The Southern Plains Cyclone

A weather newsletter from your Norman Forecast Office for the residents of western and central Oklahoma and western north Texas

We Make the Difference When it Matters Most!

Volume 7 | Winter 2009 | Issue 1

Violent Tornado at Lone Grove

Photographs of tornado damage that occurred the evening of February 11th at Lone Grove, OK. The photographers, Mike Foster, Meteorologist-in-Charge, and Rick Smith, Warning Coordination Meteorologist, at the NWS Forecast Office in Norman, OK, surveyed the damage on February 11th.

Killer Tornado in Southern Oklahoma February 10

By Alex Lamers, SCEP

The potential for an outbreak of severe weather to occur on February 10, 2009, was forecast well in advance. Below is an excerpt from the Day 4-8 Convective Outlook issued by the Storm Prediction Center (SPC) on Saturday, February 7th:

... INCREASING CONVECTIVE POTENTIAL...INCLUDING A CONSIDERABLE RISK FOR SEVERE STORMS. THIS MAY COMMENCE LATE TUESDAY AFTERNOON ACROSS PARTS OF THE SOUTHERN PLAINS...

The impending severe weather was highlighted in each subsequent forecast. By Tuesday, the SPC forecast a Moderate Risk of severe weather across much of central and eastern Oklahoma. The NWS Norman Hazardous Weather Outlook (HWO) at 6:50 AM CST mentioned the potential for tornadoes east of a dryline, including Central Oklahoma.

Tuesday, February 10th, began unlike most severe weather days in Oklahoma. At Will Rogers Airport in Oklahoma City the morning low temperature dipped to 40 degrees. But fog observed in southeast Oklahoma that morning was evidence of warm and humid air lurking near and south of a warm front. This warm front would lift northward unusually quickly during the first half of the day, as a potent upper level storm focused a core of strong low level winds from east Texas up through central Oklahoma. The moisture return, along with relatively strong surface heating and rapid cooling aloft, created a moderately unstable atmosphere. It was around 1 PM that thunderstorms first developed along the leading edge of the re-

See **Lone Grove** on page 9

Meet Your Weatherman Alex Lamers

Hello, my name is Alex Lamers, and I am a SCEP employee for the National Weather Service. The Student Career Experience Program (SCEP) allows students pursuing a degree in meteorology to work part time for a National Weather Service office. I am originally from Southern Wisconsin, so I am employed by the office in Sullivan, Wisconsin (near Milwaukee). However, I work at the NWS Forecast Office in Norman dur-

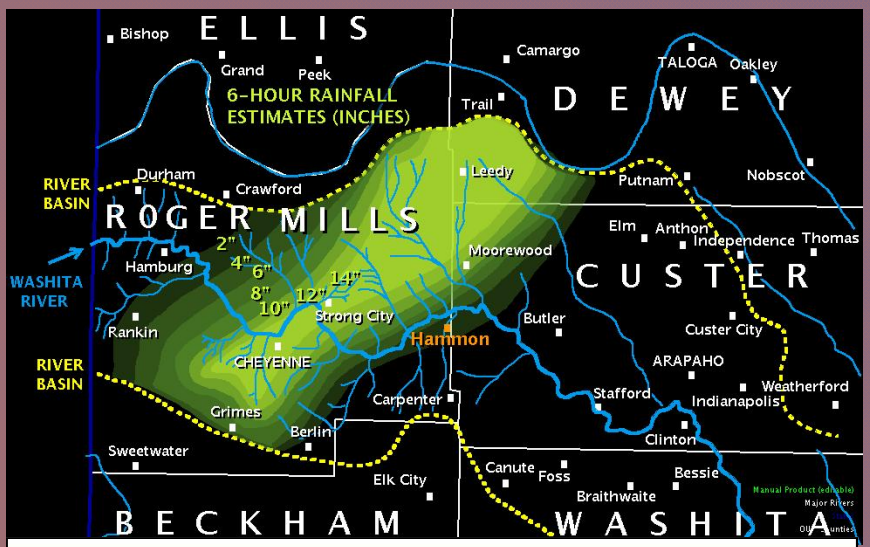
See **Alex** on page 10

The Hammon Flood of 1934: The 75-Year Anniversary

By Steven Kruckenberg, Service Hydrologist

The first weekend of April 2009, marks the 75th anniversary of the "Hammon Flood" of April 3-4, 1934 – an historic meteorological and hydrological event. Very heavy amounts of rain fell in a very short time over parts of west central Oklahoma, producing a flash flood along the Washita River that killed 17 people near the town of Hammon, OK. It is ironic that a rainfall and flood event of this magnitude occurred during a long term drought in Oklahoma in the 1930s, also known as the Dust Bowl.

Heavy rainfall totals of 6 to 14 inches occurred over a concentrated area in west central Oklahoma during the evening of April 3 and early morning of April 4, 1934. This band of heavy rain covered the eastern two thirds of Roger Mills, northwestern Custer, southeastern Ellis, and southwestern Dewey Counties. The most extreme rain was centered over Cheyenne, OK, where the U.S. Weather Bureau cooperative observer measured 14 inches, estimated to have come entirely between 6 pm and midnight. Following the storm, the U.S. Geological Survey (USGS) conducted an extensive "bucket survey" of the area, and obtained over 200 rainfall estimates. Some unofficial reports were as high as 20 inches, and one unofficial report told of 15 inches of rain falling in 2 hours and 20 minutes!



This is a re-creation of a 1934 United States Geological Survey map of rainfall amounts obtained by a "bucket survey" following the April 3-4 flood along the Washita River. All of the rain water which fell between the two basin lines (yellow) followed tributaries into the main channel of the Washita River. The resulting wall of water moved downstream to the east, killing 17 people near Hammon, OK. Note that many of the small towns labeled on this map are sparsely or no longer populated.

So what exactly is a "bucket survey?" A bucket survey is a special analysis of a local or regional rain storm where measurements from all available sources are used to help map the rainfall pattern from an intense storm. In 1934, there were very few meteorological observation stations that could accurately measure rainfall, so the USGS scientists went door to door in the region looking for buckets or any similar receptacle that had been empty prior to the storm. The USGS officials measured the water in these receptacles, calibrated for the size of the receptacle, and estimated the depth of the rainfall.

The Flood

Unfortunately, the intense precipitation associated with the Hammon Flood fell very quickly over an approximately 750 square mile area that was almost entirely within the Washita River drainage basin. Creeks and small tributaries that comprise the basin carried a tremendous volume of water rapidly north or south toward the main channel of the Washita River. Some of these tributaries such as Croten, Broken Leg, Sergeant Major, Nine Mile, West Quartermaster, and East Quartermaster creeks, experienced intense flash floods. As water from all of these creeks fed into the Washita River, the volume of water multiplied. A rapidly flowing wave of water - reportedly two miles wide at the height of the flood - moved down the river toward the east, and overwhelmed multiple homes just north of Hammon, OK, in Roger Mills County. Many people were washed away with their homes; a total of seventeen people were killed. One family lost seven members in the flood, and the bodies of two people were never recovered.

The USGS reported that river stages "exceeded anything previously recorded on the Washita from Cheyenne to Fort Cobb, a distance of approximately 150 miles." Along with homes, the flood washed away miles of railroad track and thousands of livestock. High water left many people stranded on rooftops or clinging to trees, where some waited for rescuers for more than 20 hours. The Elk City Daily News reported that the "view from the air was one of great desolation. Newspapermen who flew from near Cheyenne to Clinton reported the entire valley was inundated with fences rolled up, trees uprooted and the river cutting through fertile farmlands with a strong current." One pilot who had flown over the floodwaters reported seeing 8 houses floating down the Washita River.

Approximately 52,000 acres of land were inundated, of which many acres were left unfit for use. Damages in 1934 dollars were estimated at $3 million, and included agricultural, railroad, and highway damages. Local newspapers also reported that approximately 100 people were left homeless along the Washita River near Hammon.

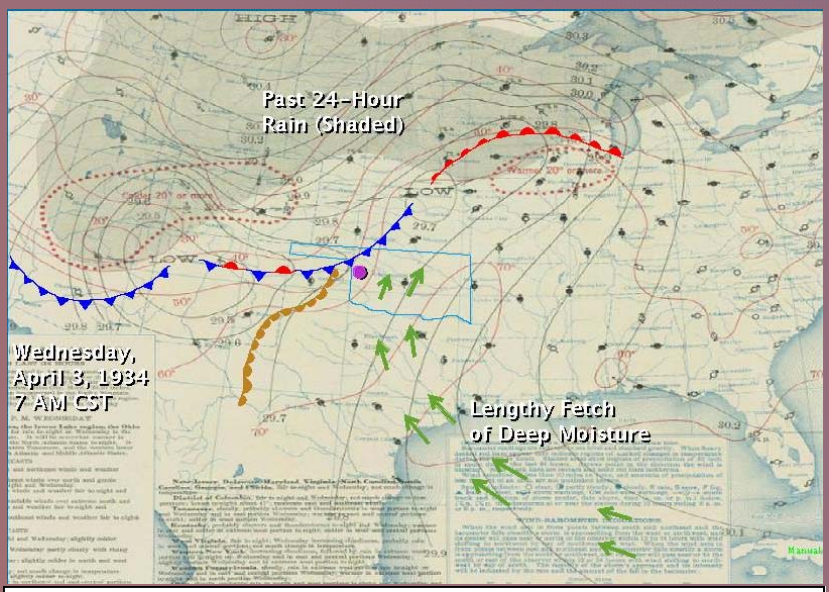
Could a flood like this happen again?
See Page 12

The Hammon Flood of 1934: Synopsis

By Patrick Burke, General Forecaster

In 1934, the United States Weather Bureau (today's National Weather Service) did not have a network of balloon sites to gather data in the upper levels of the atmosphere. This, not to mention the absence of weather radar and satellite, would have been one of the many challenges in forecasting the historic flash flood that took place near Hammon, OK. In retrospect, however, a lot of information can be gleaned from surface weather maps of the time. Daily weather maps dating back to 1871 are available online from the address given at the bottom of the page.

On the mornings of April 2nd and April 3rd, Oklahoma City and stations throughout Texas reported southerly winds and warm temperatures. The low temperature at Oklahoma City was 56 degrees on the 2nd and 66 degrees on the 3rd. Wind observations and contours of precipitation depicted a humid weather pattern for the southern Plains. Air from the far northern Caribbean Sea and southern Gulf of Mexico would have traveled west across the Gulf before turning northward into Texas and Oklahoma. This, combined with the time of year, warm morning lows, and early morning wind speeds of 10 to 20 mph, suggest deep moisture came into place by April 3rd. Dewpoints perhaps reached the lower to middle 60s in western Oklahoma.



A Daily Weather Map, dated 8 AM EST on April 3, 1934, from the National Oceanic and Atmospheric Administration's Central Library. Meteorologists at the National Weather Service in Norman, OK, modified the map by denoting a frontal boundary, possible dryline, and a lengthy fetch of deep Gulf moisture. The purple circle marks the Washita River basin upstream from Hammon, OK, where a severe flash flood took place later in the day.

Meanwhile, to the west, low pressure sagged slowly from Colorado into New Mexico. Early on the 2nd a cold front extended east-northeastward from the low, crossing the central Plains states into the Midwest. In the Intermountain West, observations of thunderstorms and cooling temperatures indicate that an upper level trough dug into the four corners region, placing southwesterly upper level winds over Texas and Oklahoma. This pattern is favorable for thunderstorm development in the spring. During the 24 hour period ending at 7 AM CST on April 3rd, however, reports of rain were confined to the north and west of the cold front. Since Gulf moisture was quickly coming into place, the initial lack of rain in Oklahoma and Texas suggests a reasonably strong cap was also in place. Events that unfolded on April 3rd conspired to break the cap over west central Oklahoma.

A weak low pressure center that was present along the front in Kansas at 7 AM CST indicates that a weaker "lead" trough moved east early in the day, while the primary upper level trough was still approaching through New Mexico. The lead trough dragged a portion of the cold front southward from Kansas into northwest Oklahoma and the Texas panhandle.

As the morning progressed, the cold front likely drifted southeast toward Hammon, OK. Although there is not enough information to confirm the presence of a dryline, one was likely in place that morning somewhere over eastern New Mexico or west Texas. Considering that thunderstorms later that day were so precisely concentrated on west central Oklahoma, with several hours of continual redevelopment, it is reasonable to think that the dryline may have become better defined and moved east, forming a triple point where it intersected the cold front – perhaps just southwest of Hammon. This would have focused converging winds near the surface, which, along with lift and cooling temperatures associated with the upper level trough, resulted in explosive thunderstorm development in west central Oklahoma.

Eyewitness accounts indicate that rain began in the mid afternoon during the warmest and most unstable time of day. This would have maximized the release of instability. Although such events are not rare, the associated thunderstorms usually do not linger over one location for six hours and produce 14 inches of rain. Typically, the release of strong instability would create a pool of rain-cooled air that would help move the thunderstorms farther east. Given the timing of the event, however, and the approach of the upper level trough, a low level jet likely formed early that

See **Flood Synopsis** on page 12

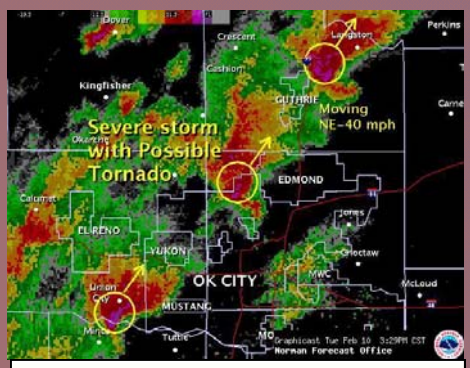
docs.lib.noaa.gov/rescue/dwm/data_rescue_daily_weather_maps.html

Damaging Tornadoes Hit Oklahoma City and Edmond

Synopsis

By Alex Lamers, SCEP

Early Tuesday afternoon, February 10th, all of the ingredients for severe weather quickly moved into place over central Oklahoma (for details see "Killer Tornado in Southern Oklahoma" – pg 1). Although thunderstorms developed along a line, the wind shear profile strongly favored development of rotating storms or supercells. The initial line became fragmented, and a series of supercells would eventually move like train cars through the western and northern sides of Oklahoma City. These storms initially developed near the Wichita Mountains in Comanche County around 1 PM CST. The leading supercell in the line reached southeast Canadian County around 2 PM CST, producing mainly large hail and gusty winds up until that point.



A graphicast issued by NWS Norman at 3:29 PM CST on February 10th, 2009, depicted three supercells moving along the same path from Yukon to Edmond to Langston.

As the supercell moved closer to Yukon, however, it began to show signs of becoming tornadic. By 2:14 PM CST, radar reflectivity showed a developing hook echo, and velocity data confirmed increasingly strong rotation. Only 4 minutes later, the hook echo was fully developed. This rapid transition prompted the Norman Forecast Office to issue a Tornado Warning at 2:17 PM CST.

Over the next 10 to 15 minutes, the office received a few wall cloud reports from Yukon and western Oklahoma City. At 2:36 PM CST, the first tornado of the day occurred near Northwest Expressway and Rockwell on the northwest side of Oklahoma City. The supercell and associated tornado warnings progressed northeast across Oklahoma County until, at about 2:52 PM CST, the supercell produced its second and most significant tornado about 3 miles west of the geographical center of Edmond. The tornado continued north-northeast, moving through neighborhoods and subdivisions on the northwestern side of Edmond. The tornado dissipated about 3:05 PM CST, just north of the Logan County line and just east of Broadway Avenue. The supercell continued moving northeast, and produced three more tornadoes in Logan, Payne and Pawnee counties.

Fortunately, the second and third supercells to track through central Oklahoma that afternoon did not produce tornadoes. They were, however, prolific producers of large hail. Some automobiles in Yukon received severe damage from multiple rounds of hail ranging from golf ball to baseball size.

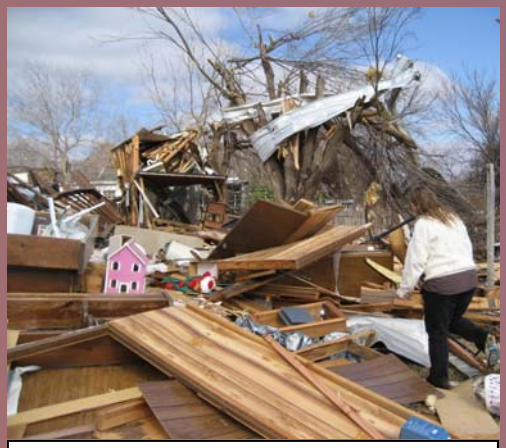
Damage Survey

By Mike Branick, Senior Forecaster

On Wednesday, February 11th, NWS Norman Senior Forecaster Mike Branick and Kiel Ortega of the National Severe Storms Laboratory surveyed damage in central Oklahoma caused by the February 10th storms. The survey team documented three tornadoes, and review of other data later confirmed a fourth. Note that these findings are preliminary until published in the National Weather Service's Storm Data publication for the month of February 2009.

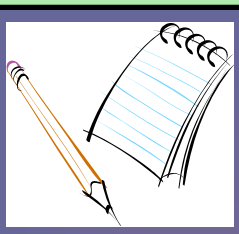
"Rockwell/Northwest Highway Tornado" (EF1)
Length 0.8 mi., width 30 yd.

This tornado began at the Target store in a shopping mall just southwest of the intersection of Rockwell Avenue and Northwest Highway. It moved northeast and ended near the corner of Whitehall Drive and Candlewood Drive. Several businesses received roof damage in both shopping malls on either side of Rockwell, on the southwest side of Northwest Highway. A small building just off Northwest Highway, containing about four small businesses, was unroofed(EF1). Three restaurants on the northeast side of the highway were damaged, including a Chuck E Cheese where one of the outer walls partially collapsed (EF1). The restaurants on either side received relatively minor damage, attesting to the relatively narrow width of this tornado. Damage to an apartment complex was mostly minor, but one apartment building was completely unroofed, and the outer brick wall of another building totally collapsed (EF1).



An Edmond woman looks through debris in the wake of a tornado that hit the area on February 10, 2009.

See **Damage** on page 11



Norman Office Forecast Notebook - A Complete Look at Events and Happenings

May 3rd Anniversary

May 3, 2009 will mark the 10 year anniversary of the most significant tornado outbreak in recent history. Look for a special article in the Spring issue of the Southern Plains Cyclone detailing NWS Norman forecasters' memories of that unforgettable event. And also watch for details on a special event being planned to commemorate the anniversary of the deadly outbreak

CoCoRaHS March Madness!

The Community Collaborative Rain, Hail and Snow Network's :"March Madness" competition pits state against state to see who can recruit the most volunteer weather observers during the month of March. Texas, you don't want Oklahoma to win. And Oklahoma, you don't want Texas to win…so tell your friends to join CoCoRaHS today !!

CoCoRaHS is a grassroots volunteer network of backyard weather observers of all ages and backgrounds working together to measure and map precipitation (rain, hail and snow) in their local communities. All you need is internet access, and a commitment to report your daily precipitation. To join, visit

www.cocorahs.org/Application.aspx

Ask Your Weatherman

Have a burning question about how the weather works? Do forecasters use a phrase that you would like to hear explained? Not quite sure how to read a hydrograph on our web site? Well… ask us! We'll be happy to answer your question in the next issue of the Southern Plains Cyclone.

Reader's Gallery

We'd like to see what the weather looks like, not from a satellite or radar image, but from your back yard! Severe weather is always interesting, but just as nice are pictures of sunsets, icicles, shallow fog, you name it. So send us your weather photos (preferably ones taken in Oklahoma and western north Texas), and we'll try to spin up a gallery to include in the next issue of the Southern Plains Cyclone!

Air Quality Awareness Week

National Air Quality Week is April 27-May 1. NOAA, the National Weather Service, and the Environmental Protection Agency are urging people to "Be Air Aware." For details, visit:

www.airquality.noaa.gov

Editor's Note

Winter has come and nearly gone, and here in Norman, I've yet to see a single flake of snow! It has certainly been cold enough at times, but a dry northwesterly jet stream has dominated our weather. The result has been developing drought (see page 8), and an increasing number of wildfires. The few times that the jet stream buckled to allow a storm in the southwest states - those times produced the late January Ice Storm (page 9), and our cover story, the February 10th tornado outbreak. Our heartfelt condolences go out to the victims of February's violent storms.

I will be passing through southern Oklahoma on my way to our regional headquarters in Fort Worth, TX. Similar to the duties Scott Curl described in his article, "NWS Operations: Hurricane Ike," (Fall 2008), I will help staff the Regional Operations Center for 4 weeks in March and early April. I look forward to participating remotely in weather operations throughout the southern United States, and I should return with plenty of stories to tell here in the Southern Plains Cyclone! The Spring 2009 issue target is late May.

NWS Teamwork: Climate Prediction Center

By Patrick Burke, General Forecaster

In the 1980's the National Weather Service established the Climate Prediction Center (CPC). As one of the nine agencies that comprise the National Centers for Environmental Prediction, the CPC plays an important role in delivering national and global climate guidance to its meteorological partners and external users. The CPC is best known for its United States climate forecasts - based largely on El Niño and La Niña conditions in the tropical Pacific.

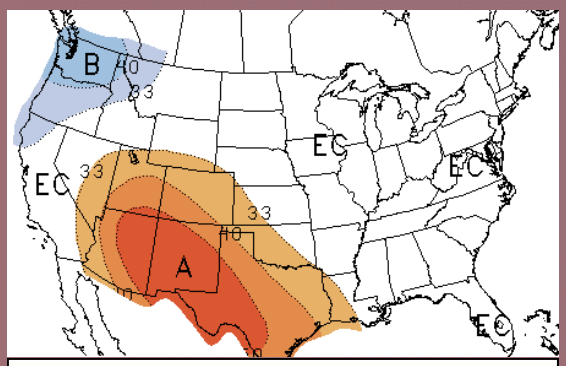
Patterns of extreme weather such as the 1997/98 winter storms, the droughts in 1998 and 1999, active and inactive hurricane seasons, and warm and cold winters are not entirely random events. The National Oceanic and Atmospheric Administration along with its academic and international partners are making great strides in linking some of these events to climate variability such as El Niño and La Niña, and other modes of natural climate variability. The CPC is at the forefront of turning this new understanding into practical tools and useful products. Better predictions of extreme climate episodes like floods and droughts could save the United States billions of dollars in damage. Managers of water, energy, transportation, and farming operations could use climate forecasts to avoid or at least mitigate weather-related losses. In 1997/98, for example, the CPC's seasonal climate forecast saved Californians $500 million to $1 billion, as they were able to take mitigation measures six months in advance of heavy rains.

The CPC organizes its work under two branches. The Development Branch performs research to identify the important physical factors responsible for climate fluctuations. The Operations Branch prepares long-range outlooks with lead times from one week to one year. These products extend into the future as far as technically feasible, and cover the land, ocean, and atmosphere. CPC interests even reach into the thin upper atmosphere called the stratosphere, where chemical concentrations are important in forecasting harmful ultraviolet radiation (the UV Index). All of these climate services are available for users in government, the public and private industry, both in the United States and abroad.

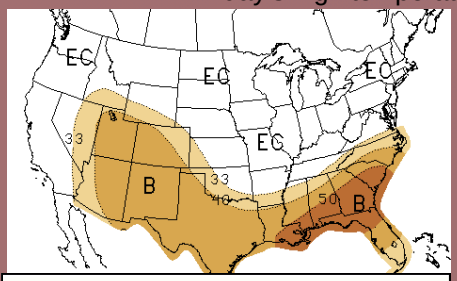
You are probably most familiar with the CPC's one and three month outlooks for temperature and precipitation. We at the NWS Forecast Office in Norman sometimes feature these products on our enhanced web page. In these forecasts, the 30-day or 90-day averaged temperature and the total precipitation are categorized as one of the following:

- Having a greater chance of being below normal (B)
- Having a greater chance of being above normal (A)
- Having an equal chance to be above normal, normal, or below normal (Equal Chances or EC)

The information is not as specific as, say, a forecast of next Saturday's high temperature because the long lead time creates greater uncertainty. These categorical forecasts have shown skill, however, especially during well defined climate events such as a strong El Niño or La Niña. Additionally, when the above or below normal categories are used, the confidence level of the forecast is expressed through a probability. For instance, in the three-month outlook valid for spring of 2009 (March-May) shown in Figure 1, there is a 40 percent chance that the average temperature will be above normal in part of western north Texas. The remaining percentage points are split among the normal and below normal categories, so there is a 30 percent chance that the average temperature will be near normal, and a 30 percent chance that it will be below normal. The sum of the three categories will always equal 100 percent.



Ninety-day precipitation outlook issued by the Climate Prediction Center in February 2009. The forecast is for March, April, and May.



Ninety-day temperature outlook issued by the Climate Prediction Center in February 2009. The forecast is for March, April, and May.

You will also note that surrounding the 40 percent area for above normal temperature is a 33 percent area extending into much of Oklahoma that is also shaded, and is forecast to have above normal temperature. In this case, although statistical guidance and climate models have predicted equal chances (33 percent in each category), forecasters favor the odds of above normal temperature because of recent trends and a developing La Niña.

The 90-day outlook for precipitation shown in Figure 2 (also valid from March-May of 2009) looks strikingly similar to the temperature outlook, with probabilities of below normal precipitation mirroring the probabilities of above normal temperature. If this forecast verifies, you will be hearing a lot more about developing drought in the months to come.

See **Climate** on page 8

By the Numbers

Oklahoma City

At Oklahoma City, December and January temperatures averaged near normal, with the usual stretches of both cold and warm weather. A few days, however, stood out:

December 14th-15th

On the 14th the daytime temperature rose to 70 degrees, almost 20 degrees above normal. The record for that date is 74 degrees in 1933. Later in the evening, a strong arctic cold front moved sent temperatures plummeting into the teens and 20s. On December 15th…the high only reached 18 degrees. This did set a new record for coldest maximum temperature to occur on that date. The previous record was 19 degrees, set all the way back in 1901.

December 27th

Unseasonably warm air overspread the region beginning on Christmas day and continuing through the 27th. Two temperature records were broken on the 27th. The high reached 76 degrees, which broke the previous record of 74 degrees set back in 2005. The low temperature only fell to 60 degrees, which shattered the previous record for warmest minimum temperature which had been 56 degrees, set back in 1936. The warm minimum of 60 degrees on December 27th set a new record for any day in December.

January 9th

The afternoon high rose to 75 degrees. This broke the record set of 73 degrees set in 2002.

Wichita Falls

December also averaged near or just above normal temperatures for December and January. As is usually the case, there were several days that reminded us more of the Spring than of Winter. Seven days brought temperatures at or above 70 degrees, and one day that topped 80 degrees!

December 14th-15th

Just ahead of an arctic cold front, high temperatures from the upper 70s to low 80s were common over north Texas. The high at Sheppard Air Force Base rose to 81 degrees. After the cold front passed, the temperature had dropped to 53 degrees by midnight, and the high temperature on the 15th was only 28 degrees. Both days broke the records, as the high of 81 on the 14th broke the old record of 80 degrees set back in 1933 and later tied in 1975, and the high of 28 degrees broke the record for coldest maximum temperature for that date, which had been 32 degrees set back in 1967.

January 22nd

The all-time warmest temperature recorded at Wichita Falls during January is 87 degrees. Few January days have ever threatened that record. January 22nd, 2008, however, tried and almost succeeded in doing so. The temperature warmed to 85 degrees before stalling. Although the thermometer at Shepherd Air Force Base fell two degrees shy of the all-time record, it did set a new record for the date; the previous record high for January 22nd was 83 degrees set in 1943.

By the Numbers

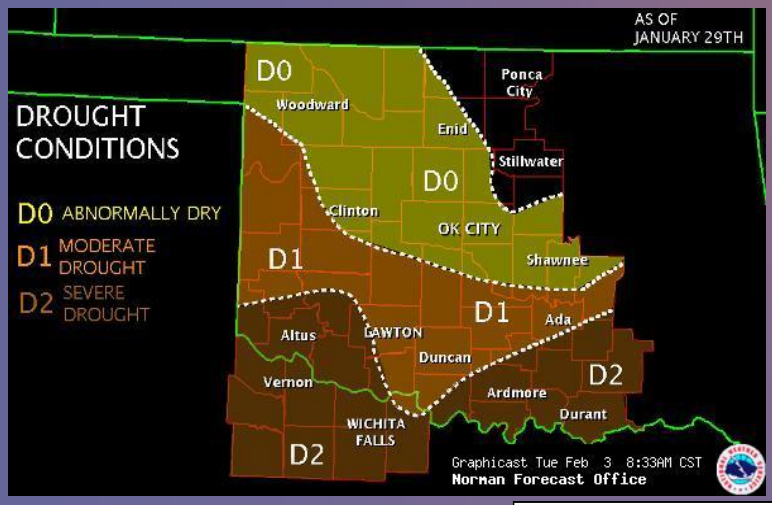
Winter 2008-2009 at Oklahoma City

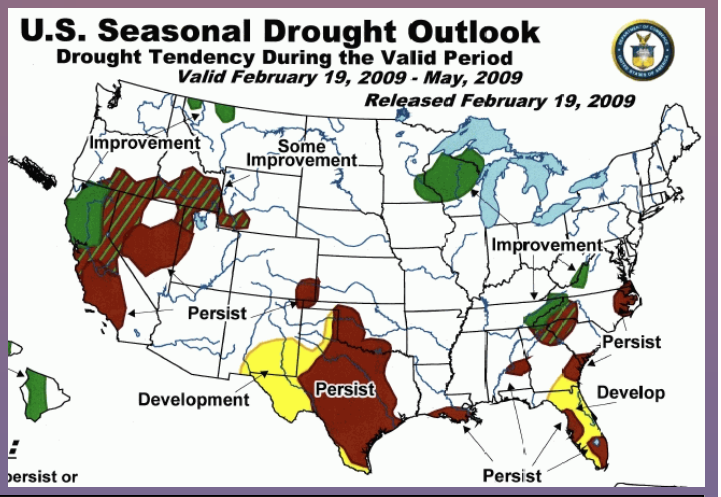
Precipitation (Inches)	December	January	February	Combined
This year	0.52	0.43	0.98	1.93
Normal	1.89	1.28	1.56	4.73
Departure	-1.37	-0.85	-0.58	**-2.80**

Winter 2008-2009 at Wichita Falls

Precipitation (Inches)	December	January	February	Combined
This year	1.05	0.13	0.68	1.86
Normal	1.68	1.12	1.58	4.38
Departure	-0.63	-0.99	-0.90	**-2.52**

No precipitation records were tied or broken at Oklahoma City or Wichita Falls this winter, as both locations reported well below normal precipitation for the two months.





(Left) An NWS Norman graphicast issued in late January, as the Climate Prediction Center (CPC) began to indicate D2-Severe Drought conditions in western north Texas and southern Oklahoma. The situation had changed very little by the end of February. (Right) The 90-day U.S. Seasonaly Drought Outlook issued by the CPC, valid through May 2009.

Climate...from page 6

Other CPC products commonly referenced in Oklahoma and Texas are the United States Drought Monitor and Seasonal Outlook. On each Thursday, the CPC, together with the United States Department of Agriculture, the National Drought Mitigation Center in Lincoln, Nebraska, and NOAA's National Climatic Data Center, issues a weekly drought assessment. The *U.S. Drought Monitor* provides a consolidated depiction of national drought conditions based on a combination of drought indicators and field reports. The CPC issues the *U.S. Seasonal Drought Outlook* on the third Thursday of each month, in conjunction with the release of the long-lead temperature and precipitation outlooks. Examples of these drought-related products are shown above.

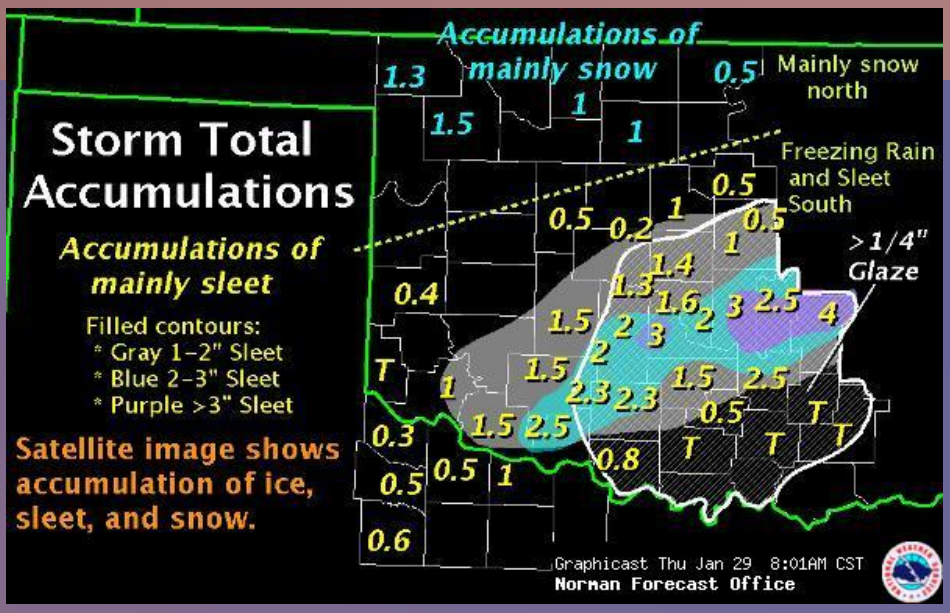
The CPC also collaborates with regional National Weather Service Offices to produces a Weekly Hazards Forecast, which provides a "big picture" summary of high-impact weather events that are likely to occur in the next week. The summary includes temperature extremes, heavy precipitation, enhanced wildfire potential, and trends in the status of local droughts.

With agriculture and water resources being so vital to Oklahoma and western north Texas, and the propensity for climate events to have impacts throughout the United States, you can see that the National Weather Service's Climate Prediction Center fills a vital role in weather forecasting. For more information, visit the web site listed below.

www.cpc.ncep.noaa.gov

Ice Storm January 25-27

By Ty Judd, Meteorologist Intern



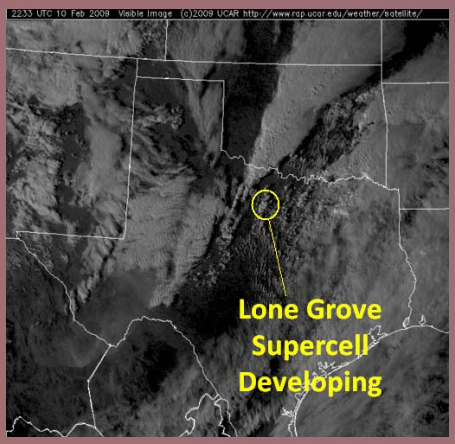
The first (and perhaps only) significant winter storm of the season affected much of Oklahoma and part of western north Texas from early on January 26th through the day of the 27th.

An arctic cold front moved through on the 25th, with areas across the northern half of Oklahoma reporting highs from the upper 20s to near freezing, and areas across southern Oklahoma and western North Texas reaching the upper 30s and low 40s. Later that night and on the morning of the 26th, moisture increased above the surface as a storm system in the western United States slowly moved toward the Plains. Extreme dry air near the surface limited the initial intensity of precipitation reaching the ground, but after several hours of moistening, precipitation in the form of drizzle and freezing drizzle began to overspread the northwest half of Oklahoma. By mid morning, widespread travel problems were reported, especially along the Interstate 44 corridor, where a fine layer of ice had covered most roads and elevated surfaces. The precipitation waned a bit during the evening hours, making the evening rush hour less dangerous. That night north winds increased, as a reinforcing shot of arctic air moved south through the region, pushing temperatures down several more degrees. Sub-freezing temperatures overspread much of western north Texas and part of southeast Oklahoma.

With the upper level storm still approaching, another round of wintry precipitation broke out before daybreak on the 27th over a wide area of Oklahoma. The precipitation over northwest Oklahoma mixed with sleet and snow, and locations along the northern two tiers of counties in Oklahoma received one to two inches of accumulation. Farther southeast, freezing drizzle developed, causing additional travel problems on area roadways. Sleet became the dominant precipitation type in much of the area by the morning rush hour, while freezing drizzle and light freezing rain continued over southeast Oklahoma. Thunderstorms

Lone Grove... from Page 1

turning moisture…where it met with sufficient lift to release the instability. The earliest storms caused significant tornado and hail damage in central Oklahoma (see Damaging Tornadoes Hit Oklahoma City and Edmond - pg 4).



By 4 PM, there had been enough widespread thunderstorm development… and production of rain-cooled air…to form a squall line extending from central to southwest Oklahoma…and into Texas near Wichita Falls. While severe hail and straight line winds continued, organized or long-lived tornadoes became less likely within the squall line. On the other hand, vertical wind profiles would become even more favorable for supercells and tornadoes by late afternoon and evening, *if* a thunderstorm were able to become isolated. The most likely place for isolated storm formation was north central Texas and south central Oklahoma, two regions which saw a full day of heating, and increasingly deep moisture. For these reasons, forecasters continued to stress the tornado threat, and a tornado watch continued. Around 4:30 PM CST, a thunderstorm formed rapidly in Young and Stephens Counties in North Texas, or about 80 miles west of Fort Worth, TX. This would be the storm to eventually strike Lone Grove. It quickly became a supercell as it moved northeast, reaching southeast Clay County by 5:30 PM. As the supercell crossed northwest Montague County it became tornadic, with the beginnings of a long track and significant tornado in far southeast Jefferson County in Oklahoma at about 6:50 PM CST. In Love County the tornado crossed through rural farmland north of Courtney, Rubottom and Oswalt. It then crossed into Carter County around 7:10 PM CST. Over the

See **Lone Grove** on page 12

Alex... from Page 1

ing the academic year while I am attending the University of Oklahoma.

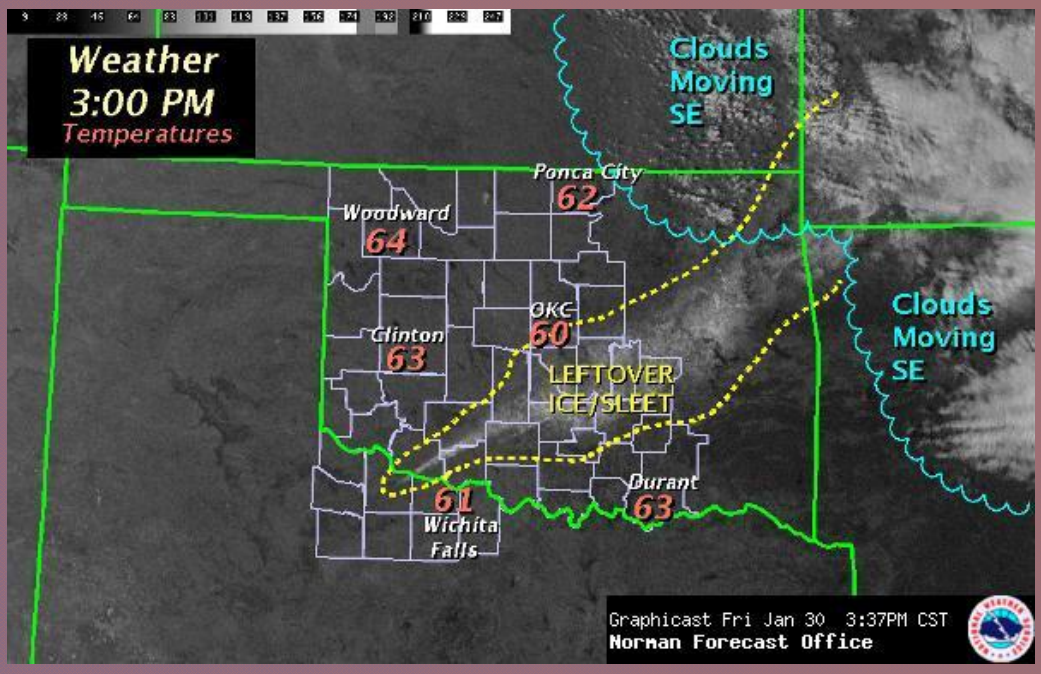
I lived in California's central valley about 60 miles east of San Francisco until 1995. In 1995, I moved to Southeast Wisconsin, and that is where I became interested in weather. I had always had an interest in aviation and loved to visit airports around the country. Naturally, weather conditions have a huge impact on aviation, so this was one of the ways that I became interested in meteorology.

In 1998, a severe thunderstorm produced extremely strong wind gusts, on the order of 100-120 mph, blowing over thousands of trees and causing damage all around my hometown. I can still remember my mother grabbing my sister and I and running down into the basement, worried that a tornado might be occurring. That event really solidified my interest in weather, and from that point forward I did as much as possible to learn about meteorology. I bought every weather book that I could find, and enrolled in summer workshops. I even attended free storm spotter training classes held by the National Weather Service.

In 2001, I completed a summer project to study thunderstorms with a mentor from the NWS office in Sullivan. After I finished that project, I began volunteering time at the office, learning as much as I could about the profession. Around that time, I also started to practice forecasting on my own time. Eventually, I applied to the University of Oklahoma and was accepted. I continue to pursue my bachelor's degree in meteorology, and plan to graduate in the spring of 2010. I hope to continue with the NWS in a professional capacity after I graduate.

Including volunteering and my current SCEP position, I've been around the National Weather Service for close to 8 years. On a typical day at the Norman office, I assist staff at our public service desk, answering questions from the public, controlling the quality of climate data and other observations, and supporting forecast operations in any way needed. During active weather or when demands for weather information are high, I also help coordinate information with our partners such as storm spotters, emergency managers, and amateur radio operators. I find working to give people warning before hazardous weather strikes extremely rewarding. I am also very interested in historic weather records and documenting major weather

See **Alex** on page 11



were even reported from Lawton, to the south sides of the Oklahoma City metro area, to near Seminole and Hughes counties. These storms produced periods of moderate to heavy sleet that turned the ground white. Accumulations of three to four inches were reported in the heaviest band in Cleveland, Seminole, Hughes, and Pottawatomie counties. South of this line, sleet accumulations of one to two inches were common, and a half to three quarters of an inch of glaze was observed farther south. Many of the locations that received the sleet had also received at least a quarter inch of glaze the day before. A few residents, mainly in and around Bryan county, remained above freezing through most of the event, keeping most precipitation in unfrozen liquid form. The storm finally ended on the 27th with a flurry of large snowflakes that amounted to little more than a light dusting in some areas.

By the time it was all said and done, school activities were cancelled from the evening of the 26th through the 28th over a large part of Oklahoma. Predictably, several hundred automobile accidents occurred. Numerous injuries were reported, not only from automobile accidents, but from people falling on slick sidewalks, parking lots, and driveways. One bright spot was that the precipitation was predominantly sleet rather than freezing rain. Tree and power line damage was minimal, and few power outages were reported. The ice storm's most severe impact was the disruption to travel and business. Satellite images revealed ice remaining on the ground for several days in a swath from near Vernon Texas up through southern and eastern Oklahoma.

Ice Storm... from page 3

Damage...from page 4

A car (left) was badly beaten by flying and falling debris when a tornado struck the Oak Tree Addition in Edmond. The tornado severely damaged this multi-story home (below) and many others. Photographers Mike Branick of NWS Norman, and Kiel Ortega of the National Severe Storms Laboratory rated some damage from this tornado as EF2 on the Enhanced Fujita scale.

"Edmond/Oak Tree Tornado" (EF2)
Length: 6.2 mi., width 75 yd.

The first evidence of tornado damage was on Western Avenue just north of Irving Elementary School, near NW 181st and Western. The tornado proceeded north-northeast for nearly 4 miles, before turning more to the northeast. The worst damage occurred in the area of the Oak Tree Country Club. The tornado crossed Waterloo Road just west of Broadway and then crossed North Broadway near Waterloo Road. The last evidence of tornado damage was to several homes in a subdivision near the intersection of Waterloo and Broadway.
Damage was continuous but varied between EF0 and EF1 until the storm crossed Kelley Avenue and entered the Oak Tree area. Here, numerous large multi-story homes received roof damage and several were totally unroofed (EF2). Several large trees, some with trunks over 2 feet in diameter, were uprooted. Semi-detached garages collapsed on at least 2 homes, and an outside wall of the kitchen on another house collapsed (EF2). Heavy metal I-beam frames of a sheet-metal industrial building just off Waterloo and west of Broadway were mangled, and a mobile home just west of Broadway and north of Waterloo was tossed or rolled a short distance and was totally destroyed (EF2). After crossing Broadway, damage was limited mostly to the roofs of several large homes (EF1).

“Logan County Tornado” (EF0)
Length: 0.7 mi., width: 25 yd.

This tornado began 8 miles east of Guthrie, 1/2 mile south of Highway 105 near Henney Road. It moved northeast, ending just north of Highway 1051/2 mile east of Henney Road. Damage was intermittent, consisting initially of several snapped trees. A home experienced roof damage on Henney Road, and another near the end of the damage path was totally unroofed.

“Payne County Tornado” (EF1)
Length: 11 mi, width: 30 yd.

This tornado began about 5 miles east of Langston and moved northeast, ending about 3 miles southwest of Stillwater. Because the tornado moved over mainly rural areas, damage was intermittent. The most significant damage was to a barn along Highway 33 west of Perkins. The barn was completely destroyed and other buildings were damaged. A cow and calf were killed.

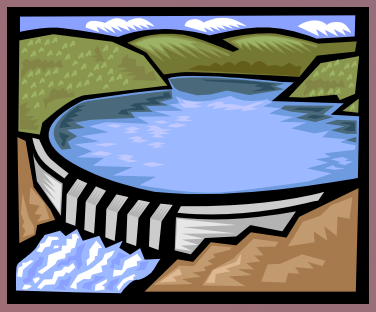
Alex...from page 10

events. I created many of the event summaries on the Norman office web page, and have worked to produce other items such as the “Storm Spotter Resource Center”.

Outside of meteorology, I’m an avid sports fan, and particularly enjoy following college basketball and college football. In fact, I travelled to Miami for the BCS National Championship game this January. I’ve always been partial to football, but I used to work as a team attendant for the Milwaukee Bucks professional basketball franchise, so basketball is a close second. I also enjoy travelling, especially around the Caribbean, and hope to go to Australia some day.

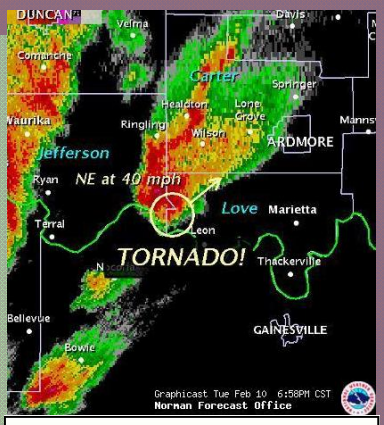
Flood Mitigation

A series of damaging and deadly floods, including those along the Washita River, during the early part of the 20th century lead to flood control and flood prevention programs being enacted by the U.S. government during the 1940s and 1950s. As a result, the state of Oklahoma leads the nation in the number of small watershed upstream flood control dams constructed with just over 2,100 dams comprising a $2 billion infrastructure that offers multiple benefits to thousands of people. In fact, the first flood control dam in the nation, Cloud Creek Dam Number 1, was built in 1948 along a tributary to the Washita River near Cordell, Oklahoma. The dam was constructed by local watershed project sponsors with assistance from the USDA Soil Conservation Service (SCS), now known as the Natural Resources Conservation Service (NRCS). The funding and technical help for this dam were authorized by the Flood Control Act of 1944. This act sanctioned pilot projects in 11 watersheds in the U.S., including the Washita River Watershed. As a result, Oklahoma also has the first completed watershed project in the nation, the Sandstone Creek Watershed Project located in Roger Mills County. A total of 24 dams were finished in the watershed between 1950 and 1953. The success of these pilot projects eventually lead to the passage of the Watershed Protection and Flood Prevention Act of 1954.



What are the benefits of these projects? According to estimates from the Oklahoma Water Resources Board (OWRB), these dams, in combination with established conservation procedures in the watersheds, provide approximately $71 million in benefits each year. The lakes formed by these dams not only provide flood control, but are also sources of water for livestock and irrigation, create wildlife habitat and recreational areas, and protect over 2 million acres of agricultural land in flood plains. Many of these dams, however, have reached or passed the end of their projected 50-year life expectancies and that without proper upkeep, failures to some of these structures could occur. The NRCS has begun rehabilitation projects for some dams. A rehabilitation pilot project of two dams in the Sergeant Major Creek Watershed in Roger Mills County was completed in the early 2000s. Rehabilitation of other water control structures has continued in Oklahoma during this decade. Hopefully, these flood control and prevention projects, if properly maintained and repaired, will ensure that events like the Hammon Flood do not occur in the future.

Lone Grove...from page 1



A graphi-cast issued by NWS Norman about a half hour before a devastating tornado struck Lone Grove, OK.

next 15 minutes, the large tornado approached Lone Grove, a town of over 5,000 people. Sometime between 7:25 PM and 7:30 PM CST, the tornado struck Lone Grove before continuing on past Interstate 35 just north of the Prairie Valley Road exit, and finally dissipating in southeast Murray County around 8:00 PM. The long track tornado had persisted for over 30 miles and more than a full hour.

At Lone Grove, damage in the city limits was extensive; an NWS survey team in the next day rated some damage as high as EF-4 on the Enhanced Fujita Scale. This is the second highest rating possible - indicative of maximum wind speeds on the order of 166 to 200 mph. Tragically, eight people in and near Lone Grove lost their lives to the violent tornado.

Flood Synopsis...from page 3

evening, offering resistance to the rain-cooled outflow, and keeping thunderstorms anchored over the Washita River basin.

On the Daily Weather Map from the morning of April 4th meteorologists made note of much cooler air in New Mexico. This indicates that the upper level trough moved east overnight. From the Washita River basin in Roger Mills County, OK, rain had fanned out to the north and northeast. Wichita, Kansas, reported over an inch and a half of rain that night, but thunderstorms remained well north and west of Oklahoma City and Wichita Falls. Subsequent Daily Weather Maps suggest that the cold front was relatively weak as it slipped through the rest of Oklahoma and north Texas. And surface weather across the United States suggests that the upper level trough yielded to a broad westerly jet stream setting up in the northern part of the country. As is sometimes the case in weather, an unusually striking event was followed by a period of relative calm. The weather system which produced one of the greatest floods to affect the upper Washita River went on to produce no remarkable weather after that.

As spring approaches, rainwater will start to fill our gauges (or so we hope!). But often in the southern Plains when it rains it pours. In addition to tornadoes, strong winds, and large hail, flooding is a distinct likelihood during many severe weather outbreaks. May and June are climatologically the wettest months for Oklahoma and Northern Texas, and thus carry the greatest risk from flooding. If you are threatened by flooding, the obvious solution is to move to resist whatever business or other plans take you through flooded lowlands, and seek higher ground. The trick is to know when you are at risk from high water, to recognize the warning signs, and take the proper action.
The National Weather Service can help with life saving information we provide in the hydrologic products listed here.

Flood Safety:

Understanding NWS Products

By John Pike, Meteorologist Intern

Flash Flood Warning is issued when water is rising *rapidly* and flooding is imminent. You should move to higher ground immediately. This warning may cover entire counties, portions of counties, or certain river basins. Flash Flooding occurs when a large volume of rain falls in a short time, or if there is a dam or levee failure. If you have a properly programmed NOAA weather radio with S.A.M.E. alert, and are receiving the signal, a Flash Flood Warning should activate the radio warning alarm tone. A flash flood warning will include one or more "Call to Action" statements that give concise and simple advice about what you can do to stay safe.

Flash Flood Statement - follows a *Flash Food Warning*. Flash flooding is either occurring, is still expected, or is no longer expected. The text of the statement will provide details, and, in the case of continued flooding, this will include information on timing, location, and impacts.

Flood Warning - also known as an “Areal” Flood Warning, is issued when water is rising *slowly*, but will overwhelm drainage capacity of the local terrain, resulting in dangerous high water. A Flood Warning may also cover counties, portions of counties, or certain river basins. There is more time for people to gather belongings and move to higher ground, but these types of floods can be every bit as life threatening as flash floods, if not treated seriously.

River Flood Warning - an Areal Flood Warning pertaining to a specific forecast point along well-known rivers and streams. After heavy rain falls, creeks and streams can carry an impressive volume of water into the main channel of major rivers. River flood stages are categorized as minor, moderate, or major. These stages are defined for each river forecast point based on the known impacts of high water at that location. Because of the time lag during which water travels to the main channel, a River Flood Warning is sometimes issued hours or maybe even a day after the rain fell. This is not always the case, however, as river flooding could occur immediately, depending on the location and intensity of the rain, and the capacity of the local terrain for carrying water.

Flood Statement - a follow up to a *Flood Warning* or *River Flood Warning*.

Urban and Small Stream Flood Advisory - alerts the public to flooding which is generally an inconvenience (not life-threatening) to those living in the affected area. This product is issued when heavy rain will cause water to pool on streets and in low-lying places in urban areas. It may apply to flooding along small streams in rural or urban areas.

Flood Watch - issued when Flash Flooding or Areal Flooding is possible over the next 48 hours, but is not imminent. The information inside a Flood Watch will define whether the event is expected to produce flash flooding or areal flooding. Evacuation to higher ground is not necessary, but you should pay attention and listen for later statements and warnings. The period of time after a *Flash Flood Watch* has been issued and before the rain begins would be an excellent time to prepare your family and possessions for the possibility that you may need to seek higher ground.

COOP Corner

We would like to recognize a recent observer award:

Harry Thomas
Wolf 4N, OK...
15 Years of Service !

And a new observer:

Dianna Brannan
Allen, OK

The Norman NWS Cooperative Observer Program Team:

Forrest Mitchell **Daryl Williams** **Ty Judd** **John Pike** **Christine Riley**

Thanks for Reading!

National Weather Service
Forecast Office
Norman, OK

Phone Number:
405-325-3816

Web Page:
weather.gov/norman

Meteorologist-in-Charge:
Mike Foster

Warning Coordination Meteorologist:
Rick Smith

Science and Operations Officer:
David Andra

Editor:
Patrick Burke

Graphical and Written Forecasts & Warnings for Your Community:

weather.gov/norman

Tour our office and the National Weather Center:

nwc.ou.edu/tourdetails.php

National Weather Service Forecast Office
120 David L. Boren Blvd. Suite 2400
Norman, OK 73072

Please share this with friends, relatives, and colleagues. Comments and suggestions are always appreciated, by phone at 405-325-3816 or by e-mail at Patrick.Burke@noaa.gov.