Southern Climate Monitor

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Photos by Katy Christian

Southern Climate Impacts Planning Program
A NOAA RISA Team

In This Issue:

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Growing Shale Gas Production Leads to Questions about Methane Leakage: Is It Low Enough to Protect Climate?

Marilu Hastings, Sustainability Program Director
The Cynthia and George Mitchell Foundation

We have all heard by now of the potential of new supplies of unconventional natural gas to revolutionize U.S. security, economic growth, and climate protection. These new supplies are made possible through the application of hydraulic fracturing and horizontal drilling to shale formations. Up until about eight years ago these hard formations, that were long known to contain huge quantities of natural gas, were off limits to development due to technological and economic barriers. Now that the key to shale development has been found, these natural gas supplies are unlocked. The growth in the supply and development of these resources is profound as illustrated in Figure 1 below. Note how large production is from major shale plays in the SCIPP region, including the Barnett, Haynesville, Woodford and Fayetteville. The U.S. Energy Information Agency (EIA) estimates that shale gas production will grow 113% from 2011 through 2040. The distribution of these resources is expected to continue shifting, especially to the Haynesville shale.[1] Natural gas development in these states will continue to impact their economic development and environment.

A prolonged debate surrounds the extraction and use of these new natural gas resources. On one hand, supporters say that shale resources provide us with the opportunity to increase U.S.-based manufacturing due to reliable, accessible and low-cost supplies of natural gas as inputs to these industrial processes. Areas like Corpus Christi, Texas are seeing a dramatic growth in facility siting due to the proximity of huge supplies of natural gas in the Eagle Ford. Although natural gas itself is not a mainstream transportation fuel, proponents of shale development claim that the U.S. can be more energy "independent" and enjoy enhanced national security by transitioning to natural gas vehicles. Several large oil and gas companies have put significant R&D and lobbying resources into the promotion of these new vehicles. Finally, the 9% drop in U.S. carbon emissions since 2007 is due in part to trends in fuel switching from coal to natural gas in the generation of electricity as shown in Figure 2.

In addition to carbon reductions, natural gas generation requires less or no water for cooling compared to coal, and there are low or no associated air emissions from natural gas.[2] If the full lifecycle environmental impacts of coal and gas from extraction through generation are compared, natural gas still nets out as a positive alternative to coal for electricity production.[3]

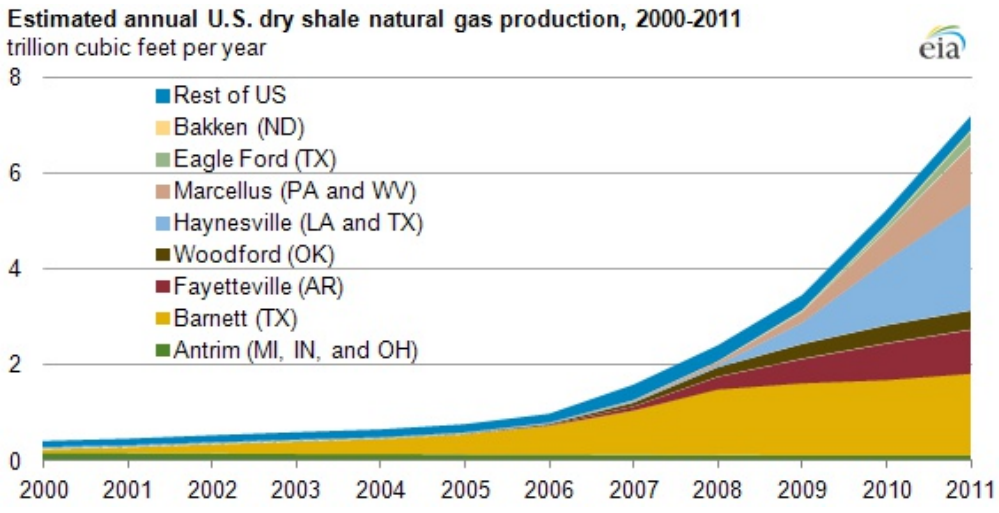


Figure 1: U.S. Energy Information Agency, "Today in Energy" (EIA, March 13, 2012

But there are challenges to the benefits of natural gas. Many groups and some scientists make the argument that the

environmental impacts of the technology itself – hydraulic fracturing – are significant enough to warrant a ban on these drilling activities. Some states, including New York, and local areas, including Flower Mound, Texas have adopted such a ban. In general, worries about groundwater and surface water contamination; air pollution from dust, silica and generators; and nuisance complaints from truck traffic and road degradation arise in communities where drilling activities are novel and the pace of drilling is unprecedented.

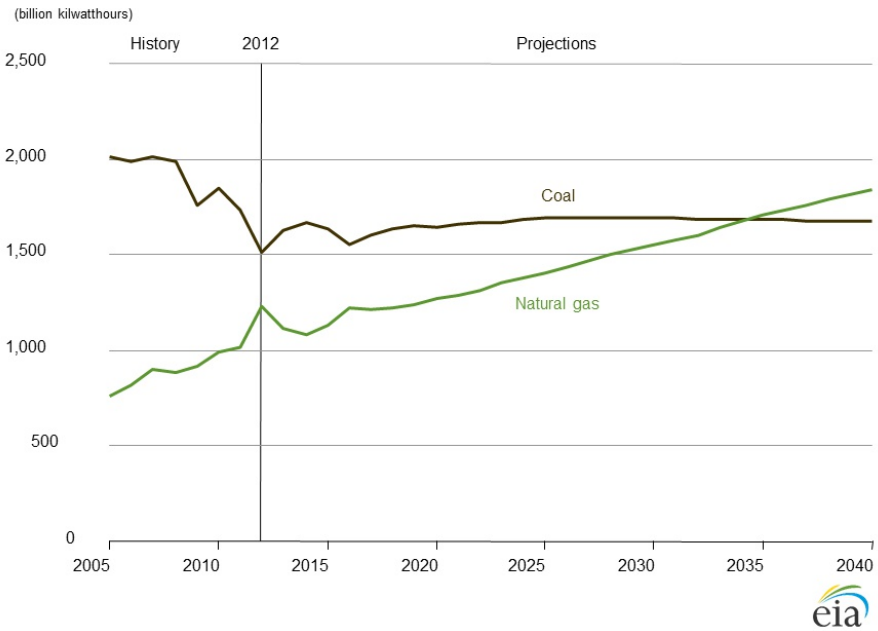


Figure 2: Electricity generation from natural gas and coal, 2005 to 2040. U.S. Energy Information Agency, "Annual Energy Outlook Early Release", December 13, 2013

For some climate scientists and advocates the most pressing concern about increased natural gas development and use is impact on greenhouse gas (GHG) emissions. Methane is an important GHG that has 20 times more Global Warming Potential (GWP) than carbon dioxide.[4] That is, methane emitted today, while it will only stay in the atmosphere for about ten years, absorbs much more energy compared to carbon dioxide. GWP is calculated based on how long a GHG stays in the atmosphere combined with its energy trapping power.

The actual level of methane escaping to the atmosphere due to oil and gas operations is a question that has received significant attention from the climate science community. Over 200 studies of how much methane escapes into the atmosphere have been conducted over 20 years. Recent studies have resulted in leakage estimates that vary from below 1% of methane production to as much as 8% for estimates based on site-specific testing.[5] Regional studies have estimated leakage rates as high as 17%.[6] The Environmental Protection Agency's most recent estimates conclude that methane leakage is about 1.5%. Understanding the actual leakage rate of methane is critical. If leakage is above an accepted threshold of 3.2%, the net climate benefits of increased reliance on natural gas are negated. Leakage above this threshold would indicate that natural gas is, on net, worse for the climate than fuels that emit more carbon dioxide.[7]

The Cynthia and George Mitchell Foundation commissioned a study to better understand why such a large variation in methane estimates occurs. A team of 16 scientists from around the U.S. conducted a meta-analysis of the 200 existing leakage studies.[8] The study found that much of the variation is due to the different methodologies used to derive methane leakage estimates. The EPA uses a "bottom-up" approach that estimates how much gas is leaking from each separate component of the natural gas system, such as valves, pipes, wells, and multiplies that leakage by the total number of those components in the entire system. Other types of estimates use a "top-down" methodology in which airplanes are commonly used to measure methane in the

atmosphere on a regional or national scale. The science team found that the bottom-up estimates are probably too low due to the inability of such specific sampling to capture "super emitters" like broken valves or compressors that may be responsible for a vast majority of methane leaks. The study found that the national atmospheric estimates are probably the most reliable. Based on this conclusion, total U.S. methane emissions might be about 25 to 75 percent higher than EPA estimates.

Despite this finding, the study team calculates that fuel switching from coal to natural gas for power production is still below the 3.2% threshold necessary to reduce greenhouse effects. However, switching diesel-fueled fleet vehicles to natural gas does not net out positive for climate due to the inherent leakiness of the distribution system. Another important conclusion from the study is that reducing avoidable methane leaks throughout the natural gas system is relatively easy in terms of technological fixes and financial feasibility. Two new studies on the cost-effectiveness of methane control technologies also demonstrate that these fixes are both effective and economical.[9,10]

Recently the Obama Administration announced its interagency strategy to reduce methane emission across the nation. The EPA, Department of Energy and Department of Interior developed voluntary actions and standards that target specific sources for reduction. Natural gas systems are not alone in emitting methane but account for 30% of emissions from 1990-2011 according to EPA.[11] Not all progress in methane leakage control will be accomplished through voluntary action. Colorado and Ohio have recently passed new regulations on methane emission limits. If natural gas operators elect to implement new voluntary standards and regulations, the industry will make important progress in ensuring that new supplies of natural gas are developed in such a way that the climate is protected and the U.S. economy thrives.

References

[1] U.S. Energy Information Agency, "Annual Energy Outlook 2013," April 15, 2013

[2] Center for Climate and Energy Solutions, "Leveraging Natural Gas to Reduce Greenhouse Gas Emissions." June 2013.

[3] E.A. Grubert, et al., "Can switching fuels save water? A life cycle quantification of freshwater consumption for Texas coal- and natural gas-fired electricity." Environmental Research Letters 7 045801 (11 pp) (2012).

[4] EPA, "Draft Inventory of U.S. Greenhouse gas emissions and sinks: 1990-2012" (EPA, 2014).

[5] A.R. Brandt et al. "Methane leaks from North American natural gas systems." Science. Vol. 343 pp. 733-735. February 14, 2014.

[6] J. Peischel et al., Journal of Geophysical Research. 118, 4974 (2013).

[7] R.A. Alvarez et al., "Greater focus needed on methane leakage from natural gas infrastructure," Proceedings of the National Academy of Sciences. 109, 6435 (2012).

[8] Ibid., A. R. Brandt et al.

[9] Carbon Limits, Quantifying Cost-effectiveness of Systematic Leak Detection and Repair Programs Using Infared Cameras. CL report CL-13-27. March 2014.

[10] ICF International, Economic Analysis of Methane Emission Reduction Opportunities in the U.S. Onshore Oil and Natural Gas Industries. March 2014.

[11] EPA, "Draft Inventory of U.S. Greenhouse gas emissions and sinks: 1990-2012" (EPA, 2014).

Drought Update

Luigi Romolo
Southern Regional Climate Center

Drought conditions in the Southern Region changed significantly over the past month. Persistently dry conditions in March, especially in western Oklahoma, northern Texas and central Texas, has led to an expansion of extreme drought. Last month, approximately six to seven percent of the Southern Region was in extreme drought or worse. As of April 1, 2014, that number has increased to just over seventeen percent. Much of north central Oklahoma has also been downgraded by one factor from moderate drought to severe drought. Other areas of drought change include northern Mississippi, where several counties are now experiencing moderate drought conditions.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	41.17	58.83	43.21	27.44	17.46	5.38
Last Week *4/1/2014*	34.69	65.31	45.56	27.99	17.02	3.38
3 Months Ago *1/7/2014*	55.41	44.59	27.25	13.05	3.58	0.72
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 *4/9/2013*	29.39	70.61	57.93	43.15	19.96	6.98

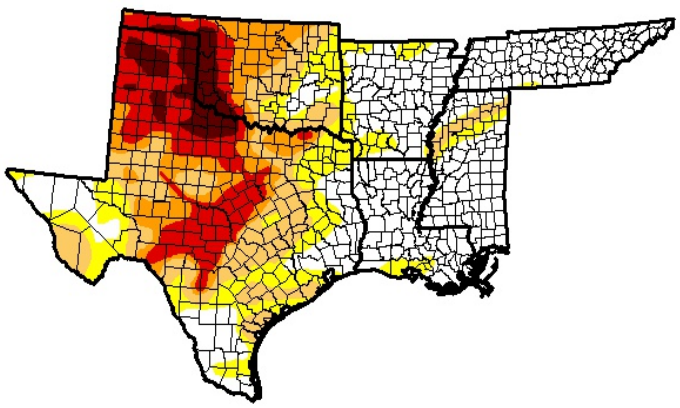
Intensity:

- *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, on top of the long-term hydrological problems are new short-term drought effects. Businesses along lakefronts are hurting and hydropower coming from the Colorado River and Lake Texoma is at an all-time low due to continued low streamflows. Fire conditions in west Texas are starting to become more of an issue as temperatures begin rising, with two small grass fires already having occurred in Palo Duro Canyon State Park and Smith County. Farmers are worried that a new dust bowl may develop in the Panhandle due to record low rainfall, and continuous dust storms that have brought soil from the Panhandle all the way to Dallas, El Paso, and Austin (Information provided by the Texas Office of State Climatology).

The month of March was a relatively quiet one in terms of severe weather. There were dozens of hail and wind reports on March 28, 2014 in eastern Texas, southern Arkansas, and northern Lousiana.

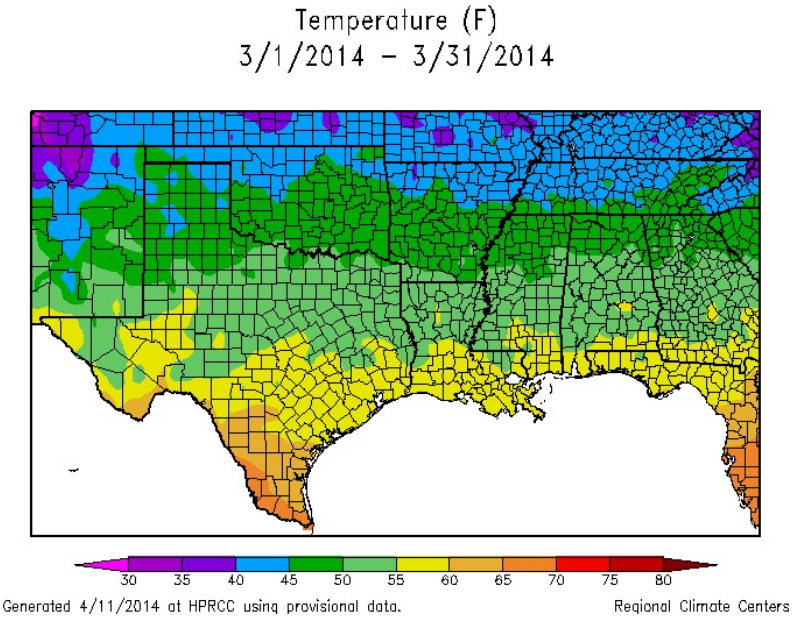


Released Thursday, Apr. 10, 2014.
Brian Fuchs National Drought Mitigation Center

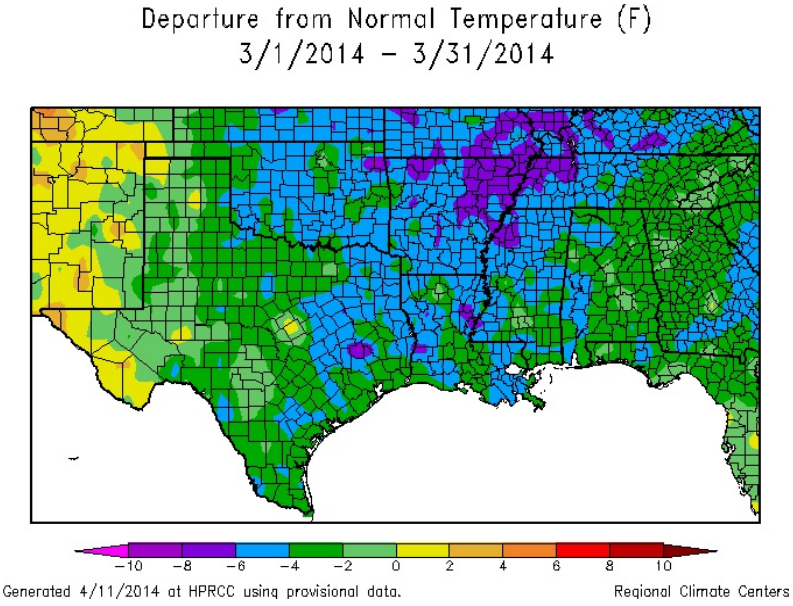
Above: Drought Conditions in the Southern Region. Map is valid for April 8, 2014. Image is courtesy of National Drought Mitigation Center.

Temperature Summary

Luigi Romolo
Southern Regional Climate Center



Average March 2014 Temperature across the South.

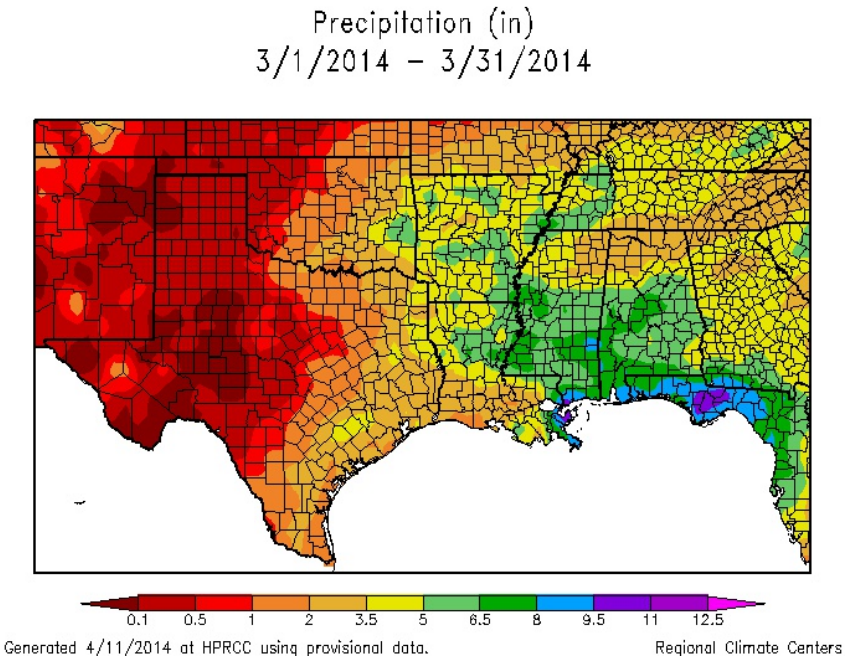


Average Temperature Departures from 1971-2000 for March 2014 across the South.

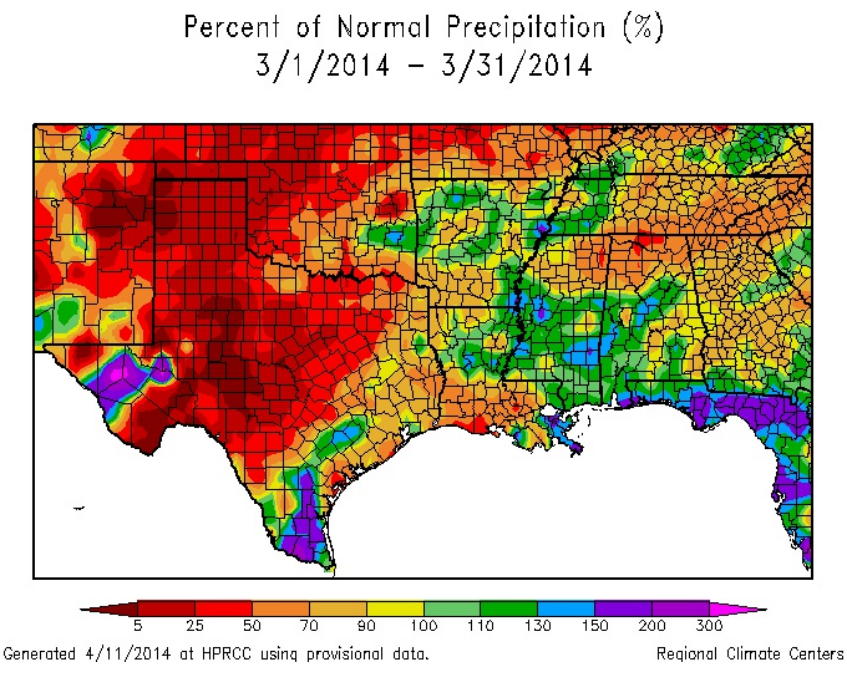
Cold temperatures continued into March for the Southern Region, with all six states experiencing below normal temperatures throughout the month. The central portion of the Southern Region experienced the highest departures from normal, with stations in north eastern Arkansas averaging as low as 6 to 8 degrees F (3.33 to 4.44 degrees C) below normal. Other portions of the central part of the region saw temperature anomalies average between 4 to 6 degrees F (2.22 to 3.33 degrees C) below normal. This included eastern Oklahoma, north eastern Texas, northern Louisiana, northern Mississippi, and western Tennessee. Elsewhere, temperature averages were only slightly below normal, with most stations reporting between 0 to 4 degrees F (0 to 2.22 degrees C) below normal. This includes western Texas, western Oklahoma, eastern Tennessee, and southern Mississippi. The statewide average temperatures for the month of March are as follows: Arkansas averaged 46.60 degrees F (8.11 degrees C), Louisiana averaged 55.00 degrees F (12.78 degrees C), Mississippi averaged 51.70 degrees F (10.94 degrees C), Oklahoma averaged 46.10 degrees F (7.83 degrees C), Tennessee averaged 45.10 degrees F (7.28 degrees C), and Texas averaged 54.90 degrees F (12.72 degrees C). Arkansas experienced its fourteenth coldest March on record (1895-2014), while for Louisiana, it was their fifteenth coldest March on record (1895-2014). Both Mississippi and Oklahoma experienced their twenty-first coldest March on record (1895-2014). It was the 25th coldest March on record (1895-2014) for Tennessee, and the thirty-fifth coldest March on record (1895-2014) for the state of Texas.

Precipitation Summary

Luigi Romolo
Southern Regional Climate Center



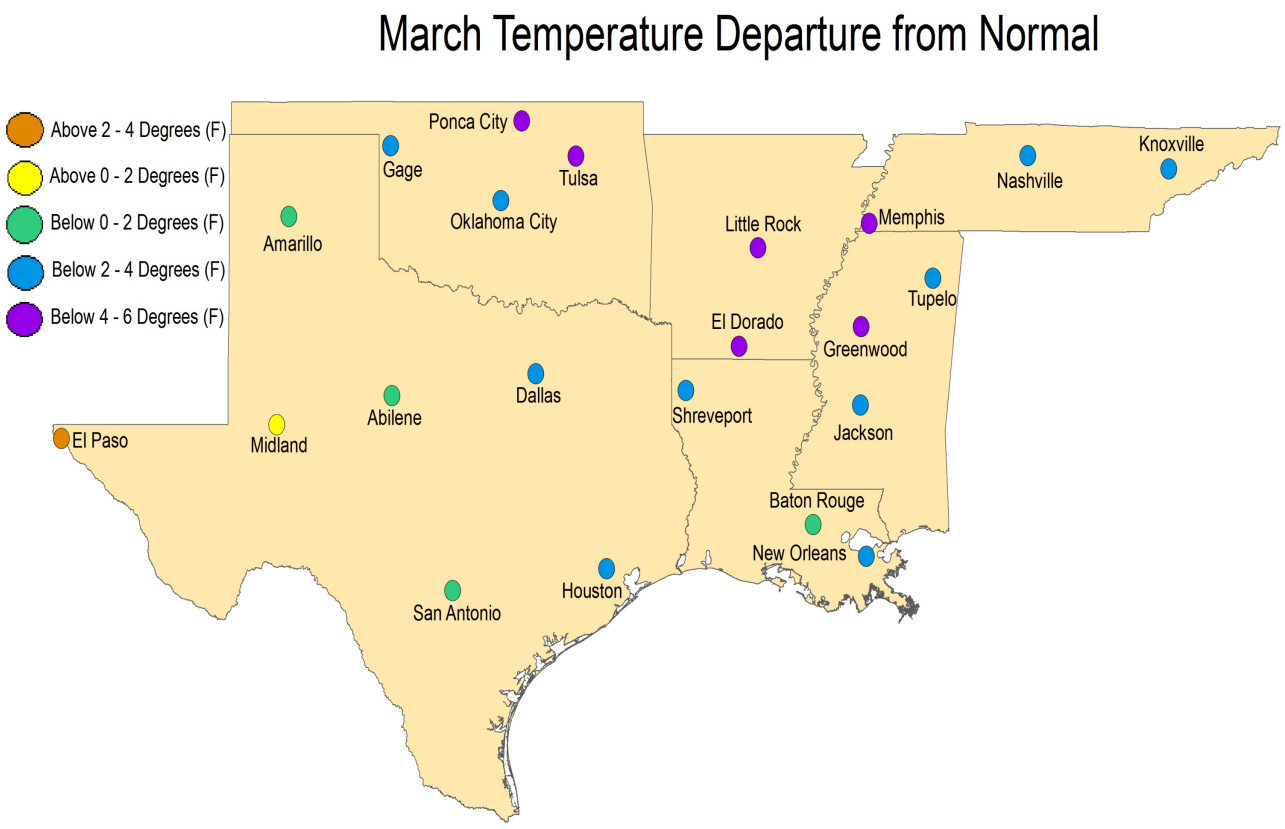
March 2014 Total Precipitation across the South.



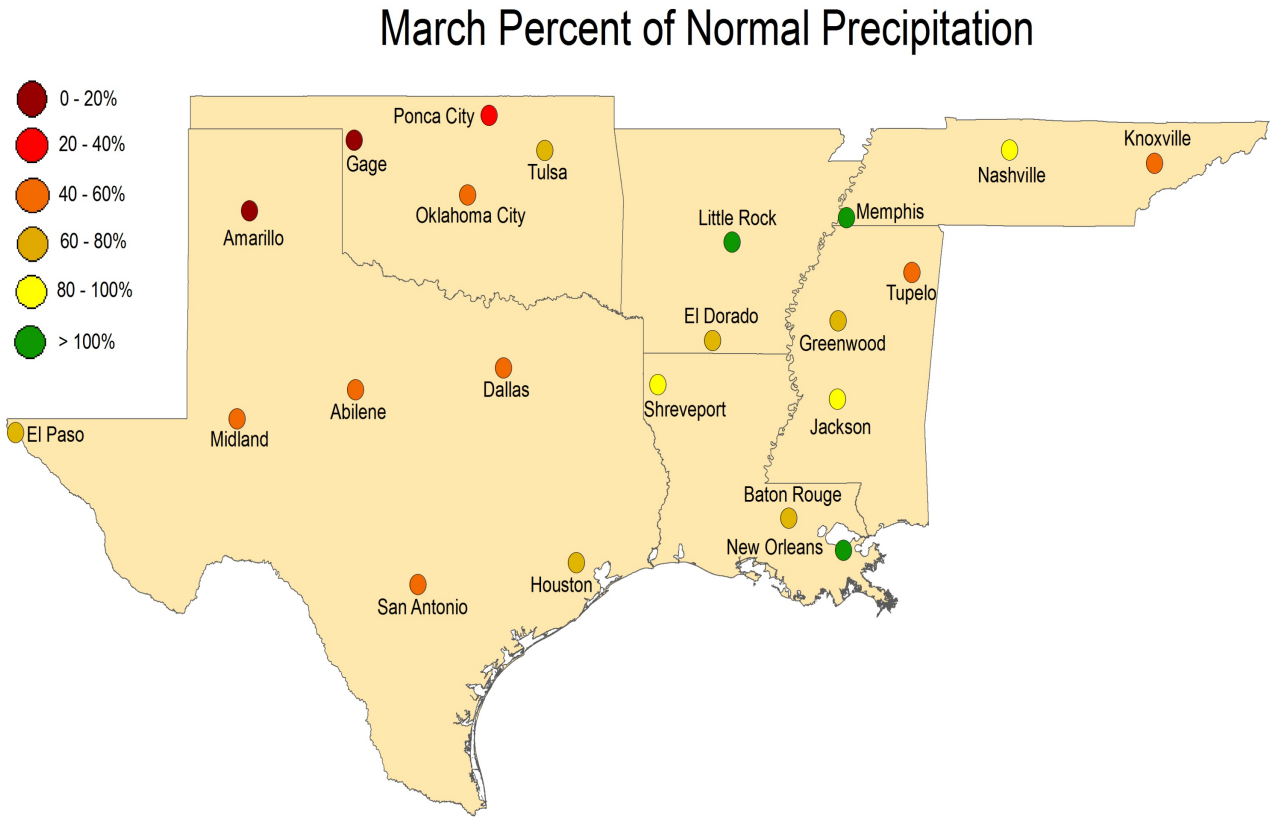
Percent of 1971-2000 normal precipitation totals for March 2014 across the South.

The month of March was generally drier than normal for most of the Southern Region. Conditions were very dry throughout most of Oklahoma and especially in the western half of the state where precipitation totals ranged between 0 to twenty-five percent of normal Similar anomalies were also observed in the central to west central counties of Texas. Elsewhere, precipitation totals ranged from fifty to ninety percent of normal, with the exception of a few small areas that received normal to above normal precipitation. For instance, much of the southern half of Mississippi experienced a slightly wetter than normal March, with precipitation totals ranging from 100 to 130 percent of normal. This was also the case for the westernmost counties of Tennessee and portions of northern Arkansas. Precipitation was also reported to be above normal in the extreme south of Texas, and in parts of the Trans Pecos Climate Division. The statewide average precipitation totals for the month of March are as follows: Arkansas averaged 4.40 inches (111.76 mm), Louisiana averaged 4.30 inches (109.22 mm), Mississippi averaged 5.56 inches (141.22 mm), Oklahoma averaged 1.75 inches (44.45 mm), Tennessee averaged 3.67 inches (93.22 mm), and Texas averaged 1.07 inches (27.18 mm). For the state of Tennessee it was the twenty-fourth driest March on record (1895-2014). State rankings for the remaining five states fell within the two middle quartiles.

Regional Climate Perspective in Pictures



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



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

Climate Perspective

State	Temperature	Rank (1895-2011)	Precipitation	Rank (1895-2011)
Arkansas	46.60	14th Coldest	4.40	55th Driest
Louisiana	55.00	15th Coldest	4.30	54th Driest
Mississippi	51.70	21st Coldest	5.56	55th Driest
Oklahoma	46.10	21st Coldest	1.75	38th Driest
Tennessee	45.10	25th Coldest	3.67	24th Driest
Texas	54.90	35th Coldest	1.07	36th Driest

State temperature and precipitation values and rankings for March 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	63.4	37.8	50.6	-5.8	81	3/28	23	3/4+	3.99	-1.16	78
Little Rock, AR	60.4	37.2	48.8	-4.6	77	3/11	16	3/3	5.30	0.42	109
Baton Rouge, LA	70.5	46.5	58.5	-1.8	84	3/22	29	3/4	3.22	-1.85	64
New Orleans, LA	68.1	50.6	59.4	-3.0	79	3/16	35	3/4+	5.26	0.02	100
Shreveport, LA	66.6	42.9	54.8	-3.8	85	3/28	25	3/3	4.02	-0.16	96
Greenwood, MS	63.9	37.9	50.9	-5.4	81	3/2	21	3/3	4.08	-1.71	70
Jackson, MS	66.6	40.9	53.8	-3.0	81	3/31	26	3/3	5.65	-0.09	98
Tupelo, MS	63.1	36.6	49.9	-3.2	77	3/2	22	3/3	3.08	-3.22	49
Gage, OK	60.7	28.5	44.6	-2.2	81	3/30+	-5	3/3	0.14	-1.79	7
Oklahoma City, OK	62.0	35.1	48.5	-2.5	86	3/31	6	3/3	1.26	-1.64	43
Ponca City, OK	59.3	29.8	44.5	-4.6	82	3/31	-1	3/3	1.14	-1.80	39
Tulsa, OK	59.8	33.6	46.7	-4.7	82	3/11	4	3/3	2.36	-1.21	66
Knoxville, TN	59.5	35.7	47.6	-2.1	74	3/11	24	3/26	2.42	-2.75	47
Memphis, TN	60.6	38.4	49.5	-4.0	77	3/31+	15	3/3	7.39	1.81	132
Nashville, TN	59.4	35.1	47.3	-2.8	79	3/11	19	3/4+	4.37	-0.50	90
Abilene, TX	69.9	40.3	55.1	-1.3	92	3/11	11	3/3	0.67	-0.74	48
Amarillo, TX	62.9	30.6	46.7	-1.2	81	3/30	3	3/3	0.20	-0.93	18
El Paso, TX	72.4	46.9	59.7	2.7	85	3/30	35	3/10	0.18	-0.08	70
Dallas, TX	67.8	42.4	55.1	-2.2	86	3/11	16	3/3	1.45	-1.61	47
Houston, TX	69.4	48.3	58.8	-3.5	85	3/28	27	3/3	2.45	-0.91	73
Midland, TX	72.2	40.5	56.4	0.5	87	3/31	18	3/3	0.19	-0.23	45
San Antonio, TX	72.7	48.5	60.6	-1.5	95	3/28	27	3/3	1.06	-0.83	56

Summary of temperature and precipitation information from around the region for March 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 Warm Spring is Forecast for Louisiana

Barry Keim, Louisiana State Climatologist, Louisiana State University

The Climate Prediction Center has issued their forecast for this upcoming Spring. The forecast includes warmer than normal conditions across the entire southern half of the United States, which then continues on up in to the Pacific Northwest, and Alaska. Obviously, this includes Louisiana in its entirety for the warm and toasty forecast. Cooler than normal conditions are predicted across the north-central United States, from Montana through the Great Lakes region. The area in between has "equal chances" of being normal, above normal, or below normal.

The precipitation forecast is calling for "equal chances" across most of the United States, with the exception of the West Coast, including southeastern Alaska, which has a higher than normal chance of being dry. Note that California is already experiencing a drought for the ages, and the weather patterns do not appear as if they will bring any mercy to the State. Some of the factors that went into this spring forecast for the United States include current levels of soil moisture, snow cover, anomalously deep frozen soil layers, and the extent of ice cover on the Great Lakes. Given all that we've been through in South Louisiana this past winter, this forecast is not a bad thing. Count your many blessings. Please contact me with any questions or complaints at keim@lsu.edu.

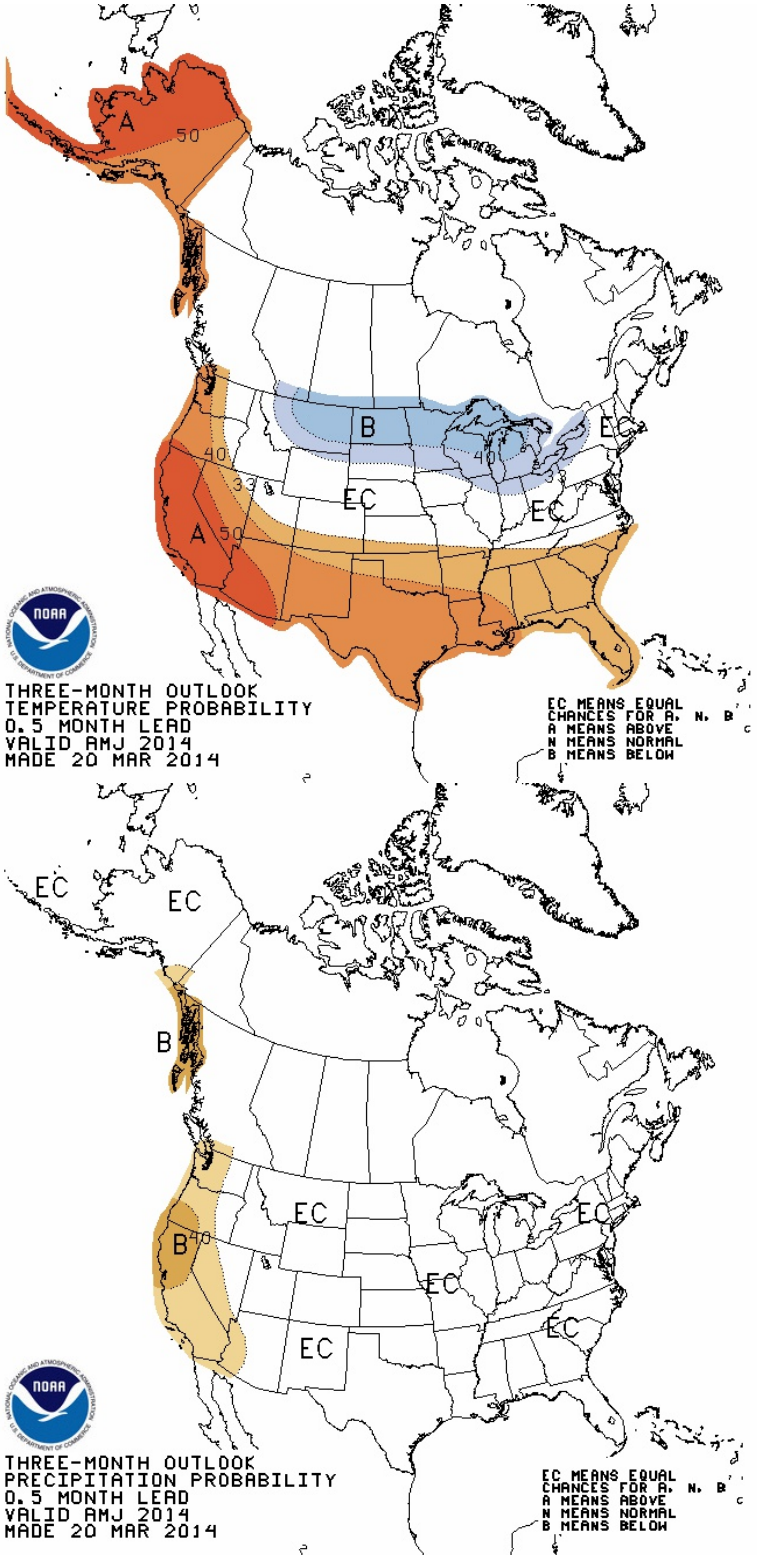


Figure 1. Spring 2014 forecast from the Climate Prediction Center. Graphic can be found at http://www.cpc.ncep.noaa.gov/products/predictions/long_range/seasonal.php?lead=1.

Monthly Comic Relief

Contact Us

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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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