Southern Climate Monitor

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Southern Climate Impacts Planning Program
A NOAA RISA Team

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

SCIPP Research Investigates How Hurricanes Generate Storm Surges

Hal Needham, Program Manager, SCIPP (LSU)

A team of SCIPP researchers made a crucial discovery about how hurricanes generate storm surges. Hal Needham and Barry Keim investigated the role of pre-landfall winds in storm surge generation, finding that storm surge heights correlate best with hurricane wind speeds 18 hours before landfall (Figure 1). These results were published this spring in *Earth Interactions* (Needham and Keim 2014). This work builds upon a previous study that noted that storm surge heights correlate better with pre-landfall winds than winds at landfall (Jordan and Clayson 2008).

Needham and Keim's paper used a data-driven approach to find these correlations. Data for this study were provided by a SCIPP database called SURGEDAT, which archived high water marks for more than 700 global storm surge events since 1880. Observations from the U.S. Gulf Coast were used in this study, as well as hurricane position and intensity data provided by Elsner and Jagger (2013).

The relationship between wind speeds and surge heights in this study were also found to be non-linear. The best correlations occurred when winds 18 hours before landfall were raised to the power of 2.2. This produced an R-squared value approaching 0.70, compared with only 0.44 at the time of landfall. This means

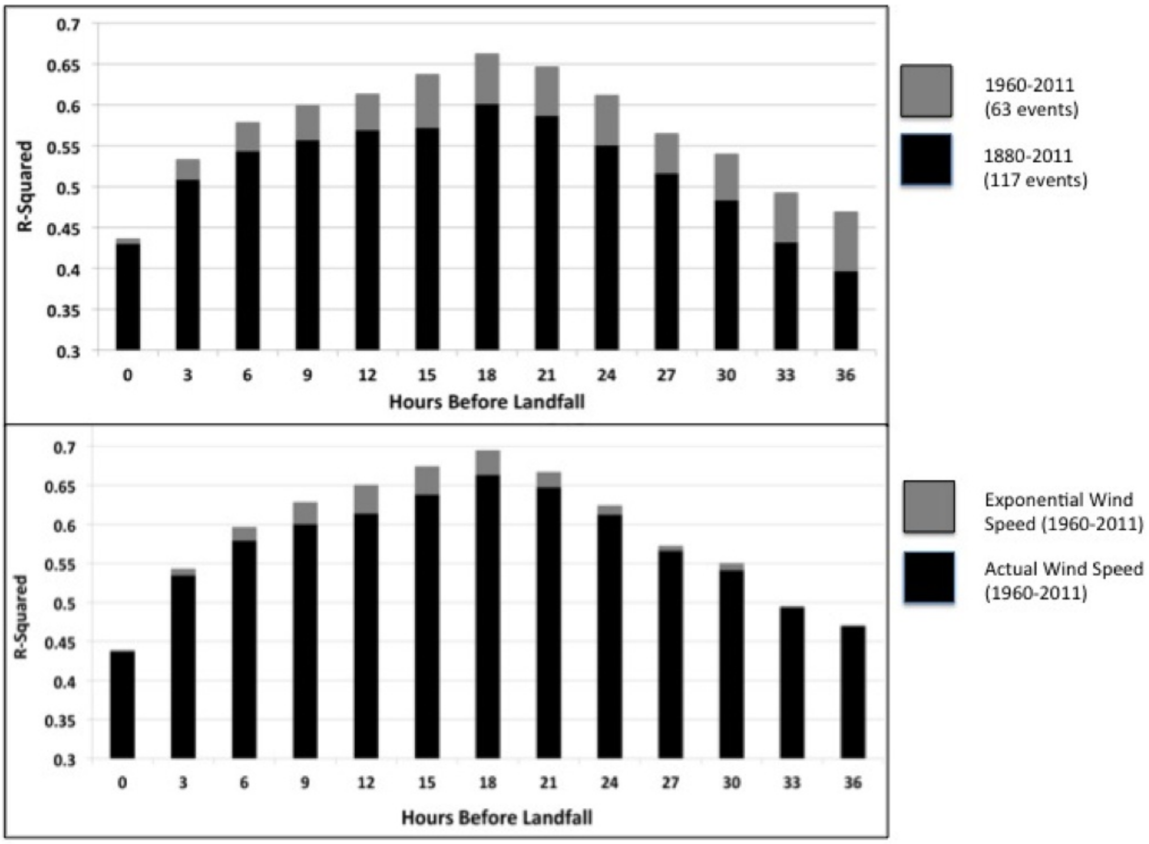

Figure 1a: Correlation of surge height vs. wind speeds at 3-hour intervals for data from 1880-2011 (117 events) and 1960-2011 (63 events). Figure 1b (Bottom): Correlation of surge heights vs. actual and exponential wind speeds at 3-hour intervals for data from 1960-2011. Surge heights correlate better with pre-landfall winds than winds at landfall.

that even modest increases in pre-landfall winds can produce large differences in surge heights.

These results may help explain how Hurricane Katrina generated such a massive storm surge in 2005. Although Katrina made landfall as a category-3 hurricane in Louisiana and Mississippi, it generated a storm surge as high as 28 feet, which was the highest surge ever recorded in the Western Hemisphere. Katrina's large size and the shallow water depth off the coast contributed to this massive storm surge, however, this study supports the notion that Katrina's strong pre-landfall winds, which exceeded 170 MPH while over the open waters of the Gulf of Mexico, also contributed to this historic surge event (Figure 2). This wind speed easily exceeds the threshold for a category-5 hurricane.

This study will be useful to the storm surge modeling community, as well as emergency management personnel and coastal scientists, especially when hurricanes rapidly strengthen or weaken before making landfall. Future hurricane research conducted by SCIPP will take other variables into account as well, such as hurricane size and forward speed, as well as the shape of the coastline and offshore water depth.

References:

Elsner, J.B., and T.H. Jagger, 2013: *Hurricane Climatology: A Modern Statistical Guide Using R*. Oxford University Press, New York, USA. 430 pp.

Jordan, II, M.R., and C.A. Clayson, 2008: A new approach to using wind speed for prediction of tropical cyclone generated storm surge. *Geophysical Research Letters*, **35**, doi: 10.1029/2008GL033564.

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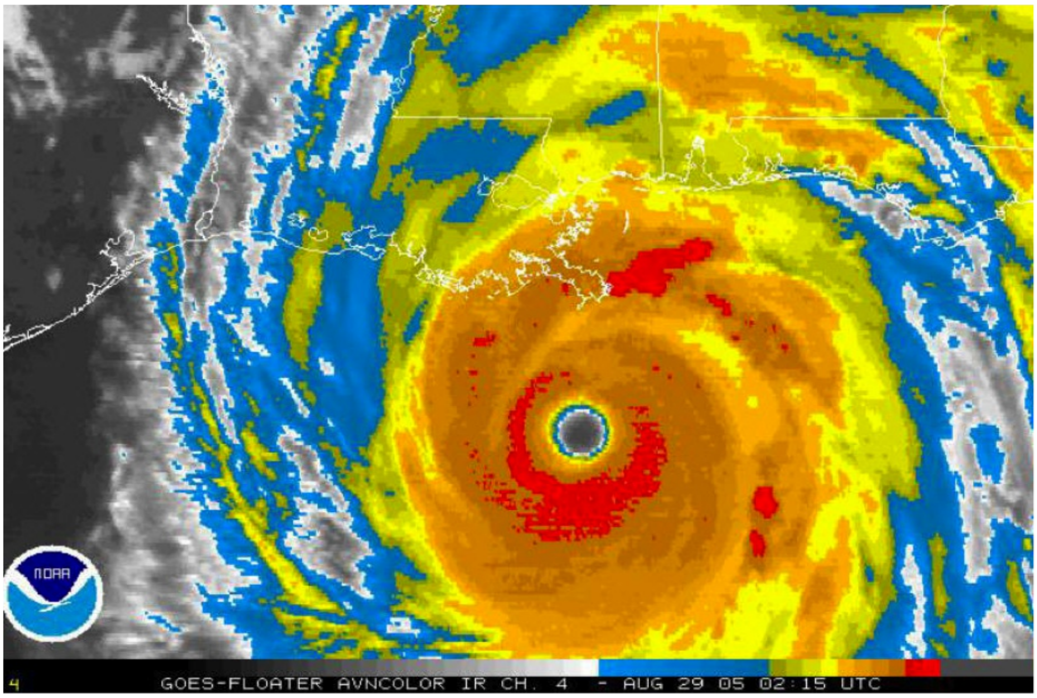


Figure 2: Hurricane Katrina generated maximum sustained winds exceeding 170 MPH while over the open waters of the Gulf of Mexico. Such intense pre-landfall winds helped Katrina generate the largest storm surge in the history of the Western Hemisphere. Photo: National Oceanic and Atmospheric Administration.

Drought Update

Luigi Romolo
Southern Regional Climate Center

Drought conditions in the Southern Region did not significantly change in the states of Arkansas, Mississippi, and Louisiana. Portions of easternmost Tennessee is, however, classified as moderate drought. In Texas and Oklahoma, drought conditions have remained relatively dire. Much of the state of Texas is still under the grip of moderate to severe drought, with extreme and exceptional drought covering much of the northern counties of the state. For Oklahoma, the majority of the state is experiencing severe drought or worse, with exceptional drought occurring in the panhandle the southern counties, and in north central portions of the state.

Drought Conditions (Percent Area)

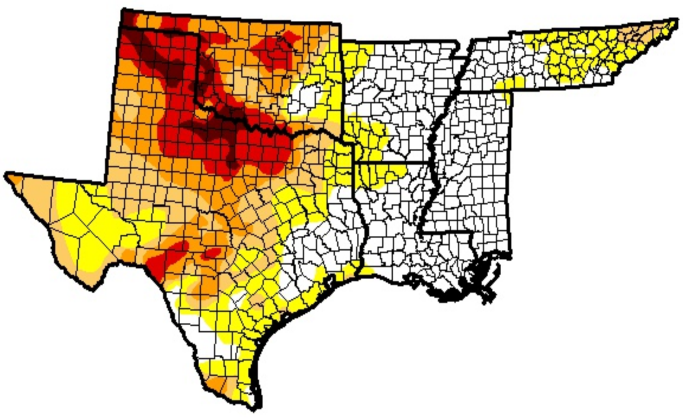
	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	35.58	64.42	42.11	27.16	13.27	3.17
Last Week *7/1/2014*	36.88	63.12	41.83	27.42	13.35	3.29
3 Months Ago *4/8/2014*	41.17	58.83	43.21	27.44	17.46	5.38
Start of Calendar Year *12/31/2013*	55.85	44.15	27.23	13.21	3.58	0.72
Start of Water Year *10/1/2013*	26.20	73.80	50.11	17.90	3.16	0.25
One Year Ago *7/9/2013*	31.12	68.88	54.97	42.91	21.56	7.32

Intensity:

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

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompany text summary for forecast statements. **http://droughtmonitor.unl.edu**

In Texas, rains across the state have helped farmers. Expected corn planting acreage and harvesting acreage are both down, at 11% and 10% respectively. Upland cotton acreage is up 11% from last year, and Pima cotton 44%, but with no estimates on harvests yet. Winter wheat came in 5% lower than 2013 with a 2% reduction in harvest numbers, which were already low in 2013. Sorghum seemed to be the big winner for harvests, where no change in acres planted has thus far seen a 9% increase in harvested acres. Other smaller crops are all doing better in 2014 than 2013 with the exception of rice, still struggling with no discharge out of the Colorado River, which is down 3%. The Colorado River is still struggling, with the Lower Colorado River Authority voting to increase water rates on customers from $151 to $174 per acre-foot and not to release water to farmers downstream (Information provided by the Texas Office of State Climatology)



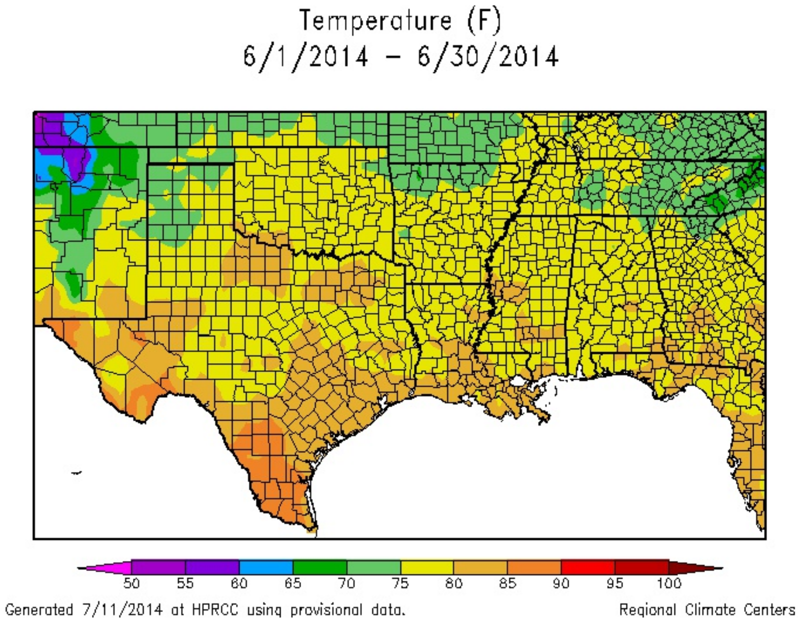
Released Thursday, July 10, 2014
Anthony Artusa, NOAA/NWS/NCEP/CPC

Above: Drought Conditions in the Southern Region. Map is valid for July 8, 2014. Image is courtesy of National Drought Mitigation Center.

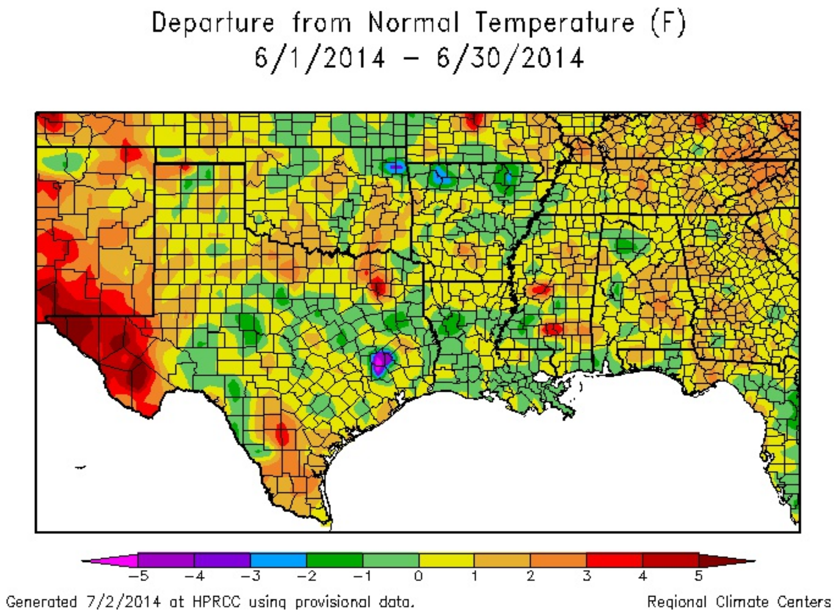
Temperature Summary

Luigi Romolo
Southern Regional Climate Center

June was a slightly warmer than normal month for the Southern Region. Much of the central and northern areas of the region averaged within two degrees F (1.11 degrees C) of normal. Conditions were much warmer in the western panhandle of Texas, with most stations averaging three to six degrees F (1.67 to 3.33 degrees C) above average. In eastern Tennessee, stations averaged between two and three degrees F (1.11 to 1.67 degrees C) above normal. All six states in the region reported state wide average temperatures that were above normal, however, all state rankings fell within the two middle quartiles. The state wide average temperatures are as follows: Arkansas averaged 76.70 degrees F (24.83 degrees C), Louisiana averaged 79.90 degrees F (26.61 degrees C), Mississippi averaged 78.60 degrees F (25.89 degrees C), Oklahoma averaged 77.20 degrees F (25.11 degrees C), Tennessee averaged 74.90 degrees F (23.83 degrees C), and Texas averaged 80.60 degrees F (27.00 degrees C).



Average June 2014 Temperature across the South

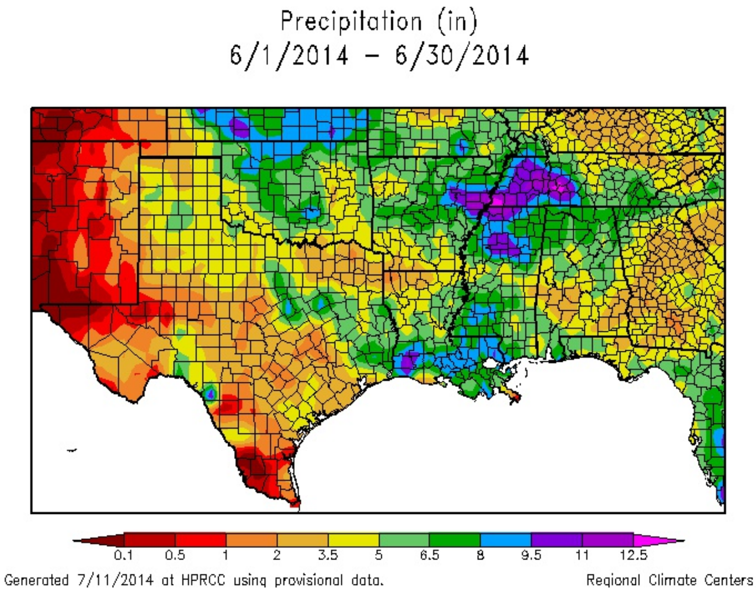


Average Temperature Departures from 1971-2000 for June 2014 across the South

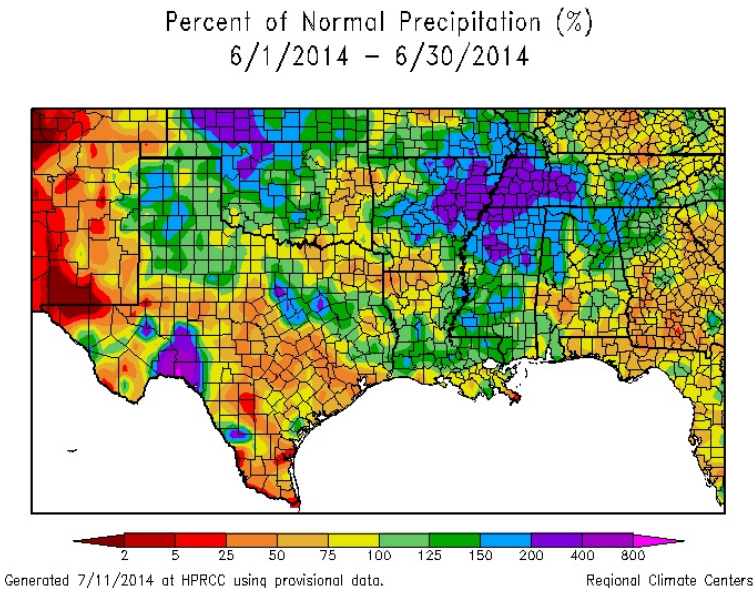
Precipitation Summary

Luigi Romolo
Southern Regional Climate Center

June Precipitation totals in the Southern Region varied spatially with some areas remaining dry, while others received more than twice the monthly average. With the exception of Crockett, Terrell, and Val Verde Counties, southern Texas remained relatively dry as most stations averaged between 25 to 75 percent of normal precipitation for the month. Conditions were similarly dry in the Arkansas, Louisiana, and Texas border region and also in eastern Oklahoma and eastern Tennessee. Conversely, it was quite wet in the Texas counties of Crockett, Terrell and Val Verde. Precipitation in this area averaged over twice the monthly average. This was also the case in north eastern Arkansas, western Tennessee and in northern Mississippi. In northern Texas, precipitation totals were near normal to above normal. Similar conditions could also be observed in southern Mississippi and in central Louisiana. All six states were wetter than normal. The average state wide precipitation totals are as follows: Arkansas reported 6.13 inches (155.7 mm), Louisiana reported 6.32 inches (160.53 mm), Mississippi reported 6.65 inches (168.91 mm), Oklahoma reported 5.57 inches (141.48 mm), Tennessee reported 6.78 inches (172.21 mm), and Texas reported 2.90 inches (73.66 mm). For the state of Tennessee, it was the sixth wettest June on record (1895-2014), while for Arkansas, it was the fourteenth wettest June on record (1895-2014). Mississippi recorded its twelfth wettest June on record (1895-2014), while Oklahoma reported its twenty-fifth wettest June on record (1895-2014). Louisiana and Texas reported their thirtieth and fifty-fifth wettest June on record (1895-2014), respectively.

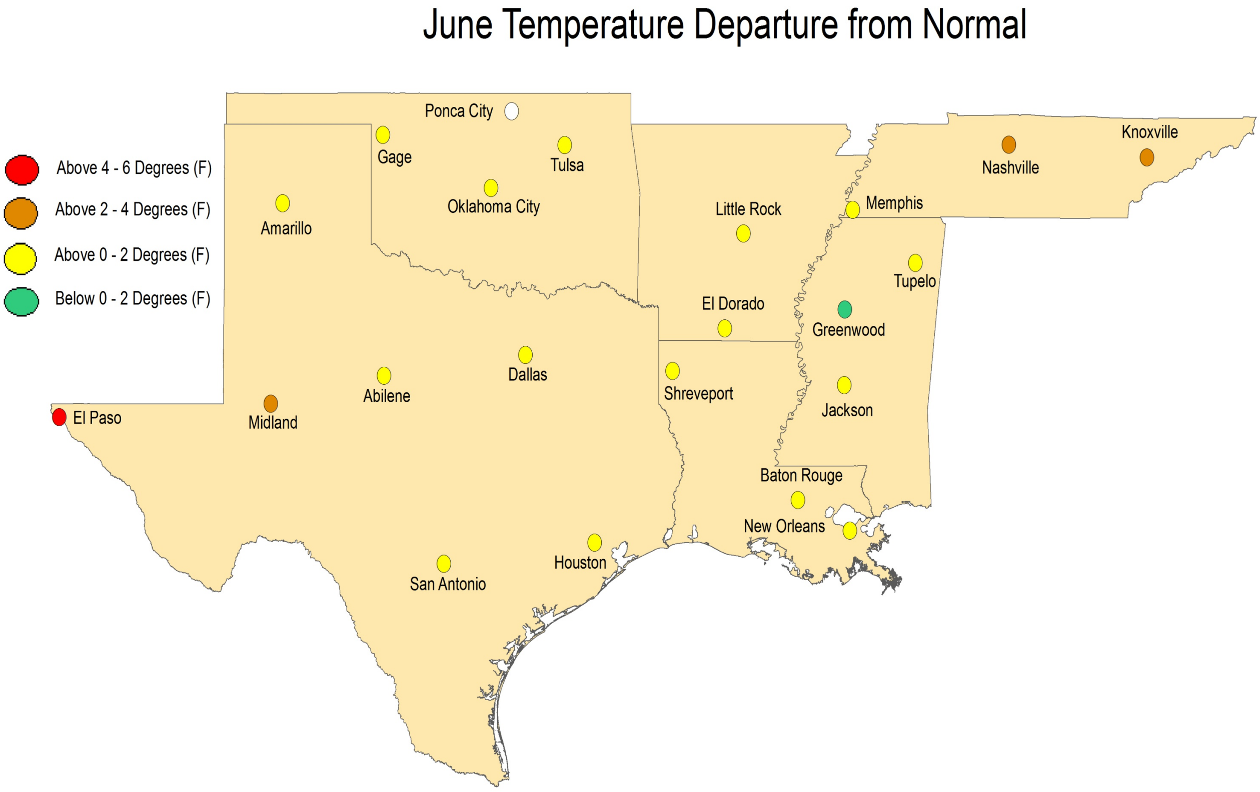


June 2014 Total Precipitation across the South

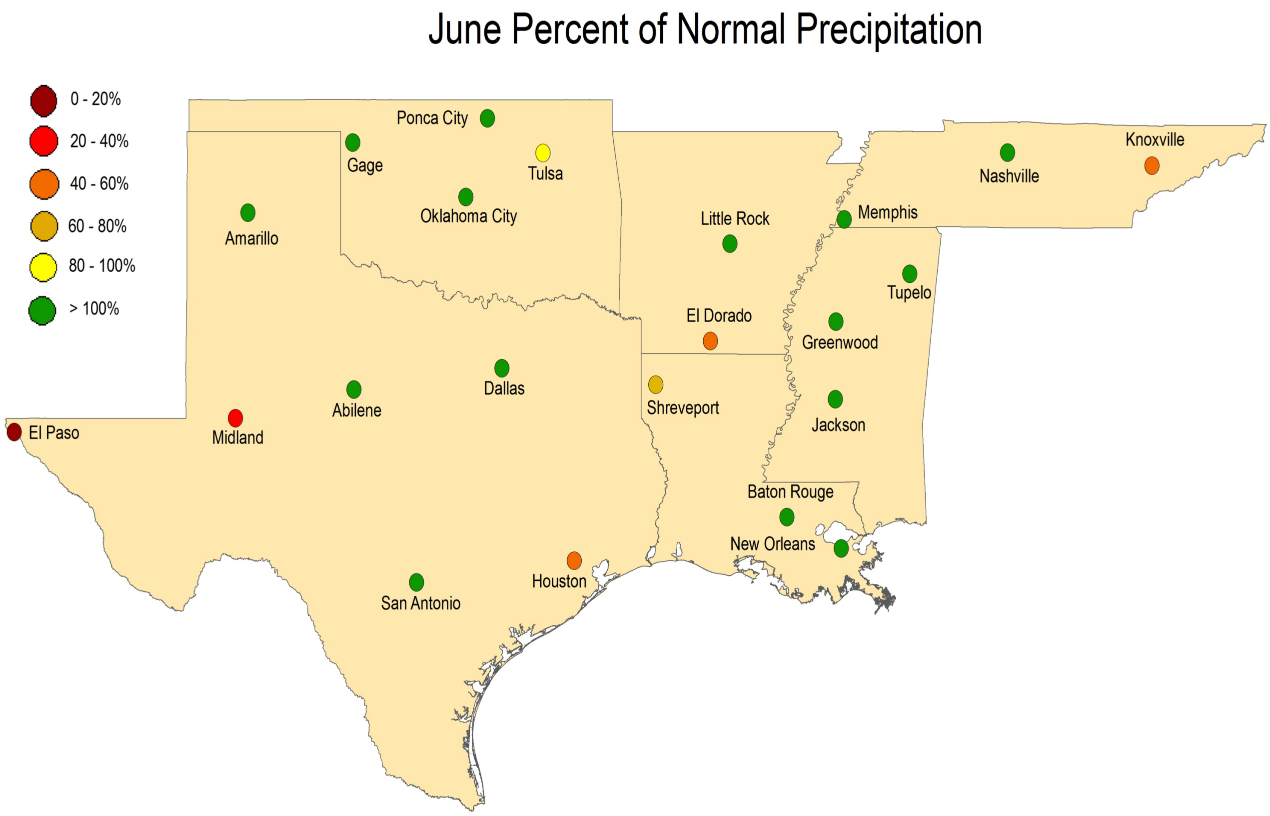


Percent of 1971-2000 normal precipitation totals for June 2014 across the South

Regional Climate Perspective in Pictures



June 2014 Temperature Departure from Normal from 1971-2000 for SCIPP Regional Cities



June 2014 Percent of 1971-2000 Normal Precipitation Totals for SCIPP Regional Cities

Climate Perspective

State	Temperature	Rank (1895-2011)	Precipitation	Rank (1895-2011)
Arkansas	76.70	53rd Warmest	6.13	14th Wettest
Louisiana	79.90	58th Warmest	6.32	30th Wettest
Mississippi	78.60	49th Warmest	6.65	12th Wettest
Oklahoma	77.20	52nd Warmest	5.57	25th Wettest
Tennessee	74.90	42nd Warmest	6.78	6th Wettest
Texas	80.60	33rd Warmest	2.90	55th Wettest

State temperature and precipitation values and rankings for June 2014. 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 (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	%Norm
El Dorado, AR	87.6	69.7	78.6	0.2	92	6/20	62	6/11	3.06	-2.12	59
Little Rock, AR	87.7	70.4	79.0	0.6	93	6/22+	62	6/14	5.45	1.50	138
Baton Rouge, LA	89.4	71.5	80.4	0.7	93	6/30+	66	6/13	11.36	6.03	213
New Orleans, LA	89.0	74.1	81.5	0.8	93	6/20	69	6/13	8.03	1.20	118
Shreveport, LA	88.9	71.8	80.3	0.4	94	6/20	63	6/11	3.11	-1.94	62
Greenwood, MS	87.9	69.9	78.9	-0.6	94	6/21	63	6/12	9.04	4.54	201
Jackson, MS	88.6	70.4	79.5	1.0	93	6/20+	64	6/12	6.44	2.62	169
Tupelo, MS	87.8	69.8	78.8	1.9	94	6/21+	62	6/14	8.34	3.52	173
Gage, OK	88.4	64.8	76.6	1.3	98	6/4	53	6/13	5.73	2.84	198
Oklahoma City, OK	87.2	68.9	78.1	1.3	95	6/4	59	6/11	8.60	3.97	186
Ponca City, OK	86.7	68.4	77.5	0.0	93	6/30+	56	6/13	8.87	4.37	197
Tulsa, OK	86.8	69.5	78.2	0.2	94	6/30	58	6/11	4.67	-0.05	99
Knoxville, TN	86.9	64.1	75.5	2.3	92	6/24+	57	6/10	2.47	-2.02	55
Memphis, TN	87.5	71.1	79.3	0.6	94	6/21	62	6/14	13.40	9.10	312
Nashville, TN	87.4	68.3	77.9	2.8	95	6/18	55	6/14	5.73	1.65	140
Abilene, TX	90.4	70.2	80.3	0.5	98	6/4	59	6/12	3.75	0.69	123
Amarillo, TX	87.3	63.2	75.2	1.0	100	6/4	52	6/10	5.39	2.11	164
El Paso, TX	101.2	74.5	87.8	5.8	109	6/3	68	6/10	0.01	-0.86	1
Dallas, TX	91.2	73.5	82.3	1.4	96	6/18+	65	6/11+	3.26	0.03	101
Houston, TX	90.7	74.2	82.5	1.2	94	6/12+	68	6/11	2.19	-3.16	41
Midland, TX	95.7	70.2	83.0	3.4	105	6/28+	55	6/10	0.48	-1.23	28
San Antonio, TX	91.9	74.3	83.1	1.6	96	6/23+	67	6/11	5.38	1.08	125

Summary of temperature and precipitation information from around the region for June 2014. 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.

A Brief History of How and Why We Name Hurricanes

Barry Keim, Louisiana State Climatologist, Louisiana State University

Use of names for hurricanes is a practice that actually began unofficially hundreds of years ago. For example, in the Caribbean, the locals used to name the storms for the saint of that day from the Roman Catholic liturgical calendar on which the storm struck a region. This practice went on for a few hundred years. As practical as that was, in the early twentieth century in the U.S., storms were named for the storm's origin using a numeric latitude/longtitude designation. Needless to say, but when there were multiple storms raging at once, this naming system became very cumbersome and confusing for everyone. Then in the 1940s, meteorologists working with Pacific hurricanes began using female names for hurricanes and the practice caught on…..again, much like the early Eighteenth and Nineteeth century practice in the Caribbean.

In the Atlantic, leading up the 1950 hurricane season, the National Hurricane Center decided to adopt a naming strategy for tropical storms and hurricanes based on the U.S. Phonetic alphabet of the time, which included the names of Able, Baker, Charlie, Dog, Easy, Fox, George, How, Item, Jig, King, Love….and so on. This system was used for three straight seasons from 1950 through the 1952 season, thereby using the same list of names in each year. This system was abandoned in the 1953 season, as a new international phonetic alphabet was introduced. At the time, the National Hurricane Center decided to do like meteorologists in the Pacific, and began using women's names for the storms. Initially, they used a 4 year list of set names, which repeated. For example, we had Hurricanes named Betsy in 1956, then again in 1961, and of course again in 1965! The next major breakthroughs in naming of storms came in 1977 and 1979. In 1977, the National Oceanographic and Atmospheric Administration and the National Hurricane Center handed off the responsibility of naming and retiring storm names to the World Meteorological Organization (WMO). Then, with the 1979 hurricane season – in the name of gender equality - men's names were worked into the rotation, alternating between storms with women's names. The list then grew into a six-year rotation of storm names (Table 1), which is now run and operated by the WMO. The lists include 21 names for each season. So far, only one year has exceeded 21 named storms and that was in 2005 – the Hurricane Katrina year - when they resorted to using the Greek alphabet for the 22nd storm, and all subsequent storms. Also, it is the WMO that decides which storm names to retire. I'll do an article on that subject at a later date. For now, let's just hope that we don't have to resort to the Greek alphabet this season! Please contact me with any questions or comments at keim@lsu.edu.

2014	2015	2016	2017	2018	2019
Arthur	Ana	Alex	Arlene	Alberto	Andrea
Bertha	Bill	Bonnie	Bret	Beryl	Barry
Cristobal	Claudette	Colin	Cindy	Chris	Chantal
Dolly	Danny	Danielle	Don	Debby	Dorian
Edouard	Erika	Earl	Emily	Ernesto	Erin
Fay	Fred	Fiona	Franklin	Florence	Fernand
Gonzalo	Grace	Gaston	Gert	Gordon	Gabrielle
Hanna	Henri	Hermine	Harvey	Helene	Humberto
Isaias	Ida	Ian	Irma	Isaac	Imelda
Josephine	Joaquin	Julia	Jose	Joyce	Jerry
Kyle	Kate	Karl	Katia	Kirk	Karen
Laura	Larry	Lisa	Lee	Leslie	Lorenzo
Marco	Mindy	Matthew	Maria	Michael	Melissa
Nana	Nicholas	Nicole	Nate	Nadine	Nestor
Omar	Odette	Otto	Ophelia	Oscar	Olga
Paulette	Peter	Paula	Philippe	Patty	Pablo
Rene	Rose	Richard	Rina	Rafael	Rebekah
Sally	Sam	Shary	Sean	Sara	Sebastien
Teddy	Teresa	Tobias	Tammy	Tony	Tanya
Vicky	Victor	Virginie	Vince	Valerie	Van
Wilfred	Wanda	Walter	Whitney	William	Wendy

Table 1. Six Year Rotation of Atlantic Basin Storm Names, 2014-2019.

Monthly Comic Relief

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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 225-578-502. 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.

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