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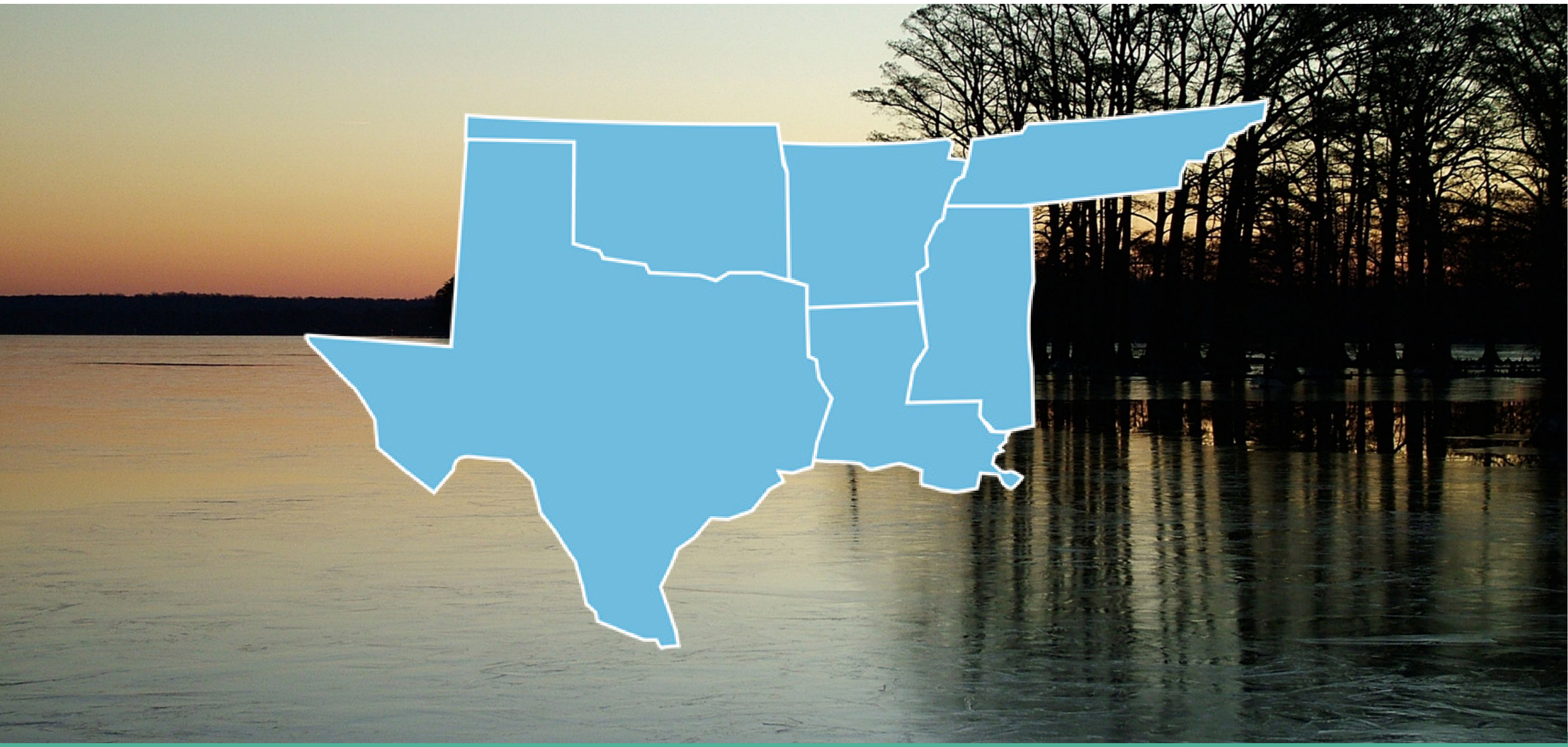

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Beyond Averages: Forecasting Seasonal Weather Patterns

Mark Shafer, SCIPP Director, University of Oklahoma

What if we could anticipate extreme weather events weeks in advance? We accept week-long forecasts as accurate, something nearly unthinkable a decade ago. As we learn more about large-scale global patterns, improve model integration of the atmosphere, ocean, land and ice, and continue advancing computing capabilities to resolve ever finer details, this vision may not be that far off.

In a recent study, the National Academies of Sciences looked at what it would take to make subseasonal and seasonal forecasts (defined as forecasts from 2 weeks to 12 months) as widely used as weather forecasts are today. The report, Next Generation Earth System Prediction: Strategies for Subseasonal to Seasonal Forecasting, presents a research agenda that emphasizes increasing the skill of forecasts, expanding the breadth of forecast models and variables, improving the prediction of extreme and disruptive events, and bringing researchers and decision makers together to develop more actionable forecasts.

Figure 1. In Spring 2015, rivers in Oklahoma and Texas went from nearly dry to overflowing in a matter of weeks. Rivers that had gone dry in the drought of 2011 (top; SOURCE: R. Riley) quickly filled and caused flooding during May 2015 (bottom; SOURCE: U.S. Army Corps of Engineers).

Over the past several decades, short-term forecasts - those that predict conditions in the atmosphere and ocean a few hours to a few days ahead - have become a vital part of decision making. Governments, businesses, and individuals routinely use such forecasts to plan the days ahead: should a school system cancel classes tomorrow due to snowy conditions? Do public safety officials need to be prepared for potential severe weather? How much power will electric utilities need to meet air condition demands this week?

However, many critical planning and management decisions are made weeks to months in advance. Improved subseasonal to seasonal forecasts ("S2S forecasts") could better inform those decisions, helping to save lives, protect property, increase economic vitality, and protect the environment. For example, emergency planners could pre-stage supplies in the areas most likely to experience extreme weather in the following months. Farmers could purchase drought or flood-resistant seed varieties as needed to increase yield for the next growing season. Naval and commercial shipping routes could be planned to take

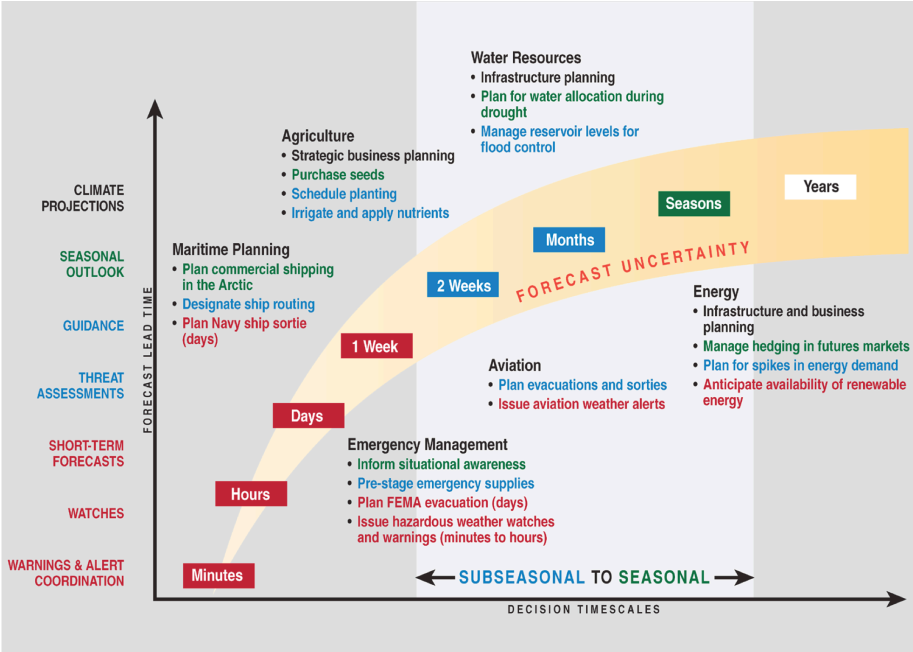


Figure 2. S2S forecasts fill a gap between short-term weather and ocean forecasts (shown in red) and longer-term Earth system projections (shown in black). They inform critical decisions (shown in blue and green) across many different sectors by providing information about likely conditions in between these more established prediction times. SOURCE: Modified from the Earth System Prediction Capability Office.

advantage of favorable conditions predicted in the weeks ahead.

All of this is not just conjecture. With a concerted and coordinated effort, it is possible to increase model skill, increase the spatial and time resolution of the models, and connect forecasts to decision-making. While forecasts of conditions from several weeks to months in the future will always have more uncertainty than weather forecast models, they can provide guidance that exceeds climatology or flipping a coin. Looking at these types of forecasts as a "ready-set-go" model extends the "ready" part of this far enough into the future to allow more actions that can reduce damage from extreme events, such as enough time to move supplies to areas where they may be needed.

Making forecasts more useful requires not just advances in skill of the models, but changes in the types of forecasts that are made. Most of us are familiar with the seasonal forecasts issued by NOAA's Climate Prediction Center. These forecasts are a statement of the probability of average temperature or total precipitation being less than, greater than, or near normal over a 3-month period. Yet our society responds to events, not averages. One hot week within an otherwise near-average summer can stress systems more than a consistently warm, but not extreme summer, even though both could have the same average temperature.

To achieve this vision, the committee identified four areas in need of development:

1. Engage users in the process of developing forecast products;
2. Increase forecast skill;
3. Improve prediction of extreme and disruptive events and the consequences of unanticipated forcing events;
4. Include more components of the Earth system in forecast models.

Improvement begins with engaging users. More forecast products are needed not just for seasonal conditions, but sub-seasonal periods. This includes forecasts such as the probability of extreme weather events during a forecast period. While the forecasts will not be able to say precisely where such events would occur, it at least provides a regional perspective on heightened probability of an event and allows communities within that general region an opportunity to begin planning.

To address this issue, the committee

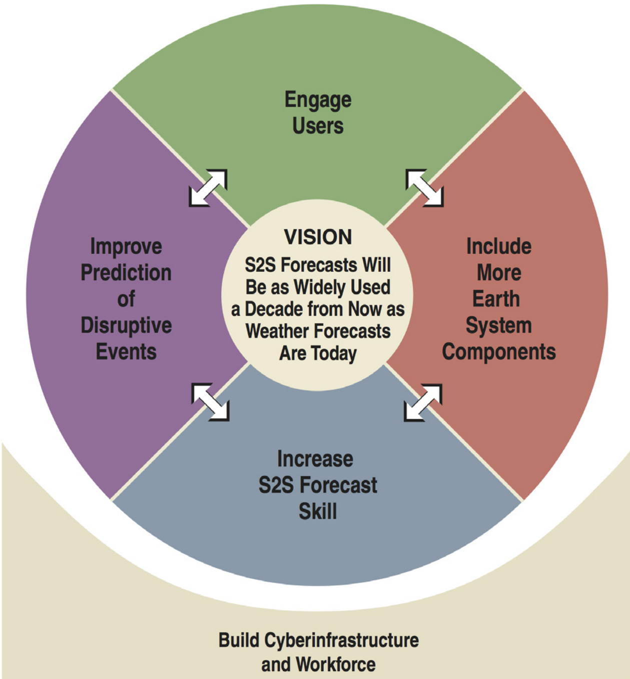


Figure 3. The four research strategies and supporting activities highlighted in the National Academies' report for advancing subseasonal to seasonal forecasting over the next decade. The white arrows indicate that the research strategies interact and are not mutually exclusive. Capability Office.

recommends that connections between those who produce the forecasts and those who use them need to be improved. This includes research on decision processes to identify opportunities to improve the use of existing and new forecast information as well as to identify barriers to use. This should be an iterative, ongoing dialogue that will help ensure that S2S models, forecast products, and decision making tools are created to match what is technically feasible with what is most useful to a diverse set of stakeholders.

The second issue, increasing forecast skill, requires basic research to expand understanding of sources of predictability and their interactions as well as research to determine the limits of predictability for specific Earth system phenomena. This includes improvements in observations, data assimilation methods (integrating observations into forecast models), reducing errors in Earth system models, and improving methods for quantifying and addressing forecast uncertainties and verifying forecast accuracy.

The third issue, improving prediction of extreme and disruptive events, addresses the scale at which forecasts are made. Extreme events such as major winter storms, excessive rainfall events, and intense heat waves can often disrupt society's normal functioning. Improved predictions of such events on S2S timescales would give communities more time to plan ahead and mitigate damage. For example, ready-set-go decision models begin anticipation of potential events well in advance (ready), so that as events become more certain or potential impacts can be better defined, actions can be prepared (set) and taken (go) as time scales shorten. S2S forecast models may be capable, with adequate research and improvements of the models, to identify potential windows of time when certain interactions between Earth system processes boost the likelihood that such events will take place.

Lastly, forecasts need to be extended beyond average temperature and precipitation. Major Earth system components such as the ocean, atmosphere, ice, and land are now routinely included in coupled Earth system models used for S2S forecasting. Improving their coupling will allow critical advances in the skill of S2S forecasting and enable predictions of additional components, such as waves, aerosols, rivers, and vegetation. These types of components allow a more complete examination of potential impacts beyond the currently available marginal shifts in mean temperature and precipitation.

Implementing the recommendations of the report will enable advances in seasonal and subseasonal forecasting that would rival many of the advances made in weather forecasting. It would provide decision makers with better information about the probability of extreme or disruptive weather events weeks to months in advance. More variables and more physical processes that could be forecast, like ocean currents and sea ice, would enable new applications. S2S forecasts likely will never achieve the skill of weather forecasts out to several days in advance, but they will enable longer-term planning with increasing confidence that will allow actions to be taken that will lessen the impacts of extreme weather events.

How can you envision such forecasts being used? What types of variables or events would you like to see in such forecasts? How far in advance would such forecasts be needed in order to begin planning for potentially disruptive events? We would love to hear your thoughts. As was noted in the report, you are an important part of this process - it is not enough to improve the forecasts and models without clear guidance on what we need to be forecasting. Let us know at scipp@southernclimate.org.

The report is available on the National Academies publication site, http://www.nap.edu/catalog/21873/next-generation-earth-system-prediction-strategies-for-subseasonal-to-seasonal.

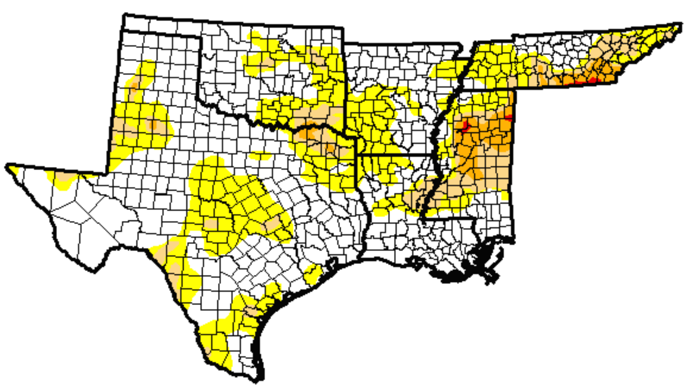
Drought Update

Luigi Romolo,
Southern Regional Climate Center

Drought conditions across the Southern Region have worsened over the past month. In central Mississippi, many counties have been downgraded from moderate drought to severe drought as conditions there have been consistently drier than normal. There is also a new small pocket of moderate and severe drought in south eastern Oklahoma and north eastern Texas. Conditions in central Texas were quite dry this past month and many counties are now identified as abnormally dry. This is also the case in west-central and south western Arkansas.

There were only a small handful of tornadoes in the Southern Region in July. Many of them were just brief touchdowns. No tornado-related injuries or fatalities were reported.

The National Weather Service had to give heat advisories often this month. Heavy power usage caused an electrical spike, leaving 12,000 people with no power for a couple days in Ector County. Four people died in El Paso due to the heat. Three of the deaths were from heat stroke and the fourth was from heat exposure. One hiker died from a heat stroke in a Texas park. Lastly, four children died in hot cars, each from different states and one was a 2-year-old boy from Texas (Information provided by the Texas Office of State Climatology).



Released Thursday, August 4, 2016

Richard Tinker, CPC/NOAA/NWS/NCEP

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	59.12	40.88	11.80	3.61	0.25	0.00
Last Week *7/26/2016*	55.49	44.51	11.56	2.87	0.36	0.00
3 Months Ago *5/3/2016*	86.25	13.75	2.74	0.00	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 *8/4/2015*	76.66	23.34	5.43	0.09	0.00	0.00

Intensity:

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

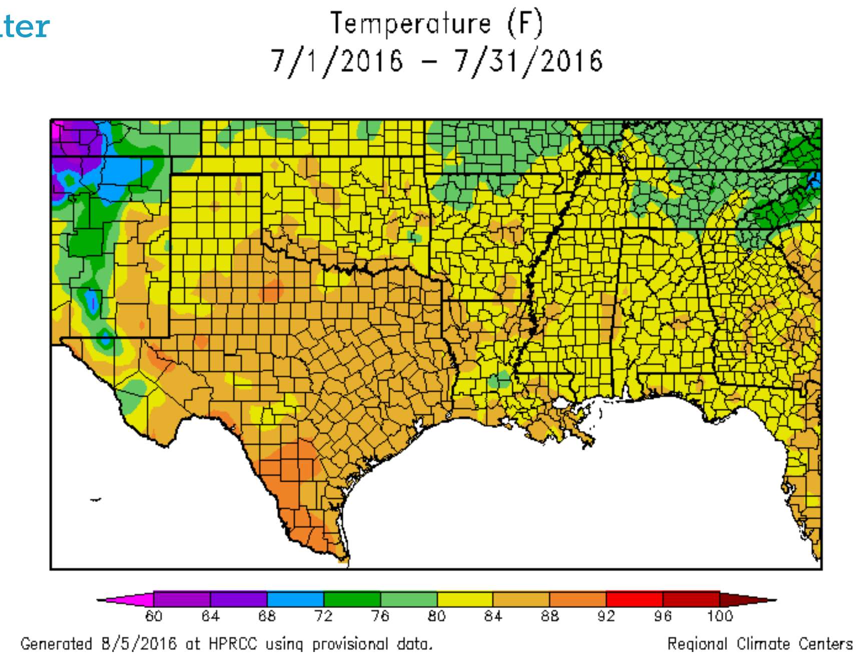
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Above: Drought conditions in the Southern Region. Map is valid for August 2, 2016. Image is courtesy of National Drought Mitigation Center.

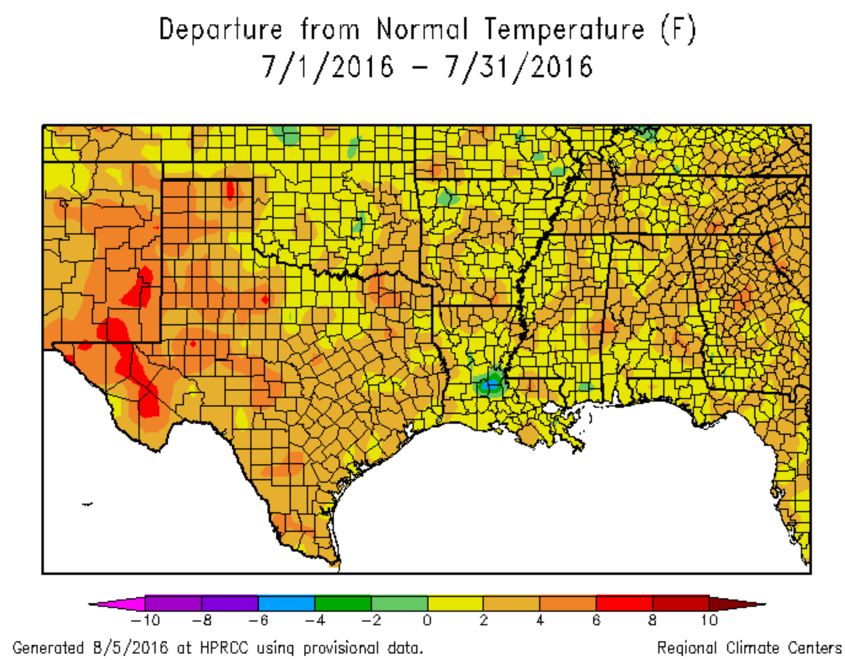
Temperature Summary

Luigi Romolo,
Southern Regional Climate Center

July temperatures were generally above average in the Southern Region, with all six states averaging warmer than the monthly expected values. Temperature anomalies ranged from 0 to 4 degrees F (0-2.22 degrees C) above normal for most stations, except in western Texas, where a bulk of the stations there averaged between 4-6 degrees F (2.22-3.33 degrees C) above normal. The statewide monthly average temperatures were as follows: Arkansas reporting 82.10 degrees F (27.83 degrees C), Louisiana reporting 83.60 degrees F (28.67 degrees C), Mississippi reporting 82.60 degrees F (28.11 degrees C), Oklahoma reporting 83.40 degrees F (28.56 degrees C), Tennessee reporting 79.80 degrees F (26.56 degrees C), and Texas reporting 85.50 degrees F (29.72 degrees C). The state-wide temperature rankings for May are as follows: Arkansas (twentieth warmest), Louisiana (ninth warmest), Mississippi (fourteenth warmest), Oklahoma (twenty-ninth warmest), Tennessee (tenth warmest), and Texas (fourth warmest). All state rankings are based on the period spanning 1895-2016.



Average July 2016 Temperature across the South

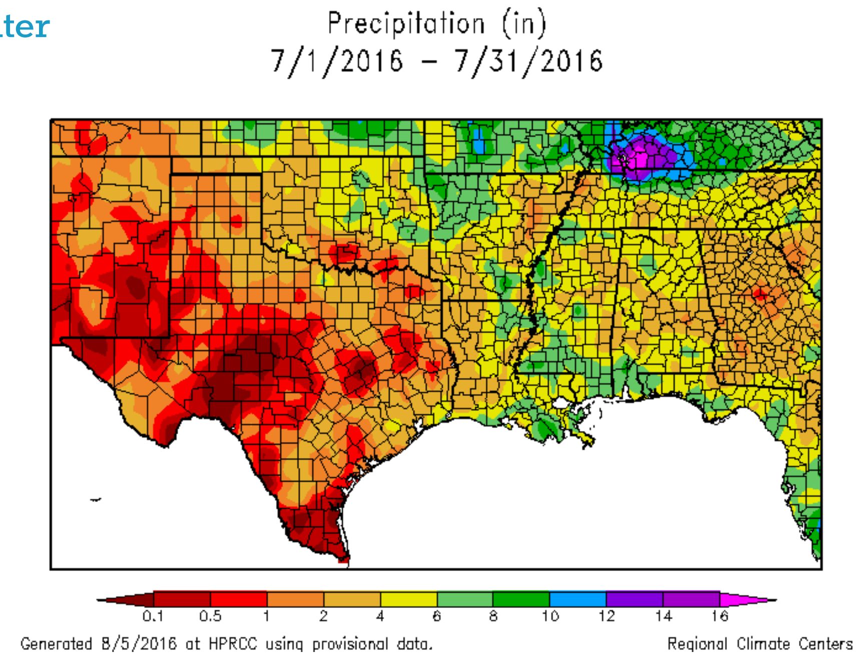


Average Temperature Departures from 1971-2000 for July 2016 across the South

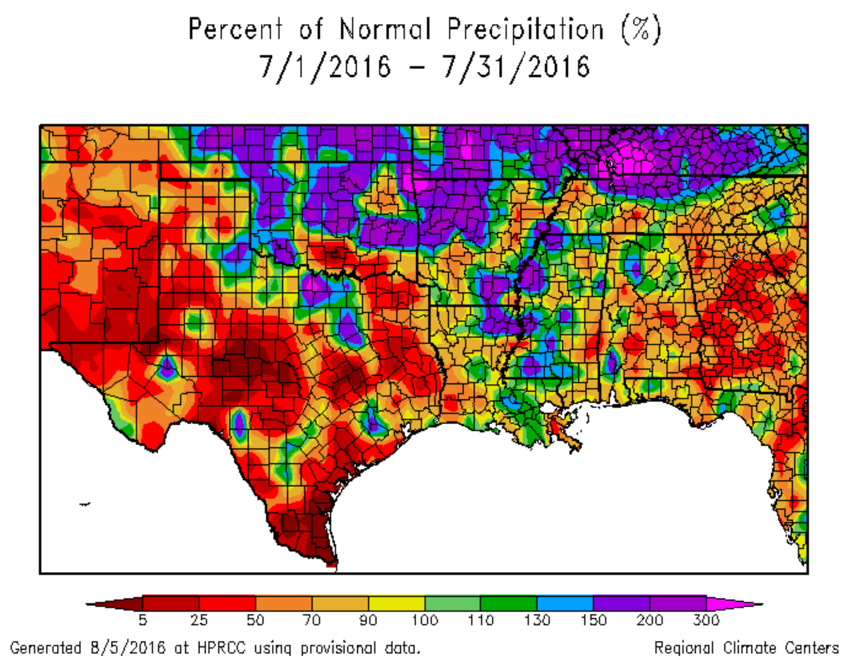
Precipitation Summary

Luigi Romolo,
Southern Regional Climate Center

Precipitation totals for the month of July varied spatially over the Southern Region, with much of the northern half of the region experiencing a wetter than normal month, and by contrast, drier than normal conditions in the southern half of the region. The wettest portions included much of northern Arkansas and eastern Oklahoma, where many stations reported over 150 percent of normal precipitation for the month. Similar values were also observed in north central Tennessee and in the Louisiana-Arkansas-Mississippi border region. Conditions were quite dry in eastern and southern Texas, with stations reporting little to no precipitation for the month. Many stations reported less than 10 percent of normal for the month. The state-wide precipitation totals for the month are as follows: Arkansas reporting 4.85 inches (123.19 mm), Louisiana reporting 5.02 inches (127.51 mm), Mississippi reporting 5.46 inches (138.68 mm), Oklahoma reporting 3.60 inches (91.44 mm), Tennessee reporting 4.87 inches (123.70 mm), and Texas reporting 1.31 inches (33.27 mm). The state precipitation rankings for the month are as follows: Arkansas (twenty-ninth wettest), Louisiana (forty-fifth driest), Mississippi (forty-second wettest), Oklahoma (thirty-seventh wettest), Tennessee (forty-fourth wettest), and Texas (twenty-second driest). All state rankings are based on the period spanning 1895-2016.

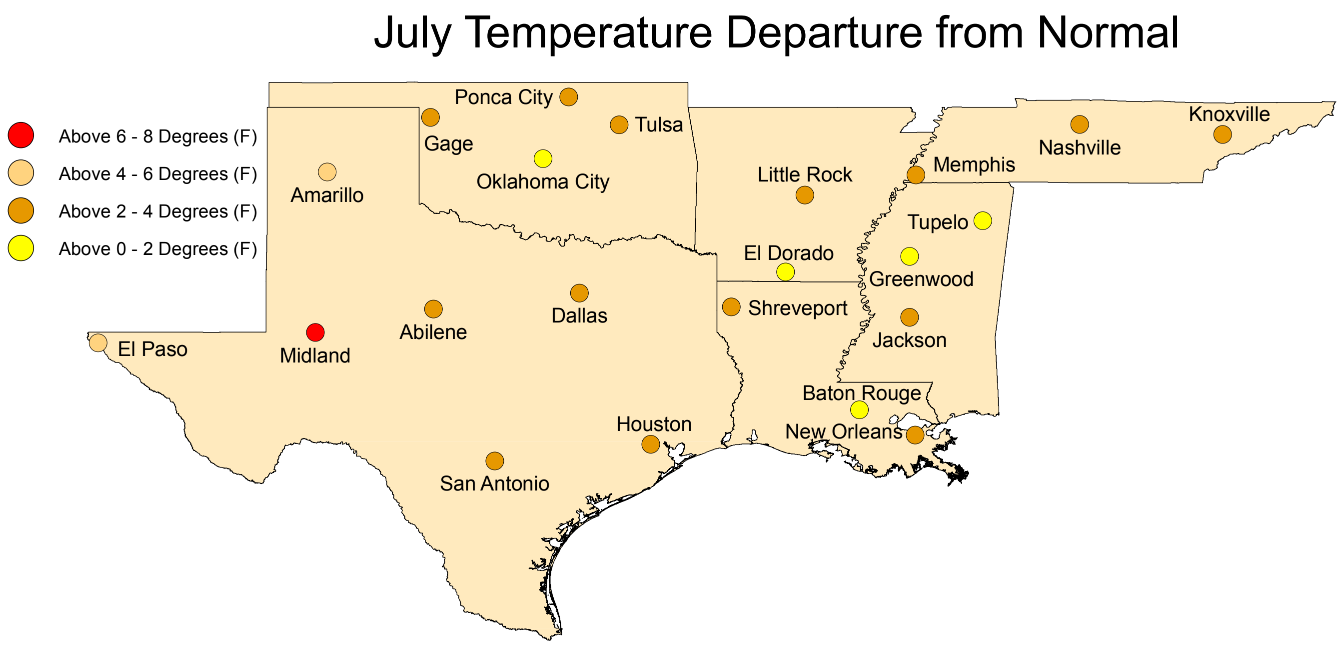


July 2016 Total Precipitation across the South

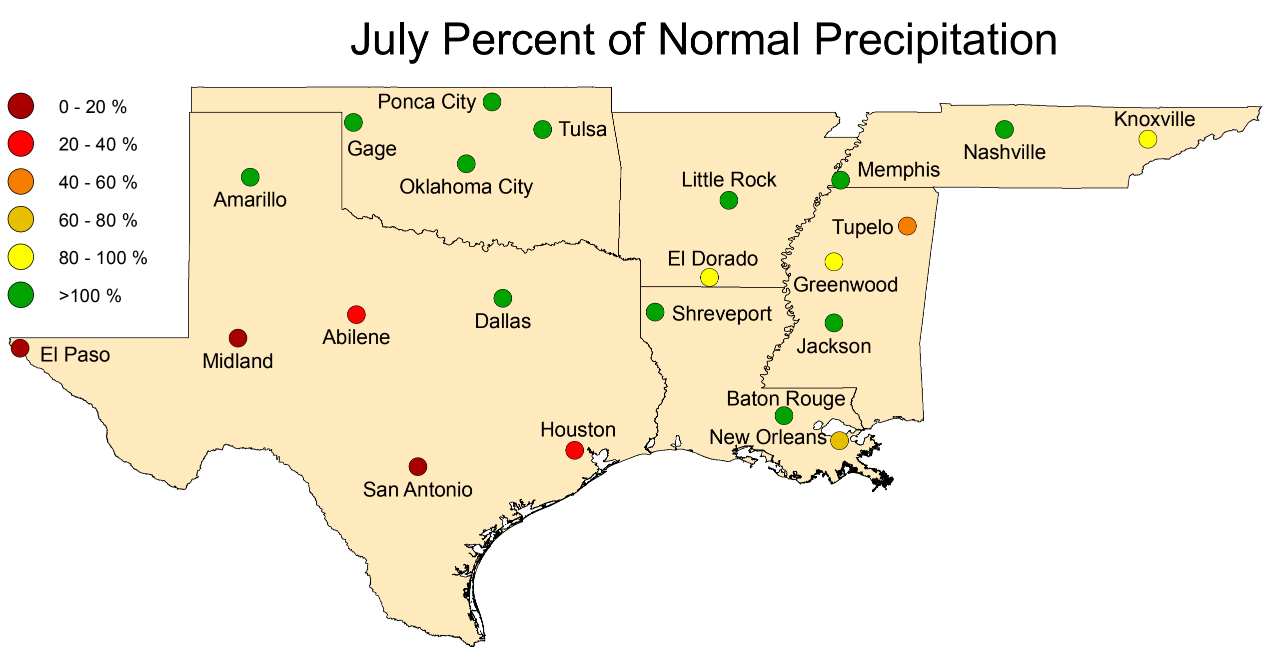


Percent of 1971-2000 normal precipitation totals for July 2016 across the South

Regional Climate Perspective in Pictures



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



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

Climate Perspective

State	Temperature	Rank (1895-2011)	Precipitation	Rank (1895-2011)
Arkansas	82.10	20th Warmest	4.85	29th Wettest
Louisiana	83.60	9th Warmest	5.02	45th Driest
Mississippi	82.60	14th Warmest	5.46	42nd Wettest
Oklahoma	83.40	29th Warmest	3.60	37th Wettest
Tennessee	79.80	10th Warmest	4.87	44th Wettest
Texas	85.50	4th Warmest	1.31	22nd Driest

State temperature and precipitation values and rankings for July 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	94.3	72.6	83.4	1.7	100	07/22	66	07/15	3.30	-0.26	93
Little Rock, AR	95.3	76.3	85.8	3.0	105	07/22	70	07/11+	7.37	4.10	225
Baton Rouge, LA	93.6	75.1	84.4	1.4	97	07/30+	72	07/29+	6.64	1.68	134
New Orleans, LA	94.0	79.4	86.7	3.4	99	07/21	75	07/16+	4.45	-1.48	75
Shreveport, LA	95.8	75.5	85.7	2.7	101	07/23	69	07/01	3.89	0.24	107
Greenwood, MS	93.0	73.1	83.0	1.8	98	07/22+	66	07/01	3.32	-0.28	92
Jackson, MS	94.3	73.5	83.9	2.3	99	07/21	67	07/01	8.30	3.49	173
Tupelo, MS	93.2	73.5	83.3	1.9	98	07/22+	67	07/01	2.34	-1.56	60
Gage, OK	95.7	70.4	83.0	2.8	107	07/07	62	07/15	3.66	1.76	193
Oklahoma City, OK	94.1	72.4	83.2	0.2	100	07/24+	67	07/29	3.65	0.72	125
Ponca City, OK	93.5	74.1	83.8	2.1	102	07/24+	66	07/14	6.55	3.22	197
Tulsa, OK	94.7	75.7	85.2	2.3	101	07/24+	67	07/14	3.76	0.40	112
Knoxville, TN	91.9	71.5	81.7	3.3	97	07/26+	65	07/01	4.80	-0.28	94
Memphis, TN	93.7	76.3	85.0	2.3	100	07/22	72	07/30+	8.02	3.43	175
Nashville, TN	92.5	72.4	82.5	3.1	97	07/26+	65	07/01	6.28	2.64	173
Abilene, TX	98.1	75.1	86.6	3.5	102	07/13+	68	07/16	0.64	-1.23	34
Amarillo, TX	97.6	67.9	82.8	4.5	108	07/11	60	07/28	3.51	0.67	124
El Paso, TX	101.4	76.0	88.7	5.9	108	07/14	70	07/02	0.24	-1.31	15
Dallas, TX	96.9	77.8	87.4	2.1	100	07/25+	71	07/15	3.89	1.72	179
Houston, TX	96.4	77.8	87.1	2.7	100	07/24+	73	07/27	1.09	-2.70	29
Midland, TX	101.4	75.0	88.2	6.1	108	07/12+	71	07/29+	0.24	-1.58	13
San Antonio, TX	97.2	76.7	86.9	2.3	100	07/15+	73	07/29+	0.33	-2.41	12

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

Lightning Facts and Misconceptions

Barry Keim, Louisiana State Climatologist, Louisiana State University

In Louisiana, we're second nationally in lightning strikes, averaging 16 strikes per square mile per year. That comes to 827,000 lightning strike per year in Louisiana. There is a lot we don't know about lightning, but there are also some serious misconceptions. I'd like to address a few facts and some the misconceptions in this article.

1. Let's start with the phrase that "lightning never strikes the same place twice." The Empire State Building in New York City provides a nice example of why that statement is horse hockey, as it's gets struck about 25 times every year, on average. If something gets struck once, why not again?

2. Are you safe from lighntning in your automobile? The anwer is generally yes, assuming you have the windows up and you're not talking on your "wired up" recharging cell phone. However, it has NOTHING to do with the rubber tires. In fact, if your car were to be struck, the lightning would likely remain on the outer shell of your car – known as the "skin effect" – and will go through your tires into the ground. You're also likely to have blow outs on your tires in the process, but you'll probably survive the experience, though you'll be quite shaken!

3. Will the rubber soles on your shoes protect you from lightning? Well...NO.....read above about the car tires. In fact, if you're struck by lightning with your sneakers on, they will likely be blown off of your feet.

4. Let's talk about "heat lightning." Is it any different from any other form of lightning? The answer is.....NOPE! All "heat lightning" is, is a storm at night that is just far enough in distance where you can see the lightning, but that you are too far away to hear the thunder.

Figure 1. Lightning in Placitas, NM. Photo taken by John Fowler on July 25, 2009. Image avialble at https://commons.wikimedia.org/wiki/File:Lightning_(3762193048).jpg.

5. Are you more likely to survive a lightning strike if you are struck in a rural or urban location? The answer is......URBAN, primarily because you are more likely to get immediate attention in a city and get to hospital more quickly. If you're Farmer John and you get struck on your tractor in the middle of a corn field, wife Martha might not notice you missing for hours!

6. Are men or women struck by lightning more often? It's men by a long shot, to the tune of about 80-85 percent. This is because men spend more time outdoors doing things like fishing, golfing, and playing other sports, or they have jobs that bring them outdoors, like construction work. Men are also more likely to ignore the threat that lightning kills and remain outdoors during a storm.

If you have any questions, feel free to contact me at keim@lsu.edu.

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Contact Us

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