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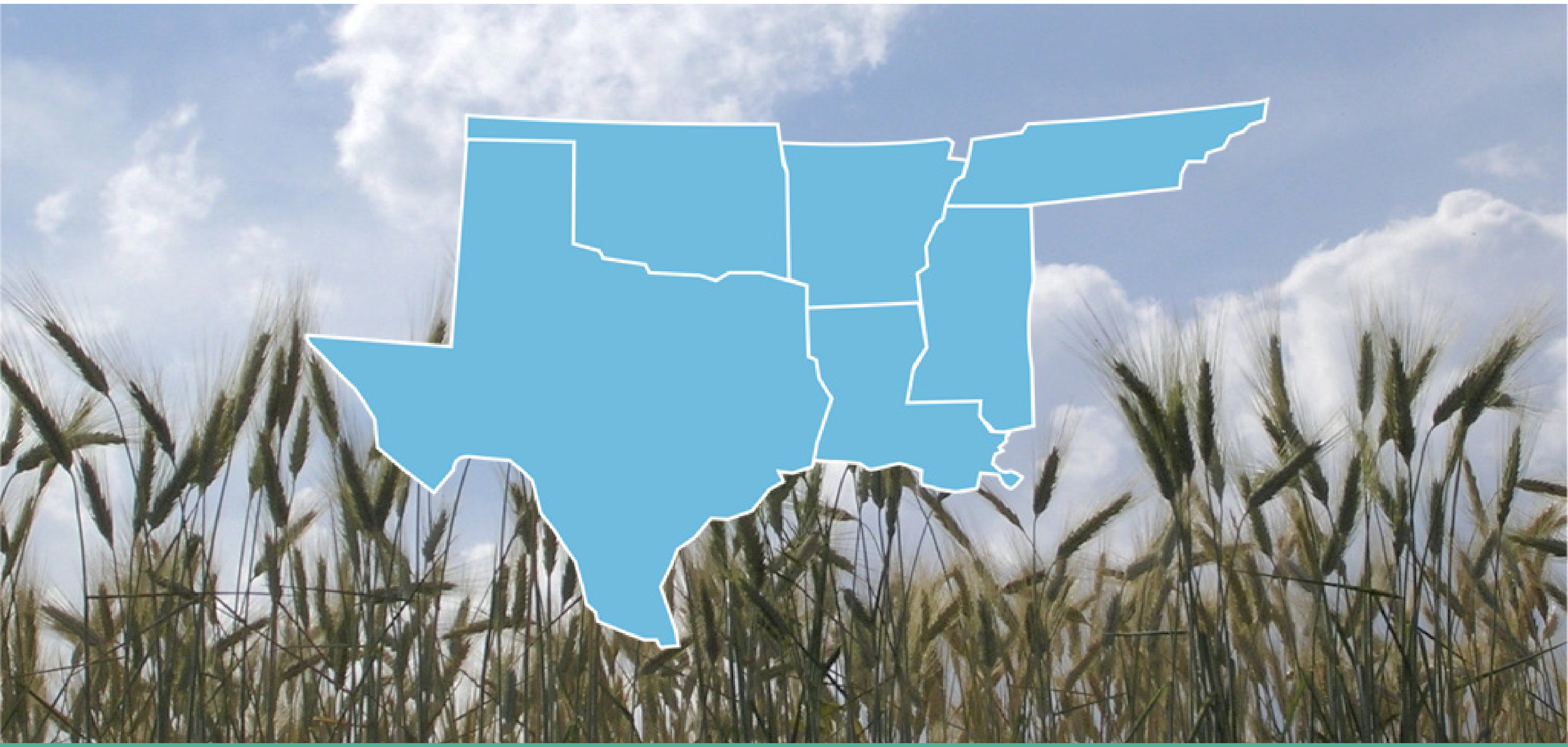

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Enhancing Local Resiliency by Planning for Climate Change

Dawn Jourdan, Professor and Executive Associate Dean in the College of Architecture, Texas A & M University

Shelby Templin, Planning at ACOG

City and county governments are typically organized by three or four primary organizing documents: the city charter, the comprehensive plan, the zoning ordinance, and the capital improvements plan. Together, these documents establish the organizing principles for town planning. The city charter serves as the incorporating document, providing guidelines pertaining to leadership and voting rights, among other aspects. The comprehensive plan is a vision document, established by the local planning department with citizen input. This document serves as a benchmark for the current city and sets the city's aspirational goals for the future. This document addresses a range of elements including: population demographics, housing conditions, environmental attributes, land use, transportation, and infrastructure, among other topics that vary specifically by both legal requirements and special interests of the community. The zoning ordinance serves to implement the vision stated in the comprehensive plan. Focusing primarily on land use, the zoning ordinance establishes site level requirements for the development of private property. Finally, the capital improvements plan is a five year plan that outlines infrastructure needs based on the above referenced development scenarios and the funding sources for these activities.

Historically, none of these documents did a very good job of proactively including the practices associated with hazard planning, both preparing for and responding to events such as hurricanes, tornadoes, wild fires, etc. In the 1970s and 1980s, some coastal states, like Florida, began to require the inclusion of a new section pertaining to natural hazards in comprehensive plans for seaside communities (Godschalk, Kaiser and Burke, 1998). In the last decade, the Federal Emergency Management Agency (FEMA) has begun requiring the adoption of local hazard mitigation plans. These plans are typically prepared by emergency managers at the city or county level with very little public input. It is also hit or miss whether this information finds its way into a community's comprehensive planning documents. As a result, local hazard planning activities can be somewhat haphazard (Pearce, 2003).

Climate change necessitates the expansion of local hazard planning activities. In coastal areas, the threat of sea level rise, in conjunction with subsistence, will require short and long term planning by local governments regarding siting future development, shoring up existing structures, and, in some cases, retreat from low lying area. Central states, like Oklahoma, require the same degree of hazard planning to help prepare for the onslaught of severe weather such as tornadoes and extreme heat and cold. Oklahomans will need to prepare for wildfires and drought conditions, as well as the flash floods that will punctuate dry periods. Current climate predictions indicate more extreme weather for all parts of the State (http://www.southernclimate.org/documents/climatechange_oklahoma.pdf). Pre- and post-disaster planning is necessary in helping communities make development and funding decisions that support resiliency.

One of the best ways to plan for resiliency is to engage community members in long range conversations about the potential effects of these climatic shifts. Resiliency planning necessitates a shift from response and recovery based planning efforts to those which focus on hazard mitigation planning (Pearce, 2003). Rather than focusing on the disaster itself, mitigation planning prioritizes a focus on those affected or potentially effected by such events. Many communities are beginning to accomplish this goal by inserting hazard planning into comprehensive planning, as either a stand-alone section or integrating the materials throughout the comprehensive plan.

Shelby Templin, a graduate student in the Division of Regional and City Planning and now a transportation planner at ACOG, worked with Dr. Dawn Jourdan and Dr. Mark Shafer to investigate the status of hazard mitigation planning in Oklahoma communities. She investigated three cities of varying sizes: Blanchard, Norman, and Tulsa. Ms. Templin sought to discern the extent to which local comprehensive plans in these cities incorporated hazard planning. Further, she strategized about how these localities might modify the current sections of their comprehensive plans to better incorporate the elements of integrated hazard planning.

The City of Blanchard, a town of 7,600, adopted its most recent comprehensive plan in 2013. This plan focuses on: Demographics and Housing; Infrastructure and Public Utilities; Parks, Flood Plains, and Land Use; and Economic Development. The plan, in its current state, contains a limited discussion of flooding, discouraging new development in the Walnut Creek Floodplain. The town relies on Grady County's Hazard Mitigation Plan. This plan is very thorough but is somewhat disconnected from Blanchard's own plans.

The City of Norman is a mid-sized city with a population exceeding 110,000. Norman's current comprehensive plan was adopted in 2004 and is in the process of being updated. Like Blanchard, Norman's comprehensive plan does not directly address the elements typically contained in a hazard mitigation plan. However, the plan does discourage development within an area identified as the 10-Mile Flats to prevent damage associated with flooding. Norman has adopted Cleveland County's Hazard Mitigation Plan. This plans identifies the following hazards as threats to Cleveland County: flooding, severe storms, wildfires, severe winter storms, and tornadoes. The comprehensive plan update that is on-going is a welcome opportunity for the city to integrate hazard planning.

Tulsa is the second largest city in Oklahoma with a population topping 400,000 residents. Tulsa's latest comprehensive plan was adopted in 2010. While there is little mention of disaster or hazard mitigation planning in the city's comprehensive plan, there is some reference in the section pertaining to transportation for the need to engage in road improvements that aid in reducing emergency response times. In addition, the plan addresses the need for the installation of green infrastructure to minimize the effects of flash flooding. Unlike the other two cities, Tulsa has its own Hazard Mitigation Plan. This plan was generated after Tulsa's designation as one of the most dangerous cities to live in due to the threat of severe weather. This plan addresses: floods, tornadoes, lightening, hailstorms, severe winter storms, extreme heat, drought, expansive soils, wildfires, earthquakes, and dam and levee failures. It does not address earthquakes, an increasing threat in that region of the State. Tulsa County also has also adopted its own mitigation plan. It was updated in 2015.

In all three cases, integration between the hazard mitigation plans and comprehensive plans is critical to ensure implementation across local and regional agencies. In her work, Ms.

Tornadoes

- Tulsa Comprehensive Plan; Section on Land Use:
  - ***How We Get There***
  - *Tulsa will implement the new vision employing the Strategic Plan. Several of the key land use recommendations include:*
    - **Protecting** the land and development within Tulsa from major threats from weather events, such as tornadoes.
    - ***Revising*** *Tulsa's zoning and subdivision codes* to create a more vibrant and resilient city from outside threats.
    - ***Conducting*** *neighborhood and small area planning in targeted areas.*
  - ***Creating*** *a viable redevelopment strategy* to include:
    - Development in areas safe from hazard threats
    - Changing development standards to address any and all threats Tulsa may encounter
    - Feasible and regulated development so that Tulsa may grow in a more regulated and strategic manner.
    - ***Initiating*** *and completing several PLANiTULSA prototype buildings as demonstration projects.*

Flooding

- Norman Comprehensive Plan; Floodplain Section:
  - *There should be strong opposition to development in the flood plains, particularly within the Ten-Mile Flats flood plain and a desire for a significant Community Separator along much of the northern boundary of the city. This plan further protects the City's environmentally sensitive areas by limiting development in the 100-year floodplain and requiring structures to be shifted to higher, non-flood plain parcels.* By limiting development within the Ten-Mile Flats floodplain, structures could be kept from damage or destruction from future flood events and other hazards associated with floodplain development.

Drought

- Tulsa Comprehensive Plan; Drought Section:
  - *Trees and other landscaping to visually enhance the space as well as provide shade and a cooler microclimate. Native or drought-resistance species should be encouraged.* Landscaping should be conducted with drought conditions in mind. Water detention ponds and native species will be integrated into all landscaping requests as to reduce the impact during a drought season.

Heat

- Norman Comprehensive Plan:
  - The Norman Comprehensive Plan does not mention any heat or weather related mitigation activities that would aid the city in extremely hot temperatures.
  - The Cleveland County Hazard Mitigation Plan lists Extreme Heat as a natural hazard and has included temperature data provided by the National Weather Service and the Oklahoma Climatological Survey. It was identified as a hazard due to prolonged periods of high temperature and wide swings in temperature. The mitigation strategy listed is to provide air conditioning to vulnerable populations.
- Norman Proposed Heat Language:
  - Add: Create new policies listed under the Land-Use and Transportation Plan heading within the Land Use Plan section, within Goal 6: Greenbelt Development
  - Add: Policy 8. Improve shade in open spaces and attempt to reduce the urban heat island effect. Developments should take into account the amount of concrete and building materials integrated in order to mitigate heat islands throughout Norman. Energy efficiency measures should also be considered to maintain coolness within buildings and homes.

Earthquakes

- Earthquakes are not addressed by the plans in these communities. The following policies are recommended for addition to the Land Use Section of the Comprehensive Plans for all three communities:
  - Add: Policy: Limit or deny property development on soils prone to shifting or liquefaction
  - Add: Policy: Restrict development near fault lines and steep slopes
  - Add: Policy: Require all new building permits issued to existing construction to meet earthquake level standards
  - Add: Policy: All new buildings and development in seismic prone areas must meet new building standards to minimize future property damage from earthquakes

Figure 1. Proposed changes by Ms. Templin to comprehensive plans. The existing code language is replicated in italics. Proposed language is underlined.

Templin provided some examples of this type of cross pollination. They are outlined in figure 1. The existing code language is replicated in italics. Proposed language is underlined.

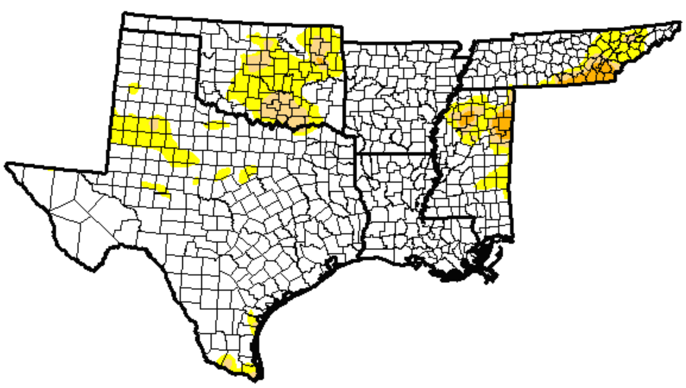
The integration of hazard mitigation planning techniques into comprehensive planning is key to ensure that local plans are responsive to current and future threats associated with shifts in climate. Even if a city is not currently engaged in a comprehensive planning update, plans can be modified gradually to account for hazard mitigation. Such changes, as required by law, should be made in an open process that engages local citizens in the planning process. This effort will reinforce the significance of understanding climate changes on the course of future development in Oklahoma communities.

Drought Update

Luigi Romolo,
Southern Regional Climate Center

Due to heavy rain through the month of August, drought conditions have improved dramatically across the Southern Region this past month. The state of Texas is now nearly drought-free, while drought conditions in south and central Mississippi have now been eliminated. Moderate to severe drought conditions are still listed in parts of southern Oklahoma, northern Mississippi, and south eastern Tennessee.

In Texas, The flooding had impacts on some companies, for example the U.S. Concrete Inc. who lost some of their business due to places being too flooded to work. The Texas Water Development Board received $3.5 million to go towards better aid systems. Farmers had varying amounts of cooperation from the weather this month. Many farmers had to resort to secondary crops, such as sunflowers, because conditions were never right for their usual crops. One farmer lost 19 cows due to lightning striking the tree the cows were taking shelter under. In spite of the rain, high temperatures posed a threat to people's health. Frequent triple digit temperatures warranted several heat advisories across the state. Utility companies reported high revenues this month, including one in El Paso that saw an increase of $1.2 million while reducing their carbon output by 1 billion tons. While energy usage at peak times were higher on average, the highest peak usage of 69,877 MWh was lower than the expected 70,588 Mwh (Information provided by the Texas Office of State Climatology).



Released Thursday, September 8, 2016
David Simeral, Western Regional Climate Center

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	84.24	15.76	4.51	1.20	0.00	0.00
Last Week *8/30/2016*	82.95	17.05	5.45	1.28	0.00	0.00
3 Months Ago *6/7/2016*	85.94	14.06	3.30	0.16	0.00	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 *9/29/2015*	36.88	63.12	37.43	18.31	5.72	0.00
One Year Ago *9/8/2015*	51.50	48.50	30.93	12.78	2.17	0.00

Intensity:

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

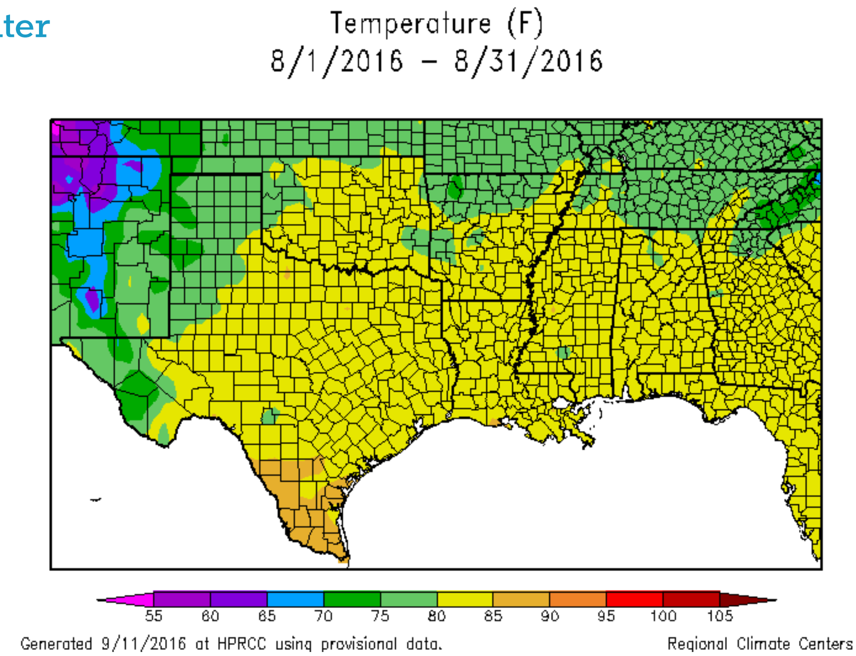
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Above: Drought conditions in the Southern Region. Map is valid for September 6, 2016. Image is courtesy of National Drought Mitigation Center.

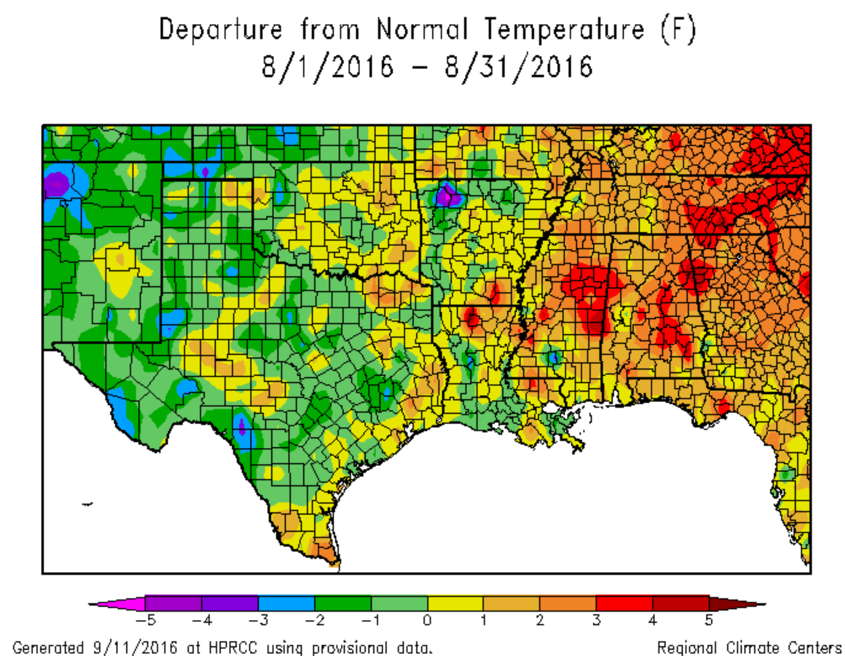
Temperature Summary

Luigi Romolo,
Southern Regional Climate Center

August temperatures in the Southern Region varied spatially, with stations in the western counties of Oklahoma and Texas experiencing a slightly cooler than normal month. Conversely, temperatures in Mississippi and Tennessee were well above average. Most stations in northern Mississippi and in eastern Tennessee averaged approximately 2-4 degrees F (1.11-2.22 degrees C) above the monthly normal. In the middle states of Louisiana and Arkansas, temperatures were generally within 2 degrees F (1.11 degrees C) of expected values. Generally speaking, August was a slightly warmer month for the region. All states in the region, with the exception of Texas, averaged above normal. The statewide monthly average temperatures were as follows: Arkansas reporting 80.00 degrees F (26.67 degrees C), Louisiana reporting 82.50 degrees F (28.06 degrees C), Mississippi reporting 82.20 degrees F (27.89 degrees C), Oklahoma reporting 80.90 degrees F (27.17 degrees C), Tennessee reporting 78.90 degrees F (26.06 degrees C), and Texas reporting 81.60 degrees F (27.56 degrees C). The state-wide temperature rankings for May are as follows: forty-ninth warmest for Arkansas, thirty-third warmest for Louisiana, nineteenth warmest for Mississippi, fifty-eighth warmest for Oklahoma, eleventh warmest for Tennessee, and forty-seventh coldest for Texas. All state rankings are based on the period spanning 1895-2016.



Average August 2016 Temperature across the South

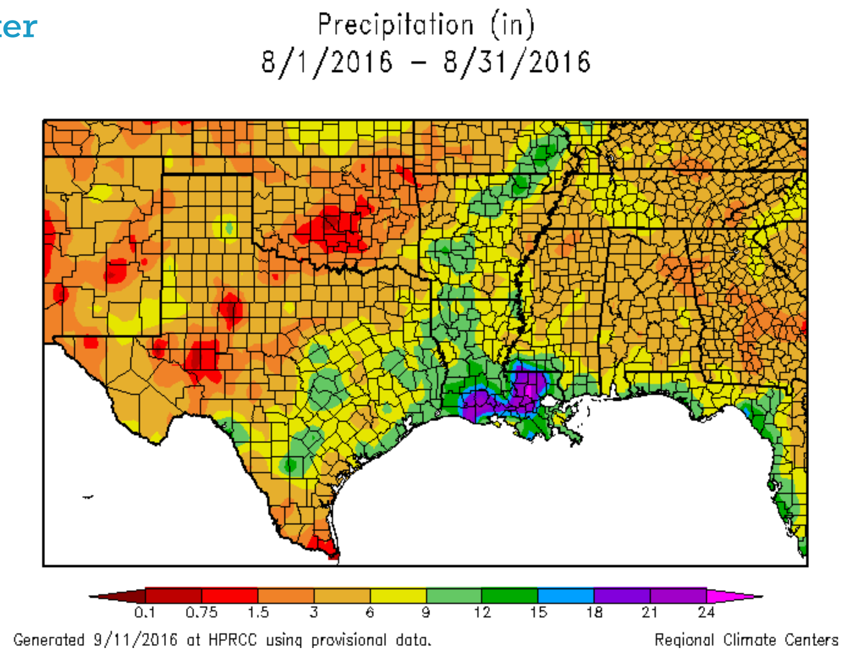


Average Temperature Departures from 1971-2000 for August 2016 across the South

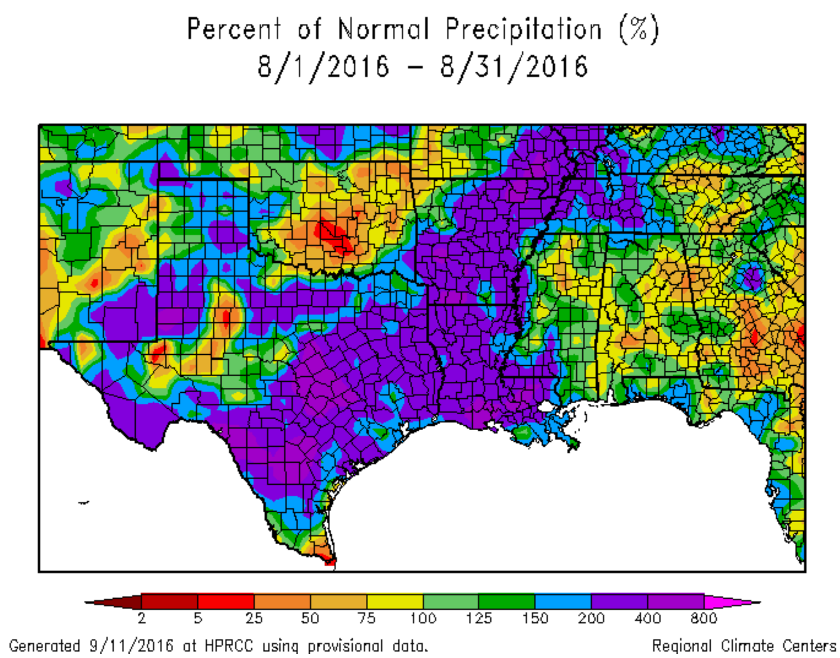
Precipitation Summary

Luigi Romolo,
Southern Regional Climate Center

August proved to be a wet month for the entire Southern Region. All six states averaged above normal precipitation. Collectively, the Southern Region averaged 5.85 inches (148.59 mm) of rain, making it the third wettest August on record (1895-2016). Conditions were considerably wet in Arkansas and eastern Texas, while in Louisiana, precipitation totals, especially in the southern parishes, was historic. The state-wide precipitation totals for the month are as follows: Arkansas reporting 7.49 inches (190.25 mm), Louisiana reporting an astounding 12.90 inches (327.66 mm), Mississippi reporting 5.77 inches (146.56 mm), Oklahoma reporting 2.86 inches (77.64 mm), Tennessee reporting 4.97 inches (126.24 mm), and Texas reporting 5.18 inches (131.57 mm). The state precipitation rankings for the month are as follows: for Arkansas it was the third wettest, for Louisiana it was the wettest ever, for Mississippi it was the fifteenth wettest, for Oklahoma it was the sixtieth wettest, for Tennessee it was the twenty-first wettest, and for Texas it was the fifth wettest. All state rankings are based on the period spanning 1895-2016. It is worthy to note that the Louisiana monthly precipitation total of 12.90 inches (327.66 mm) didn't just break the record, it smashed it. The previous August record for Louisiana occurred in 1940, when the state averaged 9.71 inches (246.63 mm), a value that was exceeded by over 3 inches (76.2 mm).

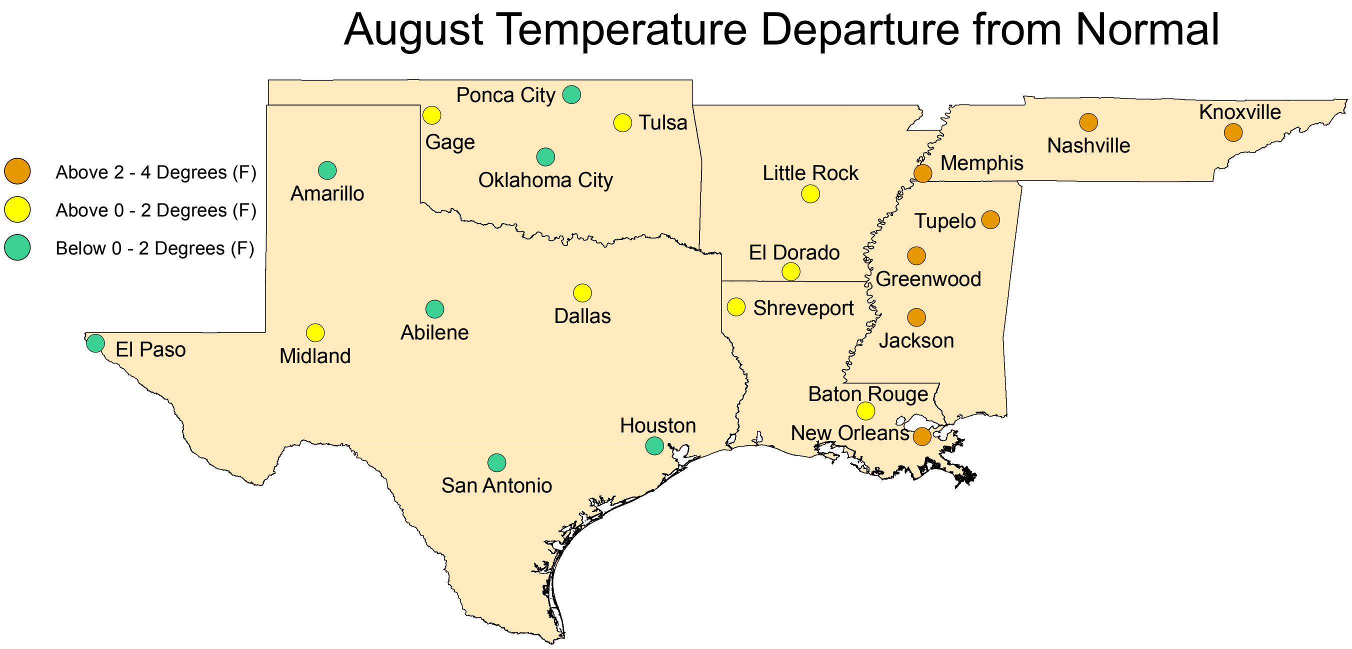


August 2016 Total Precipitation across the South

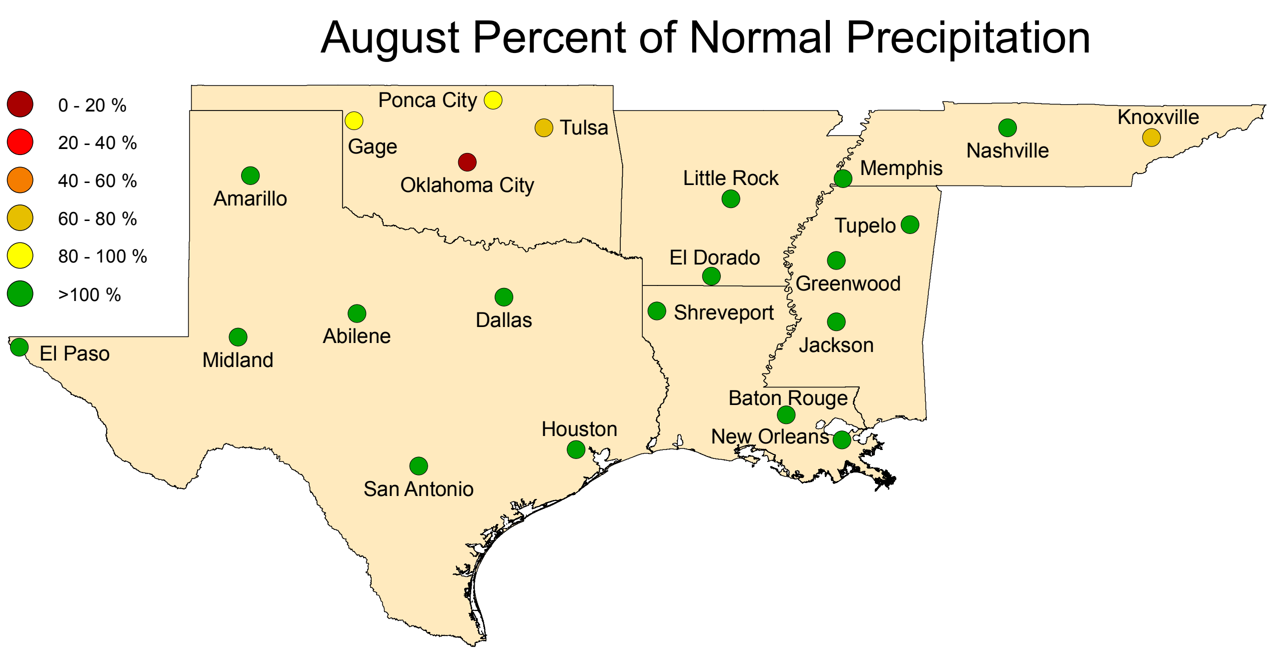


Percent of 1971-2000 normal precipitation totals for August 2016 across the South

Regional Climate Perspective in Pictures



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



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

Climate Perspective

State	Temperature	Rank (1895-2011)	Precipitation	Rank (1895-2011)
Arkansas	80.00	49th Warmest	7.49	3rd Westtest
Louisiana	82.50	33rd Warmest	12.90	1st Wettest
Mississippi	82.20	19th Warmest	5.77	15th Wettest
Oklahoma	80.90	58th Warmest	2.86	60th Wettest
Tennessee	78.90	11th Warmest	4.97	21st Wettest
Texas	81.60	47th Coldest	5.18	5th Wettest

State temperature and precipitation values and rankings for August 2016. Ranks are based on the National Climatic Data Center's Statewide, Regional, and National Dataset over the period 1895-2011.

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	90.8	73.1	82.0	0.7	100	08/05	70	08/27+	12.87	9.76	414
Little Rock, AR	91.5	76.0	83.7	1.2	101	08/05	68	08/22	7.56	4.97	292
Baton Rouge, LA	92.0	75.0	83.5	0.6	97	08/04+	71	08/12	30.04	24.22	516
New Orleans, LA	92.6	79.4	86.0	2.7	98	08/02	73	08/13	11.87	5.89	198
Shreveport, LA	93.0	75.6	84.3	1.2	101	08/12	72	08/23	7.81	5.08	286
Greenwood, MS	93.1	73.7	83.4	2.4	98	08/04	71	08/17	4.02	1.19	142
Jackson, MS	92.5	74.3	83.4	2.1	99	08/04	72	08/27+	9.42	5.18	222
Tupelo, MS	92.7	73.9	83.3	2.5	98	08/04	69	08/29	5.35	1.90	155
Gage, OK	93.3	67.0	80.2	0.9	104	08/11	55	08/21	2.23	-0.16	93
Oklahoma City, OK	93.1	70.7	81.9	-0.5	101	08/11	57	08/22	0.55	-2.73	17
Ponca City, OK	90.9	70.7	80.8	-0.2	100	08/11+	54	08/21	2.75	-0.50	85
Tulsa, OK	93.2	72.7	83.0	0.8	100	08/11+	59	08/21	2.31	-0.59	80
Knoxville, TN	91.3	71.4	81.3	3.5	97	08/27	61	08/23	2.33	-0.94	71
Memphis, TN	92.5	76.7	84.6	2.6	99	08/05	70	08/22	5.53	2.65	192
Nashville, TN	90.9	72.3	81.6	2.9	96	08/28+	62	08/23+	6.44	3.27	203
Abilene, TX	93.3	72.3	82.8	0.0	103	08/11	63	08/16	5.54	2.95	214
Amarillo, TX	88.2	63.9	76.0	-0.8	98	08/04	57	08/21+	4.10	1.19	141
El Paso, TX	92.0	69.3	80.7	-0.5	102	08/12+	63	08/21	4.46	2.45	222
Dallas, TX	94.7	76.9	85.8	0.2	107	08/12	70	08/19	4.42	2.51	231
Houston, TX	93.4	75.8	84.6	0.0	101	08/11+	72	08/14	10.41	6.65	277
Midland, TX	92.7	71.5	82.1	0.9	102	08/08+	61	08/15	3.20	1.36	174
San Antonio, TX	92.2	75.6	83.9	-1.4	102	08/12	71	08/15	4.91	2.82	235

Summary of temperature and precipitation information from around the region for August 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.

Can Water Run Uphill?

Barry Keim, Louisiana State Climatologist, Louisiana State University

Have you ever wondered if water can run uphill? I didn't think so. Why bother pondering this, when we have so many other mysteries of the universe. Everybody knows that water bows to the power of gravity, right? Or does it? Well, the reality is that water movement is largely governed by gravity, but it can move uphill under certain unique circumstances. Don't believe me? Well OK.....for you non-believers, I simply ask that you take the biggest, fattest, fluffiest towel in your bathroom cabinet. With the towel in hand, double-up its thickness, and then drape the towel over your bathtub with one end in your bathtub extending all the way to the bottom of the tub, while taking the other end of the towel and extending it out the tub on to your bathroom floor. Then, I ask you to fill your bathtub up to within a few inches of the top of the tub. If water could not move uphill, you would have nothing to worry about, right? You could setup this experiment and then go to sleep overnight, or head out to work. What do you think you'd find after several hours? Well, I can tell you that you'd find a colossal puddle on your bathroom floor. The culprit... well, "I have two words for ya" - capillary fringe! Capillary fringe draws water upward into small pore spaces due to surface tension and cohesion of the water molecules. The smaller/ tighter the space, the higher the water can be drawn uphill. That is exactly what would happen through the pores of your big fluffy towel.

In the subsurface, we have something called the water table, where all the void space in the soil is filled with water. Just above the water table, is a zone of capillary fringe, where most of the pore space is also saturated, depending on the tightness of the space (Figure 1). I can give you another example of capillary fringe that you've likely seen before. When water gets into your home, and wets your sheetrock - does this sound familiar? - water can wick up the wall (through capillary fringe) at a rate of ~1 inch per hour. It will do this at least until the water hits a seam in the sheetrock, which will likely slow down the process. So...now you know that water CAN move uphill and you're sure to impress your friends with this new found knowledge. BTW, one of first scientists to observe capillary fringe was Leonardo Da Vinci, and even Albert Einstein published his first paper on the topic. Who knew this subject was so scintillating?! Let's just hope that we don't get a real world - storm surge-induced - demonstration this hurricane season. Keep an eye to the sky! Oh...and I really don't want you to do the towel/bathtub experiment. It would be a disaster, and I don't want to take responsibility! E-mail me with questions or feedback at keim@lsu.edu.

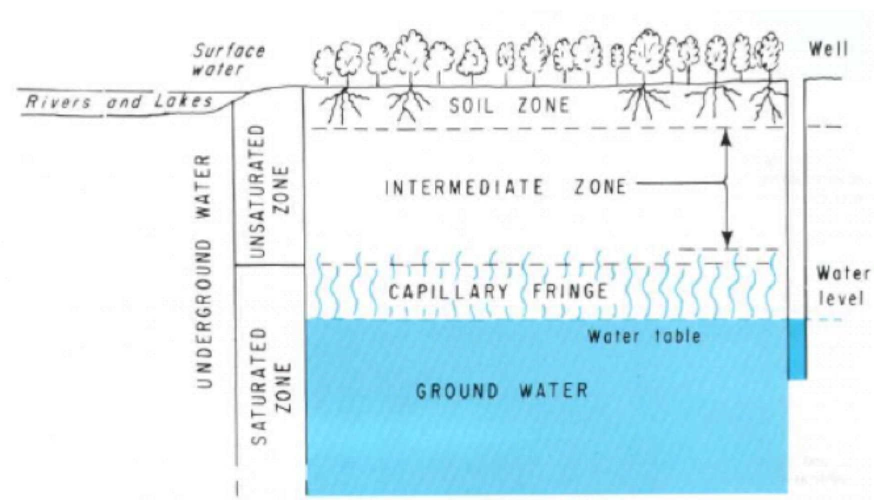


Figure 1. Capillary fringe taking place above the water table in the subsurface. Image is produced by the United States Geological Survey and is in the public domain. It can be found at https://commons.wikimedia.org/wiki/File:Ground-water_zone.png.

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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

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