

# Drought History

for Oklahoma's 9 regions



Prepared by the South Central Climate Science Center in  
Norman, Oklahoma

May 28, 2013

*Updated November 29, 2017*



SOUTH CENTRAL  
CLIMATE SCIENCE CENTER

<http://southcentralclimate.org/>  
[info@southcentralclimate.org](mailto:info@southcentralclimate.org)

<b>What is drought?</b>	<b>3</b>
<b>Why be prepared for drought?</b>	<b>3</b>
<b>How to prepare for drought?</b>	<b>4</b>
<b>How is drought measured?</b>	<b>4</b>
<b>Has Oklahoma experienced drought?</b>	<b>6</b>
<b>The Climate of the Oklahoma</b>	<b>6</b>
<b>Region 1: Oklahoma Panhandle</b>	<b>7</b>
<b>Region 2: North-Central Oklahoma</b>	<b>12</b>
<b>Region 3: Northeast Oklahoma</b>	<b>17</b>
<b>Region 4: West-Central Oklahoma</b>	<b>22</b>
<b>Region 5: Central Oklahoma</b>	<b>27</b>
<b>Region 6: East-Central Oklahoma</b>	<b>32</b>
<b>Region 7: Southwest Oklahoma</b>	<b>37</b>
<b>Region 8: South-Central Oklahoma</b>	<b>42</b>
<b>Region 9: Southeast Oklahoma</b>	<b>47</b>
<b>Drought Resources</b>	<b>52</b>
<b>Acknowledgments</b>	<b>53</b>
<b>Bibliography</b>	<b>53</b>

## What is drought?

Defining drought can be difficult because the impacts associated with drought are often far-reaching and devastating. A *meteorological drought* is a prolonged period when precipitation is below “normal” for the location (Heim 2002). An *agricultural drought* occurs when soils are too dry to grow healthy vegetation, particularly crops or forests. As water becomes scarce in rivers, lakes, and other water bodies, a *hydrological drought* develops. If, at any time, the water demands of society (e.g., water for drinking, maintaining lawns and gardens, washing clothes) exceed the availability of good-quality water, then a *socioeconomic drought* has occurred. A socioeconomic drought may arise even during times of normal precipitation because of increased water demand from a growing population, increased temperatures and wind speeds, new businesses, or other societal changes.

## Why be prepared for drought?

Since 1998, the National Oceanic and Atmospheric Administration has identified 25 droughts nationwide as weather disasters based on both damages and costs in the amount of \$235.3 billion dollars; 14 of which directly affected Oklahoma. The 2012 drought, which at its height affected over 80% of the contiguous U.S., resulted in estimated damages and costs of over \$50 billion from both direct and indirect impacts.

Drought can result in crop, pasture, and forest damage; increased livestock and wildlife mortality; increased fire hazard; threats to aquatic and wildlife habitats; increased water demand; and reduced water supplies.

Proper management of water resources is necessary to protect supplies for drinking water, sanitation, and fire protection as well as to maintain economic activity and environmental sustainability. ***Because disasters affect families, neighbors, and businesses locally, community-level planning is necessary to reduce the vulnerability to drought in the Oklahoma Panhandle.***

## ***“Droughts-of-Record” in Oklahoma***

For purpose of planning, we consider the “drought-of-record” to be the drought with the worst environmental conditions rather than the drought with the worst recorded impacts. Hence, a shorter and less severe drought with high monetary losses in our recent past (e.g., during 2011) will not outweigh a long and severe drought in our early history, when fewer people lived in the region. We choose to prepare for the worst.

The longest period of dry conditions across Oklahoma undoubtedly was during the 1930s. We compared Palmer Drought Severity Indices for these droughts in Tables 1-9, as well as the most recent (hence, memorable) drought of 2011 to present (data through December 2012). Using these indices, the drought of the 1930s well exceeds the duration and intensity of all other droughts.

## **How to prepare for drought?**

Local officials and other key stakeholders in Oklahoma will be better prepared for drought when they complete the following: (1) have assessed their vulnerability to drought, (2) understand past droughts and the local climate, (3) monitor drought, (4) prepare a thorough set of actions to be taken before, during, and after a drought, and (5) educate citizens on this plan.

Having a plan in place will enable these individuals to understand key factors to monitor so they may respond proactively to drought conditions early. Following this plan helps reduce the risk such that, when drought conditions occur, water resources do not run out. This report will help governmental officials and resource managers in Oklahoma by overviewing the climate and drought history since record-keeping began in the late 19th century.

## **How is drought measured?**

To quantify drought severity, the scientific community has developed several methods to assess drought, including departure from normal precipitation, the Palmer Drought Severity Index, and the Standardized Precipitation Index. All three use weather observations to diagnose drought conditions. The simplest of these is the annual departure from normal precipitation, which is the actual precipitation total for the year subtracted from the annual normal. Large negative values indicate a precipitation deficit for that year.

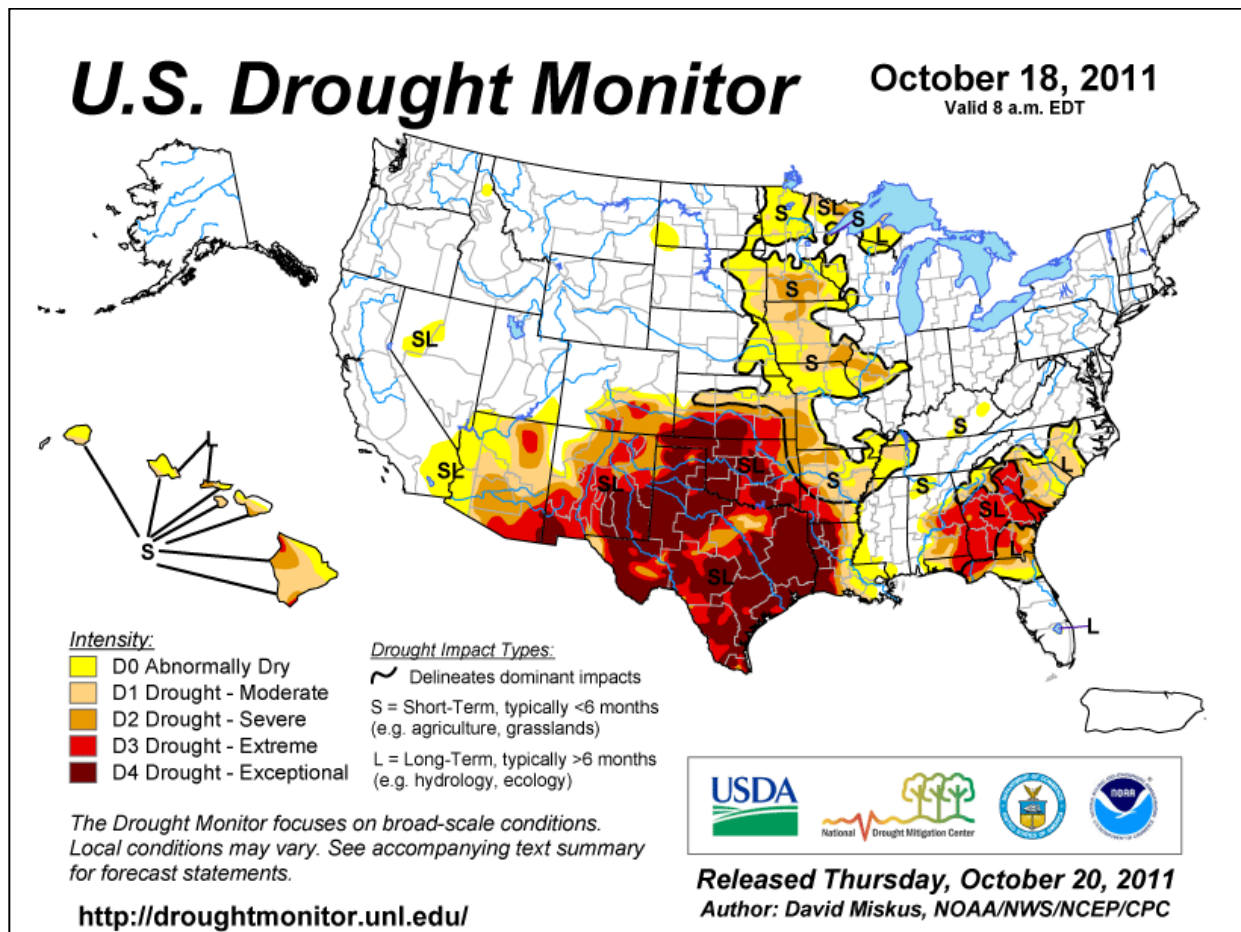
*The Palmer Drought Severity Index* uses observations or estimates of precipitation, temperature, and soil water content. Values typically range from +4 representing extremely wet conditions to -4 representing extremely dry conditions. Values less than -1 indicate some level of drought, and the values become more negative with less rainfall and hotter temperatures.

The Palmer Drought Severity Index helps to diagnose agricultural drought because it is sensitive to soil moisture conditions and works well at relatively long time scales. The index does not account for reservoir levels and streamflow, so it has drawbacks for diagnosing hydrological drought.

*The Standardized Precipitation Index* is based solely on precipitation but has the advantage of multiple time scales (e.g., 3 months, 6 months, 1 year) to better highlight short-term versus long-term droughts. Values typically range from +2 as extremely wet to -2 as extremely dry, with values less than -1 representing drought.

A more recent method to measure drought intensity is the U.S. Drought Monitor (Figure 1). This product depicts weekly drought conditions for the United States on a drought intensity scale of D0 to D4, with D0 representing areas that are abnormally dry and D4 representing areas of exceptional drought. Although the levels are subjectively determined, they are established through expert review of weather and water data, including local observations (e.g., Oklahoma Mesonet), as well as reports of drought impacts from local, tribal, state, and

federal officials as well as the public and media. Figure 1 displays the weekly percentage of area in each of Oklahoma’s region by D0 through D4 drought since 2000<sup>1</sup>.



**Figure 1.** Example map of the U.S. Drought Monitor from the drought assessment issued for the week preceding October 18, 2011. The color scale (yellow to dark red) displays the level of drought from D0 (abnormally dry) to D4 (exceptional drought). Significant regional impacts on agriculture are designated with an “S” and regional impacts on water supply are designated with an “L”. The maps are released each Thursday at 8:30 a.m. Eastern Time. Courtesy of the National Drought Mitigation Center.

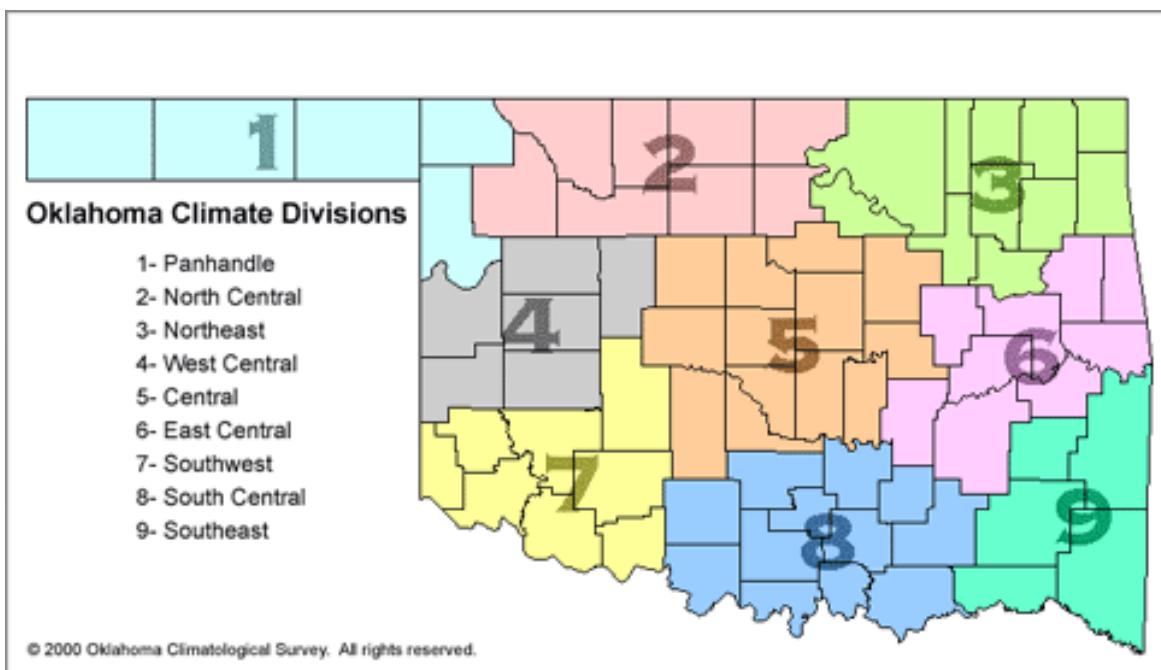
<sup>1</sup> Data provided by the National Drought Mitigation Center.

## Has Oklahoma experienced drought?

***Drought is a recurring condition in the Oklahoma***, and is part of our climate. Our climate history can provide us insight into what we may see in the future. Being “drought ready” means, in part, that we recognize how our climate has changed over time. This report examines Oklahoma’s drought history.

### The Climate of the Oklahoma

Temperature and precipitation are the two main elements of our climate. Because Oklahoma is located in the middle latitudes, east of the Rocky Mountains and far northwest of the Gulf of Mexico, its citizens experience a wide range of weather conditions. Hence, our climate is highly variable, from year to year, season to season, and month to month.

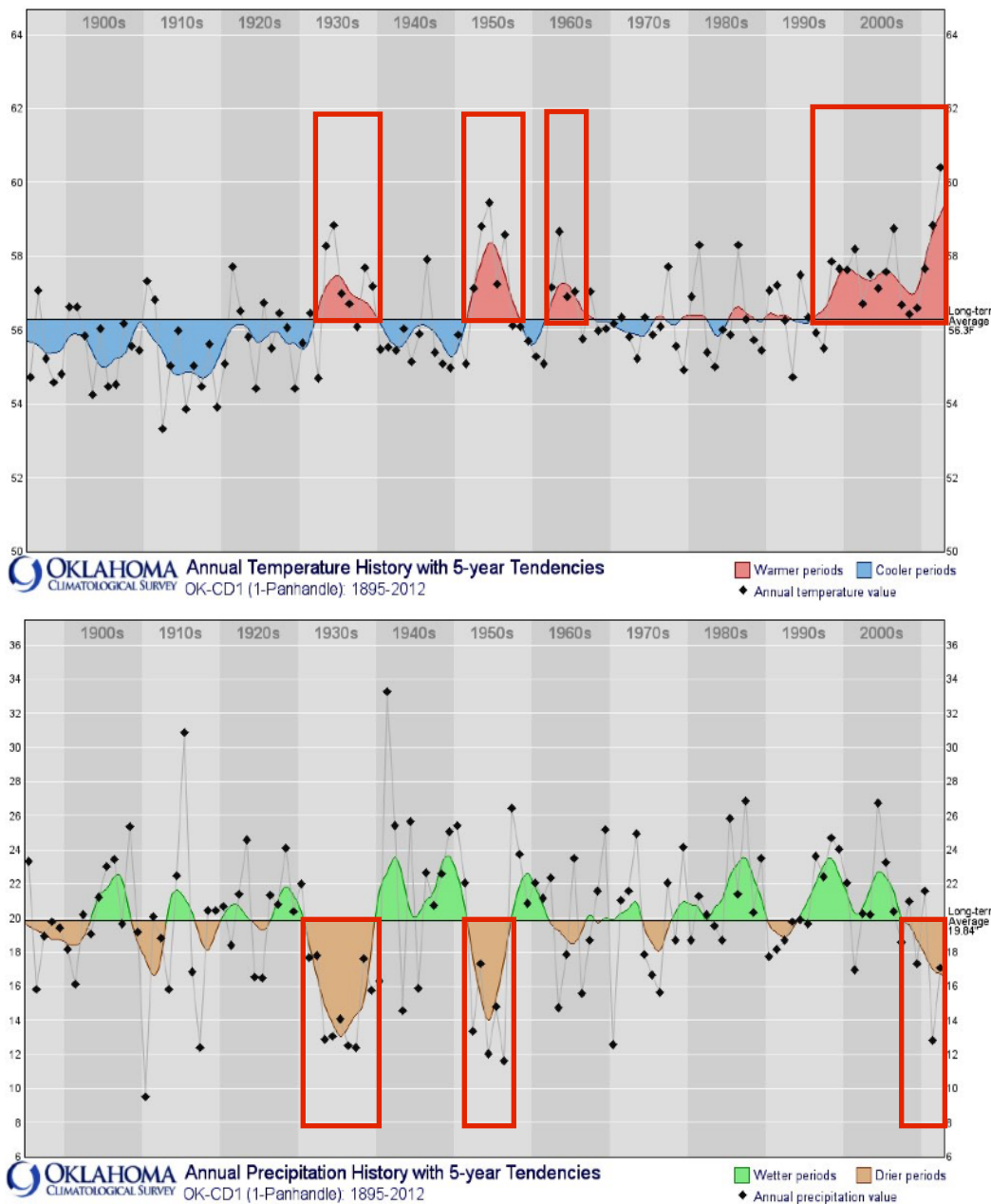


**Figure 2.** Map of the climate divisions of Oklahoma, aligned with county boundaries.<sup>2</sup>

<sup>2</sup> Data from the National Climatic Data Center and obtained from the Oklahoma Climatological Survey (<http://climate.ok.gov>).

# Region 1: Oklahoma Panhandle

The Oklahoma Panhandle has experienced a wide range of temperatures and precipitation over the past several decades. Abnormally hot and dry conditions have occurred multiple times since the early 1900s. Figure 3 shows the annual temperature (top) and annual precipitation (bottom) in the Oklahoma Panhandle since 1895.<sup>3</sup> The annual temperature for the Oklahoma Panhandle averages 56.19 degrees Fahrenheit, while precipitation averages 19.84 inches. Warmer-than-average periods have spanned the 1930s, the mid-1950s, the mid-1960s, and the late 1990s through the early 2010s. Significant periods drier-than-average conditions include the 1930s and mid-1950s.



**Figure 3.** The average annual temperature (top graph) and total annual precipitation (bottom graph) in the Oklahoma Panhandle from 1895 to 2012. To highlight warmer, cooler, wetter, or drier periods, 5-year moving averages are shaded. On the top graph, red shading (above the horizontal line) indicates warmer periods and blue shading (below the line) notes cooler periods than average. Similarly, on the bottom graph, green shading (above the horizontal line) highlights wetter periods and brown shading (below the line) highlights drier periods than average. Extended periods of relatively warm temperatures or low precipitation are outlined in red boxes.

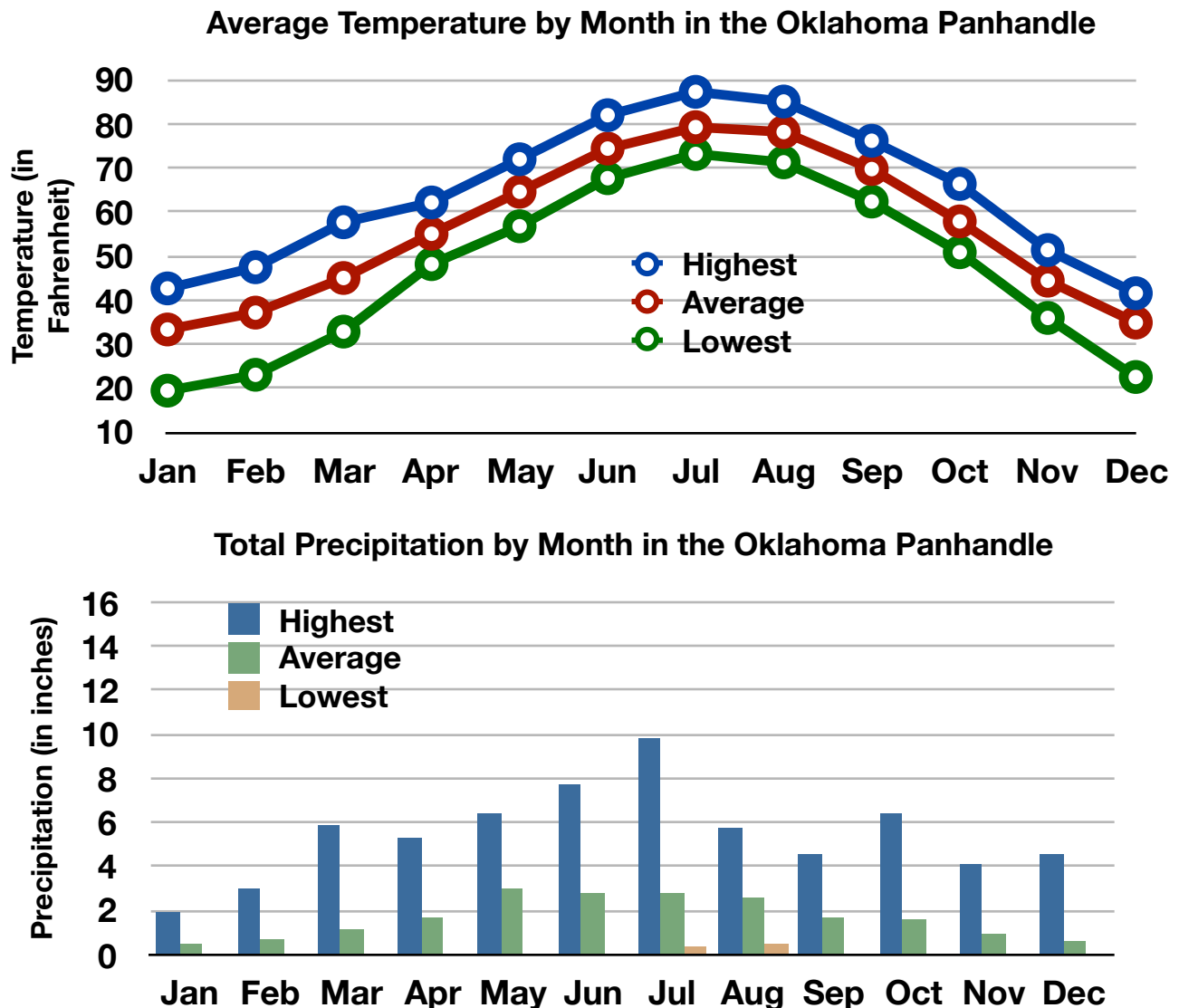
The longest drought experienced in this region lasted 97 months, with several periods of intense drought throughout. Because of its intense heat combined with non-stop dry conditions, June 1952 to February 1957 comes in second for the drought-of-record for the Oklahoma Panhandle.

**Table 1: Comparison of Palmer Drought Severity Indices (PDSI) for Several Droughts Affecting the Oklahoma Panhandle**

Time Period	Months with PDSI less than -1	Months with PDSI less than -4	Lowest PDSI Value
October 1932 - October 1940	97 (of 97 months)	11 consecutive, 9 consecutive, plus 13 other	-5.91
June 1952 - February 1957	57 (of 57 months)	20 consecutive, 10 consecutive, plus 1 other	-6.04
March 2011 - December 2012*	16 (of 22 months)	4 consecutive	-5.09

*\*Note: Data only available through December 2012; drought conditions may have continued past this date.*

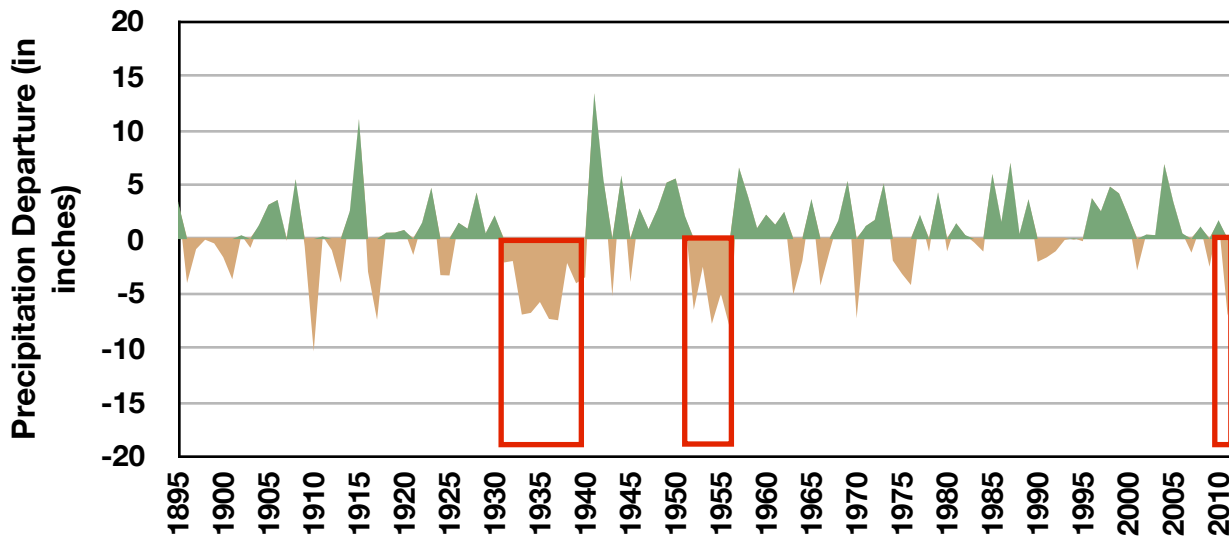
To understand when there is the greatest stress on water availability for the Oklahoma Panhandle, the average monthly temperature and precipitation, as well as their average highest and lowest monthly values, are shown in Figure 4. Warmer temperatures result in greater water loss by evaporation and transpiration. The warmest temperatures typically occur during July and August (top of Figure 4).



**Figure 4.** *Top graph:* The monthly average temperature (in degrees Fahrenheit) across the Oklahoma Panhandle using data from 1895 to 2012. The red (middle) line is the average of all climate-division average temperatures for that time period. The blue (top) line is the highest monthly average and the green (bottom) line is the lowest. *Bottom graph:* The average total precipitation (in inches) by month across the Oklahoma Panhandle using data from 1895 to 2012. The blue (leftmost of each monthly cluster) bar is the highest monthly precipitation; the green (middle of the cluster) is the average precipitation total recorded for that month; the gold (rightmost) is the lowest precipitation total recorded for that month. [Note that zero precipitation has occurred at least once during February, March, April, May, November, and December] The three peaks of precipitation, first in March, then in July, and then in October, are clearly visible.

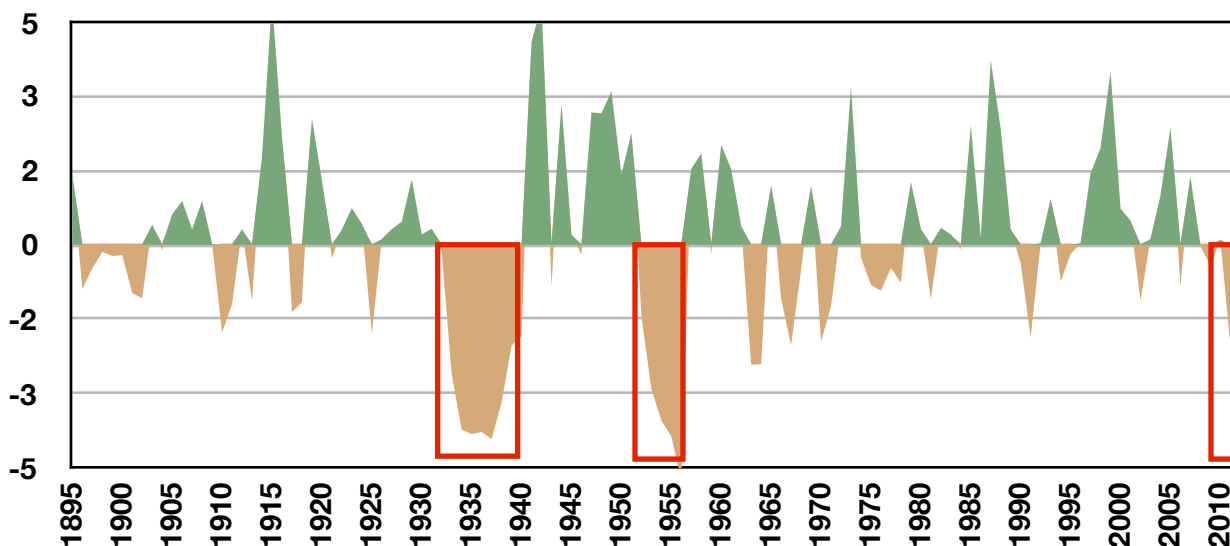
The Oklahoma Panhandle has experienced long and extreme droughts in its past. Figure 5 displays the departure from normal precipitation, and Palmer Drought Severity Index for the Oklahoma Panhandle from 1895 to 2012. Red boxes outline the same drier-than-average periods highlighted in Figure 3.

### Annual Departure from Normal Precipitation for the Oklahoma Panhandle



**Figure 5a.** Annual departure from normal precipitation (actual precipitation total for the year subtracted from the annual normal) for the Oklahoma Panhandle from 1895 to 2012.

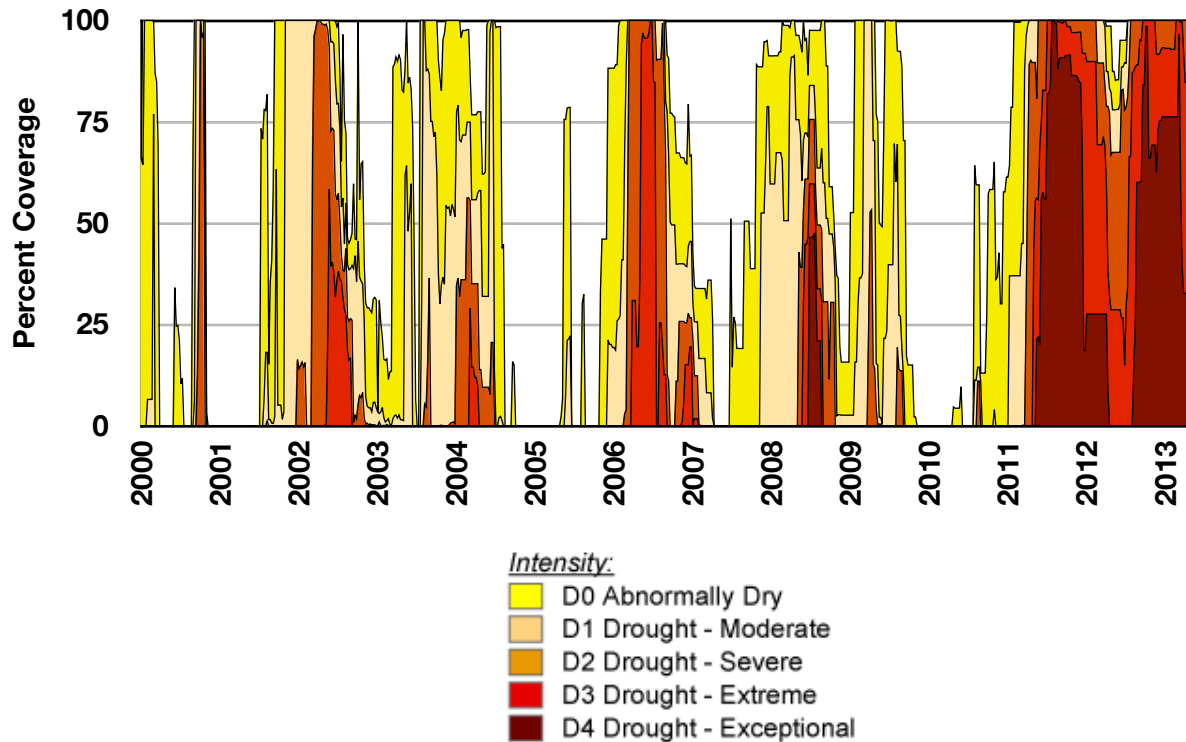
### Palmer Drought Severity Index for the Oklahoma Panhandle



**Figure 5b.** Palmer Drought Severity Index for the Oklahoma Panhandle from 1895 to 2012.

The panhandle has experienced abnormally dry conditions from 2000 to 2013. In Figure 6 we look at drought designation in the region and see that from 2006-2007 extreme conditions covered almost 100% of the region. In 2011-2013 the region experienced exceptional drought also covering nearly 100%.

### Percent of the Oklahoma Panhandle Covered by a Drought Designation

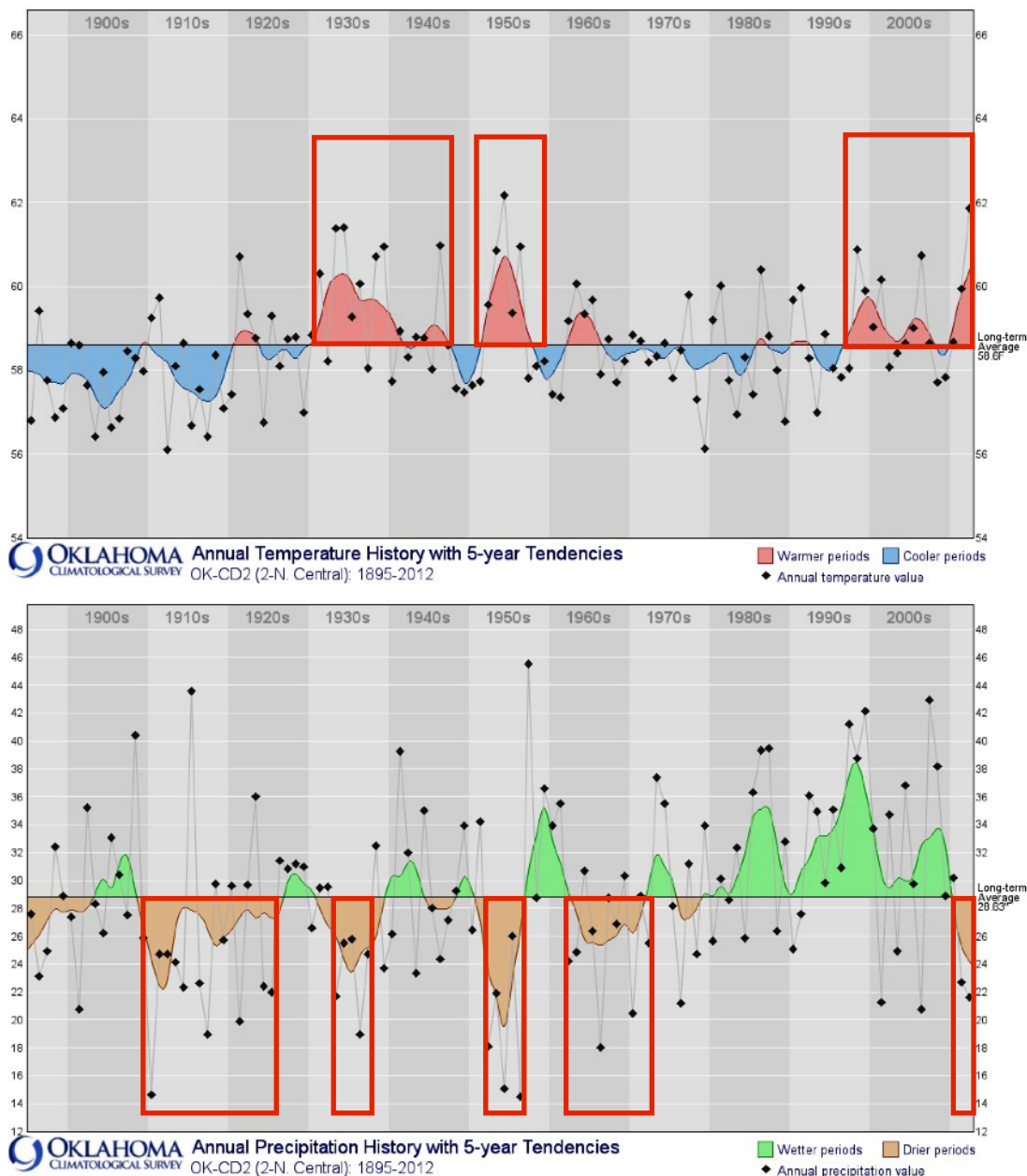


**Figure 6.** Drought history for the Oklahoma Panhandle as designated by the U.S. Drought Monitor. The color scale is identical to that in Figure 5. Note that the Oklahoma Panhandle was experiencing extreme drought (bright red) across most of the area during much of 2006 and extreme to exceptional drought (dark red) across most of the area during much of 2006 and 2011 to present (data through March 2013). Data courtesy of the National Drought Mitigation Center.

For more information on the sources of drought information, see Table 10 on page 52.

## Region 2: North-Central Oklahoma

North-Central Oklahoma has experienced a wide range of temperatures and precipitation over the past several decades. Abnormally hot and dry conditions have occurred multiple times since the early 1900s. Figure 7 shows the annual temperature (top) and annual precipitation (bottom) in north-central Oklahoma since 1895.<sup>4</sup> The annual temperature for north-central Oklahoma averages 58.5 degrees Fahrenheit, while precipitation averages 28.8 inches. Warmer-than-average periods have spanned the 1920s through the mid 1940s, the mid-1950s, and the late 1990s through the 2000s. Significant periods of drier-than-average conditions include the 1910s, 1930s, mid-1950s, mid-1960s, and the late 1970s.



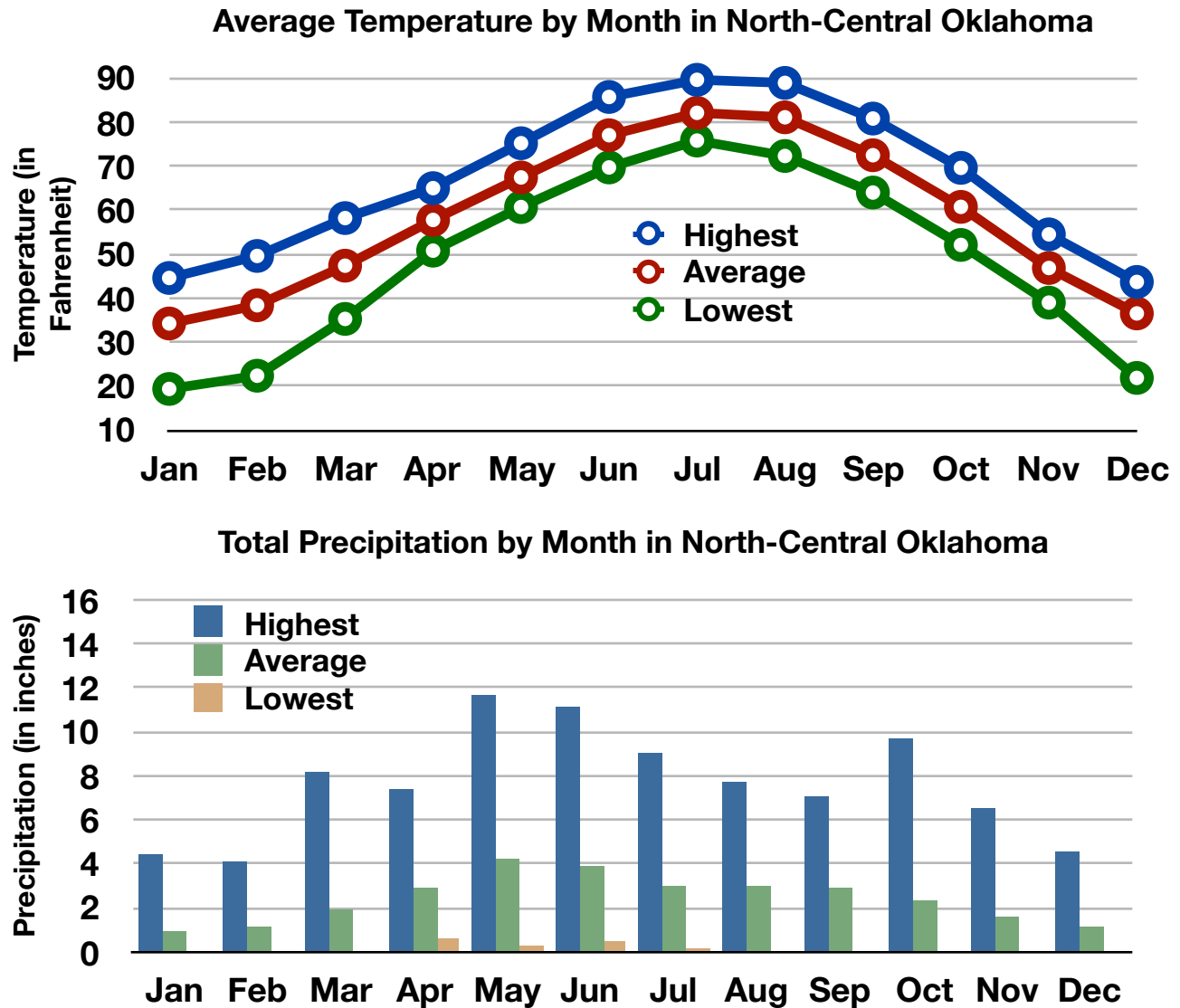
Options for the drought-of-record in this region include the droughts in the 1910s, late 1930s, and mid-1950s. The longest period of dry conditions undoubtedly was during the 1910s and 1920's. Table 2 compares Palmer Drought Severity Indices for these droughts and others. Using these indices, the drought of the 1950s well exceeds the intensity of all other droughts; hence, ***the period from January 1950 to February 1957 is the drought-of-record for north-central Oklahoma.***

**Table 2: Comparison of Palmer Drought Severity Indices (PDSI) for Several Droughts Affecting North-Central Oklahoma**

Time Period	Months with PDSI less than -1	Months with PDSI less than -4	Lowest PDSI Value
September 1909 – June 1926	98 (of 202 months)	2	-4.39
May 1933 – October 1940	72 (of 90 months)	3	-5.43
January 1950 – February 1957	66 (of 86 months)	12 consecutive, 11 consecutive, and 4 others	-6.94
February 1962 – June 1972	63 (of 124 months)	1	-4.35
January 2011 – December 2012*	16 (of 24 months)	3 consecutive plus one other	-4.2

**\*Note:** Data only available through December 2012; drought conditions may have continued past this date.

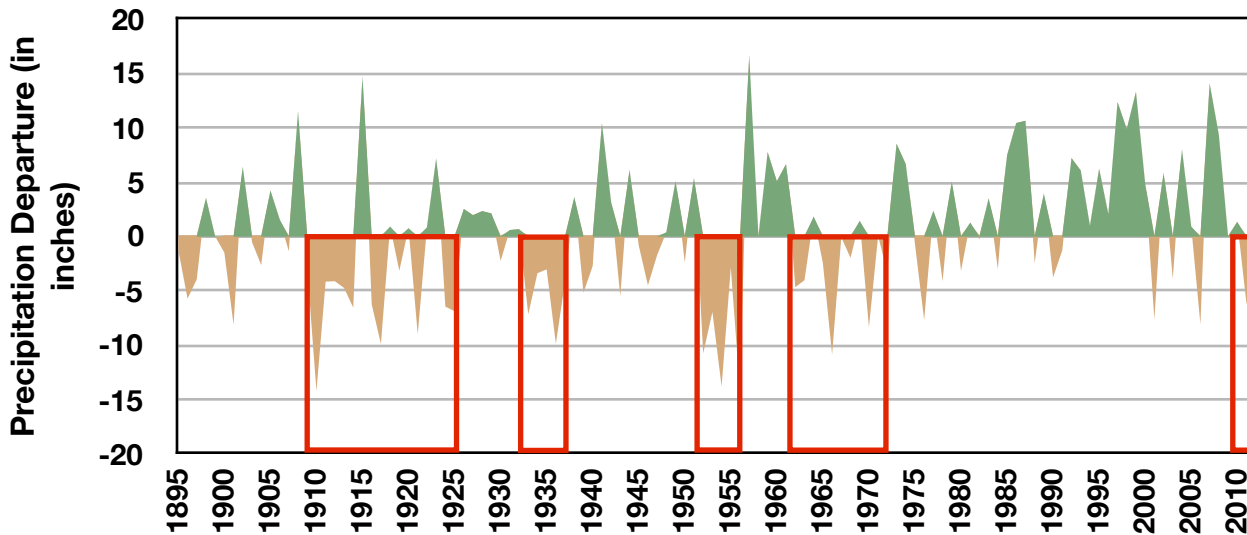
To understand when there is the greatest stress on water availability for north-central Oklahoma, the average monthly temperature and precipitation, as well as their average highest and lowest monthly values, are shown in Figure 8. Warmer temperatures result in greater water loss by evaporation and transpiration. The warmest temperatures typically occur during July and August (top of Figure 8).



**Figure 8.** *Top graph:* The monthly average temperature (in degrees Fahrenheit) across north-central Oklahoma using data from 1895 to 2012. The red (middle) line is the average of all climate-division average temperatures for that time period. The blue (top) line is the highest monthly average and the green (bottom) line is the lowest. *Bottom graph:* The average total precipitation (in inches) by month across north-central Oklahoma using data from 1895 to 2012. The blue (leftmost of each monthly cluster) bar is the highest monthly precipitation; the green (middle of the cluster) is the average precipitation total recorded for that month; the gold (rightmost) is the lowest precipitation total recorded for that month. [Note that zero precipitation has occurred at least once during January, February, March, October, November, and December.] The two peaks of precipitation, first in May, and then in June, are clearly visible.

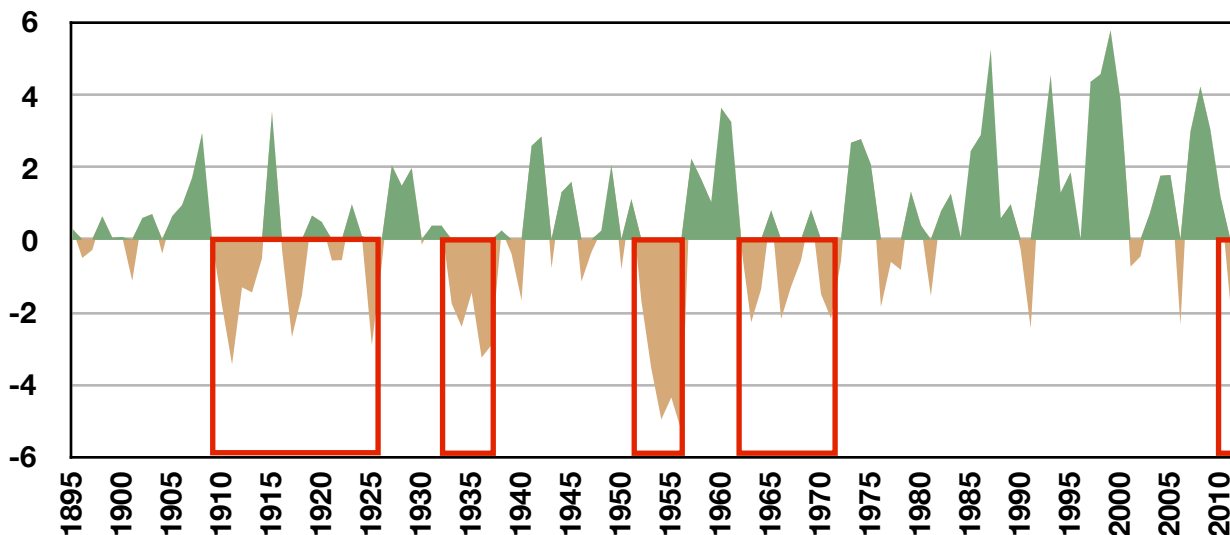
North-central Oklahoma has experienced long and extreme droughts in its past. Figure 9 displays the departure from normal precipitation and Palmer Drought Severity Index for north-central Oklahoma from 1895 to 2012. Red boxes outline the same drier-than-average periods highlighted in Figure 7.

### Annual Departure from Normal Precipitation for North-Central Oklahoma



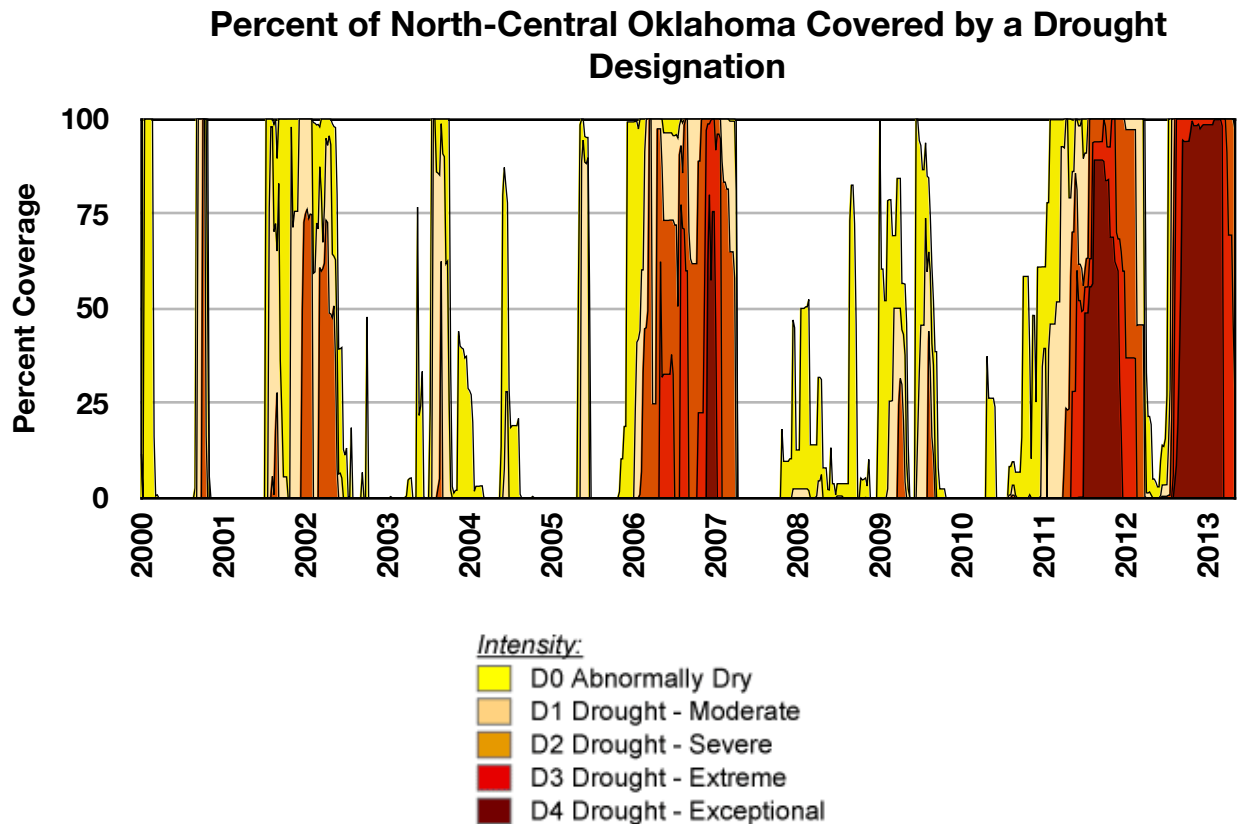
*Figure 9a.* Annual departure from normal precipitation (actual precipitation total for the year subtracted from the annual normal) for north-central Oklahoma from 1895 to 2012.

### Palmer Drought Severity Index for North-Central Oklahoma



*Figure 9b.* Palmer Drought Severity Index for north-central Oklahoma from 1895 to 2012.

North-Central Oklahoma experienced abnormally dry conditions in years 2000 to 2013. In Figure 10 we look at drought designation and see that from 2006-2007 more extreme conditions covered almost 100% of the region. In 2011-2013 the region experienced exceptional drought also covering nearly 100%.

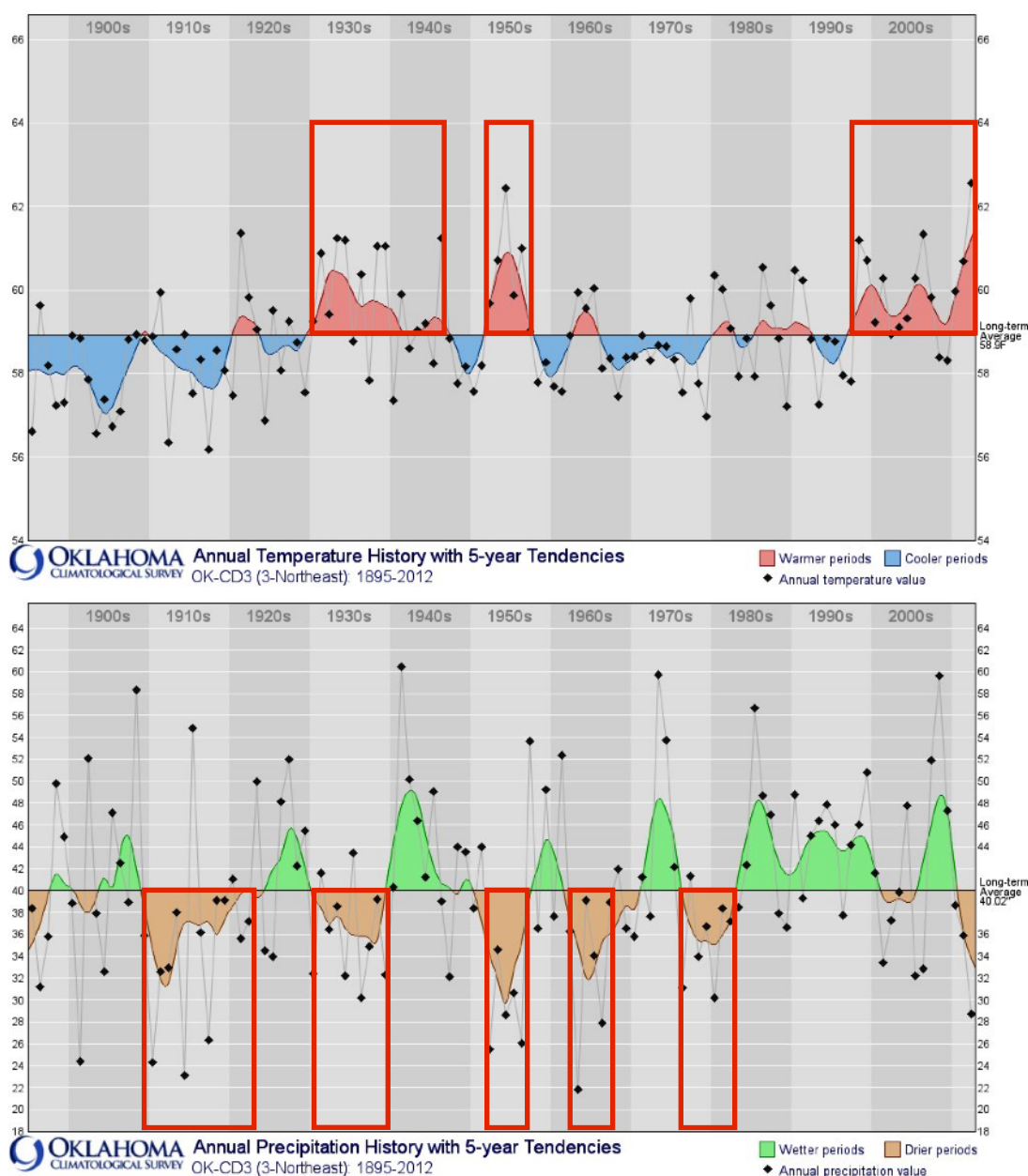


**Figure 10** Drought history for north-central Oklahoma as designated by the U.S. Drought Monitor. The color scale is identical to that in Figure 1. Note that north-central Oklahoma was experiencing extreme (bright red) to exceptional drought (dark red) across most of the climate division during much of 2006 and 2011 to present (data through March 2013). Data courtesy of the National Drought Mitigation Center.

For more information on the sources of drought information, see Table 10 on page 52.

## Region 3: Northeast Oklahoma

Northeast Oklahoma has experienced a wide range of temperatures and precipitation over the past several decades. Abnormally hot and dry conditions have occurred multiple times since the early 1900s. Figure 11 shows the annual temperature (top) and annual precipitation (bottom) in northeastern Oklahoma since 1895.<sup>5</sup> The annual temperature for northeastern Oklahoma averages 58.8 degrees Fahrenheit, while precipitation averages 40.0 inches. Warmer-than-average periods have spanned the 1920s through the mid 1940s, the mid-1950s, and the late 1990s through the 2000s. Significant periods of drier-than-average conditions include the 1910s, 1930s, mid-1950s, mid-1960s, and the late 1970s.



**Figure 11.** The average annual temperature (top graph) and total annual precipitation (bottom graph) in northeastern Oklahoma from 1895 to 2012. To highlight warmer, cooler, wetter, or drier periods, 5-year moving averages are shaded. On the top graph, red shading (above the horizontal line) indicates warmer periods and blue shading (below the line) notes cooler periods than average. Similarly, on the bottom graph, green shading (above the horizontal line) highlights wetter periods and brown shading (below the line) highlights drier periods than average. Extended periods of relatively warm temperatures or low precipitation are outlined in red boxes.

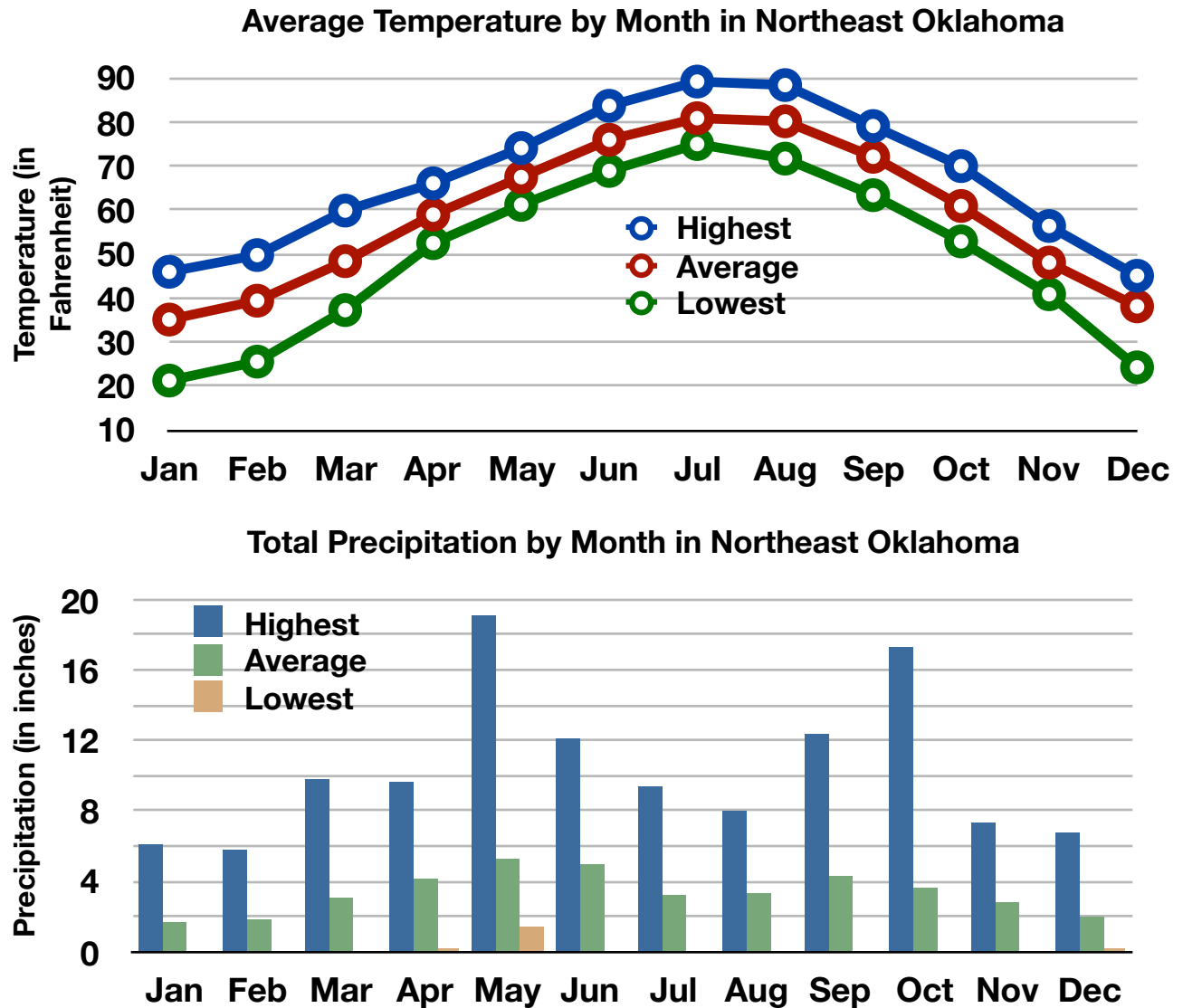
Options for the drought-of-record in this region include the droughts in the 1910s, late 1930s, and mid-1950s. The longest period of dry conditions undoubtedly was during the 1910s. Table 3 compares Palmer Drought Severity Indices for these droughts and others. Using these indices, the drought of the 1950s exceeds the intensity of all other droughts; hence, ***the period from January 1952 to August 1958 is the drought-of-record for northeastern Oklahoma.***

Because of its non-stop dry conditions, ***January 1909 through August 1918 comes in second for the drought-of-record for northeastern Oklahoma.***

**Table 3: Comparison of Palmer Drought Severity Indices (PDSI) for Several Droughts Affecting Northeast Oklahoma**

Time Period	Months with PDSI less than -1	Months with PDSI less than -4	Lowest PDSI Value
January 1909 – August 1918	77 (of 116 months)	7 consecutive plus 1 others	-6.09
February 1930 – March 1940	63 (of 122 months)	2	-4.96
January 1952 – February 1958	60 (of 74 months)	12 consecutive plus 5 consecutive	-5.55
February 1962 – March 1967	38 (of 62 months)	6 consecutive	-4.94
October 1975 – October 1982	24 (of 72 months)	0	-3.73

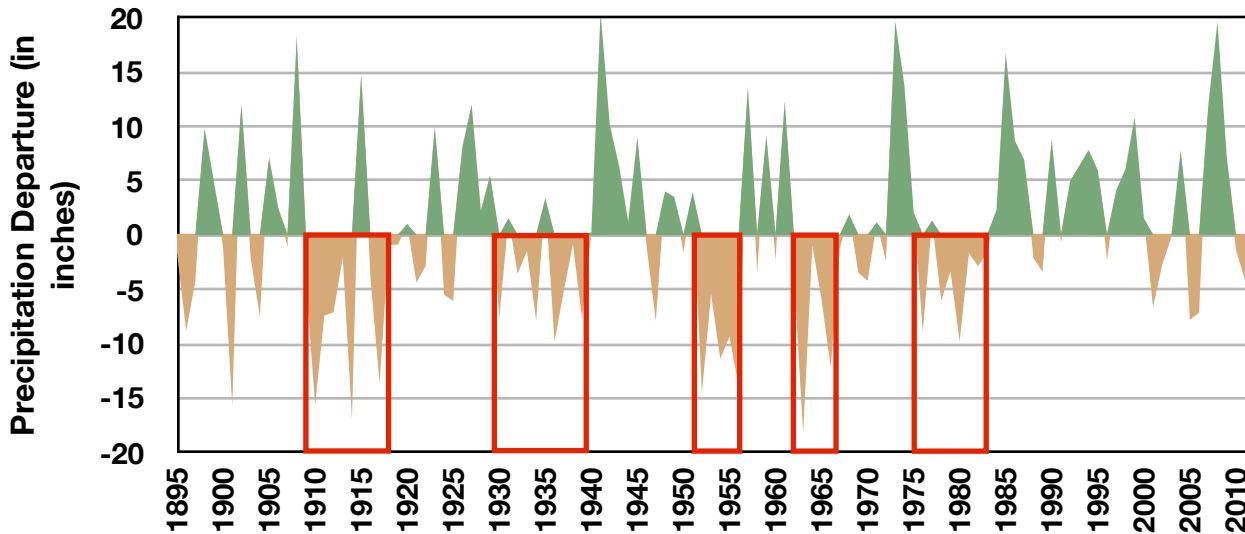
To understand when there is the greatest stress on water availability for northeastern Oklahoma, the average monthly temperature and precipitation, as well as their average highest and lowest monthly values, are shown in Figure 12. Warmer temperatures result in greater water loss by evaporation and transpiration. The warmest temperatures typically occur during July and August (top of Figure 12).



**Figure 12.** *Top graph:* The monthly average temperature (in degrees Fahrenheit) across northeastern Oklahoma using data from 1895 to 2012. The red (middle) line is the average of all climate-division average temperatures for that time period. The blue (top) line is the highest monthly average and the green (bottom) line is the lowest. *Bottom graph:* The average total precipitation (in inches) by month across northeastern Oklahoma using data from 1895 to 2012. The blue (leftmost of each monthly cluster) bar is the highest monthly precipitation; the green (middle of the cluster) is the average precipitation total recorded for that month; the gold (rightmost) is the lowest precipitation total recorded for that month. [Note that zero precipitation has occurred at least once during March, July, and November.] The two peaks of precipitation, first in May and then in October, are clearly visible.

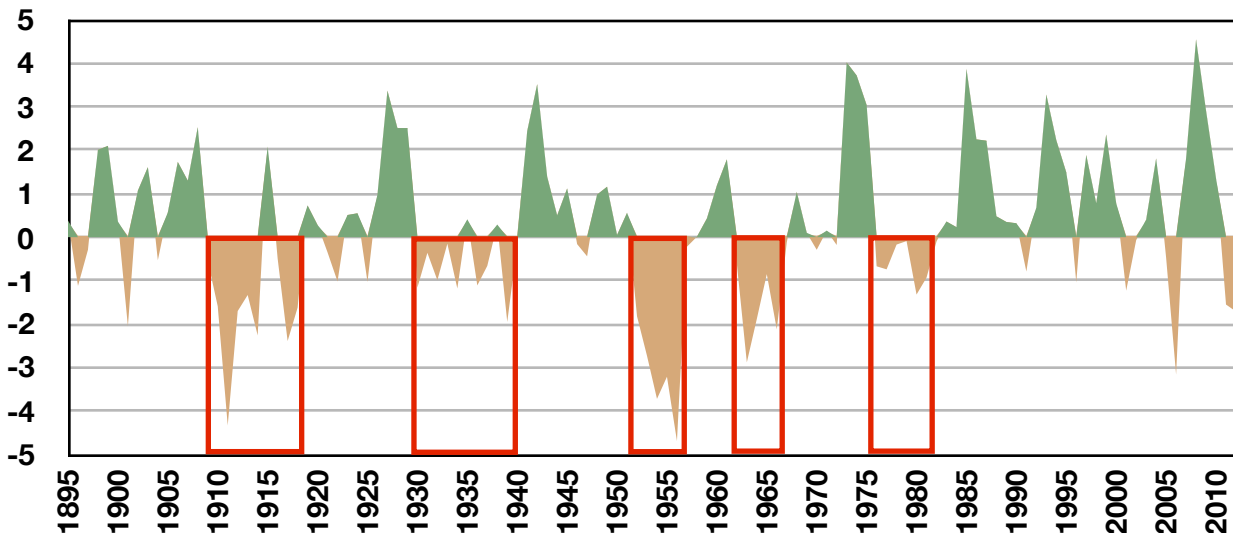
Northeastern Oklahoma has experienced long and extreme droughts in its past. Figure 13 displays the departure from normal precipitation and Palmer Drought Severity Index for northeastern Oklahoma from 1895 to 2012. Red boxes outline the same drier-than-average periods highlighted in Figure 11.

### Annual Departure from Normal Precipitation for Northeast Oklahoma



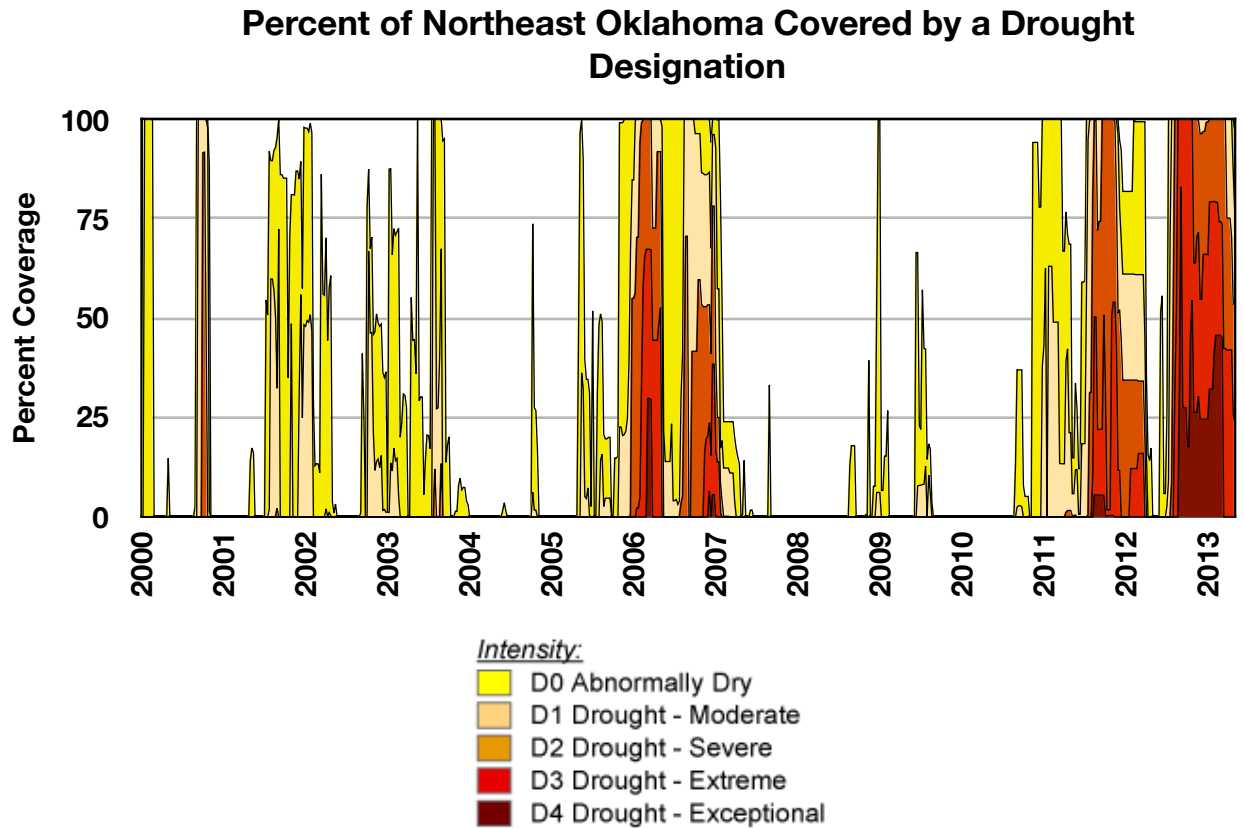
*Figure 13a. Annual departure from normal precipitation (actual precipitation total for the year subtle acted from the annual normal) for northeastern Oklahoma from 1895 to 2012.*

### Palmer Drought Severity Index for Northeast Oklahoma



*Figure 13b. Palmer Drought Severity Index for Northeastern Oklahoma from 1895 to 2012.*

Northeast Oklahoma experienced abnormally dry conditions from 2000 to 2003. In Figure 14 we look at drought designation in the region and see that from 2006-2007, more extreme conditions covered almost 100% of the region. In 2011-2013 the region experienced extreme to exceptional drought also covering nearly 100%.

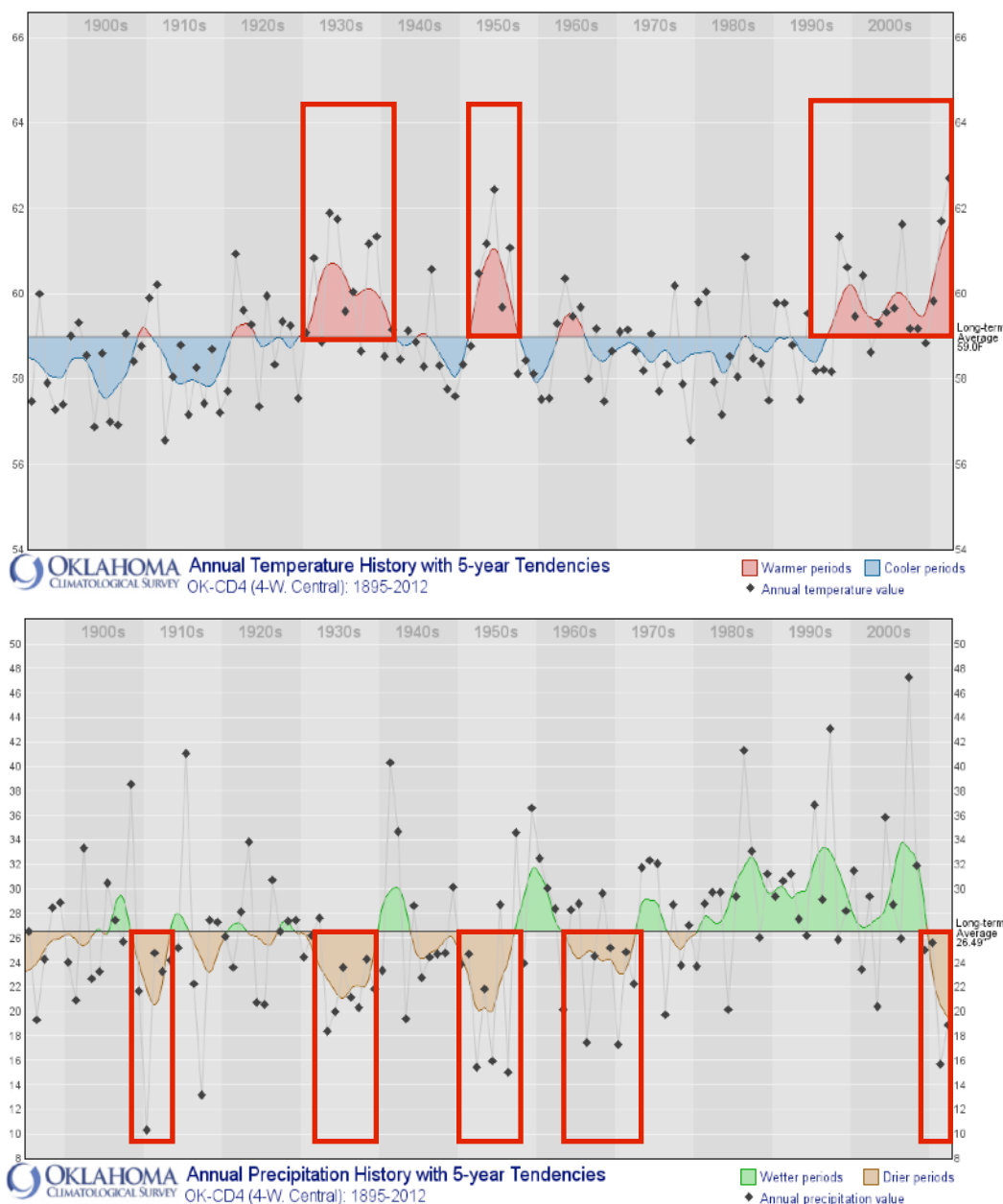


**Figure 14.** Drought history for northeastern Oklahoma as designated by the U.S. Drought Monitor. The color scale is identical to that in Figure 1. Note that northeastern Oklahoma was experiencing extreme (bright red) to exceptional drought (dark red) across most of the climate division during much of 2006 and 2011 to present (data through March 2013). Data courtesy of the National Drought Mitigation Center.

For more information on the sources of drought information, see Table 10 on page 52.

## Region 4: West-Central Oklahoma

West-Central Oklahoma has experienced a wide range of temperatures and precipitation over the past several decades. Abnormally hot and dry conditions have occurred multiple times since the early 1900s. Figure 15 shows the annual temperature (top) and annual precipitation (bottom) in west-central Oklahoma since 1895.<sup>6</sup> The annual temperature for west-central Oklahoma averages 58.90 degrees Fahrenheit, while precipitation averages 26.49 inches. Warmer-than-average periods have spanned the 1930s, the mid-1950s, and the late 1990s through the early 2010s. Significant periods of drier-than-average conditions include the 1910s, 1930s, mid-1940s through the 1950s, mid-1960s through early 1970s, and the early 2010s.



**Figure 15.** The average annual temperature (*top graph*) and total annual precipitation (*bottom graph*) in west-central Oklahoma from 1895 to 2012. To highlight warmer, cooler, wetter, or drier periods, 5-year moving averages are shaded. On the top graph, red shading (above the horizontal line) indicates warmer periods and blue shading (below the line) notes cooler periods than average. Similarly, on the bottom graph, green shading (above the horizontal line) highlights wetter periods and brown shading (below the line) highlights drier periods than average. Extended periods of relatively warm temperatures or low precipitation are outlined in red boxes.

Options for the drought-of-record in this region include the droughts in the 1930s and 1950s. The period with the longest duration of PDSI less than -4 is undoubtedly the 1950s. Table 4 compares Palmer Drought Severity Indices for these droughts and others. Using these indices, the drought of the 1950s exceeds intensity of all other droughts; hence, ***the period from February 1950 to February 1957 is the drought-of-record for west-central Oklahoma.***

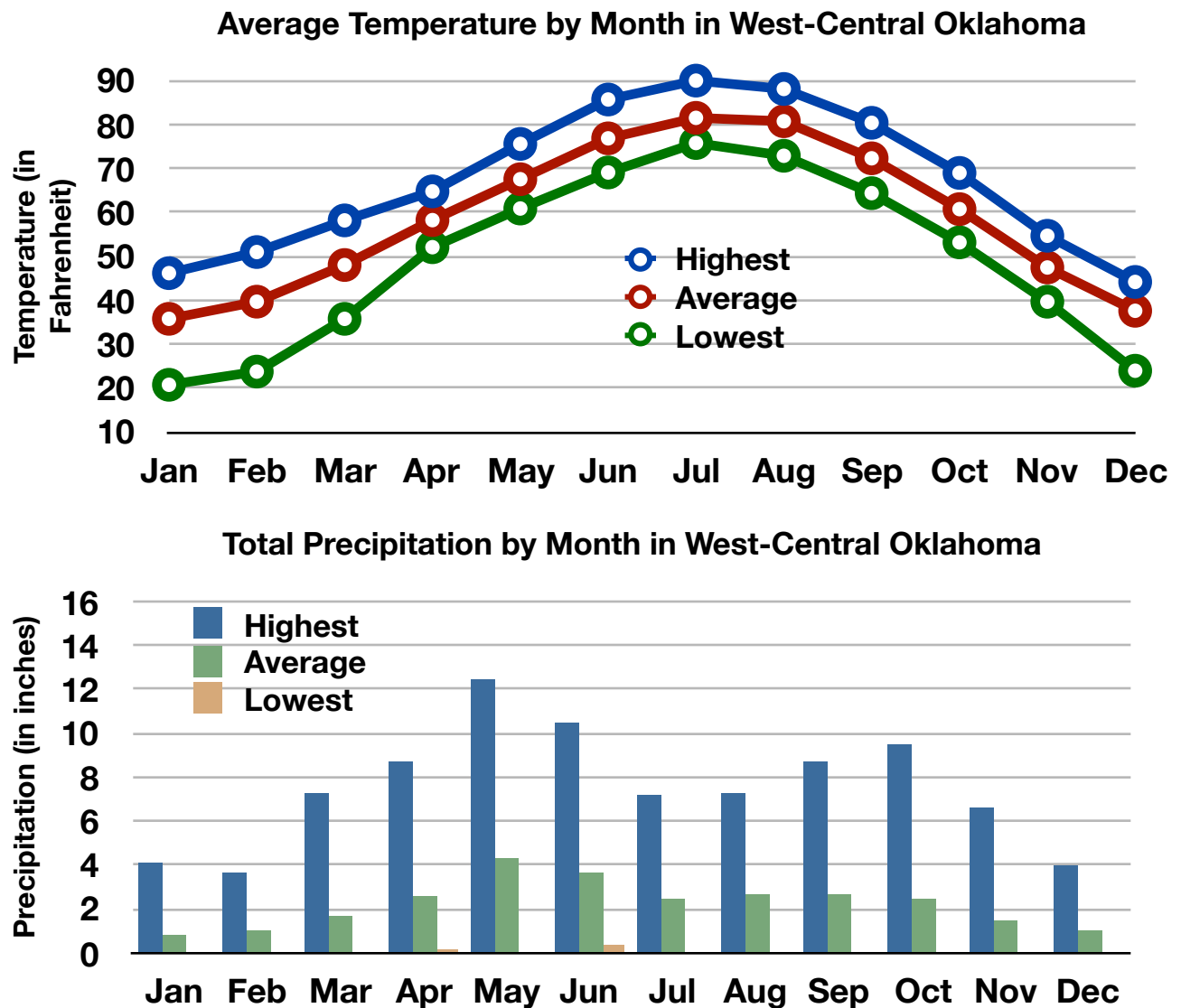
Because of its intense heat combined with non-stop dry conditions, ***May 1933 to October 1940 comes in second for the drought-of-record for west-central Oklahoma.***

**Table 4: Comparison of Palmer Drought Severity Indices (PDSI) for Several Droughts Affecting West-Central Oklahoma**

Time Period	Months with PDSI less than -1	Months with PDSI less than -4	Lowest PDSI Value
August 1909 - November 1911	26 (of 28 months)	5 consecutive plus 3 other	-5.4
May 1933 - October 1940	87 (of 90 months)	2 consecutive plus 2 other	-5.25
February 1950 - February 1957	72 (of 84 months)	8 consecutive, 7 consecutive, plus 11 other	-5.34
April 1963 - September 1972	75 (of 114 months)	5 consecutive	-4.85
January 2011 - December 2012*	24 (of 24 months)	6 consecutive	-6.19

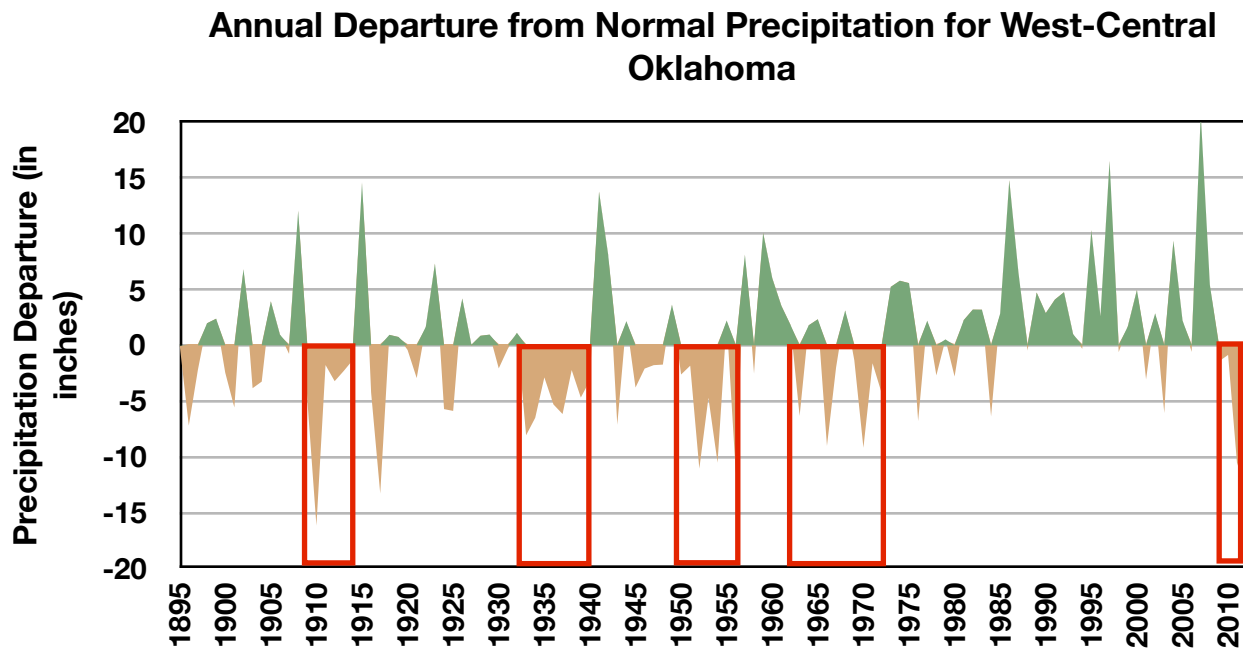
***\*Note:*** Data only available through December 2012; drought conditions may have continued past this date.

To understand when there is the greatest stress on water availability for northeastern Oklahoma, the average monthly temperature and precipitation, as well as their average highest and lowest monthly values, are shown in Figure 16. Warmer temperatures result in greater water loss by evaporation and transpiration. The warmest temperatures typically occur during July and August (top of Figure 16).

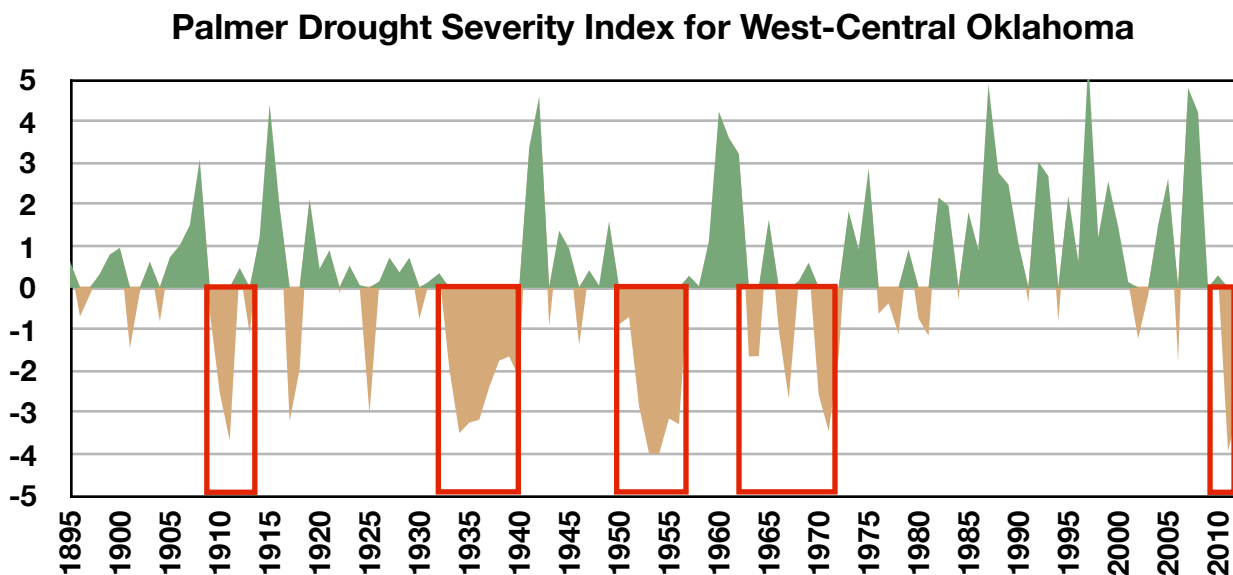


**Figure 16.** *Top graph:* The monthly average temperature (in degrees Fahrenheit) across west-central Oklahoma using data from 1895 to 2012. The red (middle) line is the average of all climate-division average temperatures for that time period. The blue (top) line is the highest monthly average and the green (bottom) line is the lowest. *Bottom graph:* The average total precipitation (in inches) by month across west-central Oklahoma using data from 1895 to 2012. The blue (leftmost of each monthly cluster) bar is the highest monthly precipitation; the green (middle of the cluster) is the average precipitation total recorded for that month; the gold (rightmost) is the lowest precipitation total recorded for that month. [Note that zero precipitation has occurred at least once during January, February, March, May, October, November, and December] The two peaks of precipitation, first in May and then in October, are clearly visible.

West-central Oklahoma has experienced long and extreme droughts in its past. Figure 17 displays the departure from normal precipitation and Palmer Drought Severity Index for west-central Oklahoma from 1895 to 2012. Red boxes outline the same drier-than-average periods highlighted in Figure 15.

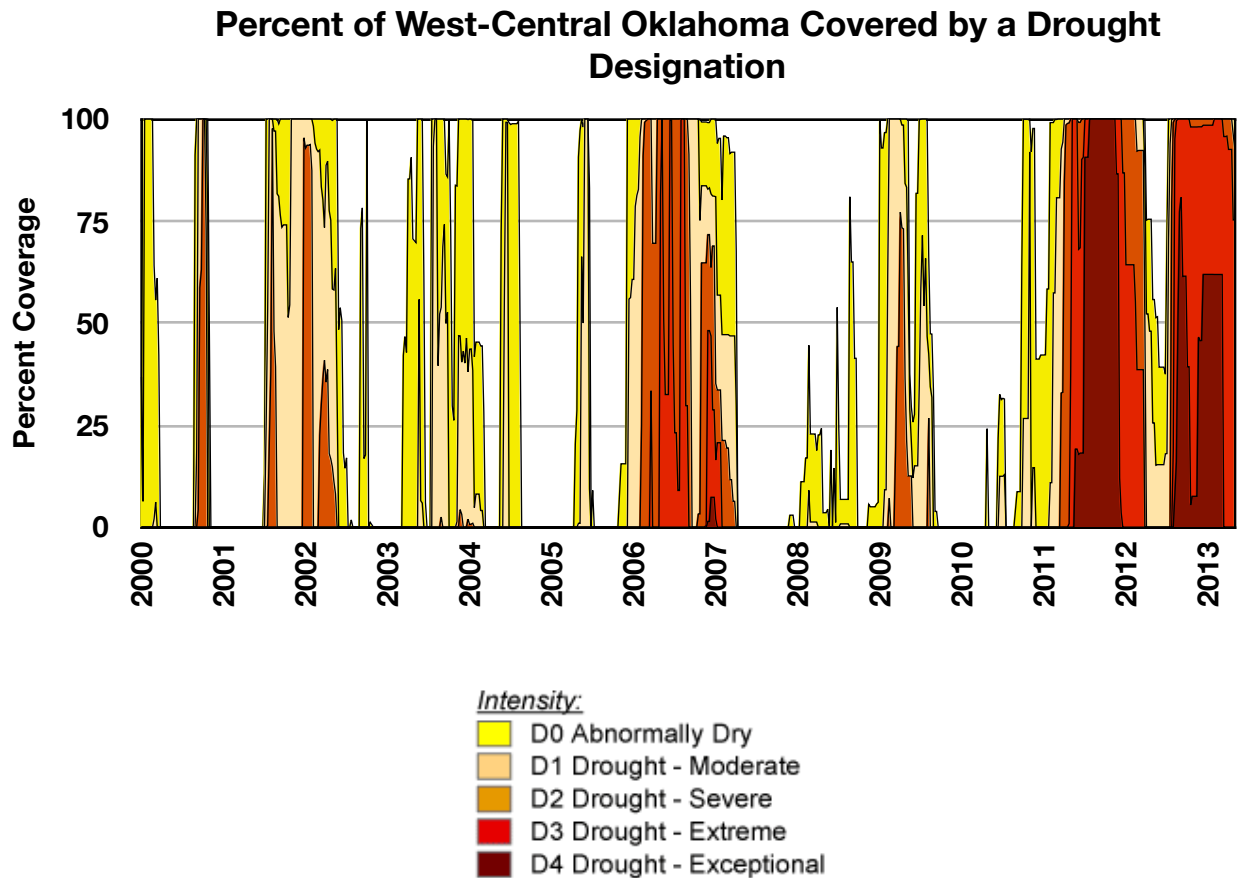


*Figure 17a.* Annual departure from normal precipitation (actual precipitation total for the year subtracted from the annual normal) for west-central Oklahoma from 1895 to 2012.



*Figure 17b.* Palmer Drought Severity Index for west-central Oklahoma from 1895 to 2012.

West-Central Oklahoma experienced abnormally dry conditions. from the year 2000 to 2013 In Figure 18 we look at drought designation in the region and see that from 2006 to 2007 extreme conditions covered almost 100% of the region. In 2011-2013 the region experienced extreme to exceptional drought also covering nearly 100%.

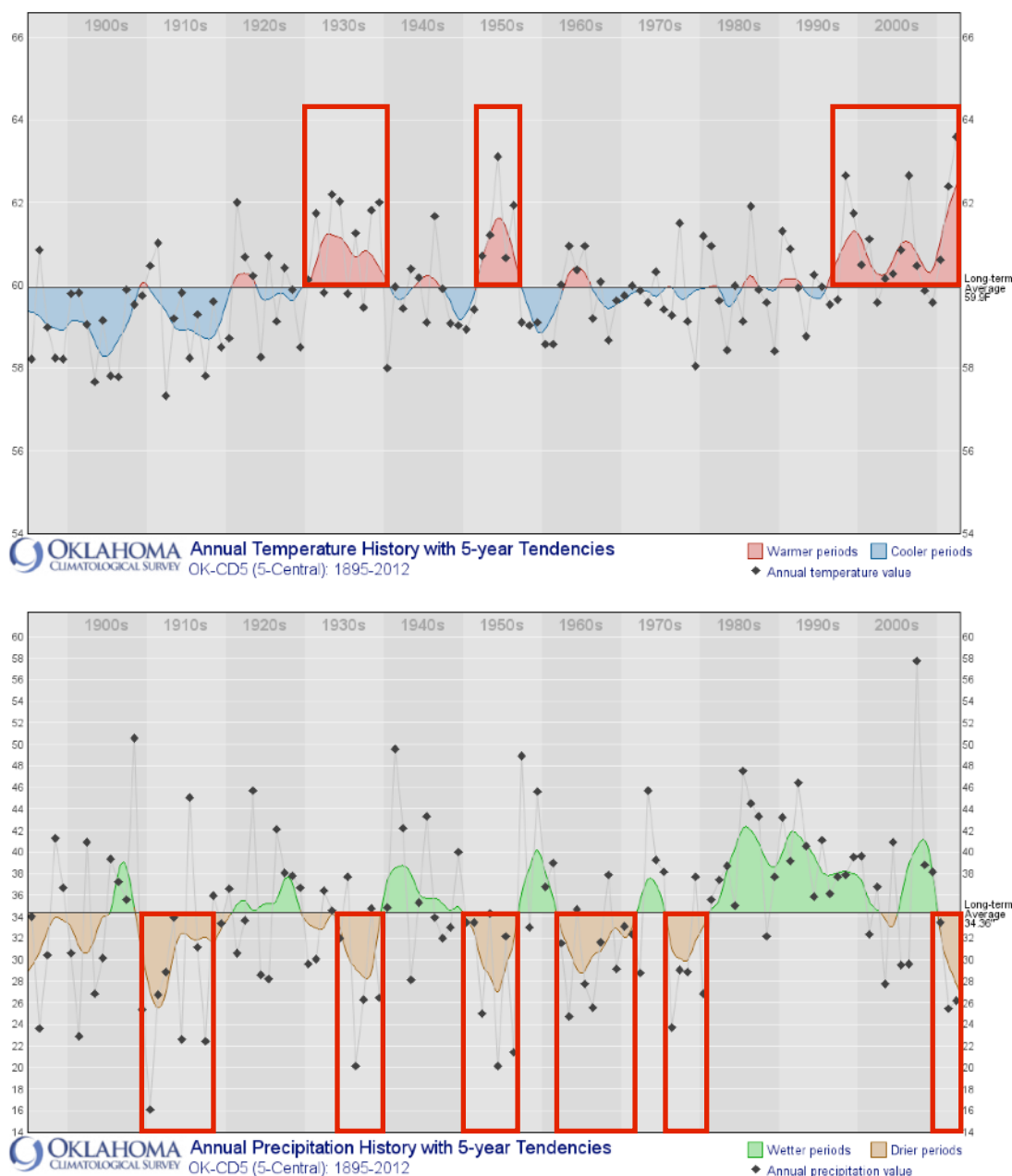


**Figure 18.** Drought history for west-central Oklahoma as designated by the U.S. Drought Monitor. The color scale is identical to that in Figure 1. Note that west-central Oklahoma was experiencing extreme (bright red) to exceptional drought (dark red) across most of the area during much of 2006 and 2011 to present (data through March 2013). Data courtesy of the National Drought Mitigation Center.

For more information on the sources of drought information, see Table 10 on page 52.

## Region 5: Central Oklahoma

Central Oklahoma has experienced a wide range of temperatures and precipitation over the past several decades. Abnormally hot and dry conditions have occurred multiple times since the early 1900s. Figure 19 shows the annual temperature (top) and annual precipitation (bottom) in central Oklahoma since 1895.<sup>7</sup> The annual temperature for central Oklahoma averages 59.86 degrees Fahrenheit, while precipitation averages 34.36 inches. Warmer-than-average periods have spanned the 1930s, the mid-1950s, and the late 1990s through the early 2010s. Significant periods of drier-than-average conditions include the 1910s, 1930s, mid-1950s, mid-1960s, the late 1970s, and the early 2010s.



**Figure 19.** The average annual temperature (top graph) and total annual precipitation (bottom graph) in central Oklahoma from 1895 to 2012. To highlight warmer, cooler, wetter, or drier periods, 5-year moving averages are shaded. On the top graph, red shading (above the horizontal line) indicates warmer periods and blue shading (below the line) notes cooler periods than average. Similarly, on the bottom graph, green shading (above the horizontal line) highlights wetter periods and brown shading (below the line) highlights drier periods than average. Extended periods of relatively warm temperatures or low precipitation are outlined in red boxes.

Options for the drought-of-record in this region include the droughts in the 1920s and 1950s. The longest period of dry conditions undoubtedly was during the 1910s. Table 5 compares Palmer Drought Severity Indices for these droughts and others. Using these indices, the drought of the 1910s well exceeds the duration and intensity of all other droughts; hence, ***the period from February 1909 to August 1918 is the drought-of-record for central Oklahoma.***

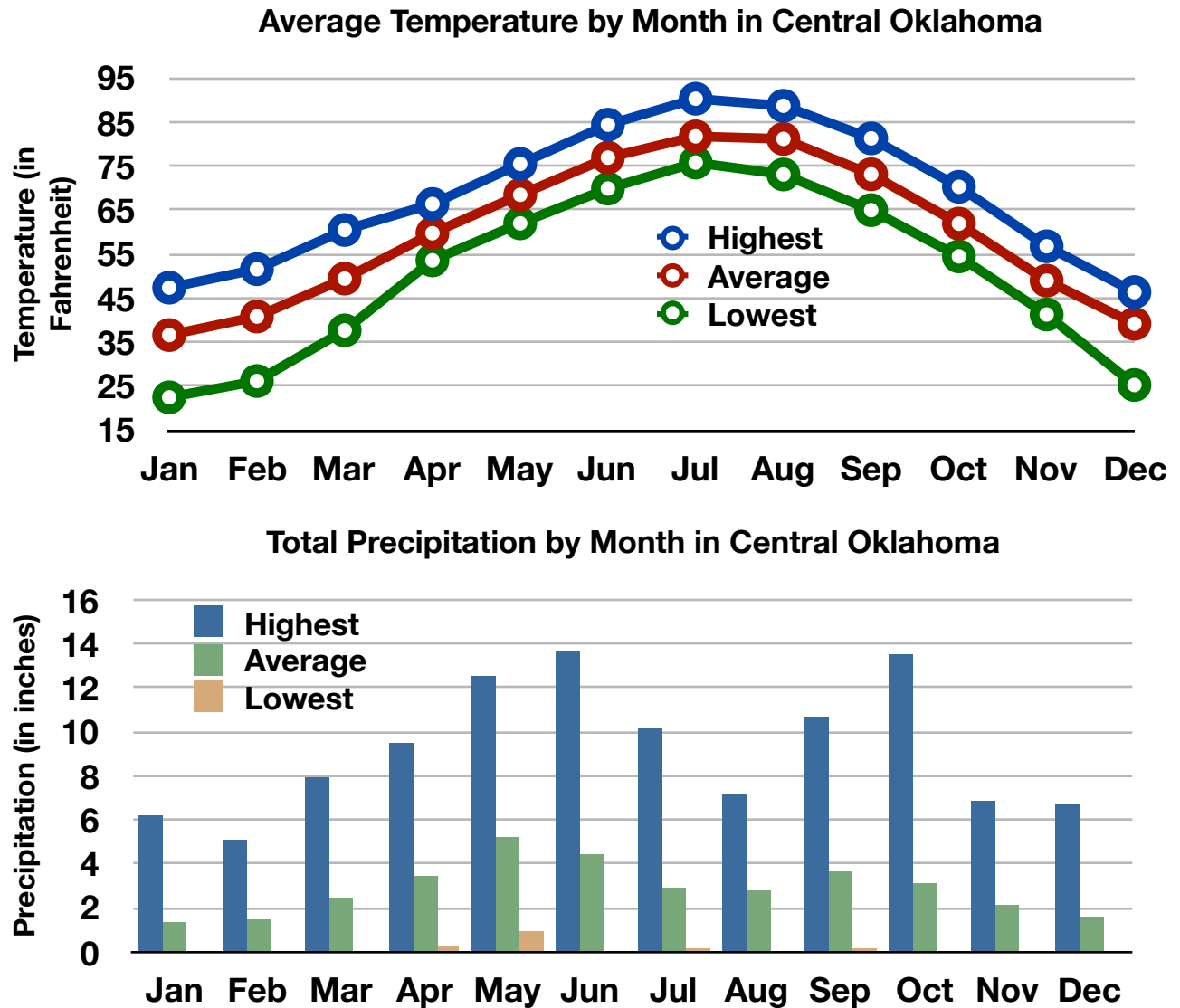
Because of its intense heat combined with non-stop dry conditions, ***November 1950 through February 1957 comes in second for the drought-of-record for central Oklahoma.***

**Table 5: Comparison of Palmer Drought Severity Indices (PDSI) for Several Droughts Affecting Central Oklahoma**

Time Period	Months with PDSI less than -1	Months with PDSI less than -4	Lowest PDSI Value
February 1909 – August 1918	88 (of 115 months)	16 consecutive	-7.43
March 1936 – June 1940	43 (of 64 months)	3 consecutive	-5.76
November 1950 – February 1957	61 (of 76 months)	10 consecutive plus 7 other	-6.17
February 1963 – September 1972	57 (of 116 months)	1	-4.19
January 1976 – May 1981	49 (of 65 months)	2 consecutive	-4.28
November 2003 – November 2006	20 (of 36 months)	6 consecutive	-4.85
November 2010 – December 2012*	26 (of 26 months)	6 consecutive plus 2 other	-5.97

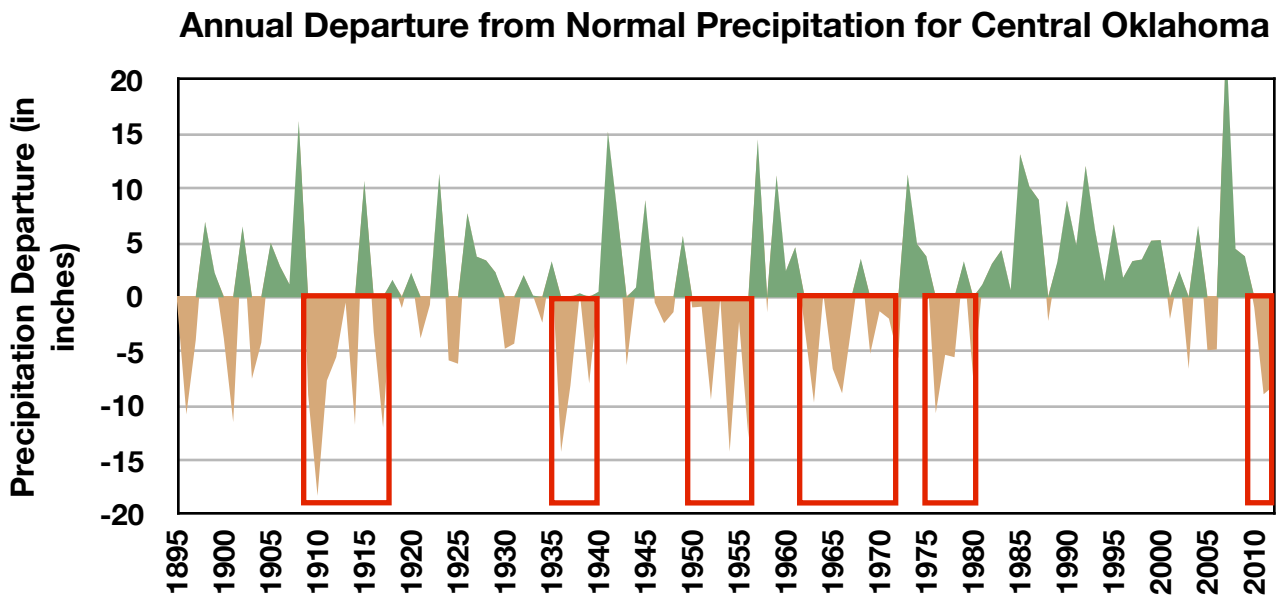
**\*Note:** Data only available through December 2012; drought conditions may have continued past this date.

To understand when there is the greatest stress on water availability for northeastern Oklahoma, the average monthly temperature and precipitation, as well as their average highest and lowest monthly values, are shown in Figure 20. Warmer temperatures result in greater water loss by evaporation and transpiration. The warmest temperatures typically occur during July and August (top of Figure 20).

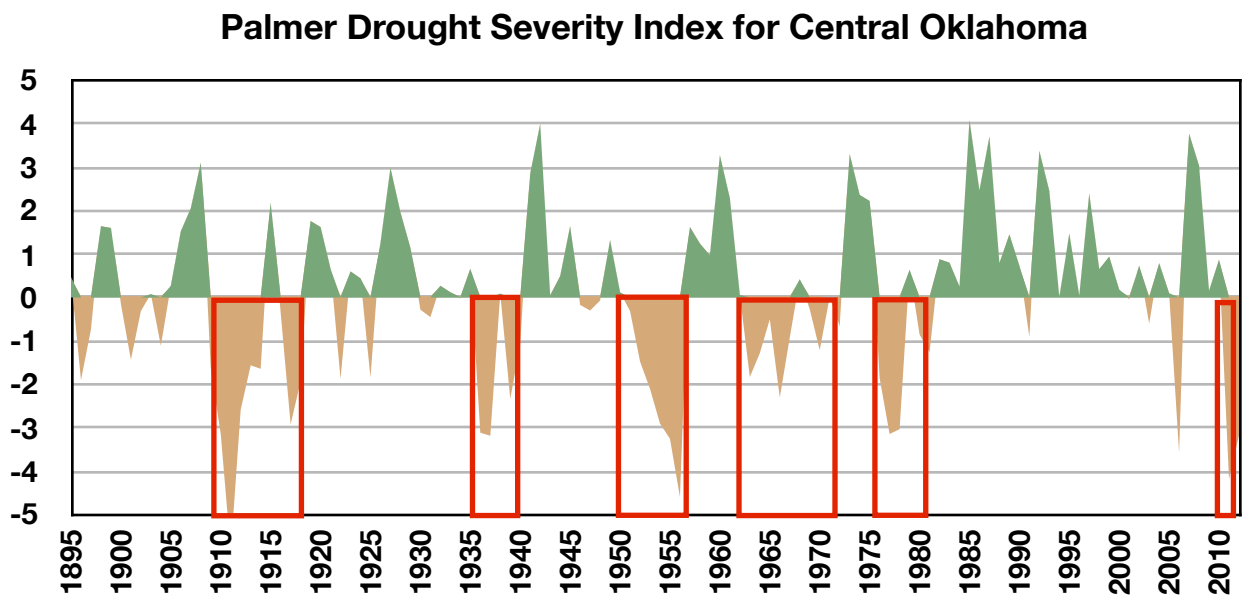


**Figure 20.** Top graph: The monthly average temperature (in degrees Fahrenheit) across central Oklahoma using data from 1895 to 2012. The red (middle) line is the average of all climate-division average temperatures for that time period. The blue (top) line is the highest monthly average and the green (bottom) line is the lowest. Bottom graph: The average total precipitation (in inches) by month across central Oklahoma using data from 1895 to 2012. The blue (leftmost of each monthly cluster) bar is the highest monthly precipitation; the green (middle of the cluster) is the average precipitation total recorded for that month; the gold (rightmost) is the lowest precipitation total recorded for that month. [Note that zero precipitation has occurred at least once during January, February, March, June, October, November, and December] The two peaks of precipitation, first in June and then in October, are clearly visible.

Central Oklahoma has experienced long and extreme droughts in its past. Figure 21 displays the departure from normal precipitation and Palmer Drought Severity Index, for central Oklahoma from 1895 to 2012. Red boxes outline the same drier-than-average periods highlighted in Figure 19.

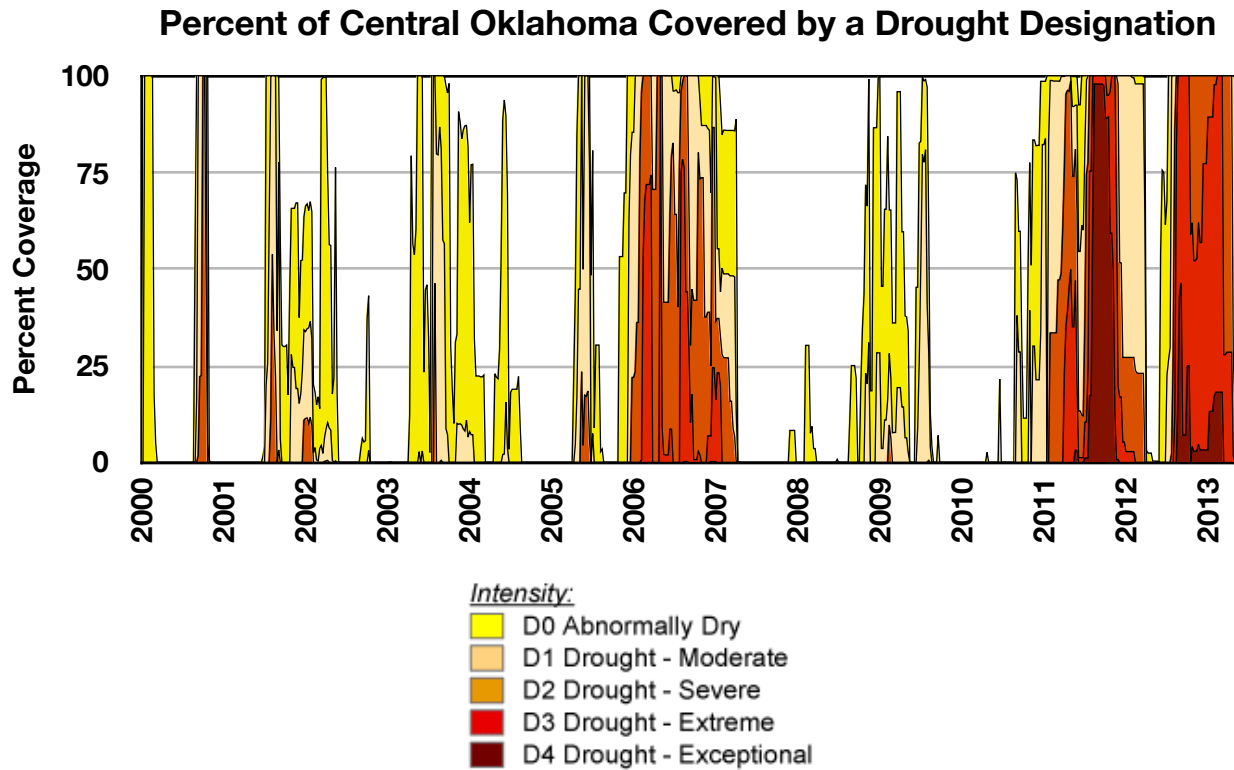


**Figure 21a.** Annual departure from normal precipitation (actual precipitation total for the year subtracted from the annual normal) for central Oklahoma from 1895 to 2012.



**Figure 21b.** Palmer Drought Severity Index for central Oklahoma from 1895 to 2012.

Central Oklahoma experienced abnormally dry conditions from years 2000 to 2013. In Figure 22 we look at drought designation for the region and see that from 2006-2007 severe to extreme conditions covering almost 100% of the region. In 2011-2013 the region experienced extreme to exceptional drought also covering nearly 100%.

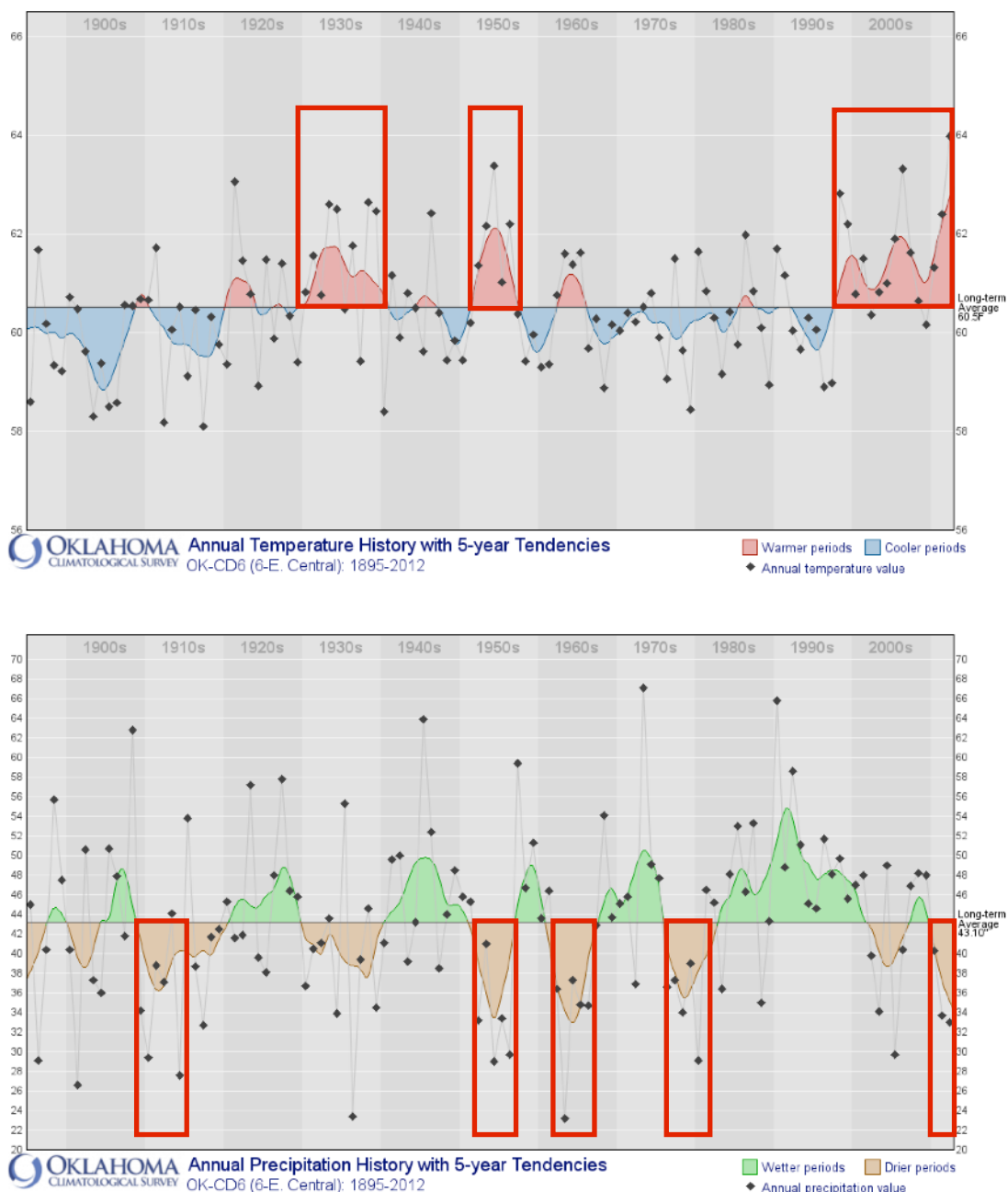


**Figure 22.** Drought history for central Oklahoma as designated by the U.S. Drought Monitor. The color scale is identical to that in Figure 1. Note that central Oklahoma was experiencing extreme drought (bright red) across most of the area during much of 2006 and extreme to exceptional drought (dark red) across most of the area during much of 2006 and 2011 to present (data through March 2013). Data courtesy of the National Drought Mitigation Center.

For more information on the sources of drought information, see Table 10 on page 52.

## Region 6: East-Central Oklahoma

East-Central Oklahoma has experienced a wide range of temperatures and precipitation over the past several decades. Abnormally hot and dry conditions have occurred multiple times since the early 1900s. Figure 23 shows the annual temperature (top) and annual precipitation (bottom) in east-central Oklahoma since 1895.<sup>8</sup> The annual temperature for east-central Oklahoma averages 60.42 degrees Fahrenheit, while precipitation averages 43.10 inches. Warmer-than-average periods have spanned the 1930s, the mid-1950s, and the late 1990s through the early 2010s. Significant periods of drier-than-average conditions include the 1910s, 1930s, mid-1950s, mid-1960s, the late 1970s, and the early 2010s.



**Figure 23.** The average annual temperature (top graph) and total annual precipitation (bottom graph) in east-central Oklahoma from 1895 to 2012. To highlight warmer, cooler, wetter, or drier periods, 5-year moving averages are shaded. On the top graph, red shading (above the horizontal line) indicates warmer periods and blue shading (below the line) notes cooler periods than average. Similarly, on the bottom graph, green shading (above the horizontal line) highlights wetter periods and brown shading (below the line) highlights drier periods than average. Extended periods of relatively warm temperatures or low precipitation are outlined in red boxes.

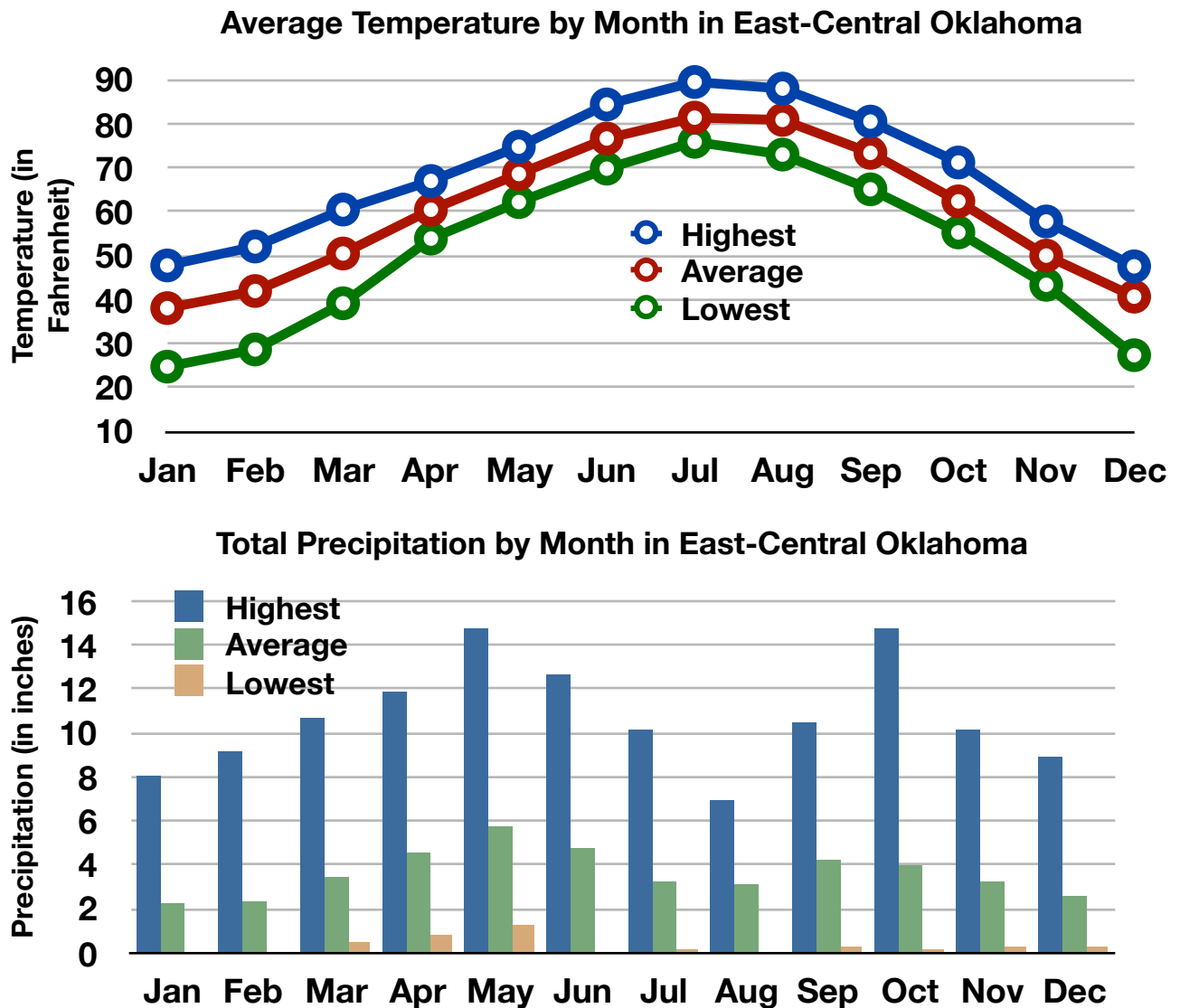
Options for the drought-of-record include the droughts in the early 1950s and 1960s. Both droughts were of approximately the same duration lasting more than 55 months. Table 6 compares Palmer Drought Severity Indices for these droughts and others. Using these indices, the droughts of the early 1950s and 1960s well exceed the intensity of all other droughts; hence, ***the periods from November 1950 to December 1956 and May 1962 to March 1967 are the droughts-of-record for east-central Oklahoma.***

**Table 6: Comparison of Palmer Drought Severity Indices (PDSI) for Several Droughts Affecting East-Central Oklahoma**

Time Period	Months with PDSI less than -1	Months with PDSI less than -4	Lowest PDSI Value
January 1909 – December 1914	41 (of 72 months)	1	-4.55
November 1950 – December 1956	60 (of 74 months)	4 consecutive plus 3 other	-4.75
May 1962 – March 1967	57 (of 59 months)	5 consecutive	-4.77
May 1977 – April 1981	30 (of 48 months)	0	-3.62
September 2002 – August 2006	32 (of 48 months)	2 consecutive plus 1 other	-4.61
December 2010 – December 2012*	25 (of 25 months)	1	-4.16

**\*Note:** Data only available through December 2012; drought conditions may have continued past this date.

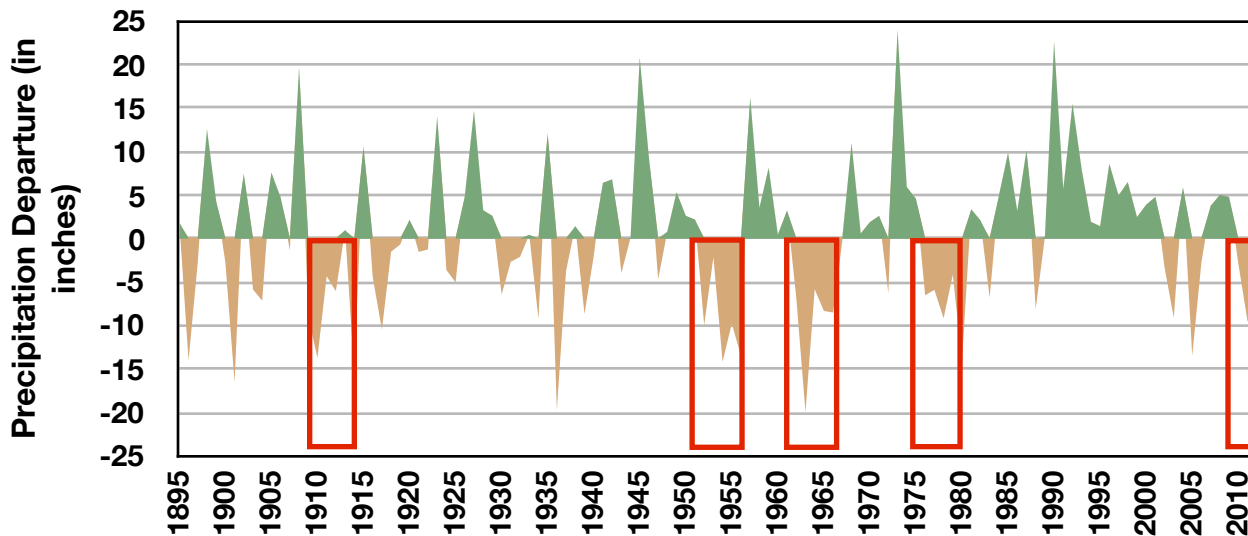
To understand when there is the greatest stress on water availability for northeastern Oklahoma, the average monthly temperature and precipitation, as well as their average highest and lowest monthly values, are shown in Figure 24. Warmer temperatures result in greater water loss by evaporation and transpiration. The warmest temperatures typically occur during July and August (top of Figure 24).



**Figure 24.** *Top graph:* The monthly average temperature (in degrees Fahrenheit) across east-central Oklahoma using data from 1895 to 2012. The red (middle) line is the average of all climate-division average temperatures for that time period. The blue (top) line is the highest monthly average and the green (bottom) line is the lowest. *Bottom graph:* The average total precipitation (in inches) by month across east-central Oklahoma using data from 1895 to 2012. The blue (leftmost of each monthly cluster) bar is the highest monthly precipitation; the green (middle of the cluster) is the average precipitation total recorded for that month; the gold (rightmost) is the lowest precipitation total recorded for that month. [Note that zero precipitation has occurred at least once during February, June, and August] The two peaks of precipitation, first in May and then in October, are clearly visible.

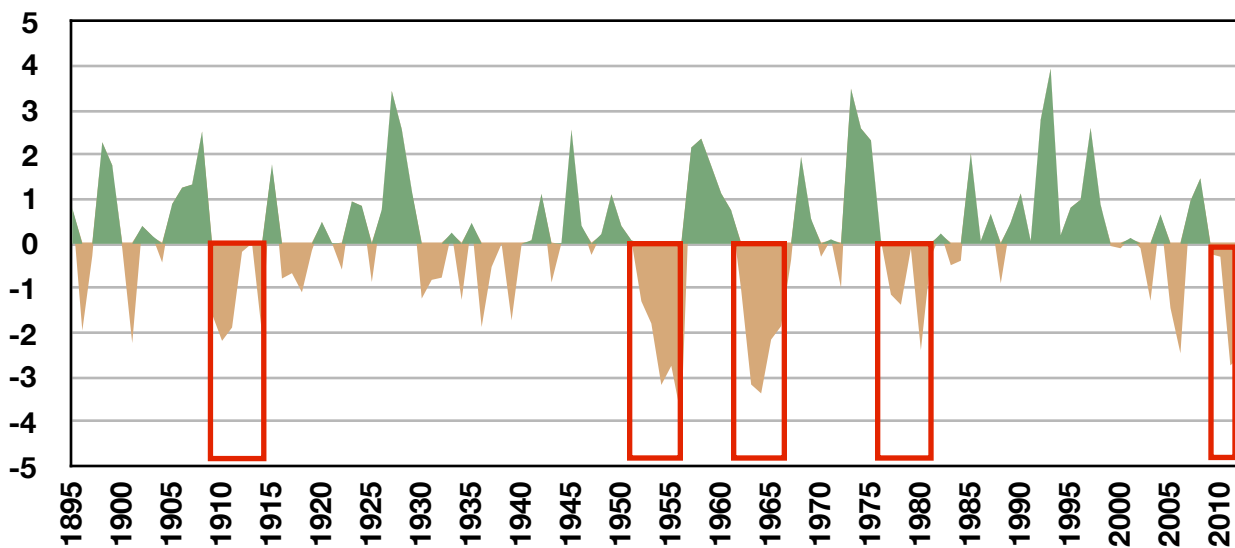
East-central Oklahoma has experienced long and extreme droughts in its past. Figure 25 displays the departure from normal precipitation and Palmer Drought Severity Index, for east-central Oklahoma from 1895 to 2012. Red boxes outline the same drier-than-average periods highlighted in Figure 23.

### Annual Departure from Normal Precipitation for East-Central Oklahoma



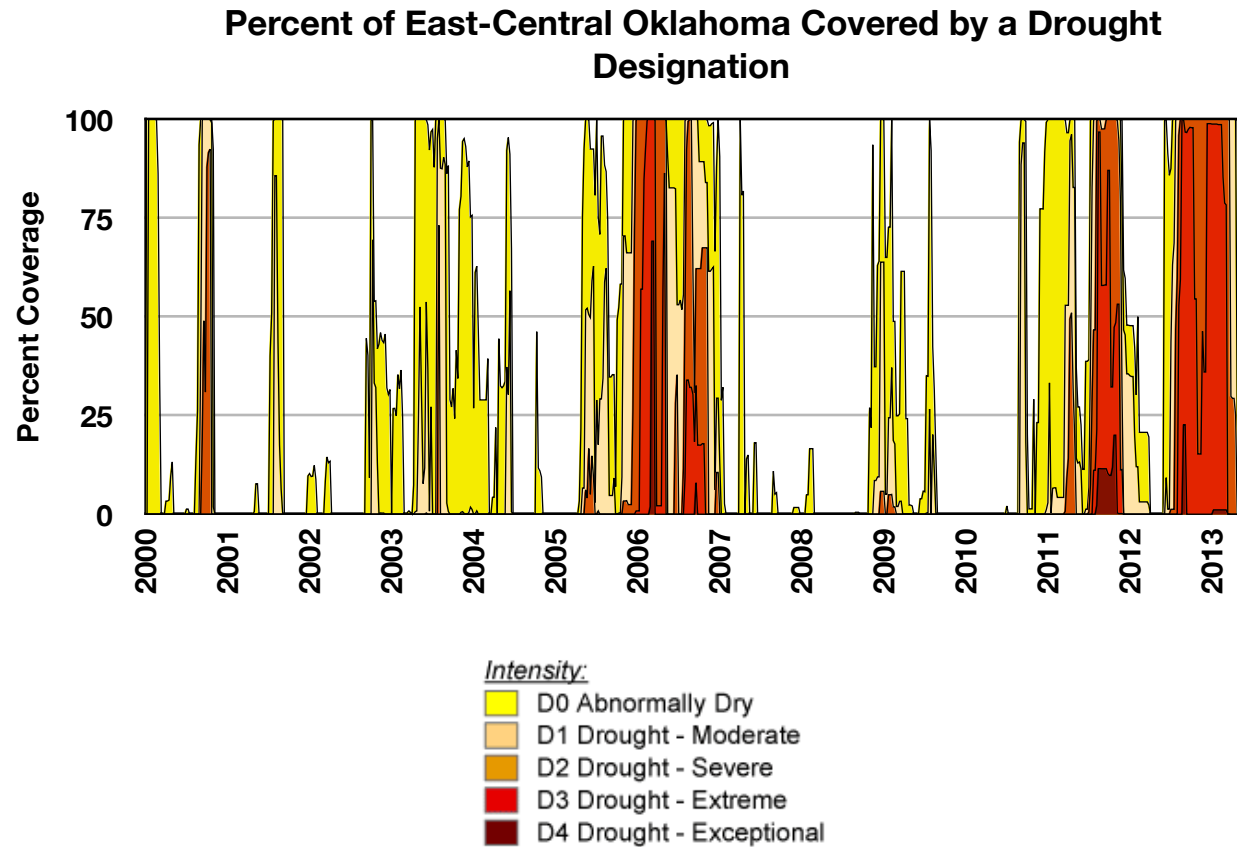
*Figure 25a.* Annual departure from normal precipitation (actual precipitation total for the year subtracted from the annual normal) for east-central Oklahoma from 1895 to 2012.

### Palmer Drought Severity Index for East-Central Oklahoma



*Figure 25b.* Palmer Drought Severity Index for east-central Oklahoma from 1895 to 2012.

East-Central Oklahoma experienced abnormally dry conditions in years 2000 to 2013. In figure 26 we look at drought designation in the region and see that from 2006-2007 there were few occurrences of severe to extreme conditions covering almost 100% of the region. In 2011-2013 the region experienced exceptional drought also covering nearly 100%.

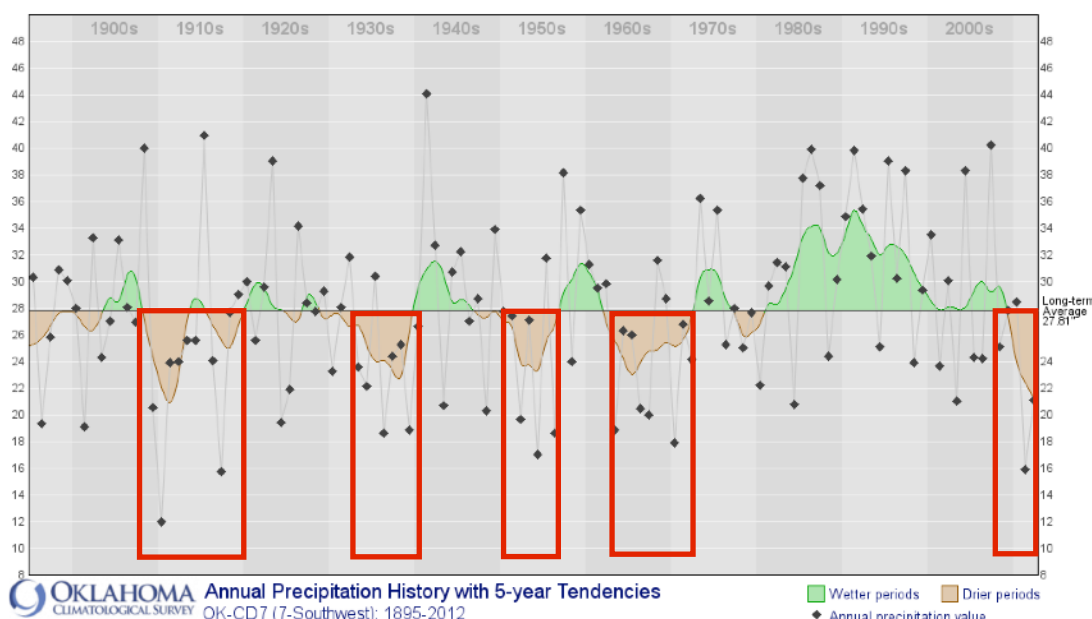
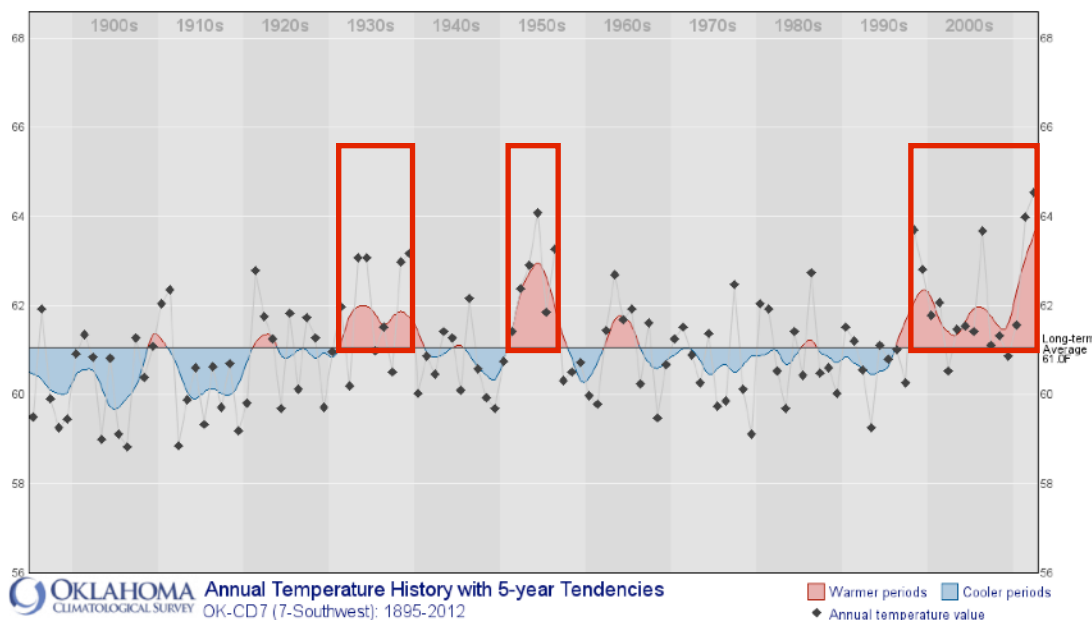


**Figure 26.** Drought history for east-central Oklahoma as designated by the U.S. Drought Monitor. The color scale is identical to that in Figure 1. Note that east-central Oklahoma was experiencing extreme (bright red) to exceptional drought (dark red) across most of the area during much of 2006 and 2011 to present (data through March 2013). Data courtesy of the National Drought Mitigation Center.

For more information on the sources of drought information, see Table 10 on page 52.

## Region 7: Southwest Oklahoma

Southwest Oklahoma has experienced a wide range of temperatures and precipitation over the past several decades. Abnormally hot and dry conditions have occurred multiple times since the early 1900s. Figure 27 shows the annual temperature (top) and annual precipitation (bottom) in southwestern Oklahoma since 1895.<sup>9</sup> The annual temperature for southwestern Oklahoma averages 60.9 degrees Fahrenheit, while precipitation averages 27.8 inches. Warmer-than-average periods have spanned the 1920s through the mid 1940s, the mid-1950s, and the late 1990s through the 2000s. Significant periods of drier-than-average conditions include the 1910s, 1930s, mid-1950s, mid-1960s, and the late 1970s.



**Figure 27.** The average annual temperature (top graph) and total annual precipitation (bottom graph) in southwestern Oklahoma from 1895 to 2012. To highlight warmer, cooler, wetter, or drier periods, 5-year moving averages are shaded. On the top graph, red shading (above the horizontal line) indicates warmer periods and blue shading (below the line) notes cooler periods than average. Similarly, on the bottom graph, green shading (above the horizontal line) highlights wetter periods and brown shading (below the line) highlights drier periods than average. Extended periods of relatively warm temperatures or low precipitation are outlined in red boxes.

Options for the drought-of-record include the droughts in the 1910s, late 1930s, and early 1960s to early 1970s. The longest period of dry conditions undoubtedly was during the 1910s and 1960s. Table 7 compares Palmer Drought Severity Indices for these droughts and others. Using these indices, the drought of the 1910s exceeds the duration and intensity of all other droughts; hence, ***the period from January 1909 to September 1918 is the drought-of-record for southwestern Oklahoma.***

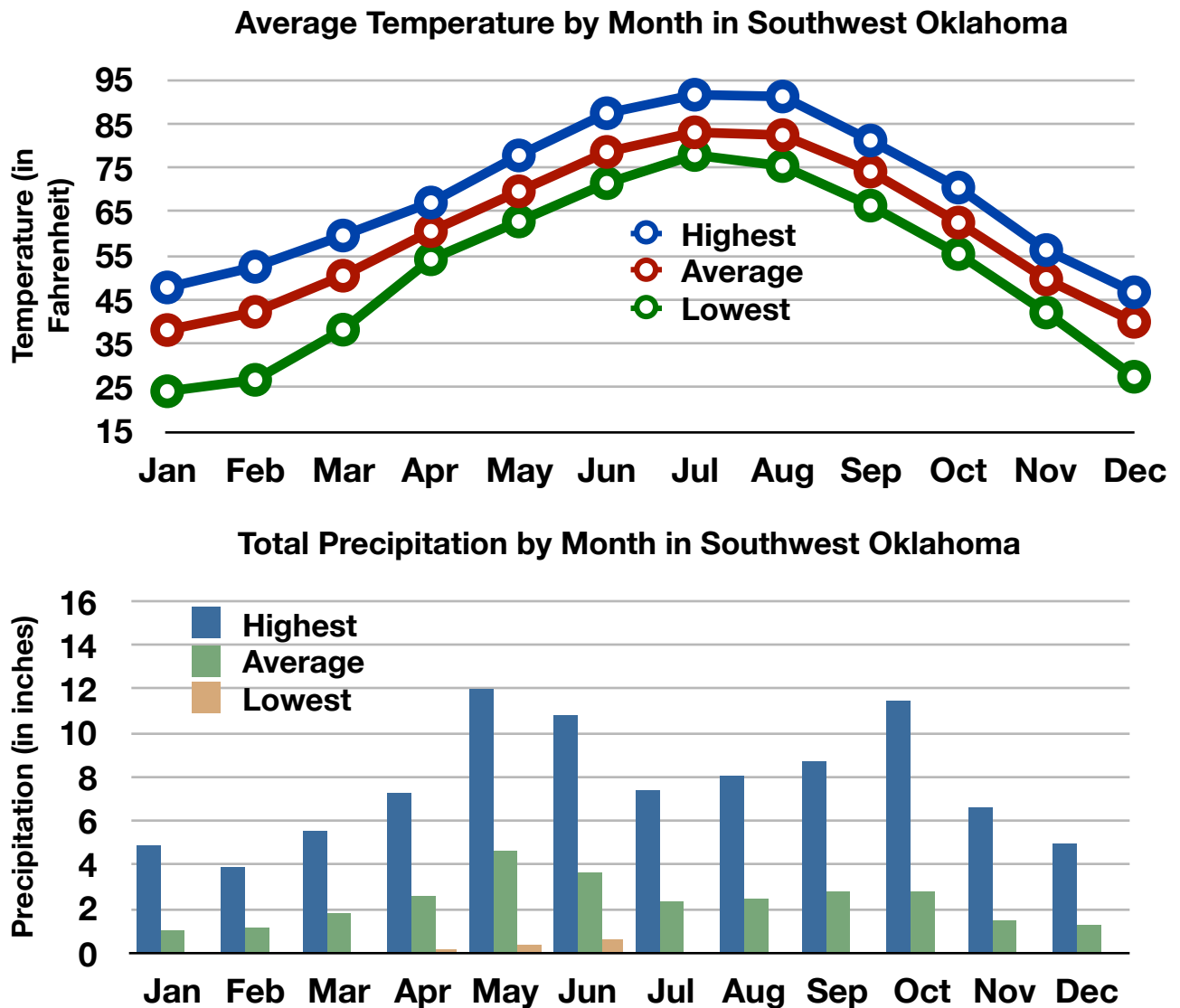
Because of its non-stop dry conditions, ***January 1963 through September 1972 comes in second for the drought-of-record for southwestern Oklahoma.***

**Table 7: Comparison of Palmer Drought Severity Indices (PDSI) for Several Droughts Affecting Southwestern Oklahoma**

Time Period	Months with PDSI less than -1	Months with PDSI less than -4	Lowest PDSI Value
January 1909 – September 1918	66 (of 117 months)	15 consecutive plus 4 others	-6.03
April 1933 – October 1940	70 (of 91 months)	3 consecutive plus 2 others	-4.81
March 1950 – February 1957	63 (of 84 months)	3 consecutive twice plus 1 other	-4.90
January 1963 – September 1972	70 (of 106 months)	8 consecutive plus 6 consecutive plus 1 other	-5.74
September 2007 – December 2012*	31 (of 64 months)	6 consecutive	-6.83

**\*Note:** Data only available through December 2012; drought conditions may have continued past this date.

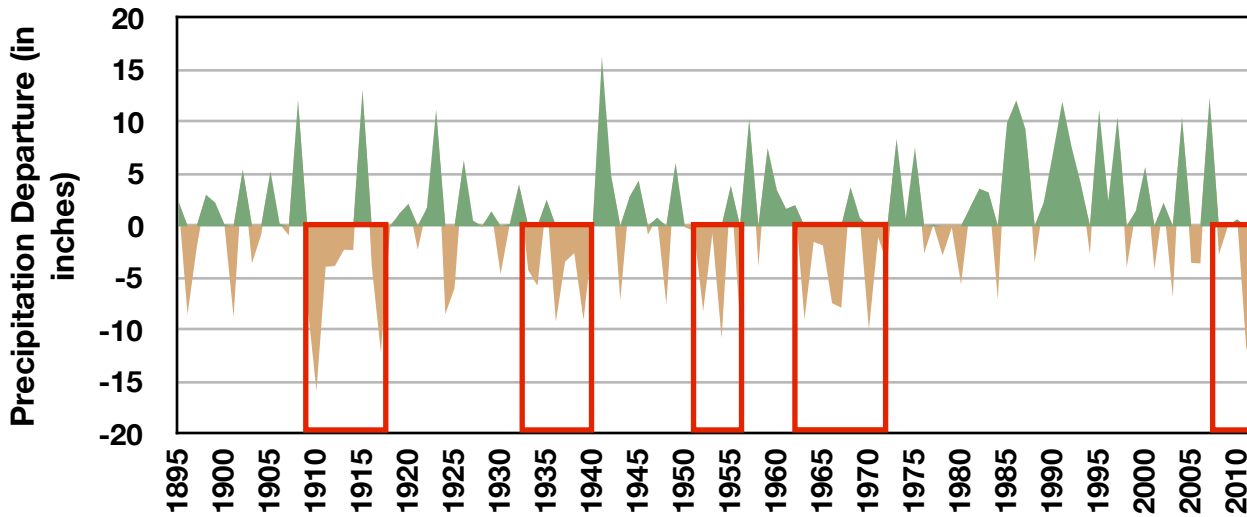
To understand when there is the greatest stress on water availability for northeastern Oklahoma, the average monthly temperature and precipitation, as well as their average highest and lowest monthly values, are shown in Figure 28. Warmer temperatures result in greater water loss by evaporation and transpiration. The warmest temperatures typically occur during July and August (top of Figure 28).



**Figure 28.** *Top graph:* The monthly average temperature (in degrees Fahrenheit) across southwestern Oklahoma using data from 1895 to 2012. The red (middle) line is the average of all climate-division average temperatures for that time period. The blue (top) line is the highest monthly average and the green (bottom) line is the lowest. *Bottom graph:* The average total precipitation (in inches) by month across southwestern Oklahoma using data from 1895 to 2012. The blue (leftmost of each monthly cluster) bar is the highest monthly precipitation; the green (middle of the cluster) is the average precipitation total recorded for that month; the gold (rightmost) is the lowest precipitation total recorded for that month. [Note that zero precipitation has occurred at least once every month except April, May, June, and July.] The three peaks of precipitation, first in May, then in June, and finally in October are clearly visible.

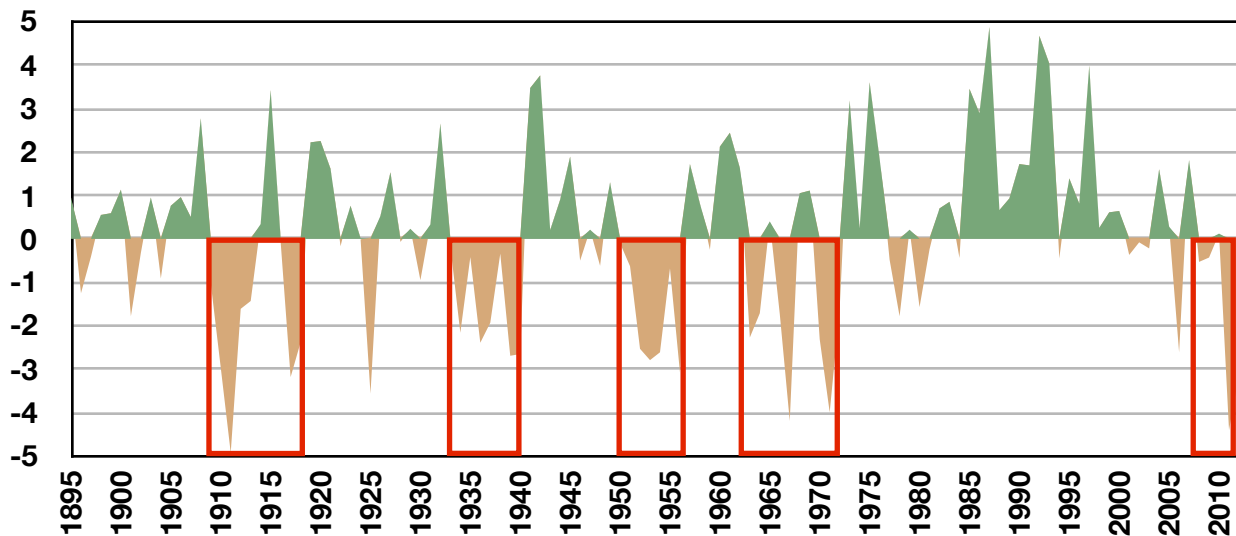
Southwestern Oklahoma has experienced long and extreme droughts in its past. Figure 29 displays the departure from normal precipitation and Palmer Drought Severity Index, for southwestern Oklahoma from 1895 to 2012. Red boxes outline the same drier-than-average periods highlighted in Figure 27.

### Annual Departure from Normal Precipitation for Southwest Oklahoma



*Figure 29a. Annual departure from normal precipitation (actual precipitation total for the year subtracted from the annual normal) for southwestern Oklahoma from 1895 to 2012.*

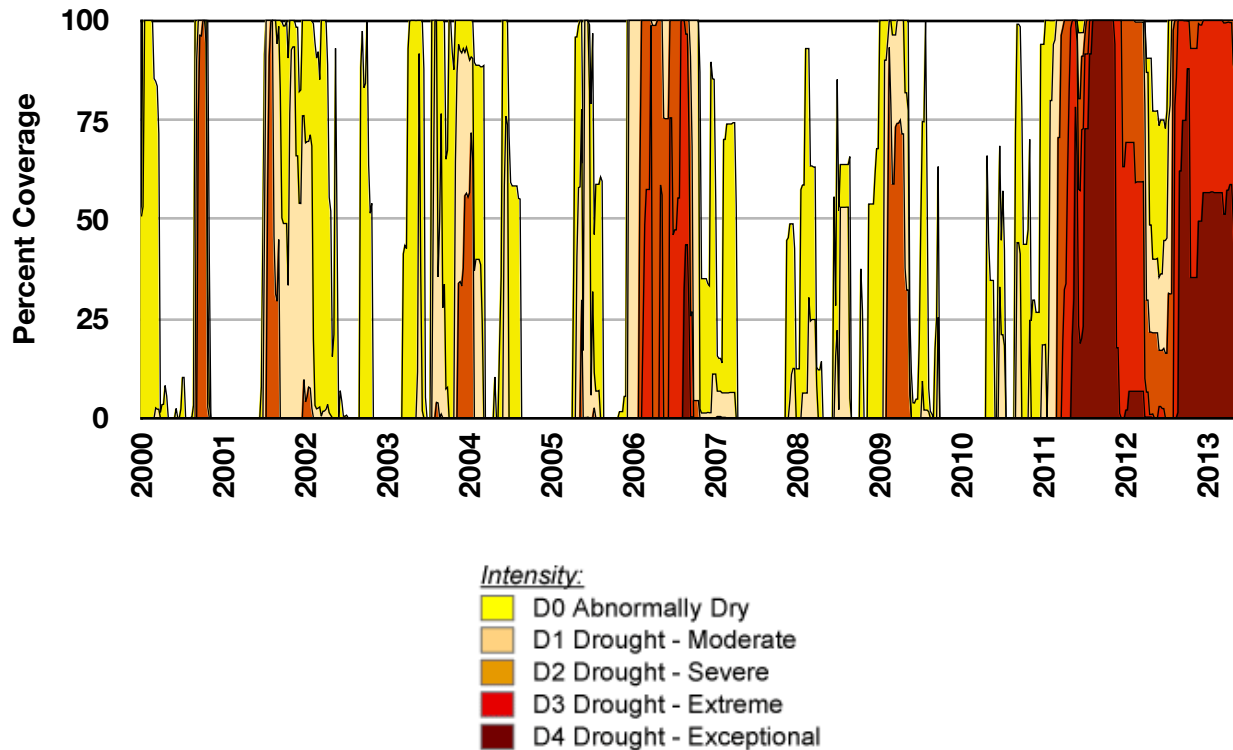
### Palmer Drought Severity Index for Southwest Oklahoma



*Figure 29b. Palmer Drought Severity Index for southwestern Oklahoma from 1895 to 2012.*

Southwest Oklahoma experienced abnormally dry conditions in years 2000 to 2013. In figure 30 we look at drought designation in the region and see that from 2006-2007 severe and extreme conditions covered almost 100% of the region. In 2011-2013 the region experienced exceptional drought also covering nearly 100%.

### Percent of Southwest Oklahoma Covered by a Drought Designation



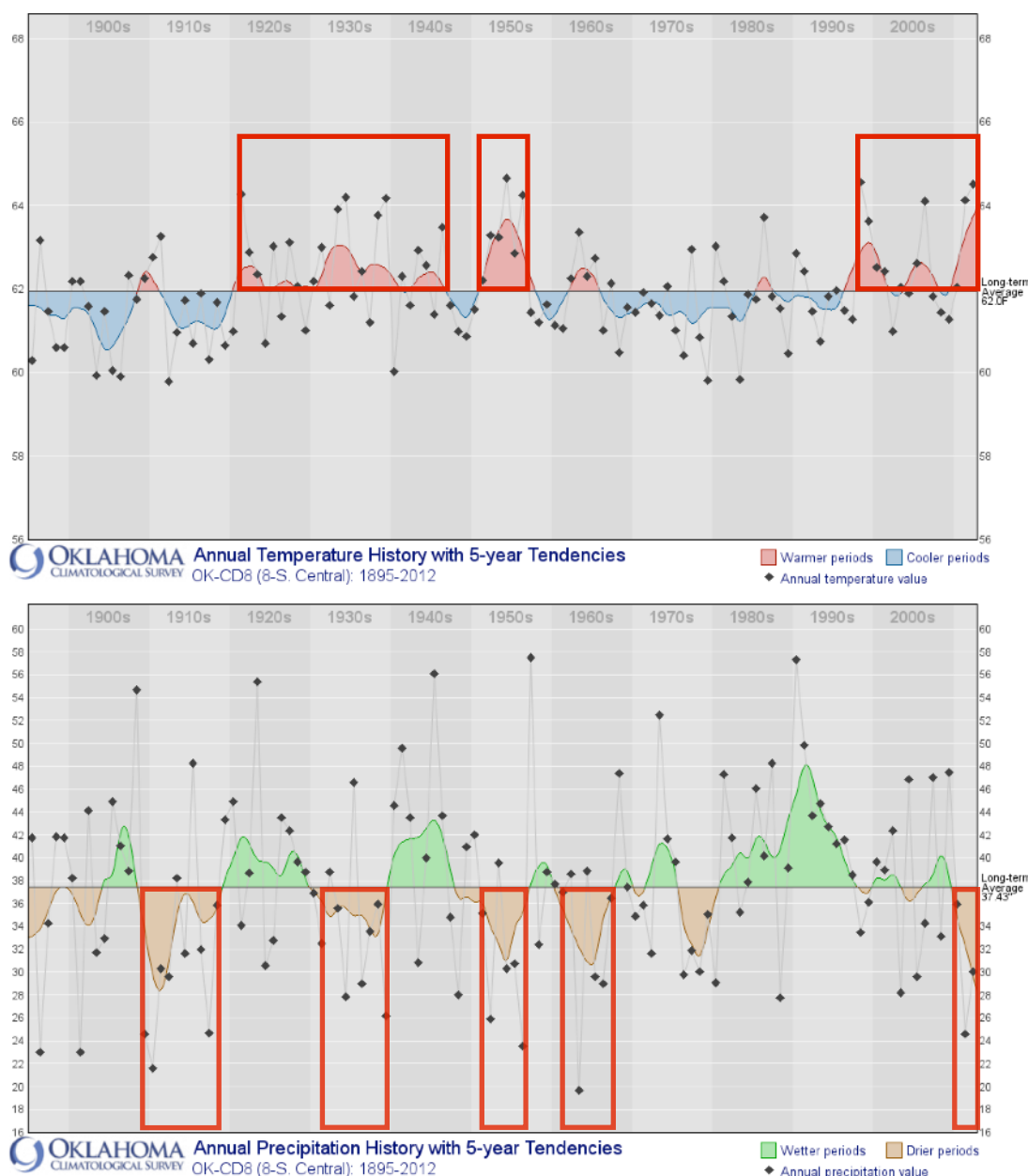
**Figure 30** Drought history for southwestern Oklahoma as designated by the U.S. Drought Monitor. The color scale is identical to that in Figure 1. Note that southwestern Oklahoma was experiencing extreme (bright red) to exceptional drought (dark red) across most of the climate division during much of 2006 and 2011 to present (data through March 2013). Data courtesy of the National Drought Mitigation Center.

For more information on the sources of drought information, see Table 10 on page 52.

## Region 8: South-Central Oklahoma

South-Central Oklahoma has experienced a wide range of temperatures and precipitation over the past several decades. Abnormally hot and dry conditions have occurred multiple times since the early 1900s. Figure 31 shows the annual temperature (top) and annual precipitation (bottom) in south-central Oklahoma since 1895.<sup>10</sup> The annual temperature for south-central Oklahoma averages 61.9 degrees Fahrenheit, while precipitation averages 37.4 inches. Warmer-than-average periods have spanned the 1920s through the mid 1940s, the mid-1950s, and the late 1990s through the 2000s. Significant periods of drier-than-average conditions include the 1910s, 1930s, mid-1950s, mid-1960s, and the late 1970s.

**Figure 31.** The average annual temperature (top graph) and total annual precipitation (bottom graph) in south-central Oklahoma from 1895 to 2012. To highlight warmer, cooler, wetter, or drier periods, 5-year moving averages are shaded. On the top graph, red shading (above the horizontal line) indicates warmer periods and blue shading (below the line) notes cooler periods than average. Similarly, on the bottom graph, green shading (above the horizontal line) highlights wetter periods and brown shading (below the line) highlights drier periods than average. Extended periods of relatively warm temperatures or low precipitation are outlined in red boxes.



Options for the drought-of-record in this region include the droughts in the 1910s, late 1930s, and mid-1950s. The longest period of dry conditions undoubtedly was during the 1910s. Table 8 compares Palmer Drought Severity Indices for these droughts and others. Using these indices, the drought of the 1910s well exceeds the duration and intensity of all other droughts; hence, ***the period from February 1909 to August 1918 is the drought-of-record for south-central Oklahoma.***

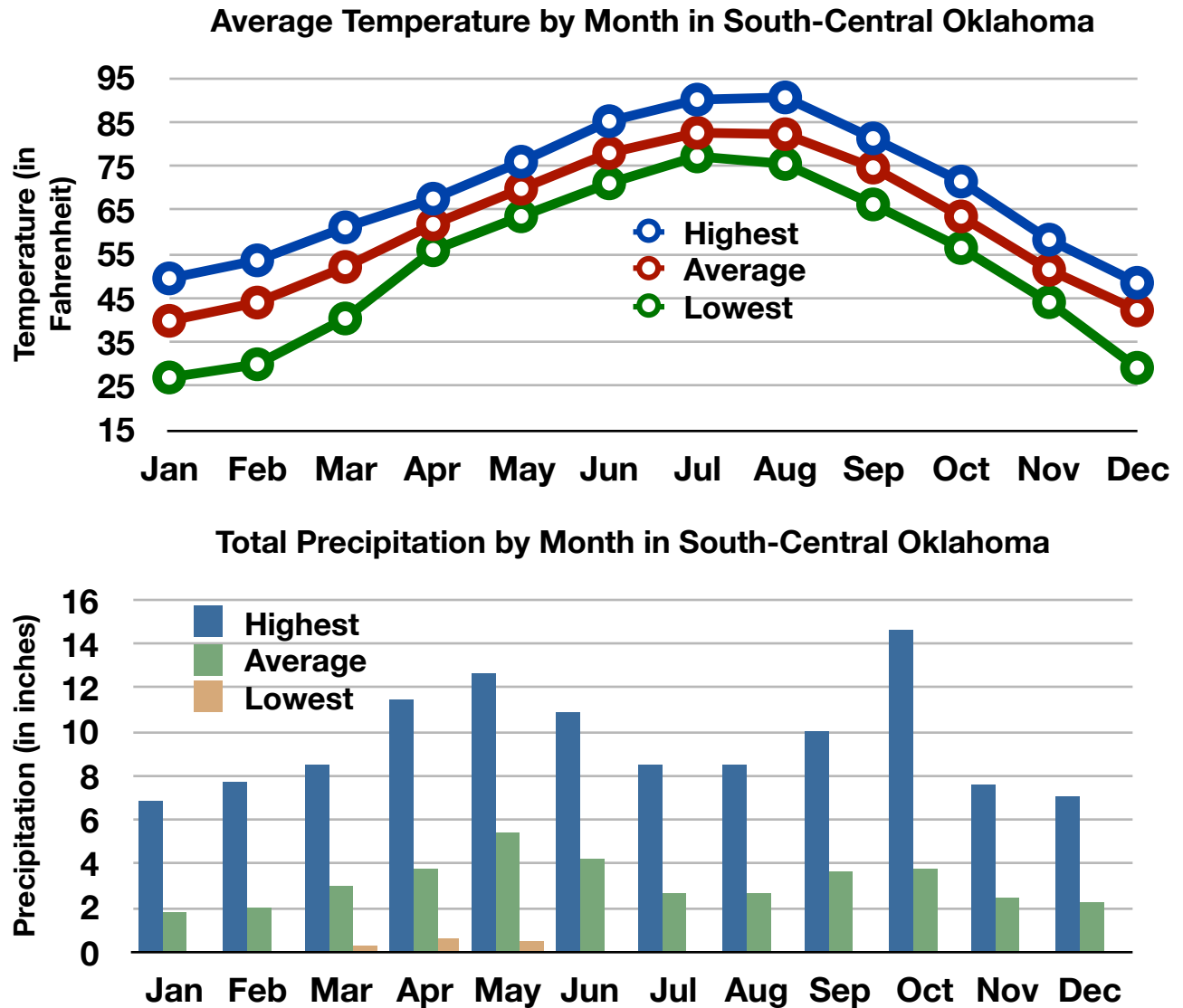
Because of its intense heat combined with non-stop dry conditions, ***November 1950 through November 1956 comes in second for the drought-of-record for south-central Oklahoma.***

**Table 8: Comparison of Palmer Drought Severity Indices (PDSI) for Several Droughts Affecting South-Central Oklahoma**

Time Period	Months with PDSI less than -1	Months with PDSI less than -4	Lowest PDSI Value
February 1909 – August 1918	87 (of 115 months)	12 consecutive plus 9 others	-6.80
June 1933 – March 1940	46 (of 82 months)	6	-4.57
November 1950 – November 1956	54 (of 73 months)	8 consecutive plus 1 other	-6.94
April 1963 – March 1967	35 (of 48 months)	5 consecutive plus 2 other	-5
January 2011 – December 2013*	34 (of 36 months)	5 consecutive	-5.69

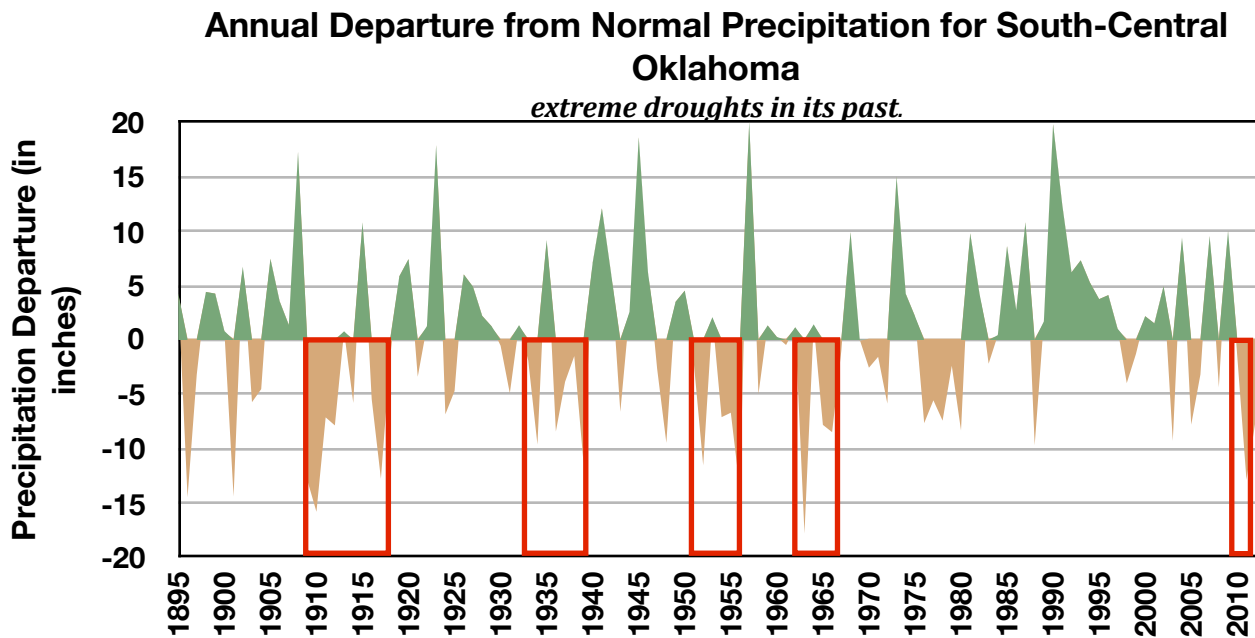
**\*Note:** Data only available through December 2013; drought conditions may have continued past this date.

To understand when there is the greatest stress on water availability for northeastern Oklahoma, the average monthly temperature and precipitation, as well as their average highest and lowest monthly values, are shown in Figure 32. Warmer temperatures result in greater water loss by evaporation and transpiration. The warmest temperatures typically occur during July and August (top of Figure 32).

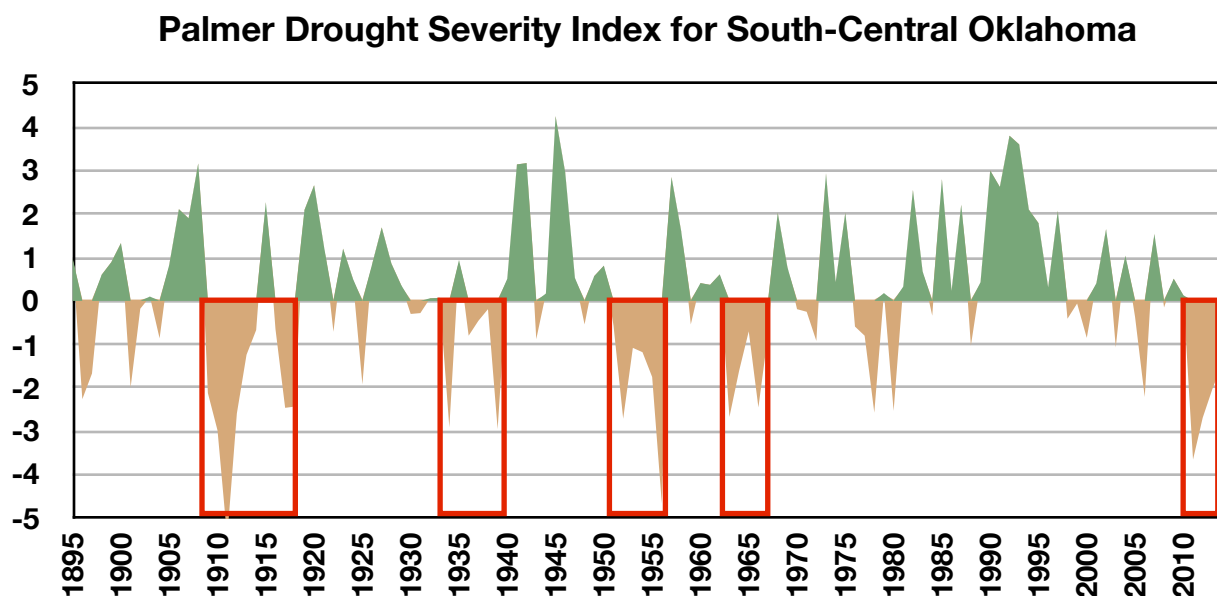


**Figure 32.** Top graph: The monthly average temperature (in degrees Fahrenheit) across south-central Oklahoma using data from 1895 to 2012. The red (middle) line is the average of all climate-division average temperatures for that time period. The blue (top) line is the highest monthly average and the green (bottom) line is the lowest. Bottom graph: The average total precipitation (in inches) by month across south-central Oklahoma using data from 1895 to 2012. The blue (leftmost of each monthly cluster) bar is the highest monthly precipitation; the green (middle of the cluster) is the average precipitation total recorded for that month; the gold (rightmost) is the lowest precipitation total recorded for that month. [Note that zero precipitation has occurred at least once during January, June, September, October, and November.] The two peaks of precipitation, first in May and then in October, are clearly visible.

South-central Oklahoma has experienced long and extreme droughts in its past. Figure 33 displays the departure from normal precipitation and Palmer Drought Severity Index, for south-central Oklahoma from 1895 to 2012. Red boxes outline the same drier-than-average periods highlighted in Figure 31.

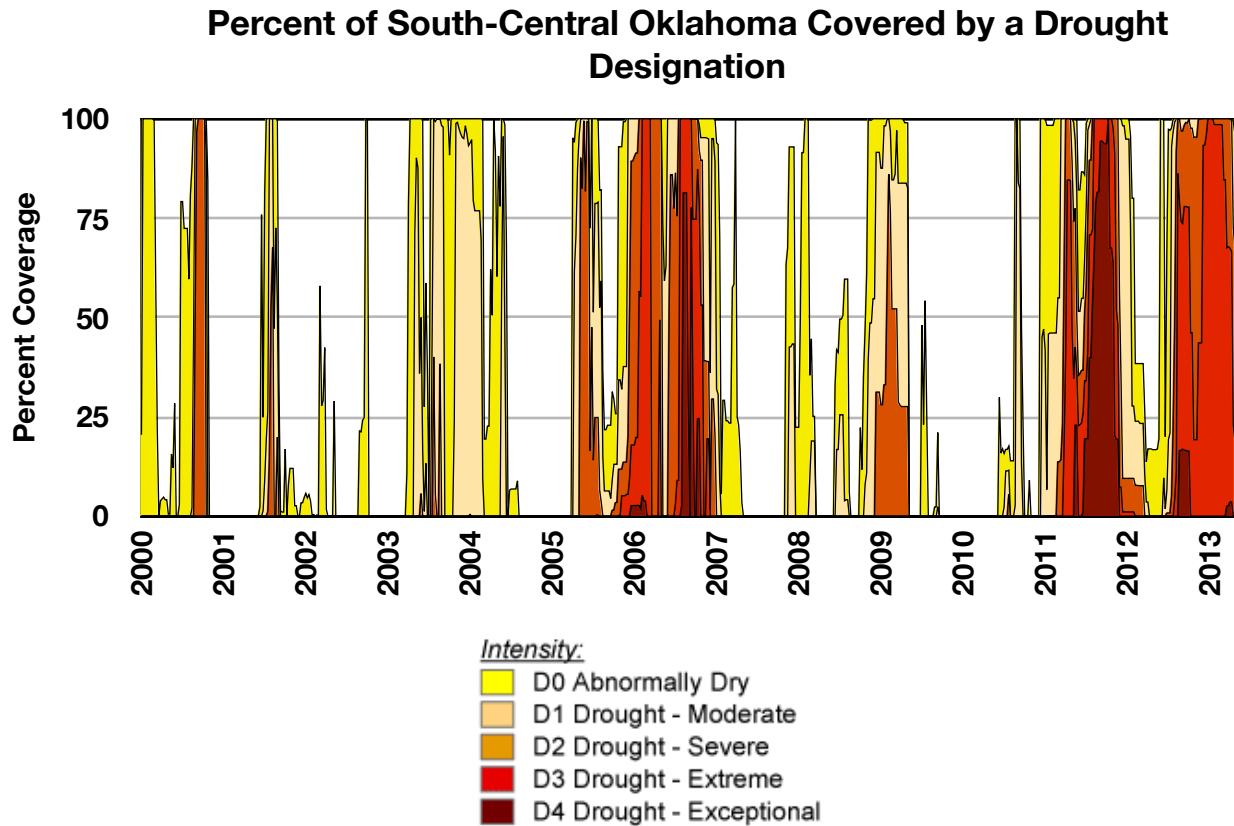


**Figure 33a.** Annual departure from normal precipitation (actual precipitation total for the year subtracted from the annual normal) for south-central Oklahoma from 1895 to 2012.



**Figure 33b.** Palmer Drought Severity Index for south-central Oklahoma from 1895 to 2012.

South-central Oklahoma experienced periods of abnormally dry to exceptional conditions from 2000 to 2013. In figure 34 we look at drought designation in the region and see that from 2005-2007 displays moderate to exceptional conditions covered almost 100% of the region. In 2011-2013 the region experienced extreme to exceptional drought also covering nearly 100%.



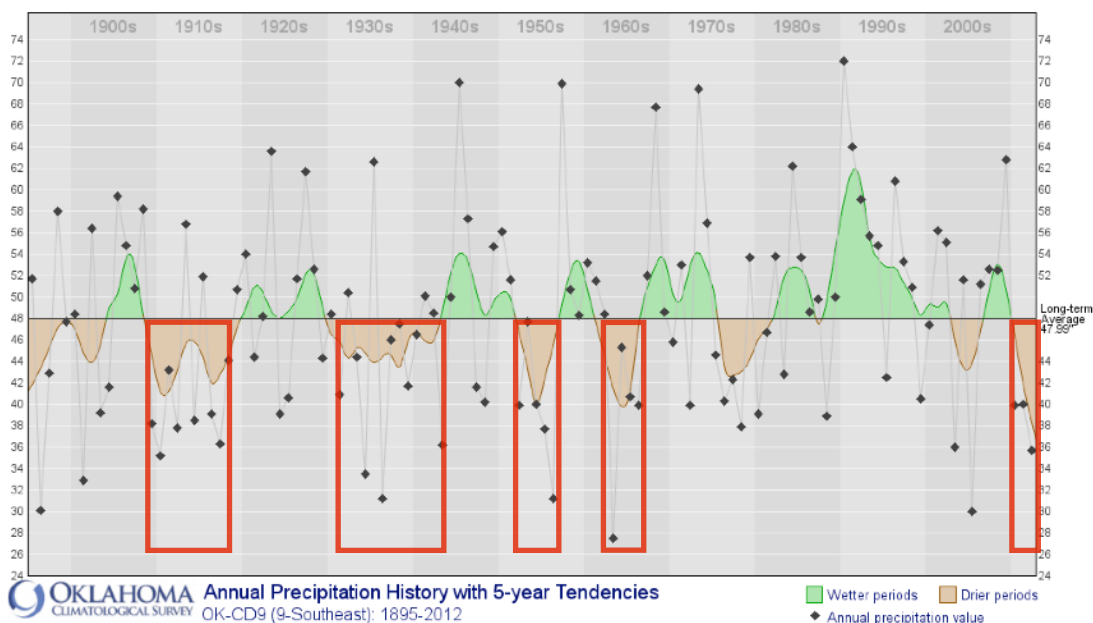
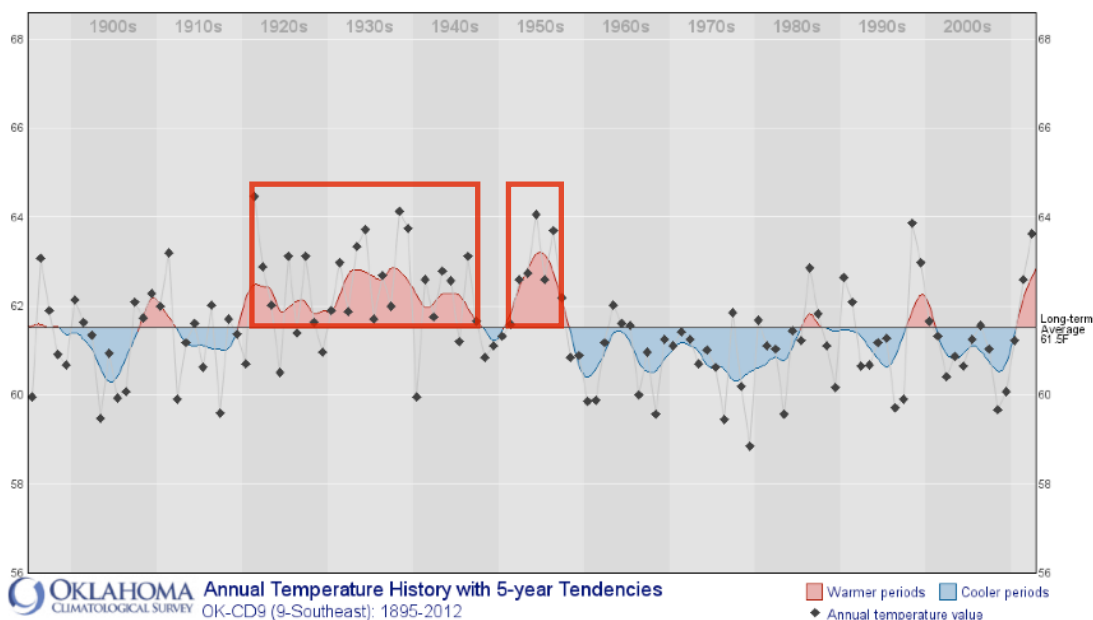
**Figure 34.** Drought history for south-central Oklahoma as designated by the U.S. Drought Monitor. The color scale is identical to that in Figure 1. Note that south-central Oklahoma was experiencing extreme (bright red) to exceptional drought (dark red) across most of the climate division during much of 2006 and 2011 to present (data through March 2013). Data courtesy of the National Data Mitigation Center.

For more information on the sources of drought information, see Table 10 on page 52.

## Region 9: Southeast Oklahoma

Southeast Oklahoma has experienced a wide range of temperatures and precipitation over the past several decades. Abnormally hot and dry conditions have occurred multiple times since the early 1900s. Figure 35 shows the annual temperature (top) and annual precipitation (bottom) in southeastern Oklahoma since 1895.<sup>11</sup> The annual temperature for southeastern Oklahoma averages 61.4 degrees Fahrenheit, while precipitation averages 48.0 inches. Warmer-than-average periods have spanned the 1920s through the mid 1940s, the mid-1950s, and the late 1990s through the 2000s. Significant periods of drier-than-average conditions include the 1910s, 1930s, mid-1950s, mid-1960s, and the late 1970s.

**Figure 35.** The average annual temperature (top graph) and total annual precipitation (bottom graph) in southeastern Oklahoma from 1895 to 2012. To highlight warmer, cooler, wetter, or drier periods, 5-year moving averages are shaded. On the top graph, red shading (above the horizontal line) indicates warmer periods and blue shading (below the line) notes cooler periods than average. Similarly, on the bottom graph, green shading (above the horizontal line) highlights wetter periods and brown shading (below the line) highlights drier periods than average. Extended periods of relatively warm temperatures or low precipitation are outlined in red boxes.



Options for the drought-of-record in this region include the droughts in the 1910s, late 1930s, and mid-1950s. The longest period of dry conditions undoubtedly was during the 1910s. Table 9 compares Palmer Drought Severity Indices for these droughts and others. Using these indices, the drought of the 1910s exceeds the duration of all other droughts; hence, ***the period from January 1909 to August 1918 is the drought-of-record for southeastern Oklahoma.***

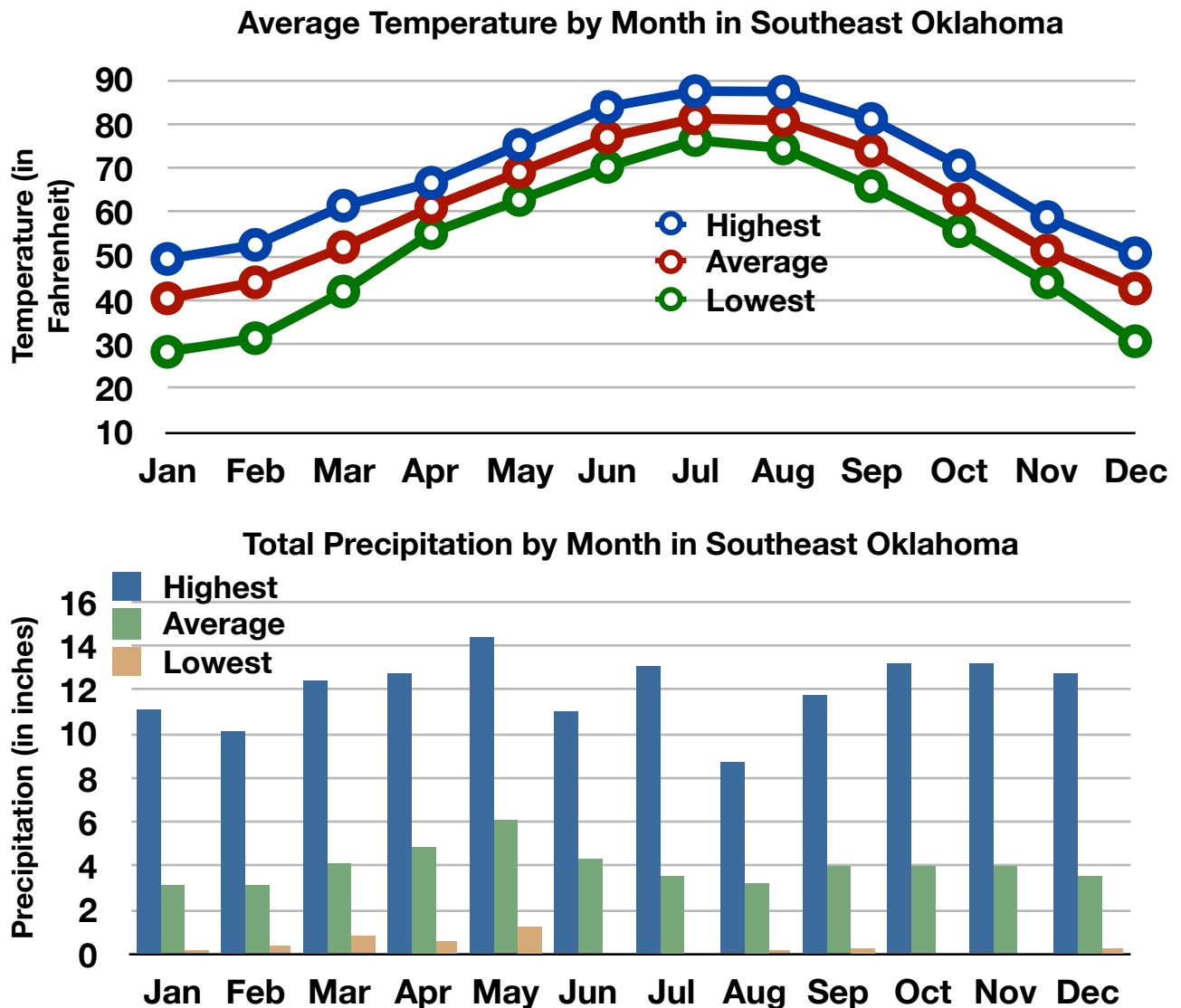
Because of its intense heat combined with non-stop dry conditions, ***November 1950 through December 1956 comes in second for the drought-of-record for southeastern Oklahoma.***

**Table 9: Comparison of Palmer Drought Severity Indices (PDSI) for Several Droughts Affecting Southeast Oklahoma**

Time Period	Months with PDSI less than -1	Months with PDSI less than -4	Lowest PDSI Value
January 1909 – August 1918	83 (of 116 months)	2	-4.55
April 1930 – October 1944	72 (of 175 months)	4 consecutive plus 1 other	-5.16
November 1950 – December 1956	55 (of 74 months)	7 consecutive	-5.6
February 1963 – March 1967	44 (of 50 months)	4 consecutive plus 1 other	-4.78
May 2010 - December 2012*	31 (of 32 months)	3 consecutive plus 1 other	-4.48

**\*Note:** Data only available through December 2012; drought conditions may have continued past this date.

To understand when there is the greatest stress on water availability for northeastern Oklahoma, the average monthly temperature and precipitation, as well as their average highest and lowest monthly values, are shown in Figure 36. Warmer temperatures result in greater water loss by evaporation and transpiration. The warmest temperatures typically occur during July and August (top of Figure 36).



**Figure 36.** *Top graph:* The monthly average temperature (in degrees Fahrenheit) across southeastern Oklahoma using data from 1895 to 2012. The red (middle) line is the average of all climate-division average temperatures for that time period. The blue (top) line is the highest monthly average and the green (bottom) line is the lowest. *Bottom graph:* The average total precipitation (in inches) by month across southeastern Oklahoma using data from 1895 to 2012. The blue (leftmost of each monthly cluster) bar is the highest monthly precipitation; the green (middle of the cluster) is the average precipitation total recorded for that month; the gold (rightmost) is the lowest precipitation total recorded for that month. [Note that zero precipitation has occurred at least once during June, July, and November.] The peak of precipitation in May is clearly visible.

Southeastern Oklahoma has experienced long and extreme droughts in its past. Figure 37 displays the departure from normal precipitation and Palmer Drought Severity Index, for southeastern Oklahoma from 1895 to 2012. Red boxes outline the same drier-than-average periods highlighted in Figure 35.

### Annual Departure from Normal Precipitation for Southeast Oklahoma

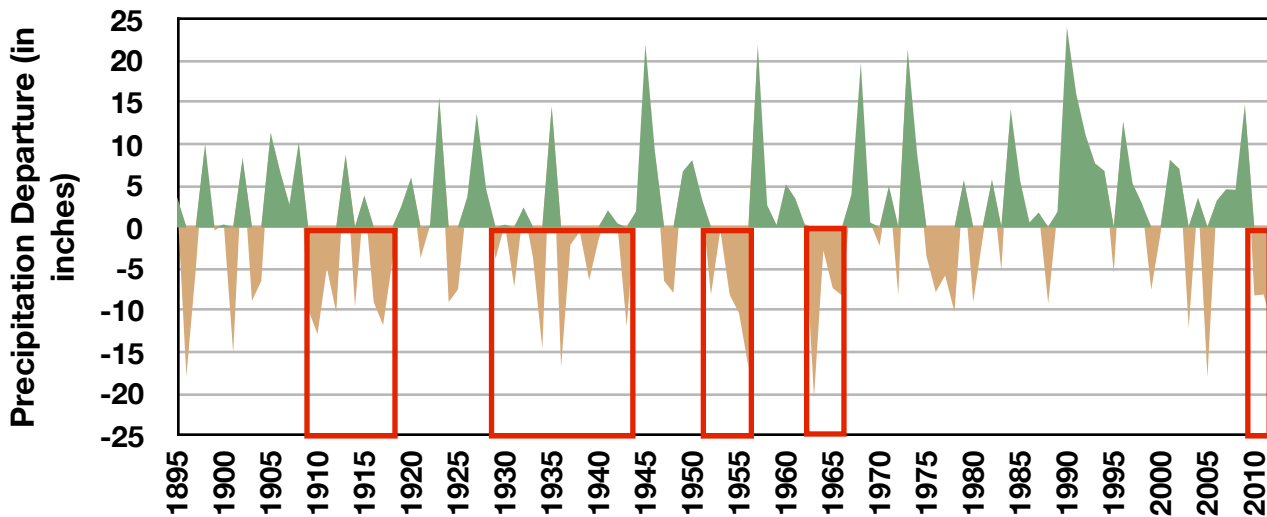


Figure 37a. Annual departure from normal precipitation (actual precipitation total for the year subtracted from the annual normal) for southeastern Oklahoma from 1895 to 2012.

### Palmer Drought Severity Index for Southeast Oklahoma

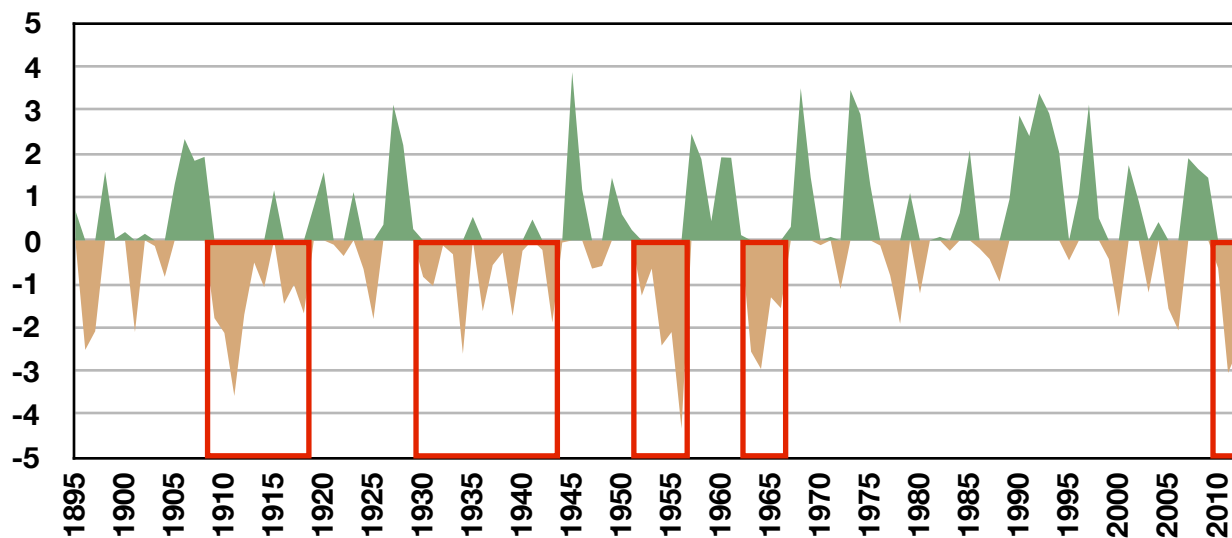
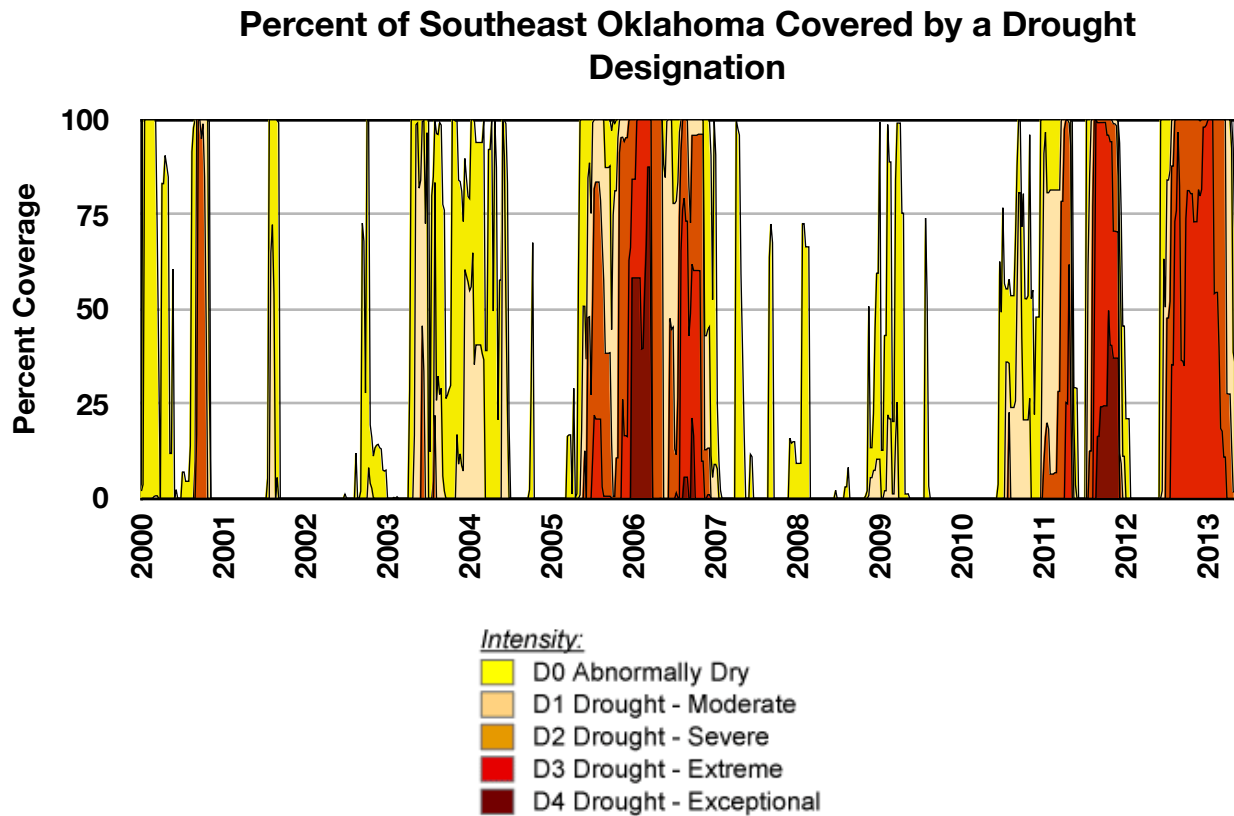


Figure 37b. Palmer Drought Severity Index for southeastern Oklahoma from 1895 to 2012.

South-central Oklahoma experienced periods of abnormally dry to exceptional conditions from 2000 to 2013. In Figure 38 we look at drought designation in the region and see that from 2005-2007 displays moderate to exceptional conditions covered 25 to 100% of the region. In 2011-2013 the region experienced extreme to exceptional drought also covering nearly 100%.



**Figure 38.** Drought history for southeastern Oklahoma as designated by the U.S. Drought Monitor. The color scale is identical to that in Figure 1. Note that southeastern Oklahoma was experiencing extreme (bright red) to exceptional drought (dark red) across most of the county during much of 2006 and 2011 to present (data through March 2013). Data courtesy of the National Drought Mitigation Center.

For more information on the sources of drought information, see Table 10 on page 52.

## Drought Resources

There are several excellent sources of information for drought monitoring and reporting, ranging from national to local (Table 10). These resources are designed to help you plan and prepare for drought conditions in your region.

Table 10 summarizes several excellent sources of information for drought monitoring and reporting, ranging from national to local.

**Table 10: Sources of Drought Information & Tools**

Source	Web Address	Uses
<b><i>Major Sources of Information</i></b>		
National Integrated Drought Information System	<a href="http://www.drought.gov">www.drought.gov</a>	Consolidated source of drought information, monitoring & reporting tools, including many of the other sources listed below
National Drought Mitigation Center	<a href="http://drought.unl.edu">drought.unl.edu</a>	Consolidated source of drought information, including drought planning, monitoring reporting, risks, and impacts
Oklahoma Climatological Survey	<a href="http://climate.ok.gov">climate.ok.gov</a>	Consolidated source of Oklahoma climate information
Oklahoma Mesonet	<a href="http://www.mesonet.org">www.mesonet.org</a>	Oklahoma's weather observing network
<b><i>Specific Drought-Related Tools</i></b>		
U.S. Drought Monitor: <i>National Drought Mitigation Center</i>	<a href="http://droughtmonitor.unl.edu/">droughtmonitor.unl.edu/</a>	Current and past diagnoses of drought conditions, both nearby and across the United States
Oklahoma Drought Monitor: <i>Oklahoma Climatological Survey</i>	<a href="http://climate.ok.gov/index.php/drought/last_30_days/drought_wildfire">climate.ok.gov/index.php/drought/last_30_days/drought_wildfire</a>	Current precipitation information, comparisons of conditions across a range of time periods, & drought indices
U.S. Seasonal Drought & Precipitation Outlooks: <i>Climate Prediction Center</i>	<a href="http://www.cpc.noaa.gov">www.cpc.noaa.gov</a>	Large-scale trends in drought across the U.S. for the next few months; Expert assessments (not forecasts) of possible changes in precipitation conditions over a range of times (6-10 days, 8-14 days, 1 month, & 3 months)

The Oklahoma Climatological Survey provides a drought monitoring web site at [http://climate.ok.gov/index.php/drought/last\\_30\\_days/drought\\_wildfire](http://climate.ok.gov/index.php/drought/last_30_days/drought_wildfire). The products on this site use precipitation, temperature, soil moisture, and other data from the Oklahoma Mesonet, the state's weather monitoring network. Tables summarize the current precipitation totals to past years across a variety of time scales (e.g., water year, current season, last 90 days), as shown in Figure 39.

Last 30 Days: Mar 10, 2013 through Apr 8, 2013						
Climate Division	Total Rainfall	Departure from Normal	Pct of Normal	Rank since 1921 (89 periods)	Driest on Record	Wettest on Record
Panhandle	0.26"	-1.39"	16%	11th driest	0.01" (1966)	5.21" (1973)
N. Central	1.36"	-1.33"	51%	30th driest	0.01" (1971)	6.97" (1922)
Northeast	2.62"	-1.05"	71%	39th driest	0.23" (1971)	10.11" (1922)
W. Central	1.18"	-1.22"	49%	31st driest	0.00" (1971)	5.87" (1973)
Central	3.21"	-0.04"	99%	27th wettest	0.05" (1936)	7.21" (1922)
E. Central	3.99"	-0.06"	98%	28th wettest	0.44" (1971)	9.29" (1945)
Southwest	1.17"	-1.14"	51%	27th driest	0.00" (1936)	6.35" (1922)
S. Central	2.74"	-0.78"	78%	42nd driest	0.23" (1950)	8.31" (1945)
Southeast	5.42"	+1.04"	124%	23rd wettest	0.77" (1966)	12.70" (2002)
Statewide	2.43"	-0.67"	78%	41st driest	0.31" (1971)	6.74" (1922)

**Figure 39.** Example of a drought monitoring product from the Oklahoma Climatological Survey (<http://climate.ok.gov>). This example provides an assessment of the past 90 days ending on April 8, 2013 and includes the following information: total rainfall for the period, departure (difference) from normal rainfall for the period, the percentage of normal precipitation for the period, how wet or dry the period has been compared to previous years, the precipitation amount for the driest similar period on record (and its year), and the precipitation amount for the wettest similar period on record (and its year).

## Acknowledgments

Weekly U.S. Drought Monitor data were provided by Brian Fuchs of the National Drought Mitigation Center, and climate division data were supplied by Monica Deming of the Oklahoma Climatological Survey. Oklahoma drought photos courtesy of the National Drought Mitigation Center.

## Bibliography

Heim, R. R., 2002: A Review of Twentieth-Century Drought Indices Used in the United States. *Bulletin of the American Meteorological Society*, **83**, 1149-1165.

NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2017). <https://www.ncdc.noaa.gov/billions/>