Southern Climate Monitor

SCIPP A NOAA RISA TEAM

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A Tale of Two Floods

Luigi Romolo PhD, Regional Climatologist, Southern Regional Climate Center

In the state of Louisiana, heavy rainfall is not uncommon. Rainfall events of 3-5 inches occur from time to time, and even events of 5-10 inches are not that rare. For example, in Baton Rouge one could expect a three-day 9 inch rainfall approximately once every decade. Even in northern Louisiana, where precipitation totals are slightly lower, 5 inches of precipitation in just a 24-hour period can occur approximately once ever 5 years. What happened in Louisiana this year with respect to heavy rainfall, however, is simply astounding from a statistical perspective, in that the state endured two one-thousand year rainfall events that were separated by a period of just five months. What is a one-thousand year rainfall? Climate scientists often use partial duration series analyses and return periods to place extreme events into historical perspective. A one-thousand year event, theoretically speaking, is one that would be expected to occur once every thousand years. Therefore, such an event is not just an event of a lifetime, nor is it just the event of the century. More aptly put, it is the event of the millennium. In short, a one thousand year event is extremely rare. The fact that the state of Louisiana experienced two such thousand year events in just five months, is practically unprecedented. The purpose of this article is to provide a brief explanation of why each flood occurred, and then survey each event with respect to severity and impacts. The first flood occurred over the period of March 8-12 and devastated the north central parishes, but it also affected over two dozen parishes in all corners of the state. The second flood occurred over the period from August 11-14 and it affected south central and eastern central parishes. Both events were associated with a long list of devastating impacts, including fatalities, flooded homes and businesses, road closures, evacuations and rescue efforts, and several disaster declarations.

March Flooding Event: March 8-12, 2016

This flooding event resulted from persistent and heavy rainfall that was the direct consequence of three combined factors: a record setting low pressure system, record high levels of precipitable water over the state of Louisiana, and the conveyor belt of atmospheric water vapor known as the Maya Express. Figure 1 shows the position of the upper-level low on March 11. The rising limb of the trough was strategically positioned to draw moisture in from Central America into the Gulf of Mexico, and subsequently into Louisiana. The strength and position of the low led to high levels of precipitable water across the state (Figure 2), while the water vapor from the Maya Express helped keep precipitable water levels

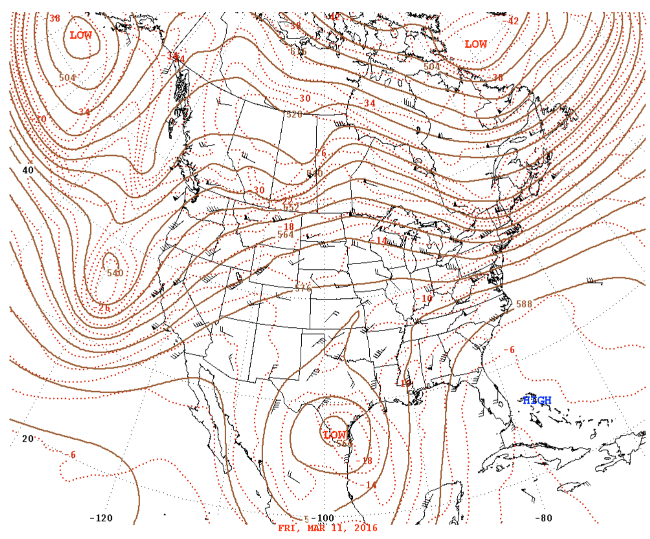


Figure 1. 500 Millibar Heights over North America on March 11, 2016. Image courtesy of NOAA's Weather Prediction Center. Image available at http://www.wpc.ncep.noaa.gov/dailywxmap/.

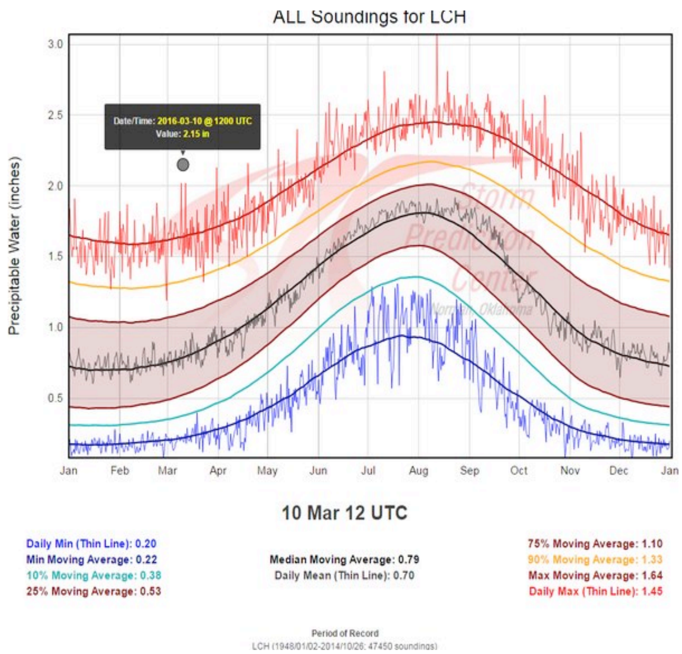


Figure 2. Precipitable water value for March 10, 2016 at 12:00 UTC and Sounding Climatology for Lake Charles, Louisiana. The value of 2.15 inches set a record for any day spanning from late November to mid-March. Reord levels were also observed in Monroe, LA and in Jackson, MS. Image Courtesy of NOAA's Storm Prediction Center via the National Weather Service's Weather Forecasting Office in Lake Charles, Louisiana.

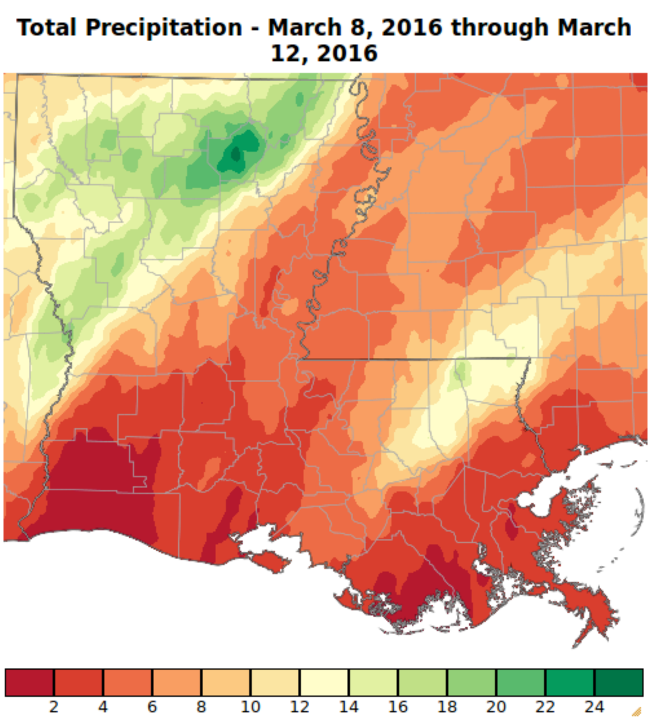


Figure 3. Precipitation totals over Louisiana from March 8-12, 2016. Image Courtesy of the Regional Climate Center Program's SC-ACIS page. Image available here.

above normal throughout the duration of the flooding event. Figure 3 shows the precipitation totals for the event spanning the period from March 8 to March 12, 2016. In the southern half of the state, rainfall totals for the event varied from just under 2 inches near Lake Charles, to over 12 inches in Tangipahoa and Washington Parishes. The highest precipitation totals occurred in the northern and west central parishes where rainfall amounts varied from 8 to 15 inches in the northwest to over 20 inches in the city of Monroe and surrounding areas. Precipitation data from the station at Monroe Regional Airport shows that the station received measurable rainfall (greater than a hundredth of an inch) for forty-three consecutive hours from March 8 to March 10th. Over the next two days, the station gained an addition 2 inches of rainfall, and over the March 8-12 period, it recorded 21.08 inches of rainfall, of which 20.66 inches fell over 4 days from March 8-11. When comparing this value the NOAA Atlas 14 Point Precipitation Frequency Estimates, we find that the rainfall total of 20. 66 exceeds the 1000 year threshold of 20.20 inches, making this a one-thousand year rainfall event. The heavy rainfall that fell over much of the northern half of Louisiana was too much for the ground to absorb and too much for rivers to carry away. Extensive flooding was observed at various locations in the state. Figures 4a and 4b shows the extent of the flooding in Bossier Parish and in Monroe. Due to the extensive flooding, the Governor issued disaster declarations for over two dozen parishes. Three people in Louisiana died and roughly 9500 homes were damaged. Most of these homes were located in the northcentral parishes, however, 1500 were damaged in Tangipahoa Parish, and 400 were reported damaged in Livingston Parish. Approximately 3500 residents were forced to evacuate and thousands of residents were displaced. In addition to this, over 100 road and highways were closed, including Interstate 10, which was closed from March 15-19 at the Texas-Louisiana border. The flooding of the interstate highway at that location was due to record high

Figure 4a (top). Flooding of a location in Bossier Parish. Image is courtesy of NOAA's National Weather Service Weather Forecast Office in Shreveport, Louisiana (NWS Shreveport).

Figure 4b (right). Flooding in the River Oaks subdivision of Monroe, Louisiana. Image is courtesy of NOAA's National Weather Service Weather Forecast Office in Shreveport, Louisiana (NWS Shreveport).

stages on the Sabine River, which was over loaded from rainfall upstream. This particular impact is an excellent example of how heavy rainfall event may affect locations downstream, where the rainfall was not extreme.

August Flooding Event: August 11-14

This flooding event was the direct result of a slow moving, well organized low pressure system. The low tracked westward from Florida and it exhibited tropical-like qualities in terms of its movement and rotation. By the 12th of August, the low was located near the Feliciana Parishes, where it proceeded to move very slowly until it was finally overtaken by a stationary front on August 14. Because the low pressure system hugged the coast as it passed over Louisiana, it provided a near-perfect conduit for water vapor to be fed into rainfall. Precipitation totals from the event varied from 0 to 6 inches in the northern half of the state, while south central and east central parishes saw rainfall totals in excess of 20 inches (Figure 5). Similar to what occurred in Monroe during the March flooding event, rainfall was relentless in Baton Rouge, with the airport station reporting 32 hours of consecutive measurable rainfall. Rainfall totals were exceptionally impressive causing historic flooding in several Parishes (Figure 6). A station in Watson, LA, for example, reported 31.39 inches of rain in just two days. In the city of Lafayette, the U.S. Climate Reference Network (USCRN) station set a record for the highest two-day total of any USCRN station in the contiguous United States, recording a two-day total of 22.89 inches. Many stations, spread over several parishes recorded rainfall totals that exceeded the one-thousand year event threshold; some by over 5 inches. Just like the March flood, many rivers in the area of heavy precipitation recorded record-level stages. For example, the Amite river crested at over 46 feet, which beat the previous record by over 5 feet. In total, this flooding event resulted in 13 fatalities and over 30,000 residents were evacuated. A total of 20 parishes were designated as federal disaster areas. Flooding of numerous roadways and highways, including Interstate-12, made rescue efforts that much more difficult. Many Louisiana

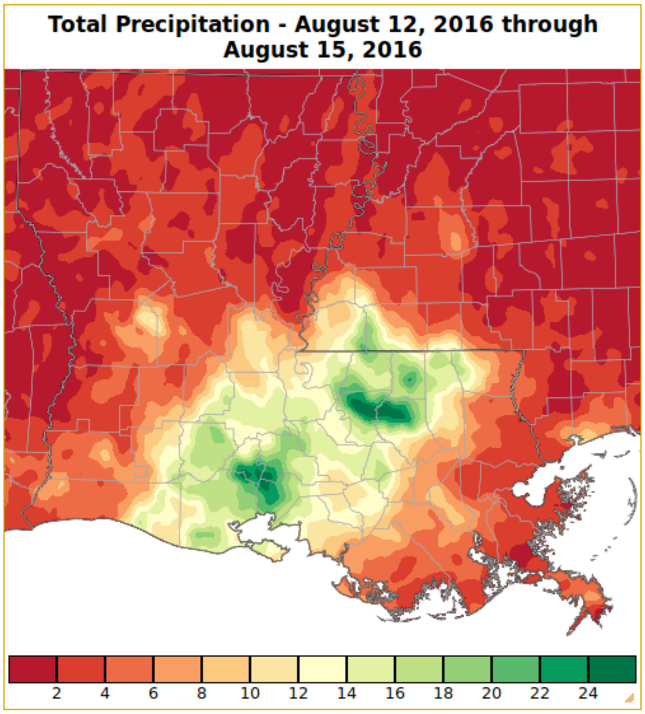


Figure 5: Precipitation totals over Louisiana from August 12-15, 2016. Image Courtesy of the Regional Climate Center Program's SC-ACIS page. Image available here.

citizens who own boats volunteered to assist in rescue efforts. Dubbed by the media as the 'Cajun Navy', they were responsible for rescuing roughly one thousand pets and residents, some of whom may have otherwise drowned. It has been reported that over 140,000 homes were damaged by the flood. Many churches, and even the Baton Rouge River Center, opened their doors to provide shelter. As of early September, over 100,000 Louisiana residents had already applied for disaster aid from FEMA. The flood also had a major impact on the Louisiana School system. Approximately one quarter of a million children (roughly one third of the school-aged population) were out of school; many of them for weeks. Although the dollar value of this event may not be accurately tallied for some time to come (over 8 billion dollars last I heard), it has been noted by many to be the worst US natural disaster since Hurricane Sandy devastated the east coast back in 2012.

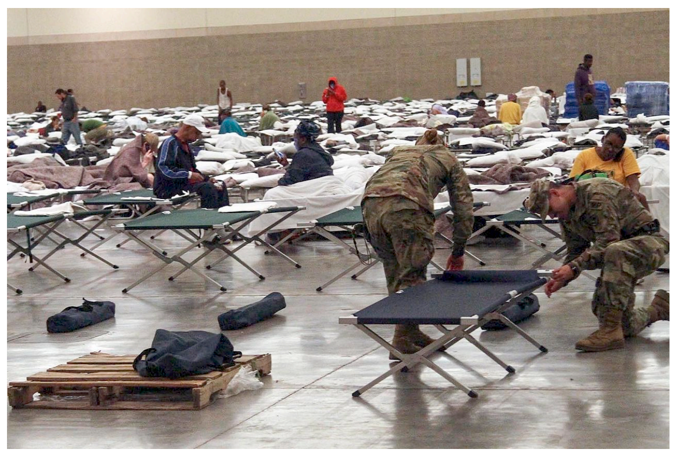
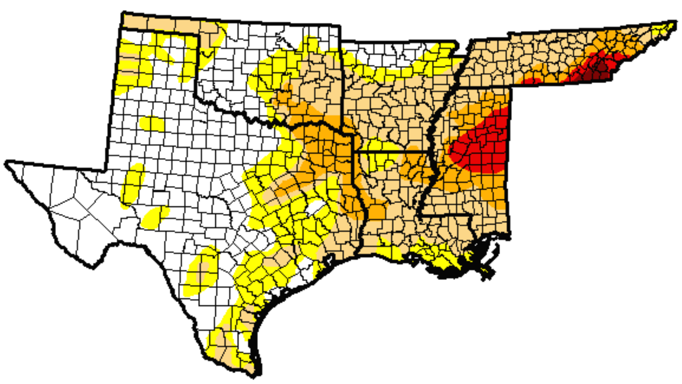


Figure 6. Aerial view of flooding in the Baton Rouge area (Left). Cots set up at the Baton Rouge River Center, which served as a shelter after the flood (Right). Source of image on left: here. Source of image on right: here.

Drought Update

Luigi Romolo,
Southern Regional Climate Center

With consecutive dry and warm months for September and October, drought conditions have changed dramatically in the Southern Region. Over the past month, the amount of areal coverage of moderate drought (or worse) has increased from roughly 10 percent to over 42 percent. In addition, the amount of severe drought (or worse) has increased from a little over two percent coverage to over 14 percent coverage. Mississippi is in 100 percent drought coverage, with much of the central portions of the state now showing extreme drought. With the exception of a few counties in the north eastern corner of the state, Tennessee is showing full drought coverage also, with a significant expansion of extreme and exceptional drought in the south eastern counties. Louisiana has shifted from being drought-free to near full coverage of moderate drought, only two and a half months after experiencing a 1000 year flooding event in the southern Parishes in August. Much of Arkansas is also experiencing moderate drought, which as of last month, was also drought-free. Drought conditions are also observed in eastern Texas and eastern Oklahoma, and in the Oklahoma panhandle.



Released Thursday, November 3, 2016

Deborah Bathke, National Drought Mitigation Center

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	37.42	62.58	42.25	14.52	3.60	0.41
Last Week *10/25/2016*	42.23	57.77	33.10	9.48	1.45	0.14
3 Months Ago *8/2/2016*	59.12	40.88	11.80	3.61	0.25	0.00
Start of Calendar Year *12/29/2015*	97.72	2.28	0.00	0.00	0.00	0.00
Start of Water Year *9/27/2016*	76.89	23.11	6.74	1.89	0.28	0.11
One Year Ago *11/3/2015*	67.33	32.67	7.15	0.00	0.00	0.00

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

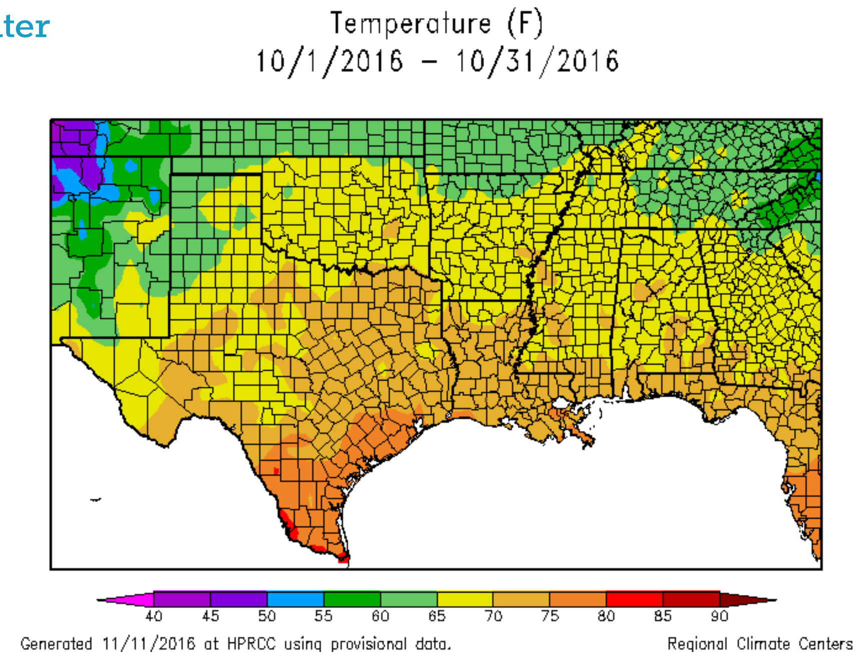
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Above: Drought conditions in the Southern Region. Map is valid for November 1, 2016. Image is courtesy of National Drought Mitigation Center.

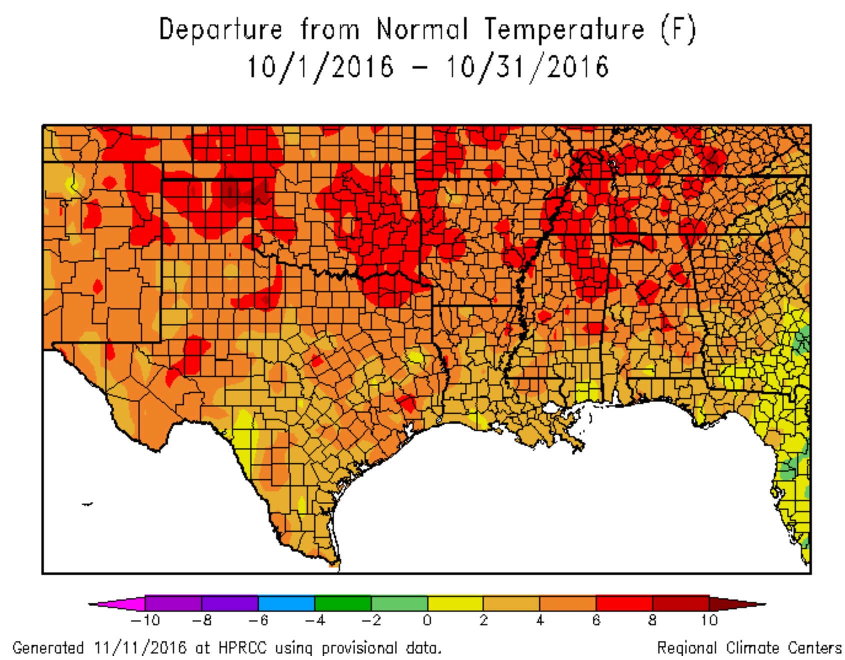
Temperature Summary

Luigi Romolo,
Southern Regional Climate Center

October temperatures in the Southern Region were consistently above normal as they were in September. All six states experienced a warmer than normal month with temperatures averaging 4 to 8 degrees F (2.22-4.44 degrees C) above average in the northern half of the region, and 2-6 degrees F (1.11 – 3.33 degrees C) above average in the southern half of the region. In fact, all six states experienced a top ten warmest October on record (1895-2016). For the region as a whole, it was the second warmest October on record (1895-2016), with a regional average temperature of 69.34 degrees F (20.74 degrees C). The statewide monthly average temperatures were as follows: Arkansas reporting 66.90 degrees F (19.39 degrees C), Louisiana reporting 71.20 degrees F (21.78 degrees C), Mississippi reporting 69.20 degrees F (20.67 degrees C), Oklahoma reporting 67.00 degrees F (19.44 degrees C), Tennessee reporting 64.40 degrees F (18.00 degrees C), and Texas reporting 70.90 degrees F (21.61 degrees C). The state-wide temperature rankings for May are as follows: fourth warmest for Arkansas, sixth warmest for Louisiana, fifth warmest for Mississippi, third warmest for Oklahoma, sixth warmest for Tennessee, and second warmest for Texas. All state rankings are based on the period spanning 1895-2016.



Average October 2016 Temperature across the South

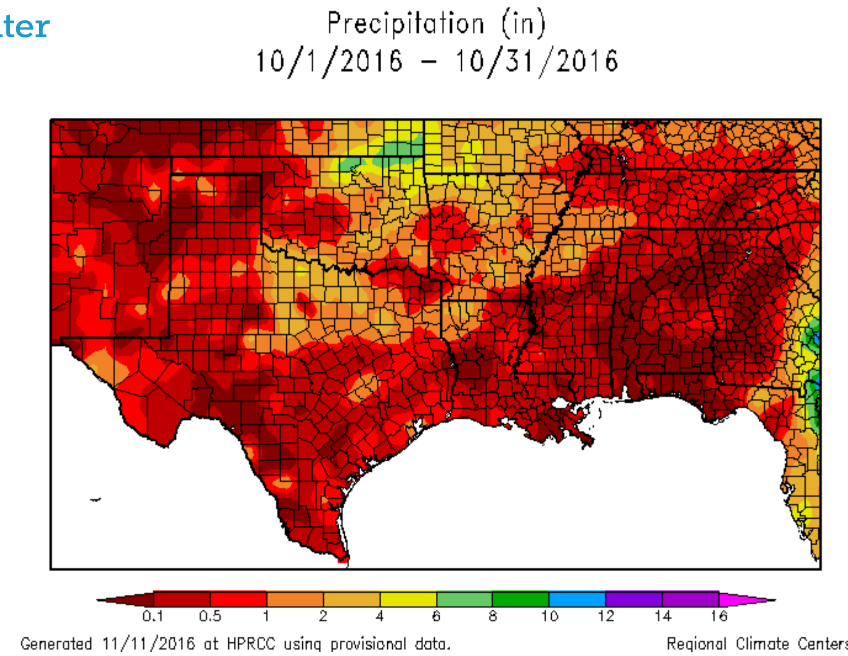


Average Temperature Departures from 1971-2000 for October 2016 across the South

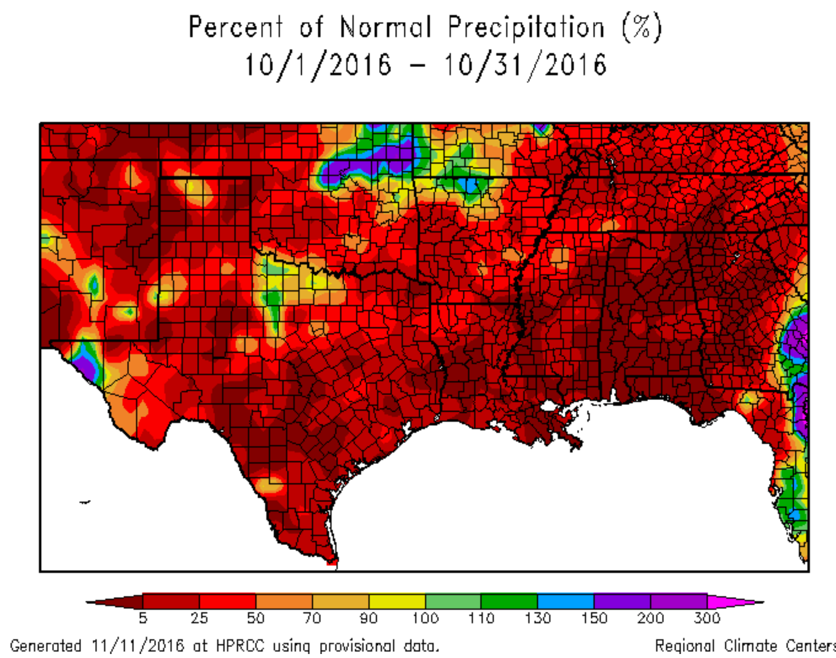
Precipitation Summary

Luigi Romolo,
Southern Regional Climate Center

Like September, October proved to be a very dry month for the Southern Region, with four of six states experiencing a top ten driest October on record (1895-2016). An overwhelming majority of stations in the region received less than a quarter of expected precipitation for the month, with many stations in the southern half of the region reporting less than half an inch (25.4 mm). For the region as a whole, it was the seventh driest October on record (1895-2016). The state-wide precipitation average was 0.86 inches (21.84 mm). The state-wide precipitation totals for the month are as follows: Arkansas reporting 1.60 inches (40.64 mm), Louisiana reporting 0.41 inches (10.41 mm), Mississippi reporting 0.55 inches (13.97 mm), Oklahoma reporting 1.67 inches (42.42 mm), Tennessee reporting 0.69 inches (17.53 mm), and Texas reporting 0.67 inches (17.02 mm). The state precipitation rankings for the month are as follows: for Arkansas it was the twenty-third driest, for Louisiana it was the fifth driest, for Mississippi it was the eighth driest, for Oklahoma it was the thirty-first driest, for Tennessee it was the seventh driest, and for Texas it was the sixth driest. All state rankings are based on the period spanning 1895-2016.

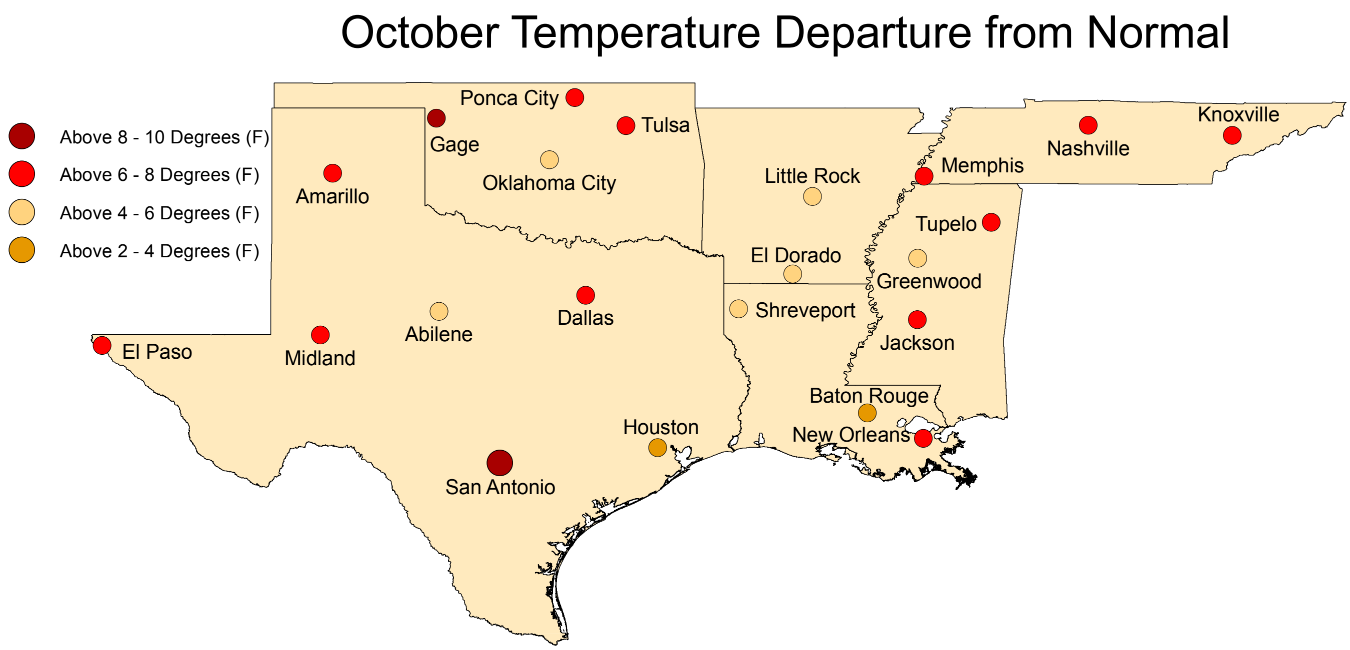


October 2016 Total Precipitation across the South

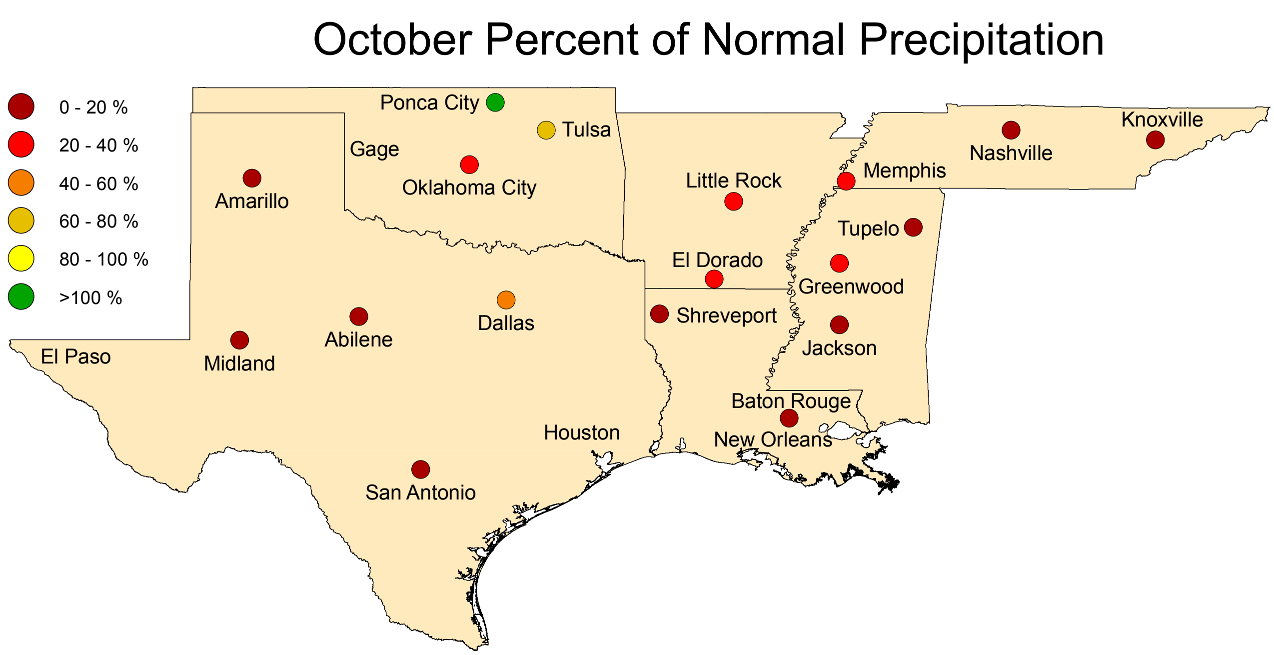


Percent of 1971-2000 normal precipitation totals for October 2016 across the South

Regional Climate Perspective in Pictures



October 2016 Temperature Departure from Normal from 1971-2000 for SCIPP Regional Cities



October 2016 Percent of 1971-2000 Normal Precipitation Totals for SCIPP Regional Cities

Climate Perspective

State	Temperature	Rank (1895-2011)	Precipitation	Rank (1895-2011)
Arkansas	66.90	4th Warmest	1.60	23rd Driest
Louisiana	71.20	6th Warmest	0.41	5th Driest
Mississippi	69.20	5th Warmest	0.55	8th Driest
Oklahoma	67.00	3rd Warmest	1.67	31st Driest
Tennessee	64.40	6th Warmest	0.69	7th Driest
Texas	70.90	2nd Warmest	0.67	6th Driest

State temperature and precipitation values and rankings for October 2016. Ranks are based on the National Climatic Data Center's Statewide, Regional, and National Dataset over the period 1895-201 1.

Station Summaries Across the South

Station Summaries Across the South

Station Name	Temperatures								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	%Norm
El Dorado, AR	81.4	54.9	68.1	4.3	90	10/07+	42	10/22	2.09	-3.10	40
Little Rock, AR	79.8	55.8	67.8	4.1	90	10/05	43	10/22	1.91	-3.00	39
Baton Rouge, LA	86.1	60.1	73.1	3.8	91	10/18+	45	10/23	0.61	-4.09	13
New Orleans, LA	86.9	68.6	77.7	6.4	94	10/04	54	10/23	0.05	-3.49	1
Shreveport, LA	85.0	59.3	72.1	5.7	92	10/07+	44	10/22	0.98	-3.98	20
Greenwood, MS	84.4	53.9	69.2	4.9	91	10/07+	38	10/22	0.82	-3.05	21
Jackson, MS	86.5	56.3	71.4	6.3	92	10/07+	40	10/22	0.49	-3.43	12
Tupelo, MS	84.3	54.7	69.5	6.5	91	10/19+	40	10/22	0.44	-3.68	11
Gage, OK	84.1	50.2	67.1	8.7	102	10/17	34	10/08	0.04	-1.95	2
Oklahoma City, OK	79.2	56.4	67.8	5.3	89	10/17+	42	10/21	0.82	-2.89	22
Ponca City, OK	79.8	55.1	67.4	7.3	92	10/17	37	10/21	5.59	2.21	165
Tulsa, OK	79.8	57.3	68.5	6.7	90	10/17+	41	10/21	2.86	-1.07	73
Knoxville, TN	79.5	52.9	66.2	6.3	88	10/20+	39	10/23	0.18	-2.33	7
Memphis, TN	81.9	59.5	70.7	6.6	92	10/07	44	10/22	1.22	-2.76	31
Nashville, TN	80.5	54.9	67.7	7.4	91	10/19	40	10/23	0.43	-2.61	14
Abilene, TX	83.3	59.4	71.3	5.5	93	10/17	41	10/21	0.40	-2.58	13
Amarillo, TX	81.6	49.7	65.7	7.4	98	10/16	36	10/07	0.13	-1.53	8
El Paso, TX	84.9	57.7	71.3	6.2	90	10/17+	48	10/21	0.00	-0.61	0
Dallas, TX	84.9	63.4	74.2	6.7	94	10/05	51	10/22	2.01	-2.20	48
Houston, TX	86.6	63.3	75.0	3.5	93	10/18	48	10/22	0.14	-5.56	2
Midland, TX	86.0	59.1	72.6	7.8	97	10/17	47	10/21	0.31	-1.42	18
San Antonio, TX	85.0	63.7	74.4	3.2	90	10/19+	46	10/22	0.16	-3.95	4

Summary of temperature and precipitation information from around the region for October 2016. Data provided by the Applied Climate Information System. On this chart, "depart" is the average's departure from the normal average, and "% norm" is the percentage of rainfall received compared with normal amounts of rainfall. Plus signs in the dates column denote that the extremes were reached on multiple days. Blueshaded boxes represent cooler than normal temperatures; redshaded boxes denote warmer than normal temperatures; tan shades represent drier than normal conditions; and green shades denote wetter than normal conditions.

Absolute Zero

Barry Keim, Louisiana State Climatologist, Louisiana State University

In the weather world, there is this term called Absolute Zero, which refers to a temperature. Not just any temperature, but a very special temperature, one that is ABSOLUTE and one that you will not ever see. To fully comprehend Absolute Zero, you need to know what constitutes temperature. Temperature represents the average rate of molecular motion, and all earthly atoms and molecules are in motion. The faster the molecules move and collide with one another, the warmer the temperature. For example, on a day when the temperature is 80°F outside, the air molecules are moving around, colliding and rebounding off of one another and the average rate of speed of those molecules is measured on some scale - we call that the temperature. If it were 40°F outside, the air molecules would be moving at a slower rate of speed than if it were 80°.

At Absolute Zero, however, there is no molecular motion, at least in theory. Here's a pet peeve of mine. Is 80°F twice the temperature of 40°F? I've heard television meteorologists say things like this on-air and it drives me crazy. The reason being is that when using the Fahrenheit and Celsius scales, 0° does not mean that there is no temperature, but rather 0° is simply another number on a continuum, and we can continue lowering the temperature on the negative side of the scale. So 20°F is not twice the temperature of 10°F. On the negative side of the Fahrenheit and Celsius scales, how far down that scale can we go? Well, we can go down as far as Absolute Zero, which has the temperature equivalent of -460° F or -273°C. That is quite literally the lowest that temperature can go, because at Absolute Zero, there really is NO temperature. Given the odd values in Fahrenheit and Celsius that correspond to Absolute Zero, we also have another temperature scale called Kelvin, which is known as the Absolute Scale, and zero Kelvin is Absolute Zero. The scale has the same unit increments as the Celsius Scale, but starts 0° at Absolute Zero, rather than the freezing point of water in the Celsius Scale. Wikipedia defines "absolute" as a term for "the most real being." It also follows that up with "the being that transcends and comprehends all other beings." Well that is a good start in understanding this animal, as what could be more zero than absolutely no molecular motion whatsoever. I note that Absolute Zero is a state that cannot be achieved on earth, but we have come close using cryocoolers, dilution refrigerators, nuclear adiabatic demagnetization, and laser cooling. E-mail me with questions or feedback at keim@lsu.edu.

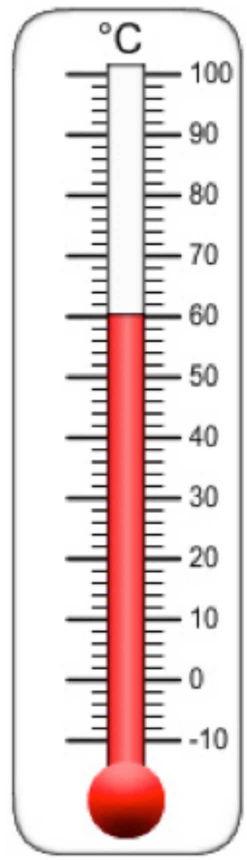


Figure 1. Thermometer from Clipart Kid found at http://www.clipartkid.com/fahrenheit-thermometer-cliparts/.

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Contact Us

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For any questions pertaining to historical climate data across the states of Oklahoma, Texas, Arkansas, Louisiana, Mississippi, or Tennessee, please contact the Southern Regional Climate Center at 225-578-5021.

For questions or inquiries regarding research, experimental tool development, and engagement activities at the Southern Climate Impacts Planning Program, please contact us at
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Monthly Comic Relief