

# Drought History

for Louisiana's 9 Regions



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

May 28, 2013

*Updated January 10, 2018*



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## 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. 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 Louisiana.***

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

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 on Louisiana. 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.

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

Local officials and other key stakeholders in Louisiana 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 northwest Louisiana 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.

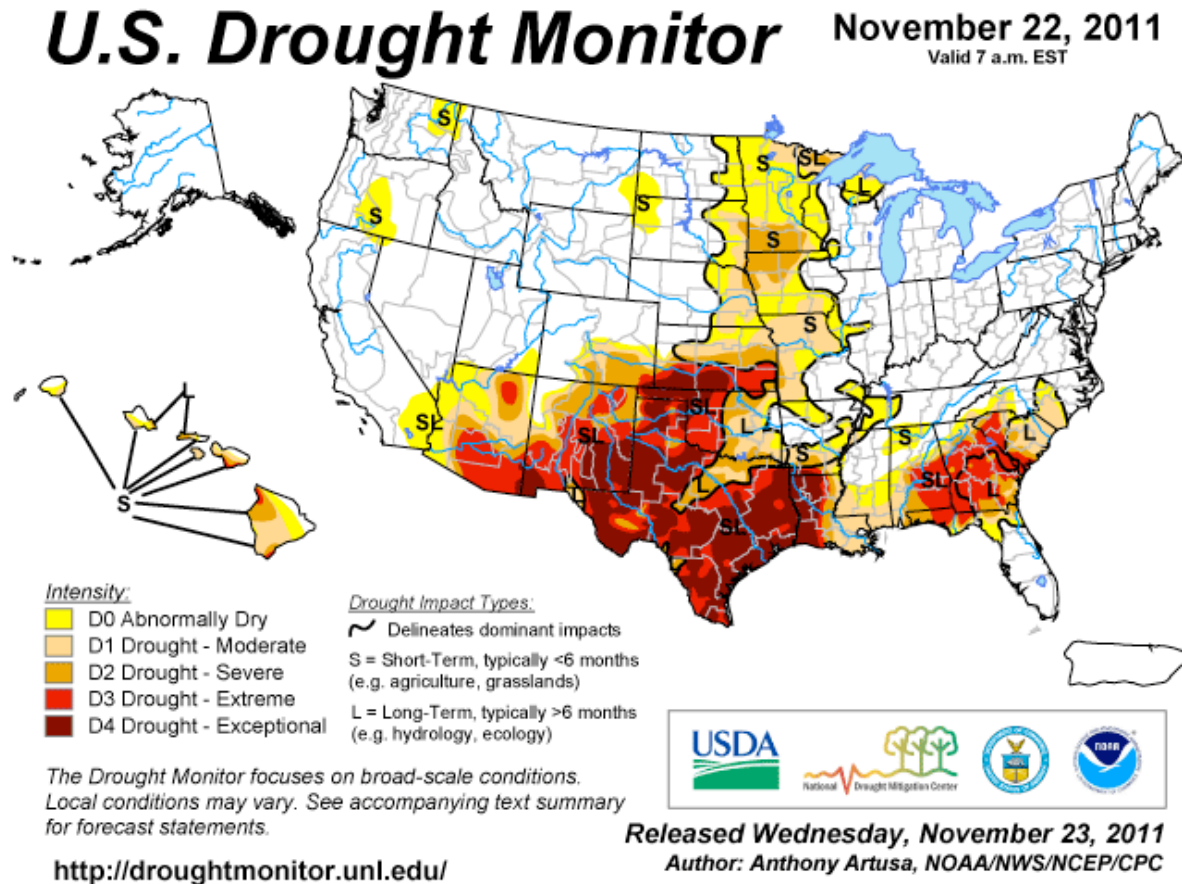
*The Palmer Drought Severity Index* uses observations or estimates of precipitation, temperature, and soil water content. Values typically range from +4 representing extremely wet conditions to -4 representing extremely dry conditions. Values less than -1 indicate some level of drought, and the values 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 5). 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 northwest Louisiana affected by D0 through D4 drought since 2000<sup>1</sup>. Short-term severe droughts in 2010 through 2011 are evident for the region.



**Figure 1.** Example map of the U.S. Drought Monitor from the drought assessment issued for the week preceding November 22, 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 Northwest Louisiana experienced drought?

*Drought is a recurring condition in Louisiana*, 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. Let’s examine our past.

### The Climate of Louisiana

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

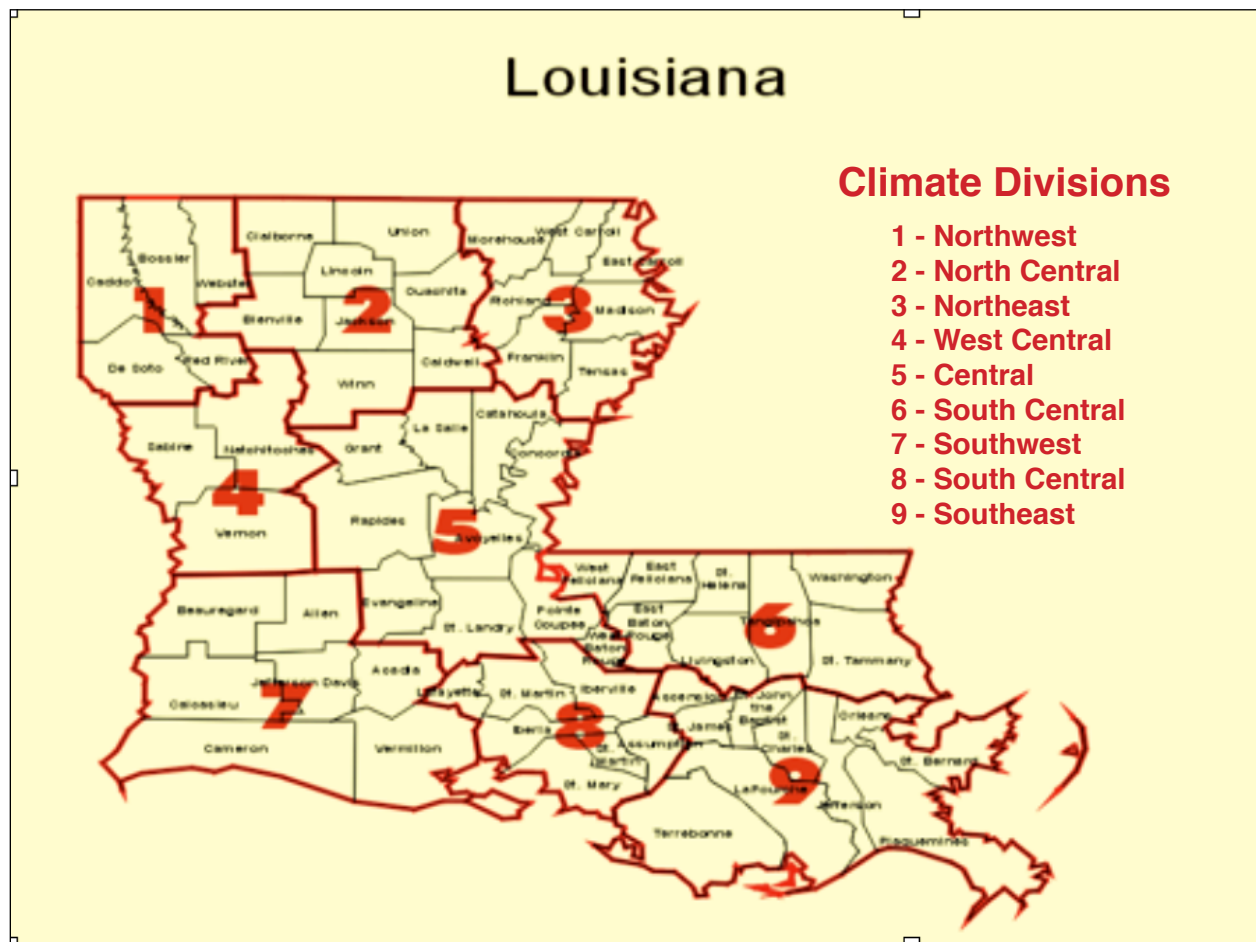
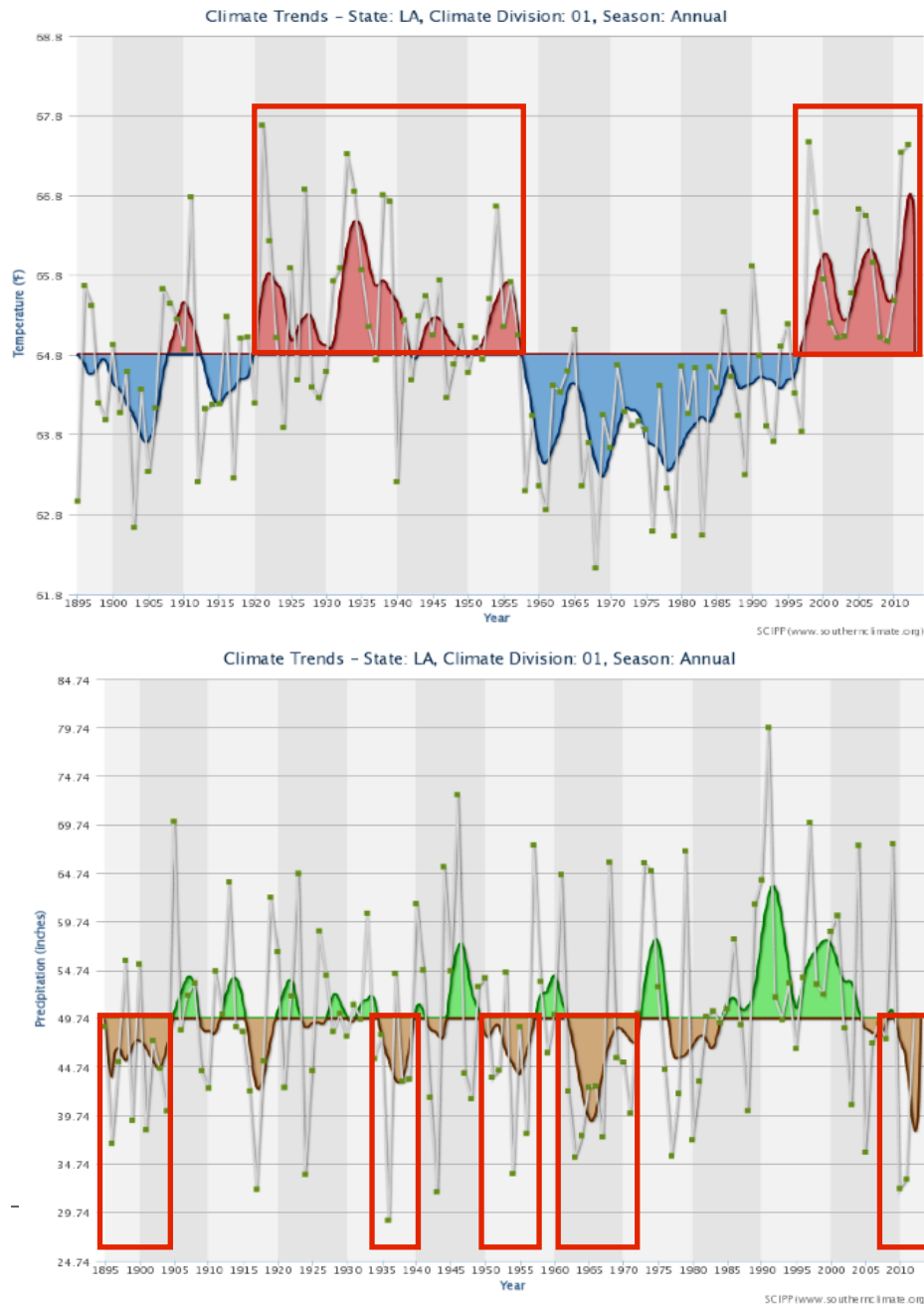


Figure 2. Map of the climate divisions of Louisiana.



# Region 1: Northwest Louisiana

Northwest Louisiana 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 northwest Louisiana since 1895.<sup>2</sup> The annual temperature for northwest Louisiana averages 67.8 degrees Fahrenheit, while precipitation averages 49.74 inches. Warmer-than-average periods have spanned the 1920s through the mid-1950s and the late 1990s through the early 2010s. Significant periods of drier-than-average conditions include the mid-1890s through the mid-1900s, the 1950s, the 1960s through the early 1970s, and the early 2010s.



**Figure 3.** The average annual temperature (top graph) and total annual precipitation (bottom graph) in northwest Louisiana 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 115 months, with several periods of intense drought throughout. Because of its non-stop dry conditions combined with a period of PDSI less than -4, June 1934 to March 1940 comes in second for the drought-of-record for central Louisiana.

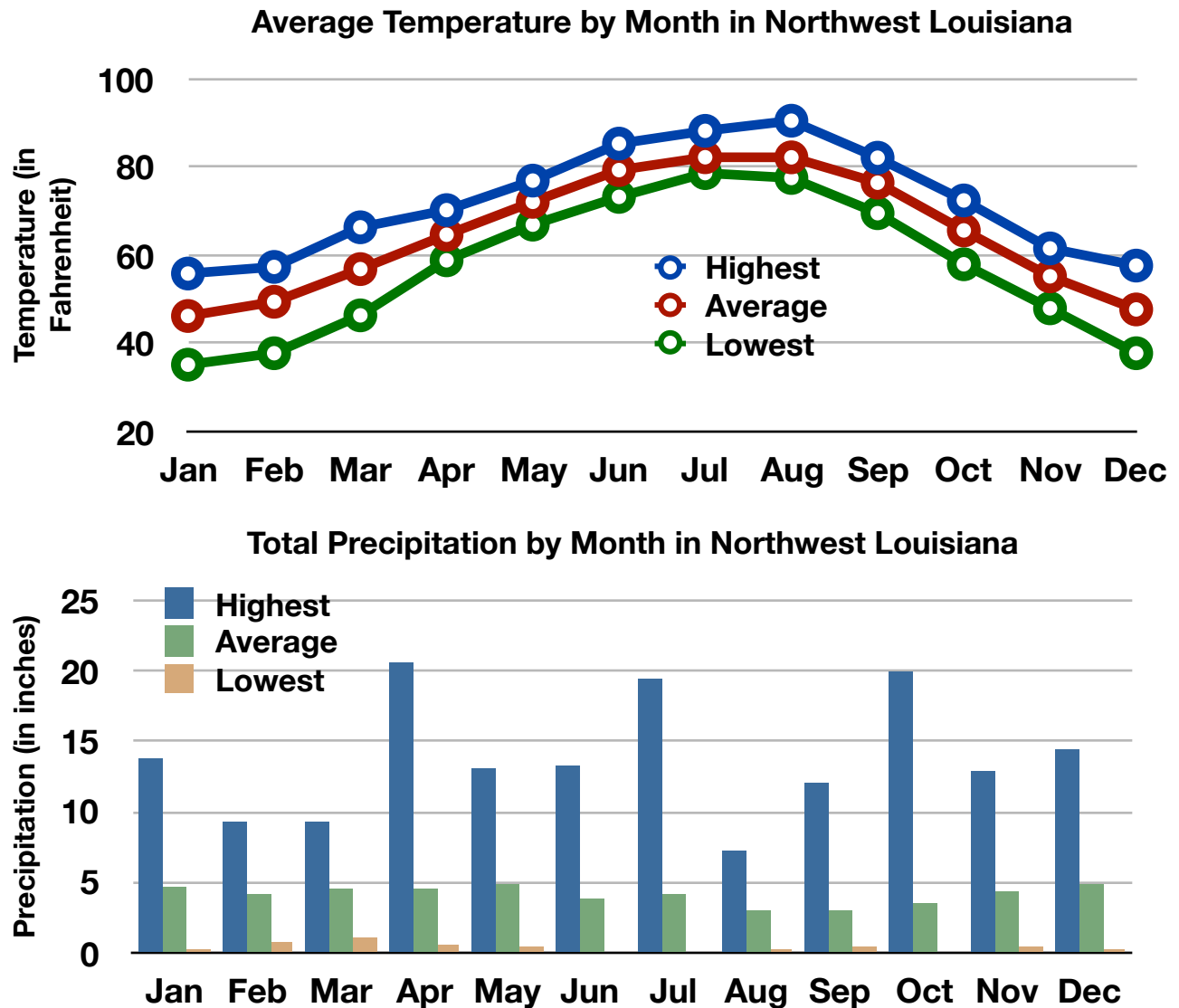
**Table 1: Comparison of Palmer Drought Severity Indices (PDSI) for Several Droughts Affecting Northwest Louisiana**

Time Period	Months with PDSI less than -1	Months with PDSI less than -4	Lowest PDSI Value
May 1986 - May 1904	54 (of 96 months)	0	-3.25
June 1934 - March 1940	48 (of 70 months)	4 consecutive	-4.74
December 1950 - December 1956	46 (of 73 months)	0	-3.73
December 1962 - June 1972	70 (of 115 months)	0	-3.44
March 2005 - December 2010*	38 (of 92 months)	0	-3.79

*\*Note: Data only available through December 2010; drought conditions may have continued past this date.*



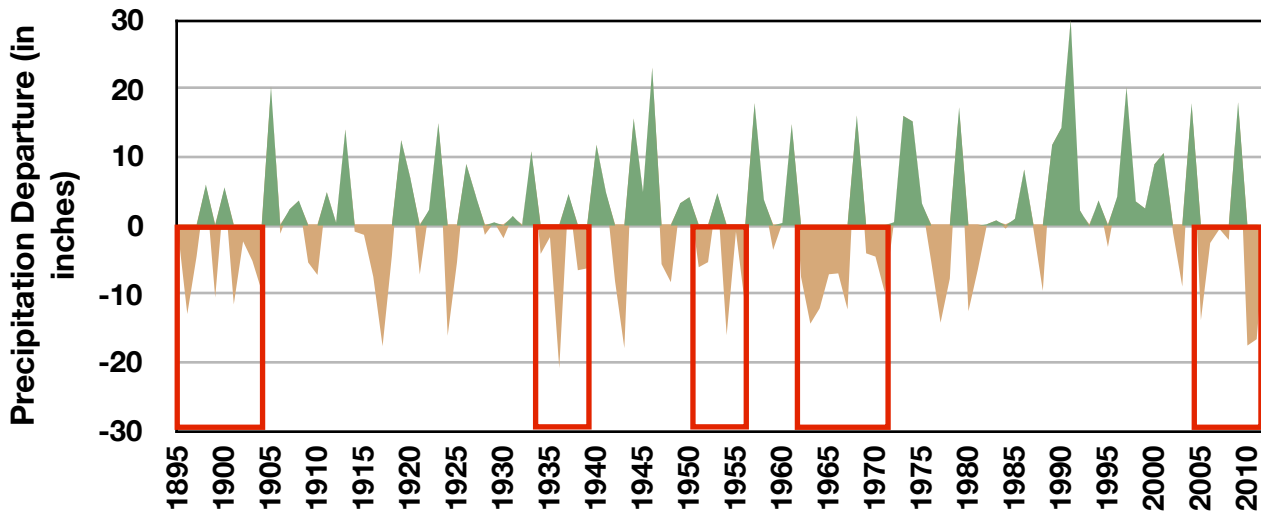
To understand when there is the greatest stress on water availability for northwest Louisiana, the average monthly temperature and precipitation, as well as their average highest and lowest monthly values, are shown in Figure 4. Warmer temperatures result in greater water loss by evaporation and transpiration.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



**Figure 4.** *Top graph:* The monthly average temperature (in degrees Fahrenheit) across northwest Louisiana using data from 1895 to 2010. 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 northwest Louisiana using data from 1895 to 2010. 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 October] The three peaks of precipitation, first in April, then in July, and finally in October, are clearly visible.

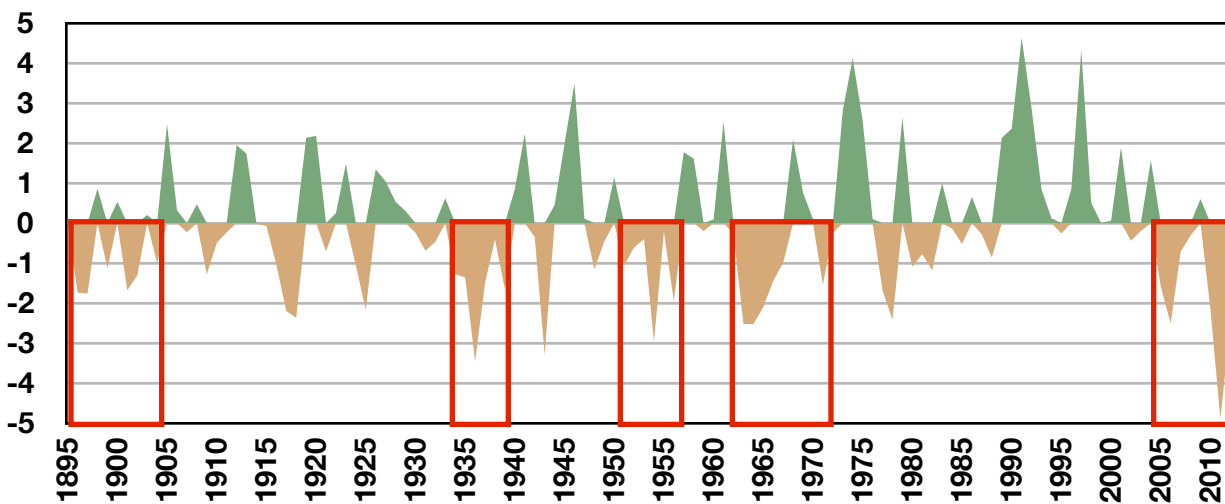
Northwest Louisiana has experienced long and extreme droughts in its past. Figure 5 displays the departure from normal precipitation and Palmer Drought Severity Index for northwest Louisiana from 1895 to 2010. Red boxes outline the same drier-than-average periods highlighted in Figure 3.

### Annual Departure from Normal Precipitation for Northwest Louisiana



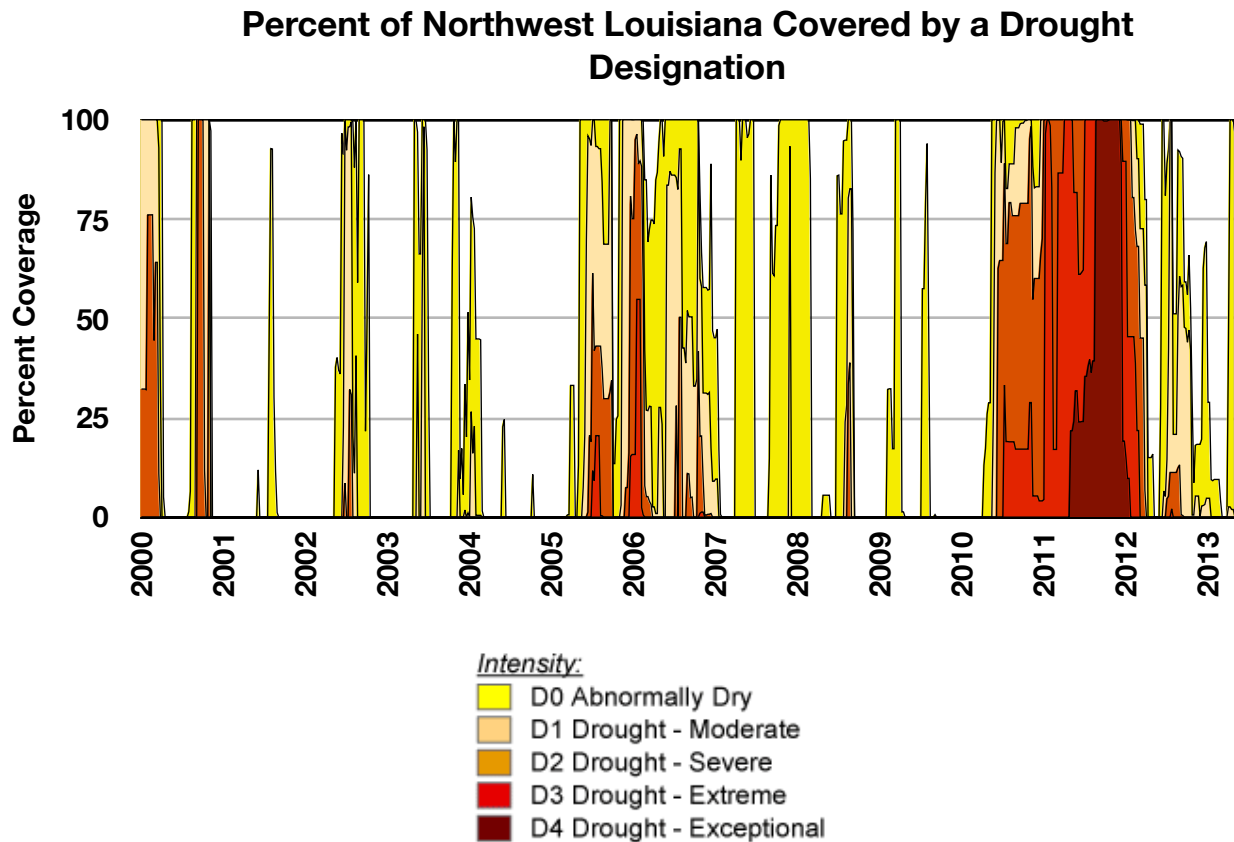
*Figure 5a.* Annual departure from normal precipitation (actual precipitation total for the year subtracted from the annual normal) for northwest Louisiana from 1895 to 2010.

### Palmer Drought Severity Index for Northwest Louisiana



*Figure 5b.* Palmer Drought Severity Index for northwest Louisiana from 1895 to 2010.

The region has experienced dry conditions from 2000 to 2013. In Figure 6 we look at drought designation in northwest Louisiana and see that from 2006-2007 abnormally dry conditions covered almost 100% of the region. In late 2010 to 2013 the region experienced extreme to exceptional drought also covering nearly 100%.

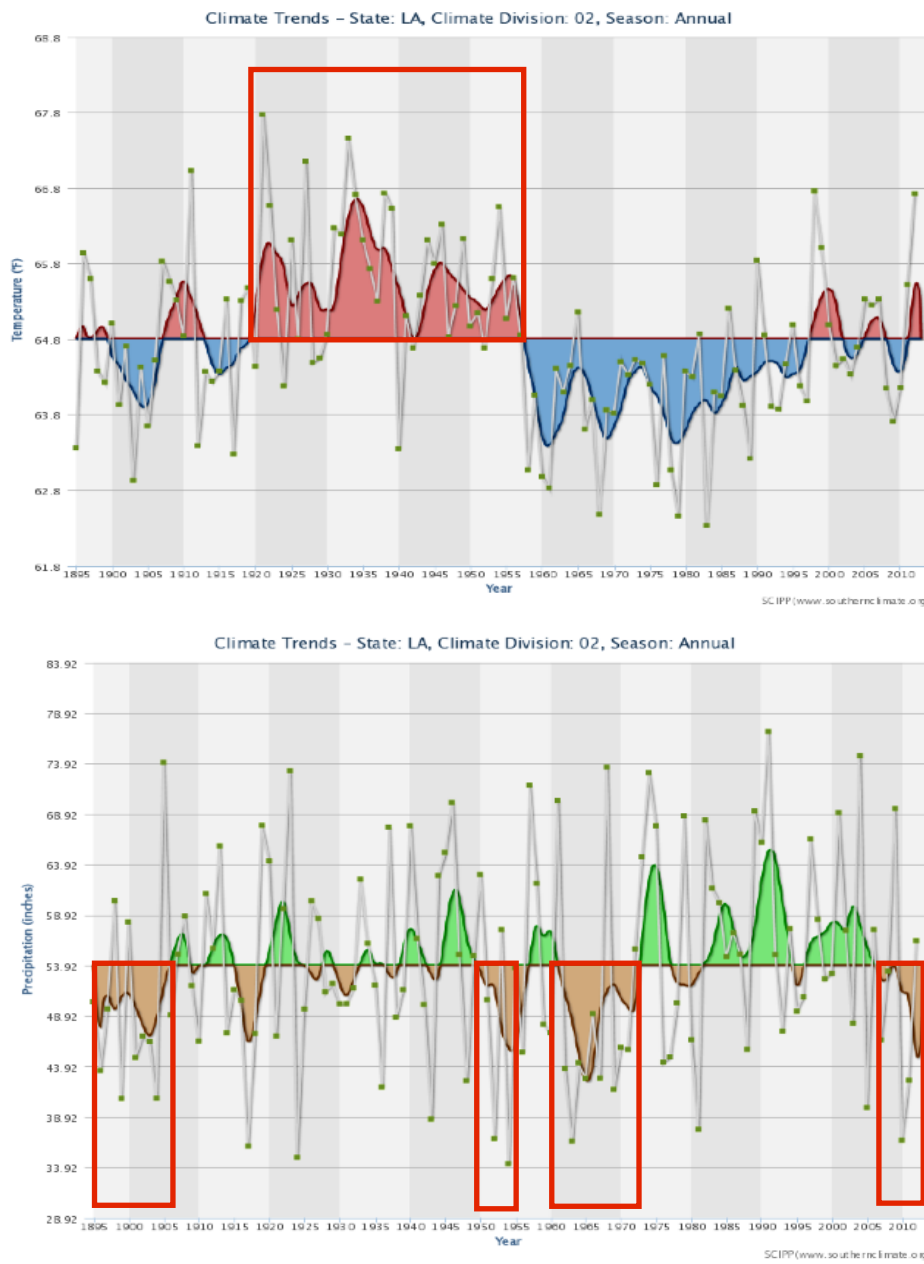


**Figure 6.** Drought history for northwest Louisiana as designated by the U.S. Drought Monitor. The color scale is identical to that in Figure 1. Note that northwest Louisiana was experiencing extreme (bright red) to exceptional drought (dark red) across most of the area during much of 2010 through 2011. 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 Louisiana

North-Central Louisiana 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 Louisiana since 1895.<sup>3</sup> The annual temperature for north-central Louisiana averages 64.8 degrees Fahrenheit, while precipitation averages 53.92 inches. Warmer-than-average periods have spanned the 1920s through the 1950s. Significant periods of drier-than-average conditions include the mid-1890s through the mid-1900s, the early 1950s, the 1960s through the early 1970s, and the early 2010s.



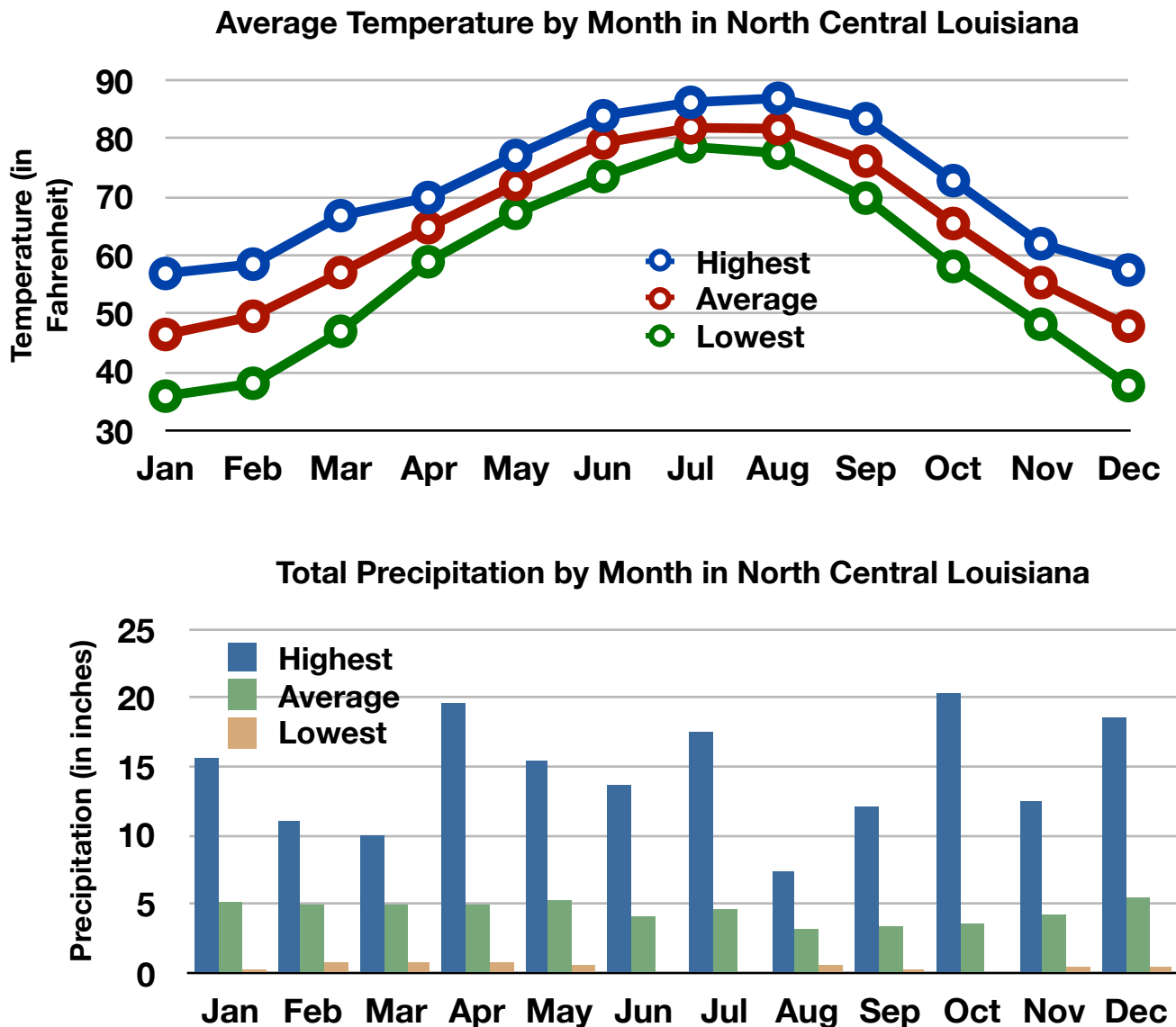
**Figure 7.** The average annual temperature (top graph) and total annual precipitation (bottom graph) in north-central Louisiana from 1895 to 2012. To highlight warmer, cooler, wetter, or drier periods, 5-year moving averages are shaded. On the top graph, red shading (above the horizontal line) indicates 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 103 months, with several periods of intense drought throughout. Because of its non-stop dry conditions combined with a period of PDSI less than -4, May 1951 to December 1956 comes in second for the drought-of-record for north-central Louisiana.

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

Time Period	Months with PDSI less than -1	Months with PDSI less than -4	Lowest PDSI Value
May 1896 - November 1904	68 (of 103 months)	0	-3.10
May 1951 - December 1956	43 (of 68 months)	2 consecutive	-4.38
October 1962 - April 1971	78 (of 103 months)	0	-3.62
June 2005- December 2010	38 (of 67 months)	0	-3.16

To understand when there is the greatest stress on water availability for north-central Louisiana, 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).

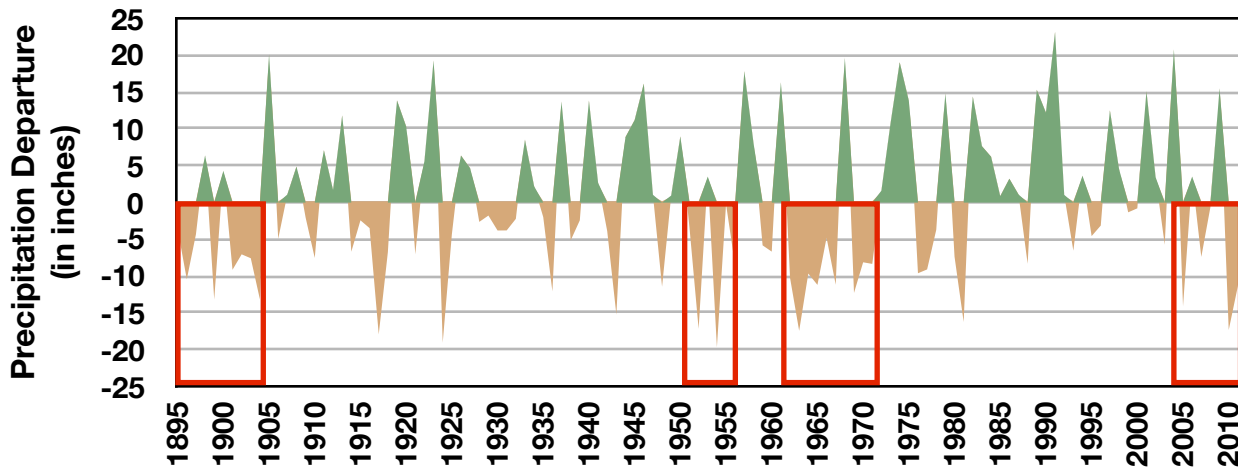


**Figure 8.** *Top graph:* The monthly average temperature (in degrees Fahrenheit) across north-central Louisiana using data from 1895 to 2012. The red (middle) line is the average of all climate-division average temperatures for that time period. The blue (top) line is the highest monthly average and the green (bottom) line is the lowest. *Bottom graph:* The average total precipitation (in inches) by month across north-central Louisiana 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 October]



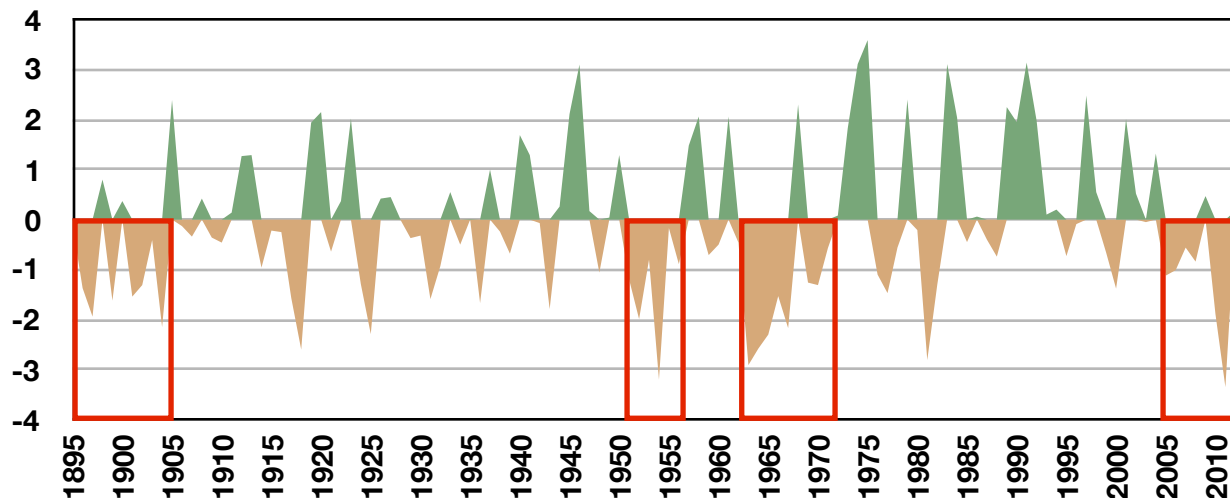
North-central Louisiana has experienced long and extreme droughts in its past seen by its precipitation, temperature, and agricultural conditions. Figure 9 displays the departure from normal precipitation and Palmer Drought Severity Index for north-central Louisiana from 1895 to 2012. Red boxes outline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

### Annual Departure from Normal Precipitation for North Central Louisiana



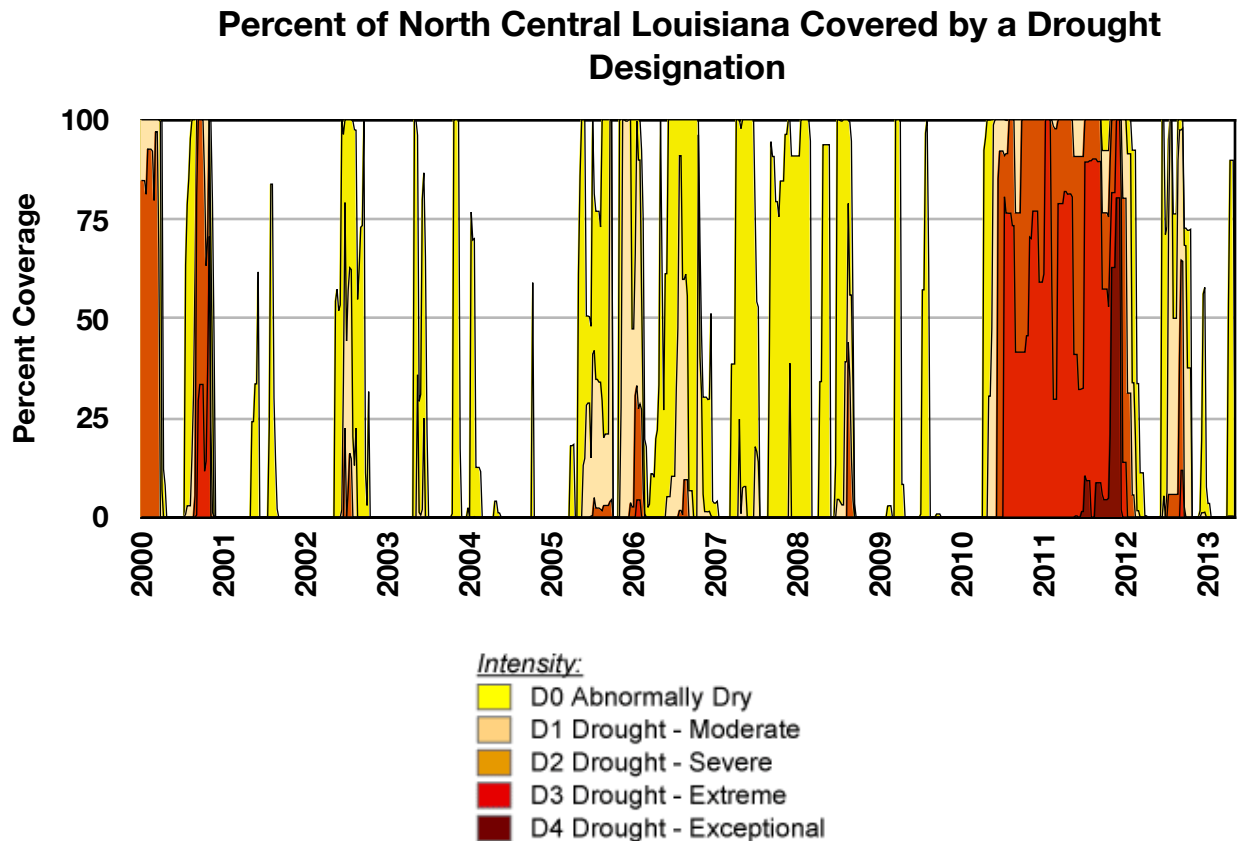
*Figure 9a.* Annual departure from normal precipitation (actual precipitation total for the year subtracted from the annual normal) for north-central Louisiana from 1895 to 2012.

### Palmer Drought Severity Index for North Central Louisiana



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

The region has experienced dry conditions from 2000 to 2013. In Figure 10 we look at drought designation in north-central Louisiana and see that in 2000 and 2001 extreme conditions that covered 75-100% of the region. From 2005-2009 abnormally dry conditions covered almost 100% of the region and in late 2010 to 2012 the region experienced extreme to exceptional drought covering nearly 50-75%.

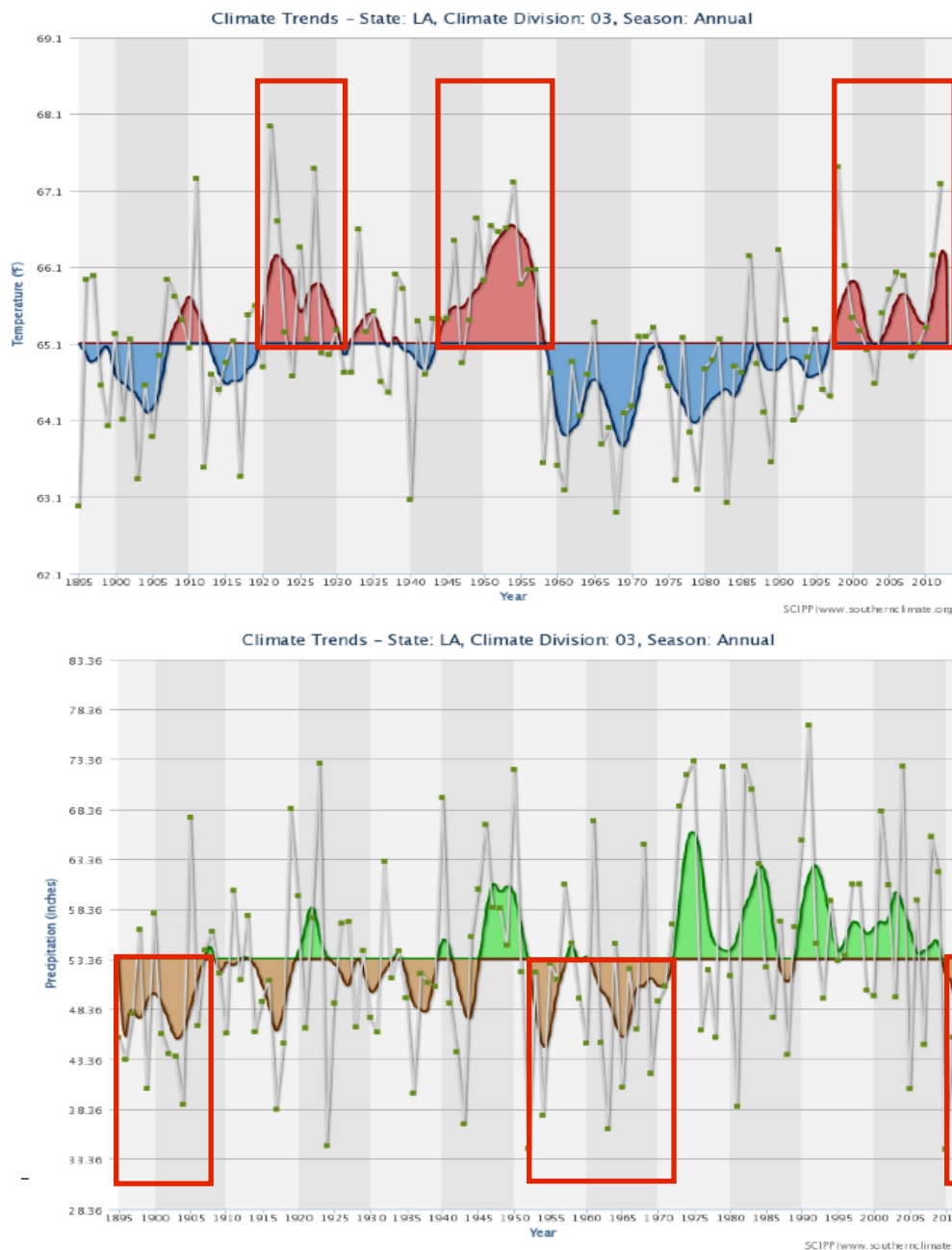


**Figure 10.** Drought history for north-central Louisiana as designated by the U.S. Drought Monitor. The color scale is identical to that in Figure 1. Note that north-central Louisiana was experiencing extreme (bright red) to exceptional drought (dark red) across most of the area during much of 2010 through 2011. 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 Louisiana

Northeast Louisiana 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 northeast Louisiana since 1895.<sup>4</sup> The annual temperature for northeast Louisiana averages 65.1 degrees Fahrenheit, while precipitation averages 53.36 inches. Warmer-than-average periods have spanned the 1920s, the mid-1940s through the 1950s, and the late 1990s through the early 2010s. Significant periods of drier-than-average conditions include the mid-1890s through the mid-1900s, the 1950s through the early 1970s, and the early 2010s.



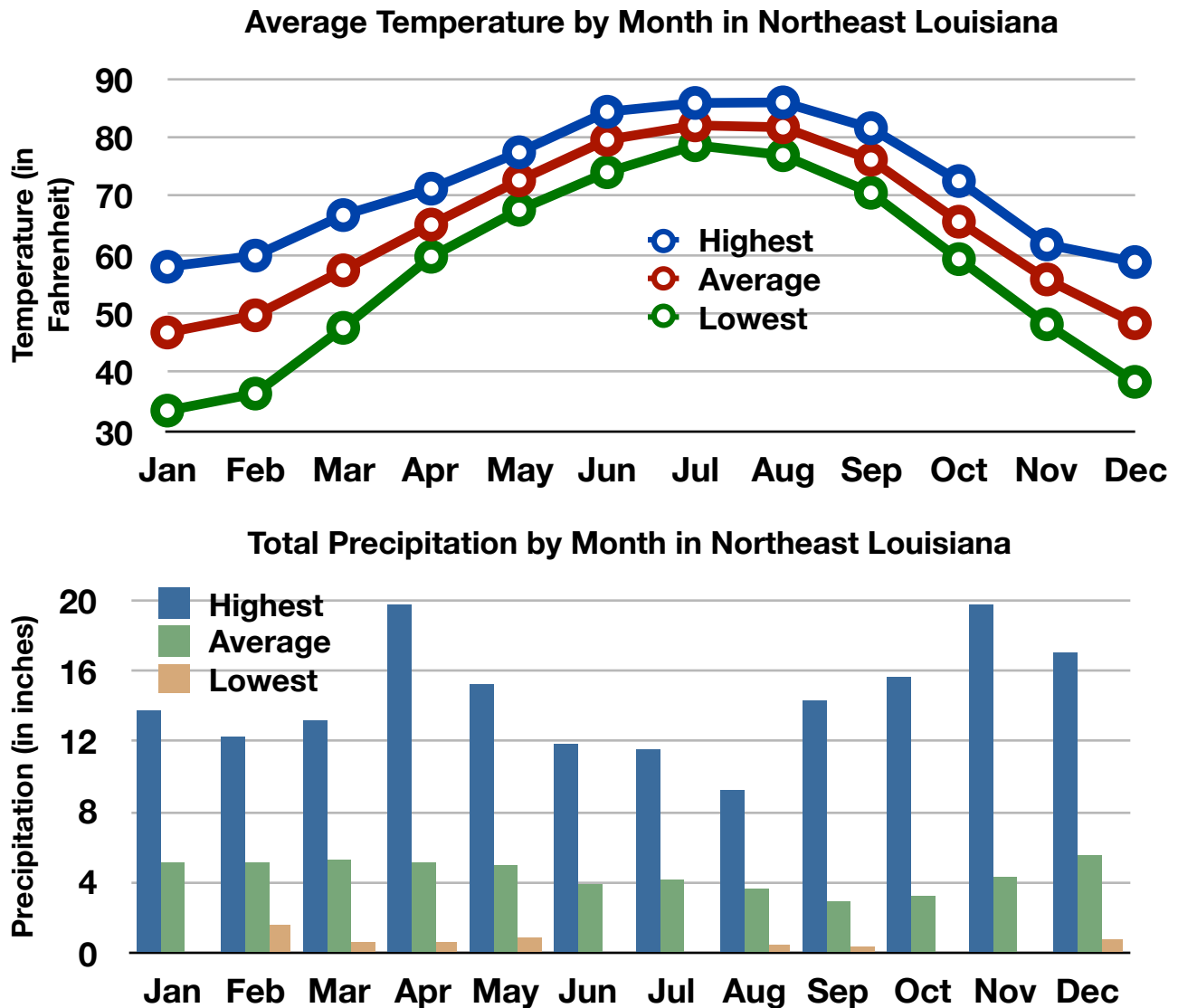
**Figure 11.** The average annual temperature (top graph) and total annual precipitation (bottom graph) in northeast Louisiana from 1895 to 2012. To highlight warmer, cooler, wetter, or drier periods, 5-year moving averages are shaded. On the top graph, red shading (above the horizontal line) indicates 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 230 months, with several periods of intense drought throughout. October 1895 to March 1907 comes in second for the drought-of-record for northeast Louisiana.

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

Time Period	Months with PDSI less than -1	Months with PDSI less than -4	Lowest PDSI Value
October 1895 - March 1907	71 (of 137 months)	0	-3.62
May 1951 - June 1970	107 (of 230 months)	4 consecutive, plus 1 other	-4.38
June 2005 - July 2010	34(of 67 months)	0	-3.68

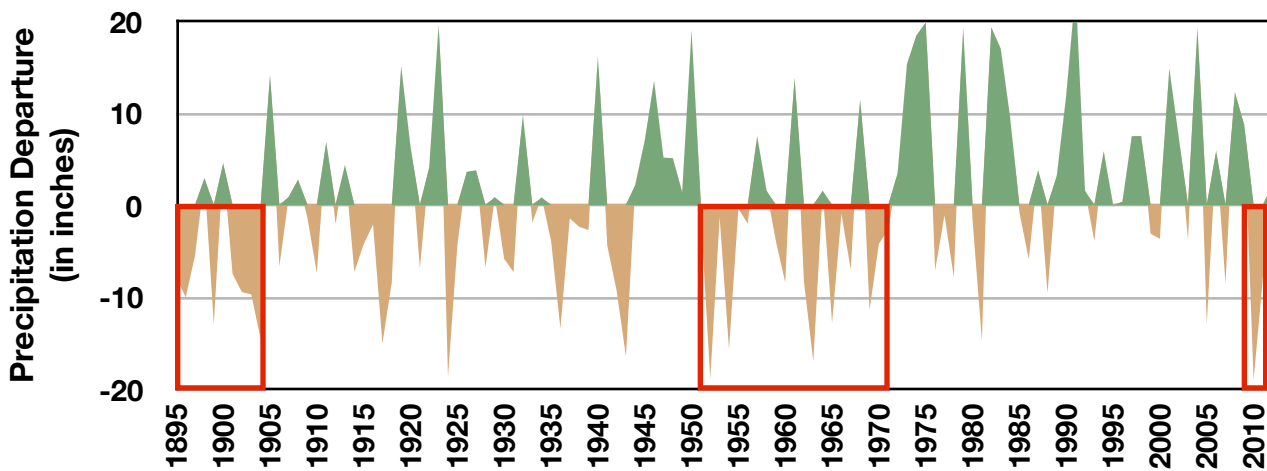
To understand when there is the greatest stress on water availability for northeast Louisiana, the average monthly temperature and precipitation, as well as their average highest and lowest monthly values, are shown in Figure 12. Warmer temperatures result in greater water loss by evaporation and transpiration.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



**Figure 12.** *Top graph:* The monthly average temperature (in degrees Fahrenheit) across northeast Louisiana 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 northeast Louisiana 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, October, and November] The two peaks of precipitation, first in April, then in November, are clearly visible.

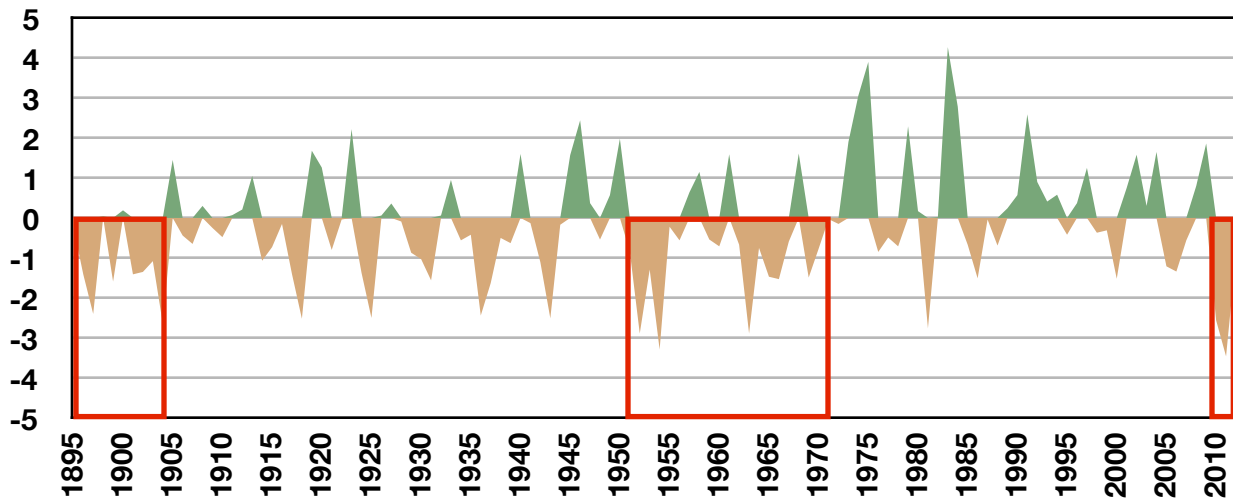
Northeast Louisiana has experienced long and extreme droughts in its past. Figure 13 displays the departure from normal precipitation, Palmer Drought Severity Index, and two-year Standardized Precipitation Index for northeast Louisiana from 1895 to 2012. Red boxes outline the same drier-than-average periods highlighted in Figure 11.

### Annual Departure from Normal Precipitation for Northeast Louisiana



*Figure 13a.* Annual departure from normal precipitation (actual precipitation total for the year subtracted from the annual normal) for northeast Louisiana from 1895 to 2012.

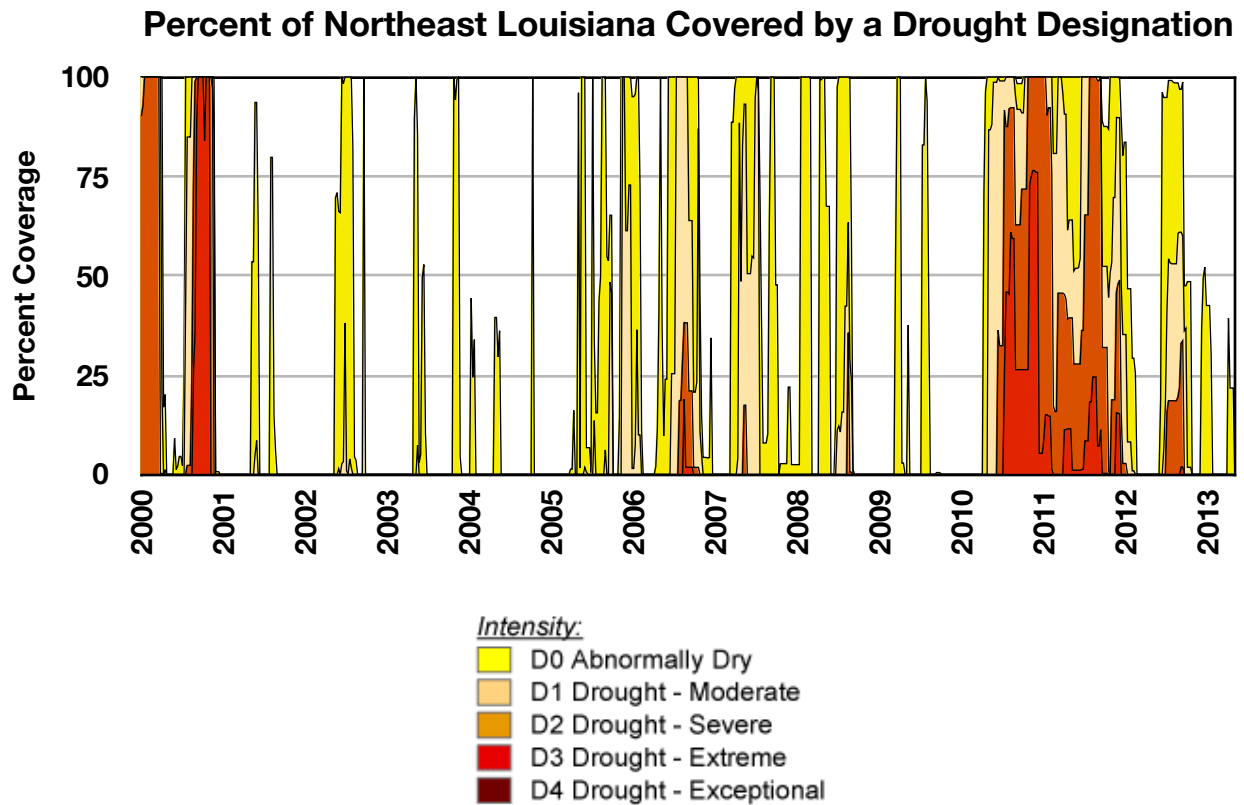
### Palmer Drought Severity Index for Northeast Louisiana



*Figure 13b.* Palmer Drought Severity Index for northeast Louisiana from 1895 to 2012.



The region has experienced dry conditions from 2000 to 2013. In Figure 14 we look at drought designation in northeast Louisiana and see that from 2006-2007 abnormally dry conditions covered almost 100% of the region. In late 2010 to late 2012 the region experienced extreme to exceptional drought also covering 50-100%.

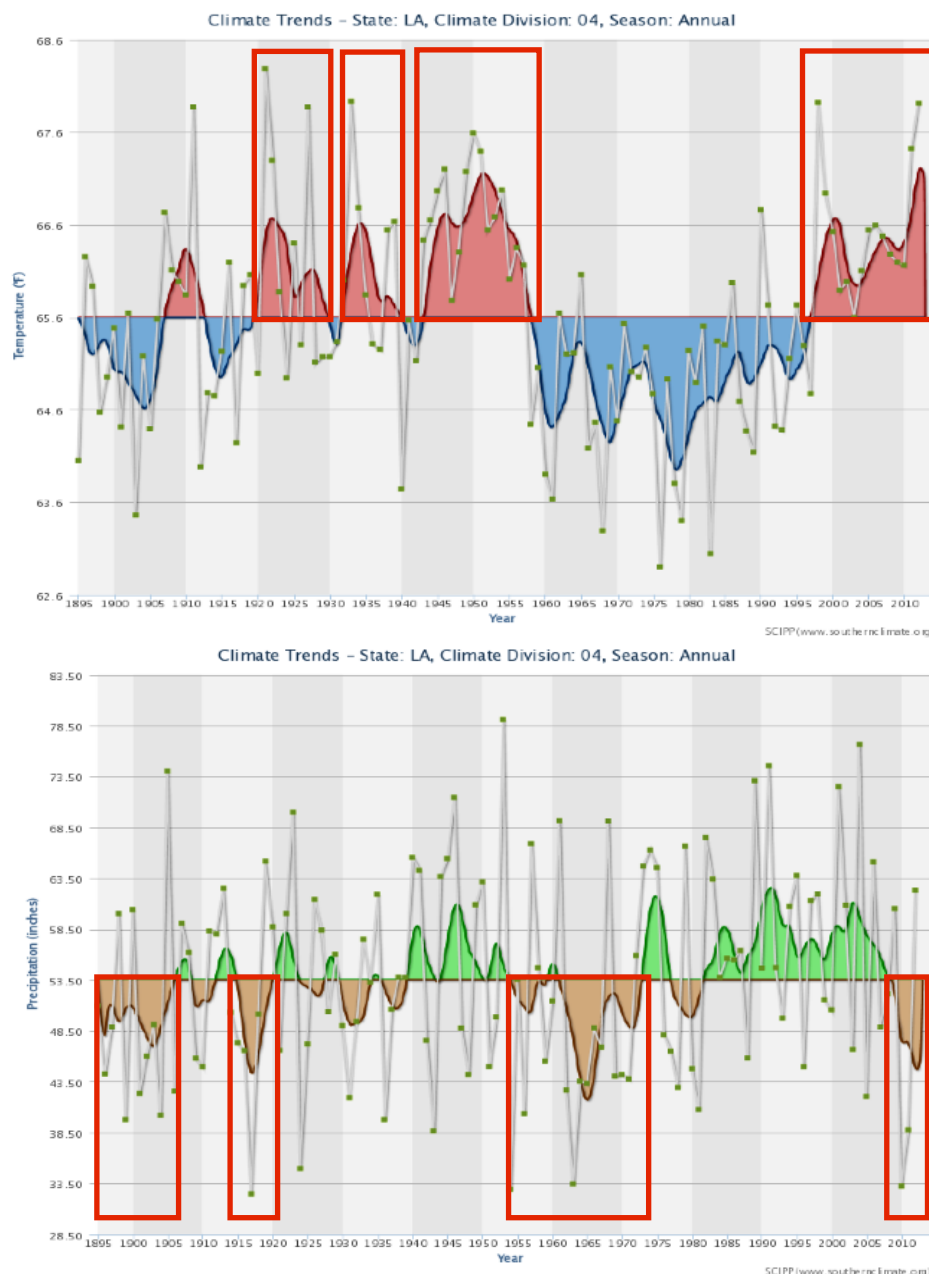


**Figure 14.** Drought history for northeast Louisiana as designated by the U.S. Drought Monitor. The color scale is identical to that in Figure 1. Note that northeast Louisiana was experiencing extreme (bright red) to exceptional drought (dark red) across most of the area during much of 2010 through 2011. 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 Louisiana

West-Central Louisiana 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 Louisiana since 1895.<sup>5</sup> The annual temperature for west-central Louisiana averages 65.6 degrees Fahrenheit, while precipitation averages 53.50 inches. Warmer-than-average periods have spanned the 1920s, the mid-1930s through the late 1930s, the mid-1940s through the mid-1950s, and the late 1990s through the early 2010s. Significant periods of drier-than-average conditions include the mid-1890s through the mid-1900s, the mid-1910s, the mid-1950s through the early 1970s, and the early 2010s.



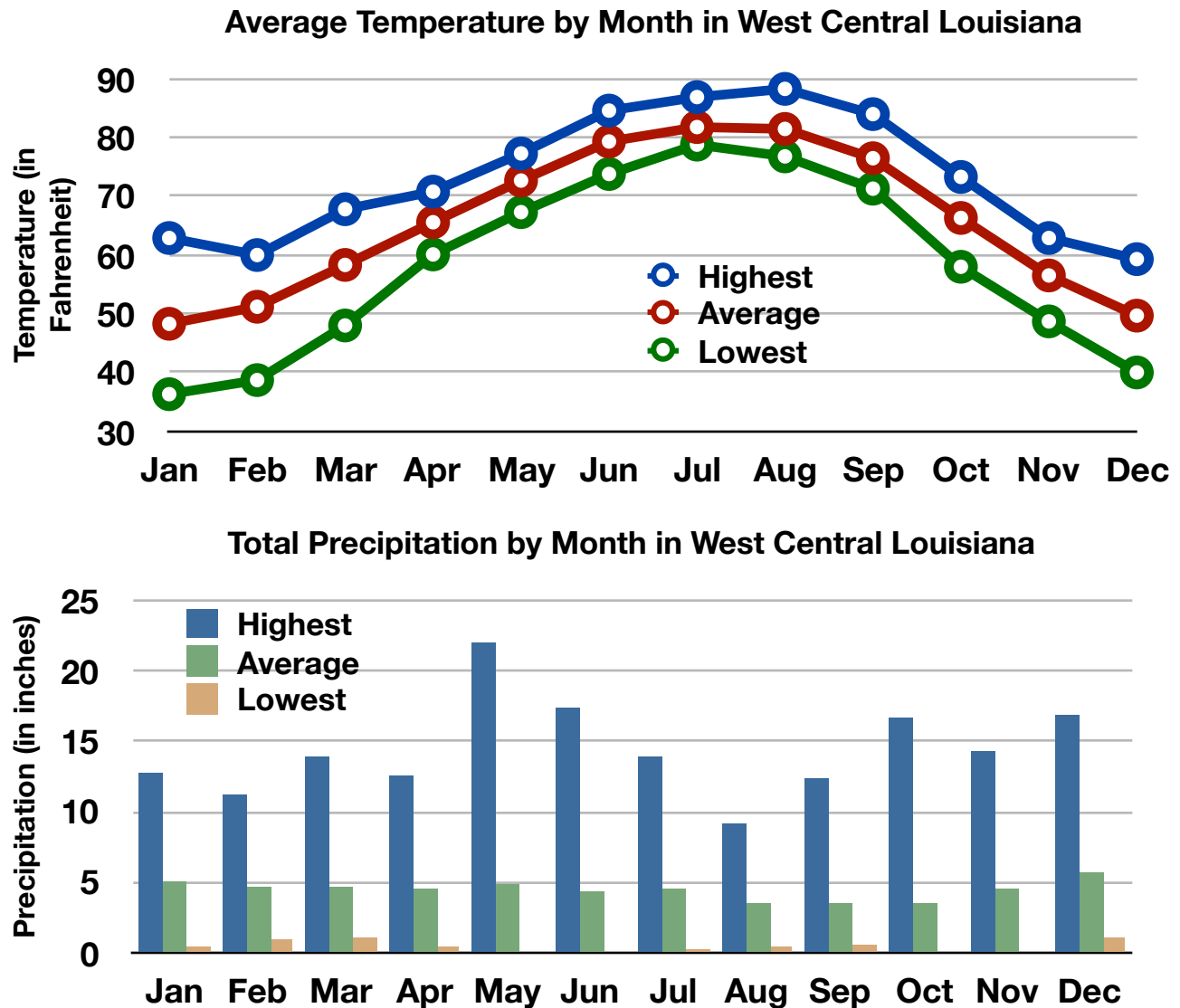
**Figure 15.** The average annual temperature (top graph) and total annual precipitation (bottom graph) in west-central Louisiana from 1895 to 2012. To highlight warmer, cooler, wetter, or drier periods, 5-year moving averages are shaded. On the top graph, red shading (above the horizontal line) indicates 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 288 months, with several periods of intense drought throughout. Because of its non-stop dry conditions combined with a period of PDSI less than -4, May 2005 to October 2011 comes in second for the drought-of-record for west-central Louisiana.

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

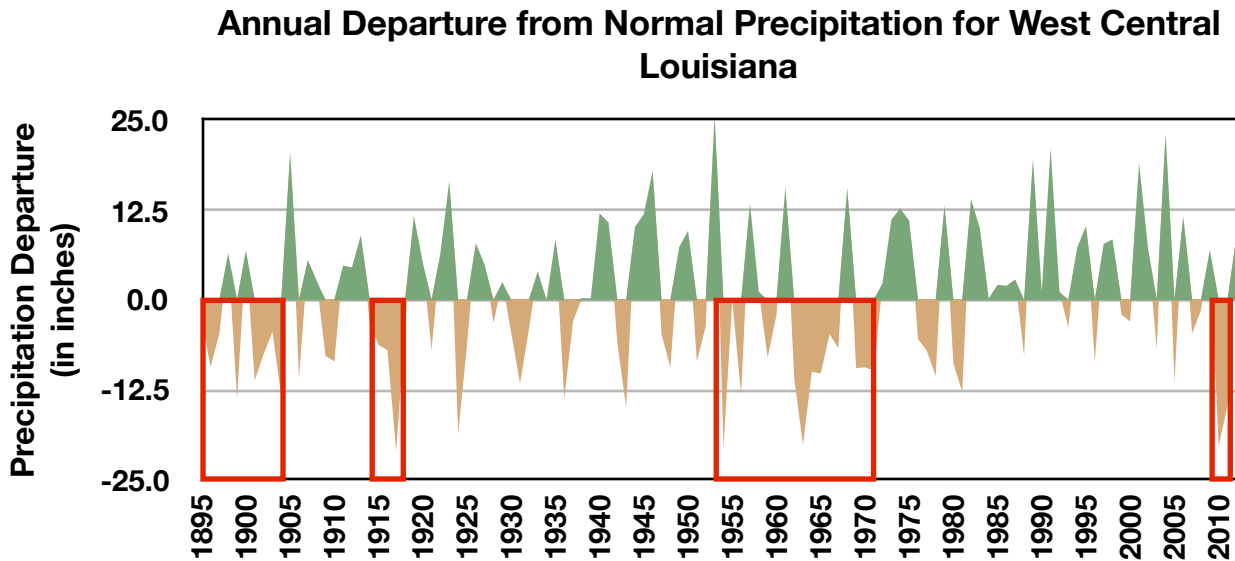
Time Period	Months with PDSI less than -1	Months with PDSI less than -4	Lowest PDSI Value
May 1896 - November 1904	66 (of 103 months)	0	-3.17
May 1915 - July 1918	37 (of 39 months)	3 consecutive, plus 2 other	-4.72
July 1947 - June 1971	168 (of 288 months)	1	-4.01
May 2005 - October 2011	46 (of 78 months)	8 consecutive	-5.81

To understand when there is the greatest stress on water availability for west-central Louisiana 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).

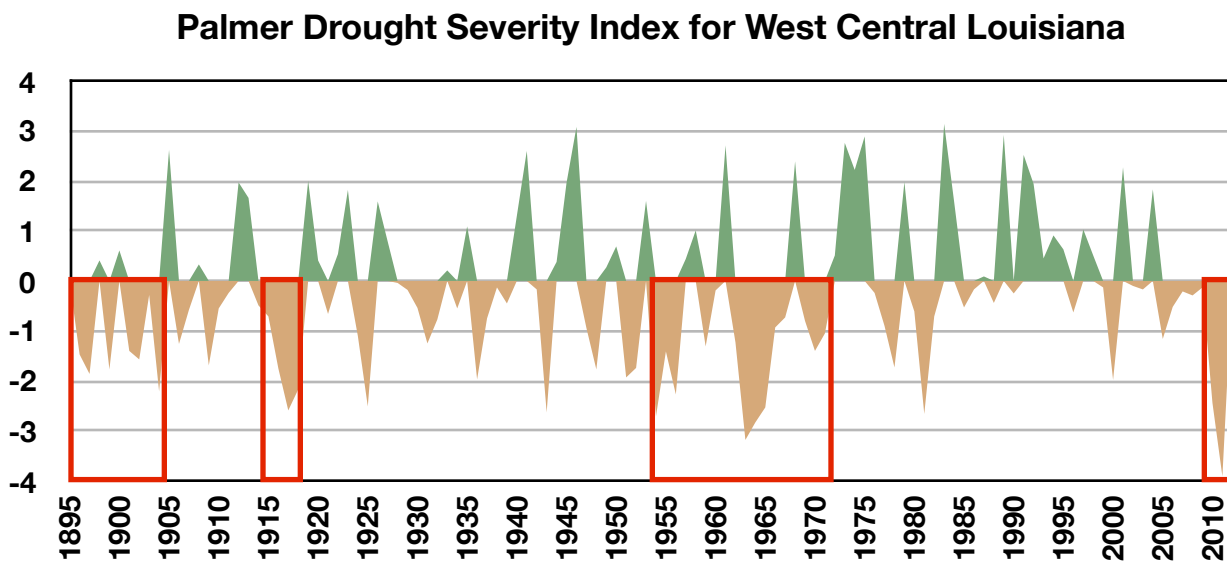


**Figure 16.** *Top graph:* The monthly average temperature (in degrees Fahrenheit) across west-central Louisiana using data from 1895 to 2012. The red (middle) line is the average of all climate-division average temperatures for that time period. The blue (top) line is the highest monthly average and the green (bottom) line is the lowest. *Bottom graph:* The average total precipitation (in inches) by month across west-central Louisiana 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 May, June, October, and November] The peak of precipitation in May is clearly visible.

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



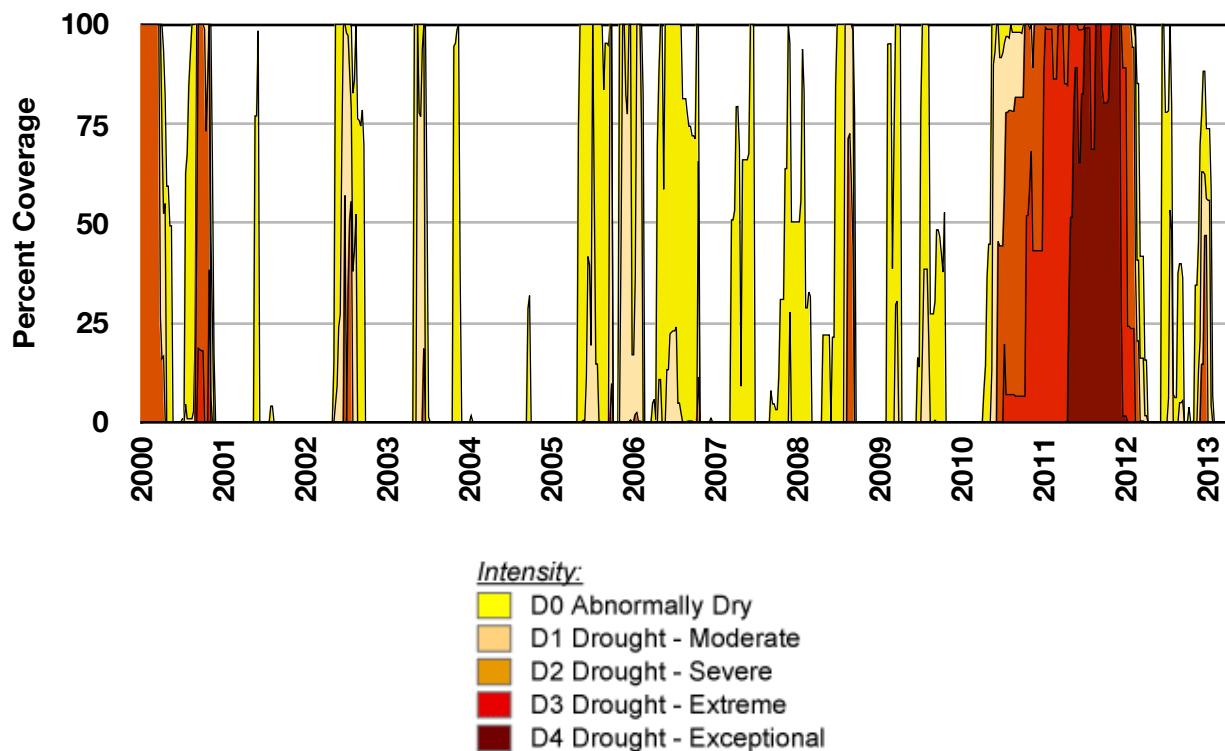
**Figure 17a.** Annual departure from normal precipitation (actual precipitation total for the year subtracted from the annual normal) for west-central Louisiana from 1895 to 2012.



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

The region has experienced dry conditions from 2000 to 2013. In Figure 18 we look at drought designation in west-central Louisiana and see that from 2006-2007 abnormally dry conditions covered almost 100% of the region. In late 2010 to 2012 the region experienced extreme to exceptional drought also covering 75-100%.

### Percent of West Central Louisiana Covered by a Drought Designation



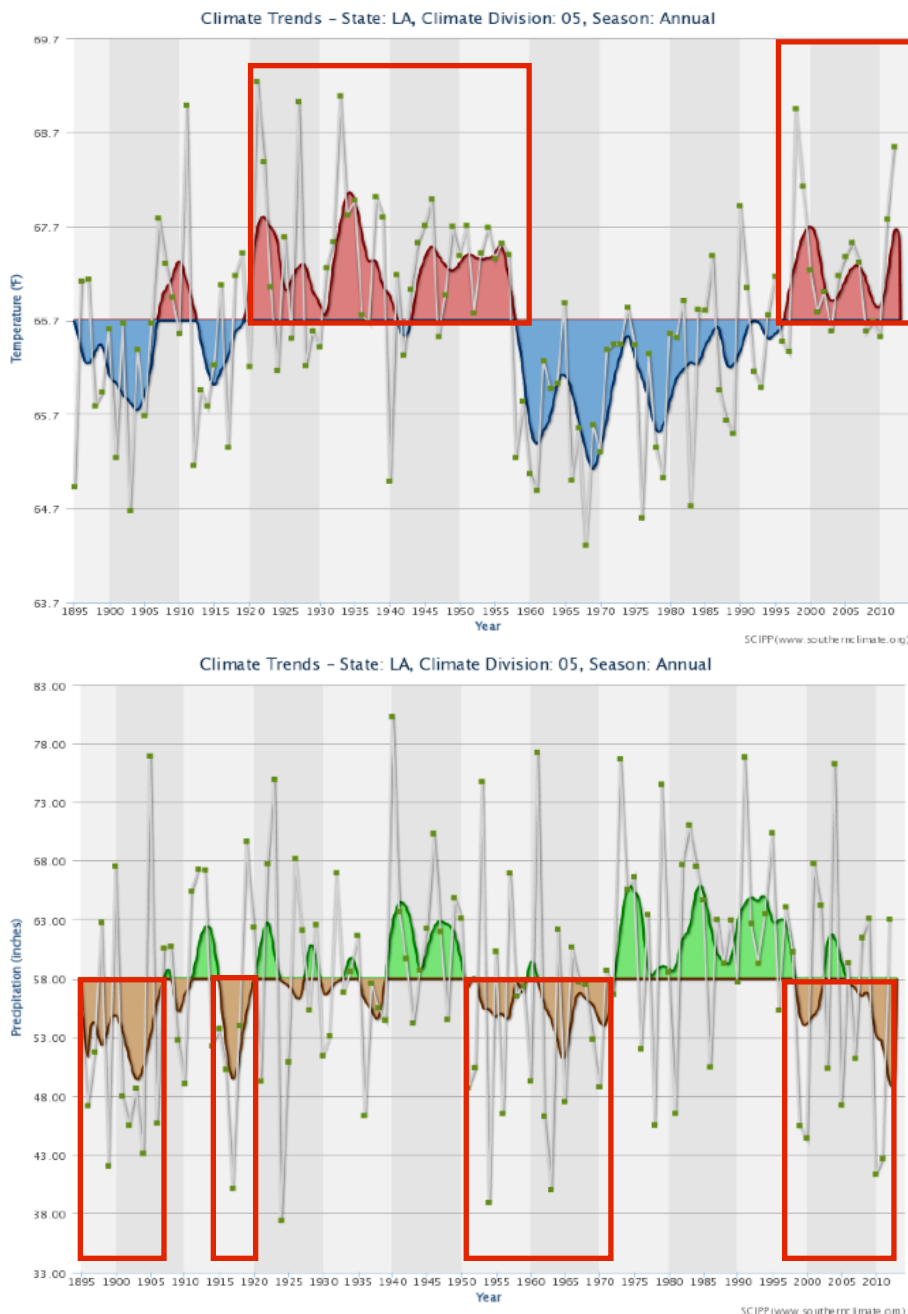
**Figure 18.** Drought history for west-central Louisiana as designated by the U.S. Drought Monitor. The color scale is identical to that in Figure 1. Note that west-central Louisiana was experiencing extreme (bright red) to exceptional drought (dark red) across most of the area during much of 2010 through 2011. 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 Louisiana

Central Louisiana 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 Louisiana since 1895.<sup>6</sup> The annual temperature for central Louisiana averages 66.7 degrees Fahrenheit, while precipitation averages 58.00 inches. Warmer-than-average periods have spanned the 1920s through the mid-1950s and the late 1990s through the early 2010s. Significant periods of drier-than-average conditions include the mid-1890s through the mid-1900s, the mid-1910s, the mid-1950s through the early 1970s, the late 1990s to the early 2000s, and the early 2010s.



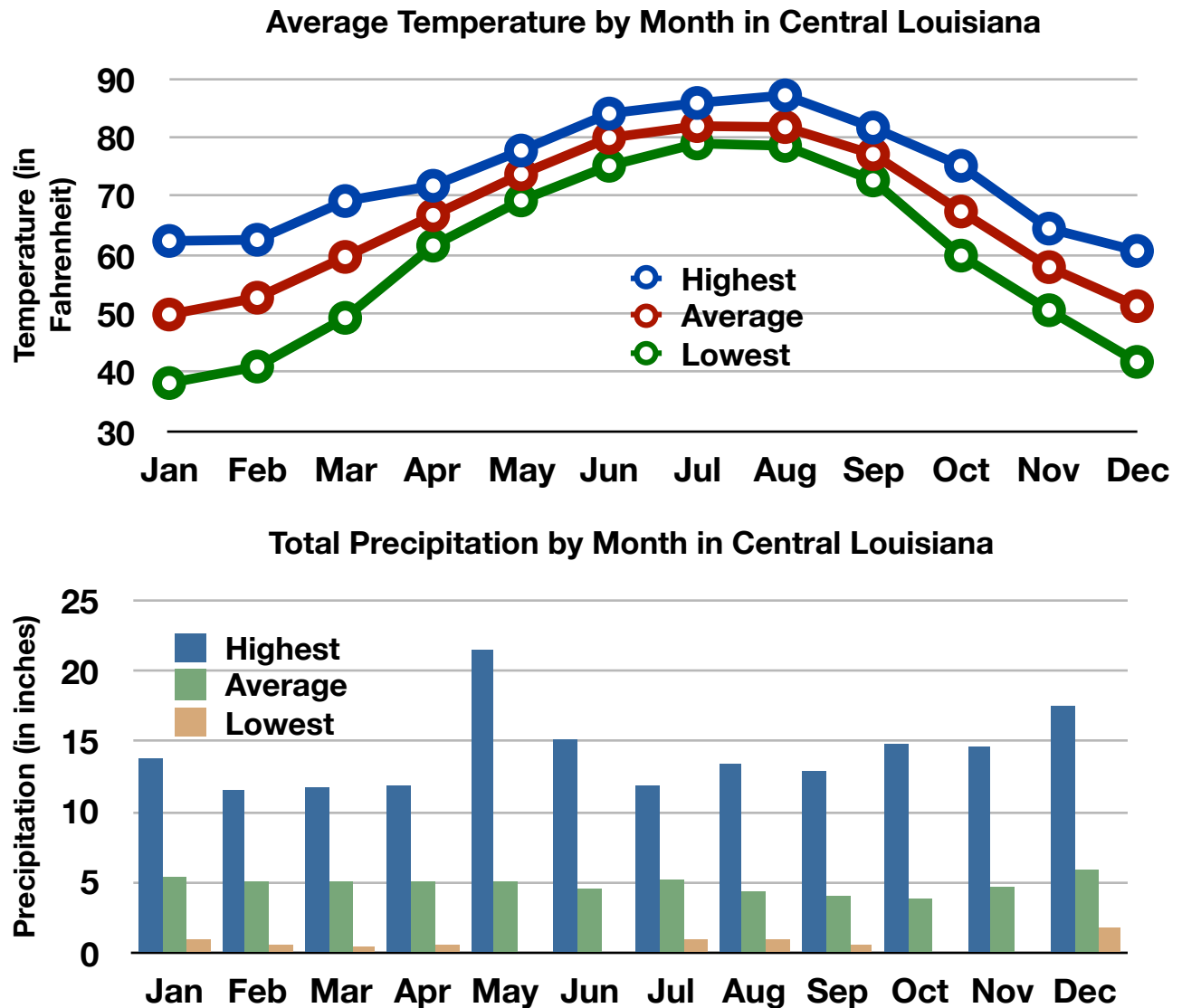
**Figure 19.** The average annual temperature (top graph) and total annual precipitation (bottom graph) in central Louisiana from 1895 to 2012. To highlight warmer, cooler, wetter, or drier periods, 5-year moving averages are shaded. On the top graph, red shading (above the horizontal line) indicates 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 246 months, with several periods of intense drought throughout. Because of its non-stop dry conditions combined with a period of PDSI less than -4, May 1998 to December 2010 comes in second for the drought-of-record for central Louisiana.

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

Time Period	Months with PDSI less than -1	Months with PDSI less than -4	Lowest PDSI Value
May 1896 - November 1904	85 (of 101 months)	0	-3.76
December 1913 - July 1918	43 (of 56 months)	3 consecutive, plus 1 other	-4.68
November 1950 - September 1982	109 (of 246 months)	1	-4.33
May 1998 - December 2010	60 (of 152 months)	3 consecutive, plus 3 other	-4.83

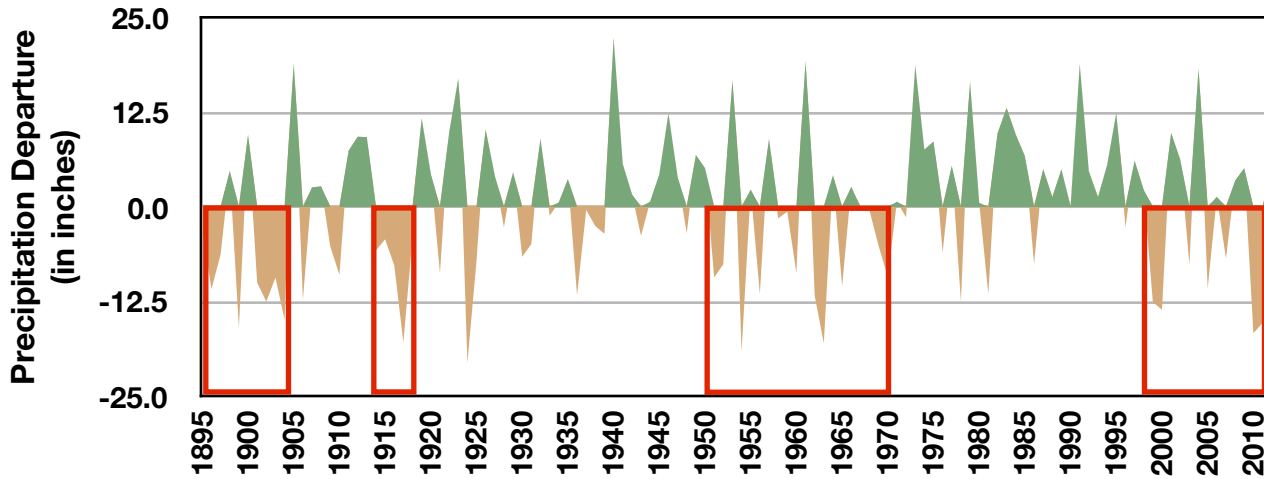
To understand when there is the greatest stress on water availability for central Louisiana, the average monthly temperature and precipitation, as well as their average highest and lowest monthly values, are shown in Figure 20. Warmer temperatures result in greater water loss by evaporation and transpiration. 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 Louisiana 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 Louisiana 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. The two peaks of precipitation, first in May, then in December, are clearly visible.

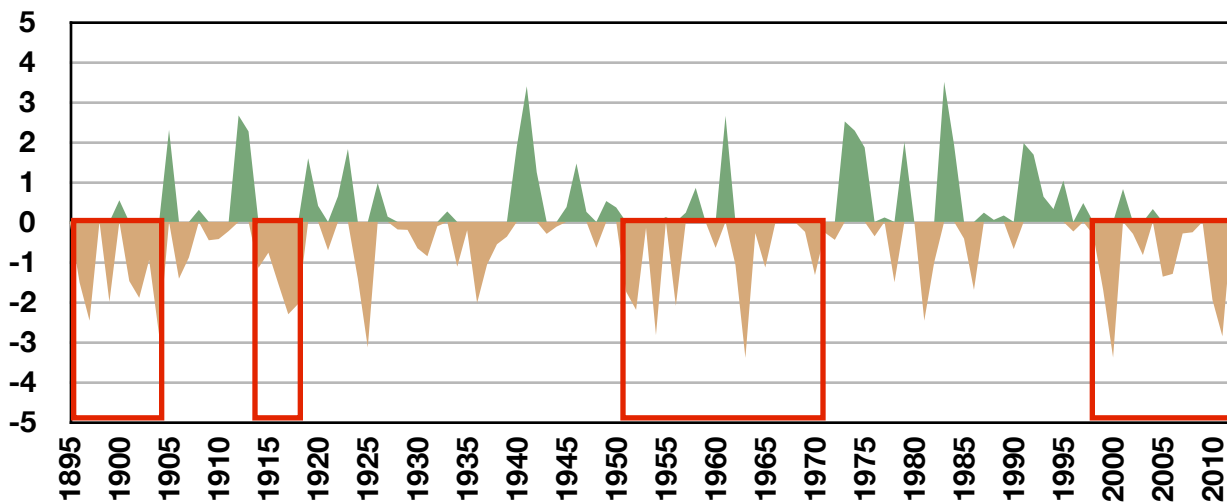
Central Louisiana has experienced long and extreme droughts in its past. Figure 21 displays the departure from normal precipitation and Palmer Drought Severity Index for central Louisiana from 1895 to 2012. Red boxes outline the same drier-than-average periods highlighted in Figure 19.

### Annual Departure from Normal Precipitation for Central Louisiana



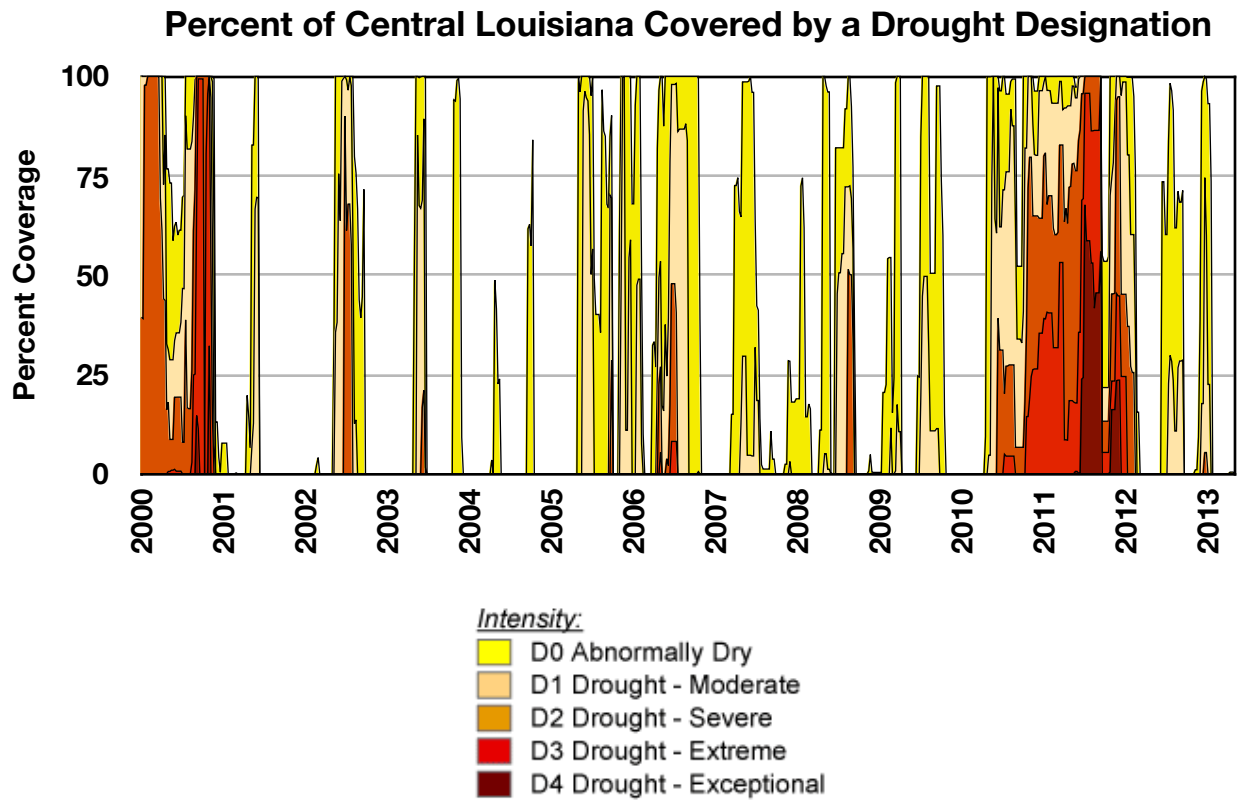
**Figure 21a.** Annual departure from normal precipitation (actual precipitation total for the year subtracted from the annual normal) for central Louisiana from 1895 to 2012.

### Palmer Drought Severity Index for Central Louisiana



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

The region has experienced dry conditions from 2000 to 2013. In Figure 14 we look at drought designation in central Louisiana and see that from 2000 to 2001 severe to exceptional conditions covered almost 100% of the region. In late 2010 to late 2012 the region experienced a combination of moderate to exceptional drought also covering 25-100% of the region.

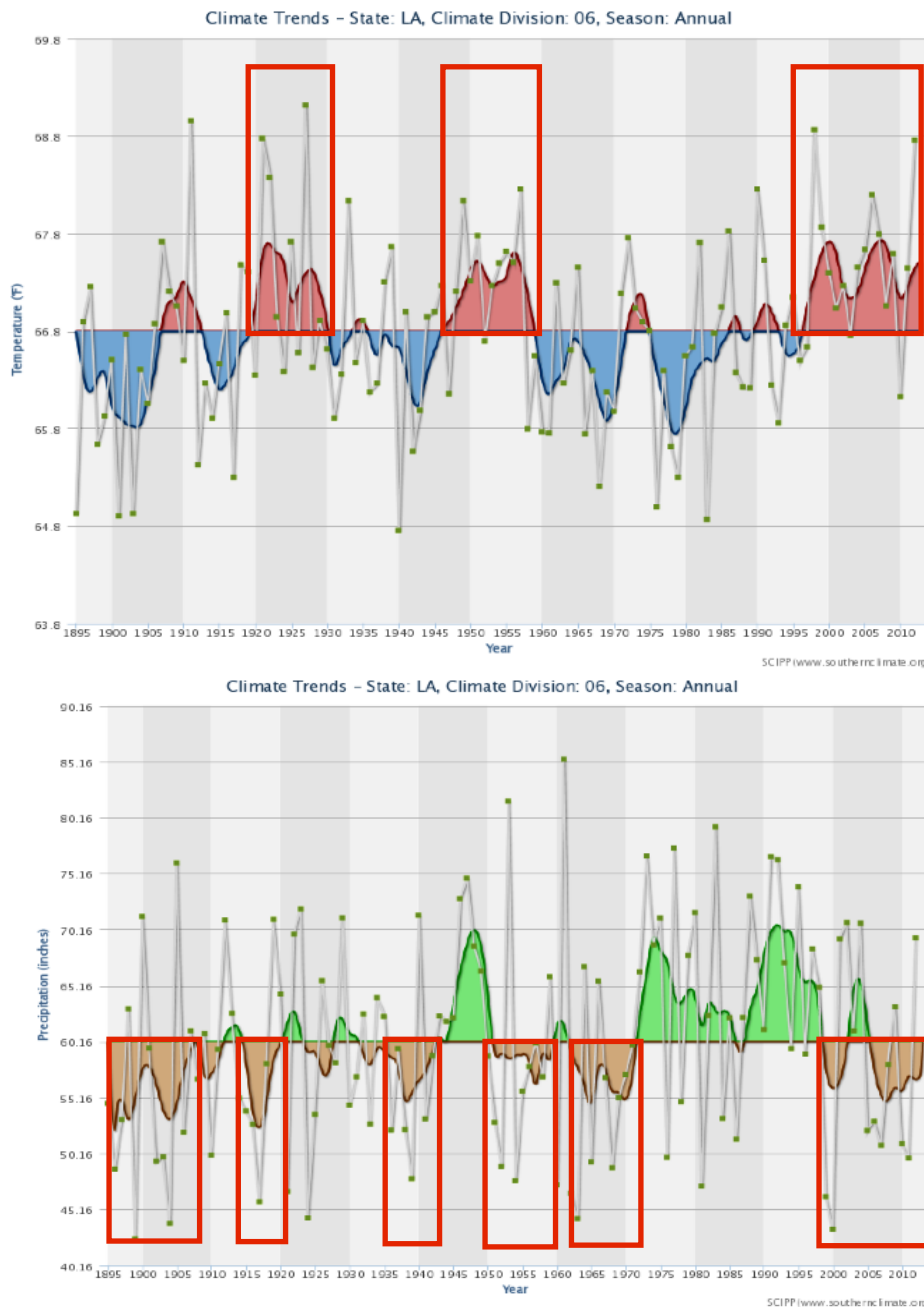


**Figure 22.** Drought history for central Louisiana as designated by the U.S. Drought Monitor. The color scale is identical to that in Figure 1. Note that central Louisiana was experiencing extreme (bright red) to exceptional drought (dark red) across most of the area during much of 2000 and 2010 through 2011. 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 Louisiana

East-Central Louisiana 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 Louisiana since 1895.<sup>7</sup> The annual temperature for east-central Louisiana averages 66.82 degrees Fahrenheit, while precipitation averages 60.16 inches. Warmer-than-average periods have spanned the 1920s, the late 1940s through the 1950s, and the mid-1990s through the early 2010s. Significant periods of drier-than-average conditions include the late 1890s through the mid-1900s, the mid to late 1910s, the mid to late 1930s, the early 1960s through the early 1970s, and the late 1990s through the early 2010s.



**Figure 23.** The average annual temperature (top graph) and total annual precipitation (bottom graph) in east-central Louisiana 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.

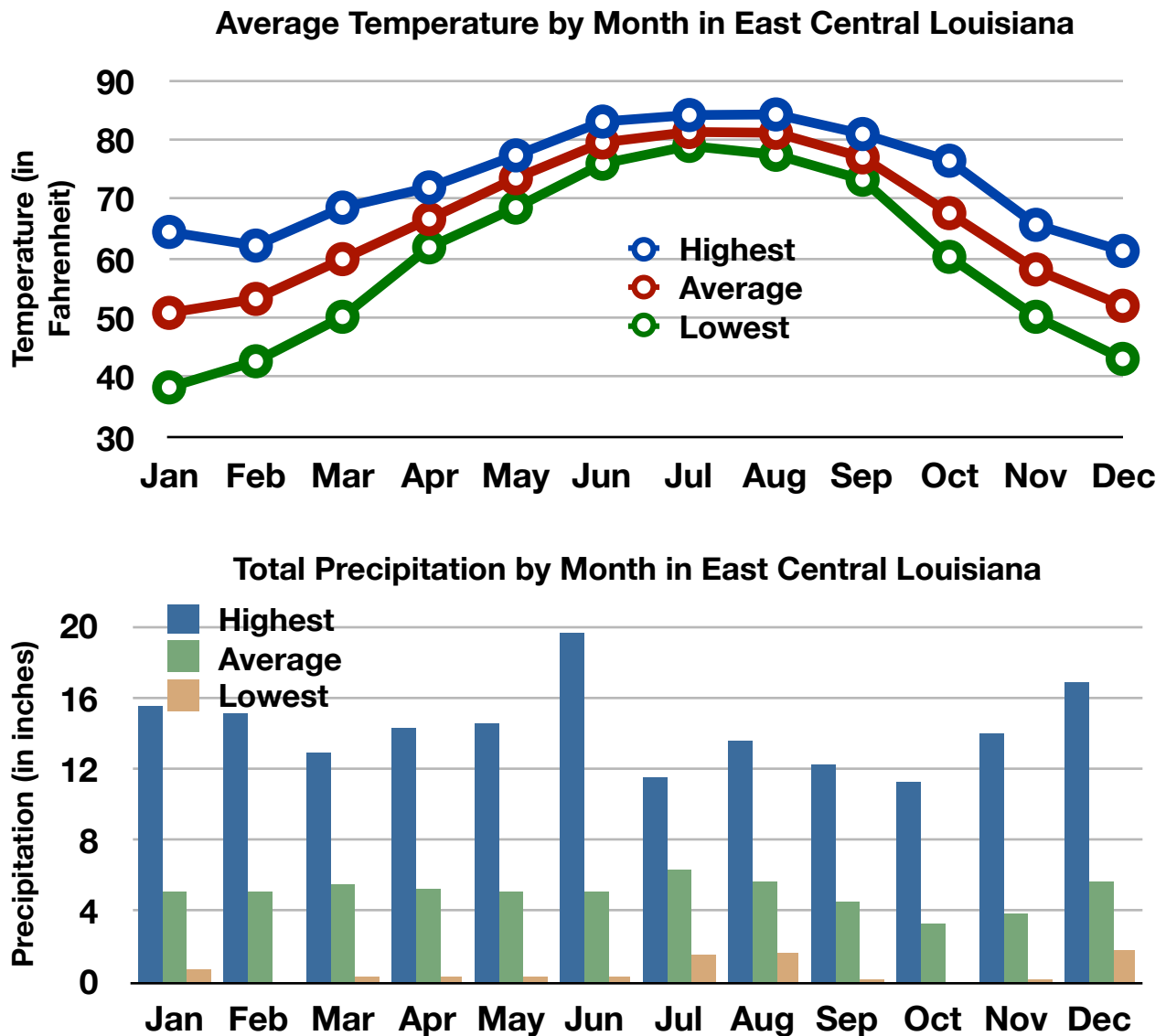
In this region, the drought of the 2000s exceeds intensity and duration of all other droughts; hence, *the period from May 1998 to May 2012 is the drought-of-record for east-central Louisiana*. February 1962 to August 1971 comes in the second for the drought of records for this region.

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

Time Period	Months with PDSI less than -1	Months with PDSI less than -4	Lowest PDSI Value
December 1895 - December 1904	63 (of 109 months)	0	-3.95
December 1913 - September 1918	42 (of 58 months)	0	-3.92
October 1935 - January 1940	38 (of 52 months)	0	-3.19
October 1950 - August 1957	52 (of 83 months)	0	-3.79
February 1962 - August 1971	55 (of 115 months)	7	-4.98
May 1998 - May 2012*	113 (of 169 months)	8 consecutive plus 2 others	-5.52

\* Denotes that the selected period is considered to be a possible “Drought-of-record”

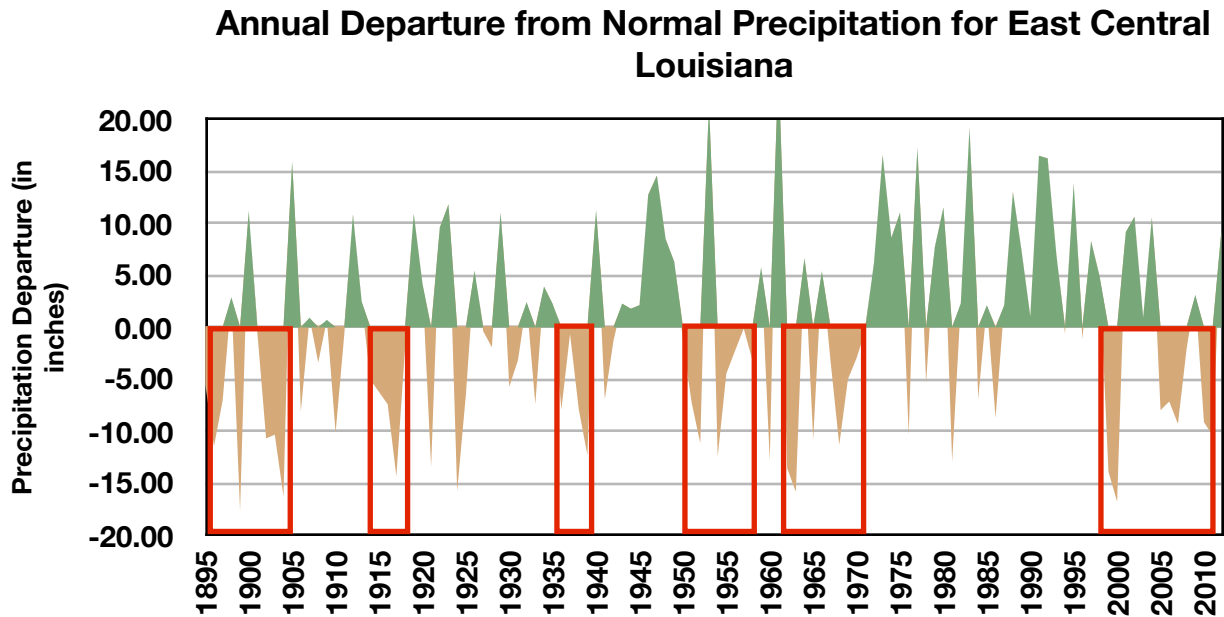
To understand when there is the greatest stress on water availability for east-central Louisiana, the average monthly temperature and precipitation, as well as their average highest and lowest monthly values, are shown in Figure 24. Warmer temperatures result in greater water loss by evaporation and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



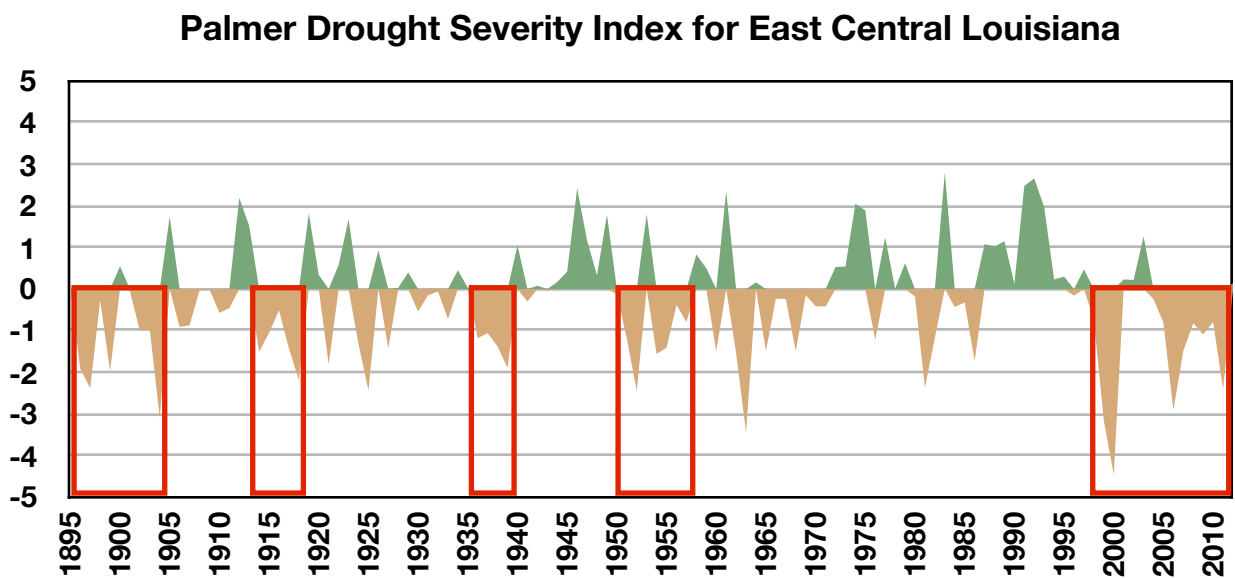
**Figure 24.** *Top graph:* The monthly average temperature (in degrees Fahrenheit) across east-central Louisiana using data from 1895 to 2012. The red (middle) line is the average of all climate-division average temperatures for that time period. The blue (top) line is the highest monthly average and the green (bottom) line is the lowest. *Bottom graph:* The average total precipitation (in inches) by month across east-central Louisiana 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. The two peaks of precipitation, first in June, then in December, are clearly visible.



East-central Louisiana 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 Louisiana from 1895 to 2012. Red boxes outline the same drier-than-average periods highlighted in Figure 23.

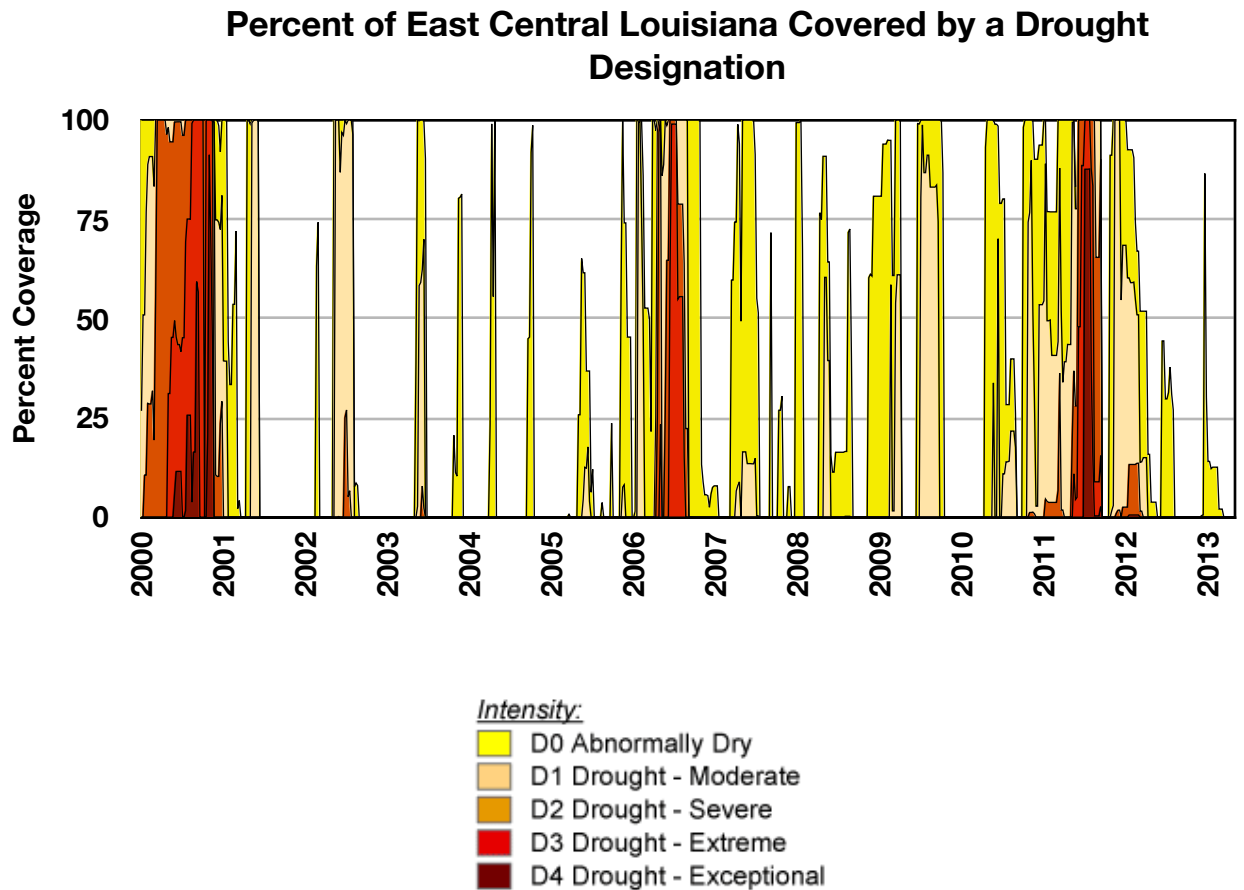


*Figure 25a.* Annual departure from normal precipitation (actual precipitation total for the year subtracted from the annual normal) for east-central Louisiana from 1895 to 2012.



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

The region has experienced dry conditions from 2000 to 2013. In Figure 26 we look at drought designation in east-central Louisiana and see that from 2000–2001 severe to exceptional drought conditions covered almost 100% of the region. In late 2011 to 2012 the region experienced extreme to exceptional drought also covering 75-100%.

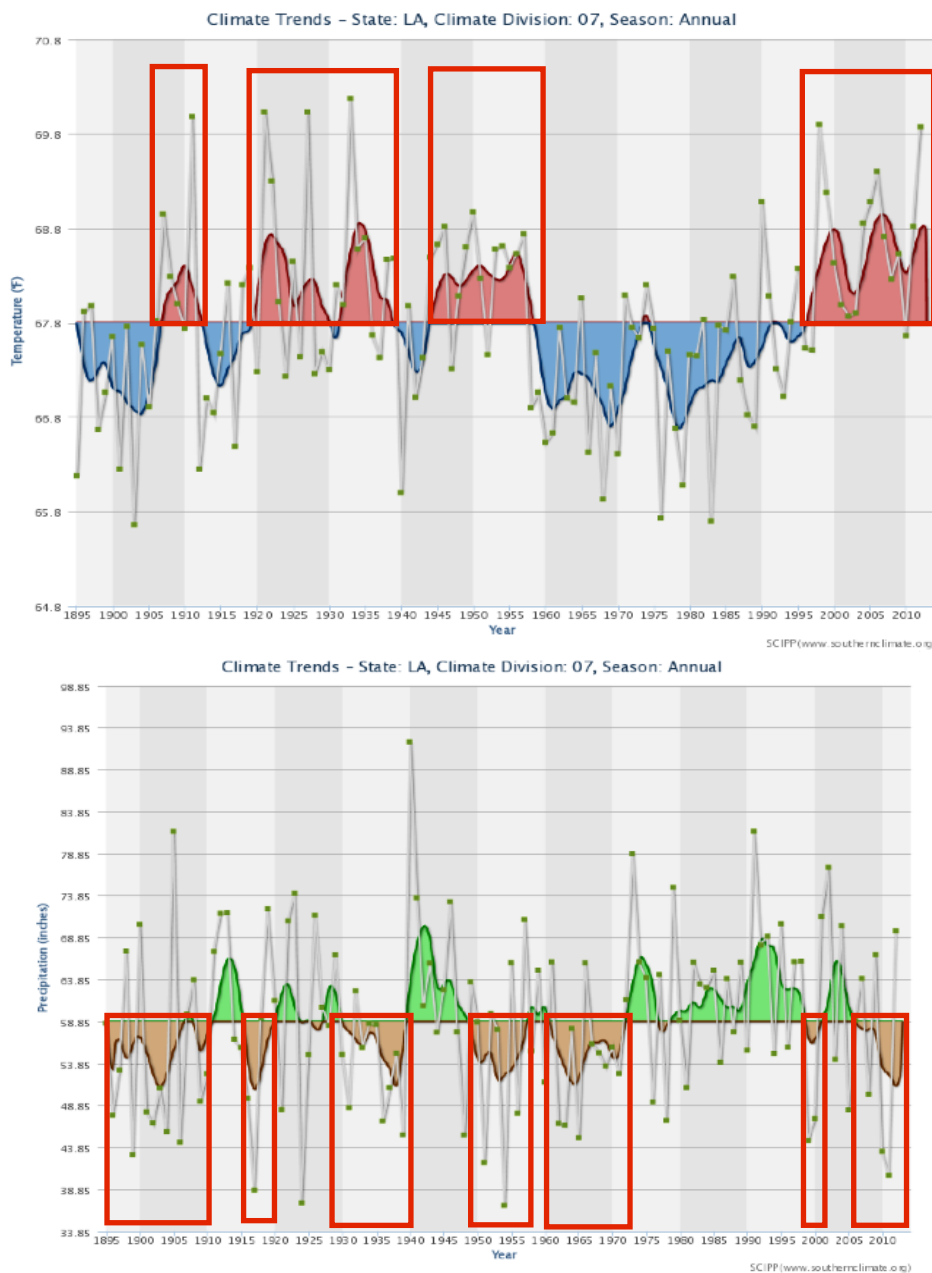


**Figure 26.** Drought history for east-central Louisiana as designated by the U.S. Drought Monitor. The color scale is identical to that in Figure 1. Note that east-central Louisiana was experiencing extreme (bright red) to exceptional drought (dark red) across most of the area during much of 2000 and 2011. 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 Louisiana

Southwest Louisiana 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 southwest Louisiana since 1895.<sup>8</sup> The annual temperature for southwest Louisiana averages 67.8 degrees Fahrenheit, while precipitation averages 58.85 inches. Warmer-than-average periods have spanned the late 1900s, the 1920s through the 1930s, the mid-1940s through the 1950s, the mid-1990s through the early 2010s. Significant periods of drier-than-average conditions include the 1900s, the mid to late 1910s, the 1930s, the late 1940s through the mid-1950s, the early 1960s through the early 1970s, and the late 2000s through the early 2010s.



**Figure 27.** The average annual temperature (top graph) and total annual precipitation (bottom graph) in southwest Louisiana 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.

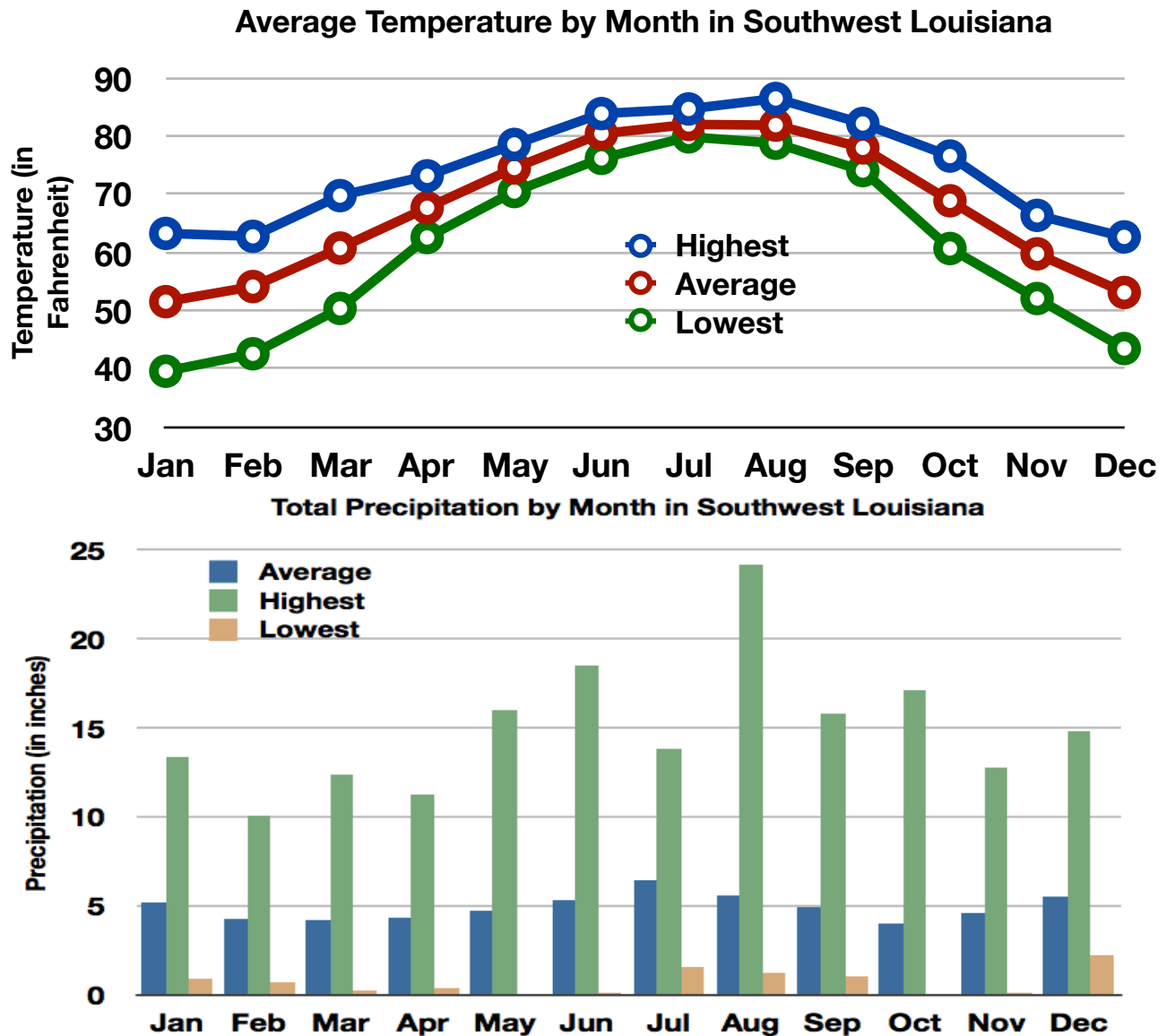
The longest drought experienced in this region lasted 173 months, with several periods of intense drought throughout. Because of its non-stop dry conditions combined with a period of PDSI less than -4, May 1998 to October 2000 stands as southwest Louisiana's *drought-of-record*.

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

Time Period	Months with PDSI less than -1	Months with PDSI less than -4	Lowest PDSI Value
January 1896 - May 1910	87 (of 173 months)	1	-4.14
December 1915 - July 1918	31 (of 32 months)	3	-4.41
April 1930 - January 1940	58 (of 118 months)	0	-3.39
August 1947 - February 1957	64 (of 115 months)	3	-4.36
February 1962 - July 1971	60 (of 114 months)	0	-3.62
May 1998 - October 2000	23 (of 30 months)	6	-4.94
August 2004 - December 2011*	53 (of 89 months)	6	-4.59

\* Denotes that the selected period is considered to be a possible "Drought-of-record"

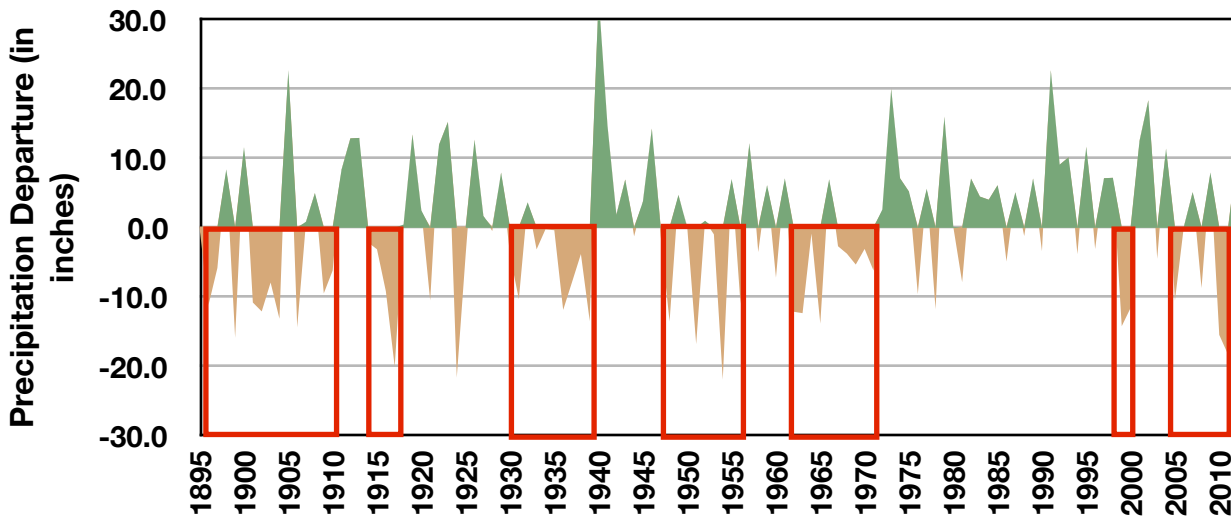
To understand when there is the greatest stress on water availability for southwest Louisiana, the average monthly temperature and precipitation, as well as their average highest and lowest monthly values, are shown in Figure 28. Warmer temperatures result in greater water loss by evaporation and transpiration.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



**Figure 28.** *Top graph:* The monthly average temperature (in degrees Fahrenheit) across southwest Louisiana 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 southwest Louisiana 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 May and October] The peak of precipitation in August is clearly visible.

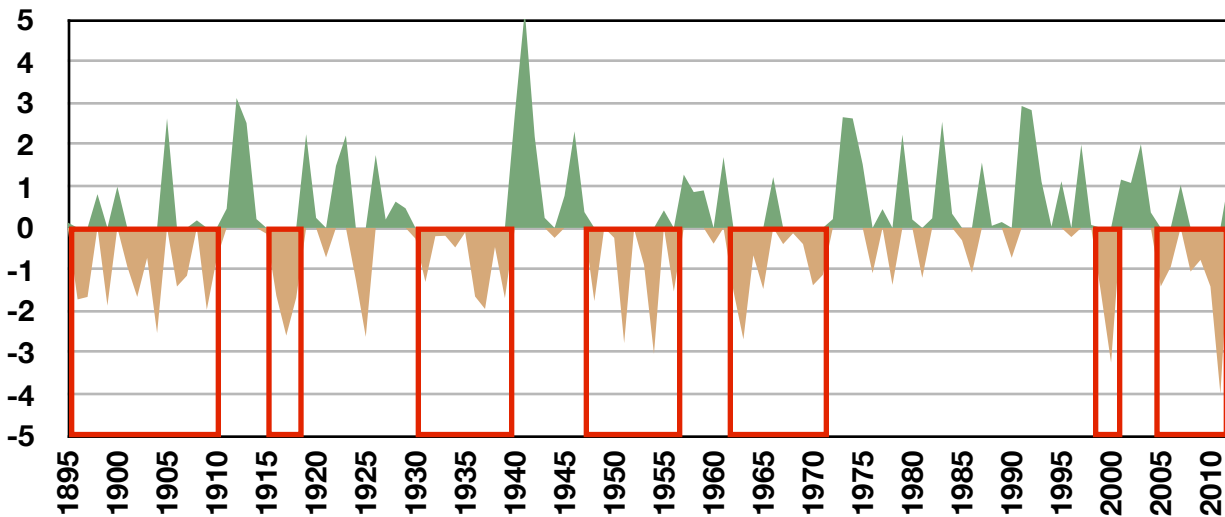
Southwest Louisiana has experienced long and extreme droughts in its past. Figure 29 displays the departure from normal precipitation, Palmer Drought Severity Index, and two-year Standardized Precipitation Index for southwest Louisiana from 1895 to 2012. Red boxes outline the same drier-than-average periods highlighted in Figure 27. ***It is evident from these three drought indicators that southwest Louisiana has experienced long and extreme droughts in its past.***

### Annual Departure from Normal Precipitation for Southwest Louisiana



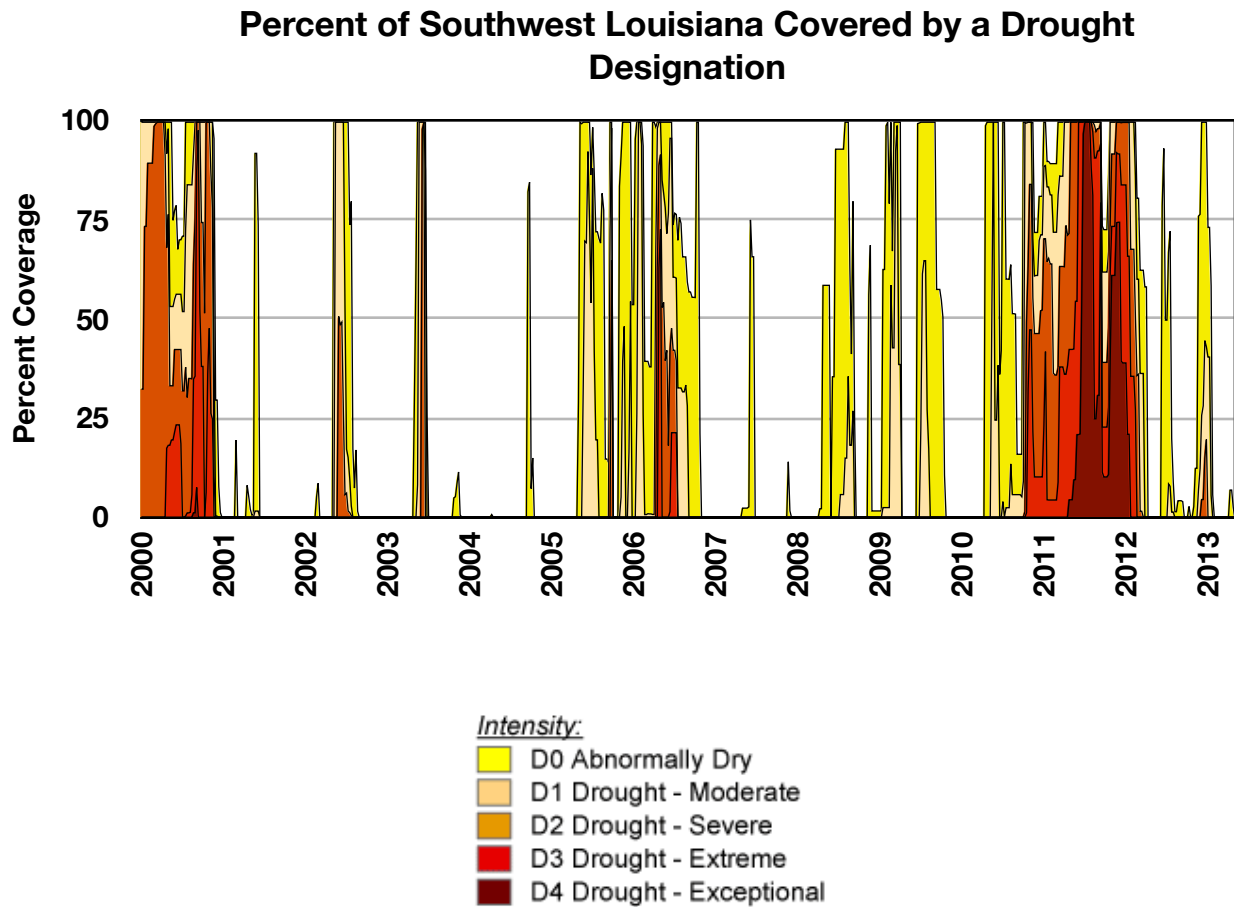
**Figure 29a.** Annual departure from normal precipitation (actual precipitation total for the year subtracted from the annual normal) for southwest Louisiana from 1895 to 2012.

### Palmer Drought Severity Index for Southwest Louisiana



**Figure 29b.** Palmer Drought Severity Index for southwest Louisiana from 1895 to 2012.

The region has experienced dry conditions from 2000 to 2013. In Figure 30 we look at drought designation in southwest Louisiana and see that from 2000-2001 severe drought conditions covered almost 30-100% of the region. In late 2010 to 2012 the region experienced severe to exceptional drought also covering 50-100%.

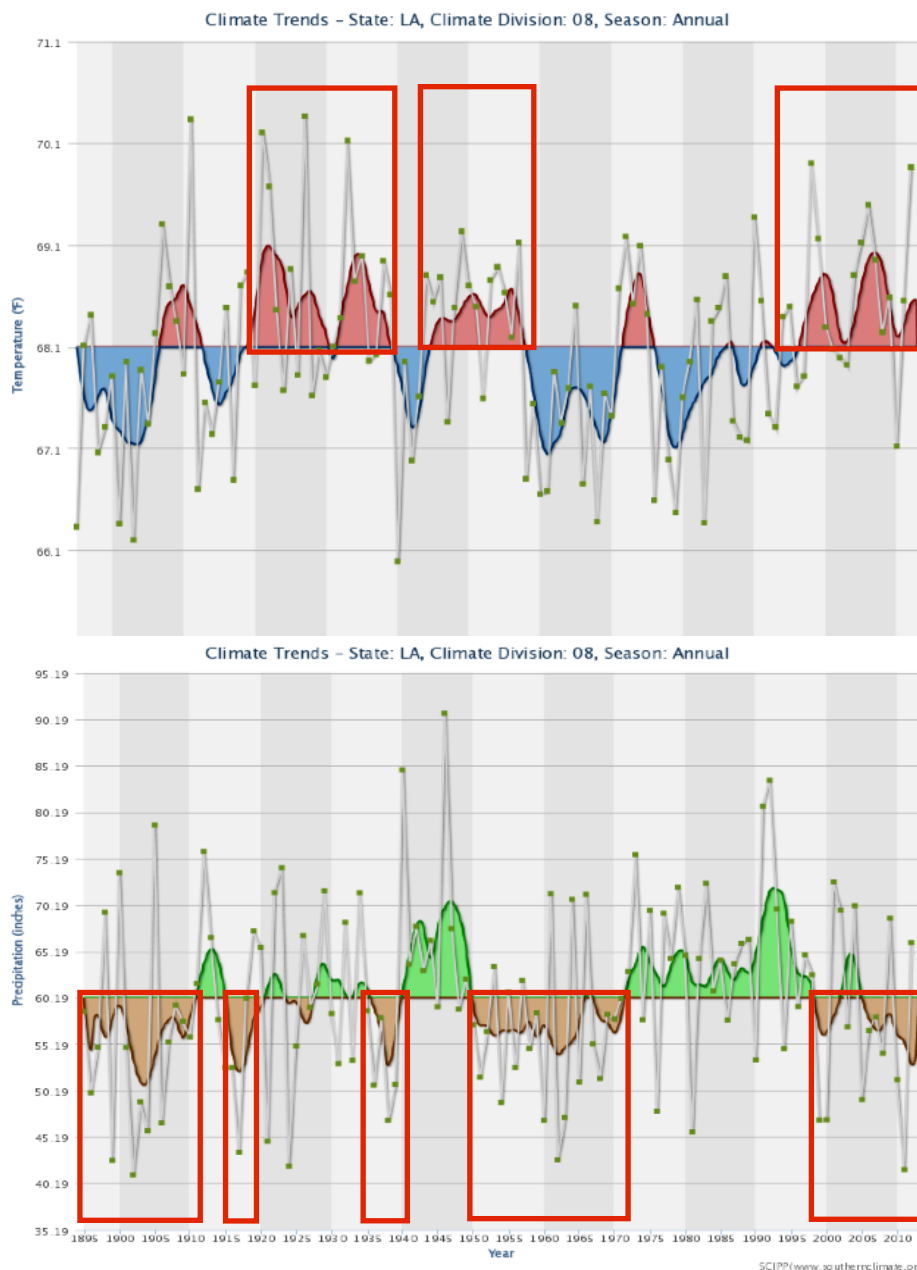


**Figure 30.** Drought history for southwest Louisiana as designated by the U.S. Drought Monitor. The color scale is identical to that in Figure 1. Note that southwest Louisiana was experiencing extreme (bright red) to exceptional drought (dark red) across most of the area during much of 2000, 2010, and 2011. 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 Louisiana

South-Central Louisiana 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 Louisiana since 1895.<sup>9</sup> The annual temperature for south-central Louisiana averages 68.1 degrees Fahrenheit, while precipitation averages 60.19 inches. Warmer-than-average periods have spanned the 1920s through the 1930s, the mid-1940s through the 1950s, and the mid-1990s through the early 2010s. Significant periods of drier-than-average conditions include the 1900s and the 1910s, the late 1930s, the 1950s through the early 1970s, and the late 1990s through the early 2010s.



**Figure 31.** The average annual temperature (*top graph*) and total annual precipitation (*bottom graph*) in south-central Louisiana 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.



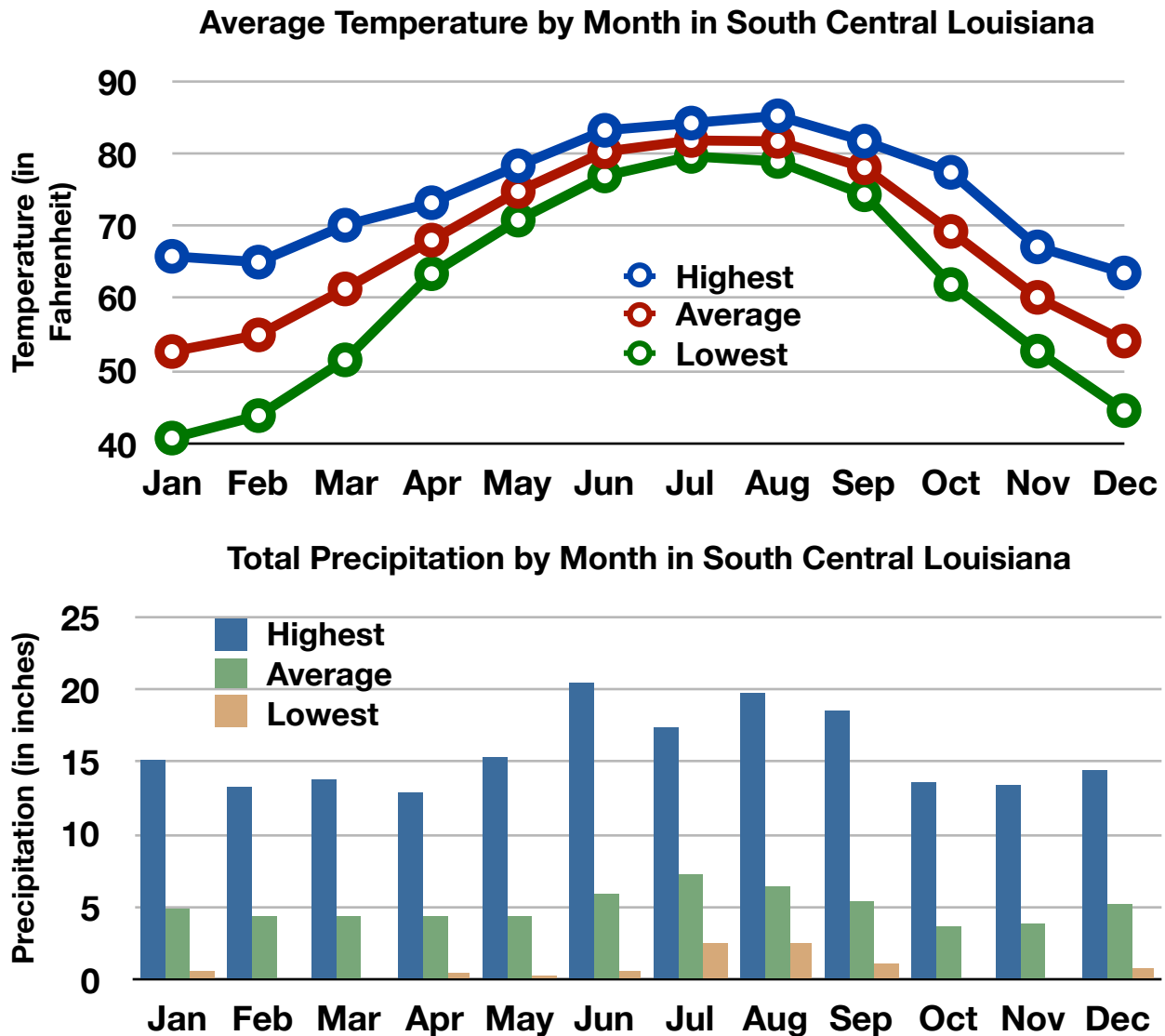
The longest drought experienced in this region lasted 248 months, with several periods of intense drought throughout. Because of its non-stop dry conditions combined with a period of PDSI less than -4, May 1998 to December 2010 comes in second for the drought-of-record for central Louisiana.

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

Time Period	Months with PDSI less than -1	Months with PDSI less than -4	Lowest PDSI Value
January 1896 - May 1911	108 (of 185 months)	3	-4.30
December 1913 - July 1918	42 (of 56 months)	0	-3.84
November 1935 - January 1940	28 (of 51 months)	0	-3.50
September 1950 - April 1971	105 (of 248 months)	3	-4.78
May 1998 - May 2012*	104 (of 169 months)	7 consecutive plus 2 others	-5.35

\* Denotes that the selected period is considered to be a possible “Drought-of-record”

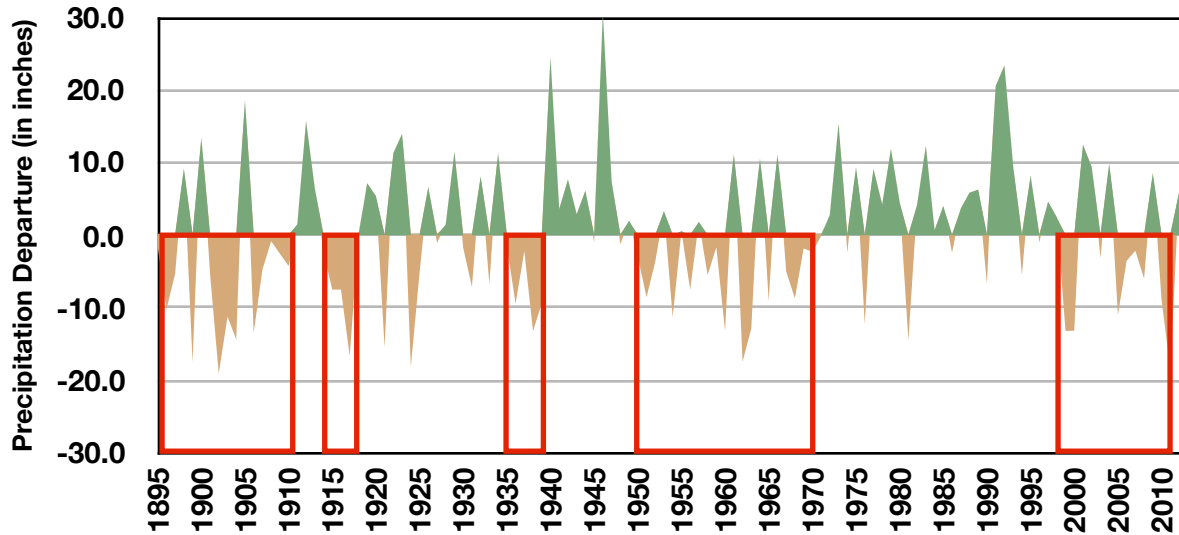
To understand when there is the greatest stress on water availability for south-central Louisiana, the average monthly temperature and precipitation, as well as their average highest and lowest monthly values, are shown in Figure 32. Warmer temperatures result in greater water loss by evaporation and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



**Figure 32.** *Top graph:* The monthly average temperature (in degrees Fahrenheit) across south-central Louisiana 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 Louisiana 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 and October] The two peaks of precipitation, first in June, then in August, are clearly visible.

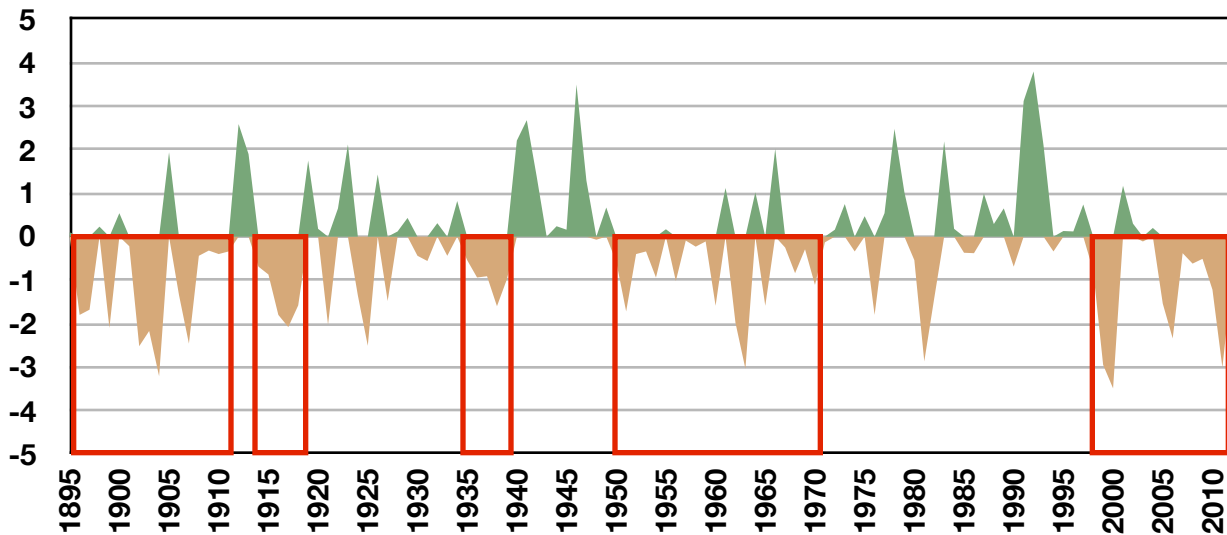
South-Central Louisiana has experienced long and extreme droughts in its past. Figure 33 displays the departure from normal precipitation and Palmer Drought Severity Index for south-central Louisiana from 1895 to 2012. Red boxes outline the same drier-than-average periods highlighted in Figure 31.

### Annual Departure from Normal Precipitation for South Central Louisiana



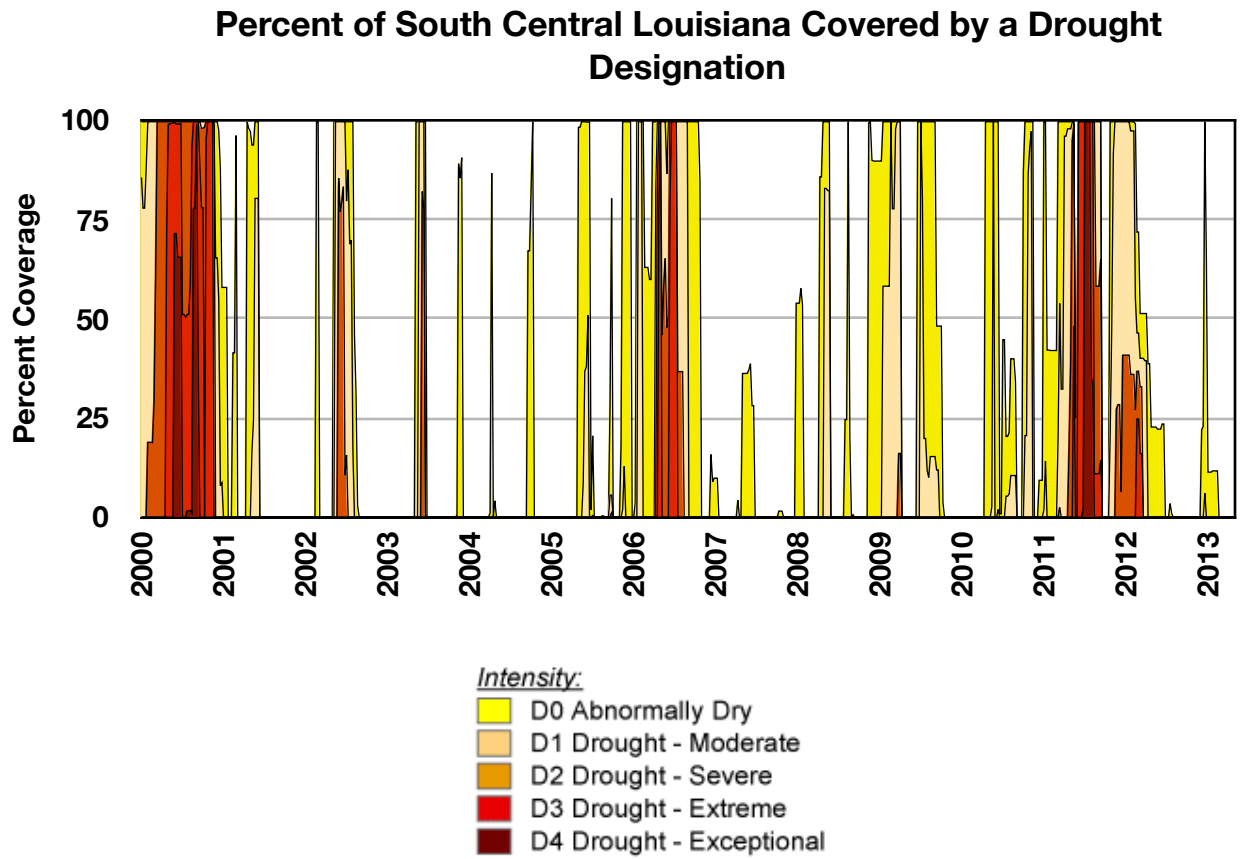
**Figure 33a.** Annual departure from normal precipitation (actual precipitation total for the year subtracted from the annual normal) for south-central Louisiana from 1895 to 2012.

### Palmer Drought Severity Index for South Central Louisiana



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

The region has experienced dry conditions from 2000 to 2013. In Figure 34 we look at drought designation in southwest Louisiana and see that from 2000-2001 severe to exceptional drought conditions covered almost 100% of the region. In late 2011 to 2012 the region experienced extreme to exceptional drought also covering 50-100%.

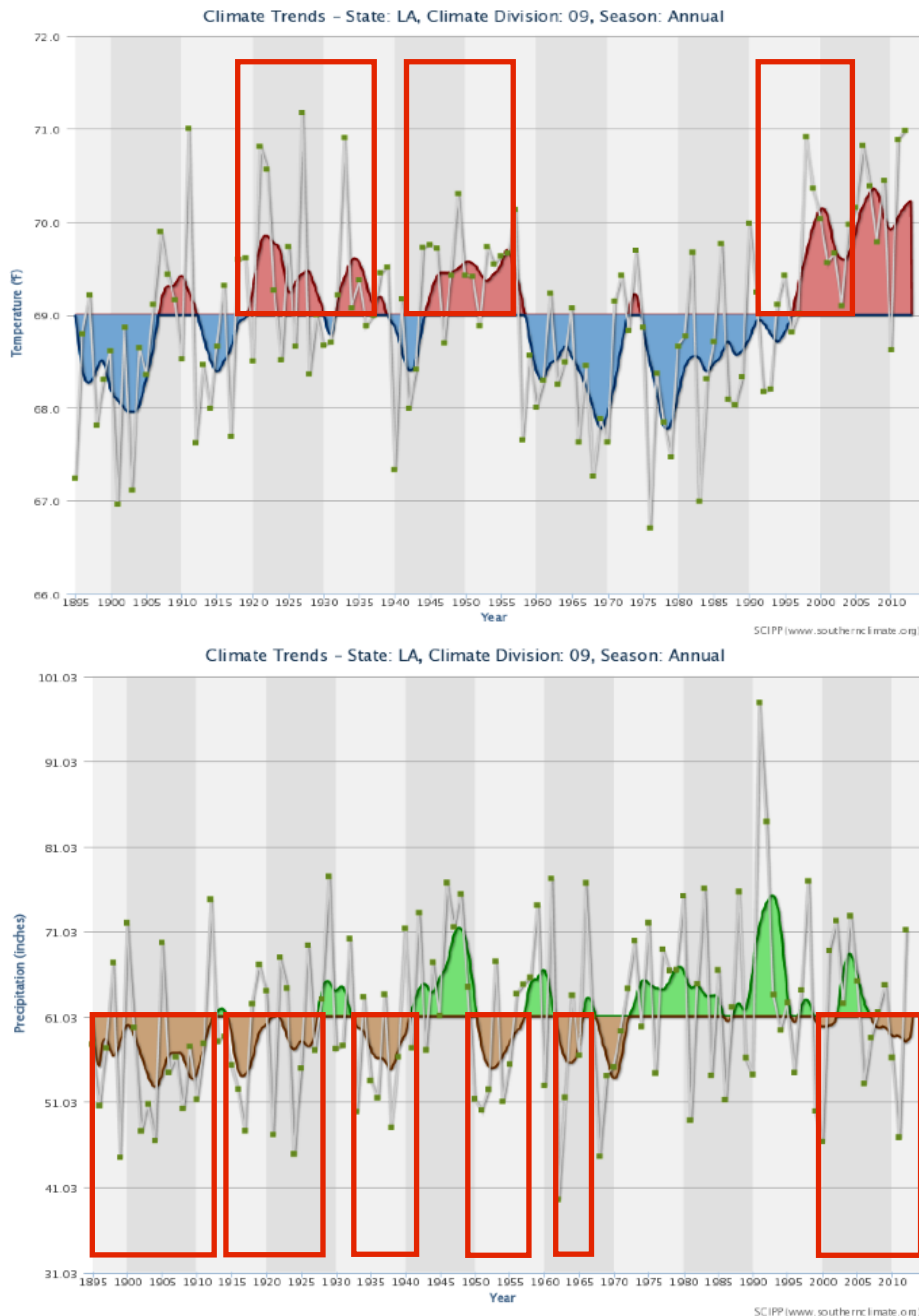


**Figure 34.** Drought history for south-central Louisiana as designated by the U.S. Drought Monitor. The color scale is identical to that in Figure 1. Note that south-central Louisiana was experiencing extreme (bright red) to exceptional drought (dark red) across most of the area during much of 2000 and 2011. Data courtesy of the National Drought Mitigation Center.

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

## Region 9: Southeast Louisiana

Southeast Louisiana 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 southeast Louisiana since 1895.<sup>10</sup> The annual temperature for southeast Louisiana averages 69.0 degrees Fahrenheit, while precipitation averages 61.03 inches. Warmer-than-average periods have spanned the 1920s through the 1930s, the mid-1940s through the 1950s, the mid-1990s through the early 2010s. Significant periods of drier-than-average conditions include the late 1890s through the late 1910s, the 1930s, the 1950s, the mid-1960s, and the late 1990s through the early 2010s.



**Figure 35.** The average annual temperature (top graph) and total annual precipitation (bottom graph) in southeast Louisiana 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.

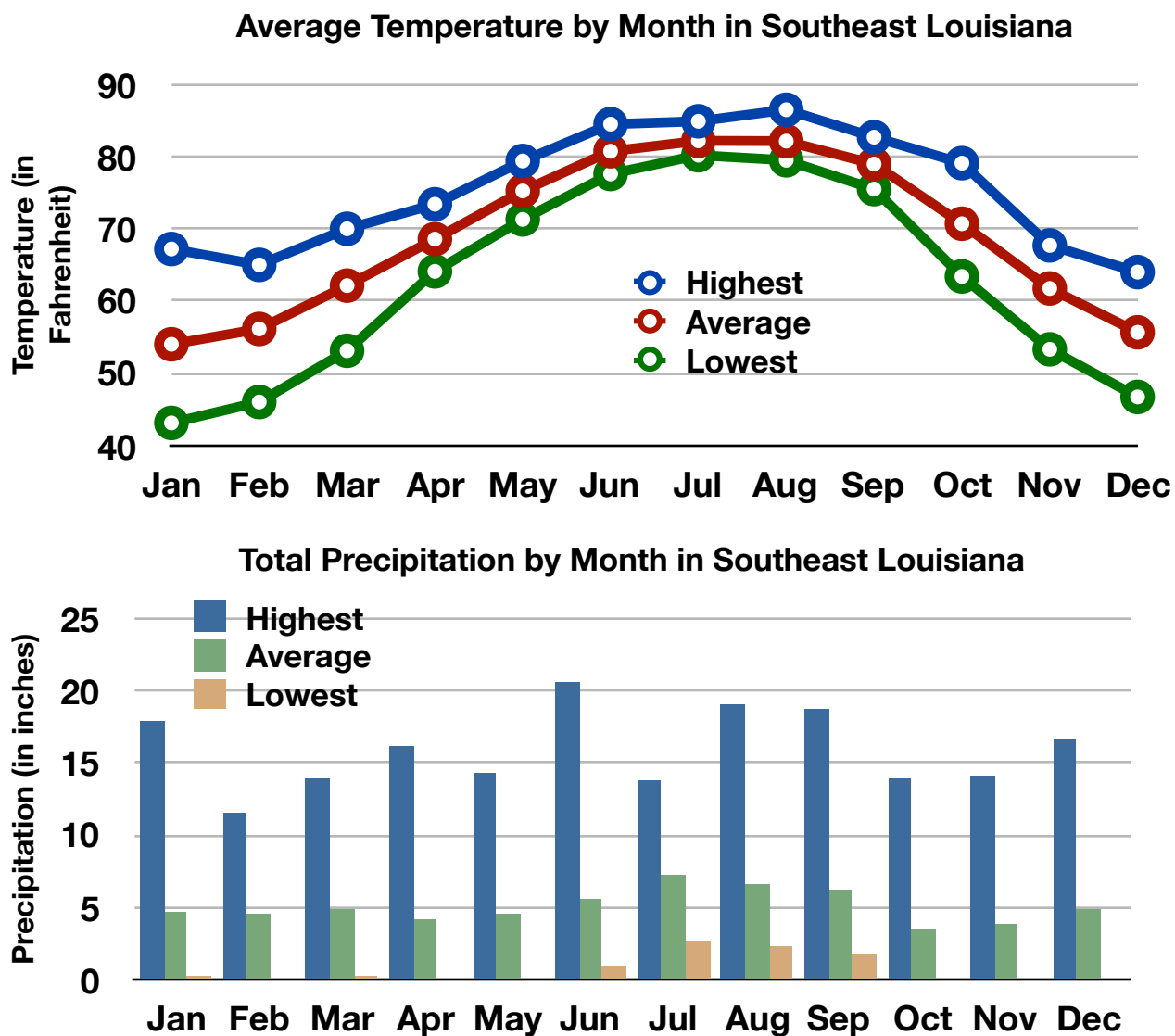
The longest drought experienced in this region lasted 185 months, with several periods of intense drought throughout. May 1998 to February 2012 comes in second for the drought-of-record for west-central Louisiana.

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

Time Period	Months with PDSI less than -1	Months with PDSI less than -4	Lowest PDSI Value
January 1896 - May 1911	96 (of 185 months)	0	-3.29
December 1913 - September 1925	55 (of 142 months)	0	-3.99
June 1933 - April 1939	44 (of 71 months)	0	-3.92
September 1950 - June 1955	43 (of 58 months)	0	-3.43
February 1962 - July 1965	25 (of 42 months)	4	-4.64
May 1998 - February 2012*	89 (of 172 months)	4 consecutive plus 5 others	-5.42

\* Denotes that the selected period is considered to be a possible “Drought-of-Record”

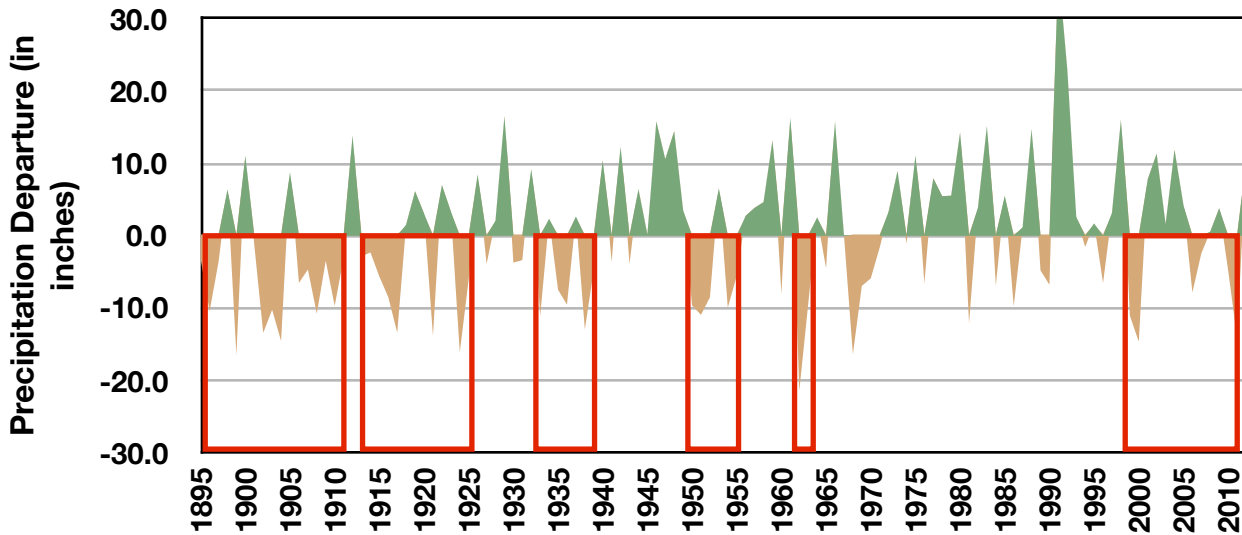
To understand when there is the greatest stress on water availability for southeast Louisiana, the average monthly temperature and precipitation, as well as their average highest and lowest monthly values, are shown in Figure 36. Warmer temperatures result in greater water loss by evaporation and transpiration.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



**Figure 36.** *Top graph:* The monthly average temperature (in degrees Fahrenheit) across southeast Louisiana 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 southeast Louisiana 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, April, and December] The peak of precipitation in June is clearly visible.

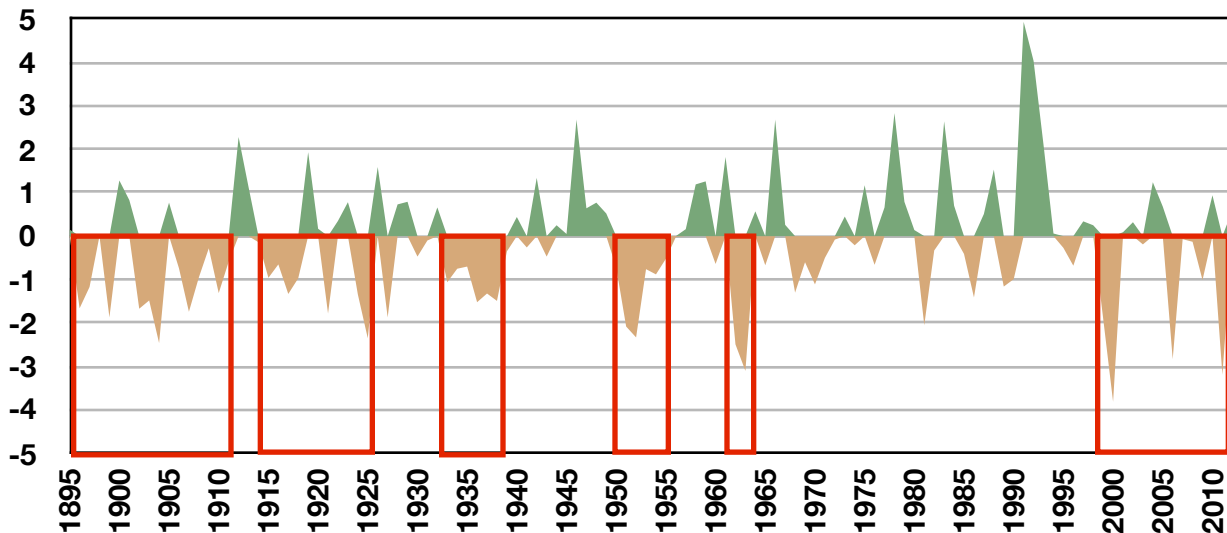
Southeast Louisiana has experienced long and extreme droughts in its past. Figure 37 displays the departure from normal precipitation, Palmer Drought Severity Index, and two-year Standardized Precipitation Index for southeast Louisiana from 1895 to 2012. Red boxes outline the same drier-than-average periods highlighted in Figure 35.

### Annual Departure from Normal Precipitation for Southeast Louisiana



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

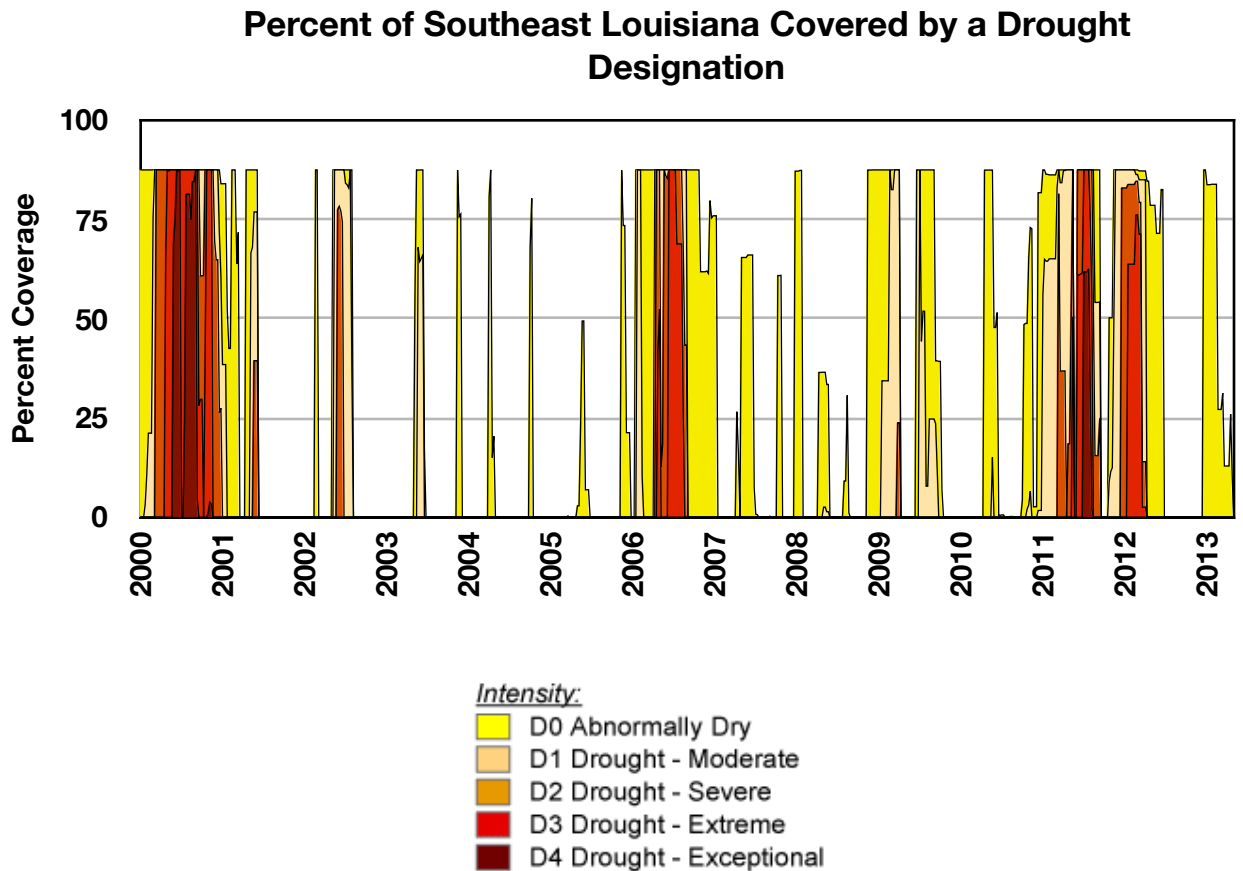
### Palmer Drought Severity Index for Southeast Louisiana



*Figure 37b.* Palmer Drought Severity Index for southeast Louisiana from 1895 to 2012.



The region has experienced dry conditions from 2000 to 2013. In Figure 38 we look at drought designation in southeast Louisiana and see that from 2000-2001 extreme to exceptional drought conditions covered almost 100% of the region. In late 2011 to 2012 the region experienced moderate to exceptional drought covering 50-100%.



**Figure 38.** Drought history for southeast Louisiana as designated by the U.S. Drought Monitor. The color scale is identical to that in Figure 1. Note that southeast Louisiana was experiencing extreme (bright red) to exceptional drought (dark red) across most of the area during much of 2000, 2006, and 2011. 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
State Climate Office - Louisiana	<a href="http://www.losc.lsu.edu/index.html">www.losc.lsu.edu/index.html</a>	Consolidated source of Louisiana climate information
<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
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 Southern Climate Impacts Planning Program provides a drought monitoring web site at <http://www.southernclimate.org/data.php>. The products on this site depict changes in precipitation and temperature across the Southern United States (including Louisiana). Tables summarize the current precipitation totals to past years across a variety of time scales (e.g., last 30 days, last 90 days), as shown in Figure 7.

### 30-Day Precip For LA - May 14, 2013 through Jun 12, 2013

Climate Division	Total Rainfall	DFN	% of Normal	Driest Rank	Driest on Record	Wettest on Record	SPI	Similar Season In Last 30 yrs (Score)
CD 1	4.56	0.1	102.2	79/121	0.55(1971)	10.08(1981)	0.38	2009(8.54)
CD 2	4.36	-0.22	95.3	70/121	0.28(1977)	10.88(1983)	0.25	2008(8.95)
CD 3	3.79	-1.02	78.8	60/116	0.21(1925)	13.80(1909)	0.08	1987(9.11)
CD 4	3.77	-1.12	77	57/118	0.21(1899)	13.45(1910)	-0.01	2006(9.05)
CD 5	4.37	-0.37	92.3	66/121	0.08(1917)	14.56(1953)	0.10	2010(8.69)
CD 6	4.52	-0.24	95	64/122	0.11(1917)	19.39(2001)	0.10	1984(8.86)
CD 7	3.63	-2.03	64.2	49/121	0.16(1917)	13.38(1980)	-0.25	1987(8.92)
CD 8	4.6	-0.2	95.9	58/122	0.06(1917)	18.55(2001)	0.12	1999(9.10)
CD 9	3.12	-1.76	63.8	40/143	0.23(1917)	18.57(2001)	-0.49	2010(8.19)

**Figure 7.** Example of a drought monitoring product from the Southern Climate Impacts Planning Program (<http://www.southernclimate.org/>). This example provides an assessment of the past 30 days ending on June 12, 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. Texas drought photos courtesy of the San Angelo, TX National Weather Service Weather Forecast Office.

### Bibliography

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