Mesonet
www.mesonet.org
connection
Volume 4 — Issue 11 — November 2013

Soil Temperature Sensors Changing

–by Stephanie Bowen

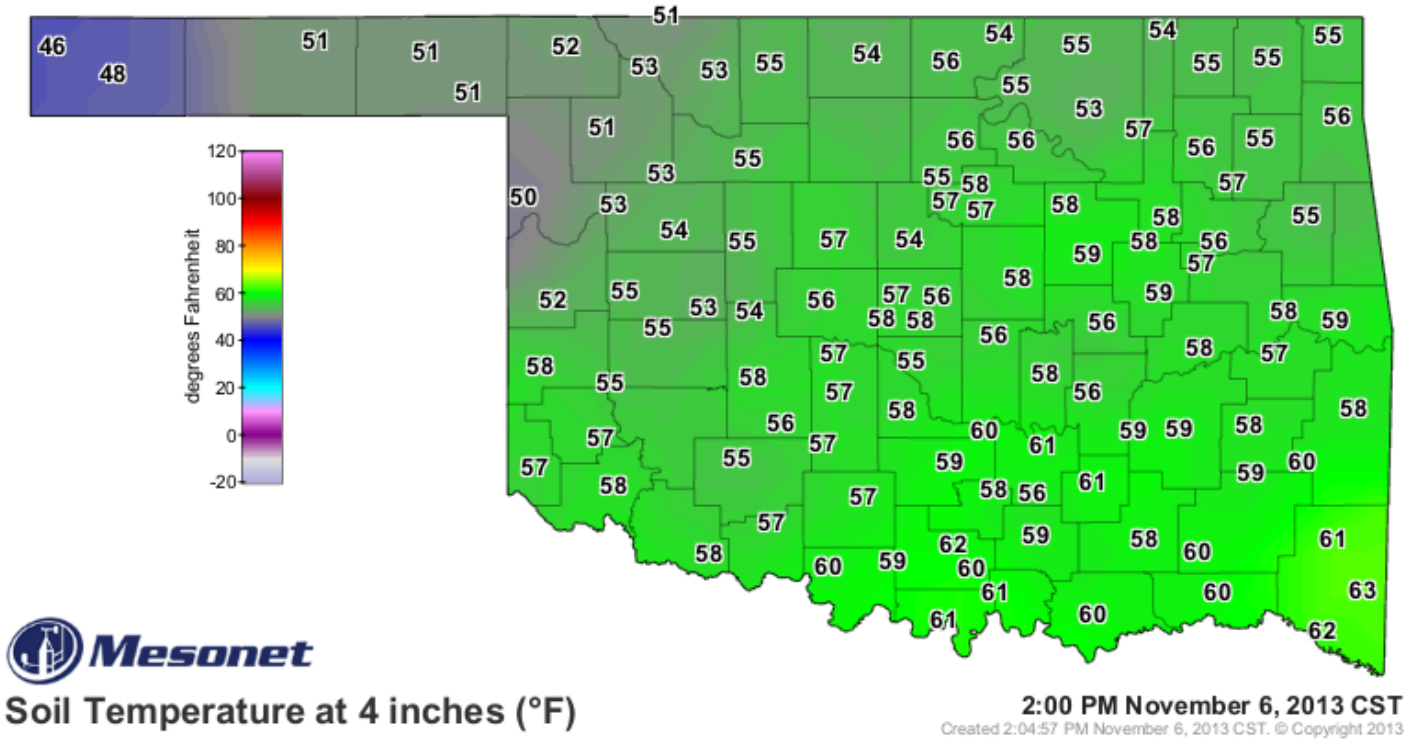
SOIL MOISTURE AND TEMPERATURE are important factors for plant and crop growth. Different seeds require different soil temperatures to germinate, and soil moisture is used to schedule irrigation and even help predict crop yields. The Mesonet has measured soil temperature since 1994 and soil moisture since 1996. In recent years, we have explored options to improve our sensors.

"Our existing soil moisture sensors are also capable of measuring soil temperature," said Chris Fiebrich, Manager of the Mesonet. "The Mesonet plans to switch its existing 5 and 10 cm soil temperature measurements over to the soil moisture sensors. We will also add new 25 and 60 cm soil temperature observations to our data stream. We have just completed over a year of extensive calibrations and field evaluation of soil temperature data to ensure the old data stream and the new are equivalent."

Starting December 1, the Mesonet will use the existing soil moisture sensors, along with new ones installed at 10 cm under sod and bare soil, to measure soil temperature. The switch will keep our total number of soil moisture and temperature measurement at eight but decrease the number of sensors we maintain down to five.

"Our top priority during this change was to improve the soil temperature and moisture variables the agricultural community and Oklahoma State University focus on," Fiebrich said.

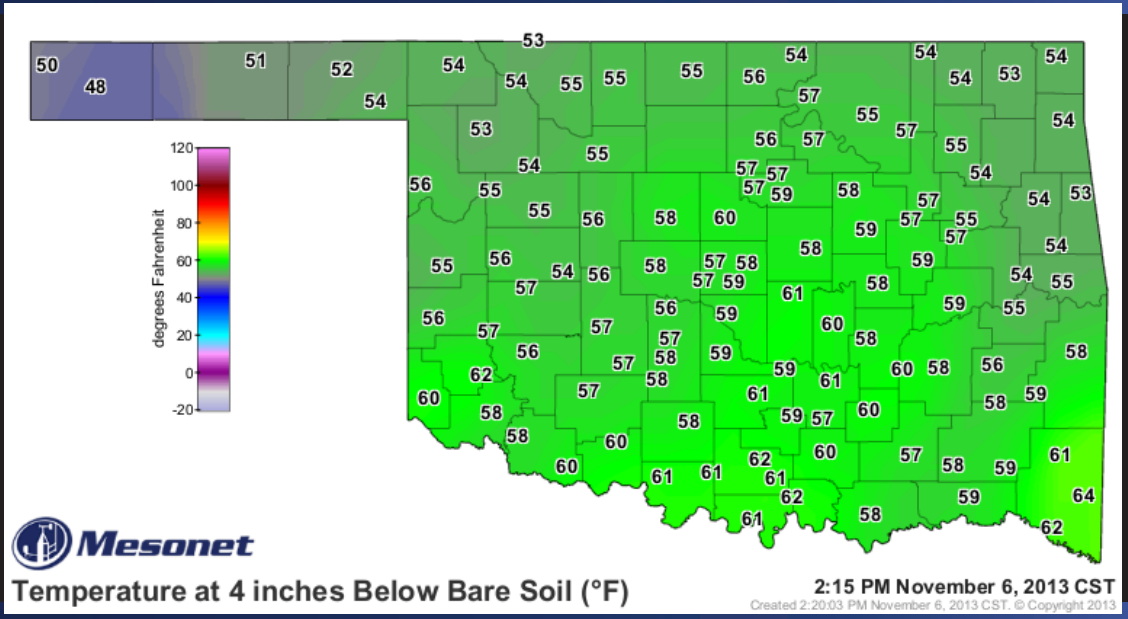
The new 10-cm bare soil temperature is a good indication of planting temperatures for plowed fields, while the 10-cm sod temperature is used in the first hollow stem model for winter wheat. Also, the 25-cm sod temperature can be used for brush control and heat flux studies. ■



MESONET IN PICTURES

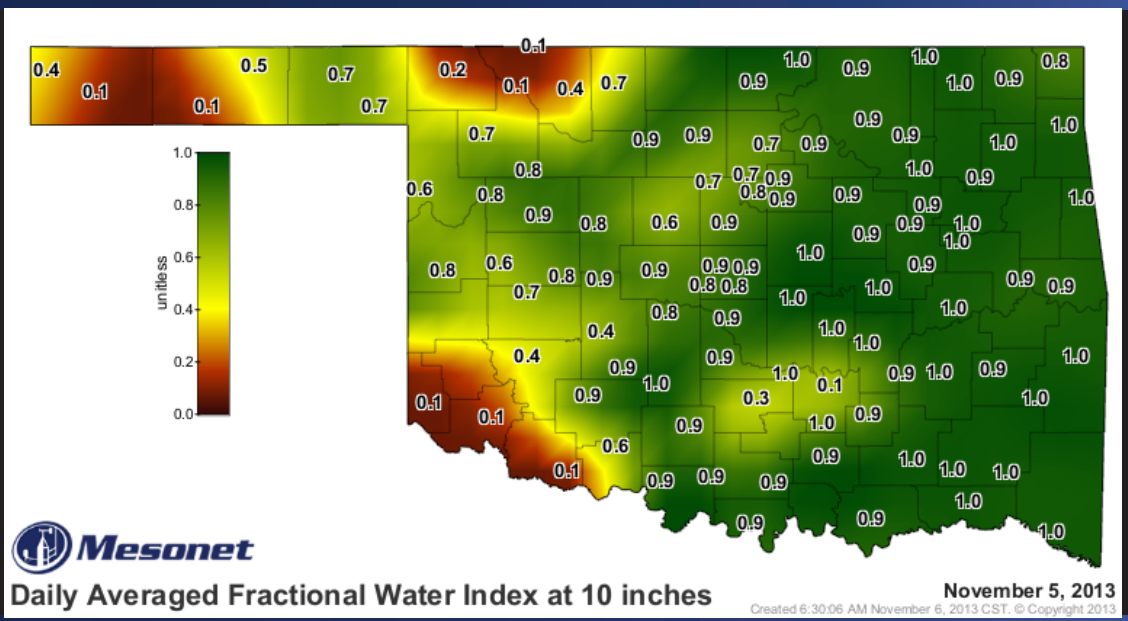
Soil Temperature 10-cm Bare

- The Soil Temperature at 4 inches (10 cm) Below Bare Soil is a good indication of planting temperatures for plowed fields. To view the soil temperature maps, go to www.mesonet.org, and click on “Weather” in the top tab. Then select “Soil Moisture/Temperature” from the side menu.



Soil Moisture Maps

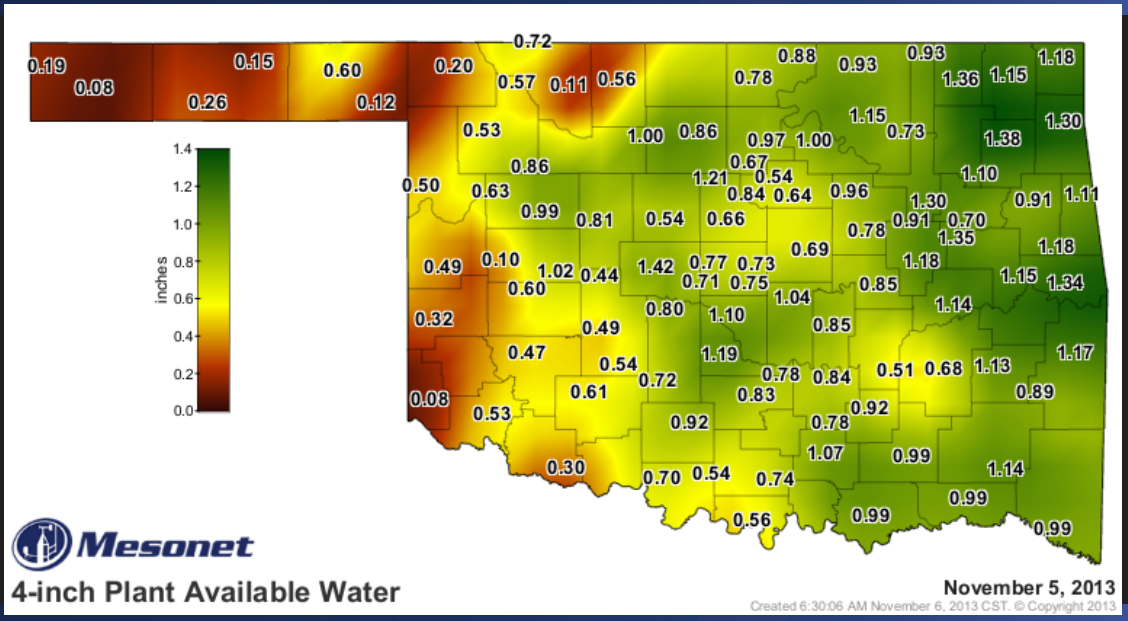
- The Daily Averaged Fractional Water Index at 10 inches map displays the 24-hour-averaged soil moisture at 10 inches (25 cm) under native sod for the previous day. Fractional water index ranges from 0 (completely dry) to 1.0 (completely saturated). To view the soil moisture maps, go to www.mesonet.org, and click on “Weather” in the top tab. Then select “Soil Moisture/Temperature” from the side menu.



MESONET IN PICTURES

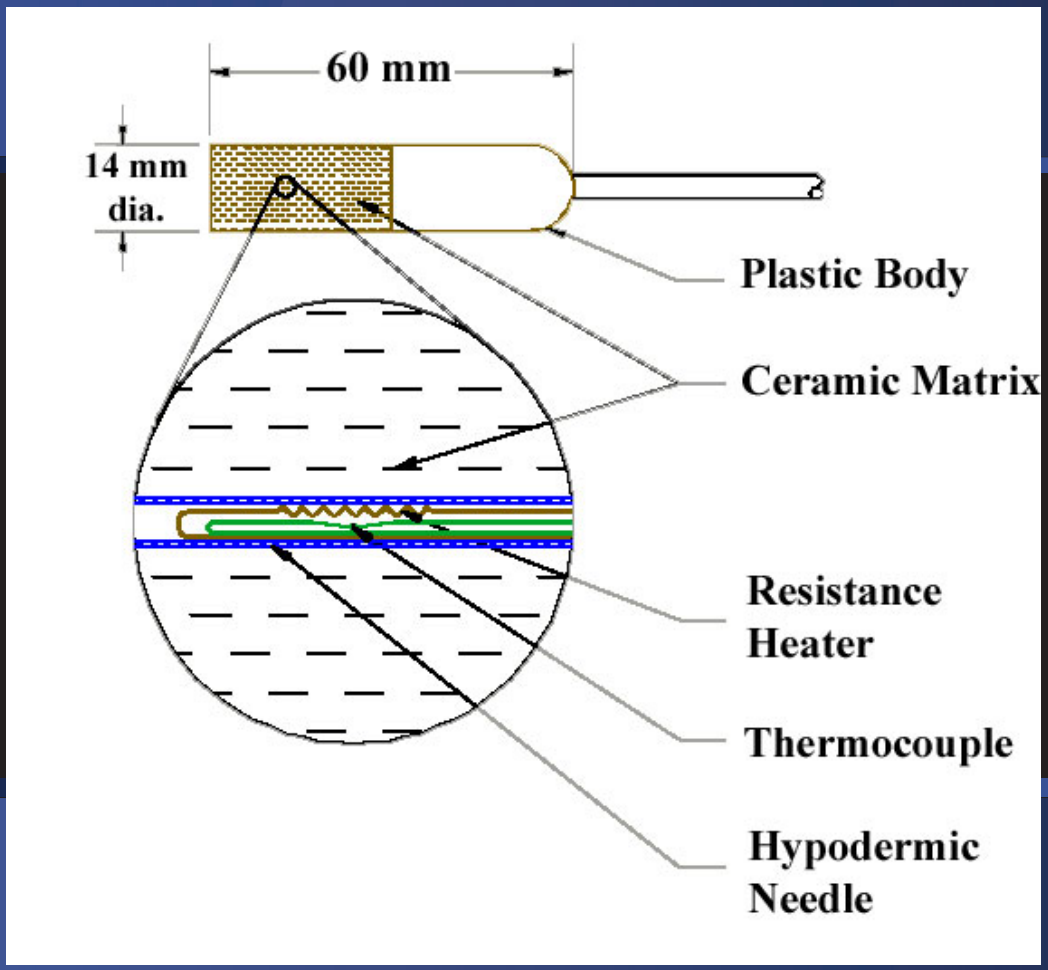
Plant Available Water

- Also available under the "Soil Moisture/Temperature" section are Plant Available Water Maps. The 4-inch Plant Available Water map is based on the 24-hour-averaged plant available water for the top 4 inches (10 cm) of soil under the existing vegetation at each Mesonet site for the previous day. Plant available water is the amount of water in the soil that is available for plant uptake.



Soil Moisture and Temperature Sensor

- The Campbell Scientific 229-L soil matric potential sensor works by taking an initial temperature measurement, applying a small heat pulse, waiting 21 seconds, and taking a second temperature reading. By measuring how much heat has dissipated, the amount of soil moisture can be determined as more moist soils "trap" the heat more than drier soils.



Soil moisture sensor also measures temperature

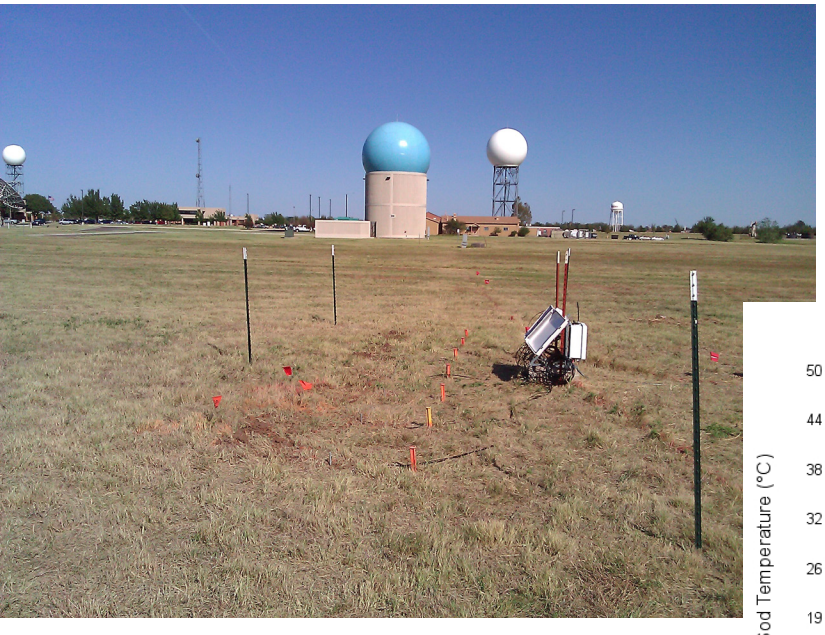
–by Brad Illston

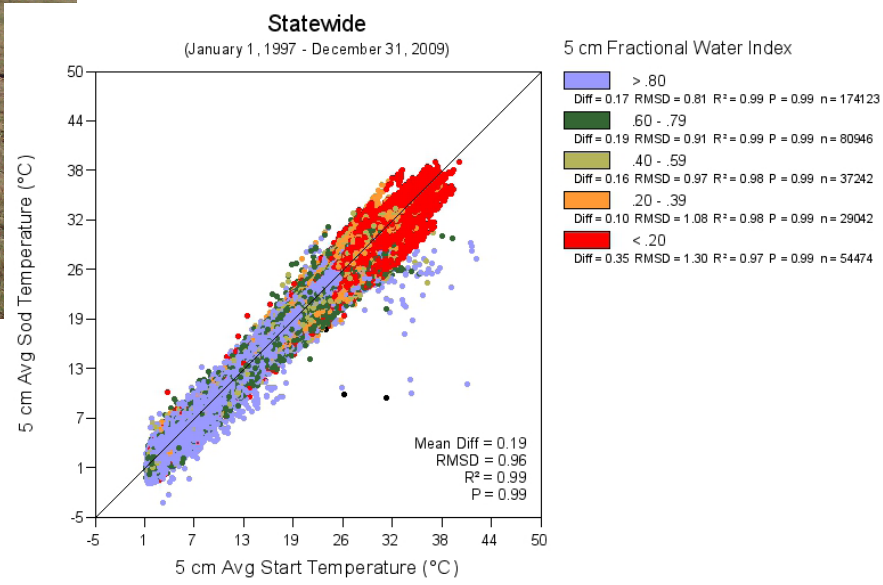
AS PART OF THE OKLAHOMA MESONET'S on-going pursuits to provide high quality data, scientists at the Mesonet researched the feasibility of utilizing the Campbell Scientific 229-L soil matric potential sensor as a dual sensor to also measure soil temperature. By switching from the BetaTHERM soil temperature sensor to the 229-L sensor, the Mesonet would have lower costs (e.g. less sensors to maintain, less field technician visits, fewer data storage needs) and remove issues faced by the BetaTHERM sensors (such as heaving in the soil) while still being able to provide research grade soil temperature measurements.

The Campbell Scientific 229-L soil matric potential sensor (see image on page 3) is about the size of a AA battery and is comprised of a small needle containing a thermocouple and heating element encased in a ceramic casing. It works by taking an initial temperature measurement, applying a small heat pulse, waiting 21 seconds, and taking a second temperature reading. By measuring how much heat has dissipated (e.g., the temperature difference), the amount of soil moisture can be determined as more moist soils "trap" the heat more than drier soils. Through a series of experiments, researchers at the Oklahoma Mesonet wanted to determine how well the previous soil temperature measurements from the BetaTHERM sensors compared to the initial temperature readings from the 229-L.

One of the experiments involved installing 21 soil temperature sensors next to the Norman Mesonet site (See photo) to understand the variability of soil temperature across a small area the size of a Mesonet station's footprint. Another experiment directly compared BetaTHERM and 229-L temperature measurements (see scatterplot) to see how strongly they were correlated and determine if this correlation was stronger or weaker depending upon soil moisture levels, soil type, or location of the station. A third experiment determined that changing the sensors connection to the datalogger would result in a noticeable improvement in measurement accuracy.

Through the series of experiments, researchers at the Oklahoma Mesonet were able to determine that the Campbell Scientific 229-L sensor that was already being used to measure soil moisture could be used to also measure soil temperature across the state. As a result, on December 1, 2013, all soil temperature measurements from the Oklahoma Mesonet will utilize this sensor. ■





Familiar Pattern Remains During October

By Gary McManus, Associate State Climatologist

OCTOBER WRAP-UP

Eastern Oklahoma saw plenty of rain during October, putting the halt to a blossoming flash drought in that part of the state. Unfortunately for drought-plagued western Oklahoma, Mother Nature was not quite so generous. Rainfall totals recorded by the Oklahoma Mesonet during October ranged from 7.15 inches at Wister in LeFlore County to a paltry 0.14 inches at Erick in Beckham County. That sort of disparity, while a bit exaggerated, spelled out the month's precipitation fortunes for the two sides of the state. The surplus in the east and the deficit in the west did manage to even things out with an average total across the state of 3.13 inches. That ranks October as the 47th wettest since records began in 1895, but still amounts to a deficit of about a third of an inch. To punctuate the disparity between the east and west, southeastern Oklahoma experienced its 20th wettest October on record and west central Oklahoma suffered through its 35th driest. The January-October period was the 31st wettest across the state with a statewide average of 33.65 inches, 1.82 inches above normal. Central Oklahoma stands out during that time frame with an average of 41.86 inches, 8.69 inches above normal to rank as the eighth wettest on record. Oklahoma City's January-October total of 50.55 inches is its second highest on record, dating back to 1891, after recording 3.42 inches during October. Oklahoma City's record total of 52.99 inches for January-October occurred in 2007.

Temperatures began the month on the hot side, but a series of cool fronts brought the statewide average back below normal by the end of the month. The month finished as the 38th coolest October on record with an average temperature of 60.5 degrees, nearly a degree below normal. The state's first freeze struck in the Panhandle on October 6. Kenton dropped to 27 degrees on that date, and Boise City and Goodwell also reached the freezing mark. By the end of the month, most of the northwestern half of the state had seen a freeze. The Mesonet's lowest recorded temperature for October was 25 degrees at Kenton on the 18th and then again at Boise City on the 19th. The highest temperature of 96 degrees was reported at Hollis on the fourth. The year was still on track to finish slightly below normal. The statewide average temperature for the January-October period was 62.5 degrees, 0.3 degrees below normal and the 50th coolest on record.

The percentage of the state impacted by drought dropped from 43 percent to 31 percent during October according to the U.S. Drought Monitor. Most of that reduction occurred across southeastern Oklahoma, as expected from their generous rainfall totals. Nearly 15 percent of the state remained in at least severe drought, with most of that showing up in the Panhandle and southwestern Oklahoma. Exceptional drought, the Drought Monitor's worst category, still covered most of Jackson and Tillman counties in far southwestern Oklahoma. At the end of October last year, virtually the entire state was mired in at least severe drought. At that point, Oklahoma was in the midst of its driest May-December on record.

3.13"
PRECIPITATION
statewide average for October

60.5°F
average statewide temperature for September

25°F
lowest recorded temperature at Kenton on October 18 and Boise City on the 19th.

31
PERCENT
of the state suffering from at least moderate drought according to the U.S. Drought Monitor

CALENDAR

NOVEMBER

- 2nd: National Weather Festival, NWC, Norman
- 5th: Weather Ready Schools, Tulsa Public Schools
- 7th: OK-First Advisory Committee Meeting, Norman
- 12th: Field Trip, Enid High School
- 13th: Field Trip, Byng High School
- 15th: Judging St. Charles Borromeo Science Fair, OKC
- 15th-16th: Oklahoma Farm Bureau Convention, Norman
- 16th: Science Olympiad Tournament, Broken Arrow
- 22nd: Central Jr. High Career Day, Moore

DECEMBER

- 3rd-4th: Oklahoma Turfgrass Conference
- 3rd-5th: Oklahoma Ag Expo, Midwest City
- 4th: Field Trip, Western Oaks Elementary, Bethany
- 7th: Science Olympiad Tournament, Putnam City High
- 7th: First Lego League State Championship, Edmond
- 13th: Judging Olive Public Schools Science Fair, Drumright
- 23rd-Jan. 1st: OU Winter Break - OCS office closed

Thank you for 20 years of partnership!

- Rush Springs - Installed November 9, 1993
- Apache - Installed November 9, 1993

CONTACTS

Accessing recent (within the past 7 days) Mesonet data
Contact: Mesonet Operator

Instrumentation, telecommunications, or other technical specifications
Contact: Chris Fiebrich

Mesonet agricultural data and products
Contact: Al Sutherland

Mesonet meteorological data
Contact: OCS Data Requests

Earthstorm - K-12 educational outreach
Contact: Andrea Melvin

OK-First - Public safety outreach
Contact: James Hocker

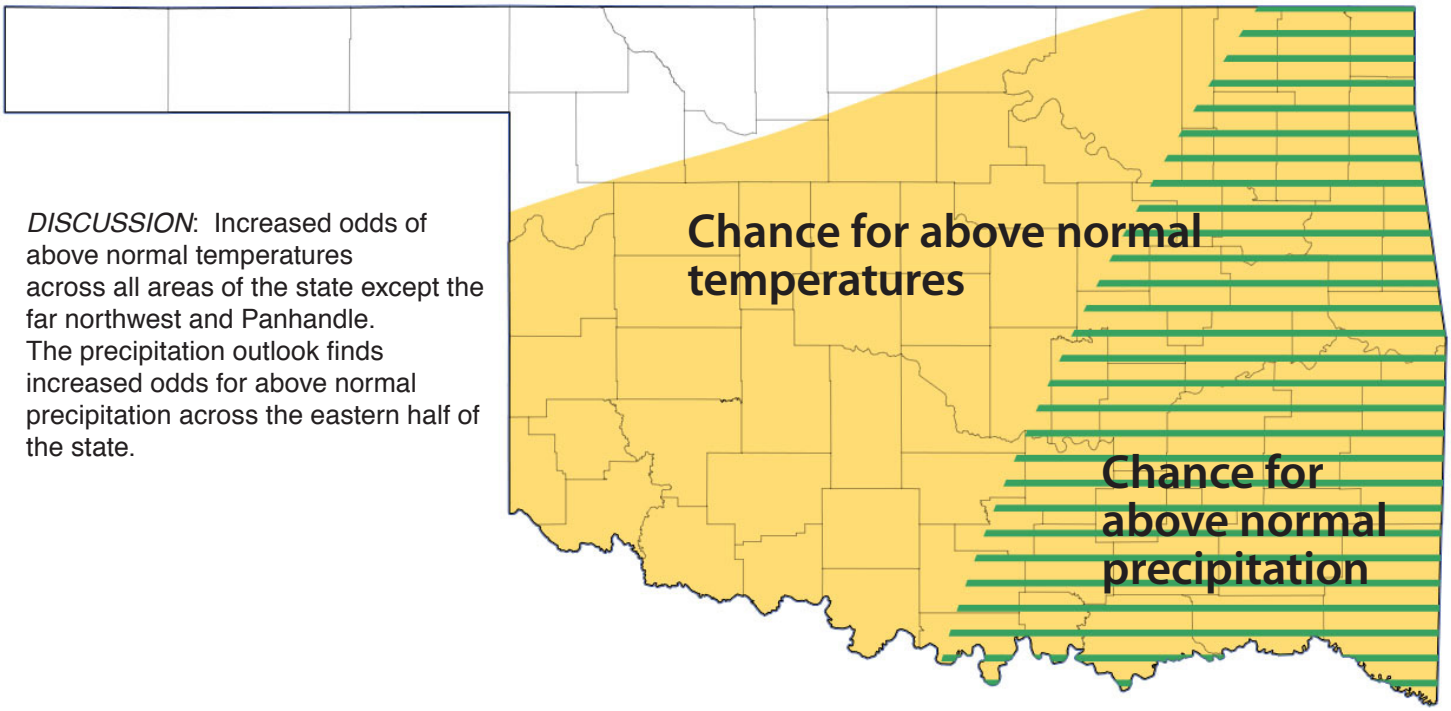
OK-FIRE - Fire management outreach
Contact: J.D. Carlson

Not sure?
Contact: 405-325-2541 or Chris Fiebrich.

FORECAST FOR NOVEMBER

Click here to view the original maps from the Climate Prediction Center.

DISCUSSION: Increased odds of above normal temperatures across all areas of the state except the far northwest and Panhandle. The precipitation outlook finds increased odds for above normal precipitation across the eastern half of the state.



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