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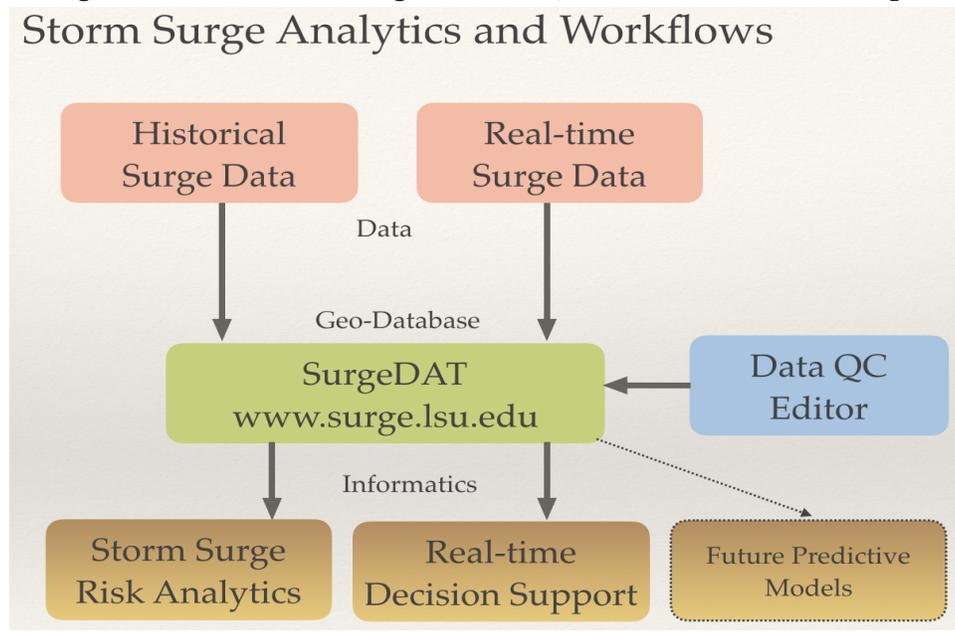
Big Data Workflows for Data-Driven Tools and Predictive Analytics

David Sathiaraj, Southern Regional Climate Center Associate Director

This article highlights the processes involved in developing Data-driven and Predictive Analytics workflows and provides brief overviews on 2 current case studies. In recent times, the word Big Data analytics is sometimes used in a narrower and simpler scope to workflows that include loading a comma-separated file into Excel and Tableau and viewing the results in bar plots and line charts. However, with the ubiquitous growth of measurements due to IoT devices and sensors and the continuous nature of the data stream, Big Data management and real-time information tools involve complex, multi-layer software and computing architectures.

The SCIPP information and data tools were developed, and currently managed and hosted by the Information Technology unit of the Southern Regional Climate Center (SRCC) at LSU. These data-driven tools are a product of a Big Data infrastructure that require continuous data ingest and processing capabilities, robust storage of and access to large data sets, and

web-based software that provide for real-time access to insights and analytics. Some of the active projects at the SRCC involve 2 Big Data domains – storm surge and river stage prediction. Building blocks to these infrastructure typically involve the following layers – a data layer (that collects data from different data sources), a consolidated database (includes routines that standardize data from different sources into a unified source) and an informatics/analytics layer (for decision support and to gain insights from the data). For SCIPP's storm surge infrastructure (SURGEDAT), a typical building block is depicted in the adjacent figure. Historical storm surge data that were collected and archived from multiple sources was combined with real-time surge data from NOAA tides and currents and USGS storm surge sensors. These data were consolidated into the spatiotemporal database, SurgeDAT. To ensure quality control of SurgeDAT observations, a QC editor was designed for data keepers to edit and add entries. Importantly, once the data layer is consolidated where data is continuously coming in, it forms a good foundation to generate decision support and analytical tools. 2 such active tools are Storm Surge Risk Analytics (that provides risk assessment and return frequency analysis on a web-based dashboard) and the other is a real-time storm surge decision support/tracker tool (provides real-time surge heights prior and during the landfall of a hurricane).



A new, ongoing project at the SRCC is the use of machine learning models to estimate storm surge in the US Gulf Coast by using the strong foundation of the data layer, SurgeDAT. This experimental work uses data from known tropical cyclone data sources, such as the National Hurricane Center's HURDAT2 database and the SCIPP's SURGEDAT database, to predict storm surge along coastal areas within a given radius of a selected point. These predictions are made using cutting-edge machine learning methodologies such as Support Vector Regression and Recurrent Neural Networks. By analyzing historical observations of storm surge from SURGEDAT and prevailing hurricane conditions from HURDAT and bathymetry values, machine learning models are trained to predict storm surge for future conditions.

The second project involves the real-time prediction of river stage along the US Inland Waterway system and involves machine learning algorithms. The work is part of a new grant award received from the Department of Energy (DoE). SRCC has partnered with a private industry partner, Trabus Technologies, on a DoE Small Technology Transfer Research (STTR) grant to develop a Voyage Planning Analytics Tool (VPAT) for the US Inland Waterway system. The main application for this tool is to enable the map-based planning

of voyages up and down the US Inland river systems (such as the Mississippi, Ohio, Illinois and Missouri rivers) for tow boat and barge operators, port terminal operators and river lock managers. River stage is an important factor in the optimal loading of barges. An inch of change in river levels can drastically impact the total barge capacity and potentially affect the generated revenue by several thousands of dollars. The work involves Big Data acquisition and processing systems that analyze more than 250 million points of information and nearly 12TB of distributed data resources that include data from hydrological, meteorological data, river lock status and marine safety domains. The observed data will be incorporated into machine learning models that will provide real-time water level insights that can be used for optimal barge loading configurations for different commodities or cargo.

The SRCC has recently invested in GPU-based computing of deep learning and machine learning based models and developing artificial intelligence based predictive insights from Big Data. The GPU based computing provides for faster computing of Big Data tasks such as developing predictive models and generating real time environmental insights. The GPU-based computing servers will be used for generating predictive insights for both of the above mentioned projects.

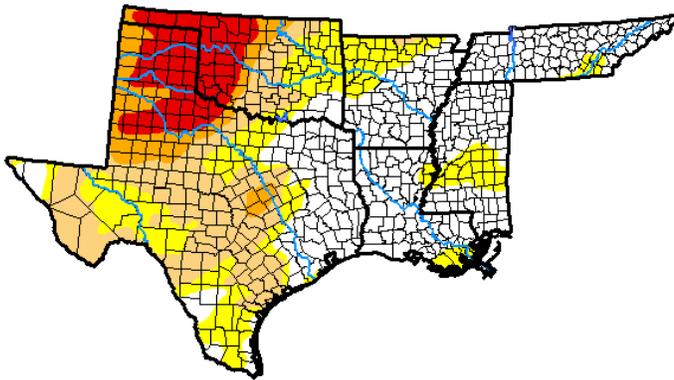
Drought Update

Kyle Brehe and Rudy Bartels,
Southern Regional Climate Center

Over the month of February 2018, extreme drought conditions expanded throughout parts of western Oklahoma and northern Texas. Severe drought conditions remained present in central Oklahoma, and northern and central Texas. Moderate drought conditions expanded throughout southern, central, and western Texas, and central and northeastern Oklahoma. Southeastern Tennessee, central Mississippi, northeastern and extreme southeastern Louisiana, northern Arkansas, eastern Oklahoma, and western, northern, central, and southern Texas are classified as abnormally dry. In contrast, conditions improved from extreme to no drought in central Arkansas.

In February, there were nine days with severe weather throughout the region. There were 103 severe weather events (11 tornadoes, 75 wind, and 17 hail events) reported throughout the Southern Region. Eight of the tornado events and 52 of the wind events occurred in Arkansas and Tennessee on February 24. The February 24 event also injured eight people, seven in Tennessee and one in Arkansas. The majority of hail events occurred on February 6 in Texas and Mississippi.

On February 28, 2018, three wind events were reported throughout Texas and Louisiana. A wind event in Caddo, Louisiana caused a utility pole to be snapped.



Released Thursday, February 27, 2018
Deborah Bathke, National Drought Mitigation Center

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	41.89	58.11	36.90	16.97	10.17	0.00
Last Week <i>02-20-2018</i>	28.44	71.56	55.73	33.47	10.85	0.00
3 Months Ago <i>11-28-2017</i>	27.70	72.30	41.44	13.44	1.59	0.00
Start of Calendar Year <i>01-02-2018</i>	31.09	68.91	42.64	15.33	0.30	0.00
Start of Water Year <i>09-26-2017</i>	72.17	27.83	2.38	0.02	0.00	0.00
One Year Ago <i>02-28-2017</i>	51.08	48.92	19.35	7.59	0.35	0.00



Above: Drought Conditions in the Southern Region. Map is valid for March 1, 2018. Image is courtesy of the National Drought Mitigation Center.

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.

Southern Climate Monitor

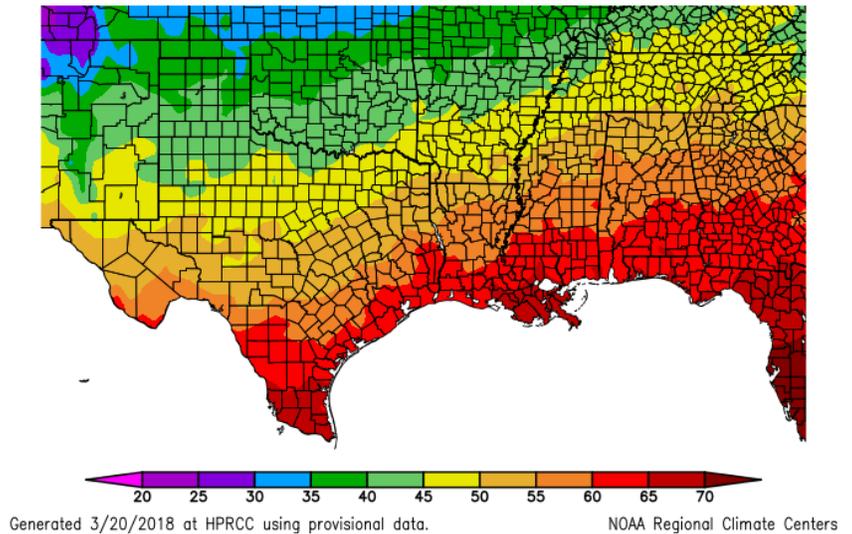
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Temperature Summary

Kyle Brehe and Rudy Bartels,
Southern Regional Climate Center

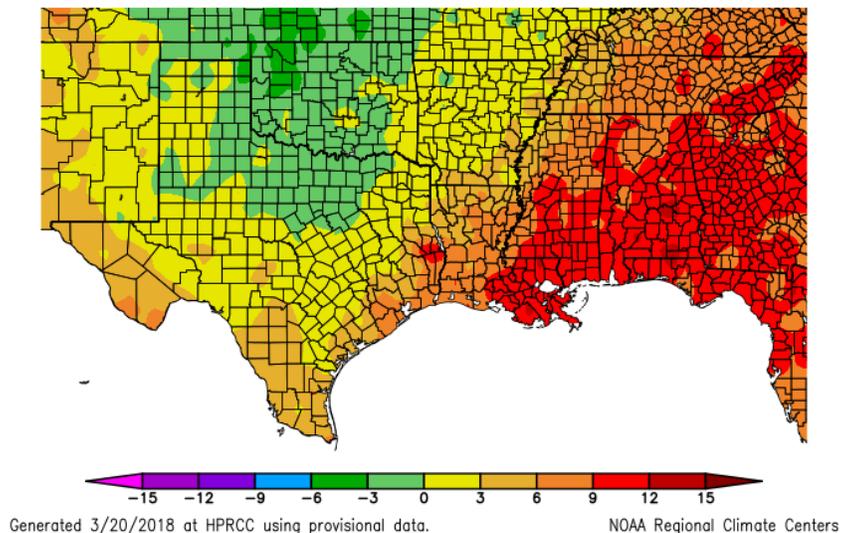
February temperatures had a defined gradient throughout the Southern Region. In northern Oklahoma and a small area of northern Texas temperatures were 3 to 6 degrees F (1.67 to 3.33 degrees C) below normal. Most of Oklahoma and northern Texas had slightly below normal temperatures. In contrast, southeastern Louisiana, eastern Tennessee, central and southern Mississippi, and a small part of eastern Texas were 9 to 12 degrees F (5 to 6.67 degrees C) above normal. Central Tennessee, northern Mississippi, and southwestern, southern, central, and northeastern Louisiana were 6 to 9 degrees F (3.33 to 5 degrees C) above normal. The statewide monthly average temperatures were as follows: Arkansas – 45.60 degrees F (7.56 degrees C), Louisiana – 60.30 degrees F (15.72 degrees C), Mississippi – 56.80 degrees F (13.78 degrees C), Oklahoma – 40.50 degrees F (4.72 degrees C), Tennessee – 48.40 degrees F (9.11 degrees C), and Texas – 52.20 degrees F (11.22 degrees C). The statewide temperature rankings for February were as follows: Arkansas (thirty-seventh warmest), Louisiana (fourth warmest), Mississippi (fourth warmest), Oklahoma (fifty-fifth coldest), Tennessee (third warmest), and Texas (twenty-eight warmest). All state rankings are based on the period spanning 1895-2018.

Temperature (F)
2/1/2018 – 2/28/2018



Average February 2018 Temperature across the South

Departure from Normal Temperature (F)
2/1/2018 – 2/28/2018



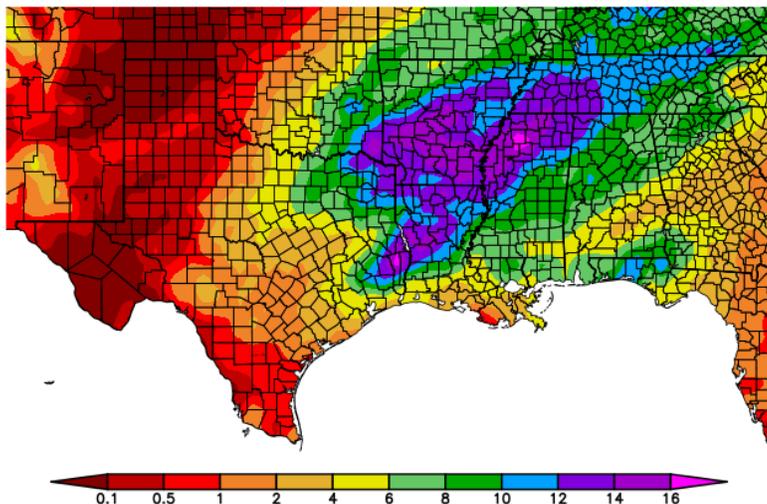
Average Temperature Departures from 1981-2010 for February 2018
across the South

Precipitation Summary

Kyle Brehe and Rudy Bartels,
Southern Regional Climate Center

Precipitation values for the month of February varied spatially throughout the Southern Region. Parts of eastern Texas, central Louisiana, southeastern Oklahoma, western Tennessee, northwestern Mississippi, and central, northeastern, and western Arkansas received 300 percent or more of normal precipitation. Northern Louisiana, northeastern and eastern Texas, eastern Oklahoma, western and central Tennessee, northern and central Mississippi, and northern, eastern, and southern Arkansas received 200 – 300 percent of normal precipitation. In contrast, parts of western Oklahoma and northern and southwestern Texas received 5 percent or less of normal precipitation. Parts of northern, western, central, and southern Texas, northwestern Oklahoma, and extreme southeastern Louisiana received 5 – 50 percent of normal precipitation. The state-wide precipitation totals for the month were as follows: Arkansas – 11.67 inches (296.42 mm), Louisiana – 8.05 inches (204.47 mm), Mississippi – 10.42 inches (264.67 mm), Oklahoma – 3.92 inches (99.57 mm), Tennessee – 10.56 inches (268.22 mm), and Texas – 2.38 inches (60.45 mm). The state precipitation rankings for the month were as follows: Arkansas (first wettest), Louisiana (eighth wettest), Mississippi (second wettest), Oklahoma (fourth wettest), Tennessee (first wettest), and Texas (seventeenth wettest). All state rankings are based on the period spanning 1895-2018.

Precipitation (in)
2/1/2018 – 2/28/2018

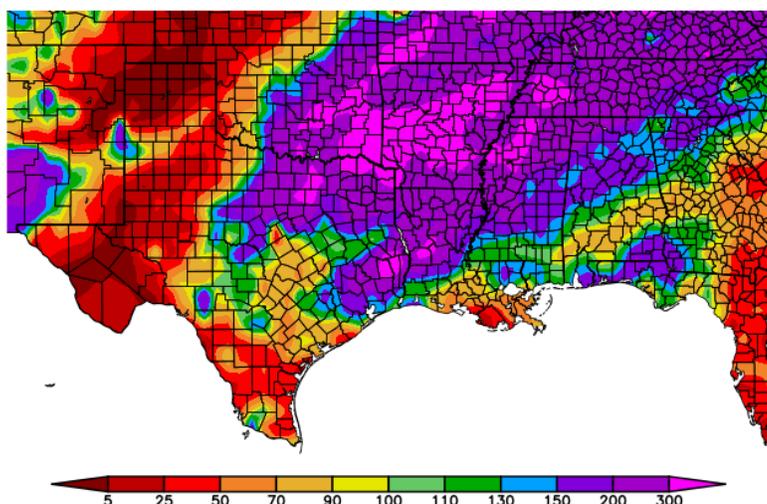


Generated 3/20/2018 at HPRCC using provisional data.

NOAA Regional Climate Centers

February 2018 Total Precipitation across the South

Percent of Normal Precipitation (%)
2/1/2018 – 2/28/2018



Generated 3/20/2018 at HPRCC using provisional data.

NOAA Regional Climate Centers

Percent of 1981-2010 normal precipitation totals for February 2018
across the South

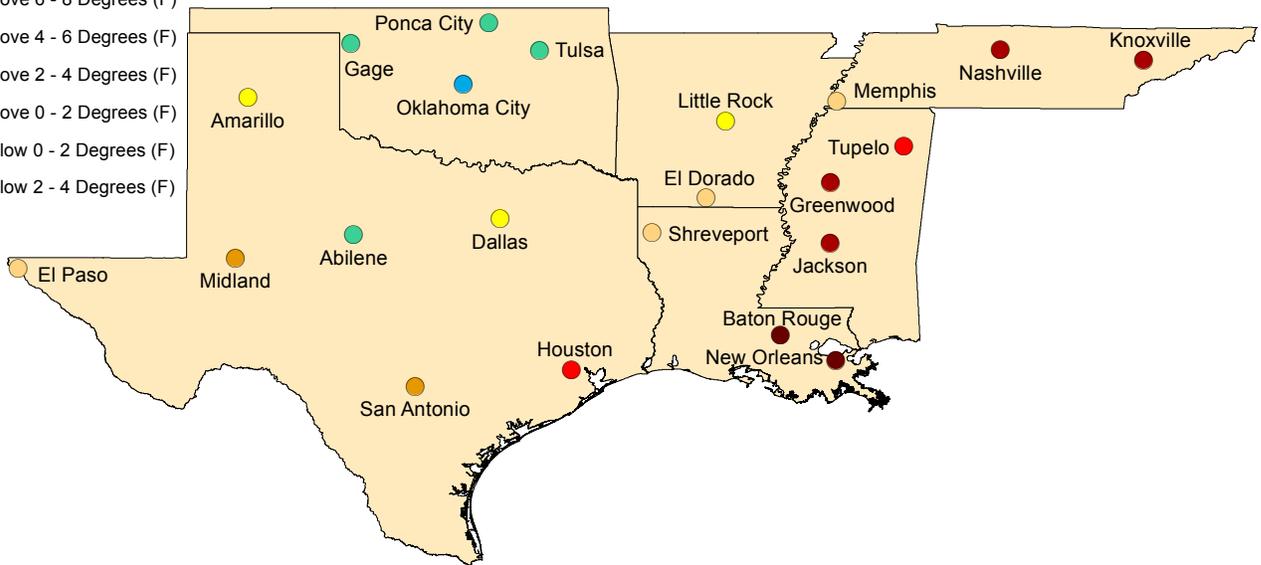
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Regional Climate Perspective in Pictures

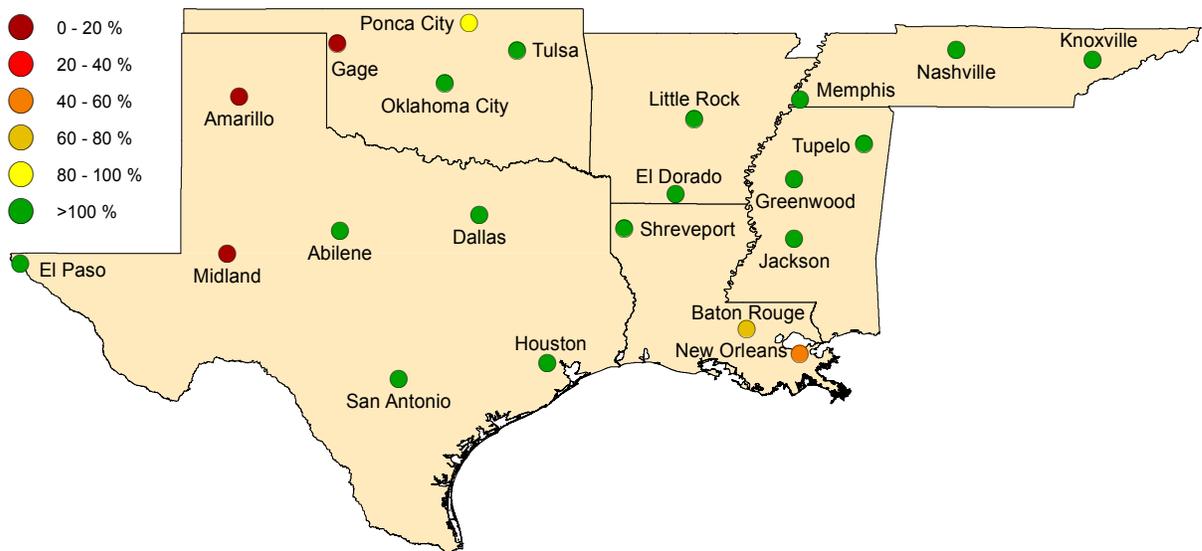
- Above 10 - 12 Degrees (F)
- Above 8 - 10 Degrees (F)
- Above 6 - 8 Degrees (F)
- Above 4 - 6 Degrees (F)
- Above 2 - 4 Degrees (F)
- Above 0 - 2 Degrees (F)
- Below 0 - 2 Degrees (F)
- Below 2 - 4 Degrees (F)

February Temperature Departure from Normal



February 2018 Temperature Departure from Normal from 1981-2010 for SCIPP Regional Cities

February Percent of Normal Precipitation



February 2018 Percent of 1981-2010 Normal Precipitation Totals for SCIPP Regional Cities

Climate Perspective

State	Temperature	Rank (1895-2018)	Precipitation	Rank (1895-2018)
Arkansas	45.60	37 th Warmest	11.67	1 st Wettest
Louisiana	60.30	4 th Warmest	8.05	8 th Wettest
Mississippi	56.80	4 th Warmest	10.42	2 nd Wettest
Oklahoma	40.50	55 th Coldest	3.92	4 th Wettest
Tennessee	48.40	3 rd Warmest	10.56	1 st Wettest
Texas	52.20	28 th Warmest	2.38	17 th Wettest

State temperature and precipitation values and rankings for February 2018. Ranks are based on the National Climatic Data Center's Statewide, Regional, and National Dataset over the period 1895-2018.

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	60.6	42.9	52	4.2	81	02/20	25	02/08+	11.84	7.05	247
Little Rock, AR	55.9	36.5	46.2	1.4	81	02/20	20	02/05	14.04	10.38	384
Baton Rouge, LA	74.4	56	65.2	10.1	87	02/22+	39	02/08+	4.02	-1.02	80
New Orleans, LA	76.4	59.7	68	11.3	84	02/22+	44	02/03	3.09	-2.21	58
Shreveport, LA	63.4	46.2	54.8	4.2	82	02/19	29	02/08	9.21	4.46	194
Greenwood, MS	65.4	46.3	55.9	8.4	83	02/20	27	02/08	13.79	9.37	312
Jackson, MS	69.9	48.8	59.4	9.9	86	02/22	27	02/03	10.53	5.77	221
Tupelo, MS	62.6	43.5	53	7.1	79	02/24	23	02/02	12.98	8.02	262
Gage, OK	52.2	23	37.6	-1.1	83	02/14	6	02/12	0.13	-0.66	16
Oklahoma City, OK	52.1	28.5	40.3	-3.4	80	02/15	10	02/05	2.63	1.05	166
Ponca City, OK	50.8	26	38.4	-1.3	78	02/15	6	02/12	1.15	-0.19	86
Tulsa, OK	53.5	30.5	42	-0.3	82	02/15	11	02/12	4.82	2.97	261
Knoxville, TN	59.6	41.9	50.8	8.3	81	02/22	19	02/03	8.28	4.02	194
Memphis, TN	59	40.6	49.8	4.3	77	02/20+	24	02/05+	13.43	9.04	306
Nashville, TN	59.7	40.6	50.1	8.4	82	02/23	19	02/02	10.91	6.97	277
Abilene, TX	61	34.1	47.5	-1.1	82	02/15	16	02/05	2.41	1.05	177
Amarillo, TX	57.3	25.4	41.3	1	78	02/14	12	02/05	0.01	-0.55	2
El Paso, TX	68.1	42.7	55.4	5.3	76	02/05	30	02/26	0.67	0.21	146
Dallas, TX	61.3	40.9	51.1	1.2	82	02/15	25	02/05	11.31	8.64	424
Houston, TX	70.8	54.2	62.5	6.1	83	02/28	36	02/12	5.73	2.53	179
Midland, TX	66.4	36.4	51.4	2.9	84	02/14	24	02/11	0.04	-0.67	6
San Antonio, TX	67.4	49.4	58.4	2.8	84	02/28	30	02/12	1.91	0.12	107

Summary of temperature and precipitation information from around the region for February 2018. 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. Blushaded 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.

NOAA's Spring Outlook

Margret Boone, SCIPP Program Manager

On March 15, 2018, the NOAA Climate Prediction Center (CPC) released the Spring Outlook for the United States. There are four outlooks included: Spring Flood Risk Potential, US Temperature Outlook, US Precipitation Outlook, and the Seasonal Drought Outlook. The Spring Flood Risk Outlook reflects the months of March, April and May, whereas the Temperature, Precipitation, and Drought Outlooks reflect the month of April, May and June.

The Spring Flood Risk Outlook depicts regions that are vulnerable to minor, moderate, or major flooding. These areas are considered vulnerable due to the underlying precipitation conditions (i.e. wet winter, saturated soils, etc.). The Spring Flood Risk Outlook shows areas along the Mississippi River may see an enhanced risk of minor to moderate flooding this Spring (Figure 1).

The U.S. Temperature Outlook (Figure 2) for this Spring illustrates the probability of regions seeing either cooler than normal (blue colors), or warmer than normal temperatures (red colors). Areas shaded in white have equal chances of

cooler than normal or warmer than normal temperatures. There is at least a 33% chance of warmer than normal temperatures across the southern two-thirds of the United States, with areas of the Southwest, Southern Plains, and Gulf Coast region having 60%-80% chance of warmer than normal temperatures. A small region of Montana, Idaho, and North Dakota has at a least 33% of cooler than normal temperatures.

The U.S. Precipitation Outlook (Figure 3) for this Spring visualizes the probability of drier than normal or wetter than normal conditions across the United States. Like the Temperature Outlook, areas in white have equal chances of drier than normal or wetter than normal conditions. Areas from Oregon to California and southeastward to Louisiana and Texas have a 33% to 40% chance of drier than normal conditions. From Montana into the Great Lakes and Northeast, along with most of Alaska and Hawaii, have a 33% to 40% of wetter than normal conditions. The rest of United States has equal chances of either drier than normal or wetter than normal conditions.

The Seasonal Drought Outlook (Figure 4) depicts trends in drought conditions across the United States. Most drought-stricken areas are likely to see drought persist throughout April, May and June. Some areas in the West and Southwest will likely see drought development, especially near current areas of ongoing drought conditions. Drought reduction and removal may occur in the northern High Plains, and eastern regions of Kansas and Oklahoma. As a reminder, these are trends based on short and long-range forecasts, and could change.

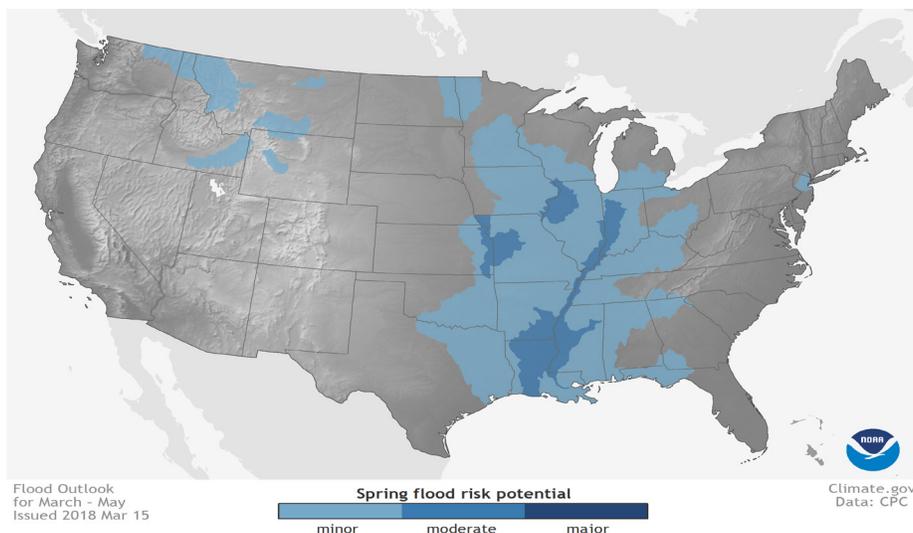


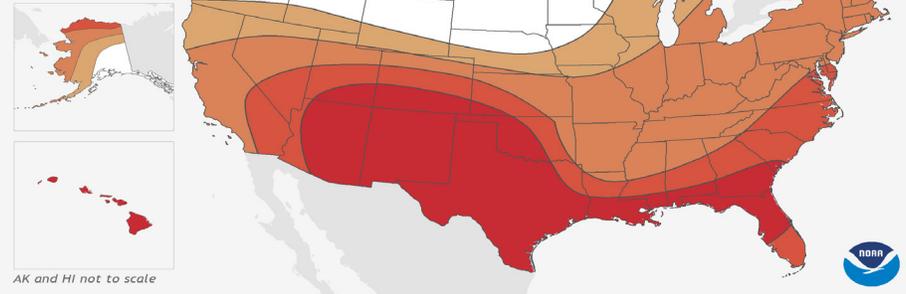
Figure 1: Spring Flood Risk Outlook (<https://www.climate.gov/news-features/videos/noaas-mike-halpert-explains-agencys-2018-spring-climate-outlook>)

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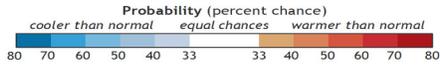
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Spring 2018

U.S. Temperature Outlook



Temperature Outlook for Apr 2018 – Jun 2018
Issued 15 March 2018



NWS Climate Prediction Center
Map by NOAA Climate.gov

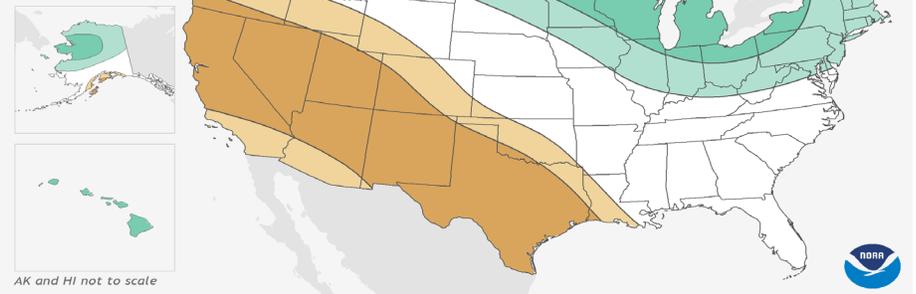
Figure 2 (left): U.S. Spring Temperature Outlook for April, May and June. (http://www.cpc.noaa.gov/products/predictions/long_range/lead01/off01_temp.gif)

Figure 3 (right): U.S. Spring Precipitation Outlook for April, May and June.

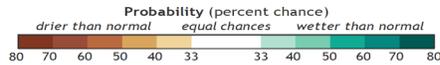
(http://www.cpc.noaa.gov/products/predictions/long_range/lead01/off01_prpc.gif)

Spring 2018

U.S. Precipitation Outlook

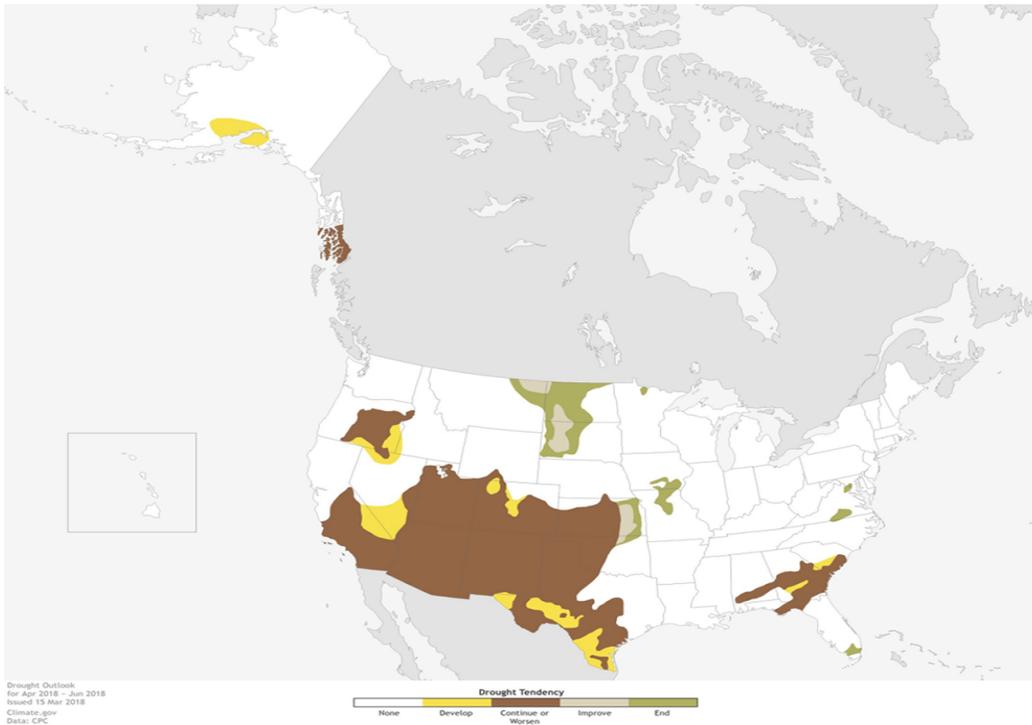


Precipitation Outlook for Apr 2018 – Jun 2018
Issued 15 March 2018



NWS Climate Prediction Center
Map by NOAA Climate.gov

Figure 4: Seasonal Drought Outlook for April, May and June. (http://www.cpc.noaa.gov/products/expert_assessment/season_drought.png)



Drought Outlook for Apr 2018 – Jun 2018
Issued 15 Mar 2018
Climate.gov
Data: CPC



Southern Climate Monitor Team

[Kyle Brehe](#), Regional Climatologist
Southern Regional Climate Center (LSU)

[Ty Dickinson](#), Student Assistant SCIPP (OU)

[Margret Boone](#), Program Manager SCIPP (OU)

[Alan Black](#), Program Manager SCIPP (LSU)

From Our Partners

South Central Climate Science Center: Early Career Researcher Development Training

February 19, 2018: We are pleased to announce our third Early Career Researcher Professional Development Training designed for graduate students, postdocs, and early career researchers (i.e., graduated within the last five years) from any discipline conducting climate-related research with relevance to the south-central U.S. (i.e., New Mexico, Texas, Oklahoma, Louisiana, or Texas/Louisiana coast). This immersive five-day training will include a series of lectures, team activities, and field trips exploring Louisiana's water and climate challenges. Participants will have the unique opportunity to converse with scientists, communicators, stakeholders, and decision-makers dealing with 'on the ground' environmental and climate impacts. Participants will learn effective communication strategies for sharing their research, how to develop multi-disciplinary research proposals, engaging in actionable science, and team-building.

If you have any questions, please do not hesitate to contact us by emailing info@southcentralclimate.org.

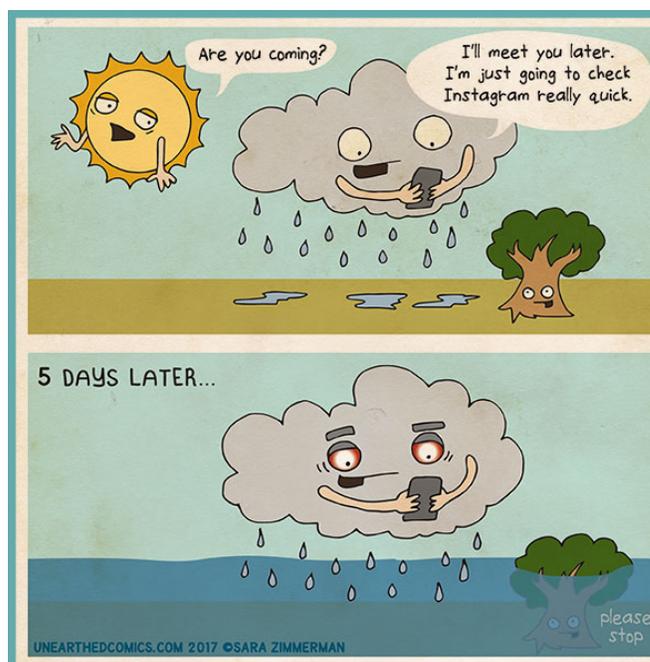
Contact Us

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.

Monthly Comic Relief



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