for the day were predominantly in the 80s. The month's highest temperature of 89 degrees was reported at Webbers Falls on this day.

May Daily Highlights

May 1-3: The month's beginning was soggy as an upper-level low pressure system kicked off a round of showers and storms. Locally heavy rainfall and minor flooding were the result with more than two inches falling across central Oklahoma. A cold front associated with the upper-level storm set off another round of storms the next day. Over two inches fell once again locally in the northeast. Rain-free areas rose into the 80s while areas behind the front or receiving rainfall remained in the 60s and 70s. The front stalled on the third and acted as a focus for more storms just as another upper-level storm moved east along the Red River. Large hail and heavy rains were the main severe threats.

May 4-11: The next eight days were marked by persistent severe weather – including tornadoes – and heavy rainfall. A large upper-level storm parked itself over the Desert Southwest area and stalled, sending out several impulses that triggered active weather in Oklahoma. The main storm system finally began to move out on the 10th, finally clearing the state on the 11th. Before its departure, however, it dumped from 4-8 inches of rainfall over a large swath of central and southwestern Oklahoma. Preliminary reports indicate 14 tornadoes touched down between May 4-8, the most powerful of which was an EF3 twister that struck the town of Sweetwater, with significant damage to that town's school. Extreme hail was reported with the storms out west on the 4th, reaching the size of baseballs in Woodward County. The Oklahoma Mesonet site at Lane recorded 6.81 inches of rainfall on the 7th. High temperatures throughout this period were mainly in the 70s and 80s with lows in the 50s and 60s.

May 12-14: High pressure at the surface held sway over the state's weather following the passage of the upper-level storm which created the storminess of the previous week. Clear skies and light winds were the norm as morning lows in the 50s and 60s gave way to highs in the 80s. Very little rain fell during this period.

May 15-21: A cold front triggered a few showers and storms on the 15th, although amounts were generally less than a half of an inch. The cold front left gusty northerly winds in its wake and lows in the 40s and 50s. Sporadic convection over the next several days would leave a hit-and-miss rainfall pattern across the state. Temperatures during this time were seasonable with lows in the 50s and 60s and highs mainly in the 70s and 80s.

May 22-25: An upper-level disturbance triggered more storms on the 22nd. The most turbulent weather occurred on the 23rd. Storms that built on a cold front dropped hail the size of softballs in Harper County. The cold front slid east once again on the 24th and ignited more storms. Highs winds and large hail accompanied heavy rainfall. The cold front stalled along the Red River on the 25th, but little rain fell on this day. High temperatures dropped from the 70s and 80s during the previous few days to the 60s and 70s on the 25th.

May 26-31: An upper-level storm moved north from Texas overnight on the 26th triggering showers and thunderstorms. One-to-two inches fell across the south central sections of the state. A trough in that area brought even heavier rain the following day. Flash flooding was a common occurrence in the southern third of the state with the heavy rainfalls falling on saturated ground. Between 4-6 inches of rain fell in the extreme south central section of the state during this six-day period. The month ended with a line of severe storms across the Oklahoma Panhandle dropping baseball-sized hail near Guymon.

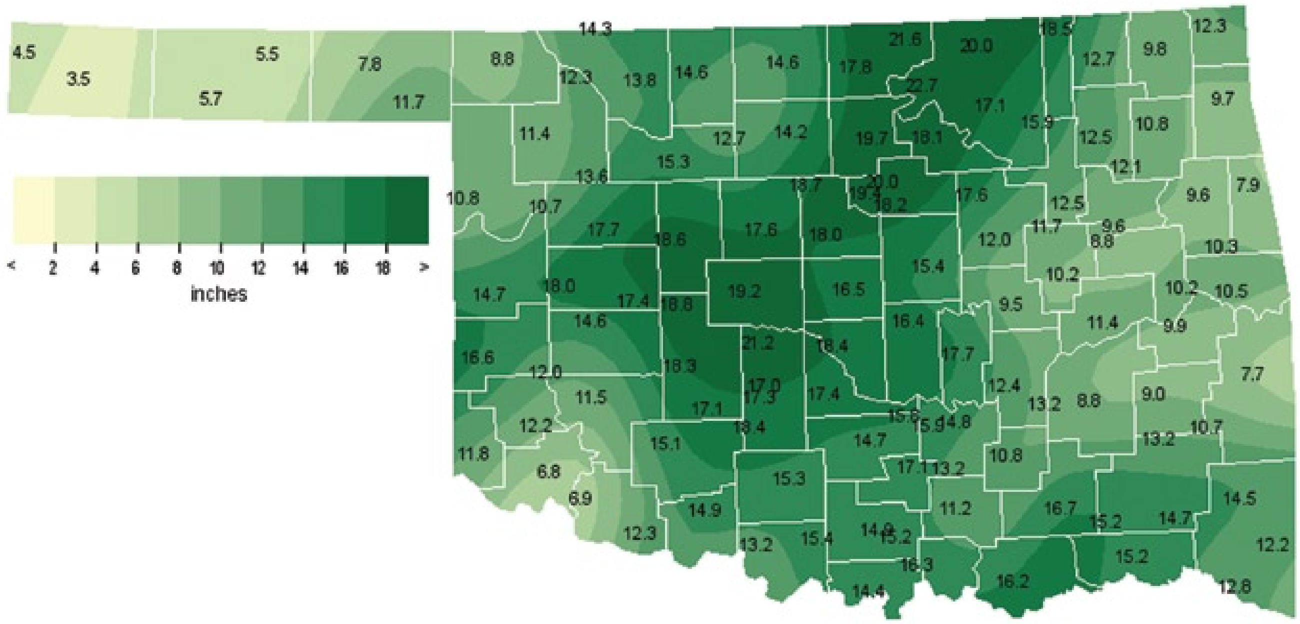
Spring 2007 Statewide Extremes

Description	Extreme	Station	Date
High Temperature	93°F	Altus	May 4th
Low Temperature	11°F	Oilton	March 4th
High Precipitation	22.68 in.	Burbank	
Low Precipitation	3.50 in.	Boise City	

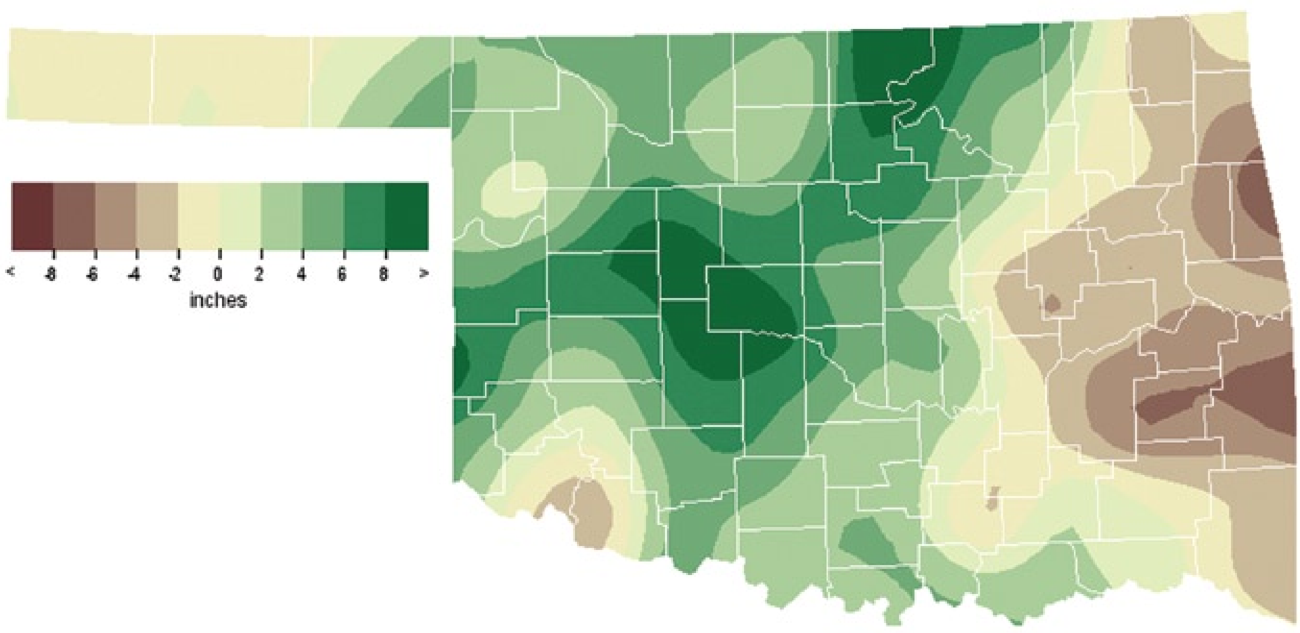
Spring 2007 Statewide Statistics

	Average	Depart	Rank
Temperature	60.7°F	1.6°F	21st Warmest
	Total	Depart.	Rank
Precipitation	13.33 in.	1.65 in.	20th Wettest

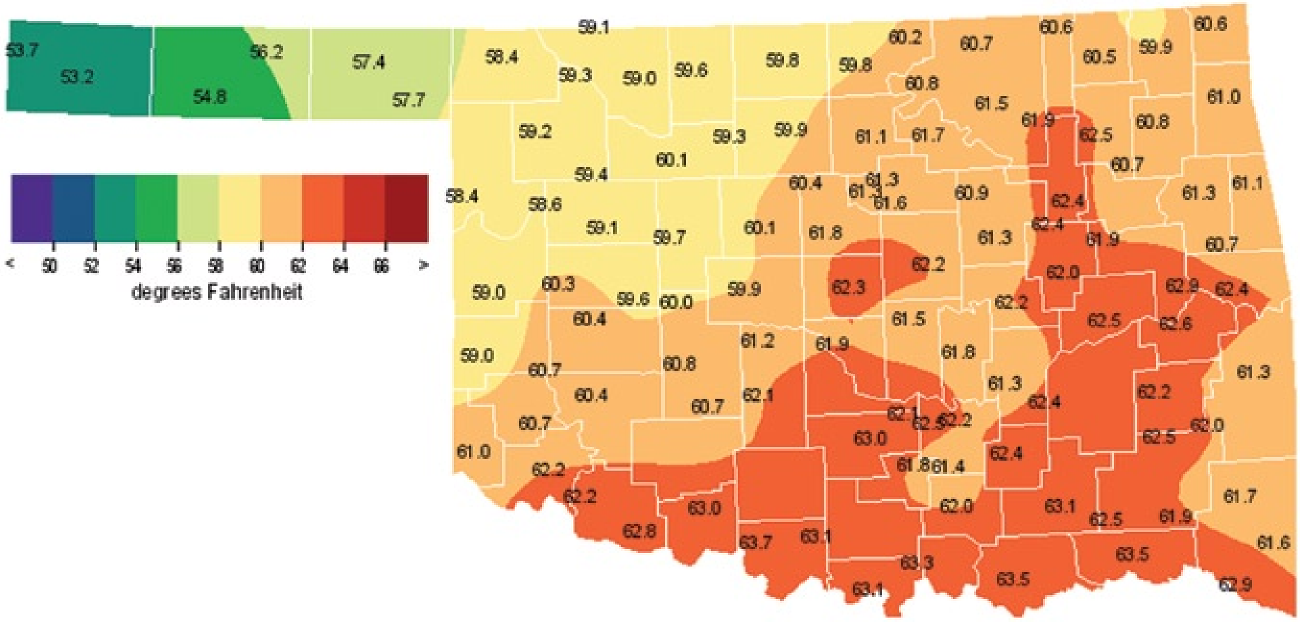
Observed Precipitation



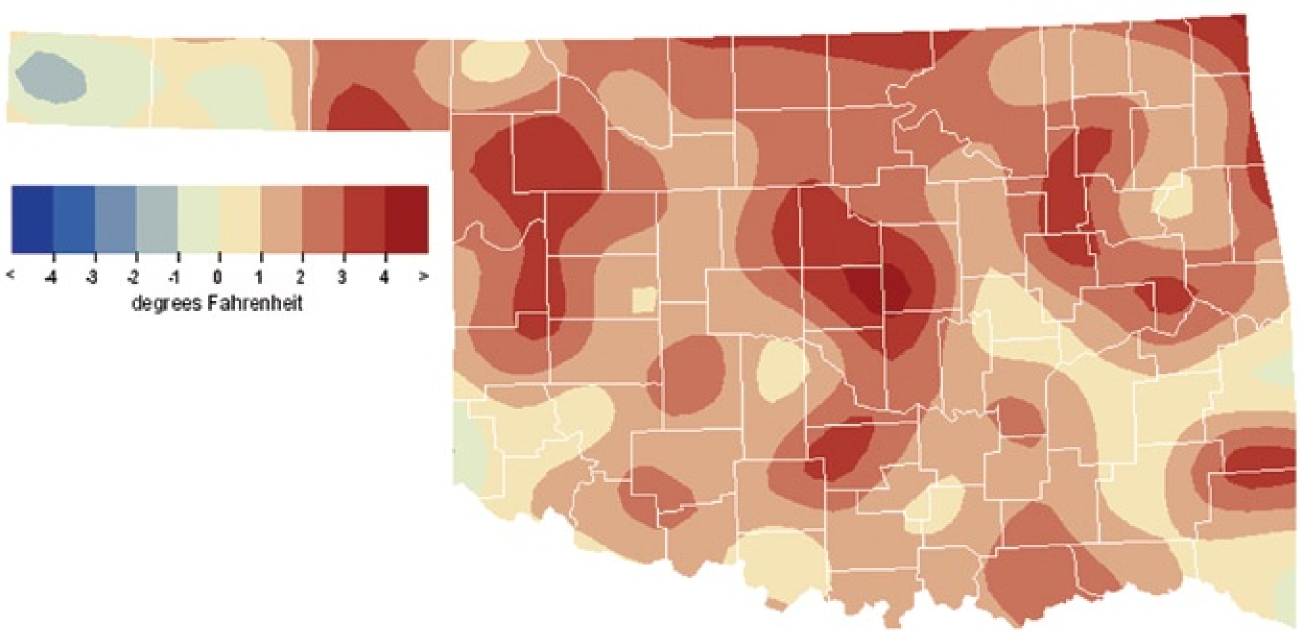
Precipitation Departure from Normal



Average Temperature



Temperature Departure from Normal



Spring 2007 Mesonet Precipitation Comparison

Climate Division	Precipitation (inches)	Departure from Normal (inches)	Rank since 1895	Wettest on Record (Year)	Driest on Record (Year)	2006
Panhandle	7.06	0.21	31st Wettest	13.27 (1957)	1.15 (1966)	3.01
North Central	14.23	3.87	8th Wettest	21.31 (1957)	1.77 (1895)	7.44
Northeast	14.28	1.13	26th Wettest	25.15 (1957)	3.12 (1895)	11.75
West Central	15.60	5.70	4th Wettest	19.30 (1957)	1.86 (1971)	7.16
Central	17.23	4.83	4th Wettest	22.89 (1957)	3.74 (1932)	8.49
East Central	10.39	-3.92	23rd Driest	30.36 (1990)	4.49 (1936)	12.07
Southwest	12.73	2.83	17th Wettest	20.48 (1957)	3.28 (1971)	6.79
South Central	14.75	1.84	26th Wettest	27.30 (1957)	4.50 (2005)	11.69
Southeast	12.45	-2.88	34th Driest	30.18 (1990)	7.12 (1936)	14.84
Statewide	13.33	1.65	20th Wettest	22.74 (1957)	4.89 (1895)	9.19

Spring 2007 Mesonet Temperature Comparison

Climate Division	Average Temp (F)	Departure from Normal (F)	Rank since 1895	Hottest on Record (Year)	Coldest on Record (Year)	2006
Panhandle	56.2	0.9	30th Warmest	59.5 (1963)	49.4 (1915)	59.0
North Central	59.7	2.0	20th Warmest	61.6 (1963)	52.8 (1924)	61.3
Northeast	61.1	2.5	8th Warmest	62.1 (2006)	53.5 (1924)	62.1
West Central	59.6	1.6	26th Warmest	62.8 (2006)	52.9 (1915)	62.8
Central	61.4	1.9	17th Warmest	63.8 (2006)	54.5 (1924)	63.8
East Central	62.0	2.0	16th Warmest	63.7 (1974)	55.1 (1931)	63.6
Southwest	61.4	0.9	31st Warmest	64.9 (2006)	55.1 (1915)	64.9
South Central	62.7	1.3	23rd Warmest	65.6 (2006)	56.5 (1931)	65.6
Southeast	62.2	1.5	24th Warmest	64.6 (2006)	56.8 (1924)	64.6
Statewide	60.7	1.6	21st Warmest	63.1 (2006)	54.3 (1924)	63.1

Spring 2007 Mesonet Extremes

Climate Division	High Temp	Day	Station	Low Temp	Day	Station	High Monthly Rainfall	Station	High Daily Rainfall	Day	Station
Panhandle	91	May 4th	Buffalo	13	Mar 2nd	Boise City	11.67	Slapout	2.98	Mar 28th	Slapout
North Central	90	May 21st	Woodward	16	Mar 4th	Blackwell	19.67	Red Rock	4.19	Mar 20th	Newkirk
Northeast	90	May 13th	Miami	14	Mar 4th	Pryor	22.68	Burbank	5.14	Mar 20th	Foraker
West Central	87	May 4th	Bessie	18	Mar 4th	Camargo	18.63	Watonga	4.26	May 6th	Erick
Central	88	May 14th	Stillwater	11	Mar 4th	Oilton	21.20	Minco	3.97	May 8th	El Reno
East Central	91	May 12th	Webber Falls	16	Mar 4th	Tahlequah	13.16	Stuart	3.54	May 7th	Tahlequah
Southwest	93	May 4th	Altus	17	Mar 4th	Tipton	18.29	Fort Cobb	5.86	May 8th	Fort Cobb
South Central	89	May 14th	Burneyville	16	Mar 4th	Sulphur	17.07	Sulphur	6.81	May 7th	Lane
Southeast	89	May 14th	Broken Bow	19	Mar 4th	Broken Bow	15.25	Hugo	4.08	Apr 24th	Cloudy
Statewide	93	May 4th	Altus	11	Mar 4th	Oilton	22.68	Burbank	6.81	May 7th	Lane

AGRICULTURE WEATHER WATCH

BY: Albert Sutherland, CPA, CCA
Mesonet Assistant Extension Specialist
Oklahoma State University

From too little rain to way too much. These last years have been two of the most challenging for Oklahoma farmers.

There was more wheat harvested in Oklahoma this year than in 2006, but the 2007 crop is likely to be 23% below early season estimates. As of July 12, the Oklahoma wheat crop was estimated at 116 million bushels. In central Oklahoma, many wheat fields will not add to the statewide wheat volume. Bart Cardwell, OSU Garfield County Agriculture Extension Educator, estimated that only 25% of the 380,000 acres planted to wheat in Garfield County will be harvested in 2007. Unharvested fields have too high a percentage of sprouting wheat to make them marketable.

Wheat is not the only crop suffering from May, June and July rainfall. Alfalfa and grass hay have either been too wet to cut or if cut, too wet to bale. While uncut hay loses feed value, wet cut hay left in the field deteriorates and rots.

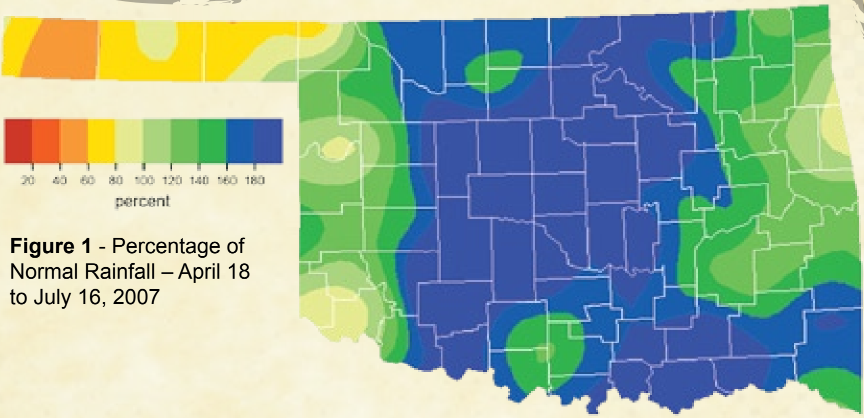


Figure 1 - Percentage of Normal Rainfall – April 18 to July 16, 2007

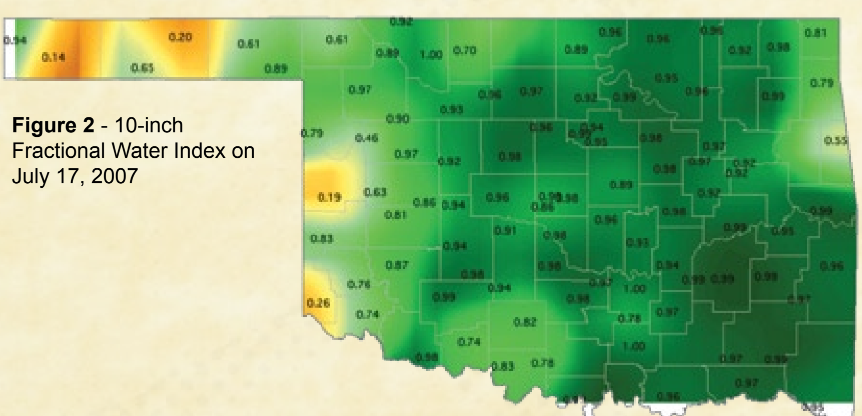


Figure 2 - 10-inch Fractional Water Index on July 17, 2007

Row crops are way behind in establishing a good root system. Part of this comes from the cooler, cloudier weather in June slowing plant growth. But most of the trouble came from saturated soils with their low oxygen levels. Soybeans, peanuts and cotton will need a series of warm, sunny days that are not too hot to develop a sufficient root system.

The row crop that has done the best is corn. The concern now is if there are still enough roots to supply all of water needed to fill the kernels.

While crops have languished, pasture grass and cattle have done well. Cattle have been a real moneymaker for Oklahoma agricultural producers and continue to be an agricultural bright spot. Except in standing water areas, pasture growth has been excellent.

The weather has been closer to normal only for a small number of western and eastern Oklahoma counties. The 90-day map of rainfall in Figure 1 shows how far above normal central Oklahoma rainfall was from April 18 to July 16, 2007. Soil moisture shown in the map of 10-inch Fractional Water Index values in Figure 2 mirrors the rainfall patterns. This reflects how well the Oklahoma Mesonet soil moisture sensors respond to soil wetting and drying.

So what do agricultural producers need in August, September and October? The ideal weather would provide warm, sunny days with good rains spaced 8-10 days apart. One can only hope there are few if any days with intense heat and strong drying winds. Many crops will need some extra days this fall to reach full maturity. So the Oklahoma farmers' wish list includes a long, mild, frost free fall.

To access the products mentioned in AgWatch go to Oklahoma AgWeather at **http://agweather.mesonet.org**. Data on the Oklahoma Agweather Web site is from the Oklahoma Mesonet, managed in partnership by the University of Oklahoma and Oklahoma State University and operated by the Oklahoma Climatological Survey.

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

AUGUST

- Keep up with water demand. The height of the watering season is a great time to decide where drip or sprinkler systems would be a real asset.
- Plan for new plantings with water efficiency in mind. Group plants with similar water needs together. Reserve areas closer to the water valve for high water demand plants.
- Children head back to school in mid-August. Make sure they are safe by trimming shrubs or trees near streets to maintain good driver visibility.
- Continue control of rose black spot with an approved fungicide.
- If you missed or skipped white grub control in July, you can apply an approved fast acting insecticide in August.
- Divide iris and replant or share the rhizomes with a friend.
- Plant frost hardy and short season vegetables. In August, plant cucumber, beet, broccoli, cabbage, Chinese cabbage, carrots, cauliflower, collards, Irish potatoes, leaf lettuce, parsnip, green peas, radish, Swiss chard and turnip.
- Prepare new garden areas by: 1) watering, 2) spraying weeds with glyphosate, 3) waiting 7-10 days; and 4) tilling the area.
- If a moderate to heavy rain event occurs, check pecan trees for emerging pecan weevil.

SEPTEMBER

- Apply a lawn pre-emergent by mid-September for winter annual weed control, popular products include Princep, Barricade, Balan, Surflan or Team.
- Fertilize tall fescue in late September. Tall fescue will need nitrogen as it grows more in cooler air temperatures. Use a quick release fertilizer at a rate of 1 pound of actual nitrogen per 1,000 square feet.
- Broadcast tall fescue seed mix for grass in shady areas or to thicken existing stands. Mix _ to _ pound of improved Kentucky bluegrass with 4 pounds of tall fescue per 1,000 square feet.
- After mid-September, plant pansies for fall, winter and spring color. Pansies will produce new blooms throughout the winter when the air temperature gets above 40ºF.
- Divide and replant spring-flowering perennials.
- In the garden, plant garlic, rutabaga and spinach. You can still plant radish, Swiss chard and turnip.
- To increase garden soil organic matter, plant Austrian winter peas, vetch, wheat or rye as a winter cover crop. Plan to till green plants into the soil a couple of weeks before you want to plant next spring.

OCTOBER

- Plant deciduous trees and shrubs.
- Plant most bulbs. Wait until November to plant tulips.
- Take a soil test to determine the nutrient status of your soil. Take your soil sample to your county OSU Cooperative Extension Service office for analysis. There is a fee for analysis.

CLASSROOM ACTIVITY [Soil Moisture]

Soil moisture is one of the variables observed by the Oklahoma Mesonet. There are many different ways to measure soil moisture, but for most purposes, Mesonet soil moisture values are presented as Fractional Water Index (FWI). FWI ranges from 0.0 (driest) to 1.0 (wettest). In other words, as soil moisture goes up (the soil gets wetter), so does the FWI. When the soil is completely saturated (in other words, when it can't hold any more water), the FWI will be very close to 1.0 A powder-dry soil will have an FWI near zero.

You can use the FWI to find out about whether plants will have enough moisture to thrive in the environment.

Fractional Water Index Categories

FWI Value	Soil Moisture Category	Explanation
0.8-1.0	Excellent Soil Moisture	Plenty of available water for plants.
0.5-0.8	Limited Plant Growth	Watering or irrigation is needed for full plant growth.
0.0-0.5	Dry	Soils are too dry for plant growth. Plants may wilt or die.

FWI is measured at multiple levels in the soil. This way, people can check whether a recent rain has penetrated to deeper layers of the soil. Sometimes, light rain events only moisten the top layers of soil, and don't help deeper layers, where mature plant roots will reach for water.

Questions

Please refer to the graph on the following page (page 20) to answer the following questions.

1. On January 1st, 2006 (the left hand side of the traces), which depth was the driest? Which was the wettest?
2. On January 28th, 2006, the Oilton Mesonet site received about one-half inch of rainfall. How did the 5cm FWI (blue trace) respond to this rainfall?
3. On January 28th, how did the FWI at deeper levels respond (25 cm: orange; 60 cm: brown)?
4. In general, which of the soil moisture traces changed the most often over the six months?
5. Look at traces during May and June (near the right-hand side of the graph). Which trace dried out the slowest?
6. Based on your above answers, what can you say about the time it takes to dry out deeper soil layers versus shallower soil layers?

Figure 1 - Fractional Water Graph

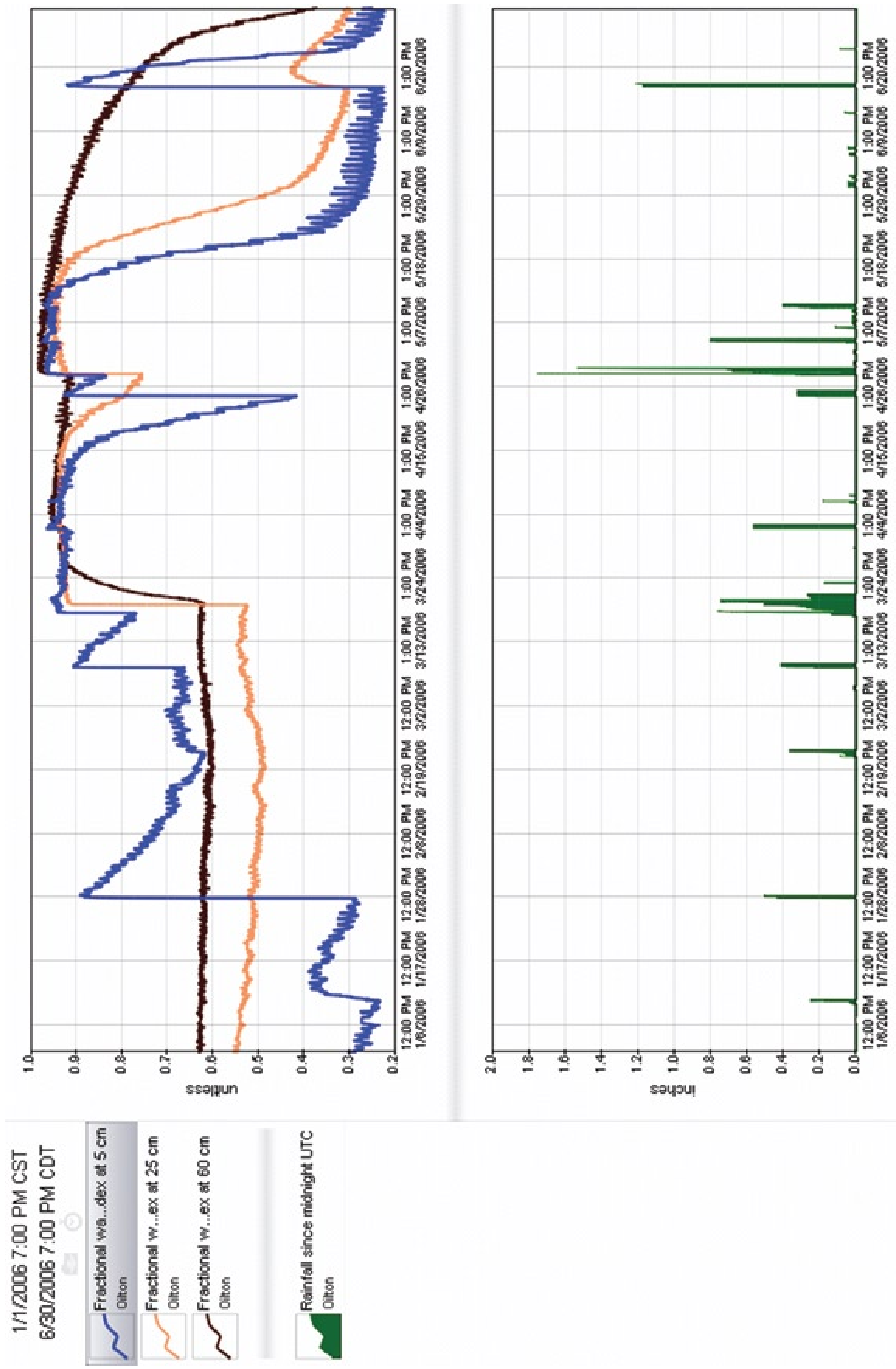


Figure: The top traces show soil moisture (FWI) at three levels for January-June 2006 at Oilton. The blue trace shows the shallowest level, 5 cm. The orange trace shows FWI at 25 cm deep, while the brown shows FWI at 60 cm. The bottom panel shows rainfall events during the period.

Answers to Questions on page 19

1. On January 1st, the 5 cm probe (blue trace) was the driest. The 60 cm probe (brown trace) was the moistest.
2. The 5 cm soil moisture trace responded to the rain with a rapid increase in FWI, from about 0.3 to about 0.9. This indicates that the soil moisture increased dramatically.
3. The deeper soil probes (orange at 25 cm and brown at 60 cm) seemed to have no reaction to the rains of January 28th. Their traces remained flat.
4. The 5 cm trace (blue) changed the most over the course of six months.
5. The 60 cm trace (brown) was the slowest to dry out during May and June.
6. In general, soil moisture at deeper levels responds more slowly to rain and lack of rain than shallower levels.

Oklahoma Squall Lines

Perspectives from the Past

By James Hocker

Have you ever been shaken out of bed in the middle of the night to the sounds of torrential rains and a seemingly never-ending rumble of thunder? Have you ever seen a wall of dark clouds approaching that spanned the entire horizon? Have you ever been in a storm that continued to produce moderate rainfall even after the heaviest part of the storm had passed long before? If you answered yes to any one of these questions, chances are you have experienced a specific type of storm known as a squall line.

Squall lines are a large grouping of thunderstorms that are organized in the shape of a line which stretches continuously for at least 30 miles and lasts 30 minutes or longer. This type of storm can vary in life span with weaker lines lasting only 30 minutes to 1 hour and powerful ones lasting many hours. Extremely organized and long-lived squall lines can have lengths that easily span hundreds of miles and have durations at upwards of half a day or more. For example, Figure 1 illustrates a very intense squall line moving from west to east across Oklahoma on May 7, 1995. Notice how much land area is affected by this line – roughly one-third of the main body of Oklahoma is experiencing rainfall from this system simultaneously.

Squall lines are a significant component of the annual cycle of severe weather that affects Oklahoma. Although such active weather brings with it a risk of strong winds, hail and isolated tornadoes, squall lines provide widespread rainfall crucial to the hydrologic and agricultural needs of the state. However, while the general seasonal cycle of severe storms is well known, relatively little is known about the geographic coverage and frequency of organized squall line activity across Oklahoma. In order to address these unknowns, the Oklahoma Climatoloical Survey recently conducted a 10 year squall line study to learn more about these impressive storms. In particular, the 1994-2003 study was focused on determining the following characteristics of these storms: where do they form, where do they move, where do they occur most often, and where do they end. Storms were identified using radar data archives dating back to the early- to mid-1990s and analyzed using a set of radar viewing programs and Geographic Information Systems (GIS) software.

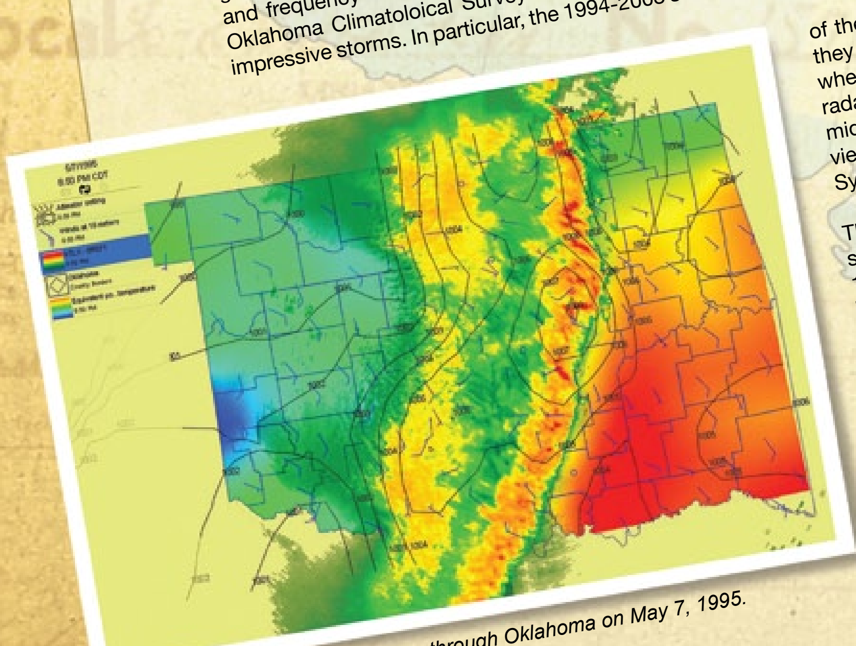


Figure 1. Intense squall line moving through Oklahoma on May 7, 1995.

The study found that a total of 477 organized squall lines occurred across Oklahoma from 1994 to 2003. On a monthly basis, squall lines increased significantly during April (76), peaked in May (141), and decreased through June (83) into July (27). In terms of monthly percentages, the three-month period from April through June represented the most significant portion of storms with nearly 63% of the total. Conversely, no other month included more than approximately 6% of the total squall line occurrences. Figure 2 displays a detailed daily breakdown of squall line occurrence overlaid with a two-week moving average. The daily frequencies indicate that squall lines were most common across Oklahoma during the last two weeks of May through the first week of June. A secondary period of squall line storms occurred between August and October which is associated with Oklahoma's typically short severe weather season in the fall.

For the total duration of the study, squall lines were found to occur most often across eastern Oklahoma with decreasing numbers towards western Oklahoma (Fig. 3). The large green circle in Figure 3 indicates that storms most commonly started in central Oklahoma while the red arrow denotes the average direction of storm movement which was from west to east. The concentration of squall line starting and ending points was also found and is shown in Figure 4. The results revealed the most common areas for squall line initiation (Fig. 4a) included west central and northern Oklahoma, with the most significant area in east central Oklahoma. The highest concentration of squall line ending points (Fig. 4b) was found to be across far eastern Oklahoma along the Arkansas border

Squall lines were also divided into monthly periods to determine the differences in their activity from month to month. Figure 5 presents all of the monthly findings which include the number of storms, storm tracks, average starting point, and average track. These results show that squall line activity was most prevalent and extensive in coverage during the months of April through June. Activity during all other months was relatively sparse and typically more focused across regions of eastern and northern Oklahoma. The analyses also revealed that storm motions typically shifted throughout the year with southeastward moving storms most common during June through September and northeastward moving storms prevalent throughout the rest of the year.

In short, squall lines are a key component of Oklahoma's annual cycle of severe weather. While these storms can occur anywhere at any time, the 10 year study revealed that eastern Oklahoma has been impacted by these storms in the past more than any other region of the state. Interestingly enough, eastern Oklahoma is also the climatologically wettest part of the state, so future research on squall lines will likely focus on how much these storms contribute to the water needs of this region.

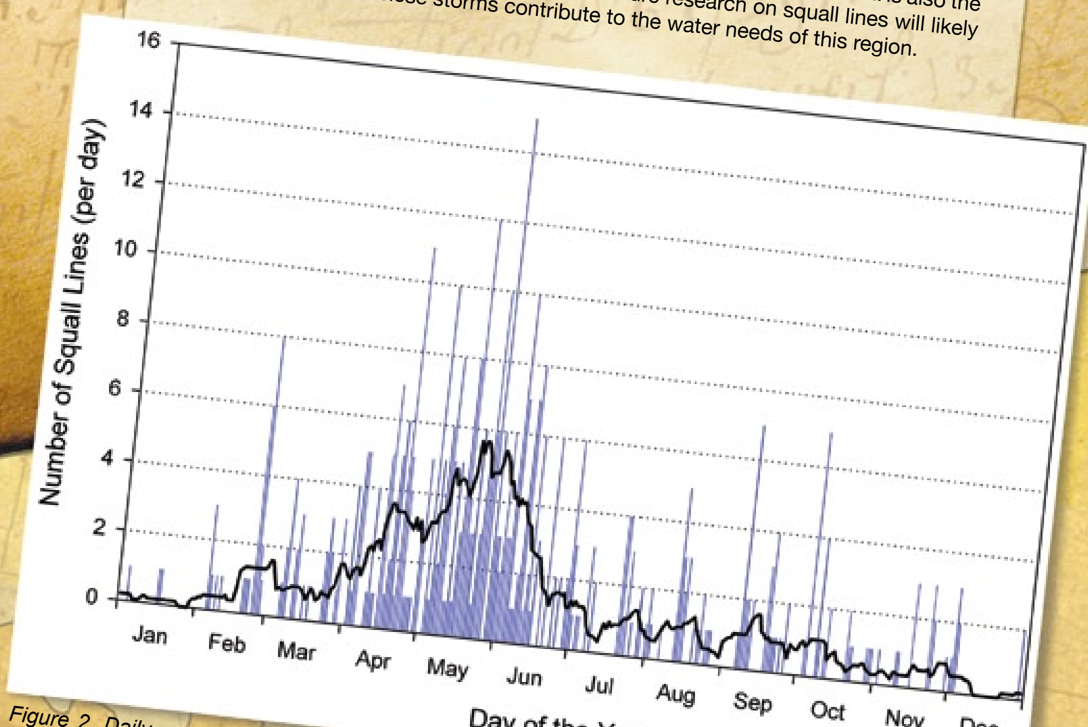


Figure 2. Daily number of Oklahoma squall lines during 1994-2003. The black line represents a 2-week running mean of squall lines.

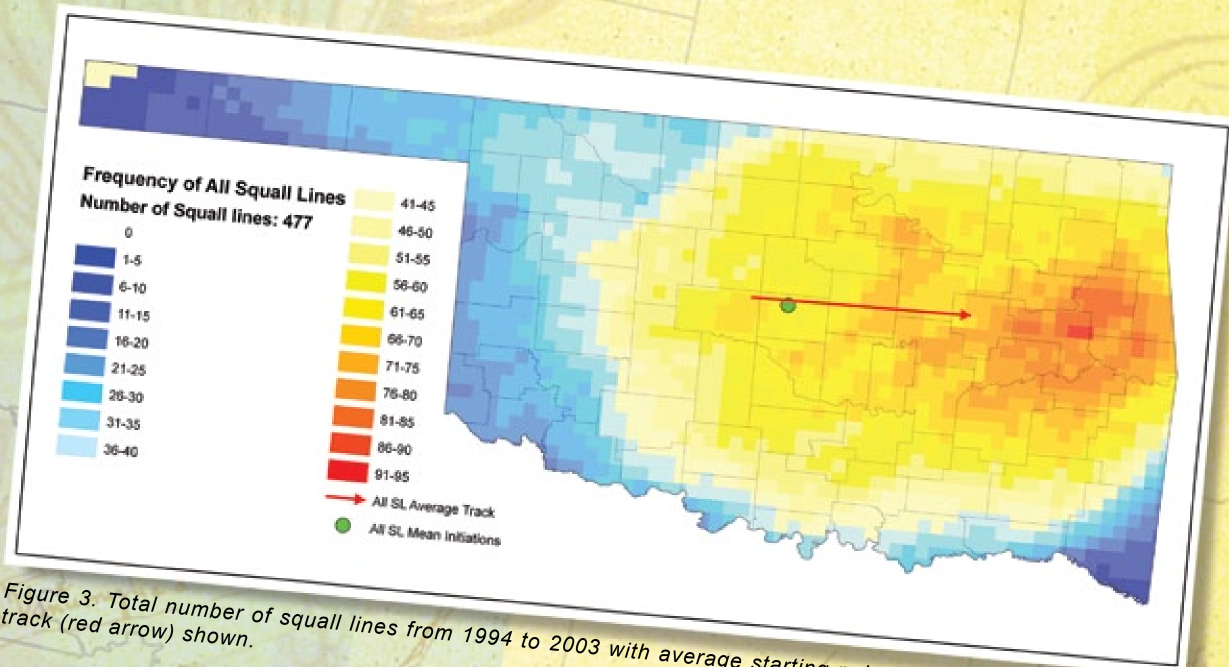


Figure 3. Total number of squall lines from 1994 to 2003 with average starting point (green circle) and average track (red arrow) shown.

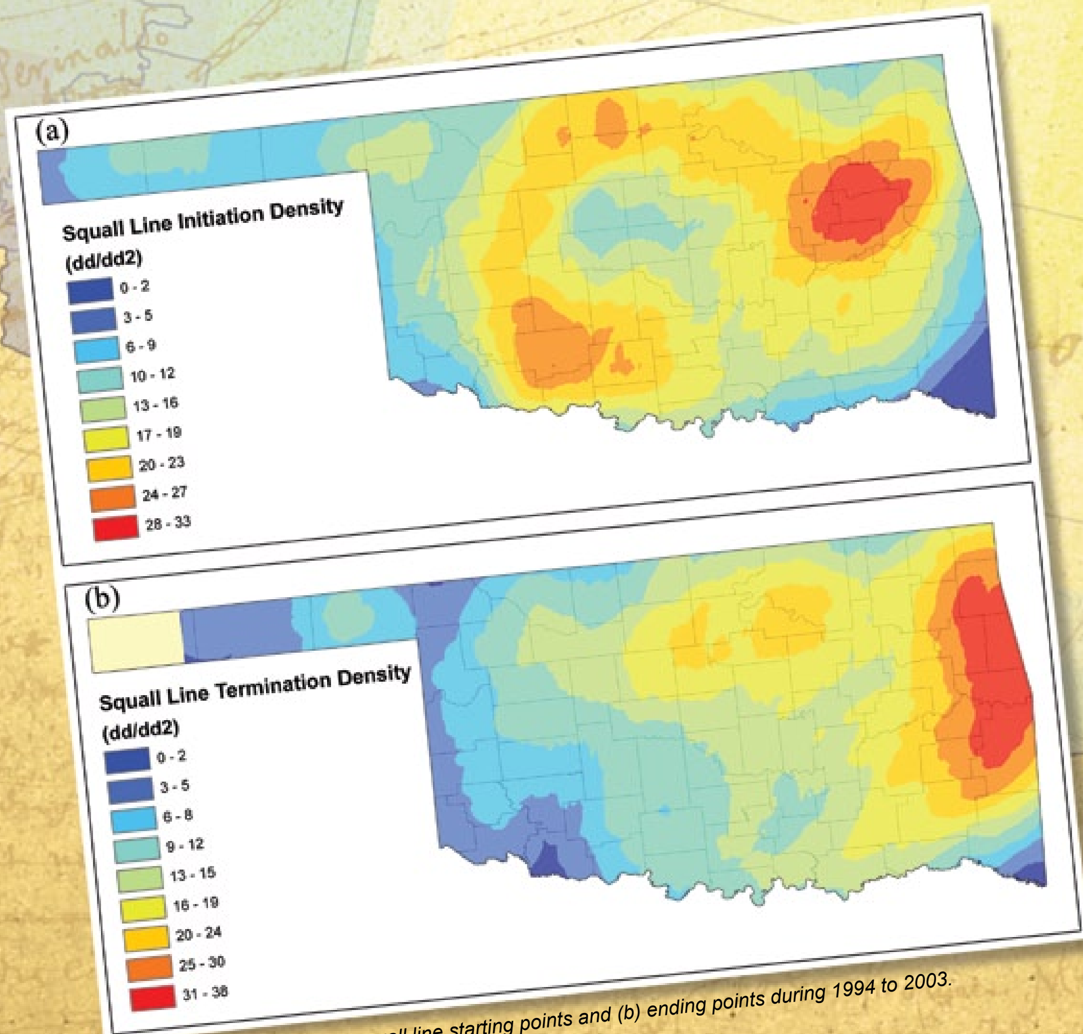


Figure 4. The density of (a) squall line starting points and (b) ending points during 1994 to 2003.

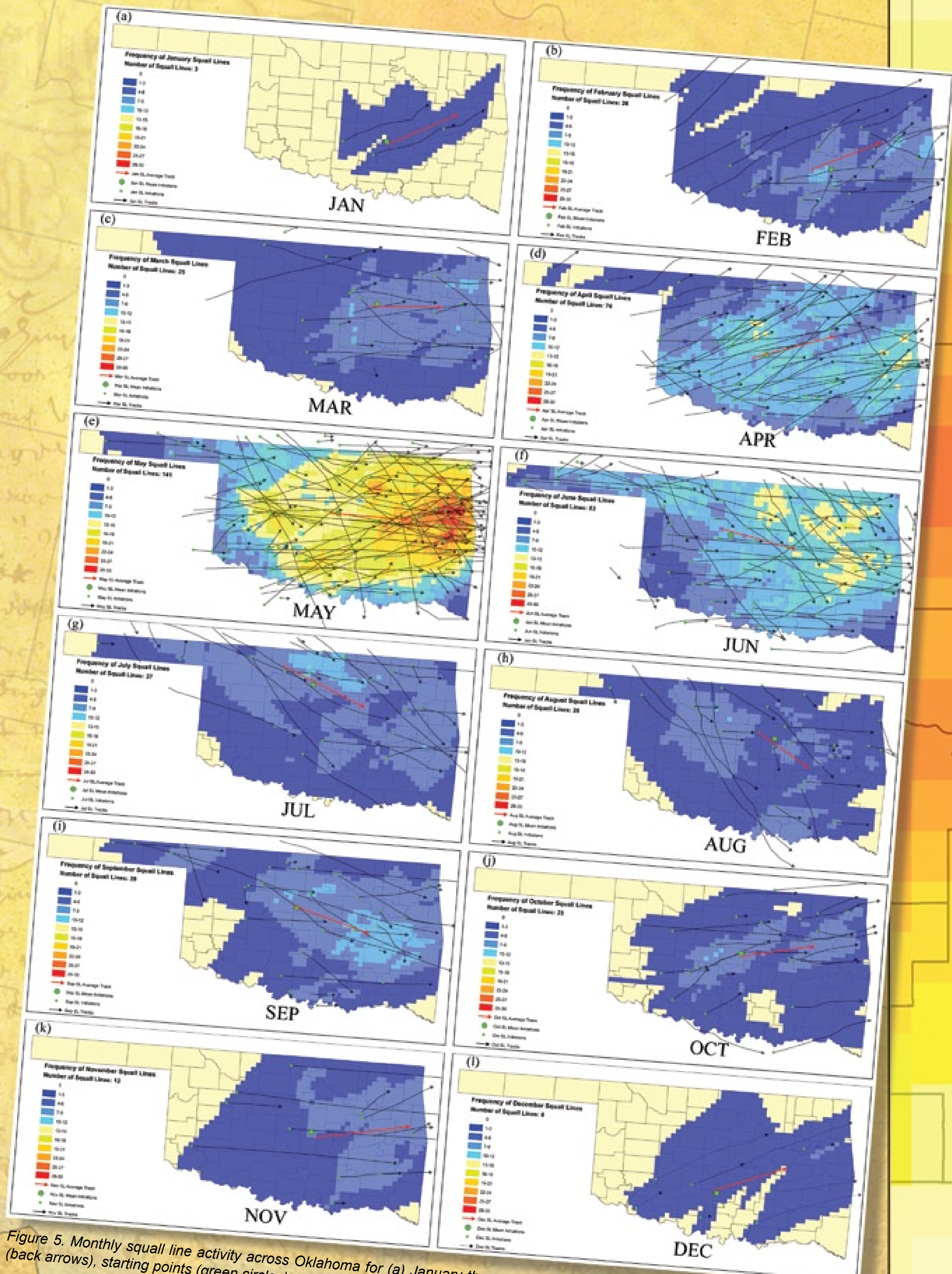


Figure 5. Monthly squall line activity across Oklahoma for (a) January through (l) December with storm totals (color scale), tracks (back arrows), starting points (green circles), and average tracks (red arrows) included.

Hiking and Camping safety+tips

Safety tips courtesy of the American Red Cross (www.redcross.org)

Hiking and camping provide exercise and interest for people of any age. Just getting out and walking around is a wonderful way to see nature. Since unexpected things happen, however, the best way to help guarantee a good time for all is to plan ahead carefully and follow commonsense safety precautions.

+ If you have any medical conditions, discuss your plans with your health care provider and get approval before departing.

+ Review the equipment, supplies and skills that you'll need. Consider what emergencies could arise and how you would deal with those situations. What if you got lost, or were unexpectedly confronted by an animal? What if someone became ill or injured? What kind of weather might you encounter?

+ It's safest to hike or camp with at least one companion. If you'll be entering a remote area, your group should have a minimum of four people; this way, if one is hurt, another can stay with the victim while two go for help. If you'll be going into an area that is unfamiliar to you, take along someone who knows the area or at least speak with those who do before you set out.

+ It's a good idea to assemble a separate "survival pack" for each hiker to have at all times. In a small waterproof container, place a pocket knife, compass, whistle, space blanket, nylon filament, water purification tablets, matches and candle. With these items, the chances of being able to survive in the wild are greatly improved.

+ Always allow for bad weather and for the possibility that you may be forced to spend a night outdoors unexpectedly.

+ If your trip will be strenuous, get into good physical condition before setting out. If you plan to climb or travel to high altitudes, make plans for proper acclimatization to the altitude.

+ Pack emergency signaling devices, and know ahead of time the location of the nearest telephone or ranger station in case an emergency does occur on your trip.

+ Make sure you have the skills you need for your camping or hiking adventure. You may need to know how to read a compass, erect a temporary shelter or give first aid. Practice your skills in advance.

+ Leave a copy of your itinerary with a responsible person. Include such details as the make, year, and license plate of your car, the equipment you're bringing, the weather you've anticipated and when you plan to return.

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