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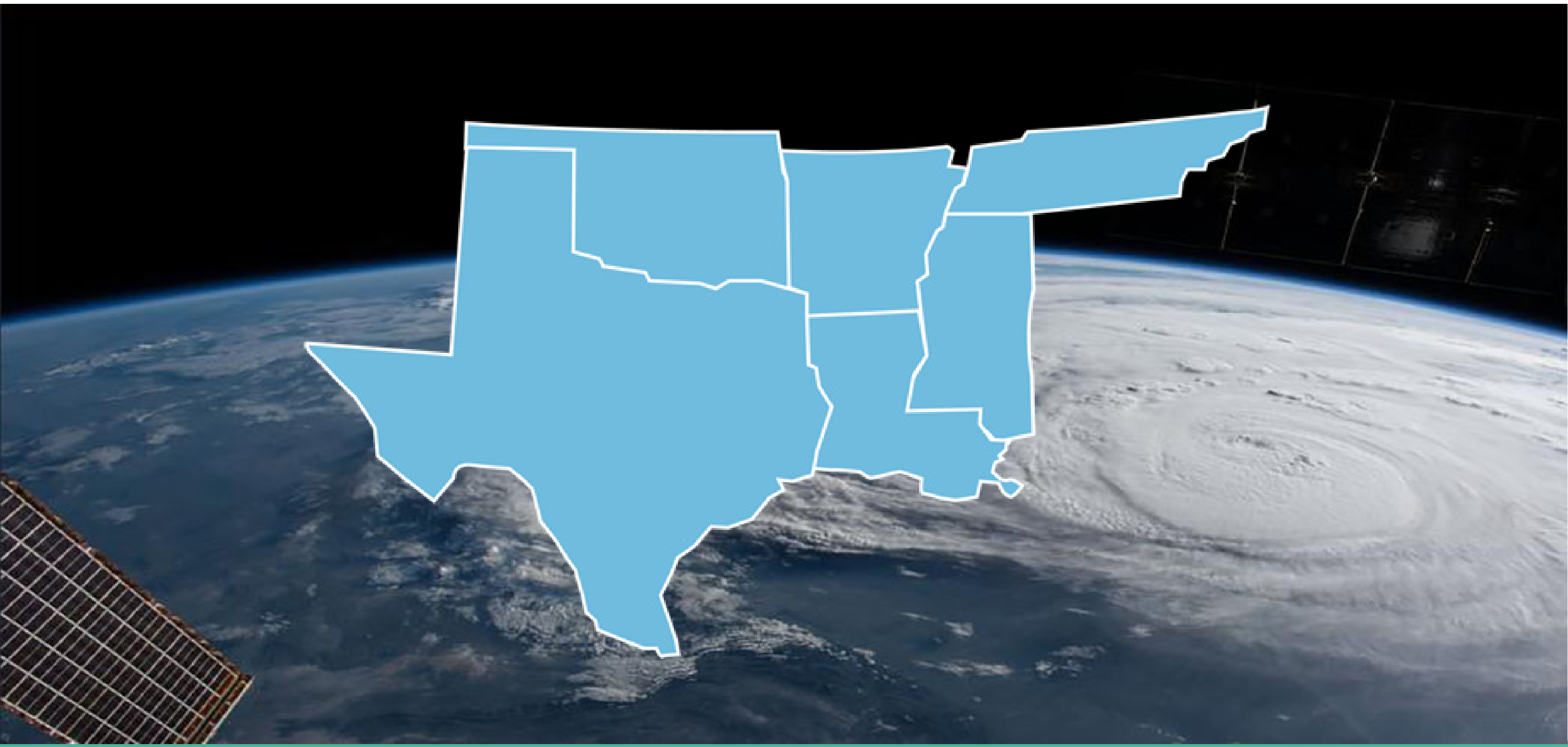
Southern Climate Monitor

August 2017 | Volume 7, Issue 8



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

Trouble in the Tropics? A Quick Overview as Hurricane Season Ramps Up

Carly Kovacik, National Weather Service Atlanta, General Forecaster

Tropical Meteorology is the study of the short-term weather patterns and conditions within a broad belt of the atmosphere that stretches around the Earth, referred to as the "Tropics", generally located between 23.5 degrees north and 23.5 degrees south of the equator (Ahrens 2007). In this region of the world, air temperature fluctuations from season to season are rather small due to only very minute changes in the sun angle. As a result, the air within the Tropics is very warm and humid, which often leads to the development of numerous showers and thunderstorms (Ahrens 2007). Occasionally, a cluster of thunderstorms will merge together and, given the right atmospheric conditions, develop into a Tropical Storm or a Hurricane (often referred together as "Tropical Cyclones"). The most common time of the year for Tropical Cyclones to develop is from late Spring through late Fall. This is referred to as "Hurricane Season" and the season officially begins on June 1 and ends on November 30 every year.

With it being August, the atmosphere is considered to be conducive for Tropical Cyclone development. In fact, it is almost at its peak. This means that now is a great time to review knowledge of Tropical Cyclone development and safety. Begin by becoming more familiar with the recent state of the atmosphere. Typically, Tropical Cyclones need several ingredients in order to develop. These include: warm sea surface temperatures (SSTs) over a vast area of the ocean (typically greater than 26.5C or 80F), light winds, and a deep layer of the atmosphere with high humidity (Ahrens 2007). Figure 1 shows a recent representation of the SSTs, which indicates favorable conditions for Tropical Cyclone development. As can be seen, SSTs are above 26.5 degrees Celsius across most of Gulf of Mexico and northern Atlantic.

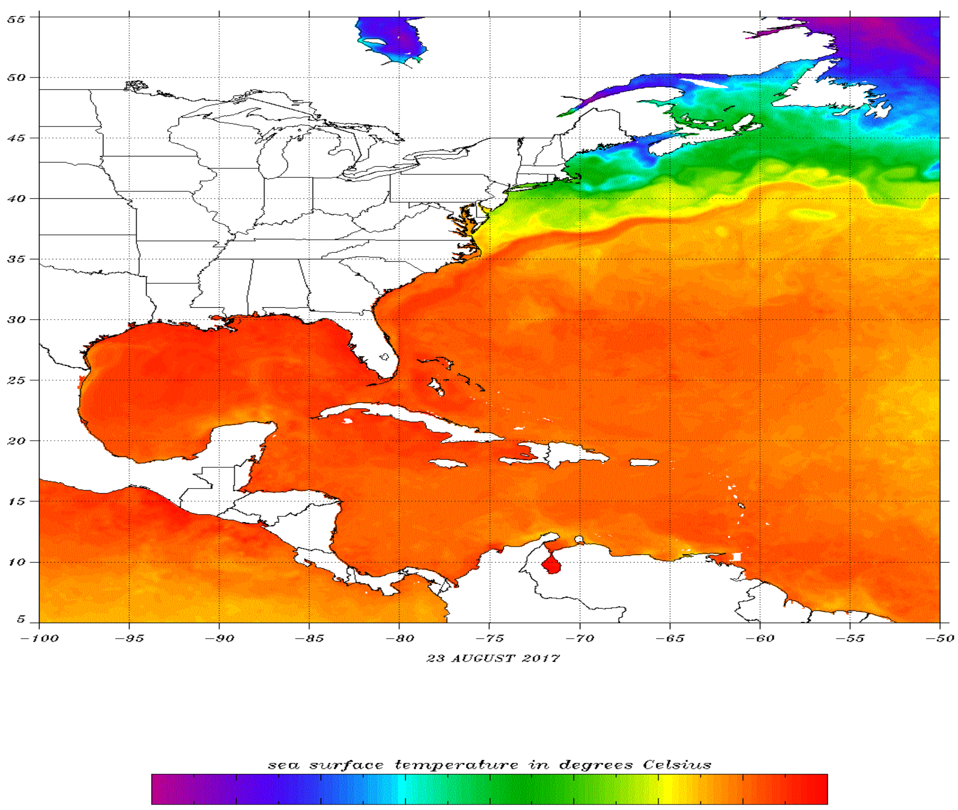

Figure 1. SSTs for the Gulf of Mexico and northern Atlantic Ocean for the month of August. The higher the SST (especially above 26.5C), the more favorable the conditions for Tropical Cyclone development. It can be easily seen that temperatures are currently more than favorable for Tropical Cyclone development.

In addition, a deep layer of humidity can be seen within the Tropical region of the globe through the use of Precipitable Water (PW) data available from the Cooperative Institute

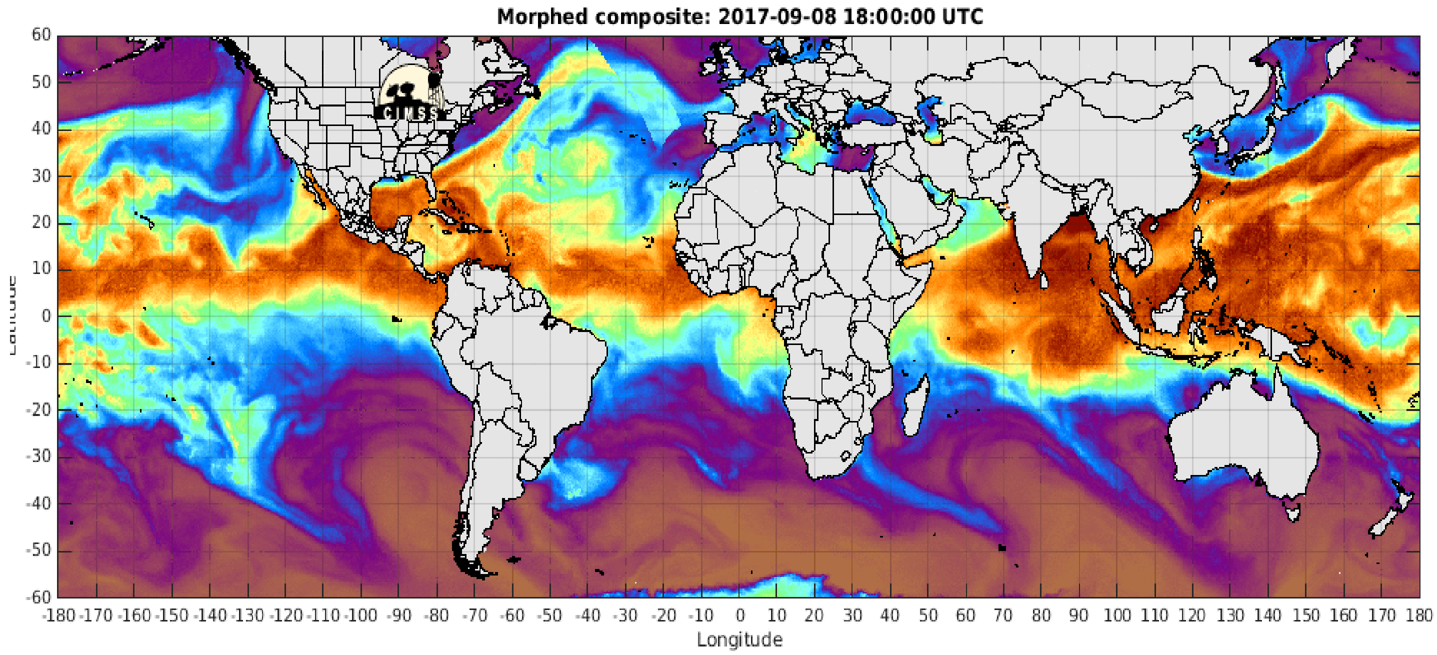

Figure 2. Precipitable water (PW) values across the northern Atlantic, assumed to be representative of the month of August. PW is measured in inches and the higher the value the greater the amount of water vapor in the atmosphere. In this image, higher PW values (burnt orange colors) are seen right off the coast of Africa all the way to the Caribbean and Gulf of Mexico. An airmass moving off the West Coast of Africa would encounter plenty of moisture to help it develop Tropical characteristics assuming other conditions are also favorable.

for Mesoscale Meteorological Studies (CIMMS). Precipitable water is essentially a measure of the amount of water vapor the atmosphere can hold. Typically, higher humidity is associated with PW values greater than about 2 inches (refer to Figure 2). Oftentimes, a dry airmass over Africa will venture off the western Coast and encounter both the warm Atlantic Ocean water along with abundant deep-layer humidity, sometimes leading to the development of an organizing cluster of thunderstorms, or the beginning of a Tropical Cyclone.

As an example, in mid-August, several organizing areas of thunderstorms were located across the tropical waters of the northern Atlantic Ocean. This can be seen in the image below (Figure 3) from the National Hurricane Center (NHC). Note that these areas of potential Tropical development coincide very well with high SSTs and high PW values that were evident in the previous two figures.

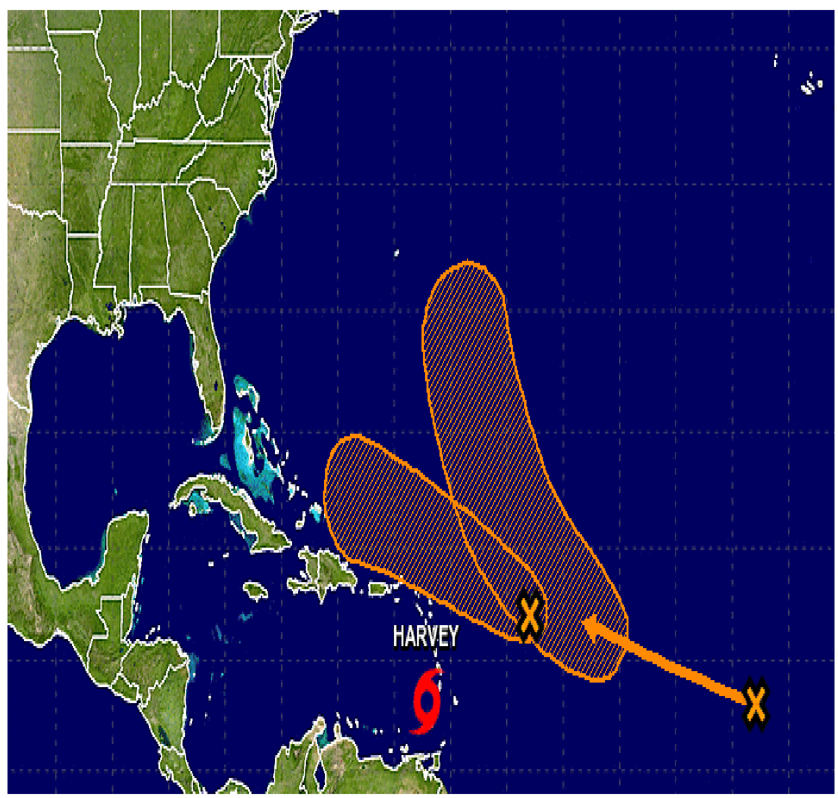

Figure 3. An example from mid-August of Tropical Cyclone potential from several organizing areas of thunderstorms. These areas correspond well with areas of the Atlantic Ocean with high SST and PW (refer back to Figures 1 and 2).

The 2017 Atlantic Hurricane Season Outlook still indicates the potential for an above-normal season, with between 14-19 named storms, 5-9 Hurricanes, and 2-5 Major Hurricanes (see Figure 4). According to the NHC, it is possible that this season could be the most active season since 2010.

Now that it is clear how, where, and when Tropical Cyclones develop, along with what the forecasters at the NHC are predicting for the remainder of the Hurricane Season, it is an excellent time to review proper preparations for Tropical Weather impacts. While certain areas of the country are more prone to tropical impacts than others, it is still important to understand the threats and what can be done to minimize the impacts and remain safe. It is imperative to note that Tropical Depressions and Tropical Storms can be just as devastating to life and property as a Hurricane, so be sure to follow the same general guidelines for ALL tropical hazards.

According to the NHC, the primary hazards from Tropical Cyclones are storm surge (flooding), inland flooding from torrential rainfall, extremely strong winds, high surf/rip currents, and in some cases tornadoes. Of these threats, storm surge is the hazard that has historically been the leading cause of hurricane related deaths in the United States (National Hurricane Center). Storm surge can travel several miles inland, especially if a bay, river, estuary, etc. is nearby. Flooding rains is the second leading cause of death from Tropical Cyclones, followed by wind and the remaining hazards (National Hurricane Center)).

Hurricane Watches vs. Warnings:

When a Tropical Cyclone develops, the NHC will issue a Tropical Cyclone Advisory, which is updated at least every 6 hours. This product will typically contain the cyclone's position, motion, maximum winds, and a list of any ongoing watches and/or warnings. In cases where there is potential for a Tropical Cyclone to make landfall, the NHC may issue a Watch, which can be in the form of either a Storm Surge Watch, a Tropical Storm Watch, or a Hurricane Watch. These products mean that such conditions are possible. In cases where a Tropical Cyclone is expected to make landfall and/or cause life-threatening conditions, a Warning will be issued, either in the form of a Storm Surge Warning, an Extreme Wind Warning, a Tropical Storm Warning, or a Hurricane Warning (National Hurricane Center).

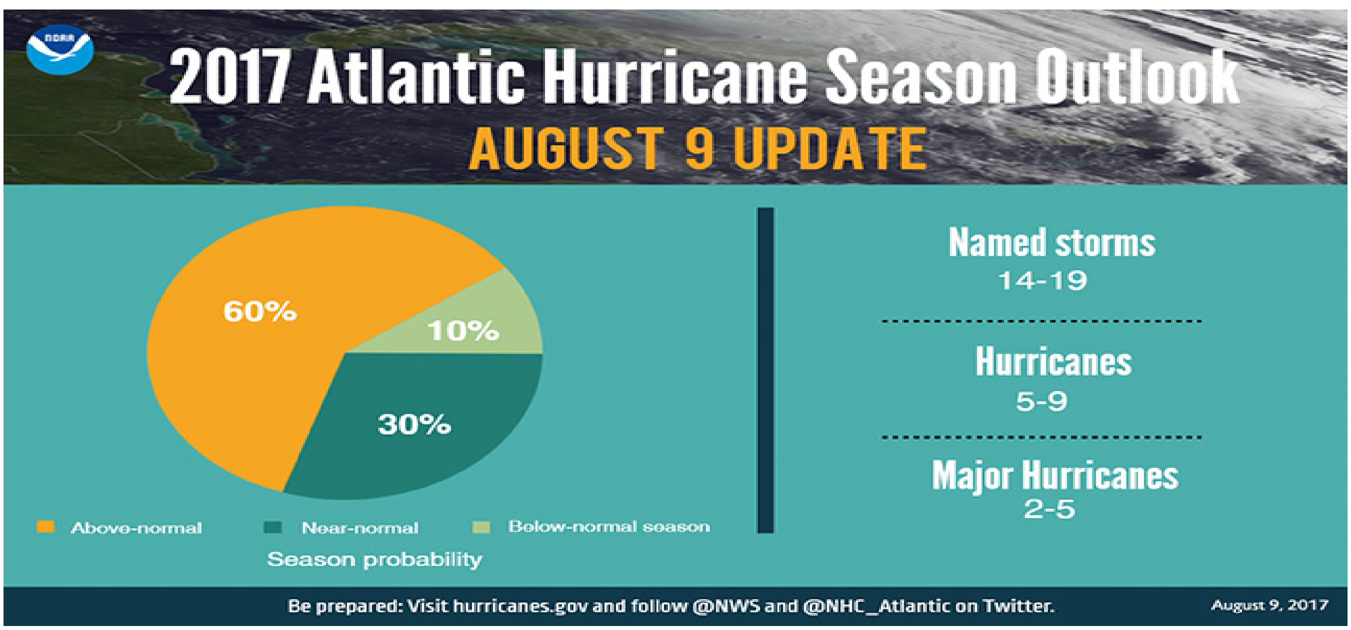

Figure 4. The 2017 Atlantic Hurricane Season, indicating a 60% chance of above-normal activity in the Atlantic with the potential for 14-19 named storms. Note that this is a prediction and is sometimes refined as new information becomes available.

Preparing for a Hurricane:

Although it is best to be prepared before Hurricane Season begins, when a watch or warning is issued, it is imperative to have a preparation plan in place. The NHC has prepared a "list" of basic guidelines to follow to ensure that people are prepared before a Tropical System approaches. These include the following:

Know your zone: Find out if you live in a hurricane evacuation area by contacting your local government/emergency management office.

Put Together an Emergency Kit: : Items contained in this kit might include non-perishable food, water, a flashlight with extra batteries, a first aid kit, cell phone with charger, etc.

Write/Review a Family Emergency Plan: : Simply sit down with family members and discuss where to go in the event of a Tropical System and how to contact one another.

Review Insurance Policies: Make sure to have adequate coverage for home and personal property.

Understand NWS Forecast Products: Especially tropical products, such as watches and warnings.

When a Tropical System is impeding, it is important to:

Stay tuned to the forecast: NOAA Weather Radio is recommended.

Follow instructions issued by local officials: Evacuate if told to do so.

Secure your home: Particularly windows.

For those interested in learning more about Tropical Cyclones, there are plenty of online resources available. The following link from the National Weather Service is dedicated to assist in Tropical Cyclone Outreach and Education. On this website, brochures, checklists, videos, etc. are available and designed to help everyone become properly informed and prepared on this topic: http://www.nws.noaa.gov/om/hurricane/outreach.shtml.

In closing, the following image (Figure 5) provides a quick reference to all Hurricanes that made landfall along the United States Coastline:

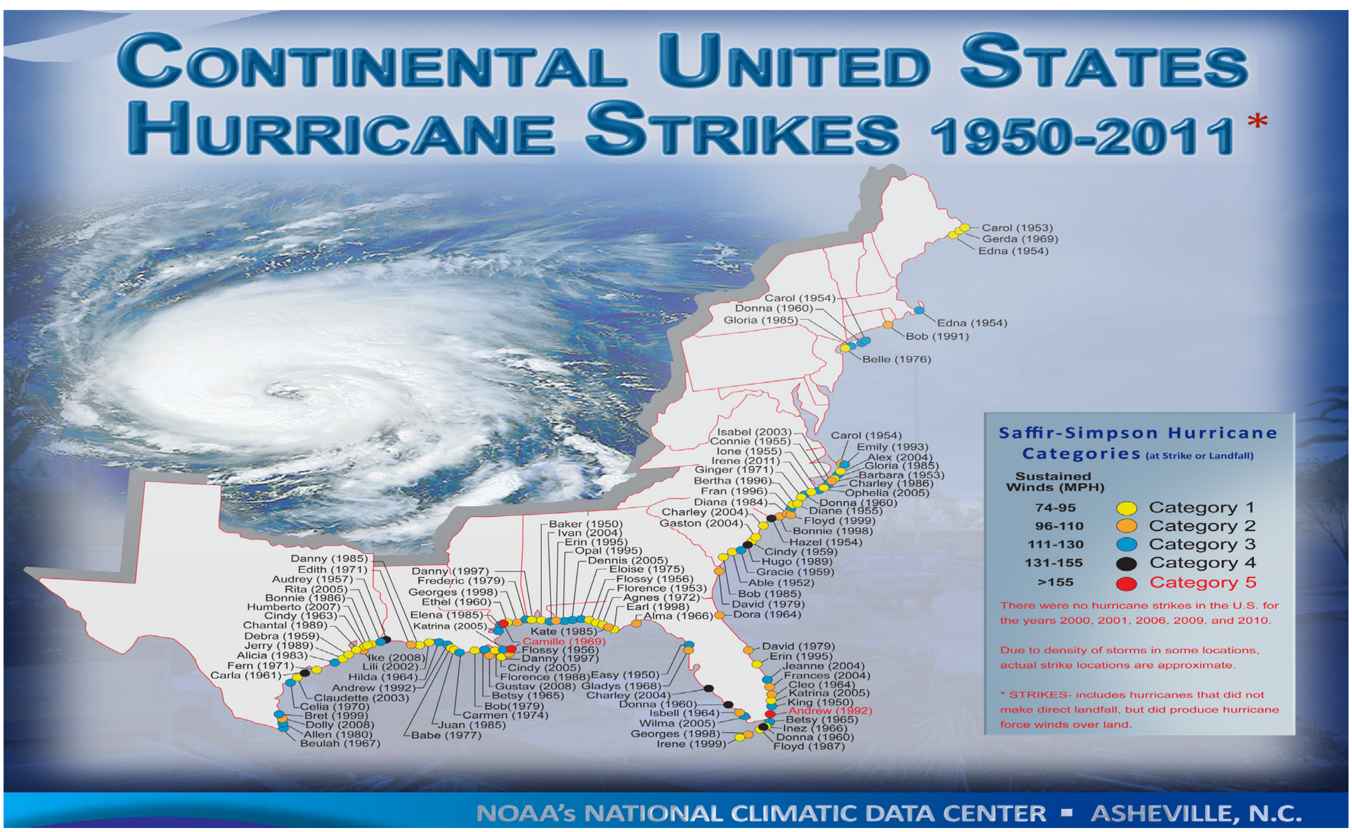

Figure 5. An overview of all the Hurricanes that have made landfall along the United States Coastline from 1950-2011. The colored circled corresponds to the "category" or strength of the Hurricane at the time of landfall.

References:

To learn more, visit the provided references:

Ahrens, C. D., 2007: Meteorology Today: An Introduction to Weather, Climate, and the Environment. Tomson Brooks/Cole, 406-412.

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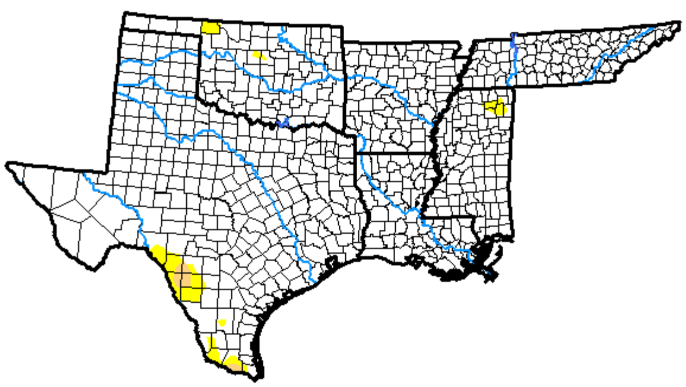
Please also contact Carly Kovacik at carly.kovacik@noaa.gov with any questions.

Drought Update

Kyle Brehe and Rudy Bartels,
Southern Regional Climate Center

Over the month of August 2017, drought conditions improved for most parts of the region, such as areas in Oklahoma and central and northern Texas. In contrast, drought conditions worsened in southern Texas. Currently, there are areas of moderate drought present in southwestern Texas. At this time there are no areas of severe, extreme, or exceptional drought. There are a few small areas of abnormally dry conditions in southern Texas, northern Oklahoma, and northeastern Mississippi.

Hurricane Harvey made landfall on August 25, 2017, in southeastern Texas, with major hurricane status. The hurricane stalled and dropped over 50 inches (1270 mm) of rain in parts of southeast Texas, which broke many records throughout the area. John Nielsen-Gammon, Texas state climatologist, reported that Hurricane Harvey averaged 34.72 inches (881.89 mm) of rain in the southeastern Texas region over five days, which broke the previous record of 21.39 inches (543.31 mm) for that region set in 1899. Some other reports coming in throughout the southeastern Texas region were Cedar Bayou reporting 52 inches (1320.8 mm) of rain, Houston reporting 43 inches (1092.2 mm) of rain and Beaumont receiving more than 45 inches (1143 mm) of rain. This event caused at least 60 deaths throughout the area.



Released Thursday, August 31, 2017

Chris Fenimore, NCEI/NESDIS/NOAA

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	97.51	2.49	0.44	0.00	0.00	0.00
Last Week *08-22-2017*	92.37	7.63	1.25	0.00	0.00	0.00
3 Months Ago *05-30-2017*	80.26	19.74	2.30	0.00	0.00	0.00
Start of Calendar Year *01-03-2017*	53.95	46.05	27.69	11.09	1.11	0.00
Start of Water Year *09-27-2016*	76.89	23.11	6.74	1.89	0.28	0.11
One Year Ago *08-30-2016*	82.95	17.05	5.45	1.28	0.00	0.00

Intensity:

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

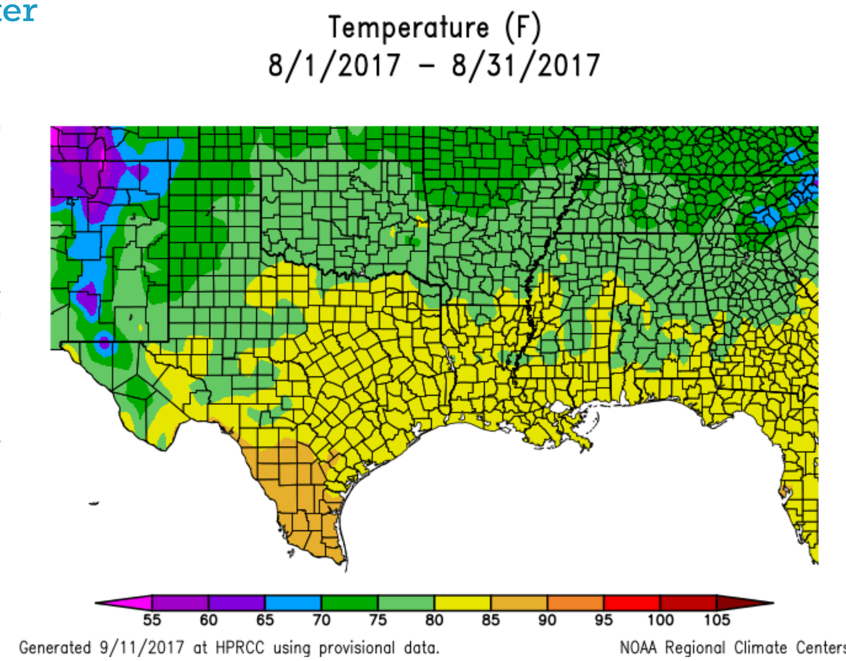
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Above: Drought Conditions in the Southern Region. Map is valid for August 29, 2017. Image is courtesy of the National Drought Mitigation Center.

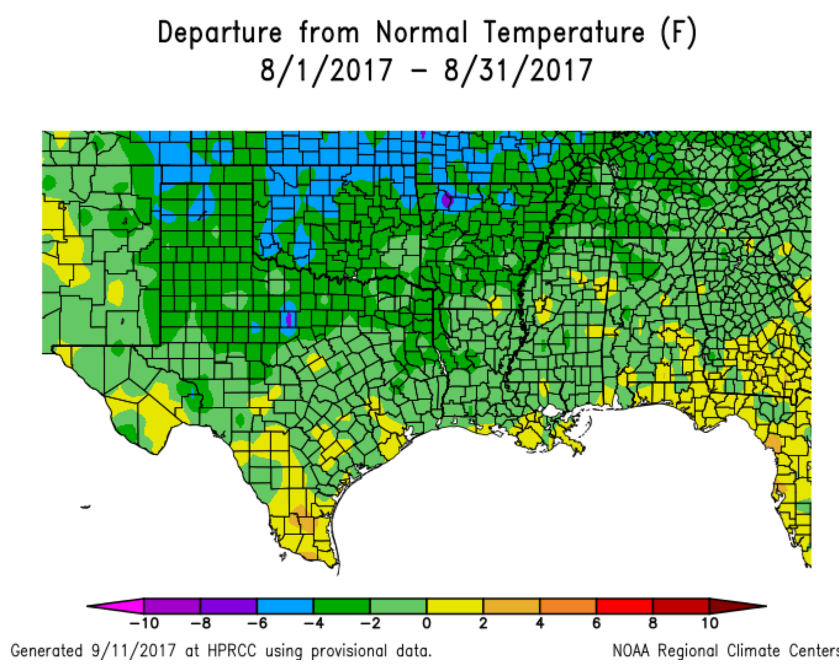
Temperature Summary

Kyle Brehe and Rudy Bartels,
Southern Regional Climate Center

August had below to near normal temperatures for most of the region. There were areas of 4 to 6 degrees F (2.22 to 3.33 degrees C) below normal in northern Texas, northern Arkansas, and northern and western Oklahoma. There was a small area in northwestern Arkansas that reported 6 to 8 degrees F (3.33 to 4.44 degrees C) below normal temperatures. Most of Oklahoma, Arkansas, northern Texas, northwestern Louisiana, northeastern Mississippi, and western and central Tennessee reported 2 – 4 degrees F (1.11 to 2.22 degrees C) below normal temperatures. There were clusters in Mississippi, southern Louisiana, and southern Texas that were near to slightly above normal temperatures. In extreme southern Texas there were two clusters of 2 to 4 degrees F (1.11 to 2.22 degrees C) above normal temperatures. The statewide monthly average temperatures were as follows: Arkansas reporting 76.80 degrees F (24.89 degrees C), Louisiana reporting 81.00 degrees F (27.22 degrees C), Mississippi reporting 79.40 degrees F (26.33 degrees C), Oklahoma reporting 77.20 degrees F (25.11 degrees C), Tennessee reporting 74.60 degrees F (23.67 degrees C), and Texas reporting 80.60 degrees F (27.00 degrees C). The state-wide temperature rankings for August are as follows: Arkansas (seventeenth coldest), Louisiana (thirty-sixth coldest), Mississippi (thirty-third coldest), Oklahoma (ninth coldest), Tennessee (twenty-third coldest), and Texas (thirtieth coldest). All state rankings are based on the period spanning 1895-2017.



Average August 2017 Temperature across the South

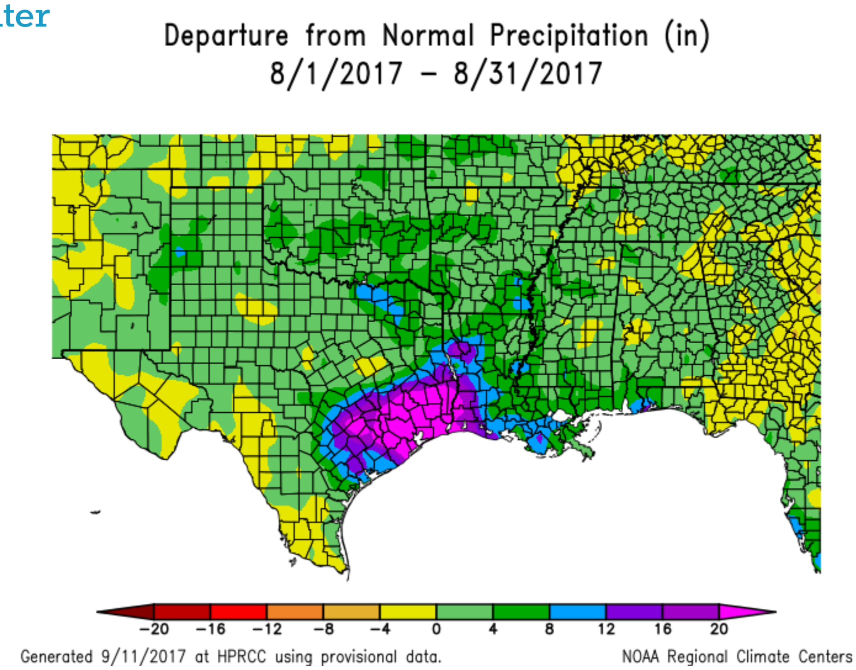


Average Temperature Departures from 1981-2010 for August 2017 across the South

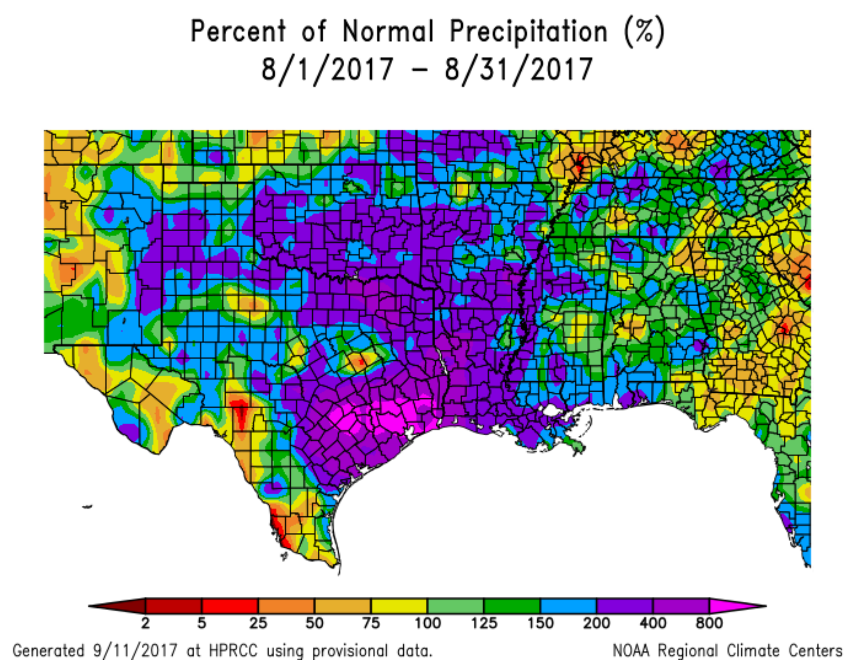
Precipitation Summary

Kyle Brehe and Rudy Bartels,
Southern Regional Climate Center

Precipitation values for the month of August were above normal for most of the Southern Region. Due to Hurricane Harvey, parts of western Louisiana and northeastern and southeastern Texas reported 400 percent or more of normal precipitation. Some areas in southeastern Texas reported 800 percent of normal precipitation. Central and southern Oklahoma, western and southern Arkansas, northern and eastern Texas, and most of Louisiana reported 200 – 400 percent of normal precipitation. There were also clusters in western Tennessee and northern, western, and southern Mississippi that reported 200 – 400 percent of normal precipitation. There were clusters of 50 – 75 percent of normal precipitation in southern Tennessee, and central and southwestern Texas. A few areas in southwestern Texas reported 2 – 25 percent of normal precipitation. The state-wide precipitation totals for the month are as follows: Arkansas reporting 5.95 inches (151.13 mm), Louisiana reporting 12.64 inches (321.06 mm), Mississippi reporting 6.90 inches (175.26 mm), Oklahoma reporting 6.20 inches (157.48 mm), Tennessee reporting 4.67 inches (118.62 mm), and Texas reporting 6.57 inches (166.88 mm). The state precipitation rankings for the month are as follows: Arkansas (tenth wettest), Louisiana (second wettest), Mississippi (eighth wettest), Oklahoma (third wettest), Tennessee (twenty-third wettest), and Texas (first wettest). All state rankings are based on the period spanning 1895-2017.

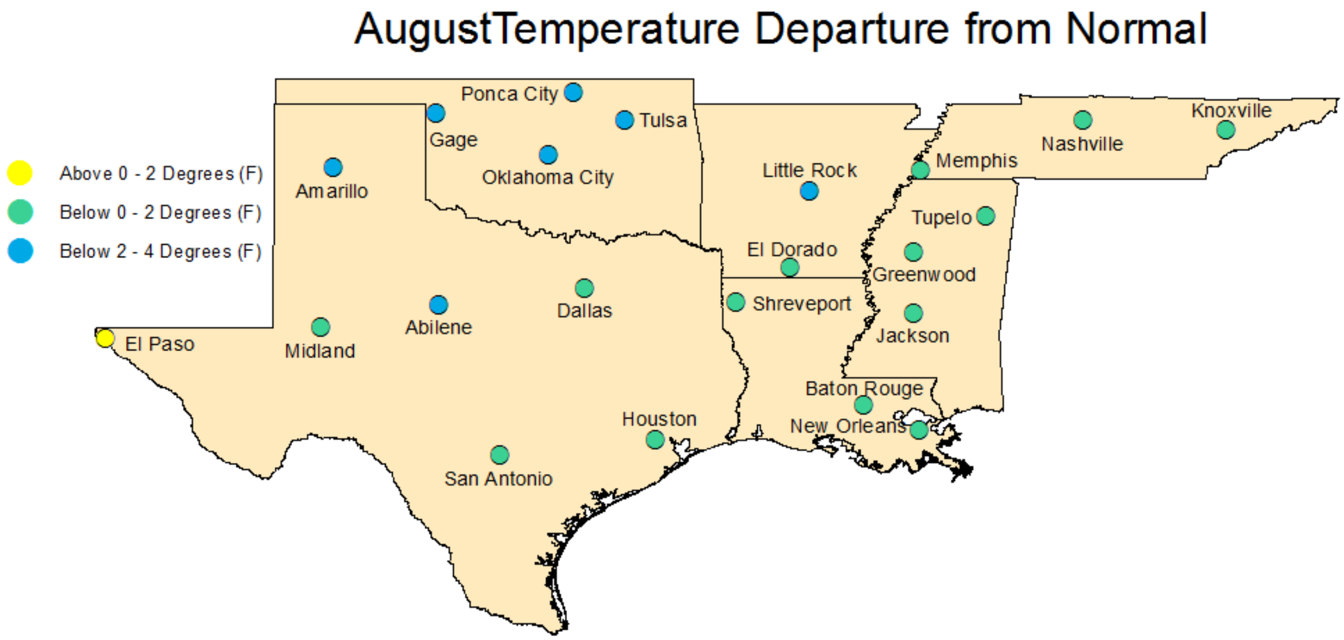


August 2017 Total Precipitation across the South

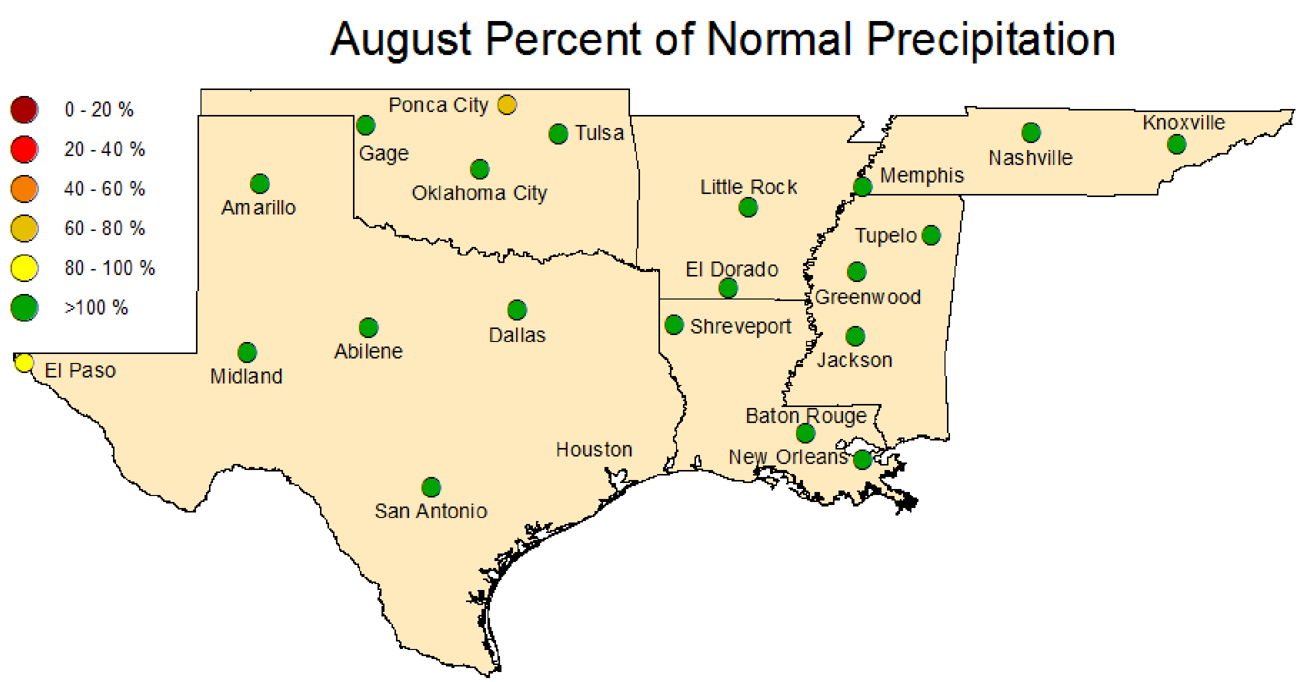


Percent of 1981-2010 normal precipitation totals for August 2017 across the South

Regional Climate Perspective in Pictures



August 2017 Temperature Departure from Normal from 1981-2010 for SCIPP Regional Cities



August 2017 Percent of 1981-2010 Normal Precipitation Totals for SCIPP Regional Cities

Climate Perspective

State	Temperature	Rank (1895-2017)	Precipitation	Rank (1895-2017)
Arkansas	76.80	17th Coldest	5.95	10th Wettest
Louisiana	81.00	36th Coldest	12.64	2nd Wettest
Mississippi	79.40	33rd Coldest	6.90	8th Wettest
Oklahoma	77.20	9th Coldest	6.20	3rd Wettest
Tennessee	74.60	23rd Coldest	4.67	23rd Wettest
Texas	80.60	30th Coldest	6.57	1st Wettest

State temperature and precipitation values and rankings for August 2017. Ranks are based on the National Climatic Data Center's Statewide, Regional, and National Dataset over the period 1895-2017.

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	87.7	71.7	79.7	-1.6	97	08/20	65	08/25	5.5	2.39	177
Little Rock, AR	86	70.5	78.3	-4.2	95	08/20	63	08/25	3.47	0.88	134
Baton Rouge, LA	89.6	73.7	81.7	-1.2	96	08/19	69	08/29	7.74	1.92	133
New Orleans, LA	90.1	76.1	83.1	-0.2	96	08/19	73	08/29+	15.77	9.79	264
Shreveport, LA	89.4	73.7	81.6	-1.5	97	08/20+	69	08/05	7.7	4.97	282
Greenwood, MS	88.9	71.1	80	-1	96	08/19	64	08/25	6.31	3.48	223
Jackson, MS	88.7	72.6	80.7	-0.6	95	08/15	67	08/01	6.72	2.48	158
Tupelo, MS	89.1	70	79.6	-1.2	97	08/19	61	08/25	4.3	0.85	125
Gage, OK	88.4	63.7	76.1	-3.1	102	08/05	52	08/30	4.44	2.05	186
Oklahoma City, OK	87	67.7	77.3	-5.1	99	08/05	61	08/29	7.13	3.85	217
Ponca City, OK	88	65.8	76.9	-4.1	100	08/05	55	08/30	2.46	-0.79	76
Tulsa, OK	88.2	68.8	78.5	-3.7	98	08/20+	59	08/30	6.07	3.17	209
Knoxville, TN	85.4	66.8	76.1	-1.7	91	08/22+	56	08/06	5.95	2.68	182
Memphis, TN	87.5	71.3	79.3	-2.6	95	08/21+	65	08/24	9.29	6.41	323
Nashville, TN	87.4	68	77.7	-1	96	08/20	58	08/05	8.32	5.15	262
Abilene, TX	90.4	68.7	79.6	-3.2	99	08/06+	57	08/30	3.86	1.27	149
Amarillo, TX	84.6	62.5	73.6	-3.2	95	08/05	53	08/31	7.4	4.49	254
El Paso, TX	92.8	70	81.4	0.3	99	08/07	64	08/31	2.01	0	100
Dallas, TX	93	75.8	84.4	-1.2	100	08/19+	71	08/31+	4.24	2.33	222
Houston, TX	91.3	76	83.7	-0.9	99	08/18	71	08/28	39.11	35.35	1040
Midland, TX	92.2	69.7	81	-0.2	100	08/06	58	08/31	2.52	0.68	137
San Antonio, TX	93.8	75.4	84.6	-0.7	100	08/05	65	08/31	5.87	3.78	281

Summary of temperature and precipitation information from around the region for August 2017. 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.

How Rare was the Houston Rainfall Event?

Barry D. Keim- Louisiana State Climatologist, Louisiana State University

With Hurricane Harvey now in the record books, lets see if this storm actually broke any records. Figure 1 below shows a bar chart of the daily rainfall at the wettest station in Houston through Hurricane Harvey's rainfall event. At this site, the largest 1-day rain was 26.56 inches, the largest 2-day rainfall was 32.88 inches, the 3-day total was 46.32, the 4-day total was 51.00, and over 5-days, the site recorded an amazing 51.88 inches. Rainfall statistics from the Southern Regional Climate Center show that a 100-year event was exceeded for 1-day, 2-day and 5-day totals, where 3-day and 4-day recurrence interval durations were unavailable. At the 5-day duration, the 100-year event is estimated at 26.30 inches, and this one location is Houston recorded a whopping 51.88 inches, which is nearly twice the rainfall estimate for the 100-year event.

Looking at this from another perspective, I examined data from Hydrometeorological Report 51 (HMR 51), which presents what the National Weather Service believes to be the upper limit of the atmosphere to produce rainfall. These values are called Probable Maximum Precipitation - or PMP - and are primarily used in the design of dams across the United States. At the 24-hour duration, HMR 51 suggests that the upper limit for a 10 square mile rainfall event could be as large as 47.1 inches, whereby the gauge analyzed with the largest total storm rainfall was 26.56 inches – which is only about 56 percent as large as the estimated PMP event. At the 2-day duration, HMR 51 indicates that 51.8 inches is the upper limit for a 10 square mile area. At two days, this same site recorded 32.88 inches – which is 63 percent of PMP. At 72-hours, HMR 51 indicates that 55.7 inches is possible, whereby in Hurricane Harvey 46.32 inches was recorded - 83 percent of the estimate PMP. I've looked at a large number of large rainstorms, and this 83 percent of PMP is about as close as I can remember a recent storm ever coming to the PMP estimates.

One of my friends, John Nielsen-Gammon - the Texas State Climatologist - has declared this recent storm to be the heaviest storm on record in the U.S., outside of Hawaii. This storm came in at 51.88 inches, breaking the previous record of 48 inches from Tropical Storm Amelia measured at Medina, Texas in 1978. So, bottom line this storm in not only in the record books to be recorded for posterity, it also literally in the record books, as the largest storm ever in the conterminous U.S. Please contact me with any questions at keim@lsu.edu.

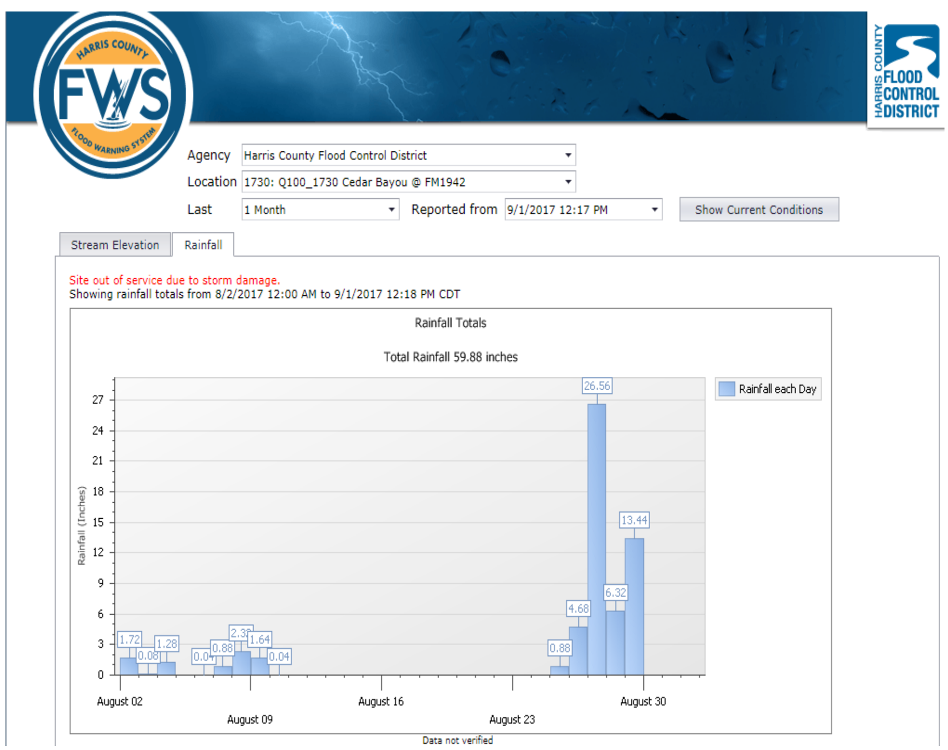


Figure 1. Daily rainfall totals from gauge: 1730: Q100_1730 Cedar Bayou @ FM1942, which is a part of the Harris County Flood Warning System. Graphic can be found at https://www.harriscountyfws.org/GageDetail/Index/1730?span=7%20Days&v=rainfall

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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 & www.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.

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From Our Partners

USDA Southern Plains Climate Hub:

August 31, 2017 : High School soil health agriculture curriculum distributed to Oklahoma FFA by Climate Hub

The USDA Southern Plains Climate Hub, in partnership with the USDA Natural Resources Conservation Service, Redlands Community College and the Soil Carbon Coalition have produced a soil health curriculum supplement for use in secondary school agriculture education and science classes.

Studies have shown that by improving the health of the soil, agriculture producers can increase the water holding capacity of the soil, reduce erosion, reduce fuel use, increase fertilizer efficiency and reduce greenhouse gas levels through carbon sequestration and emission reductions. This curriculum supplement is designed to expose Junior High and High School students to the concepts and practices involved in improving soil health and adapting to extreme weather events.

For more information contact Clay Pope, USDA Southern Plains Climate Hub Coordinator at 405-699-2087 or claygpope@gmail.com

Monthly Comic Relief