SCIPP
A NOAA RISA TEAM

Southern Climate Monitor

September 2015 | Volume 5, Issue 9

In This Issue:

The Southern Climate Monitor is available at
www.srcc.lsu.edu & www.southernclimate.org

A Shocking Intervention: How the September 5th-6th Events Impacted Louisiana

Nicholas Sokol, Graduate Student, Louisiana State University

Lightning is often regarded as a fascinating, but terrifying, phenomena that humans all over the globe have experienced at one point or another in their lifetime. Lightning is often interpreted differently depending on the geographic location of its inhabitants. Depending upon the socio-cultural background of the beholder, lightning can either be a magnificent display of the atmosphere's power and beauty, or a dreadful phenomena that only harms and intervenes with people's lifestyles. Both views are acceptable and true, as an onlooker can find beauty in the tortuosity exemplified during a lightning event, as well as the terror exuded when a flash propagates near one's self or personal property. This was the case during the September 5th and 6th thunderstorms in Louisiana when the lightning frequency of those storms induced chaos socially, economically, and politically. The lightning events on those days will clearly have some small scale repercussions in the future. This article will discuss some of the ramifications of the thunderstorms of the 5th and 6th, as well as address the current state of lightning research and how it can be expanded upon to better serve decision-making and mitigation planning in the future.

Lightning in the southern region of the United States is not a rare phenomenon. In fact, climatologically the region has one of the highest densities of lightning than any other area in the country (Cecil 2015). If we look at the inter-regional statistics, Florida experiences the most lightning in the South, with Southern Louisiana and much of the Gulf region following closely behind (Bouquegneau & Rakov 2010). This information can be observed from NOAA's Lightning Imaging Sensor - which is equipped to the Tropical Rainfall Measuring Mission satellite - and Optical Transient Desponder satellites, which have allowed atmospheric scientists to generate climatologies for up to 50 degrees north and south for much of the globe (Figures 1 & 2).

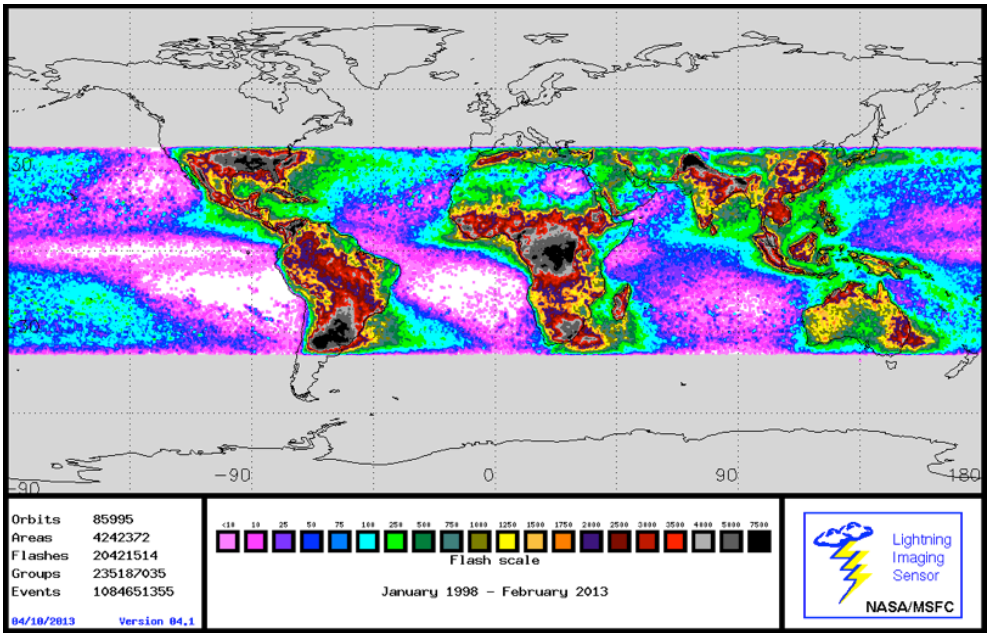


Figure 1. Lightning Climatology of the Earth from 1998 to 2013. Image extracted from NOAA.

Even with current technology, getting an accurate count of the electrical phenomena that took place during the weekend of September 5-6, 2015 is a difficult task. Current technology relies upon satellite observations, electromagnetic sensors, and lightning bells (which were invented by Benjamin Franklin in the 18th century, and have been improved to detect electric field differences between the atmosphere and ground since that time).

Many people know what lightning is, but most do not know how it is generated within a cloud. Lightning occurs in large cumulonimbus clouds where updraft winds have been recorded to be as high as 31 m/s (Cooray 2015). Such excessive speed is necessary to allow supercooled water particles within the cloud to collide with other particles, coalesce, and then form graupel (Figure 3). As graupel grows in size, it will continue to collide with other supercooled water particles, which will shed a negative ion onto the graupel. What this ends up causing is either a dipole or tripole charged cloud, with positively charged supercooled water at the top of the cloud, and negatively charged graupel near the middle or base of the cloud. It is important to note that tripole clouds can have a positive pocket near the base of the cloud - it has been postulated that all thunderstorm clouds are tripoles and the first flash of the storm eliminates the bottom positive pocket of energy (Bouquegneau & Rakov 2010). This is a very basic explanation on how lightning is formed!

So with all the knowledge floating around about lightning, and with storm chasers constantly uploading photos to our favorite social media sites, what is there to fear from a few millisecond light show? Well for one, lightning protection in the outdoors is very limited. The best place to be during a lightning storm is inside a building or vehicle. In the case of September 5th, when the Louisiana State University had planned its first football game of the season, neither the players nor the patrons of the game were safe in the open air space of the stadium. It is important to note, that the air space may have been open, but the seats were packed. This is not safe in a case of lightning, because if one person is struck, the energy could be conducted to another body near the person who was originally struck. Because of this danger, a lightning safety warning was projected through speakers in the stadium. Many fans did not want to leave their seat either due to excitement for the game or the risk of

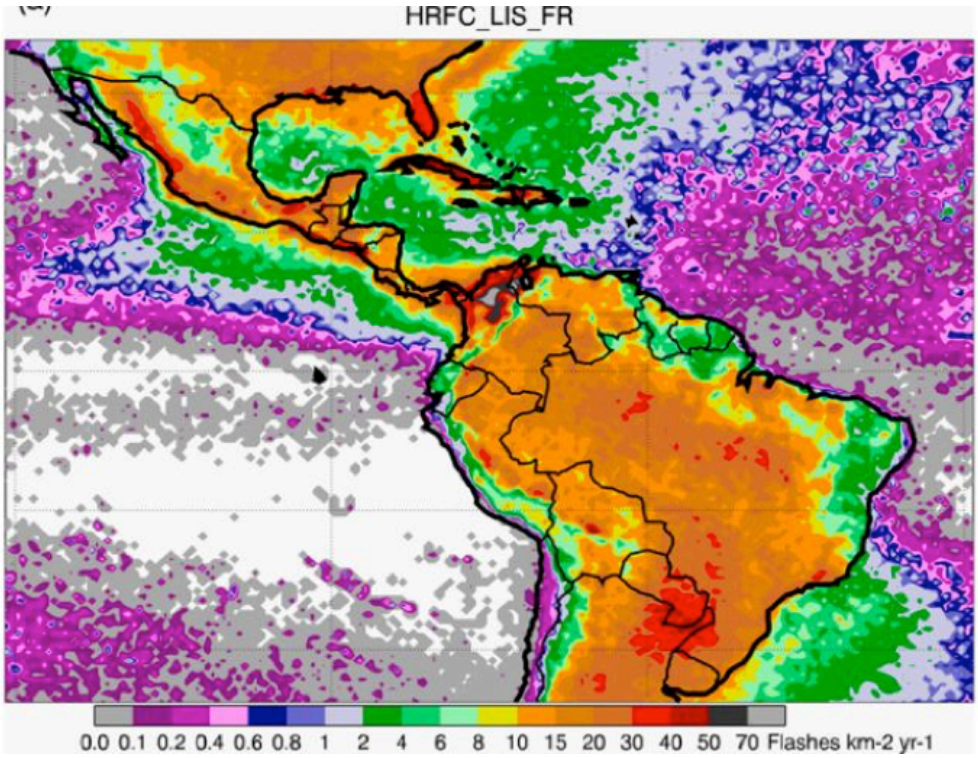


Figure 2. Average amount of flashes per year for the tropics and subtropics. Image taken and edited from Cecil et al.

Figure 3. The difference between Graupel and Hail.

having their spot taken by other keen patrons who were standing. By the time the second lightning alert was announced, many attendees decided to abandon the game en masse. This created bedlam for those merely trying to exit the stadium (I personally can contribute to this, as it took stadium personnel an hour to release students from the swelteringly hot and uncomfortable ramps within Tiger Stadium).

The aftermath of the game's cancellation was enormous. The University issued a statement saying that it has not had to cancel a game since 1918, when the entire season was canceled due to World War I. Aside from the fact that no one got to enjoy the game, beyond Tiger Stadium, people were bogged down in the hellacious traffic that ensued after the cancellation had been officially declared. Typically, traffic around Baton Rouge is not particularly enjoyable during an LSU football game, but in this particular instance, some traffic reports claiming two to three hour delays according to data from the Louisiana Department of Transportation and Development. In addition, individuals who traveled to view the game were agitated, as they had paid for a flight to view the game in Baton Rouge and had wasted their time and money, all because of lightning.

Economically, the lightning event on the 5th did more damage than most would believe. A plethora of auto accidents brought about a loss of money for many individuals. For more quantifiable numbers, we can look at the fact that LSU has decided to refund the price of tickets to all patrons who purchased them from LSU. Based off of the typical price for tickets, it can be assumed that LSU lost around $5,000,000 in ticket sales (not to mention to the amount lost to concessions) that would have been put towards maintenance of the campus or sports facilities. This is especially hard for LSU, because the state government has reduced funding to the university and sporting profits actually contribute to the academic side of the university.

It has been reported that the lightning on the 5th of September lasted for about three hours. An accompanying plot shows the frequency and polarity of strikes for the day (Figure 4). From the graph, we can see that between 1830 and 1900 (UTC time) lightning activity in Baton Rouge increased appreciably and persisted at a high rate for some time after the start of the storm. On a spatio-temporal scale, this duration is significant, because it places people who are attempting to travel from one location to another at risk, and the lightning phenomena coupled with torrential downpours inundated most people with a sense of panic. People often neglect the acoustic effects of lightning - thunder - can have on people. If within a close enough proximity to a lightning strike, thunder can induce shock and involuntary actions from individuals. This can exacerbate driving conditions and produce even greater chances of risk and danger to pedestrians, especially inebriated ones.

In the future, it would behoove individuals who will attend public events to understand the dangers of lightning. It is beautiful and magnificent, but its glorious incandescence is diminutive in comparison to the danger it imposes upon individuals out in the open. Research and the dissemination of that knowledge can help prevent small-scale disasters due to lightning storms, and prevent individuals from being harmed by it. As

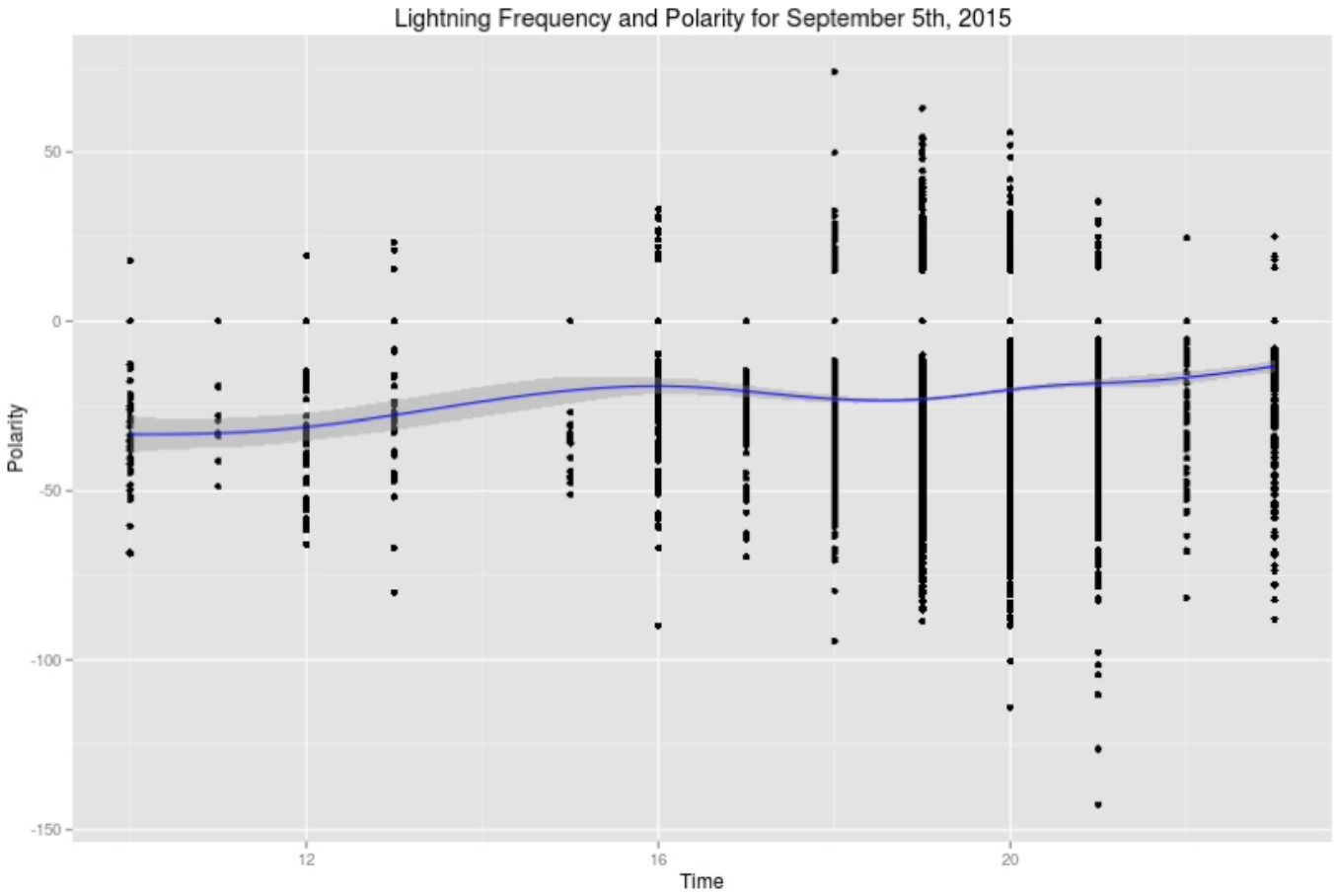


Figure 4. A plot of lightning frequency and polarity over time for September 5th, 2015. The curve highlights the increase or decrease in polarity of strikes over time. Data used in the graph were retrieved from the USPLN.

mentioned earlier, for all that humanity knows about lightning, there are a multitude of implications and physical traits of lightning that we do not yet completely understand. Only time will reveal the shocking mysteries of lightning and atmospheric electricity, and promulgate greater understanding amongst the population.

References

Bouquegneau, Christian, Vladimir A. Rakov, and William Beasley. "How Dangerous Is Lightning?" Mineola, N.Y: Dover Publications, 2010. Print.

Cecil, Daniel. "TRMM LIS Climatology of Thunderstorm Occurrence and Conditional Lightning Flash Rates." Journal of Climate 28.16 (2015): 11. Web of Science. Web. Sept. 2015.

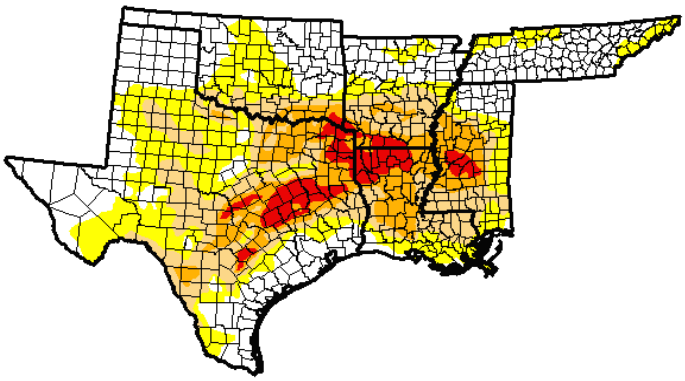
Cooray, Vernon. "An Introduction to Lightning." 2015. Print.

Drought Update

Luigi Romolo,
Southern Regional Climate Center

Drier than normal conditions, combined with above average temperatures spelled a recipe for drought expansion across the central portions of the Southern Region. Over the month of September, the areal coverage of drought in the region increased by approximately thirteen percent. More dramatically, the amount of extreme drought increased by over five percent. As of September 29, 2015, extreme drought is located in the Arkansas-Louisiana-Texas border region, where conditions have been unusually dry. Similar drought patterns can be observed in east central Texas and in central Mississippi.

Because September was an extremely dry month for most of the Southern Region, there was little to no severe weather reports. On September 8, 2015, a cluster of wind reports were made in central Oklahoma. Reports generally noted downed tree limbs, but wind velocities were cited.



Released Thursday, October 1, 2015
Eric Luebehusen, U.S. Department of Agriculture

Above: Drought conditions in the Southern Region. Map is valid for September 29, 2015. Image is courtesy of National Drought Mitigation Center.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	36.88	63.12	37.43	18.31	5.72	0.00
Last Week *9/22/2015*	41.15	58.85	31.60	14.71	4.61	0.00
3 Months Ago *6/30/2015*	92.89	7.11	0.92	0.00	0.00	0.00
Start of Calendar Year *12/30/2014*	41.57	58.43	33.88	18.43	8.80	2.36
Start of Water Year *9/30/2014*	41.74	58.26	35.49	22.66	8.47	1.98
One Year Ago *9/30/2014*	41.74	58.26	35.49	22.66	8.47	1.98

Intensity:

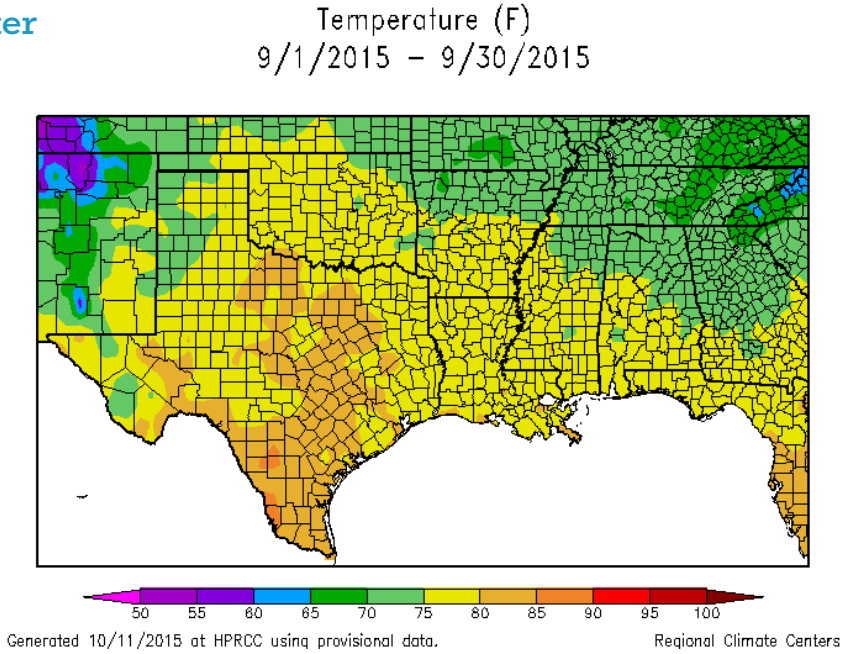
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

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

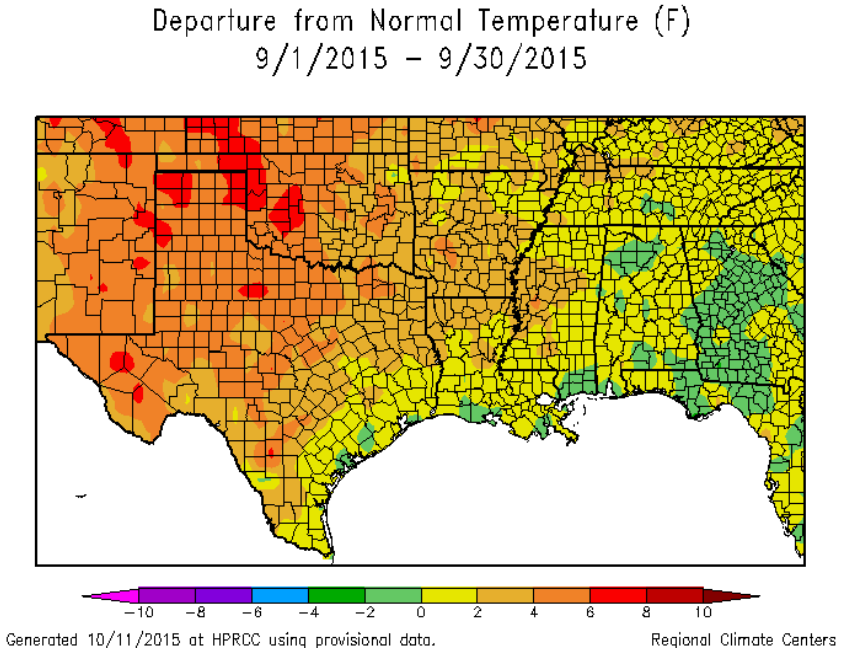
Temperature Summary

Luigi Romolo,
Southern Regional Climate Center

September temperatures in the Southern Region were much warmer than normal, particularly in western Texas and western Oklahoma, where anomalies ranged from 4 - 8 degrees F (2.22 – 4.44 degrees C) above normal. Along the Gulf Coast and in the eastern portions of the region, temperatures were above normal, but much closer to normal, with stations ranging between 0-2 degrees F (0 – 1.11 degrees C) above expected values. The state-wide average temperatures for the month are as follows: Arkansas averaged 74.70 degrees F (23.72 degrees C), Louisiana averaged 78.40 degrees F (25.78 degrees C), Mississippi averaged 76.26 degrees F (24.56 degrees C), Oklahoma averaged 76.60 degrees F (24.78 degrees C), Tennessee averaged 71.00 degrees F (21.67 degrees C), and Texas averaged 79.30 degrees F (26.28 degrees C). Texas experienced its eighth warmest September on record, while for Oklahoma it was the twelfth warmest September. Arkansas and Louisiana recorded their thirty-third and thirty-fifth warmest September on record, respectively. All other state rankings fell within the two middle quartiles. All records are based on the period spanning 1895-2015.



Average September 2015 Temperature across the South

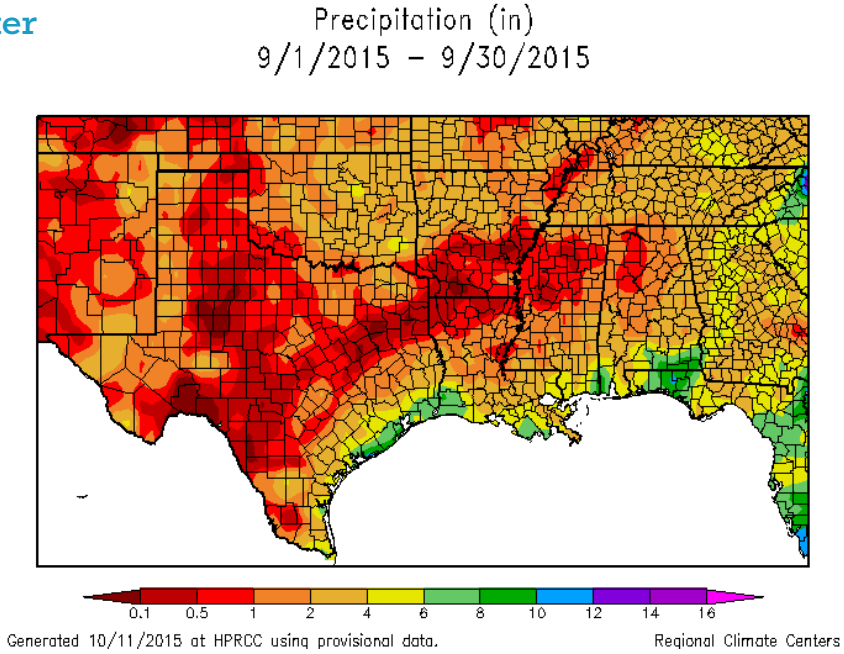


Average Temperature Departures from 1971-2000 for September 2015 across the South

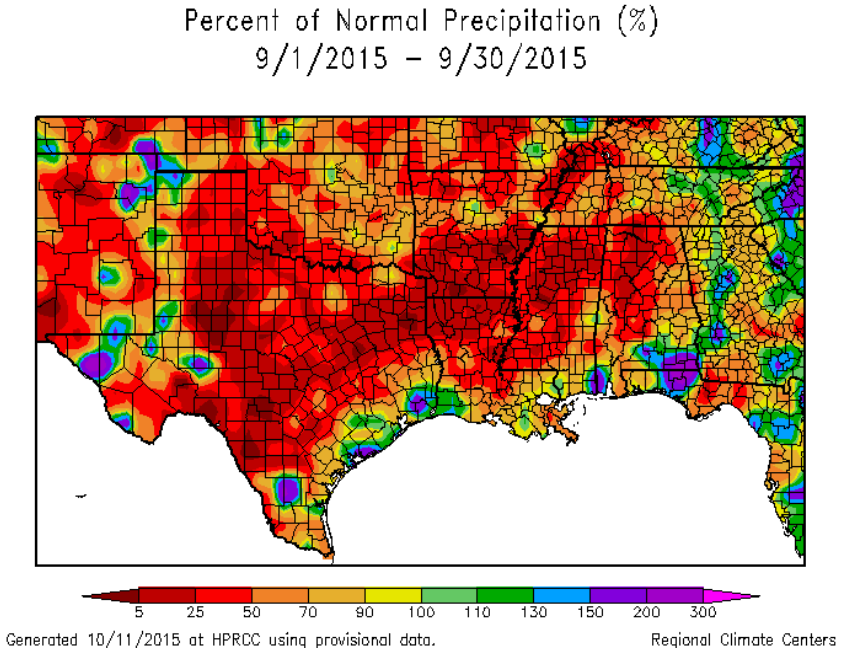
Precipitation Summary

Luigi Romolo,
Southern Regional Climate Center

September was a drier than normal month for all states in the Southern Region, and an extremely drier than normal month for the majority of counties in central Texas, northern Louisiana, northern Mississippi, southern Arkansas and southern Oklahoma. Precipitation totals in the central portions of the region ranged from zero to twenty-five percent of normal. The state-wide average precipitation totals for the month are as follows with: Arkansas reporting 1.44 inches (36.58 mm), Louisiana reporting 2.65 inches (67.31 mm), Mississippi reporting 1.72 inches (43.69 mm), Oklahoma reporting 1.78 inches (45.21 mm), Tennessee reporting 2.57 inches (65.28 mm), and Texas reporting 1.41 inches (35.81 mm). Arkansas experienced their eleventh driest September on record, while Texas and Mississippi reported their fifteenth and eighteenth driest, respectively. The state of Oklahoma experienced their twenty-second driest September, while for Louisiana, it was the twenty-sixth driest on record. Though it was drier than normal in much of Tennessee, their monthly state-wide temperature ranks out at thirty-fifth driest. All records are based on the period spanning 1895-2015.

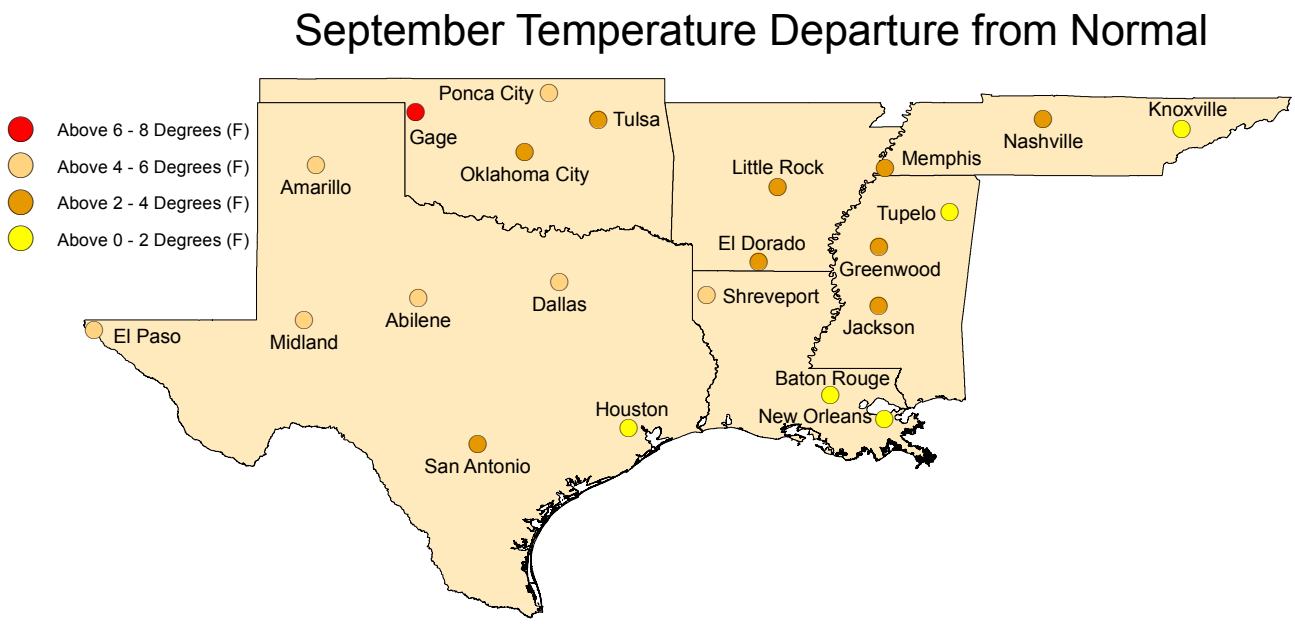


September 2015 Total Precipitation across the South

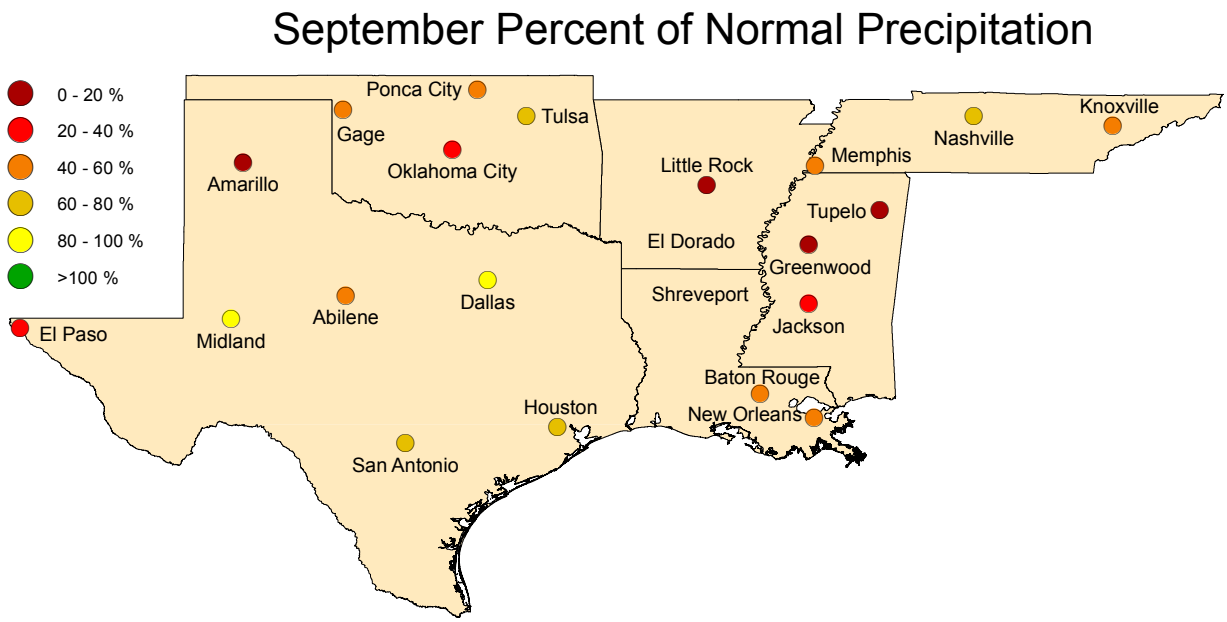


Percent of 1971-2000 normal precipitation totals for September 2015 across the South

Regional Climate Perspective in Pictures



September 2015 Temperature Departure from Normal from 1971-2000 for SCIPP Regional Cities



September 2015 Percent of 1971-2000 Normal Precipitation Totals for SCIPP Regional Cities

Climate Perspective

State	Temperature	Rank (1895-2011)	Precipitation	Rank (1895-2011)
Arkansas	74.70	33rd Warmest	1.44	11th Driest
Louisiana	78.40	35th Warmest	2.65	26th Driest
Mississippi	76.26	41st Warmest	1.72	18th Driest
Oklahoma	76.60	12th Warmest	1.78	22nd Driest
Tennessee	71.00	45th Warmest	2.57	35th Driest
Texas	79.30	8th Warmest	1.41	15th Driest

State temperature and precipitation values and rankings for September 2015. Ranks are based on the National Climatic Data Center's Statewide, Regional, and National Dataset over the period 1 895-201 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	91.0	63.6	77.3	2.7	97	09/18+	48	09/13	0.04	-3.07	1
Little Rock, AR	90.3	66.3	78.3	3.3	99	09/08+	52	09/13	0.12	-3.06	4
Baton Rouge, LA	89.8	69.1	79.5	0.8	97	09/20	54	09/13	2.21	-2.33	49
New Orleans, LA	87.7	73.3	80.5	0.8	96	09/20	61	09/14	2.72	-2.25	55
Shreveport, LA	93.1	68.9	81.0	4.1	99	09/08+	56	09/14+	0.07	-3.09	2
Greenwood, MS	90.5	64.7	77.6	2.9	98	09/19+	47	09/13	0.34	-3.32	9
Jackson, MS	91.2	66.0	78.6	3.0	100	09/05	49	09/14	0.95	-2.08	31
Tupelo, MS	86.0	63.5	74.7	0.6	95	09/05	49	09/14+	0.41	-3.03	12
Gage, OK	91.0	64.4	77.7	7.1	104	09/07	53	09/19	0.89	-1.05	46
Oklahoma City, OK	89.3	65.6	77.4	3.5	99	09/08+	57	09/12	1.06	-3.00	26
Ponca City, OK	87.3	65.3	76.3	4.2	100	09/07	50	09/12	1.34	-1.95	41
Tulsa, OK	86.8	65.9	76.3	3.4	98	09/07	52	09/12	2.93	-1.33	69
Knoxville, TN	82.2	62.5	72.3	1.2	91	09/04+	47	09/14	1.58	-1.66	49
Memphis, TN	87.5	67.5	77.5	2.3	97	09/05	53	09/13	1.32	-1.77	43
Nashville, TN	85.3	62.8	74.0	2.5	95	09/05+	49	09/14	2.28	-1.13	67
Abilene, TX	92.7	68.2	80.5	5.0	100	09/08	59	09/29	1.09	-1.15	49
Amarillo, TX	88.2	62.1	75.1	5.6	98	09/14	53	09/26	0.16	-1.76	8
El Paso, TX	91.9	69.3	80.6	5.2	100	09/06	61	09/27	0.33	-1.18	22
Dallas, TX	93.0	72.4	82.7	4.7	101	09/07	64	09/13	2.14	-0.41	84
Houston, TX	89.4	70.5	79.9	0.1	96	09/06	59	09/14+	2.59	-1.53	63
Midland, TX	92.0	67.7	79.8	5.3	98	09/18	59	09/30	1.77	-0.09	95
San Antonio, TX	93.9	73.0	83.5	3.8	100	09/05	65	09/14	2.32	-0.71	77

Summary of temperature and precipitation information from around the region for September 2015. 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.

Saharan Desert Facts

Barry Keim, Louisiana State Climatologist, Louisiana State University

So, you think that Louisiana is hot, eh? Well, I have some humbling news for you as I share some facts about the Saharan Desert in this week's weather entry. The Saharan desert is large, covering about 3.5 million square miles. This is larger than the contiguous United States (which doesn't include Alaska or Hawaii) at a size of about 3.1 million square miles. So the Lower 48 could easily fit inside the Sahara with quite a bit of breathing room around the edges. To put this in a more local perspective, it would take 67 Louisianas to make up the area of the Sahara. Most of the Sahara averages less than 1 inch of rainfall a year, and there are some parts of the desert that average less than 0.2 inches of rain a year. Heck, in Louisiana, we have more precipitation in a summer morning dew, than many of these places get in rainfall over an entire year. And note that places in the northern African desert can go years with no rain at all, followed by one thunderstorm that delivers an inch or more. As a result, vegetation has a tough time in this neck of the woods (Figure 1), which is in stark contrast to Louisiana, where the vegetation will consume you, your family, dog, and eventually your house, if given enough time. Sand and rock are everywhere, and in fact, there is more surface cover in rocks than sand, though in some areas there are huge sand dunes that are 100s of feet high - called ergs. In the Algerian desert, the July average high temperature is 116 degrees F, and the temperature has soared to 131 degrees in Ghadames, Libya. Desert areas can also get rather cool in winter dipping down to freezing temperatures. The total population of the Sahara totals about 2 million people according to the Conservation Instititute (http://www.conservationinstitute.org/interesting-sahara-desert-facts/), which is less than half that of Louisiana alone (at 4.65 million) and only a fraction of 1 percent of the United States popluation at roughly 320 million. Looking at this another way, we have about 160 people in the U.S. for every 1 person in the Sahara. I know we hate the incredibly humid conditions that we must endure every summer.... and fall, winter, and spring, but lets be thankful that we have our moisture or otherwise, Louisiana could look very much like the Sahara, as we do have some things in common. If you have any questions, feel free to contact me at keim@lsu.edu.

Figure 1. The Saharan Desert. Image taken by chiaoyinanita and is in the public domain found at https://pixabay.com/en/sahara-sand-nature-desert-dry-838494/.

Southern Climate Monitor Team

Luigi Romolo, Regional Climatologist
Southern Regional Climate Center (LSU)

Gina Fujan, Student Assistant SCIPP (OU)

Margret Boone, Program Manager SCIPP (OU)

Hal Needham, Program Manager SCIPP (LSU)

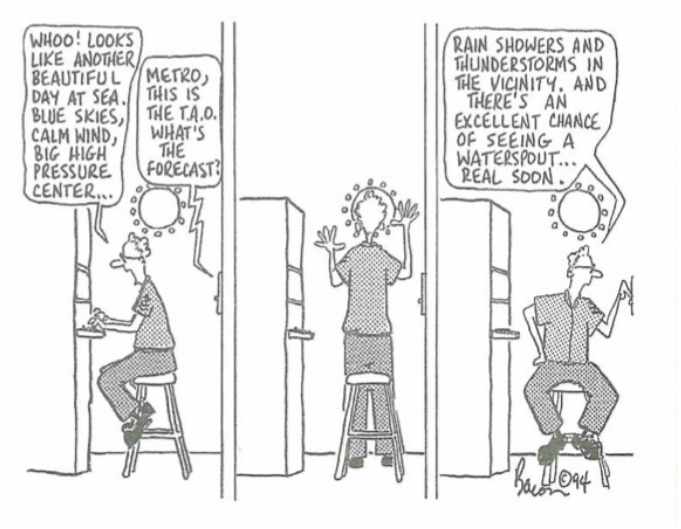
Contact Us

To provide feedback or suggestions to improve the content provided in the Monitor, please contact us at monitor@southernclimate.org. We look forward to hearing from you and tailoring the Monitor to better serve you. You can also find us online at www.srcc.lsu.edu & southernclimate.org.

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 405-325-7809 or 225-578-8374.

Monthly Comic Relief



SCIPP
A NOAA RISA TEAM