



# SOUTHERN CLIMATE *MONITOR*

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**LSU**



**SCIPP**

Southern Climate Impacts Planning Program



## ANALYZING PROJECTED CHANGES AND TRENDS OF TEMPERATURE AND PRECIPITATION IN THE SCIPP REGION

*Lu Liu and Yang Hong, University of Oklahoma*

### Objective

This study aims to examine how future climate, temperature and precipitation specifically, are expected to change under the A2, A1B and B1 emission scenarios over the six states that make up the Southern Climate Impacts Planning Program (SCIPP): Oklahoma, Texas, Arkansas, Louisiana, Tennessee, and Mississippi.

### Introduction

Climate influences the world through changing temperature, precipitation, snowmelt, and a host of other natural phenomenon. The Global Climate Change Impacts in the United States Report compiled by the U.S. Global Change Research Program claims that, "Climate changes are already affecting water, energy, transportation, agriculture, ecosystems, and health" and additionally finds that the "global temperature has increased over the past 50 years." Regional climate, being a combined product of global climate forcing and also of regional atmosphere-landslide surface feedbacks, localizes the global impacts on society and is closely linked to regional water resources and local hazard management. The frequency and extent of local extreme weather is of great importance to regional social and economical systems, thus regional climate plays a significant role in policy making and management, which allows more relevant and localized practices.

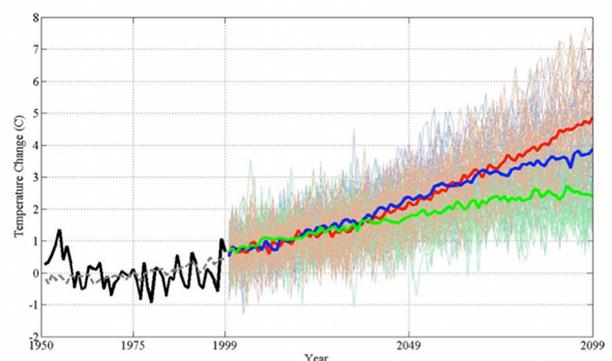
Global climate studies usually rely on Global Climate Models (GCMs), which simulate past climate and project future climate. Downscaling techniques were applied to subset climate data from global scale to the study region for regional climate study. The two primary downscaling methods commonly used are dynamic and

statistical. Statistical downscaling relates large scale climate features to local climate using simple statistical relationship which is computationally less intensive, however less physically relevant and depend on the quality of the observational data.

### Data and Methodology

For this study the observational data used were the gridded National Climatic Data Center (NCDC) Cooperative Observer station data. The World Climate Research Programme's (WCRP's) Coupled Model Intercomparison Project phase3 (CMIP3) multi- model dataset were archived for climate projection analysis after statistical downscaling described above.

Both observation and CMIP3 data have two outputs: surface temperature ( $^{\circ}\text{C}$ ) and monthly precipitation (mm/day). The CMIP3 data cover the continental U.S. and portions of southern Canada and northern Mexico at a  $1/8^{\circ}$  (~12 km) resolution spatially downscaled from  $2^{\circ}$  grid using the Bias-



**Figure 1. Surface temperature anomaly relative to 1950-1999 mean over SCIPP from 2000-2099. Light red background is the 16 GCMs' temperature projection for A2 scenario. Light blue is for A1B and light green is for B1. The bold lines are the ensemble means for the corresponding scenarios.**

Correction and Spatial Disaggregation (BCSD) approach. Simulations start from 1950 to 1999, and projections under three IPCC AR4 CO2 emission scenarios start from 2000 to 2099.

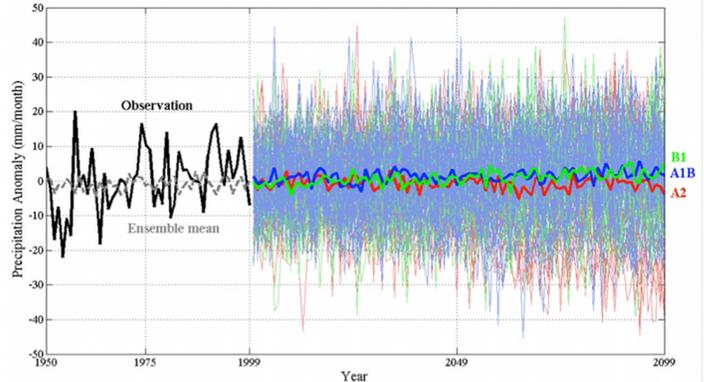
The three scenarios of the 21st century for future greenhouse gas emissions used in CMIP3 data were A2, A1B and B1, as defined in the IPCC Special Report on Emissions Scenarios.

**Results and Conclusions**

The results of the study found that the average temperature in the SCIPP region is projected to change 2.3 to 4.8 °C by the end of the 21st century based on different emission scenarios. Temperature increases more significantly in the second half of the century than the first half. (Figure 1).

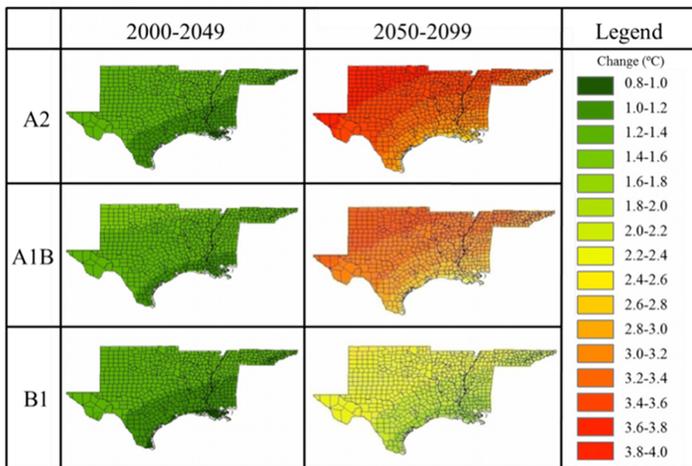
Precipitation does not have a discernible upward or downward trend during the 21st century based on the analysis (Figure 3).

However, the eastern and northeastern portions of SCIPP are forecasted to be wetter. Tennessee



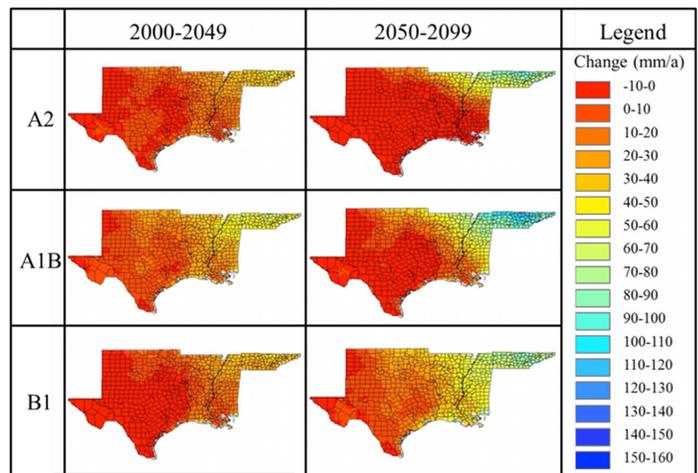
**Figure 3. Precipitation anomaly over SCIPP from 2000-2099. Light red background is the 16 GCMs' temperature projection for A2 scenario. Light blue is for A1B and light green is for B1. The bold lines are the ensemble means for the corresponding scenarios.**

exhibited the most significant increase in annual precipitation while Texas is projected to have the greatest decreases in precipitation (Figure 4). The transition from late summer to early winter (specifically the months of August, September,



**Figure 2. Projected ensemble temperature change distribution for each state within the SCIPP region for the period 2000-2049 and 2050-2099 relative to 1950-1999 mean**

Spatial results revealed that the northern and northwestern portions of SCIPP are projected to warm more significantly than regions closer to the Gulf of Mexico (Figure 2). While the SCIPP region is projected to have increased temperatures in all seasons, summer and fall are found to have the most significant temperature increases (Figure not shown).



**Figure 4. Projected ensemble precipitation change for each state within the SCIPP region for the period 2000-2049 and 2050-2099**

November, and December) is projected to be wetter for the region as a whole (Figure not shown).

**Implications**

These changes have profound implications for local water resources management as well as

broader regional decision-making. These results represent an initial phase of a broader study that has been undertaken to assist SCIPP regional and local water planning efforts in an effort to more closely link climate modeling to longer-term water resources management and to continue assessing climate change impacts on regional hazards management in the South.

**DROUGHT CONDITIONS**

*Luigi Romolo, Southern Regional Climate Center*

Despite heavy rainfall totals in the southeastern portion of the region, drought conditions remain relatively unchanged. This is in part due to the fact that much of the drought in this region is situated in areas outside of the reach of Hurricane Isaac. Conditions have deteriorated though most of Oklahoma, with almost the entire state being in extreme or exceptional drought. Elsewhere, the majority of Texas is still experiencing moderate to severe drought conditions. This is also the case in western Tennessee, where conditions were generally drier than normal for the month. In the

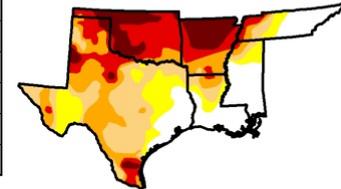
case of Arkansas, much of the northern portions of the state are in exceptional to extreme drought conditions.

**U.S. Drought Monitor**

August 28, 2012  
Valid 7 a.m. EST

South

	Drought Conditions (Percent Area)					
	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	20.94	79.06	66.22	46.19	28.33	11.29
Last Week (08/21/2012 map)	21.86	78.14	66.80	45.62	27.98	11.71
3 Months Ago (05/29/2012 map)	12.92	87.08	43.29	15.05	5.57	0.37
Start of Calendar Year (12/27/2011 map)	26.47	73.53	69.01	54.81	39.11	17.15
Start of Water Year (09/27/2011 map)	18.34	81.66	76.26	70.61	63.67	53.77
One Year Ago (08/23/2011 map)	6.38	93.62	83.57	74.13	65.66	50.93



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

To the Right: Drought conditions in the Southern Region. Map is valid for April 2012. Image courtesy of the National Drought Mitigation Center.

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

<http://droughtmonitor.unl.edu>



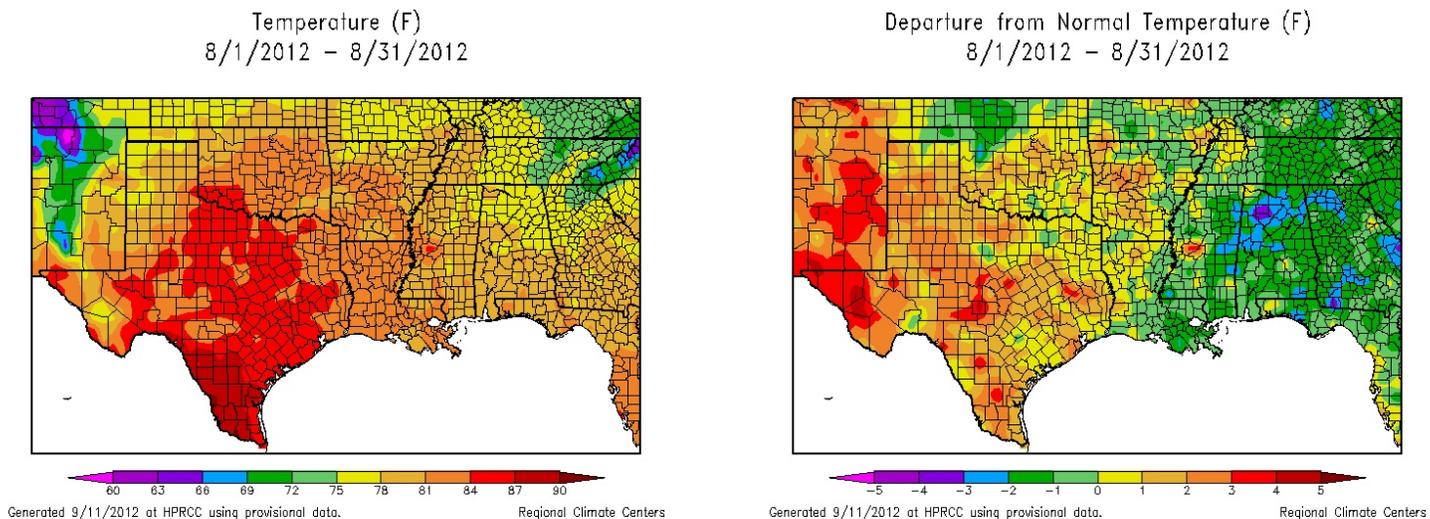
Released Thursday, August 30, 2012  
Brian Fuchs, National Drought Mitigation Center

**TEMPERATURE SUMMARY**

*Luigi Romolo, Southern Regional Climate Center*

August temperatures varied spatially across the Southern Region. In the east, Both Tennessee and Mississippi experienced average monthly temperatures that ranged from 0 to 2 degrees F (0 to 1.11 degrees C) below expected values. This was also the case for much of southeastern Louisiana and northeastern Arkansas. In the west, temperatures generally averaged 0 to 3 degrees F (0 to 1.67 degrees C) above normal, with the exception of the western Texas panhandle, where temperatures ranged from 3 to 5 degrees F (1.67 to 2.78 degrees C) above normal. The state average temperatures were as follows: Arkansas

averaged 80.00 degrees F (26.67 degrees C), Louisiana averaged 81.80 degrees F (27.67 degrees C), Mississippi averaged 79.30 degrees F (26.28 degrees C), Oklahoma averaged 81.30 degrees F (27.39 degrees C), Tennessee averaged 75.50 degrees F (24.17 degrees C), and Texas averaged 83.70 degrees F (28.72 degrees C). For Texas it was the eighteenth warmest August on record (1895-2012), while Mississippi experienced its twenty-sixth coldest August on record (1895-2012). All other state ranking fell within the two middle quartiles.



**Average temperatures (left) and departures from 1971-2000 normal average temperatures (right) for August 2012, across the South.**

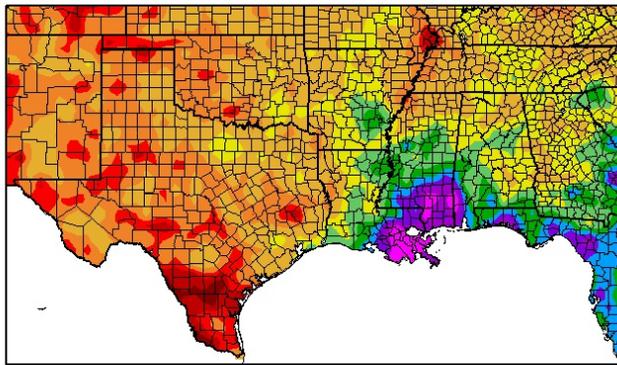
## PRECIPITATION SUMMARY

*Luigi Romolo, Southern Regional Climate Center*

August precipitation varied dramatically over the Southern Region, mostly in part to Hurricane Isaac, which drenched much of Louisiana, Mississippi, and southern Arkansas. Elsewhere, such as Texas and Oklahoma, conditions were quite dry. A small pocket of wetter than normal conditions occurred in north central Texas. In Tennessee, conditions were normal to slightly above normal in the central and eastern counties, while the western third of the state received below normal precipitation for the month. The driest part of the Southern Region was observed in southern Texas, where a majority of the stations there received only between 0 to 50 percent of normal precipitation. Hurricane Isaac's slow track over the south central portion of the region allowed for

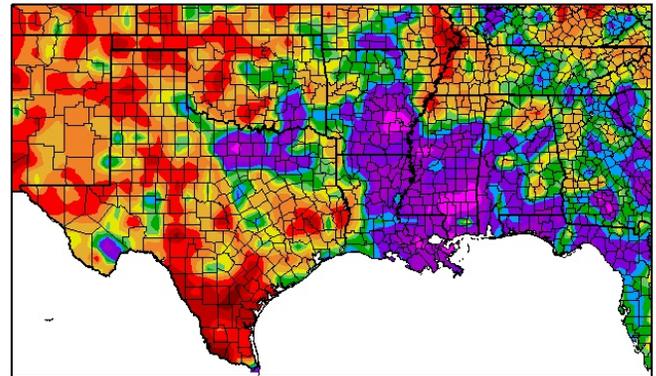
some rather impressive rainfall totals. Southern Mississippi average between 10 and 15 inches. In southeastern Louisiana, rainfall totals for the last week of the month ranged between 4 and 12 inches. Louisiana and Mississippi both experienced their second wettest August on record (1895-2012). Louisiana averaged a total of 8.47 inches (215.14 mm), whereas Mississippi averaged a total of 8.58 inches (217.93 mm). Arkansas experienced its twenty-second wettest August on record (1895-2012) with a state average precipitation total of 4.38 inches (111.25 mm). Other state precipitation totals include Texas with 2.07 inches (52.58 mm), Tennessee with 3.76 inches (95.50 mm), and Oklahoma with 2.80 inches (71.12 mm).

Precipitation (in)  
8/1/2012 – 8/31/2012



Generated 9/11/2012 at HPRCC using provisional data. Regional Climate Centers

Percent of Normal Precipitation (%)  
8/1/2012 – 8/31/2012



Generated 9/11/2012 at HPRCC using provisional data. Regional Climate Centers

**Total precipitation values (left) and The percent of 1971-2000 normal precipitation totals (right) for August 2012.**

## ***SUMMER IS NOW IN THE REAR-VIEW MIRROR***

*Barry D. Keim, Louisiana State Climatologist*

Autumn in southeastern Louisiana begins a period when afternoon thunderstorms begin to disappear and fronts begin crossing the State. Along with each cold front comes a change in the airmass from the hot and humid air from the Gulf of Mexico – which we have in place for almost all of the summer season – to cooler and drier air from either Canada or occasionally from the Pacific Ocean. BUT, for the next several weeks, we will oscillate between summer-like conditions, which will give way to the occasional surge of cool, crisp, Canadian air. With that in mind, let's recap this past summer's temperatures, as well as the past 8 months.

The National Oceanographic and Atmospheric Administration recently reported that this past summer was the 3rd warmest summer on record for the contiguous United States, with our record-keeping dating back to 1895. It is no coincidence that much of the Great Plains and Midwest are currently in drought, which only allows the temperatures to climb. In Louisiana, however, we had the 38th warmest summer, averaging 81.6

degrees. Note that Louisiana's long term summer average is 81.2 degrees, and the warmest summer on record in the State was last year (2011) averaging 85.0 degrees. This past summer in south Louisiana, we have been very wet, which helps hold down the temperatures. I also examined where we stand regarding temperature for this point in the year (January through August). Much to my surprise, this year, marks the warmest January to August period on record (Figure 1). In Louisiana, we averaged 71.1 degrees, breaking the record of 70.9 degrees for this period set in 1911. We are currently on track to have the warmest year on record, if patterns persist. I also want to add that August was the second wettest August on record for Louisiana, with much of the rainfall caused by Hurricane Isaac. The State averaged 8.47 inches for the month. However, this value pales in comparison to wettest August, which had 11.31 inches in 1940. That August, Louisiana was hit by a hurricane and a tropical storm. If you have any questions, feel free to contact me at keim@lsu.edu.

## CLIMATE PERSPECTIVE

State	Temperature	Rank	Precipitation	Rank
Arkansas	80.0	50 <sup>th</sup> Warmest	4.38	22 <sup>nd</sup> Wettest
Louisiana	81.8	49 <sup>th</sup> Warmest	8.47	2 <sup>nd</sup> Wettest
Mississippi	79.3	26 <sup>th</sup> Coldest	8.58	2 <sup>nd</sup> Wettest
Oklahoma	81.3	53 <sup>rd</sup> Warmest	2.8	59 <sup>th</sup> Wettest
Tennessee	75.5	40 <sup>th</sup> Coldest	3.76	52 <sup>nd</sup> Wettest
Texas	83.7	18 <sup>th</sup> Warmest	2.07	53 <sup>rd</sup> Driest

State temperature and precipitation values and rankings for August 2012. 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 Name	Temperatures (degrees F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	Max	Min	Mean	Depart	High	Date	Low	Date	Obs	Depart	%Norm
El Dorado, AR	92.7	69.5	81.1	-0.1	99.0	8/7	56.0	8/23	4.75	1.53	148
Little Rock, AR	93.7	71.5	82.6	1.3	106.0	8/4	63.0	8/22	5.72	2.79	195
Baton Rouge, LA	90.4	73.9	82.2	0.8	96.0	8/3	68.0	8/23+	6.40	0.54	109
New Orleans, LA	89.2	75.4	82.3	-0.2	95.0	8/14	71.0	8/19	18.61	12.46	303
Shreveport, LA	94.1	73.2	83.6	0.7	101.0	8/13	62.0	8/23	3.62	0.91	134
Greenwood, MS	90.2	69.5	79.8	-1.5	96.0	8/1	59.0	8/22	4.14	1.70	170
Jackson, MS	90.7	71.3	81.0	0.1	98.0	8/1	61.0	8/23+	8.95	5.29	245
Tupelo, MS	88.9	69.6	79.3	-0.4	98.0	8/1	60.0	8/22	3.14	0.47	118
Oklahoma City, OK	96.5	71.5	84.0	2.8	113.0	8/3	61.0	8/19	2.17	-0.31	87
Ponca City, OK	95.6	67.5	81.5	-0.4	111.0	8/1	53.0	8/20	2.53	-0.83	75
Tulsa, OK	96.1	69.8	82.9	0.7	112.0	8/2+	58.0	8/11	3.32	0.47	116
Knoxville, TN	86.6	66.0	76.3	-0.6	93.0	8/28+	58.0	8/22+	4.14	1.25	143
Memphis, TN	92.7	72.7	82.7	1.5	99.0	8/8	63.0	8/12	2.64	-0.36	88
Nashville, TN	88.4	67.2	77.8	-0.1	99.0	8/2	56.0	8/21	3.70	0.42	113
Amarillo, TX	94.0	66.0	80.0	3.7	107.0	8/3	57.0	8/29	1.18	-1.76	40
El Paso, TX	96.4	72.4	84.4	3.3	102.0	8/4+	64.0	8/31	0.65	-1.10	37
Dallas, TX	97.5	75.5	86.5	2.1	108.0	8/9	65.0	8/22	3.19	1.16	157
Houston, TX	95.4	76.8	86.1	2.8	99.0	8/30	72.0	8/21	3.88	0.05	101
San Antonio, TX	98.5	76.0	87.2	3.0	103.0	8/10	71.0	8/20	2.41	-0.16	94

Summary of temperature and precipitation information from around the region for August 2012. 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. Blue-shaded boxes represent cooler than normal temperatures; red-shaded boxes denote warmer than normal temperatures; tan shades represent drier than normal conditions; and green shades denote wetter than normal conditions.

**Disclaimer:** This is an experimental climate outreach and engagement product. While we make every attempt to verify this information, we do not warrant the accuracy of any of these materials. The user assumes the entire risk related to the use of these data. This publication was prepared by SRCC/SCIPP with support in part from the U.S. Department of Commerce/NOAA. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of NOAA

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The *Monitor* is an experimental climate outreach and engagement product of the Southern Regional Climate Center and Southern Climate Impacts Planning Program. To provide feedback or suggestions to improve the content provided in the *Monitor*, please contact us at [monitor@southernclimate.org](mailto: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](http://www.srcc.lsu.edu) and [www.southernclimate.org](http://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 225-578-502. 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.