



TEXAS CoCoRaHS OBSERVER



Summer 2023

Vol. 9 - 2



Welcome to The Texas CoCoRaHS Observer Newsletter

The purpose of this newsletter is to keep observers informed of the latest news, events, training, and happenings related to the CoCoRaHS program here in Texas, as well as news about the latest weather patterns affecting each region of Texas seasonally.

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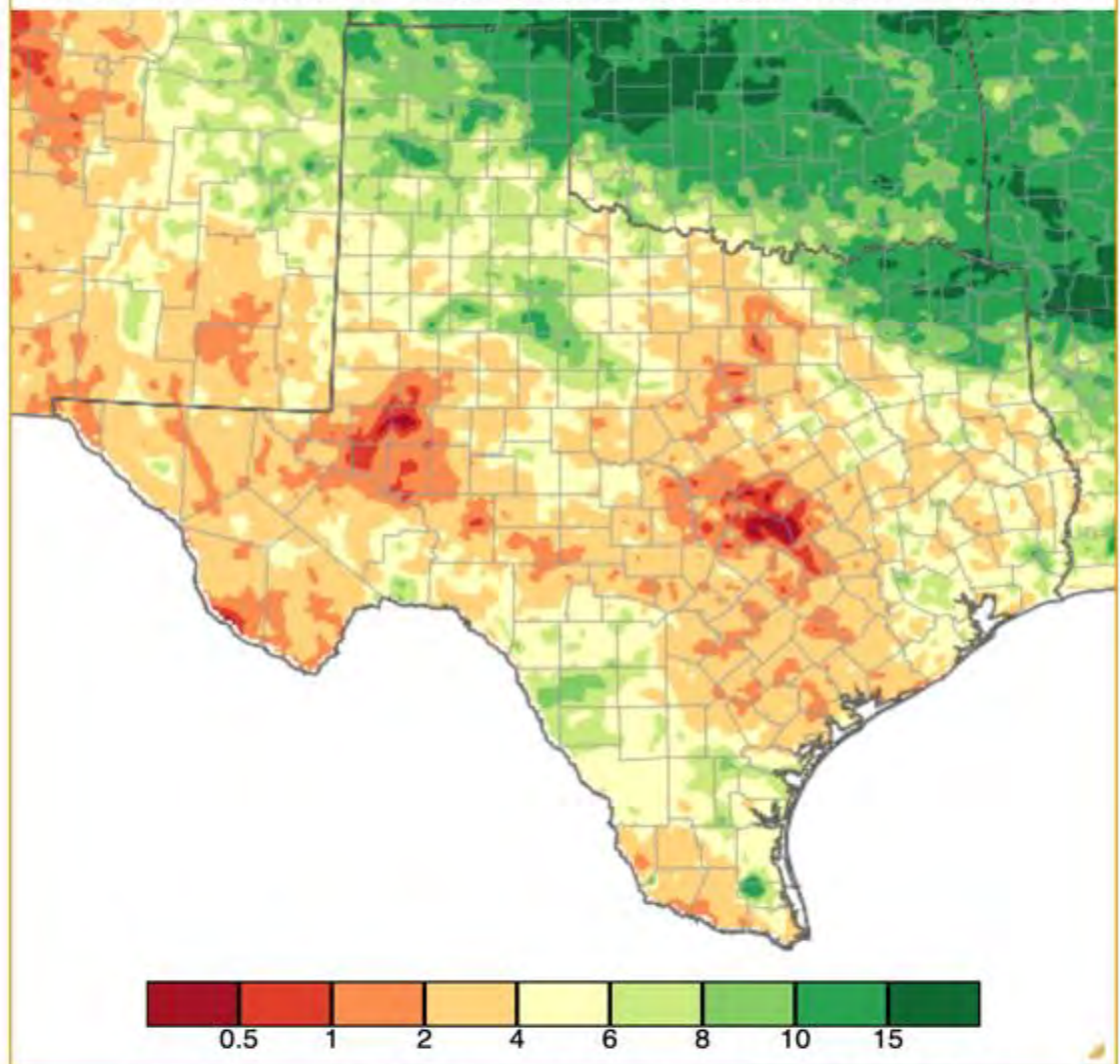
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Texas Summer Weather Summary

Summer 2023 Texas Overview

John Nielsen-Gammon, Texas State Climatologist
Texas A&M University

Total Precipitation - June 1, 2023 through August 31, 2023



Summer precipitation from PRISM analysis, courtesy of SC-ACIS.

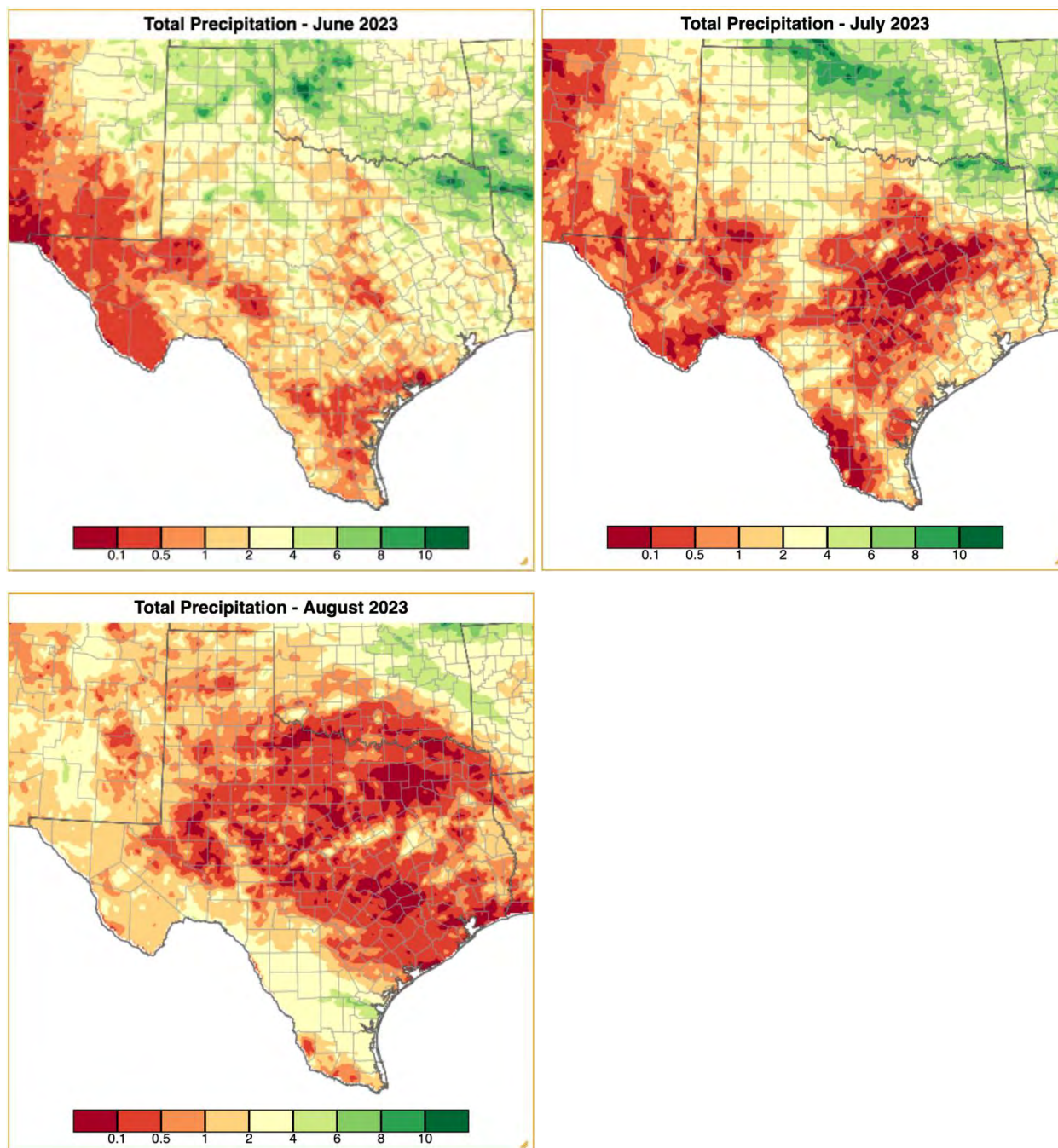
For the first time I can remember, the wettest part of the state was in the northeast corner of the Texas Panhandle!

Continued page 2 >

“Because Every Drop Counts, As Do All Zeros”

Texas Summer Weather Summary (continued)

After a decent start to June, a heat dome arrived and did a number on the rest of the summer. The first heat wave, in mid- to late-June, was notable for its high humidity. With decent rains having occurred from April onwards, the plants were ready to kick back, enjoy the sun, and grow like crazy. But just like immature spring breakers, they didn't know when to quit. Before they knew it, they'd burned through their available water allocation, and with little knowledge of what to come, they left the soil dry for the dog days of July and August.



Figures 2 – 4: PRISM maps of precipitation during June, July, and August in Texas, from scacis.rcc-acis.org.

Areas marked in dark orange, above, had less than 0.5 inches for the month, which is barely enough to neutralize a day or two of dryness. Such conditions were widespread from parts of South Texas to east-Central Texas and north to the Red River.

Texas Summer Weather Summary (continued)

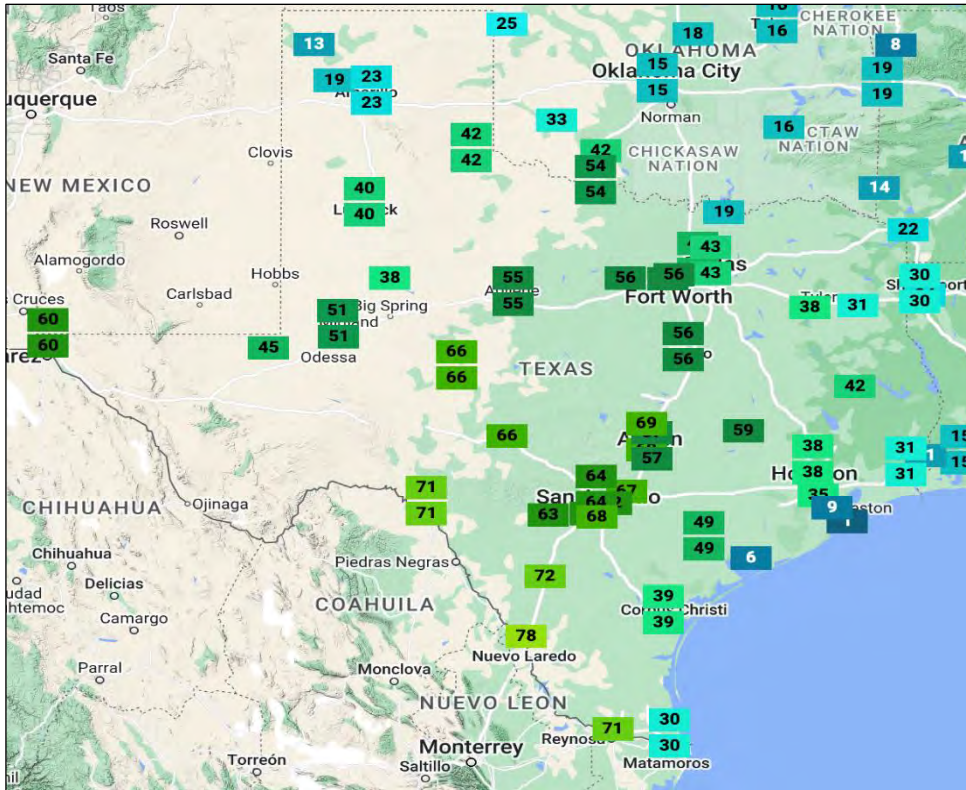


Figure 5: SERCC ClimPer map of number of 100-degree days

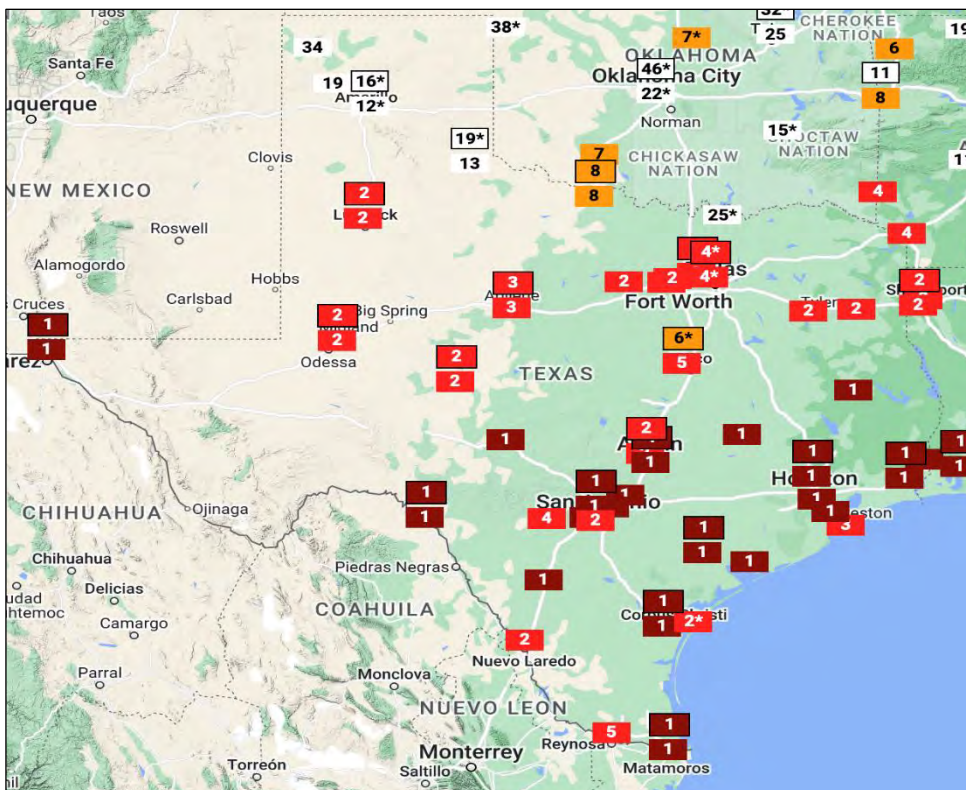


Figure 6: Map of historical rankings of summertime temperatures, from SERCC ClimPer.

With all the sunny, dry weather, with a record warm Gulf of Mexico just upstream, and with most of the moisture gone by early July, Texas raised a bumper crop of 100 degree days. Much of south-central and west-central Texas had more than two months' worth of 100 degree weather, and much of the rest of the state nearly made it to that threshold.

Near and south of I-10, it was the hottest summer on record, and most of the rest of the state came in second-hottest behind 2011. Only the mild first half of June prevented 2023 from being the hottest summer ever overall for Texas.

The outlook for fall calls for cooler temperatures. Which is what one would expect...it's fall, right? But these temperatures might cool right past normal and be on the cool side this winter. Also, presumably, it will be cloudy and rainy if the winter follows the El Niño script. I don't know about you, but I could really use some 40-degree weather about now. And I'm tired of this 40-degree Celsius stuff -- that's too hot! I want my 40 degrees Fahrenheit.

West Texas/Southeast New Mexico Regional Summary

West Texas and Southeast New Mexico had a typical summer, characterized by little convective activity and below-normal rainfall.

By: Jim DeBerry, Meteorologist, Hydrology Program Manager, NWS Midland

June

June was uneventful as the summertime ridge arrived in force, resulting in dry and warm weather across the Southern Plains. However, a few hydrologic events were noted.

On the afternoon of June 2nd, thunderstorms developed a mile northeast of Seminole in Gaines County, resulting in a few roads flooding. Some of these roads were closed, and a few motorists stranded. Thunderstorms 5 miles south of Seagraves flooded Highway 349 and temporarily closed FM 1429. Later that afternoon, thunderstorms inundated streets in Andrews in Andrews County, stranding motorists there. That evening, thunderstorms moved into Dawson County, flooding roads 2 miles north of Grandview. Some of these roads were barricaded, and motorists stranded. In Howard County, thunderstorms flooding roads west of Big Spring, forcing motorists to take detours and stranding others.

On the evening of the 7th, thunderstorms hit Andrews again, flooding numerous streets there. Thunderstorms also flooded streets on the south side of Big Spring.

Many rural areas of West Texas and Southeast New Mexico also likely saw some flash flooding in June, but these events were not reported due to sparse population density.

Monthly radar rainfall estimates ranged from no rainfall in western Presidio County to up to 10" in northern Dawson County. Highest observed rainfall was 3.93" at Andrews in Andrews County. Average rainfall of all stations reporting was 0.97".

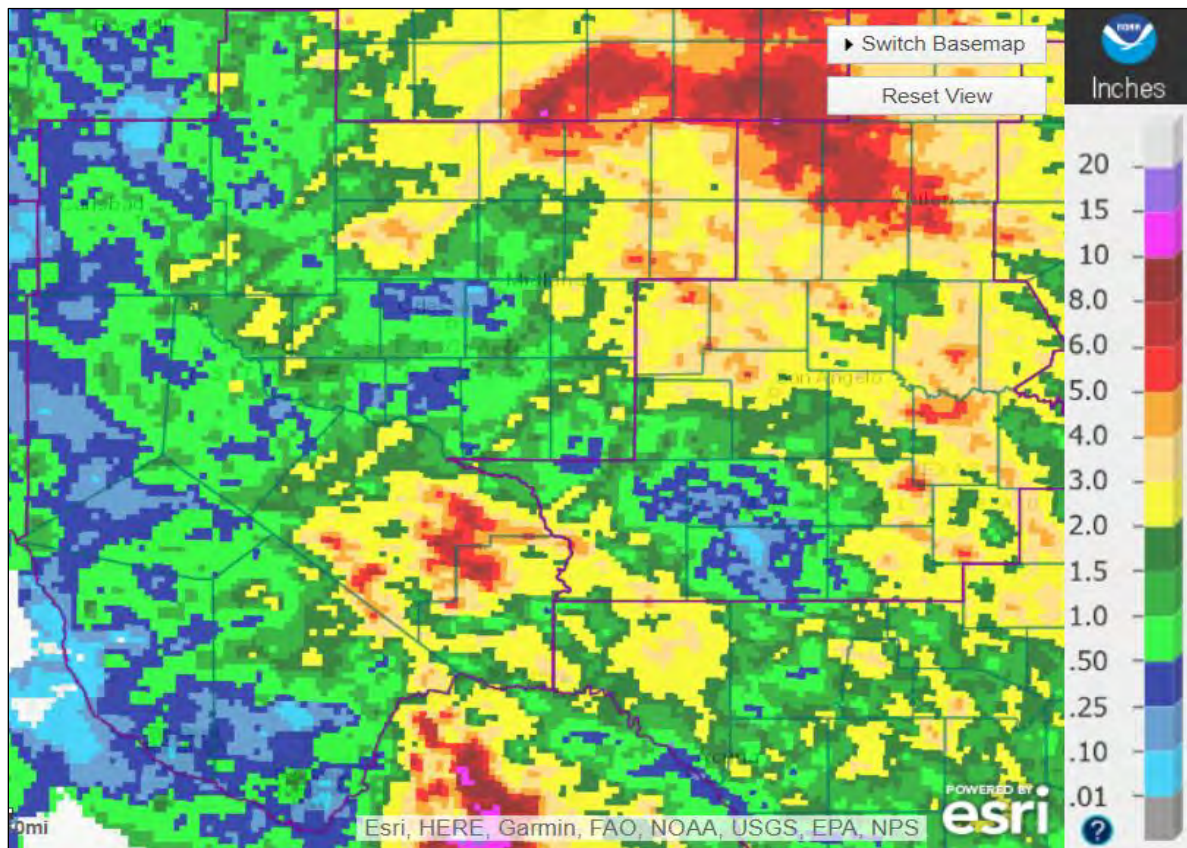


Figure 1: June Precipitation

West Texas/Southeast New Mexico Regional Summary (continued)

July

The summertime ridge dominated the synoptic pattern with a vengeance in July, resulting in little rainfall across West Texas and Southeast New Mexico. Most rain fell in the first few days of the month.

Only July 1st, thunderstorms flooded low water crossings in Snyder in Scurry County, necessitating two high-water rescues.

The rest of the month was dry, with little hydrologic activity and no other reports of flooding.

Monthly radar rainfall estimates ranged from nothing in southeast Brewster County to up to 6" in northern Lea County. Highest observed rainfall was 2.36" 7 miles northwest of Alpine in Jeff Davis County. Average rainfall was only 0.45".

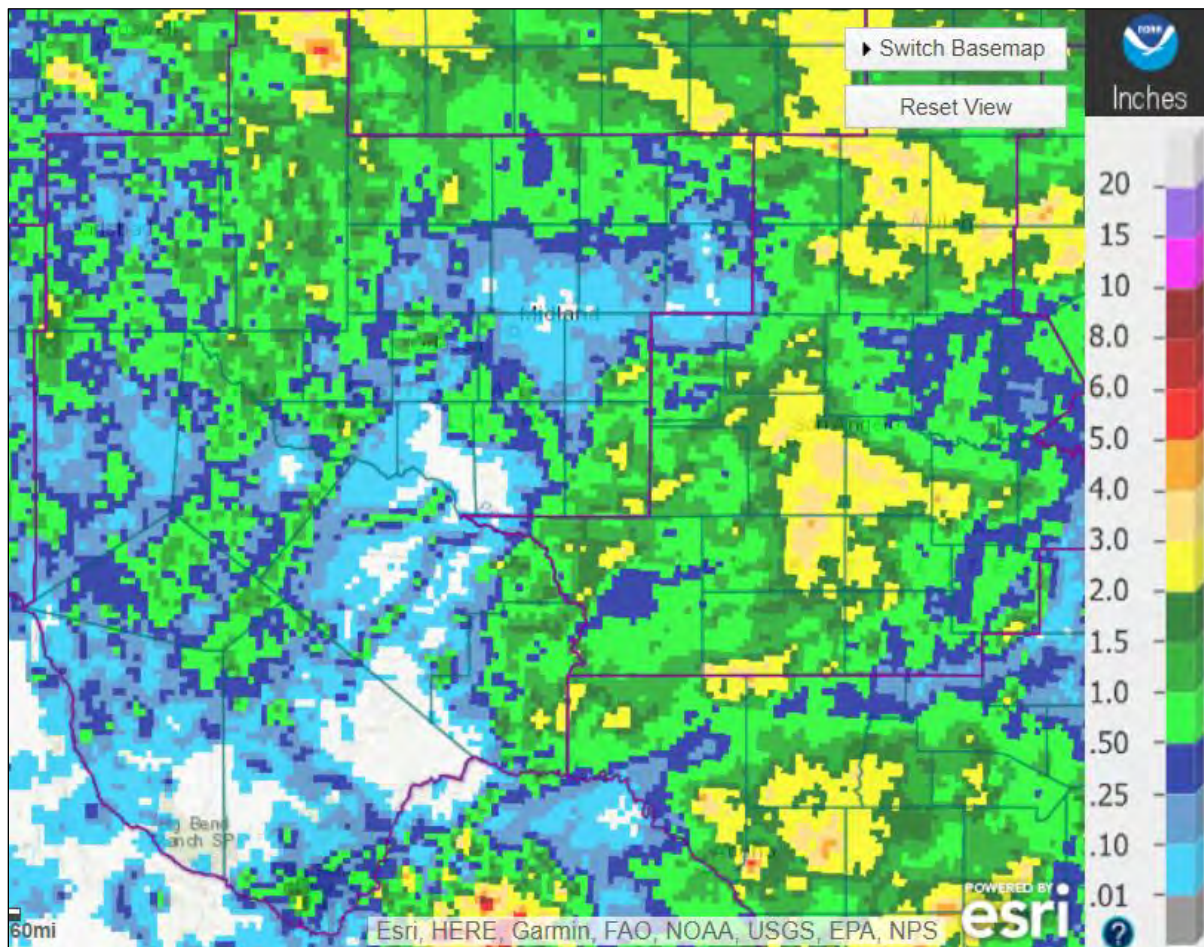


Figure 2: July Precipitation

West Texas/Southeast New Mexico Regional Summary (continued)

August

August was uneventful hydrologically except for one notable event. On August 23rd, remnants of Tropical Storm Harold entered the lower Trans Pecos, and moved northwest across the HSA, exiting through the Guadalupe Mountains. Unfortunately, the radar at NWS Midland was out of service that day, so areal rainfall coverage was hard to come by. Thus, the monthly radar precipitation map on the next page does not reflect rainfall from the storm. However, numerous low water crossings along U.S. Hwy 385 south of Fort Stockton flooded in Pecos County. The river gage on the Rio Grande south of Dryden in Terrell County reported over 5" of rainfall from the storm. The Rio Grande jumped from less than 5' to just over 27' in 6 hours. However, the Rio Grande at Dryden is still well below the flood stage of 59' at this reach of the river.

Monthly radar precipitation estimates ranged from as little as 1/100" in the Presidio Valley in Presidio County to up to 5" in southern Terrell County. However, highest observed rainfall was 5.78" at the Terrell County Airport in Terrell County. Average rainfall was 1.08".

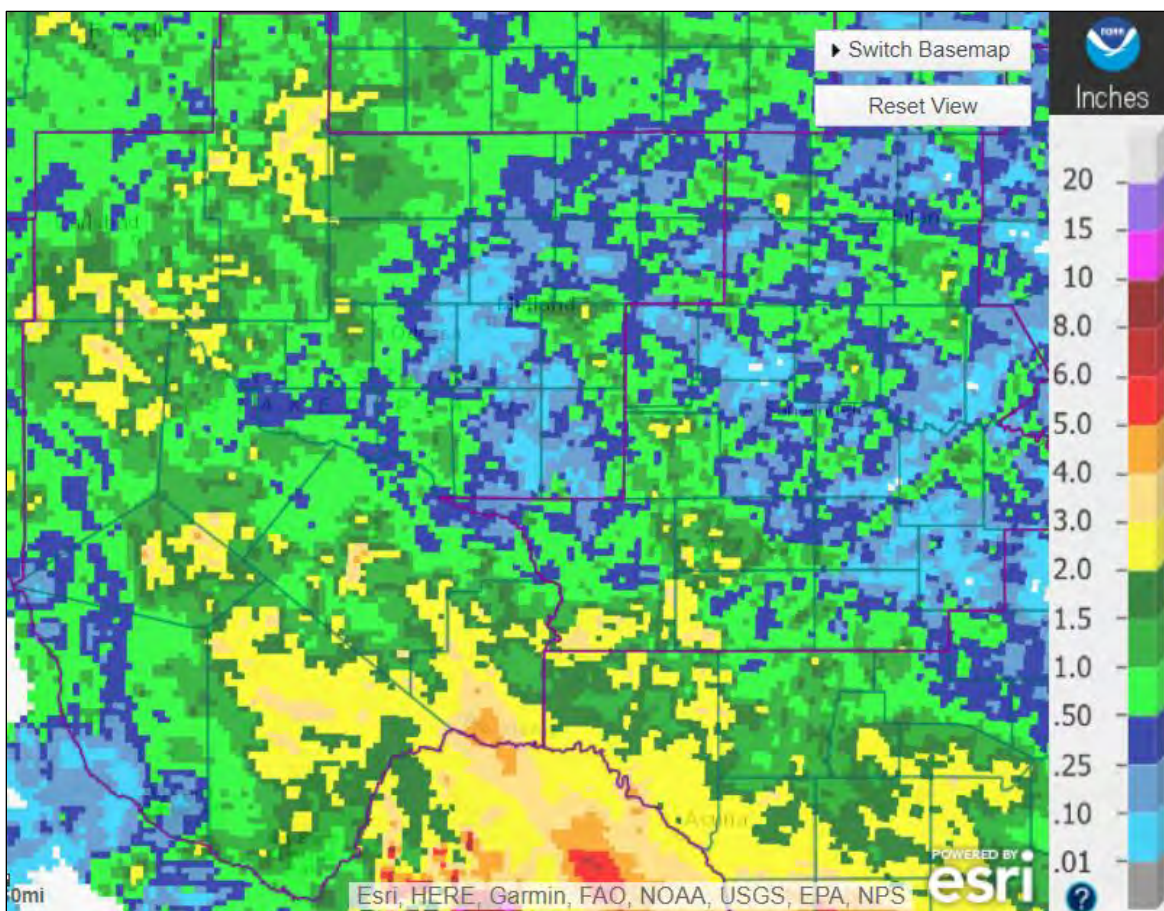


Figure 3: August Precipitation

Overall, Summer 2023 was dry for West Texas and Southeast New Mexico.

West Texas/Southeast New Mexico Regional Summary (continued)

As of August 29th, most of Southeast New Mexico and a portion of the central Permian Basin were in extreme drought. Most of the rest of the area fared little better in severe drought. Only the Big Bend Area was out of drought, mainly due to rainfall from the remnants of Tropical Storm Harold.

Area reservoirs are at 45.7% of conservation capacity as of September 1st.

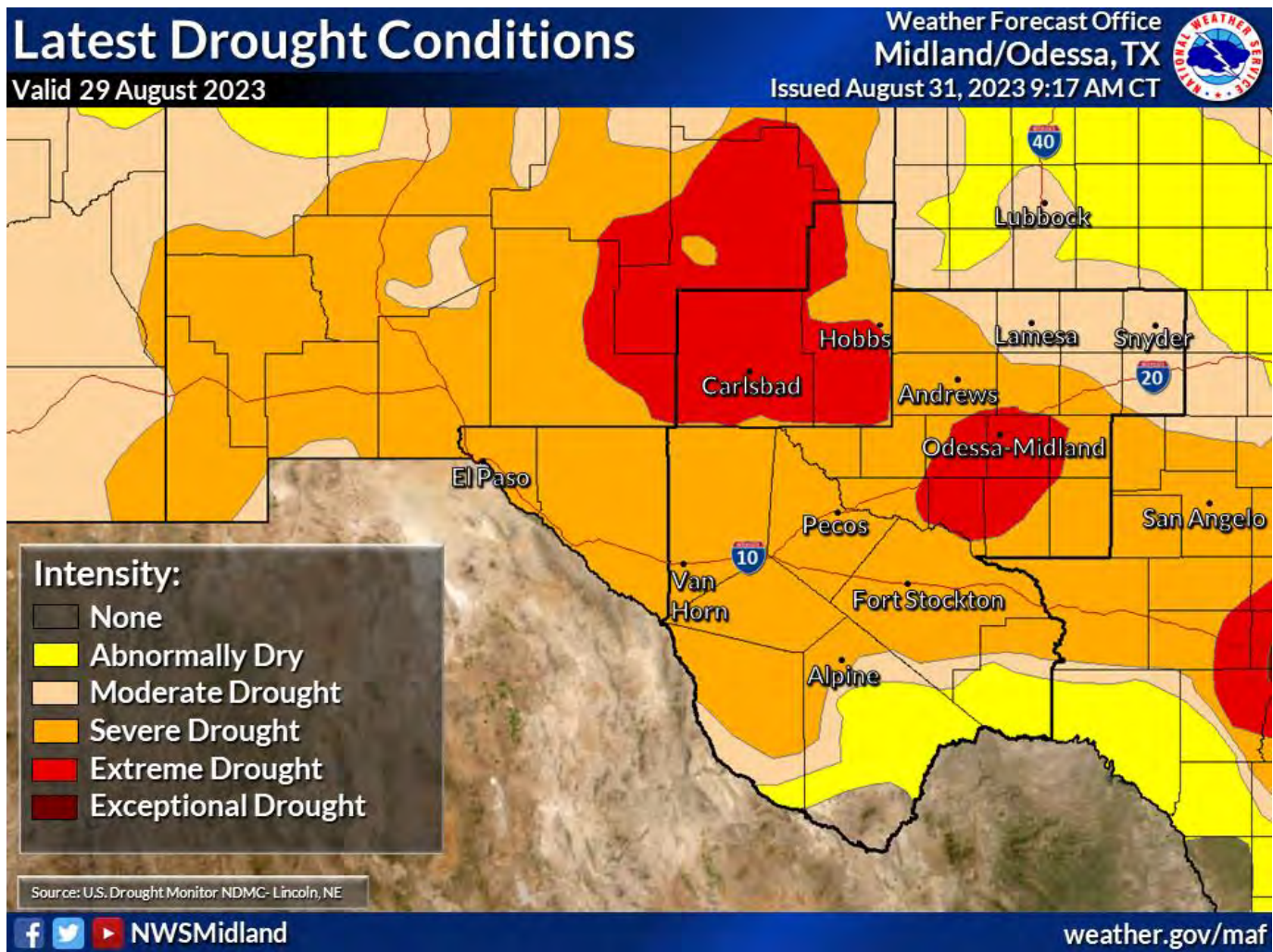


Figure 4: Drought Conditions at the end of August 2023

Austin/San Antonio Regional Summary

The Hottest Summer on Record for Most (and One of the Driest for Some)

By: Keith White – WFO Austin/San Antonio

For the second summer in a row, the bulk of the season was hotter and drier than normal, and in most cases significantly so! For some locations, most of the summer's rainfall occurred over the course of the first 10 days of June (Figure 1). But then, the heat turned up on blast and mostly stayed that way through the rest of the summer. Tropical Storm Harold also brought significant rains to mainly southwestern portions of the region on August 22nd. Otherwise, subtropical ridging dominated our weather this summer with excessive heat and significant expansion and degradation of drought.

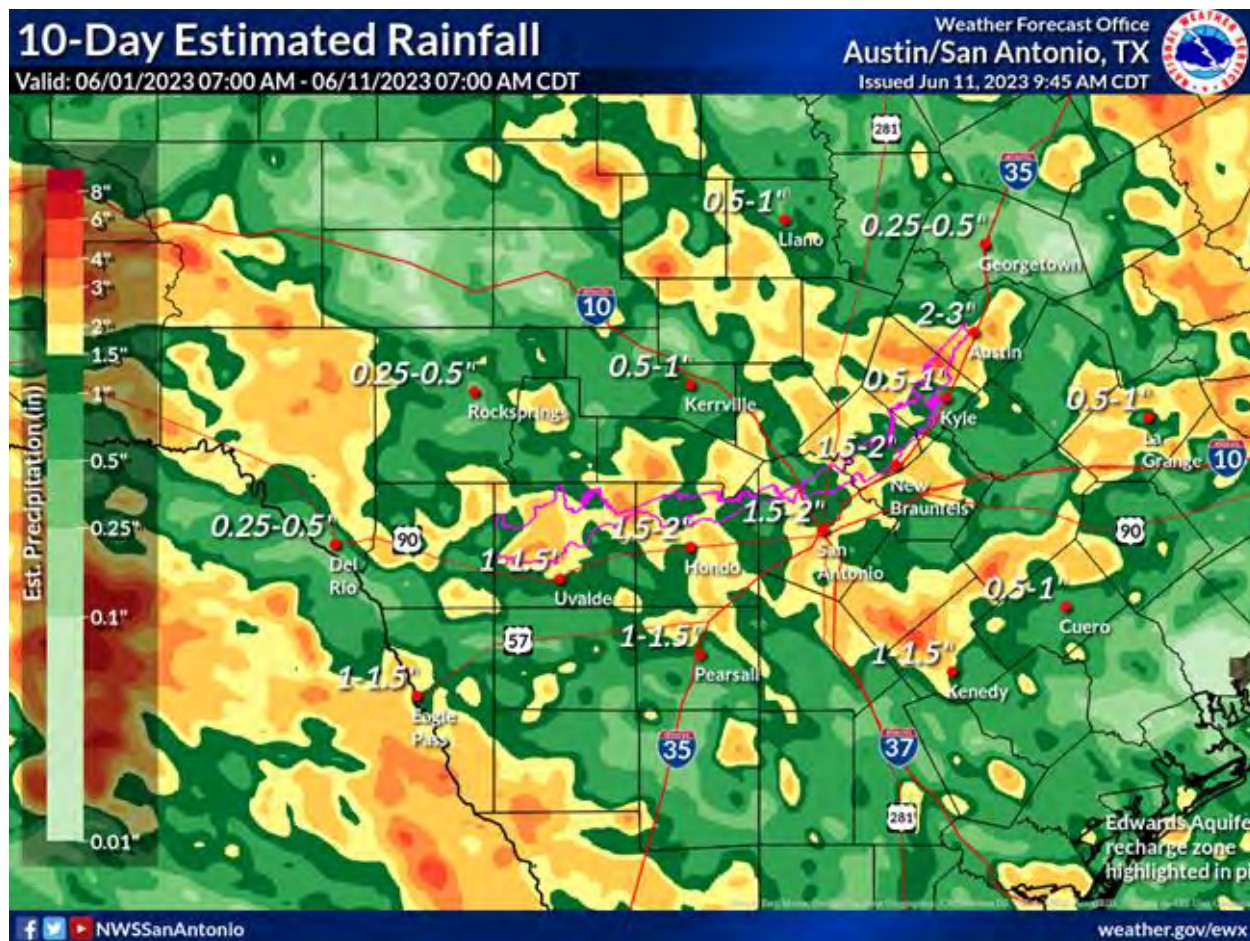


Figure 1: 10-day rainfall estimates ending 7am June 11, 2023

For the first week or so of June, temperatures were benign enough, and were in fact below normal for most areas. But with the rains that fell in the lead-up to mid-June, we were primed for high humidity. As high pressure began to take control of our weather in the 2nd and especially 3rd week of the month, temperatures were routinely above normal, and all-time records for Heat Index were set on June 20th in San Antonio (116 degrees) and June 21 in Austin (118 degrees). Meanwhile, the all-time record high temperature at Del Rio was broken on June 20 (113 degrees), then broken AGAIN the very next day (115 degrees). Other than some spotty storms in the Hill Country on the 16th, 18th, and 20th, and some more widespread storms across the Hill Country, I-35 corridor, and Coastal Plains on the 21st, dry weather prevailed through the final 3 weeks of the month. Several large hail reports sent in via CoCoRaHS on the 16th helped us immensely in verifying Severe Thunderstorm Warnings in the Hill Country and northern Austin Metro area. Some swaths of 1-2" rainfall amounts did occur on the 21st from Llano southeastward through parts of Blanco, Hays, Caldwell, and Gonzales Counties, but this would be the last notable rainfall for these areas for quite some time.

Austin/San Antonio Regional Summary (continued)

Continuing the trend from June, much of the area saw below normal rainfall for the month of July. There was one round of heavy rainfall which prompted the issuance of a few flood advisories across the Rio Grande Plains and southern Edwards Plateau on the evening of the 1st. Several CoCoRaHS observers measured 1.5-3" amounts in portions of Val Verde, Uvalde, Media, and Frio Counties, and for a few areas this event alone provided more rain than average for the month of July. For about a week following that, some isolated light to moderate rains and near-normal temperatures topping out mainly in the 90s were a welcome reprieve, but the door would quickly shut on that. As soils continued to dry out and high pressure continued to dominate our weather, we got a lot of sunshine. Without much water left in the soils to evaporate, most of the sun's energy went straight into heating. By July 8-9, temperatures were back to near and above 100 degrees. This would begin a new record streak of 100-degree days in Austin (Camp Mabry) that would not end until Tropical Storm Harold brought a little rain and a high of 99 on August 22nd. At 45 consecutive days, this shattered the previous record of 27 from 2011.

Additional rains were hard to come by for the rest of July. Portions of the region received light to moderate rain on July 22-23 as scattered showers and storms developed along a weak "cold front" (if you can really call it that.) But amounts were generally paltry except for some 1-2" amounts in southern Kendall and NW Bexar Counties. Some areas, particularly in Williamson County, would see no rain at all in July and through much of August. Several locations in Williamson County went over 2 months without measurable rain! And during the period from July 25-August 15, the vast majority of CoCoRaHS observers in south-central TX reported zero rainfall, while only 2 reported amounts greater than 0.25", one in Caldwell County and one in Lavaca County.

Meanwhile, already hot temperatures continued to soar. Highs each day mainly ranged from 98-110 across the area, and a few locations did not see a day with below normal average temperatures not just during this period, but for nearly the entire summer. All this heat led to additional evaporation, and so streamflow, reservoir, and aquifer levels continued a steady decline. Wildfire activity ticked up significantly in the 2nd half of the summer. Some residents reported issues with their foundations. As these and many other impacts increased, the Drought Monitor depicted some areas degrading through all four drought categories. A summer that started with only 41% of the region in any level of drought on June 6th ended with nearly that much of our area in Exceptional (D4) Drought (35%).

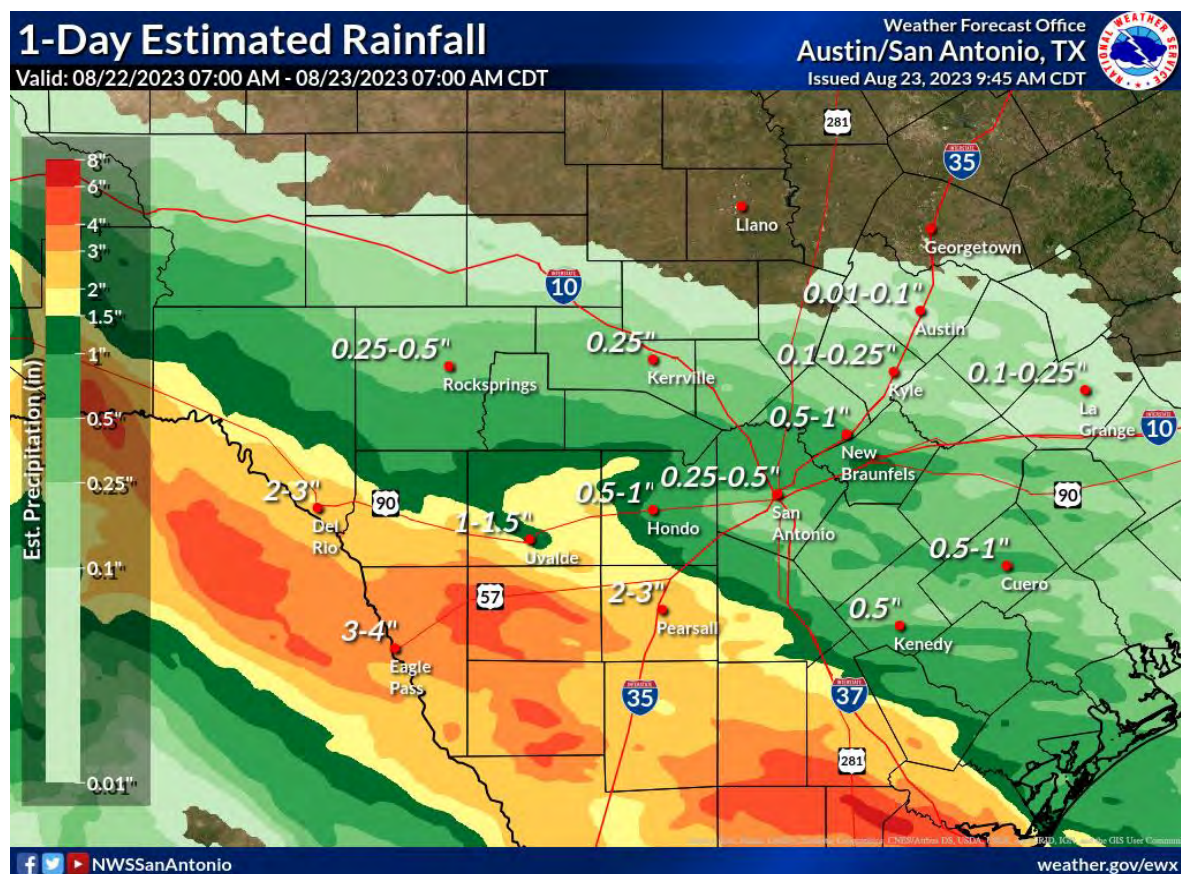


Figure 2: Rainfall between 7am August 22, 2023, and 7am August 23, 2023. Rainfall associated with Tropical Storm Harold.

Austin/San Antonio Regional Summary (continued)

Meaningful relief did arrive with Tropical Storm Harold on August 22, but mainly for southwestern areas that were not in nearly as dire need for rain as the rest of our region (Figure 2). Rainfall amounts as high as 5.58" were reported in Crystal City, with 2+" amounts confined mainly to areas southwest of a Del Rio to Pleasanton line. Meanwhile, locations in Llano, Burnet, and Williamson County missed out completely. Some of these areas did finally see some light rainfall amounts on the evening of August 27, but still easily ended the summer with their lowest total rainfall on record. After the exit of Harold, temperatures spiked one last time, then a "cold" front arrived on the 27th, bringing scattered storms to mainly the Hill Country. On the 28th, one last round of scattered storms focused mainly on areas west of San Antonio towards the southern Edwards Plateau, with only spotty 1-2+" amounts. Temperatures behind the front were still above normal, with 100-degree days continuing into early September.

When the books officially closed on Meteorological Summer at 12am Local Standard Time on September 1st, it ultimately ended as the hottest summer on record at 3 of our 4 primary climate sites of Austin (Camp Mabry and Bergstrom), San Antonio, and Del Rio. Camp Mabry ended up recording the 2nd hottest (and 2nd driest) summer on record. Several of our longer-term Cooperative Observer sites such as our office here in New Braunfels, Llano, Hallettsville, and others also had their hottest summer on record, though a few locations "only" fell within the top 3 or 4 hottest summers.

In terms of total precipitation this Summer, obviously a lot was left to be desired. Most areas east of US-281 received less than 4" this summer (Figure 3), and some a LOT less, i.e., Williamson County. This translated to less than half of normal, and widespread deficits of 4-7" were experienced in these areas. There was better news in western portions of the area, but even then, only some parts of Maverick, Dimmit, and Zavala counties experienced above-normal rainfall. Only two CoCoRaHS observers in the entire region measured more than 7" of rain in the past 3 months, one in NW Frio County and one in Crystal City, thanks mostly to Harold.

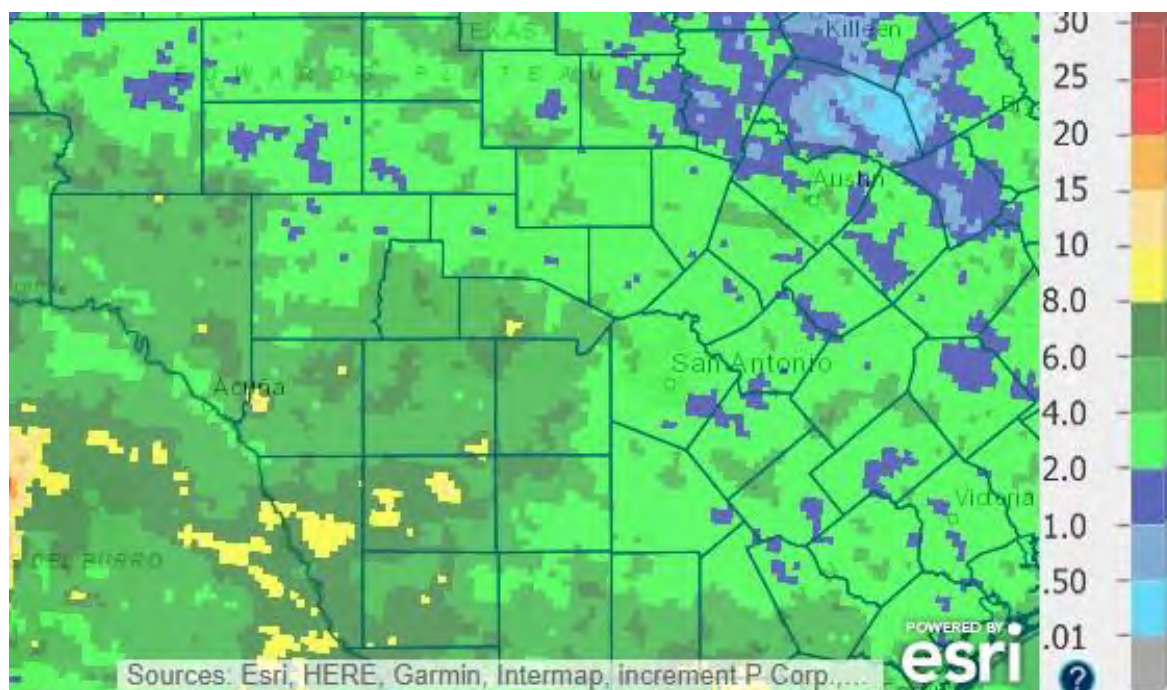


Figure 3: Rainfall estimates over the 90 days ending 7am August 30, 2023.

As a result of these late summer rains, drought conditions improved markedly for these southwestern areas late this summer, but the area with the highest rainfall deficits both this year and last didn't have the same luck. The highest category of drought, Extreme (D4) Drought, expanded across much of the Hill Country and I-35 Corridor (Compare Figures 4 and 5 on next page). Canyon Lake reached the lowest pool elevation recorded since it was created and filled in the late 1960s. Many rivers were barely flowing, if at all! We're all looking forward to the potential for El Niño to at least tilt our odds towards cooler, wetter than normal weather this winter, however there are no guarantees, and it's unlikely that we'll make up the long-term rainfall deficits of the past two years before the arrival of spring next year.

Austin/San Antonio Regional Summary (continued)

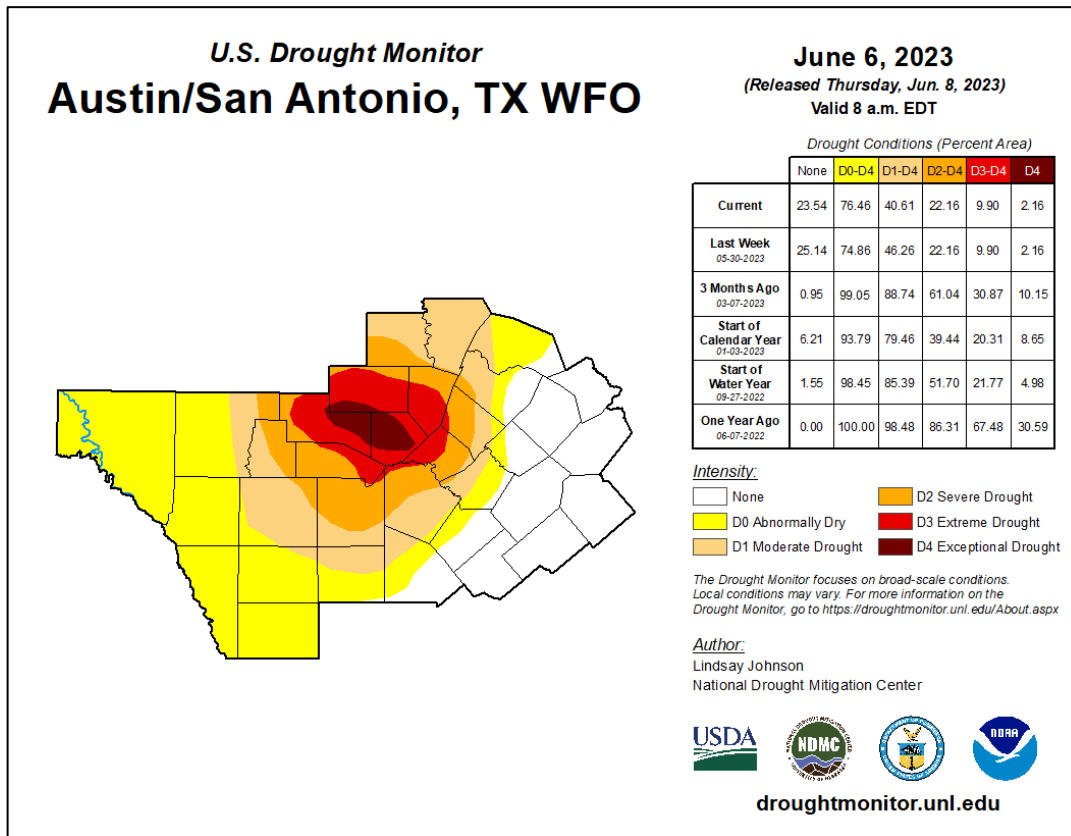


Figure 4: United States Drought Monitor for South-Central TX valid 7am CDT Tuesday, June 6, 2023

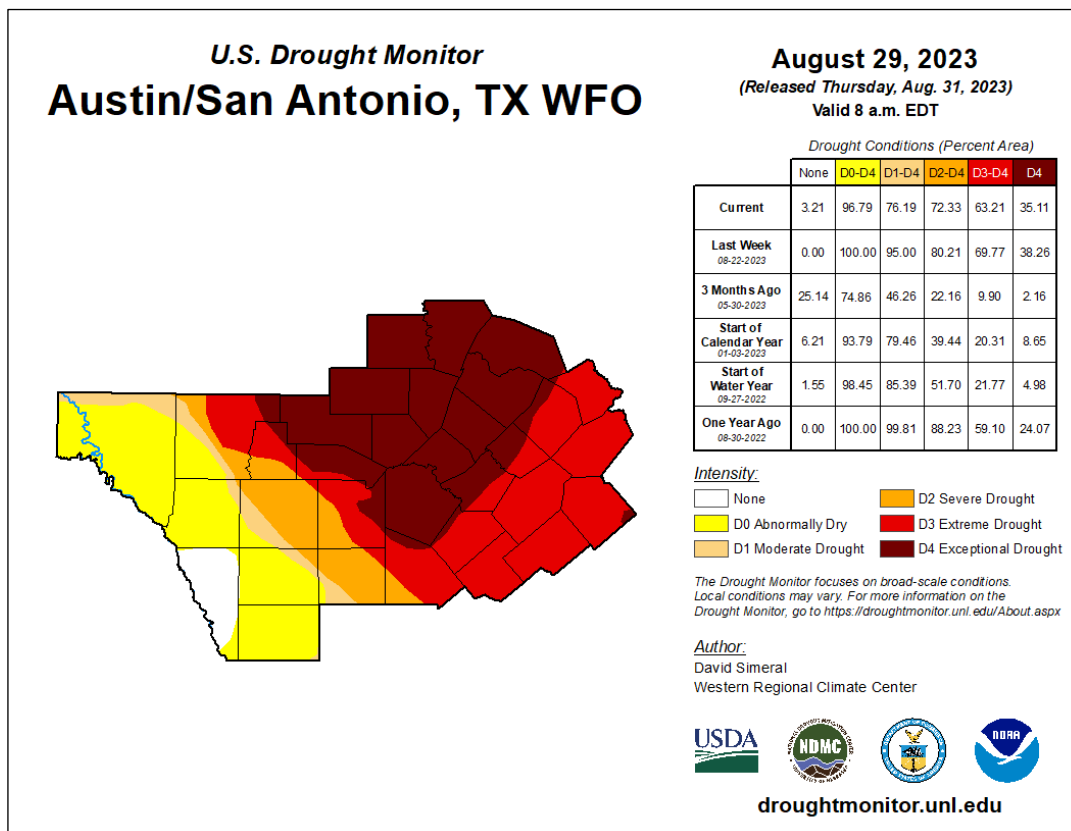


Figure 5: United States Drought Monitor for South-Central TX valid 7am CDT Tuesday, August 29, 2023

El Paso Regional Summary

Record Heat Overshadows Dry, Drought Stricken Monsoon Season

By: Connor Dennhardt, Meteorologist - National Weather Service El Paso

One of the drier summers on record, this season was one to forget for most local CoCoRaHS observers. High pressure aloft dominated the majority of the season with multiple prolonged heat waves. El Paso, Texas broke several all-time heat records, including the most 100-degree days in the year, the longest consecutive streak of 100-degree days, and hottest August temperature ever recorded. US Drought Monitor currently has all of El Paso and Hudspeth Counties in Severe Drought (D2) status, which is likely to persist or worsen as the typically dry fall season further exhausts available soil moisture.

The subtropical high was consistently further west than typical for the North American Monsoon, resulting in below normal precipitation area wide. Gulf moisture moving up from northern Mexico was highly inconsistent and rarely stayed in place this season. Thunderstorms over the nearby high terrain failed to consistently develop with the intensity necessary for outflow boundaries that reach El Paso and allow for evening rain chances. Far West Texas sites only recorded 10 to 15 days with measurable precipitation throughout the entire season, with 90-day precipitation totals ranging from **1.25-2.50"**, well below the **4.00"** climate normal. Most locations in southern New Mexico and far West Texas finished with around **30-50%** of expected rainfall. Precipitation was slightly more favorable across central Hudspeth County, but still slightly below normal for the summer season.

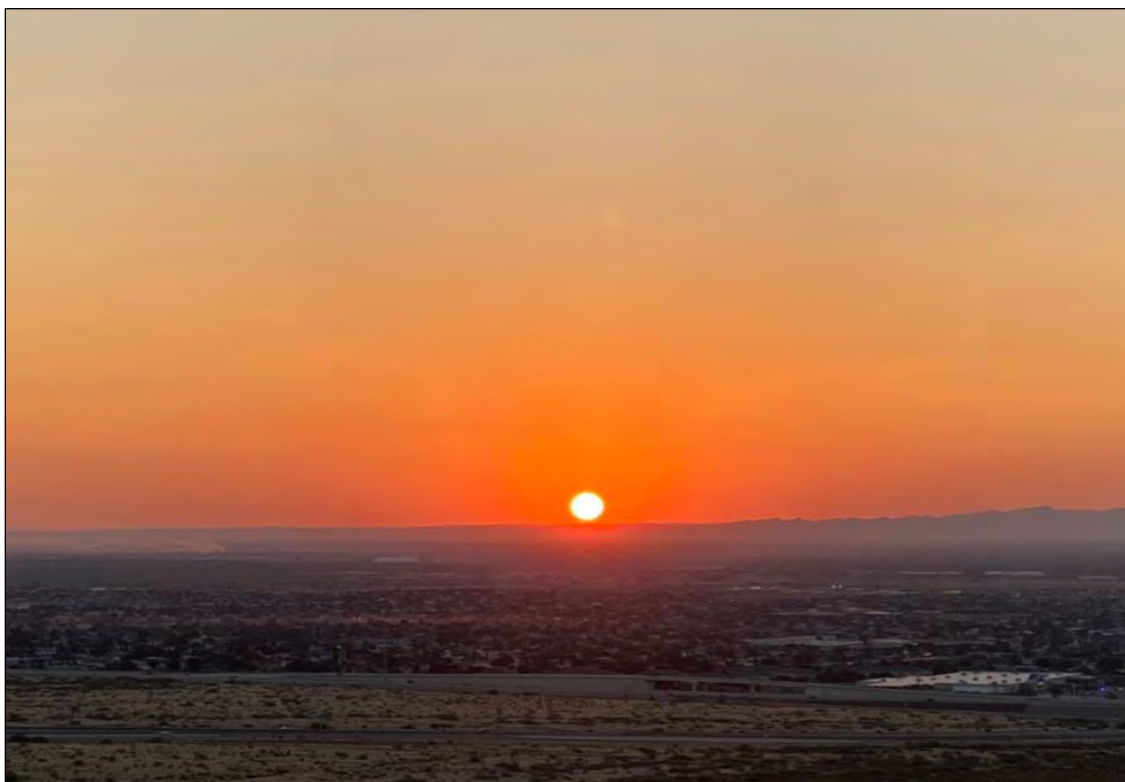


Figure 1: Sunrise seen Trans-mountain Pass in El Paso, TX precluding another dry, hot day on June 26th, 2023

June began as a typically dry and warm month, with temperatures during the first half of the month right around climate normals. Only one day of rainfall was recorded for all observers, June 6th. A few observers in eastern El Paso County reported rainfall of **0.50-0.75"**, while most within the El Paso metro reported less than **0.15"**. The summer heat wave quickly set in by mid-June and never really let go after that. El Paso International Airport consistently recorded high temperatures above 105 degrees in late June.

El Paso Regional Summary (continued)

The July heat wave was one for the record books, finishing as the hottest month in El Paso's recorded history. An average high temperature of 105 degrees shattered multiple records and monsoon flow was marginal at best. Monthly totals ranged from **0.10"** to **0.75"**, well below the monthly climate average of **1.58"** for El Paso. Local observers recorded measurable precipitation only 3-6 days of the month. Thunderstorms did reach the metro on July 10-13, which accounted for the majority of precipitation for the month.

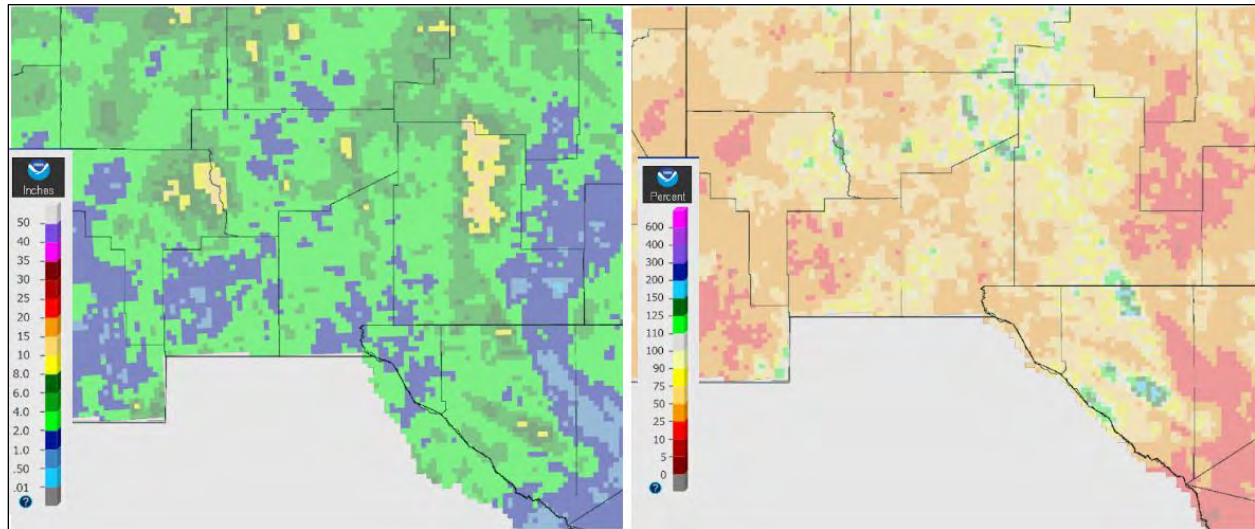


Figure 2: 90-Day Precipitation Totals and Percent of Normal for southern New Mexico and far west Texas

Yet another record heat wave occurred the first half of August before the best rainfall of the season occurred in mid and late August. However, an influx of Gulf moisture the second half of the month resulted in some of the best rainfall of the season. Scattered showers and thunderstorms reached El Paso County on August 13-14, with many observers reporting **0.25-0.75"** of rain. On August 23rd, remnants of a Tropical Cyclone Harold tracked up the Rio Grande Valley, providing widespread rains to the region. The heaviest rains occurred over mostly rural locations in Hudspeth County, but a CoCoRaHS observer in eastern Hudspeth did report **2.30"**. Heavy rain occurred overnight on August 28th as a strong thunderstorm formed over Central El Paso County, resulting in street flooding and a few road closures in El Paso. CoCoRaHS observers reported **0.75-1.25"** of rain that day, the best one day total of the summer.

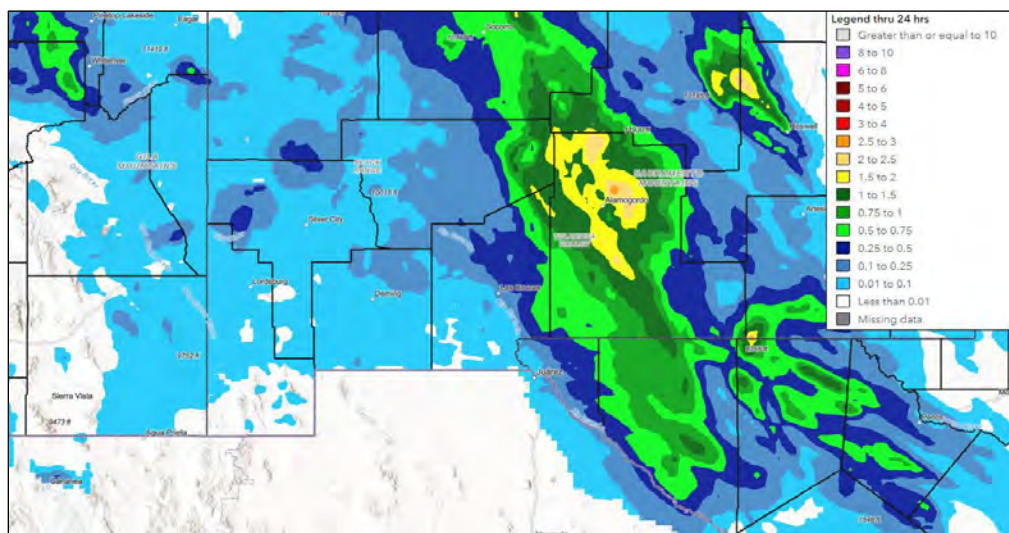


Figure 3: Rainfall analysis of Tropical Cyclone Harold's remnants on 8/23/2023. The heaviest rains fell over Hudspeth and Otero Counties.

The summer season featured 37 active observers in El Paso County, and 3 in Hudspeth County. This monsoon season garnered a total of 1,909 daily reports submitted, along with 51 multi-day reports. Only 15% of these daily reports were measurable precipitation, so thanks to everyone for reporting zeroes. No Significant Weather Reports or Condition Monitoring Reports were submitted this season. Thanks again to all our local observers who participated in the 2023 summer season!

East Texas Regional Summary

Active Weather at Times Followed by Hot & Dry

By: Davyon Hill (Meteorologist-National Weather Service-Shreveport)

A very active start to summer 2023 across East Texas, as several disturbances moved across the region during the first 10 days of the month. These systems brought generally 1" to 2" of rainfall across the region, especially across CoCoRaHS sites near and north of the Interstate 20 corridor, with a few locations reporting over 3" in Smith County. Some severe weather was also reported, with widespread reports of downed trees on the 3rd and 10th of the month. By the 11 & 12th, a cold front slowly moved into the region, bringing more severe weather in the form of damaging winds, and one golf ball size hail report from NWS Shreveport in the Albion community in Red River County. However, by the 13th, storms continue to develop across the region in wake of the front. Because these storms were more elevated, they produced widespread large hail across the region. Several CoCoRaHS sites, along with NWS Shreveport local storm reports, reported numerous accounts of hail ranging from golf ball to baseball size, with even a softball size hail report near Gary City, TX. By the 14th, the aforementioned frontal boundary returned northward as a warm front. Additional severe weather formed along the boundary, including a few scattered 1" to 2" hail reports and an EF-2 tornado in Cass County, TX. Another round of severe weather hit the region during the late evening hours on the 15th and just after midnight on the 16th, as a Derecho formed ahead of another frontal boundary. Widespread winds over 70 mph knocked down trees and power lines across most of East Texas between the I-30 and I-20 corridors. There was also an EF-1 tornado that developed in eastern Panola County near the Texas/Louisiana border. Unfortunately, that wasn't the end as more elevated storms produced 1" to 2" hail in wake of the line just before sunrise on the 16th across Smith, Cherokee, and Angelina Counties. Additional daily convection continued to form and move across the region through the 26th, but most of it was confined to areas near and north of the I-20 corridor. This weather brought more widespread damaging winds on the 18th and 23rd, and 1" to 2" hail on the 17th and 26th in Harrison and Bowie Counties respectively. Although the remainder of the month remained dry, many CoCoRaHS sites reported 4" to 9" of rainfall, especially near and north of I-20 corridor. For sites across Deep East Texas, rainfall generally ranged from 1" to 3".



**Fig.1: Large Hail - Jun. 13, 2023
near Gary City, TX
(Panola County)**

Image Courtesy of Natalie Thames – KSLA-TV Viewer



**Fig.2: Tornado – Jun. 14, 2023
Between Queen City & Domino, TX
(Cass County)**

Image Courtesy of Southcentral Storm Chasers

East Texas Regional Summary (continued)

Like June, the month of July started out with active weather, as damaging winds hit portions of the region on the 2nd and 3rd of the month. Additional heavy rain was observed afterwards, with flash flooding reported in Harrison County on the 6th. Another 4" to 5" of rain was reported on the 8th at several CoCoRaHS sites in Bowie County. By the 16th, another cool front moved into the region, bringing more widespread wind damage north of the I-20 corridor. However, the weather pattern made a sharp turn beyond this. Upper-level ridging became the dominate weather pattern over the region from middle July through most of August, resulting in little to no rain across the region. Severe to exceptional drought conditions rapidly developed across the region, and triple digit temperatures became the norm. Elevated fire conditions also developed and burn bans were enacted across most East Texas counties, as wildfires started to form. Despite widespread moderate to heavy rainfall returning on the 27th of August, burn bans along with drought and elevated fire conditions remained through the end of the summer months.

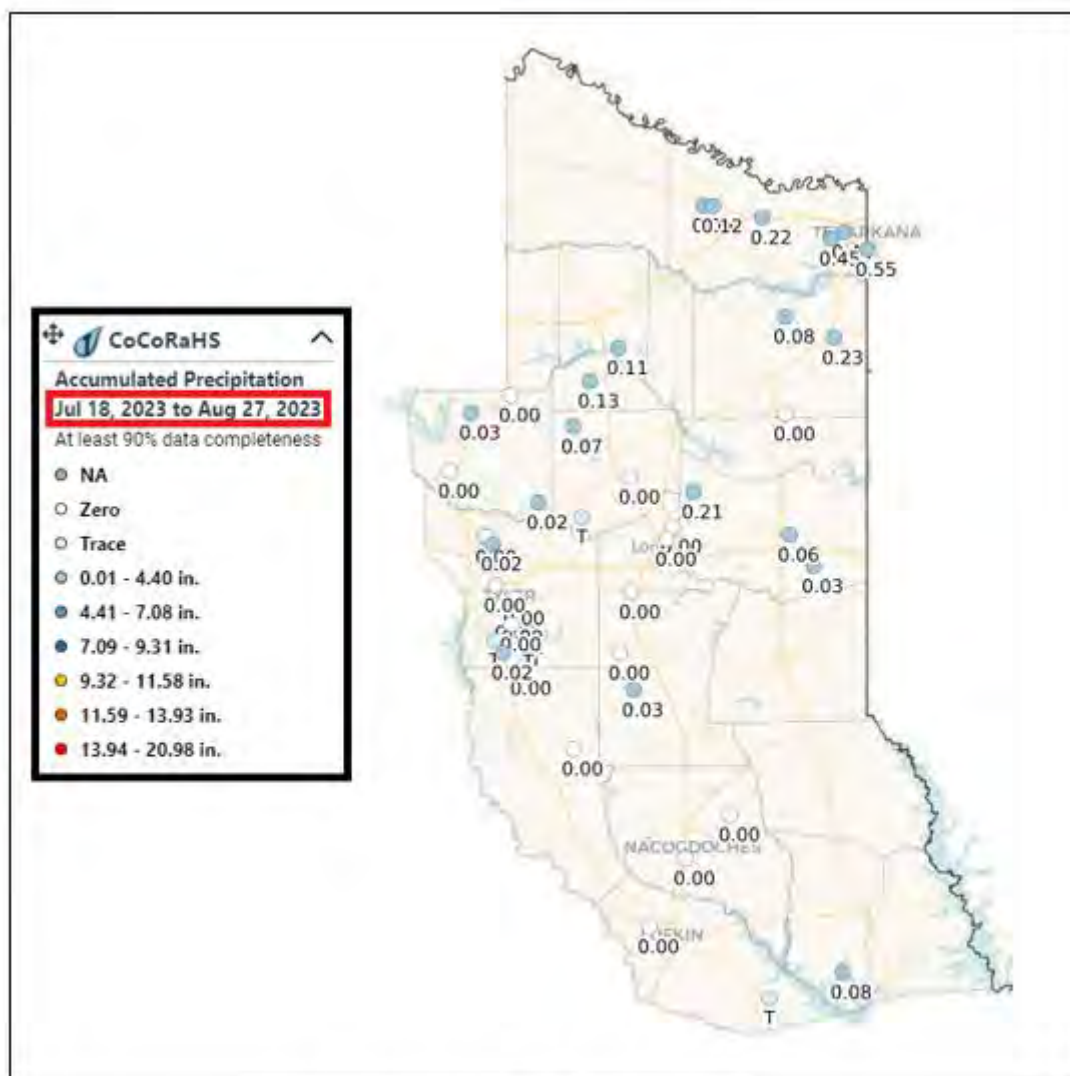
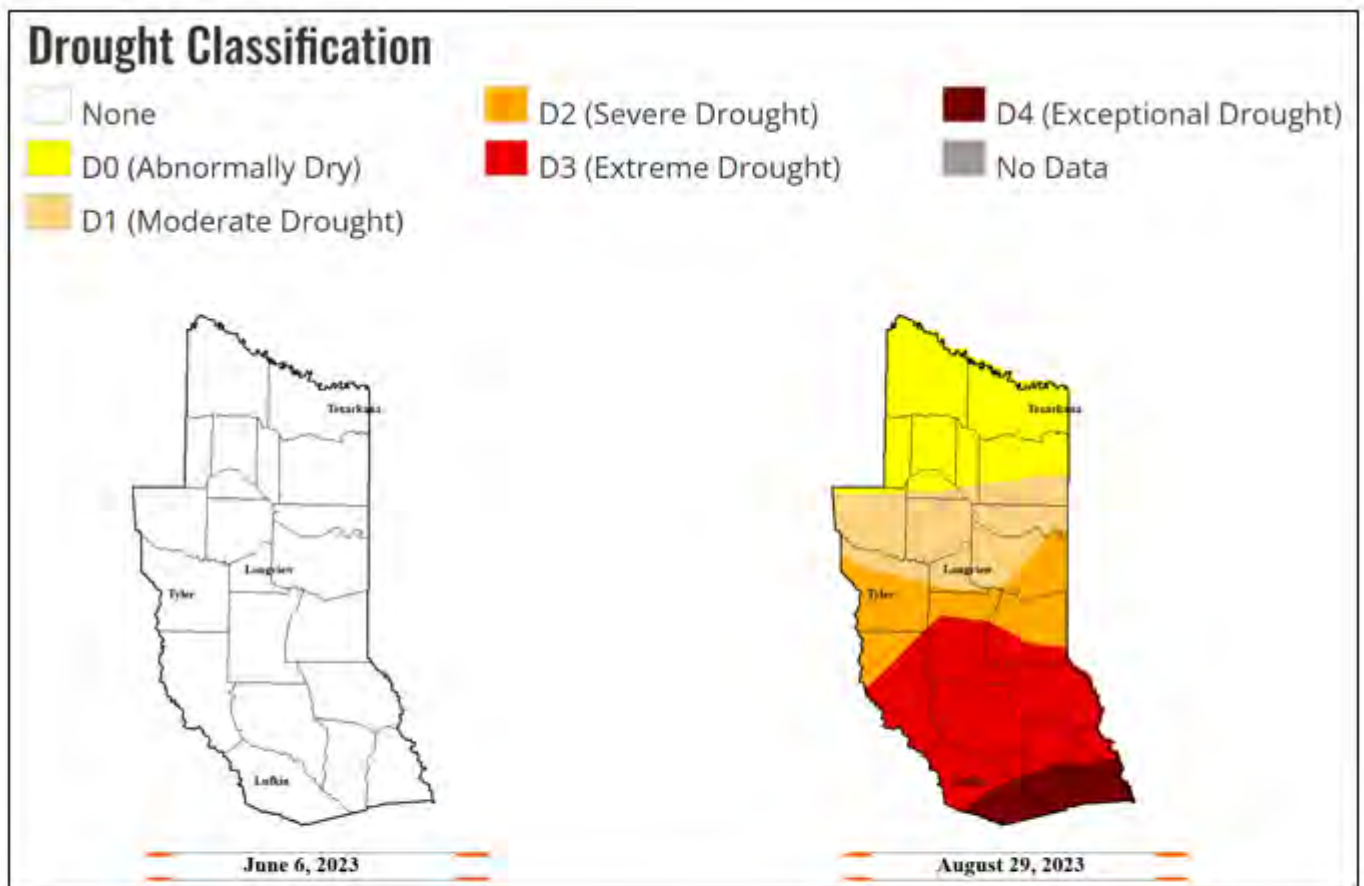


Fig.3 - CoCoRaHS Rainfall Totals
July 18 through August 26, 2023
Image Courtesy of CoCoRaHS

East Texas Regional Summary (continued)



**Fig.4: Drought Monitor
Comparison Map (Jun. 6 to Aug 29, 2023)
Image Courtesy of NDMC/USDA/NOAA**

Abilene/San Angelo Regional Summary

Summer 2023 Starts Cool and Wet but then Extreme Heat and Drought

By: Joel Dunn, Observation Program Lead, NWS Abilene/San Angelo

June 2023

Summer across West Central Texas began cooler and wetter than normal. The cautious hope for a cooler summer would ultimately be dashed upon the cruel rocks of extreme heat and drought. The charts below show the daily maximum high temperature and precipitation (if it occurred). It can be seen that at the beginning of June temperatures were generally mild for summer. What can also be seen is the spike in temperatures on the 9th that will become commonplace over the next two and a half months. Likewise, when the extreme heat arrived, the precipitation all but left, ultimately kicking off the drought.

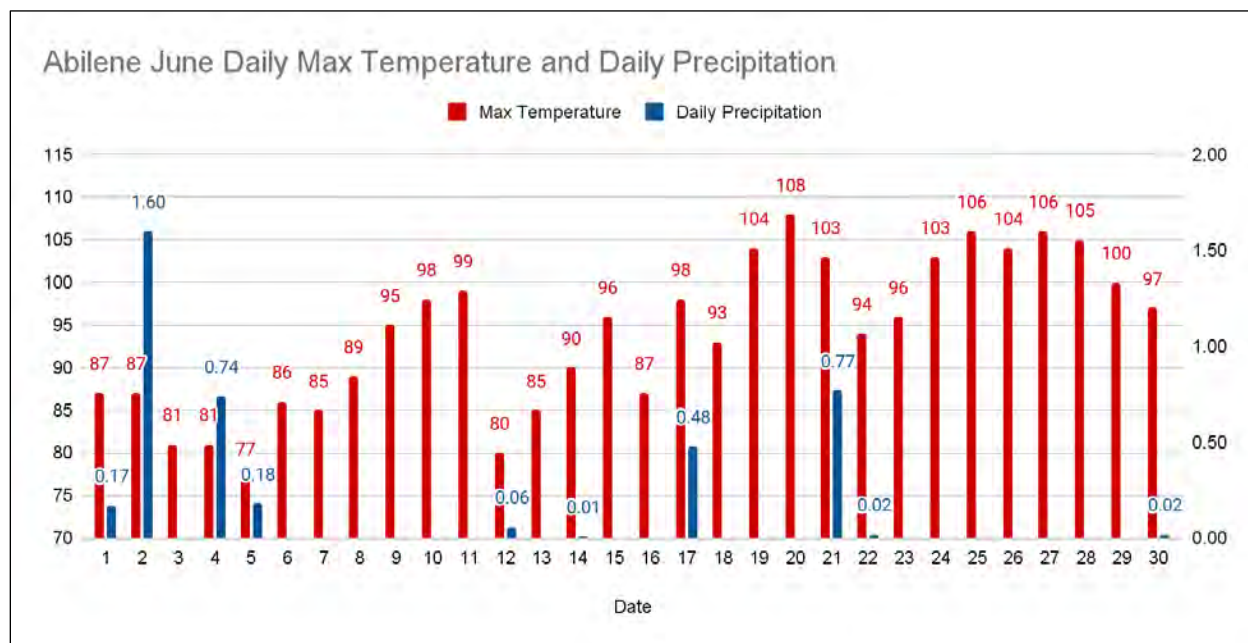


Image 1 - Chart of Daily Max Temperatures and Precipitation in Abilene during the month of June

Abilene had some of the coolest afternoon high temperatures at the beginning of the month and received the most precipitation of the three automated sites maintained by the National Weather Service. Yet, they were not exempt from the heat of late June, though the additional moisture helped soften the blow slightly. Soil moisture content and relative humidity play a big role in how high the afternoon temperatures get.

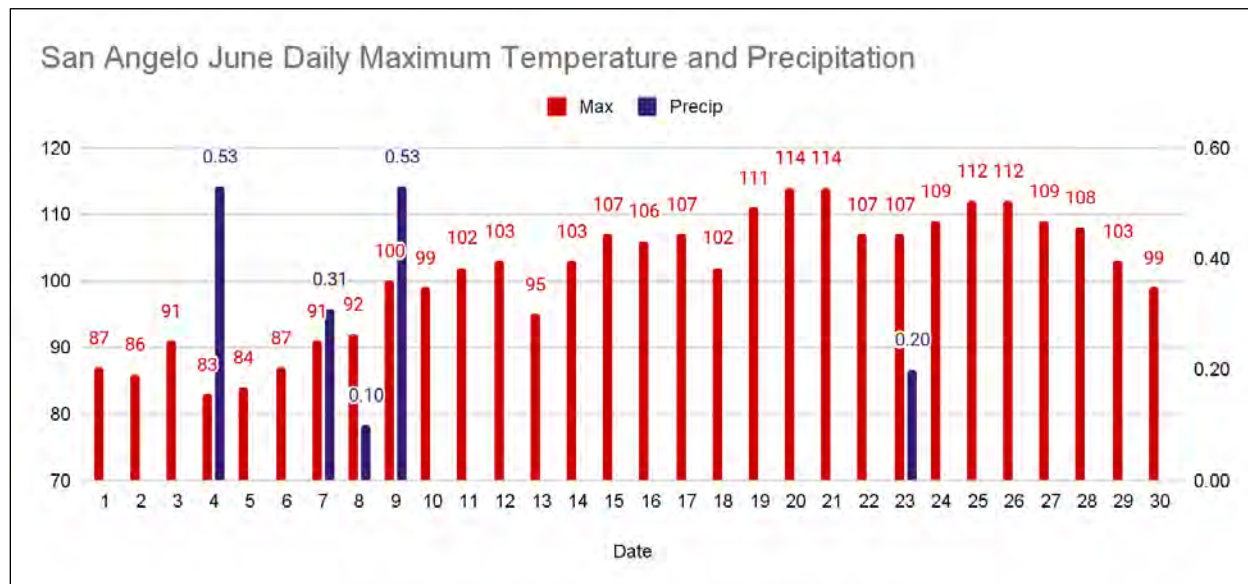


Image 2 - Chart of Daily Max Temperatures and Precipitation in San Angelo during the month of June

Abilene/San Angelo Regional Summary (continued)

Most notable for San Angelo in June is the breaking of their all-time record high temperature of 111°F (20th, and 21st). This temperature had been tied several times, once in 1933, 1943, 1944, 1960, and 2023 (The all-time record high of 111°F was tied the day before it was broken). Yet on June 20th, the afternoon high temperature reached 114°F and is now the all-time record high temperature for San Angelo. To add insult to injury, San Angelo reached 114°F again the very next day to tie the new all-time record high temperature.

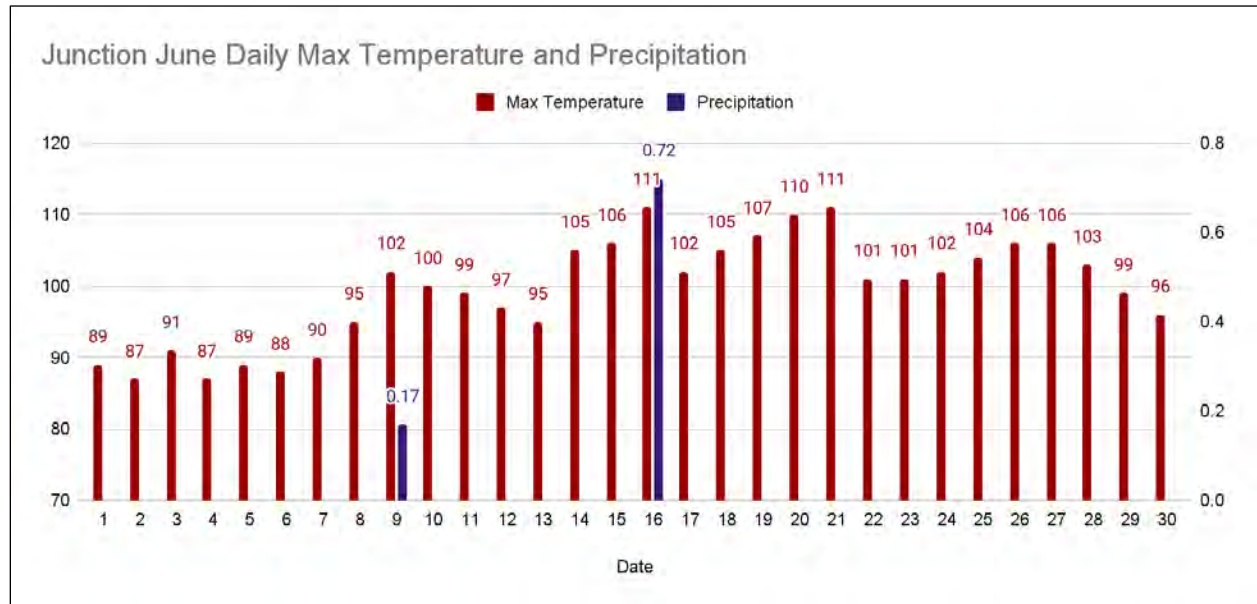


Image 3 - Chart of Daily Max Temperatures and Precipitation in Junction during the month of June

Junction fared the worst as far as precipitation, coming in with a monthly rainfall total of 0.89". This is below normal by 1.94". As noted earlier, moisture content, in the air and in the soil, plays a big role in how high the afternoon temperatures can reach. Though Junction had the least amount of precipitation, they tend to keep higher relative humidity's as they are in the Hill Country and thus closer to the coast.

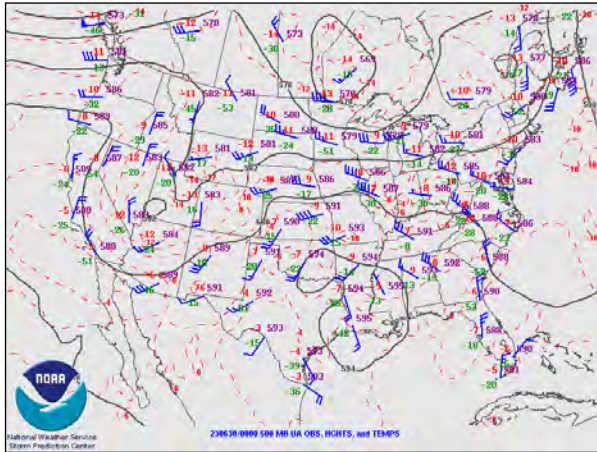
West Central Texas closed out the month of June warmer than normal due to the exceptionally hot afternoon high temperatures. However, some areas received enough rainfall to end the month wetter than normal. See the table below for more details.

Station	Average Temperature	Departure From Normal	Monthly Precipitation	Departure from Normal
Abilene	81.9°F	0.8°F	4.05"	0.61"
San Angelo	85.8°F	3.6°F	1.67"	-0.64"
Junction	85.5°F	4.4°F	0.89"	-1.94"

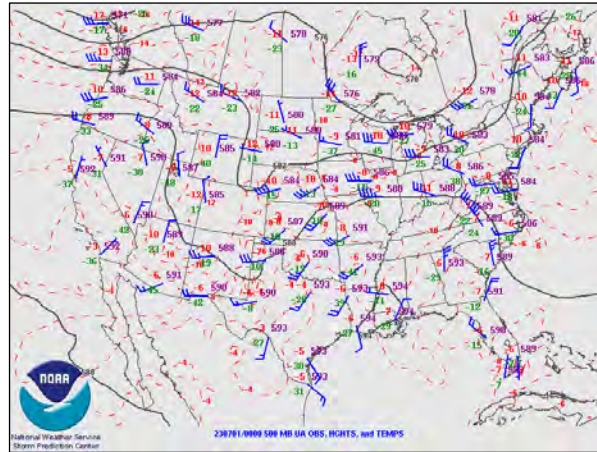
Table 1 - June Average temperatures and precipitations with associated departure from normal

Abilene/San Angelo Regional Summary (continued)**July 2023**

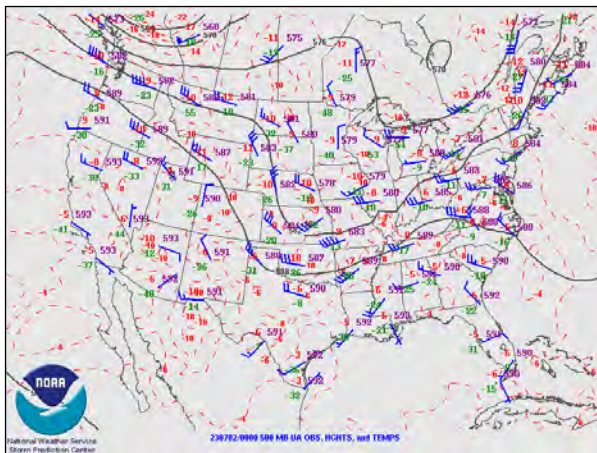
The month of July is typically hot, yet it has one pattern that has been observed over the past few years. The first week of July often experiences one last gasp of spring, or at least a cold front. This year was no exception, and the high temperatures were brought down to climatological normal. It was brought down by upper air low pressure, which migrated east across the United States. The afternoon high temperatures were sub-triple digits, which was quite a welcome change after the record-breaking heat during the second half of June. In fact, for portions of the Concho Valley, the Heartland, and the Hill Country, the total monthly rainfall for July occurred during this first week.



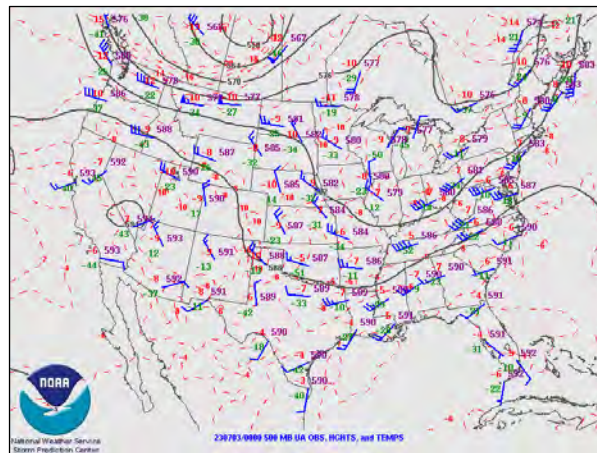
500mb Map June 30, 2023 00Z



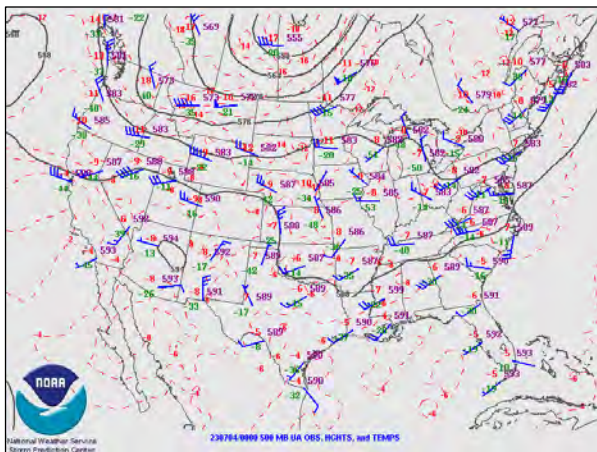
500mb Map July 1, 2023 00Z



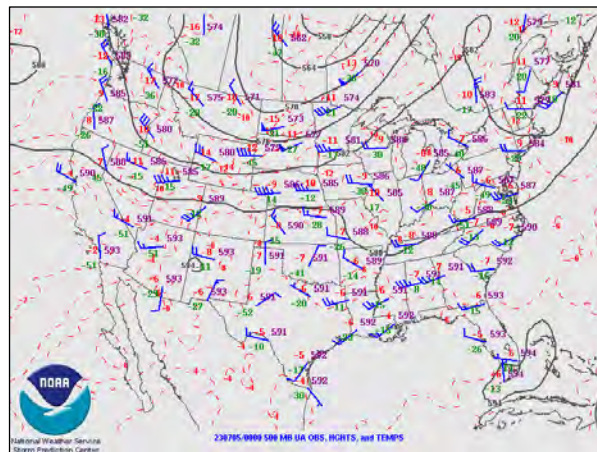
500mb Map July 2, 2023 00Z



500mb Map July 3, 2023 00Z



500mb Map July 4, 2023 00Z



500mb Map July 5, 2023 00Z

Table 2 - 6-days map series showing 500mb constant pressure

Abilene/San Angelo Regional Summary (continued)

After about 10 days, the upper-level high pressure that normally sits over this area reasserted itself and 100-degree days returned. Rainfall chances came to an end and the summer doldrums dominated West Central Texas. Every station was warmer than normal and nearly all of West Central Texas was drier than normal. The exception is the Hill Country, which received enough rainfall to put it just over half an inch above normal.

Station	Average Temperature	Departure From Normal	Monthly Precipitation	Departure from Normal
Abilene	87.8°F	3.1°F	1.80"	-0.12"
San Angelo	88.4°F	3.6°F	0.86"	-0.24"
Junction	88°F	4.5°F	2.16"	0.68

Table 3 - July Average temperatures and precipitations with associated departure from normal

August 2023

If July was hot then August was a scorcher. It was the month of records, heat was endured and little to no rain fell until the end of the month. Abilene, which tends to trend a bit cooler than San Angelo, experienced the most records either tied, or broken. In all Abilene set or tied 20 records. Fifteen record high temperatures, including their all-time record high temperature of 111°F was tied on the 17th of August. In addition, Abilene experienced 5 record high minimums. High minimums are overnight lows that are so warm they warrant recording. Most notably, the warmest overnight low they recorded was 84°F on the 8th of August. Below is a chart showing the daily high temperatures for August in Abilene. Records were tied or broken on days in black.

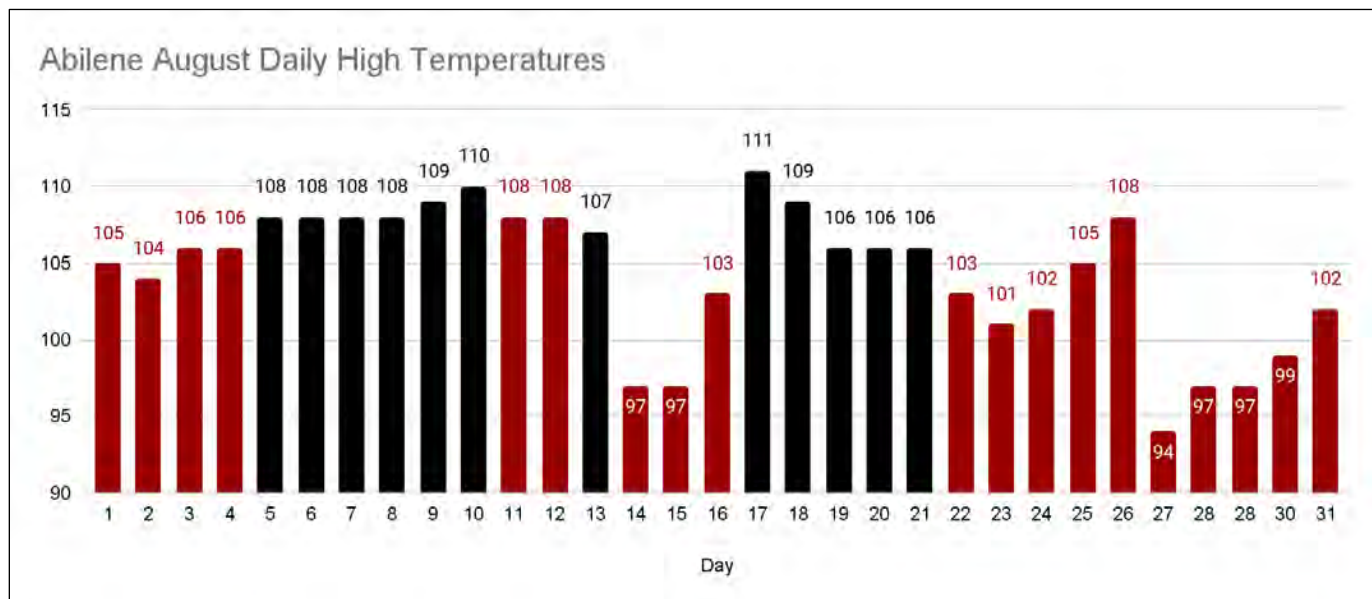


Image 3 - Chart of Daily Max Temperatures and Precipitation in Abilene during the month of August

Abilene/San Angelo Regional Summary (continued)

San Angelo didn't fare much better with 18 records either tied or broken just in the month of August. Twelve record afternoon high temperatures, and 6 high minimums. Below is a chart showing the daily high temperatures for August in San Angelo. Records were tied or broken on days in black.

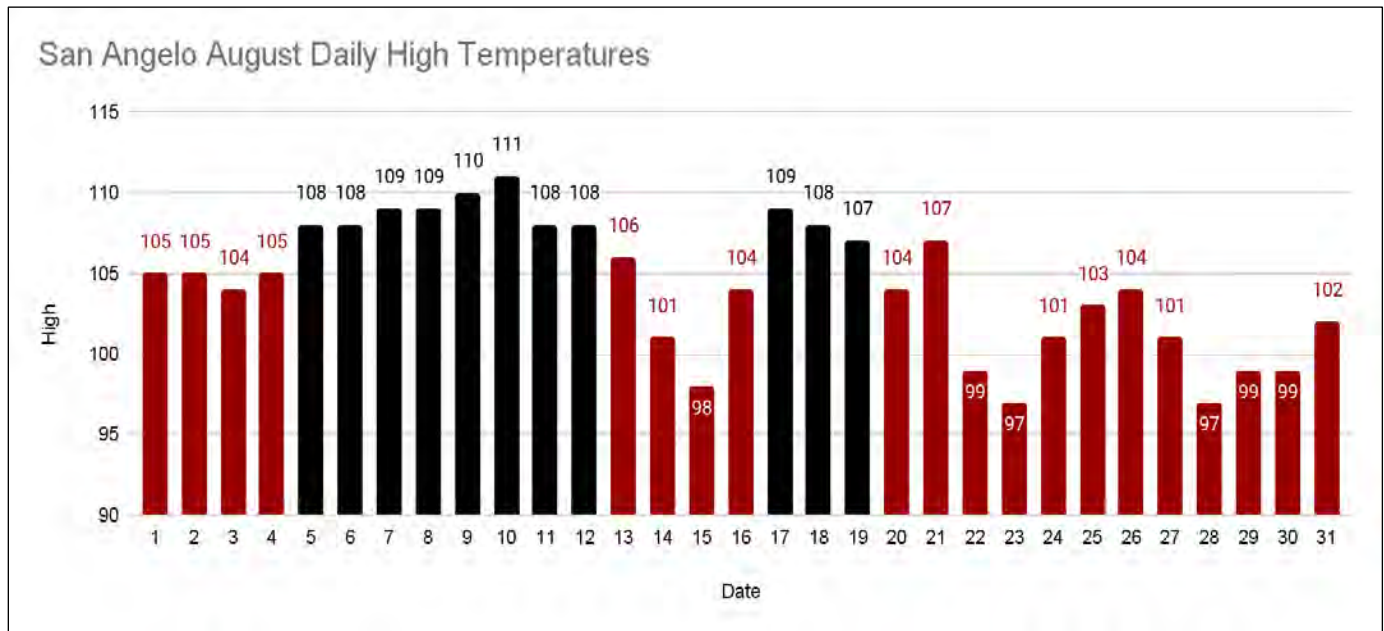


Image 4 - Chart of Daily Max Temperatures and Precipitation in San Angelo during the month of August

Examining the month as a whole, Abilene recorded 28 days over 105°F, which is the most 105° days Abilene has ever recorded in August, while San Angelo recorded 39, which is only third most 105° record in August.

As if the summer knew it had raked West Central Texas over the proverbial coals, the upper level high pressure shifted northeast toward Tennessee, providing a few much needed sub-triple digit days.

Despite the blistering heat and numerous records set, this summer did not beat out the legendary summer of 2011. San Angelo experienced its second hottest summer, and Abilene it's third hottest.

Corpus Christi Regional Summary

Tropical Storm Harold Saved the Region from Dry Conditions

By: Juan Carlos Pena Jr., Meteorologist, Corpus Christi NWS

After a wet spring, dry conditions reared its ugly head to during the summer months, and if not for a tropical storm mid to late August, rainfall accumulations would've been dismal. June was extremely dry with most of South Texas getting anywhere between 10-50 percent normal rainfall (100 percent of normal rainfall is average) (figure 1). Only observers in Webb County got close to their average for the month, with accumulations for the month ranging from 1.50-3.50". Elsewhere, the monthly accumulations across South Texas ranging anywhere from 0.50-2.00" of rain (figure 2).

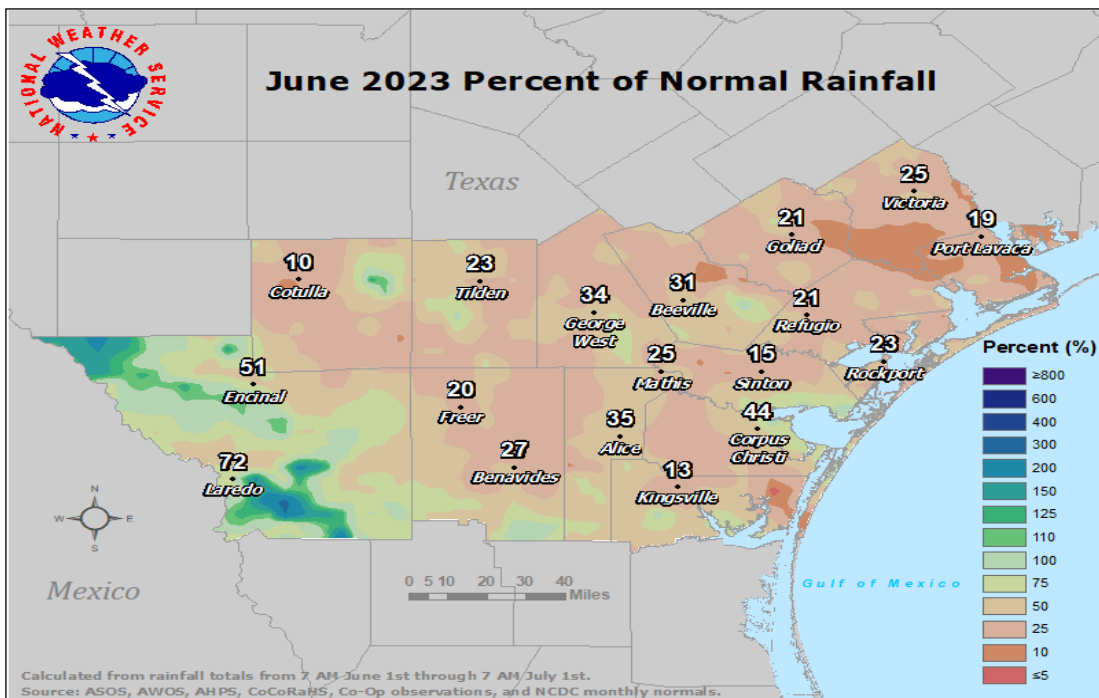


Figure 1: June preliminary percent of normal rainfall for South Texas.

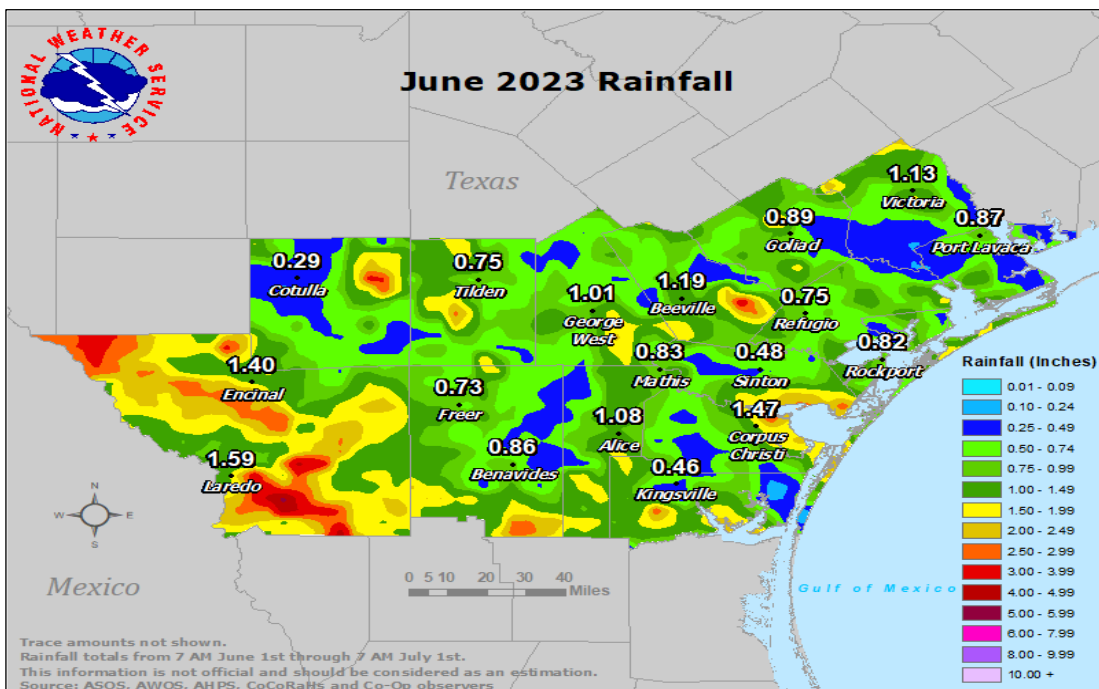


Figure 2: June preliminary precipitation totals for South Texas.

Corpus Christi Regional Summary (continued)

Things didn't improve much in July. Rainfall accumulations were bleak with only a portion of South Texas receiving normal to above normal rainfall across portions of Duval and Jim Wells Counties. Elsewhere across South Texas, most observers saw 2 to 50 percent of normal rainfall (figure 3). Across Duval and Jim Wells, observers for the month reported anywhere from 4.00" - 8.00" of rain. Elsewhere, monthly accumulations ranged from 0.10-2.00" for the month of July (figure 4). With two extremely dry months, drought conditions worsened across the region.

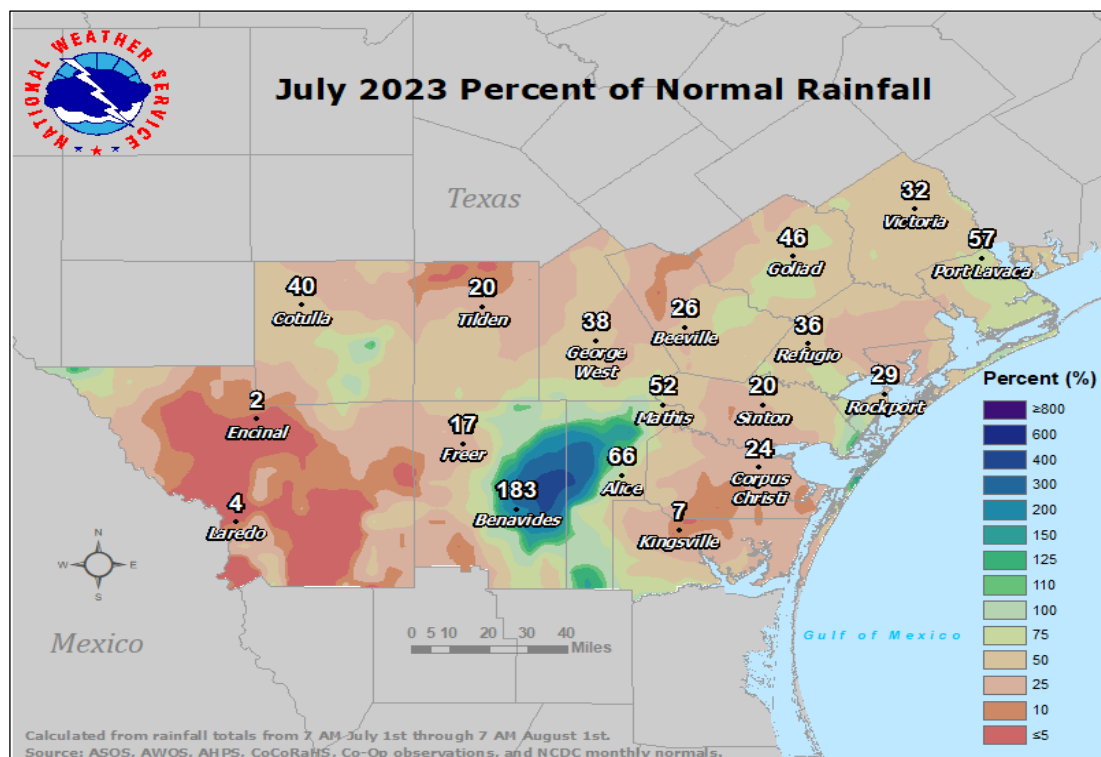


Figure 3: July preliminary percent of normal rainfall for South Texas.

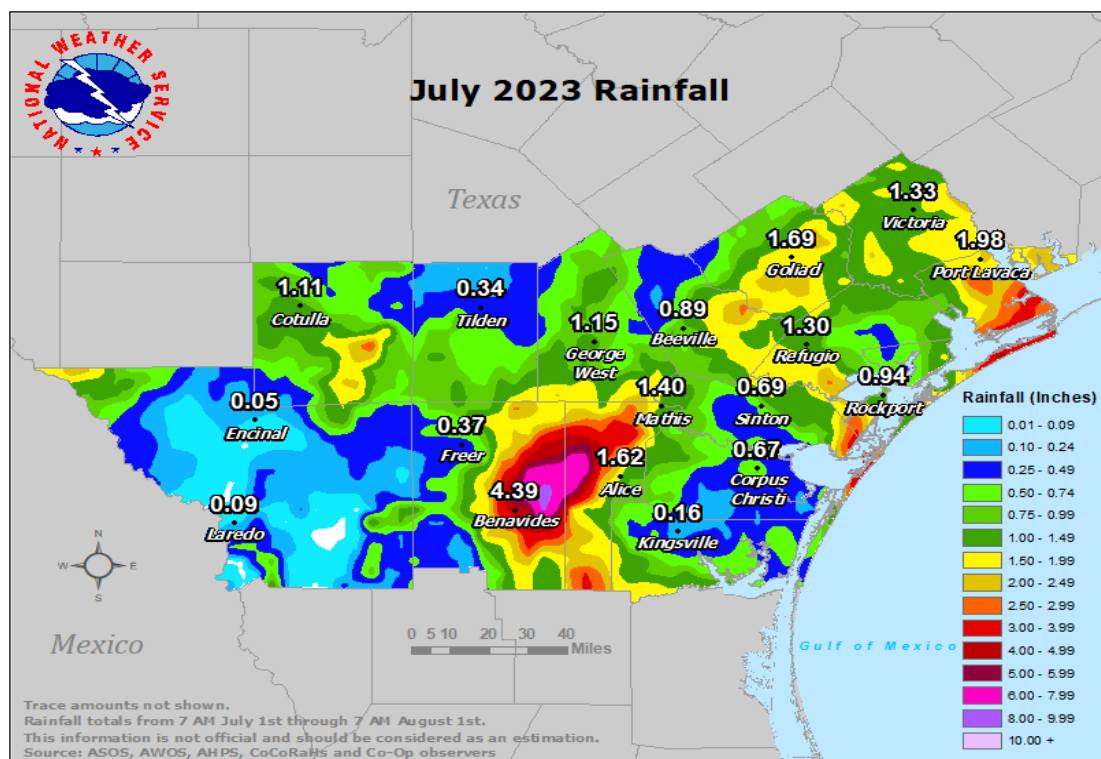


Figure 4: July preliminary precipitation totals for South Texas.

Corpus Christi Regional Summary (continued)

August opened up as dry and June and July, with very little optimism for beneficial rainfall. However, by mid-August, the National Hurricane Center and local offices began tracking a tropical disturbance that was forecast to move into South Texas. This disturbance eventually became Tropical Storm Harold and brought much needed beneficial rainfall to the region. Observers generally south and west of I-37 saw above normal rainfall accumulations with observers across the Victoria Crossroads not being so lucky, only seeing 5-40 percent of normal rainfall (figure 5). When it was all said and done, observers across the Coastal Plains and southern Coastal Bend reported monthly accumulations between 3.00-8.00" with observers across the Brush Country reporting from 1.50" - 4.50". Across the Victoria Crossroads who received limited rainfall from Tropical Storm Harold, observers only reported anywhere from 0.20-1.25" of rain for the month (figure 6 next page).

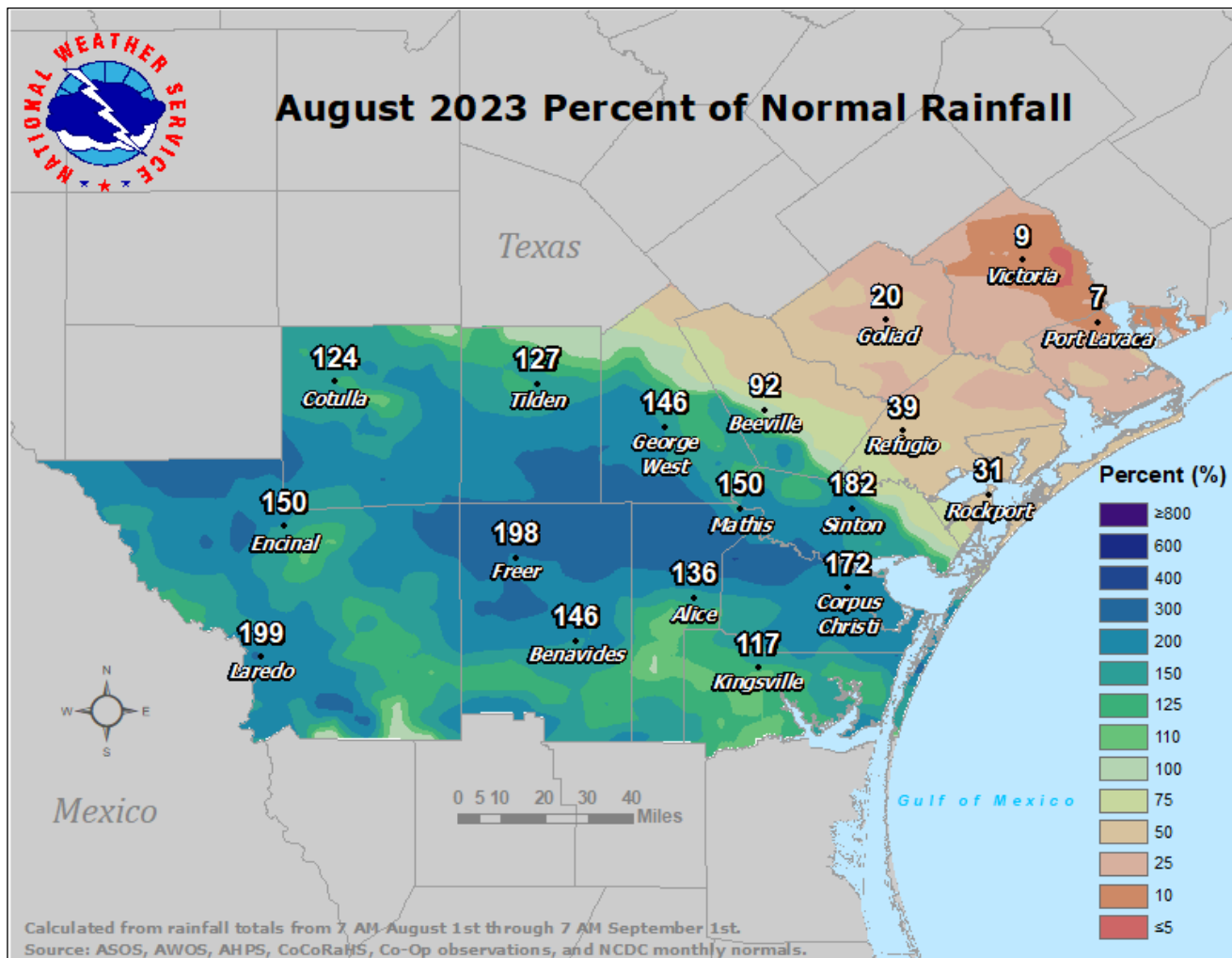


Figure 5: August preliminary percent of normal rainfall for South Texas.

Corpus Christi Regional Summary (continued)

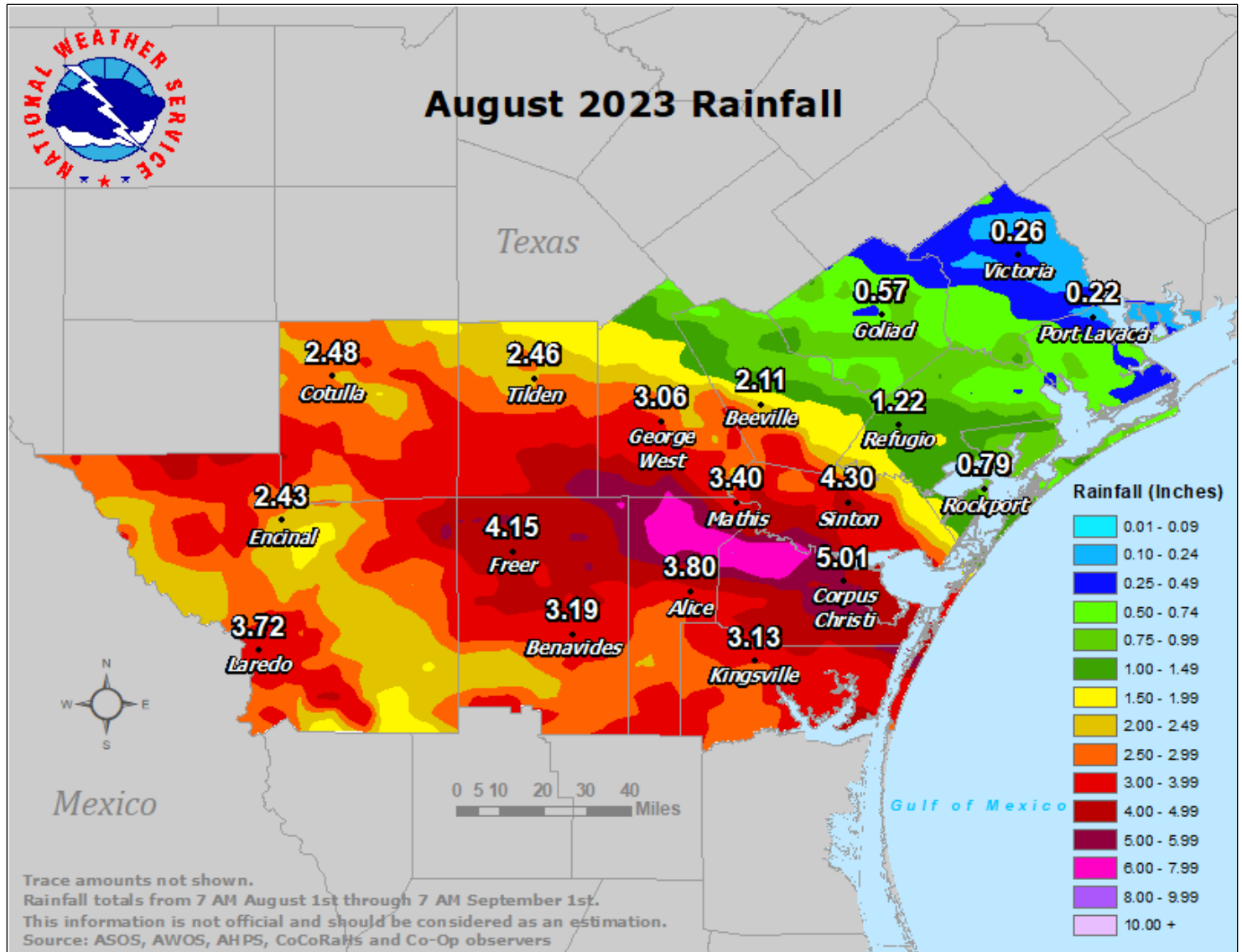


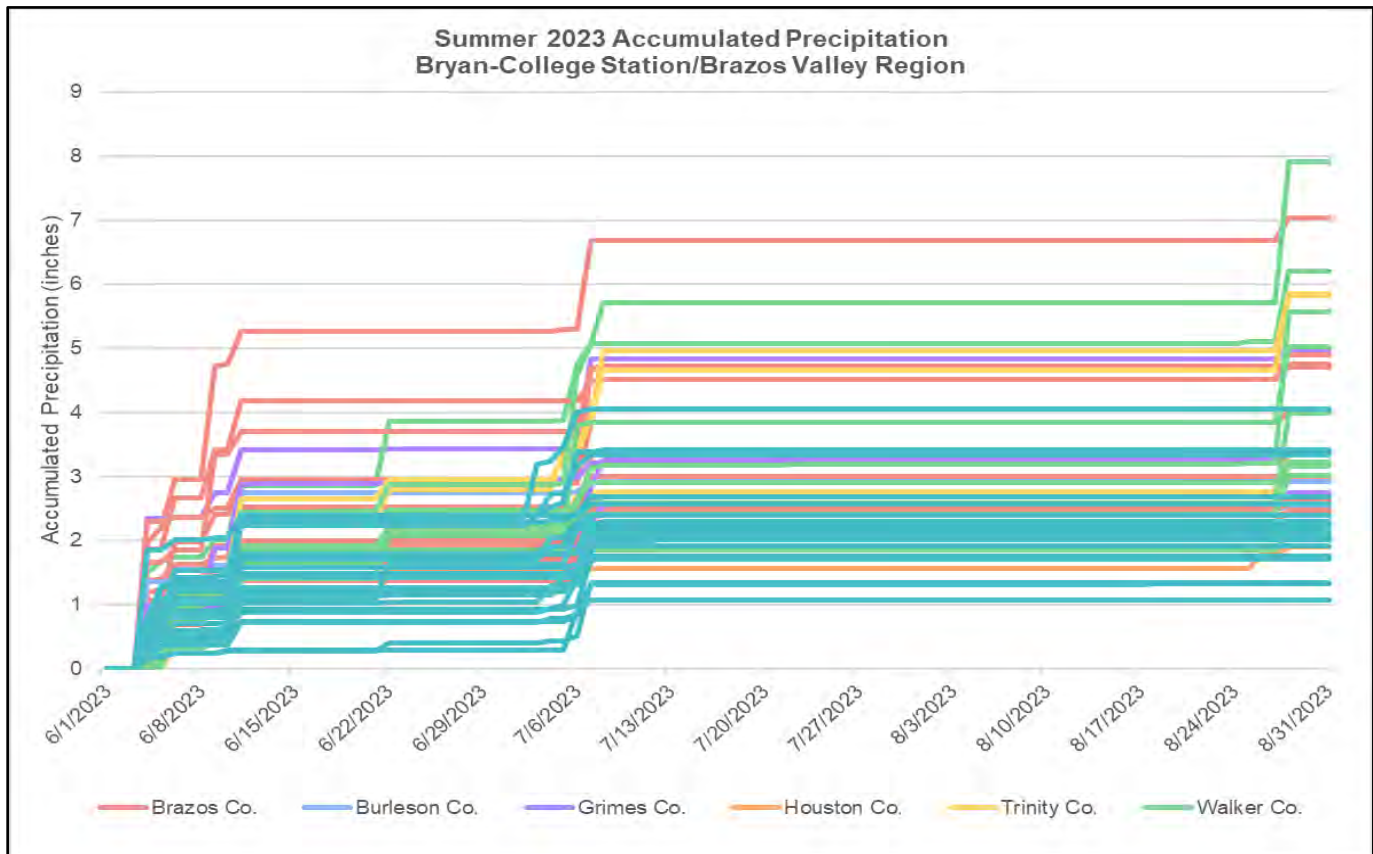
Figure 6: August preliminary precipitation totals for South Texas.

Brazos Valley Regional Summary

Summer 2023 Precipitation Summary

Bryan-College Station/Brazos Valley Region, Texas

By: Victoria Elliott, Texas A&M University, Office of the State Climatologist of Texas



Summary:

The Dog Days of Summer have not been kind to our precipitation totals! Throughout the 3 months of summer 2023, most of the rainfall occurred within the first half of June. The beginning of July brought a bit more precipitation to our region before accumulations plateaued for the rest of the summer. The overall average rainfall accumulations for the Brazos Valley was 3.34" while the normal seasonal amount is near 10". As a result, we fell 6.76" below what is normally expected for summer in our area. All counties in the Brazos Valley were below the "normal" threshold, with Houston County being the driest at 8.68" below normal. This was followed by Washington (-7.64"), Grimes (-6.74"), Walker (-6.60"), Trinity (-6.46"), Burleson (-5.87"), and Brazos (-5.30"). Although we had a very wet spring, the prolonged period of little rain and high summer temperatures quickly resulted in a serious drought that is not expected to go away any time soon.

Observer Statistics:

Throughout the spring season we had 65 active observers reporting their precipitation totals with 34 observers missing no more than 10 days of reporting. Of these, 5 did not miss a single day! Overall, 57 stations were used to calculate this season's records. We thank you for your vital contributions!

Season Statistics:

Wettest Day: 2.36", August 28, Walker County

Wettest Seasonal Total: 7.91", Walker County

Driest Seasonal Total: 1.07", Washington County

Soggy Socks Award: (longest spell with measurable rain): 6 days, July 3-8, Washington County

Dusty Soles Award: (longest spell without measurable rain): 56 days, July 7-August 31, Washington County

Brownsville/Rio Grande Valley Regional Summary

Record Heat Brings Drought, Wildfire, and Water Supply Concerns

Early June Storms Give Way to Summer Swelter and Loss of Soil Moisture

By: Barry Goldsmith, Warning Coordination Meteorologist, NWS Brownsville/Rio Grande Valley

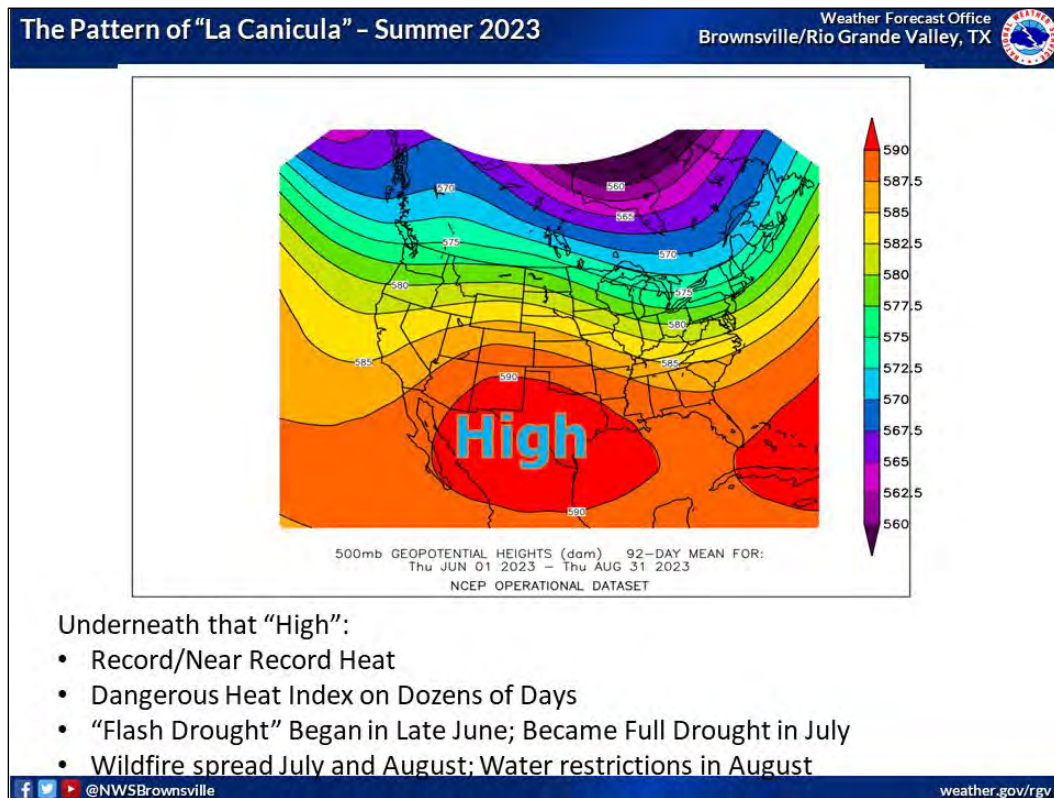


Figure 1. The steering pattern at 500 mb across much of North America during summer 2023. The high pressure ridge, colloquially known as "La Canicula" in the Lower Rio Grande Valley, lasted for most of the summer. Also known as the "heat dome", the ridge was responsible for record to near-record heat across Texas and frequent strains on the power grid.

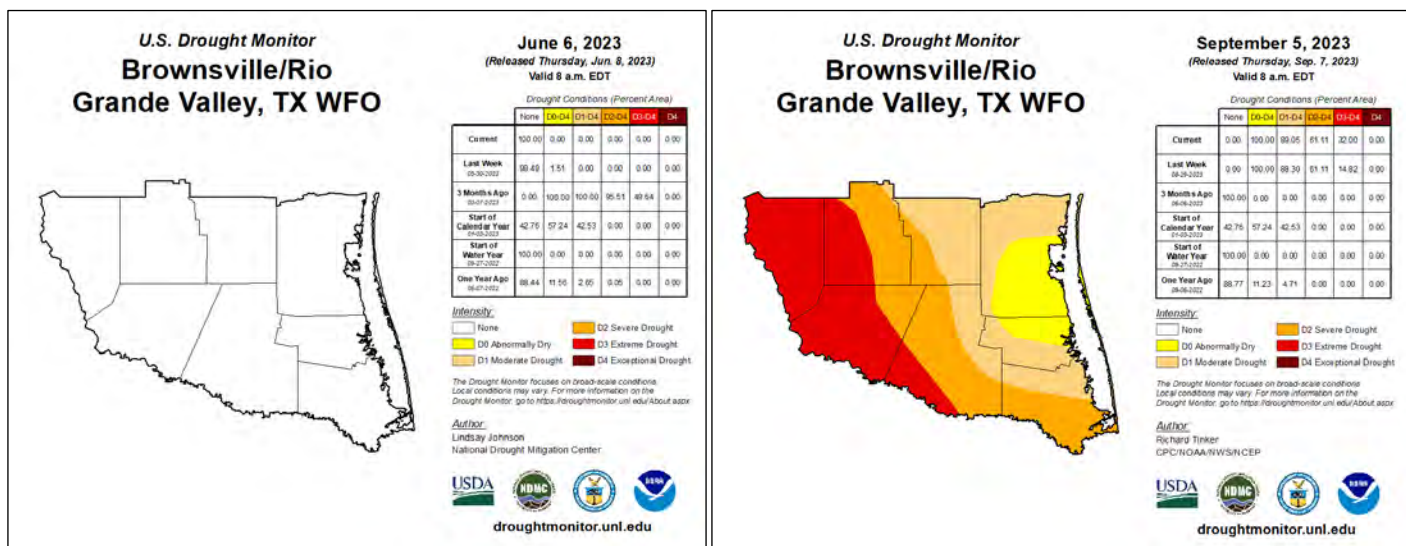


Figure 2: Near record rainfall between March 28 and June 8, 2023, eliminated drought and even brought local soil moisture surpluses. These were quickly evaporated as the hot and rain-free "heat dome" arrived on June 9th and persisted through the rest of summer. Limited rainfall, record heat, low humidity, and frequent wind brought Severe (Level 2) to Extreme (Level 3) Drought back by the end of August across the populated Valley through the Brush Country. Rains from Tropical Storm Harold helped keep conditions a little better in Kenedy, Willacy, and Brooks County.

Brownsville/Rio Grande Valley Regional Summary (continued)

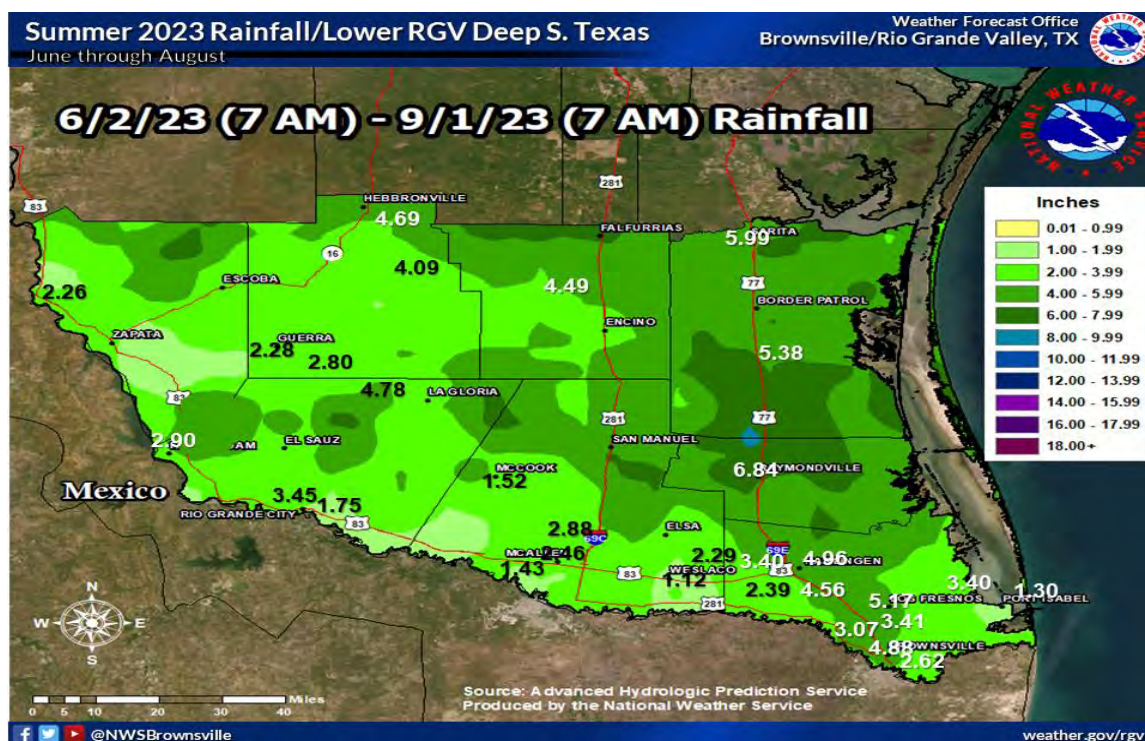


Figure 3: Annotated rainfall map for summer 2023 across the Lower Rio Grande Valley/Deep South Texas region.

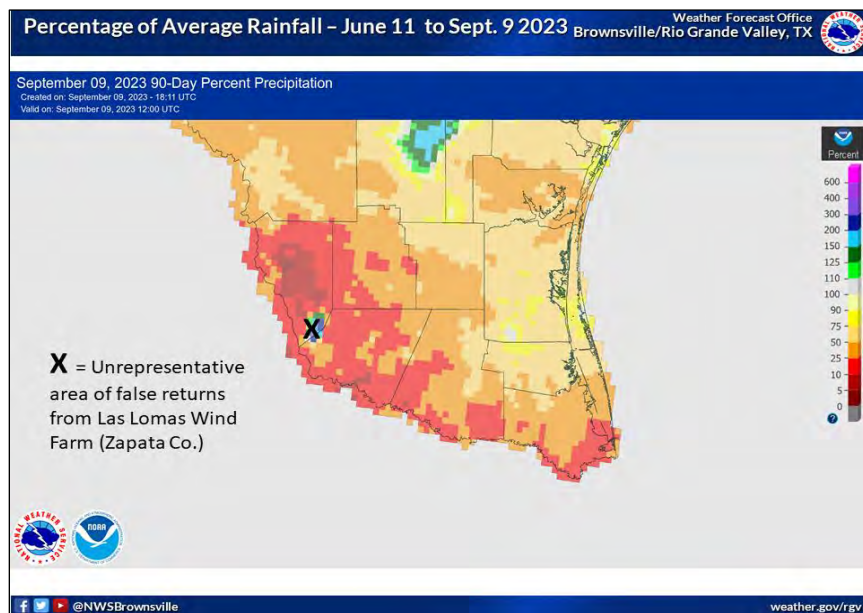


Figure 4. Rainfall departure from average, June 11 through September 9, 2023. From Zapata County through the populated Interstate 2/IH 69E corridor, rainfall was less than 25 percent of average.

Month-by-Month Summary

June started where May left off: A few more upper level disturbances (below) in westerly flow aloft aided two squall lines (June 3 and early June 8) that bookended a two-afternoon window of locally severe thunderstorms mainly across Cameron County on the June 4 and 5. The additional rainfall closed out one of the wettest intra-spring periods on record (March 28-June 8; see the climate summary for spring 2023 for details). Strong winds up to 65 mph knocked down tree limbs, power lines, and a fireworks stand (below) on the 4th; hail between 1 and 2 inches in diameter fell between Rio Hondo, Harlingen, San Benito, and Brownsville. The last of the Julian (March 20 through June 21) spring squall lines on the 8th raced across the Lower Valley, producing wind gusts between 53 and 60 mph in Cameron County and along the Lower Texas coast.

Brownsville/Rio Grande Valley Regional Summary (continued)

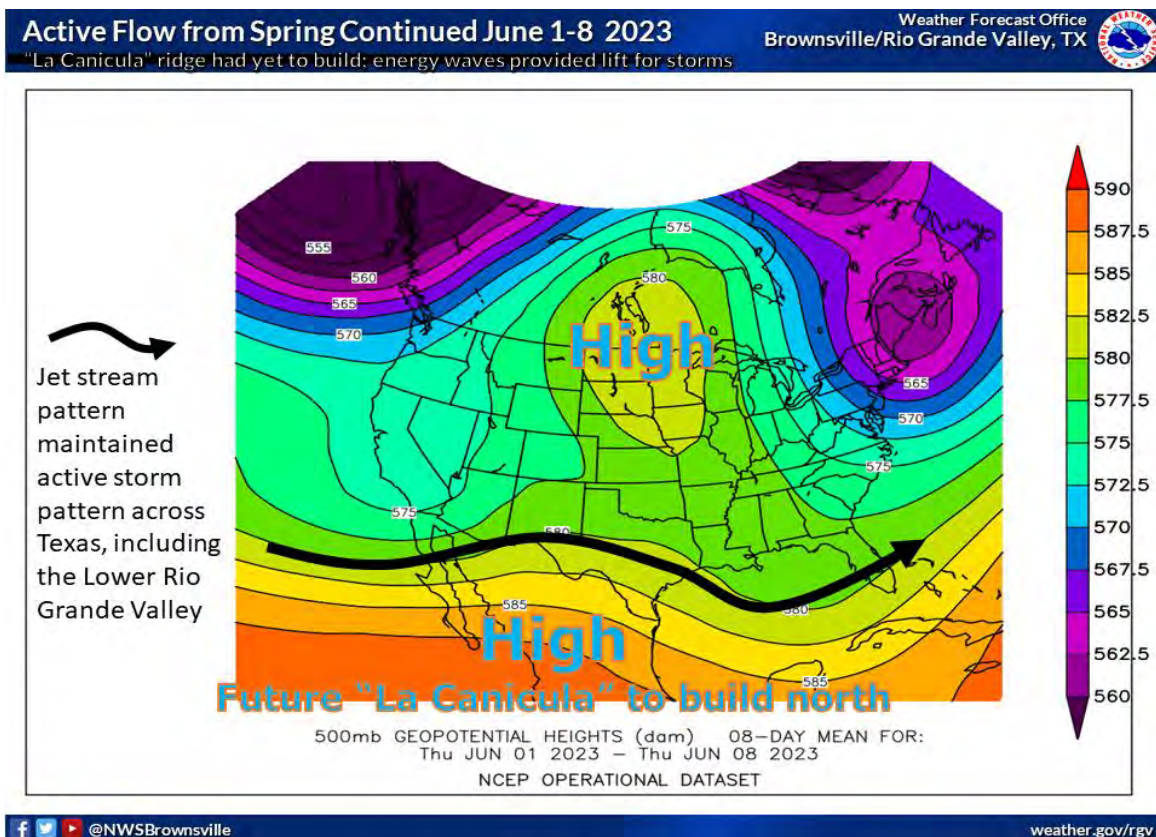


Figure 5. 500 mb steering pattern for June 1-8, 2023. Frequent thunderstorm events occurred across the Lower Rio Grande Valley associated with embedded energy waves along and just south of the mid-level jet stream – notably on June 3, June 4-5, and June 8. The "La Canicula" ridge (lower left of image) would build quickly north by June 9th, and dominate the flow the rest of June – with the jet stream shifting well north of the region.



Above photo 1: Flipped fireworks stand in east San Benito, June 4, 2023, from wind gusts estimated at 60 mph. The stand was facing directly into the north wind and not securely anchored.

Brownsville/Rio Grande Valley Regional Summary (continued)

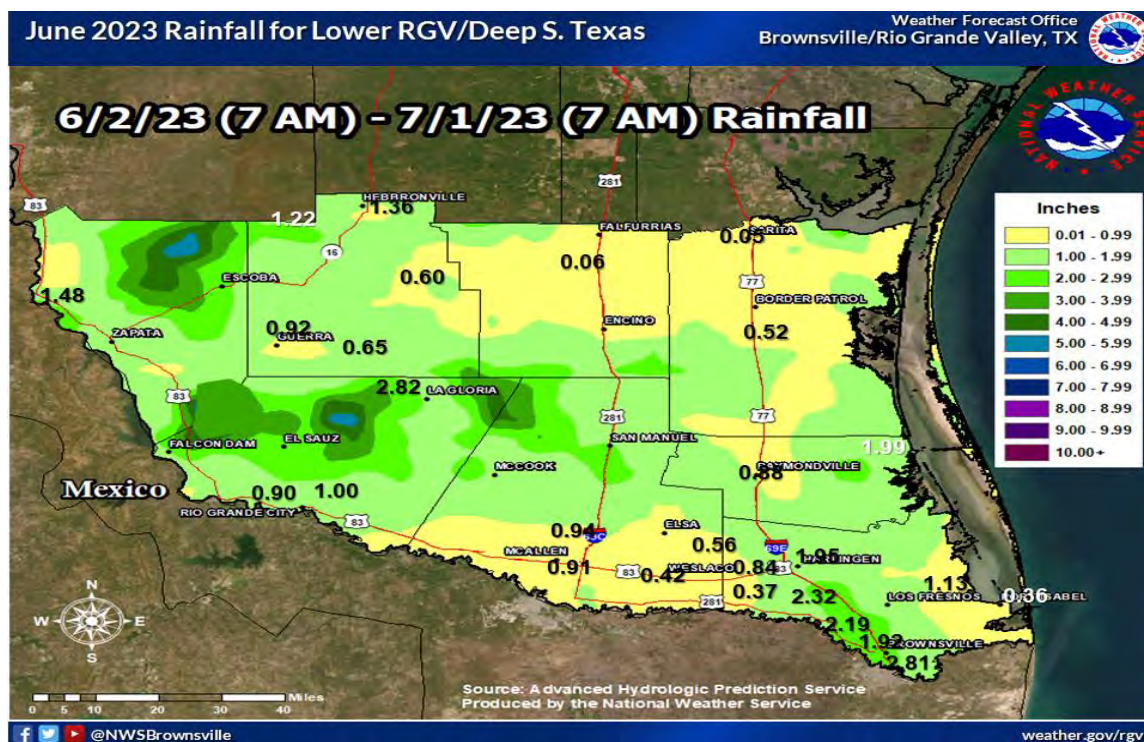


Figure 6. June 2023 rainfall for the Lower Rio Grande Valley/Deep S. Texas region. Nearly all of the rain fell between June 3 and June 8, before the “heat dome” took control

The steering pattern abruptly shifted on June 9th, as the 500 mb (around 18,000 feet above the ground) high pressure ridge built into the “La Canícula” position (Permian Basin Texas, southeast New Mexico, Coahuila and Chihuahua states, Mexico) (below) and would strengthen and persist, stretching eastward across Central and South Texas for the remainder of June. The combination of an impressively hot atmosphere with surface southerly winds running over initially moist soils contributed to a prolonged – and unprecedented – period of excessive heat across the region, especially along and east of the Interstate 69C/US 281 corridor from Brooks/Hidalgo to the coast. Heat advisories (for heat index values of 111 or higher for 2 or more hours) were issued on nineteen occasions – daily -for all or parts of the Lower Valley/Deep South Texas ranch country beginning June 12th. Excessive heat **warnings** (for heat index of 116 or higher for 2 or more hours) were issued on six occasions. Based on prior research in 2009, heat advisories were generally expected to be issued for the southern tip of Texas between 3 and 6 times per year; excessive heat warnings were not truly considered. Nearly all of these hazards verified based on the local criteria; most impressive was the count of observations of **excessive heat** in June 2023, compared with other periods. Using McAllen as a proxy for the core of the Valley’s population, June 2023 had an **eleven-day streak of heat index of 116 or higher** (June 13th through 23rd) and a monthly total of 12 days. No other Junes in the modern record came close to the 2023 benchmark; most recently, the hot June of 2019 had three consecutive days (June 7-9) and four days in total.

New monthly average temperatures were recorded for several Valley locations, including Brownsville, Harlingen, and Port Mansfield. The frequent excessive heat took its toll on people – as there was little time for the region to acclimate to mid-summer (or even hotter) conditions following the wet spring which featured a number of comfortable evenings and mornings. Most days between June 12 and 30 had long-duration heat index above 90 through the night. All of this contributed to an 11 to 18 percent increase in heat-related hospitalizations (ER visits) compared with the near-record hot June of 2022, and there was one known indirect heat-related death in San Benito on the 25th.

For agriculture, the boon of a wet Julian spring was wiped out by the three weeks of record heat under a very strong “La Canícula” heat dome. Flash drought began at the end of June, as growers and livestock owners began seeing sharp declines in crop growth. The USDA Farm Services Agency (FSA) extension agent who serves ranch and livestock communities across the southern tip of Texas reported crispy pastures devoid of soil moisture and dried/drying up stock ponds by the end of June – more akin to a longer-term Extreme or Exceptional Drought.

Brownsville/Rio Grande Valley Regional Summary (continued)

July was a continuation of June, with above average temperatures dominating the month – though departures from average shrunk a bit given that July includes a portion of the hottest period (July 25-31) on the calendar. A weak tropical wave loitering near the mid and lower Texas coast between July 5 and 7 produced decent rain across the Gulf, and pockets of heavy rainfall reached land, especially on the 6th – where morning through early afternoon showers and thunderstorms dropped an estimated 1 to 2 inches (or more) in northern Willacy and southern Kenedy County. The early month rains staved off dryness and drought in these areas, but locations across the Rio Grande Plains and Brush Country were not as fortunate. No rain fell there, and by the start of August, pockets of dryness had turned to Severe (Level 2 of 4) Drought. The early month rains farther east were overcome by the aforementioned heat and lack of rain after the 7th, and Level 0 (abnormal dryness) arrived by August 1st.

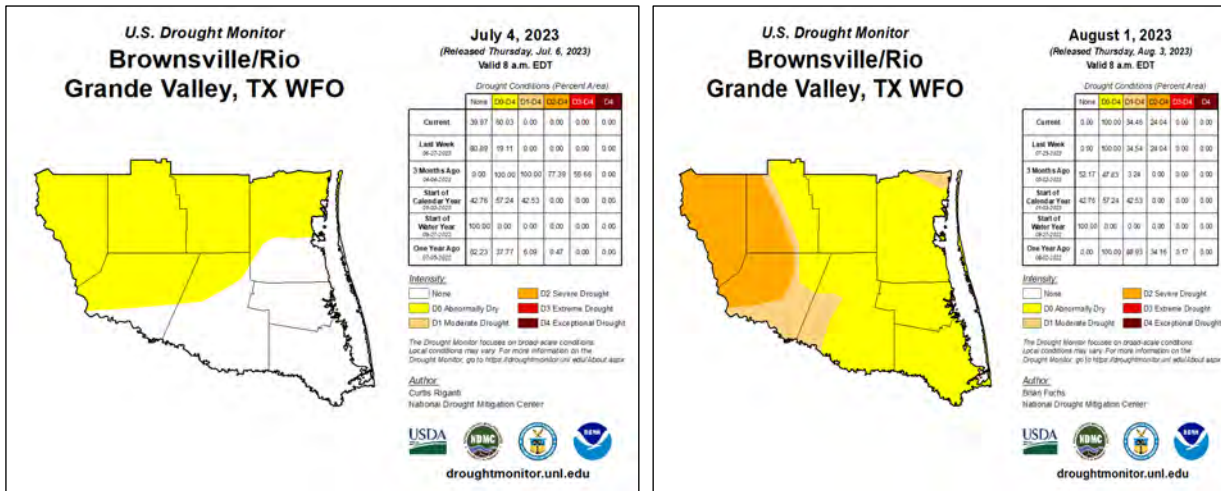
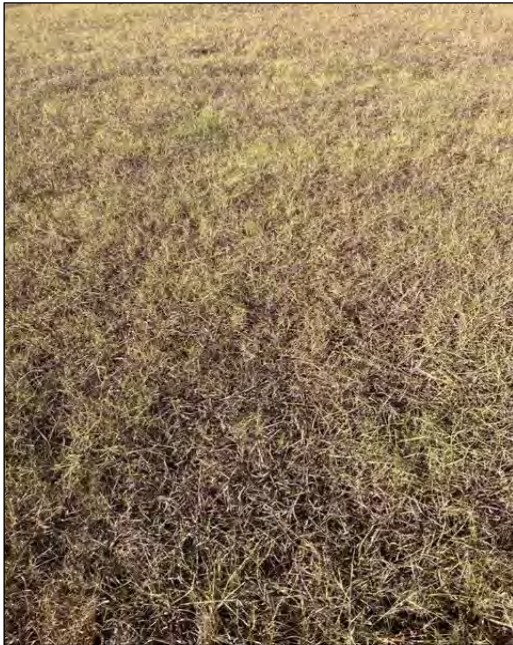


Figure 7. Dryness/Drought Comparison between July 4 and August 1, 2023. Severe (Level 2) and Moderate (Level 1) Drought developed rapidly in July as pastures, brush, and livestock and various detention ponds dried up considerably. While the long-term drought indicators were at the low end of the scale, flash drought was severely impacting livestock managers and crop growers – including cotton – with crop production reduction and water transport necessary for livestock.



Above photos 2 & 3: Rapidly developing dryness, or Flash Drought, shown north of Harlingen on July 26th (left) and August 5th (right). Photo credits: Dale Murden, Texas Citrus Mutual.

For the combination of June and July, Brownsville (since 1878), Harlingen (since 1912) and Port Mansfield (since 1958) had new heat records, with all other available Valley locations falling in the top five warmest – except McAllen (since 1942), which was several degrees behind 2009's benchmark.

Brownsville/Rio Grande Valley Regional Summary (continued)

August continued the “heat beat” for nearly the first three weeks of the month, with drought worsening. Extreme (Level 3 of 4) Drought developed in Zapata and Jim Hogg County, and Severe (Level 2 of 4) Drought covered all but an area near the coast (Willacy, southern Kenedy, northern Cameron). Dryland crops and livestock continued to suffer under the persistent heat wave, as the “heat dome” was unrelenting. The ridge of high pressure did expand and shift east and northward, into the southern Plains and extending across much of the Gulf States. Though the ridge expanded, its southern extent continued across all of Texas, keeping any rain at bay while dry ground enhanced the conversion of short wave insolation into heat, rather than a combination of heat and evapotranspiration, with nearly all rangeland brown and “crispy”.

At the end of the period (August 21), the core of the ridge was located over the mid-Mississippi Valley, and extended east through the mid-Atlantic and southeast U.S. coast. Easterly flow underneath the ridge combined with a tropical disturbance embedded within to produce an area of moisture, which headed west at a decent pace. Early on August 22, the wave developed sufficiently – including a low level circulation – to be named Tropical Storm Harold. Harold was a diffuse cyclone until just before landfall at 10 AM on the 22nd along the mid-Kenedy County barrier island. “Setup” rainfall on the 21st was minimal, but the outer bands moved onshore after midnight on the 22nd and provided welcome rain, especially to Kenedy, Willacy, and western Cameron County. Just after daybreak, however, Harold’s circulation consolidated – and a “dry slot” on its southwestern flank ran across the populated Rio Grande Valley over the Zapata County. While there was rain everywhere, the event rainfall was paltry compared with locations along and north of the center of circulation. That center moved through central Kenedy, southern and central Brooks, and northern Jim Hogg County before exiting the Deep South Texas ranch country into the Laredo area. Harold, racing along at 21 mph, was unable to produce the precipitation needed to truly dent the drought in the populated Lower Rio Grande Valley – through the 2 to 3.7 inches that fell from northeast Willacy through Kenedy, northern Brooks, and Hebbronville (Jim Hogg, far northeast corner) did help there. A final feeder band of showers rolled through the lower Valley early on the 23rd, before hot and dry air returned.

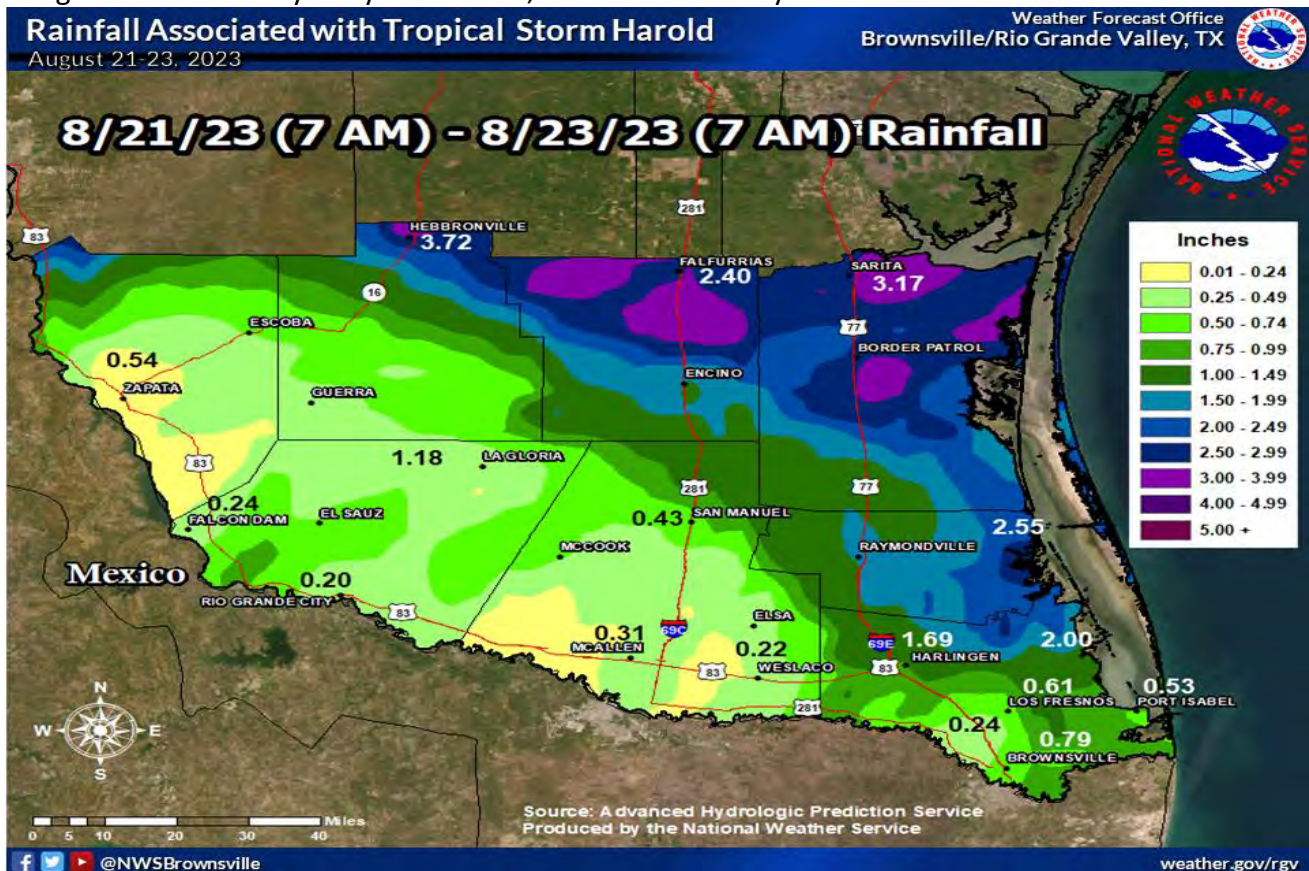


Figure 8: Rainfall associated with Tropical Storm Harold and a feeder band following the storm (early August 23). The center made landfall about 35 miles north of Port Mansfield (Kenedy Barrier Island) and tracked through central Brooks County and northern Jim Hogg before exiting the local region into Webb County. CoCoRaHS observers in Port Mansfield and Jim Hogg County provided helpful rainfall observations.

Brownsville/Rio Grande Valley Regional Summary (continued)

Summer overall will be rightfully remembered as the year of the “heat dome” – or, as locals ascribe, “La Canícula” that never ended (and continued deep into September to boot). While other summers have seen extended “Canícula” periods (the astronomical period is July 3 through August 11), the early onset, timed with the Julian solstice, made it that much worse for people, pets, livestock, and crops. There will be a notable financial impact of the reduced production and or loss of dryland crops or crops that were unable to be irrigated due to late season water supply issues, and those numbers will be available in autumn.

Statistically, summer ranked within the top five hottest on record – some records dating back more than a century – for all available Lower Rio Grande Valley locations. All but McAllen landed at the top of the heap (below), and with above average temperatures likely for the rest of the calendar year, the region is almost certain to see top five annual temperatures as well. Finally, the number of 100 degree days are staggering across the board, with Brownsville and Harlingen setting new summer records, and McAllen falling just shy of the blistering overall summer – especially July and August – of 2009.

Finally, for a second summer in a row, water storage levels at Falcon International Reservoir remained very low – and by August, an increasing number of municipalities instituted Stage 2 conservation rules based on the percentage of Amistad-Falcon falling below 25 percent. During the week prior to Harold, the USA share bottomed out at 23.1 percent. And, while Harold provided some water the Lower Rio Grande basin watershed headwaters, it was a figurative “drop in the bucket” as values rose from 14.6 percent only back to 15.3 percent; with “La Canícula” dominating into September, with triple digit heat, low humidity, and high evaporation rates along the Sierra Madre foothills, the value fell back to 14.7 percent by September 11. Without a tropical cyclone in early autumn, the reservoirs are assured to remain at very to critically low levels through most of autumn.

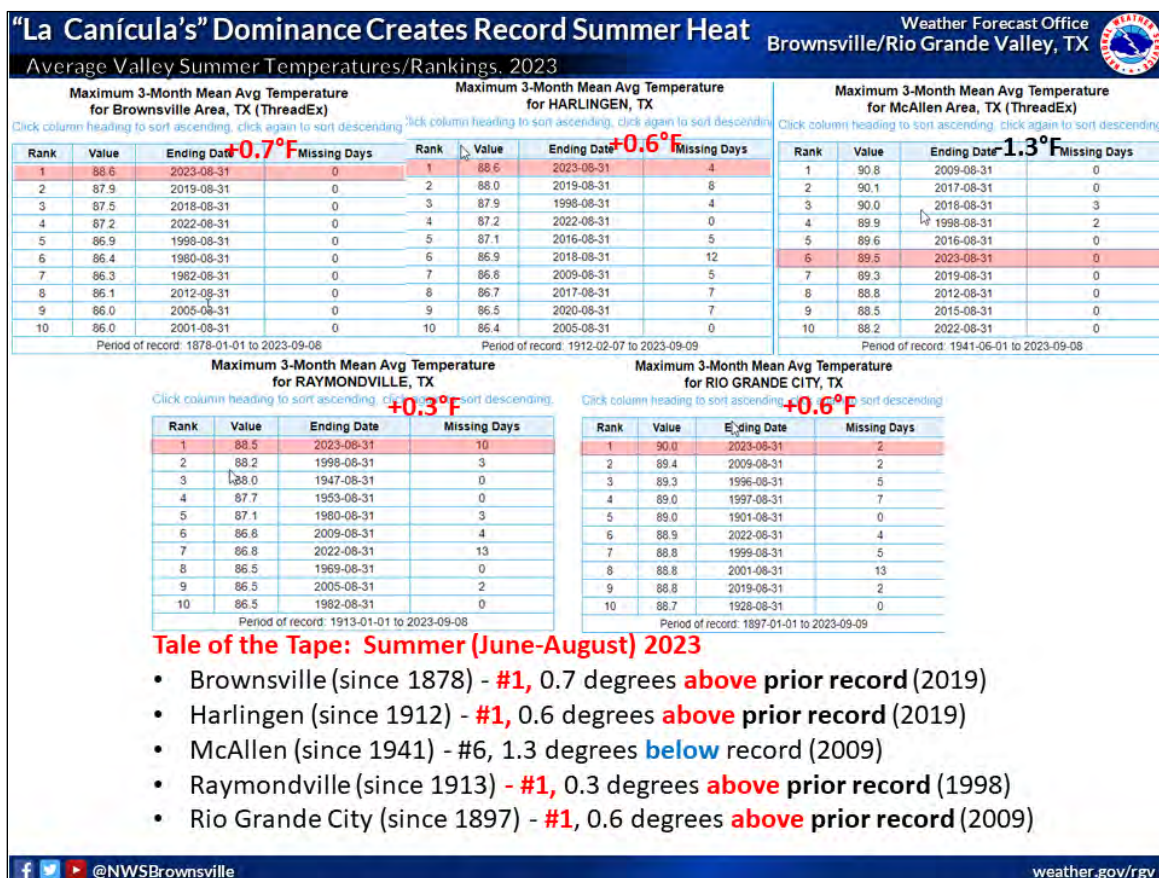


Figure 10: Top ten temperature (day and night combined) temperature rankings, summer (June-August) 2023, for available Lower Rio Grande Valley locations. Only McAllen (6th hottest) was not ranked number 1.

Brownsville/Rio Grande Valley Regional Summary (continued)

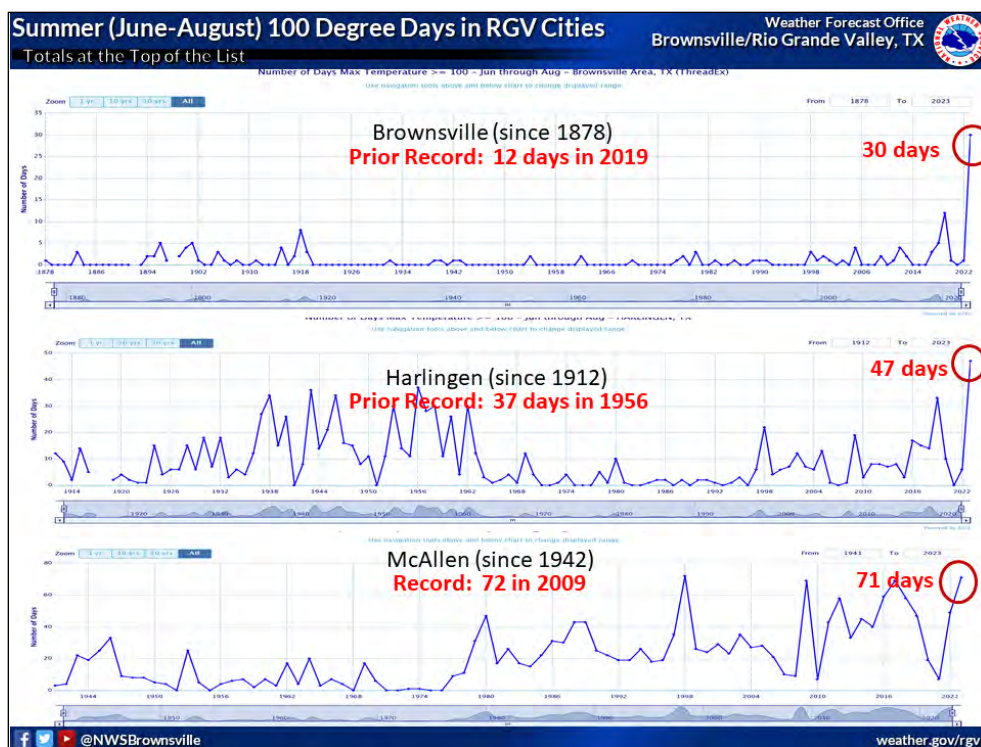


Figure 11: Numbers of 100-degree days for Brownsville, Harlingen, and McAllen in summer 2023 (June-August). Brownsville and Harlingen soared above prior records, while McAllen just missed on their prior record of 72 in the searing summer of 2009.

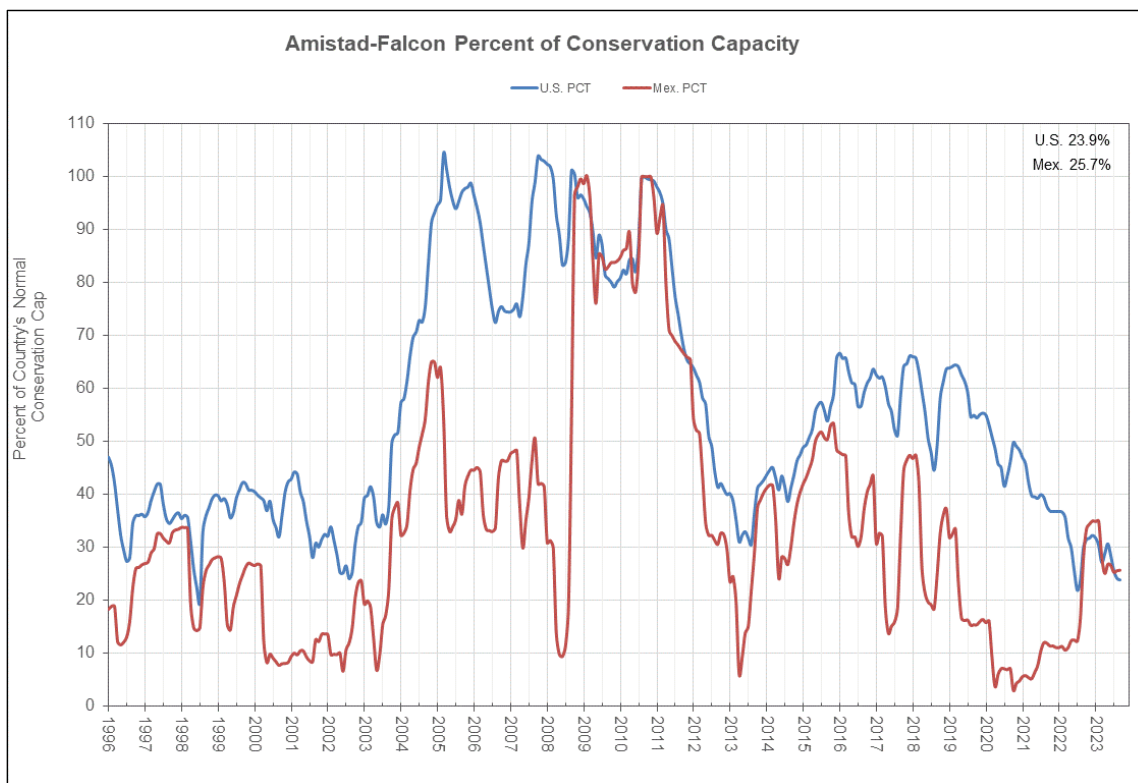


Figure 12: Percent of Conservation (ownership) Capacity for the US and Mexico, Amistad minus Falcon International Reservoirs. For the second summer in a row, the US percentage fell below 25 percent, triggering Stage 2 water conservation rules in several Valley communities. These are among the lowest values in the past 25 years. Data courtesy of the International Boundary and Water Commission.

North Texas Regional Summary

Rainfall above Normal in Northeast Portions, Very Dry Elsewhere

By: Greg Story, North Texas CoCoRaHS Regional Coordinator

Greetings CoCoRaHS observers from the North Texas Regional Coordinator! Congratulations, as you have made it through one of the hottest and driest summers of record over North Texas. This past summer season started out with a little rain, but by August the weather pattern was very dry. The variability of the rainfall over North Texas reminds me how important your rainfall reports are. Why? They help in determining the areas which may flood, as well as determining drought locations, which certainly was the case by the end of August. Your reports continue to be invaluable to the National Weather Service and other entities (such as the Texas State Climatologist and the National Drought Mitigation Center).

Reviewing the past several months, we started 2023 in January with above normal rainfall over extreme East Texas and all of Southeast Texas. Elsewhere in Texas the precipitation was near to below normal. In February much of North Texas saw above normal precipitation, while most of South Texas was below normal. In March most of the state had below normal rainfall. Only a few small locations saw near to above normal precipitation, including the Red River valley, parts of East Texas, Deep South Texas, and over the Texas Big Bend region. There was much below normal rainfall over far West Texas. In April the weather pattern turned wet with near to above normal rainfall over the southeast half of the state. Meanwhile the precipitation was near to below normal over the northwest half, with much below normal rainfall over far West Texas. In May it was dry over North Texas. However, the rainfall was near to above normal over the remainder of the state. The rainfall was much above normal over the Texas panhandle, as well as over parts of the Texas Big Bend. In June most of the state had near to below normal rainfall. However, a couple scattered places had above normal precipitation, such as northeast Texas as well as west central and southwest Texas. In July most of Texas had below normal rainfall. Only a small area along and near the Red River in northeast Texas saw above normal values. Meanwhile, much below normal rainfall was noted across central and southwest Texas. In August below normal rainfall was noted just about everywhere in Texas. The only exception was in an area across Deep South Texas from Corpus Christi to Eagle Pass where they did see some above normal values due to tropical storm Harold.

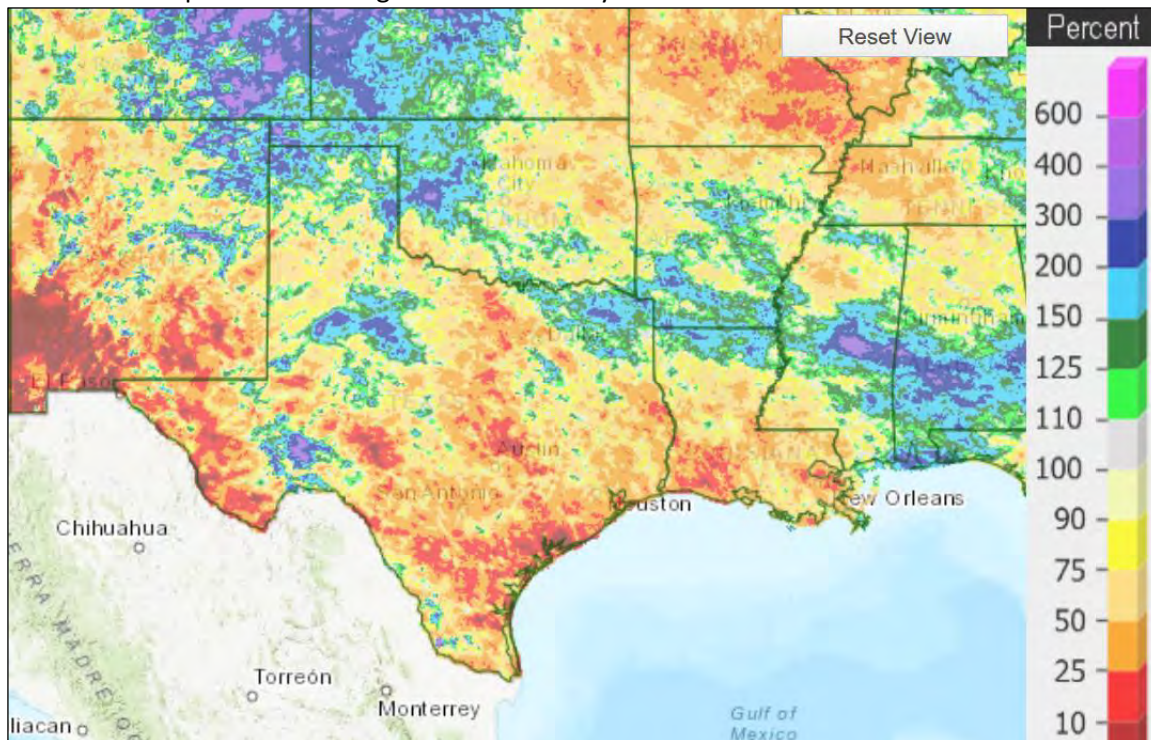


Figure 1: Percent of normal precipitation for June 2023.

At DFW airport in June 2023 received 0.78" of an inch of rain. The normal amount of rain in June is 3.70" so DFW was -2.92" below normal for the month. In Waco for June 2023, 0.40" of an inch of rain was measured. The normal amount of rainfall in Waco for June is 3.35" so Waco was -2.95" below normal for the month.

North Texas Regional Summary (continued)

There were about four storm systems which affected our weather in June. Here are the highlights of the weather below.

June 2 - 3:

An upper air disturbance passed across West Texas on the 2nd which produced showers and some severe thunderstorms over especially western Texas. The heaviest rainfall was 3.15" north northwest of McAdoo and 2.87" east of Andrews. In far North Texas they received 1.47" northeast of Bonham and 1.11" southeast of Ravenna. Showers and thunderstorms redeveloped along the outflow boundaries left by the previous days' convection on the 3rd. The heaviest rain in North Texas on the 3rd was 3.70" northeast of McKinney and 2.95" east northeast of Mansfield. Elsewhere in Texas they received 3.10" east northeast of Merkel.

June 10 - 13:

A short wave trough interacted with a warm, humid air mass to produce showers and severe thunderstorms over especially northeast Texas the afternoon and evening of the 10th. They received 4.48" southwest of Powell and 3.63" northeast of Longview. The trough pushed a frontal boundary into North Texas, and more showers and thunderstorms occurred from the 11th to the 13th as the front stalled. On the 11th very large hail occurred with the storms in the far northern parts of the DFW metroplex. The maximum rainfall amounts on the 11th were 2.80" just north northeast of Dallas and 2.37" north northeast of Oak Leaf in Ellis County. On the 12th the heaviest rainfall was 1.60" west southwest of Sherman and 1.30" near Monkstown at the Caddo Wildlife Management Area. Then on the 13th they picked up 2.00" southeast of Abilene and 1.66" at Paris.

June 15 - 16:

A stationary front continued to linger over extreme North Texas on the 15th. A short wave trough combined with the front to produce more showers and severe thunderstorms late on the 15th over primarily north central and northeast Texas. Locally heavy rainfall occurred. There was 4.93" east of Big Sandy, 4.29" northeast of Longview, and 4.12" just east of Van Alstyne on the 15th. On the 16th the heaviest rain shifted to the Texas Hill Country where 2.60" was measured north northwest of Ingram and 2.57" fell south southwest of Harper.

June 23:

There were several days of scattered showers and thunderstorms throughout the middle of June. On the 23rd some of the thunderstorms produced some locally heavy rain over the eastern parts of north Texas. There was 2.24" south southwest of Henderson, 2.10" at Wills Point, and 1.94" at Tyler.

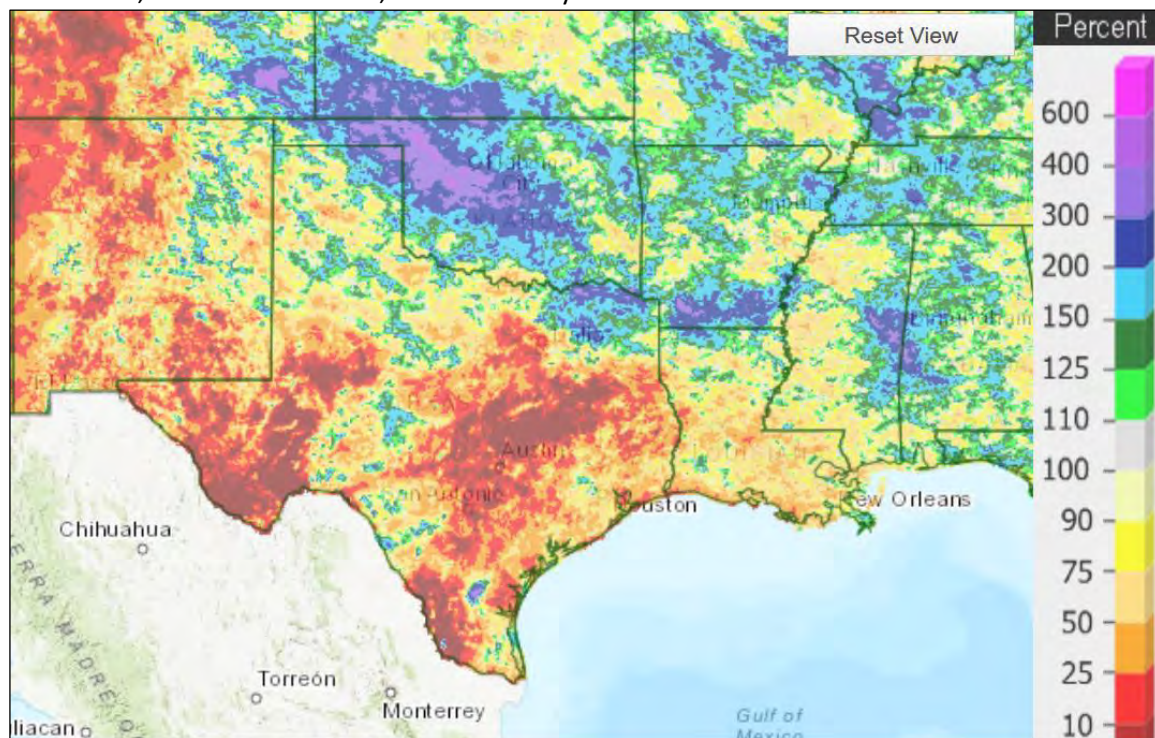


Figure 2: July 2023 percent of normal precipitation.

North Texas Regional Summary (continued)

The DFW airport in July 2023 received 0.47" of an inch of rain. The normal amount for July is 2.08" so DFW was -1.61" below normal for the month. Waco for July 2023 picked up 0.40" of an inch of rain. The normal amount of rainfall in Waco for July is 5.17" so that is 4.77" below normal for the month.

There were about four storm systems which affected our weather in July. Here are the highlights of the weather below.

July 3:

A weak front slid out of Oklahoma into north central and northeast Texas. This front produced scattered showers and thunderstorms, some of which contained locally heavy rain. Northwest of Frisco had 5.51" and 4.65" fell west of McKinney.

July 8 - 9:

A mesoscale convective system (MCS) moved out of Oklahoma into north central and northeast Texas late on the 8th and into the 9th. Very heavy rainfall fell over extreme northeast Texas on the 8th, with the area east of DeKalb getting 5.25", and to the north northeast of New Boston had 2.96". Over southeast Texas, thundershowers occurred due to land/sea interactions. The region northeast of Richmond picked up 2.87". Residual rainfall fell on the 9th which was heaviest at Paris with 2.75", Gilmer with 1.56" and west of Lavon with 1.43".

July 11:

A new MCS moved south out of Oklahoma into North Texas after midnight on the 11th. The rainfall prior to sunrise was heaviest northeast of Denton where 1.18" was measured and east southeast of Fairview there was 1.08". Out in west Texas, 1.38" fell just south of Hawley.

July 16:

A cluster of thunderstorms developed over North Texas and produced some welcome rainfall in a few locations. In the DFW metroplex, the area south southwest of Anna received 1.52" while a gauge northeast of downtown Fort Worth picked up 1.51". Elsewhere in Texas, Paris received 2.04" while Monkstown got 1.95".

July ended up very hot and dry across North Texas. Fort Cavazos (Station GRK, formerly Fort Hood) ended the month with 23 days straight of 100-degree weather.

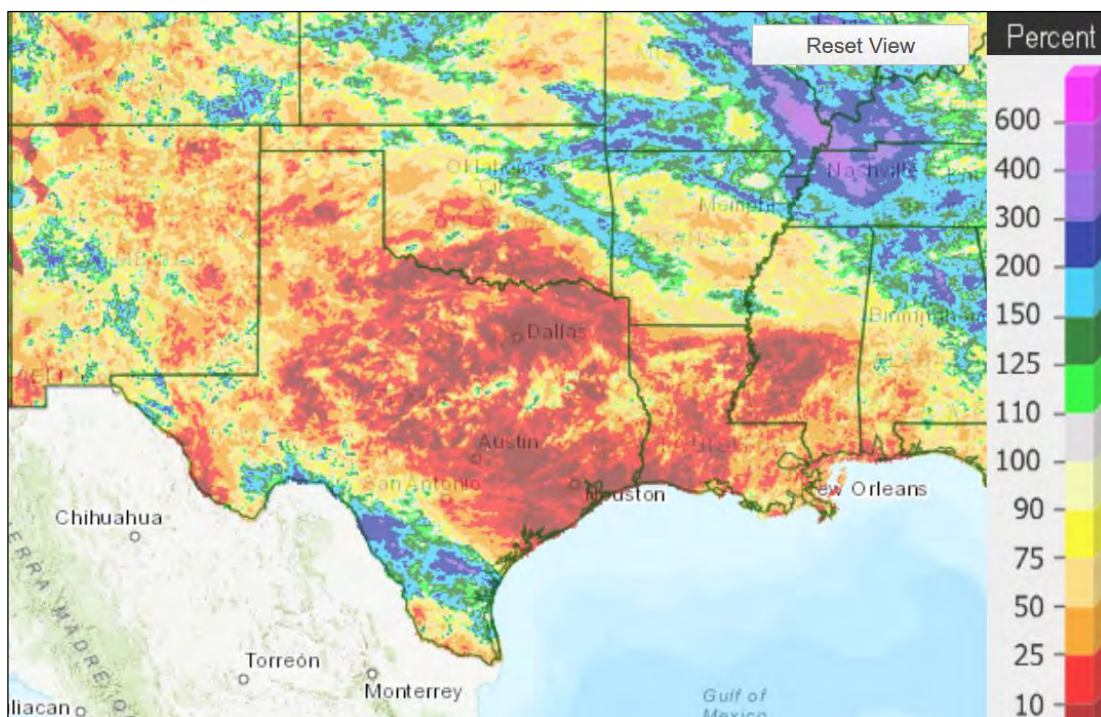


Figure 3: Percent of normal precipitation for August 2023.

North Texas Regional Summary (continued)

At DFW Airport in August 2023 only a Trace of rainfall fell. The normal amount of rain in August is 2.18" so DFW was -2.18" below normal for the month. This tied the record for the second driest August of record. In Waco for August 2023 only 0.34" of an inch of rain fell. The normal amount of rainfall in Waco in August is 2.05", this is -1.71" below normal for the month.

There were about three significant storm systems which affected our weather in August. Here are the highlights below.

August 14:

A cold front moved through North Texas. A few lucky locations received some rainfall south of the DFW metroplex in what started out being a very hot and dry August. They measured 1.70" west southwest of Mertens and 1.26" east southeast of Valley Mills.

August 22:

Tropical storm Harold came onshore along the lower Texas Gulf Coast. While it did not bring any rain to North Texas, it did produce some welcome rainfall to Deep South Texas. Prior to sunrise on the 22nd, 2.50" fell at Rio Grande City and 2.07" at Port Mansfield. Then during the day and evening of the 22nd, two areas in particular received very heavy rain. One was near Corpus Christi where 6.95" fell southeast of Orange Grove. The second was close to Del Rio where 5.62" fell at Dryden. This led to major flooding on the Rio Grande at Foster Ranch near Langtry.

August 27 - 28:

A weak cold front moved into Texas on the 27th. Showers and thunderstorms developed near the front and brought some rain to some areas that had not received measurable precipitation for a long time. The rain was most widespread east and south of DFW. The maximum rainfall amounts were 4.12" southwest of Clifton and 4.01" southwest of Freestone. Residual rainfall continued over South Texas on the 28th. The maximum rainfall was 2.03" north northeast of Lakehills and 1.59" south of Pipe Creek.

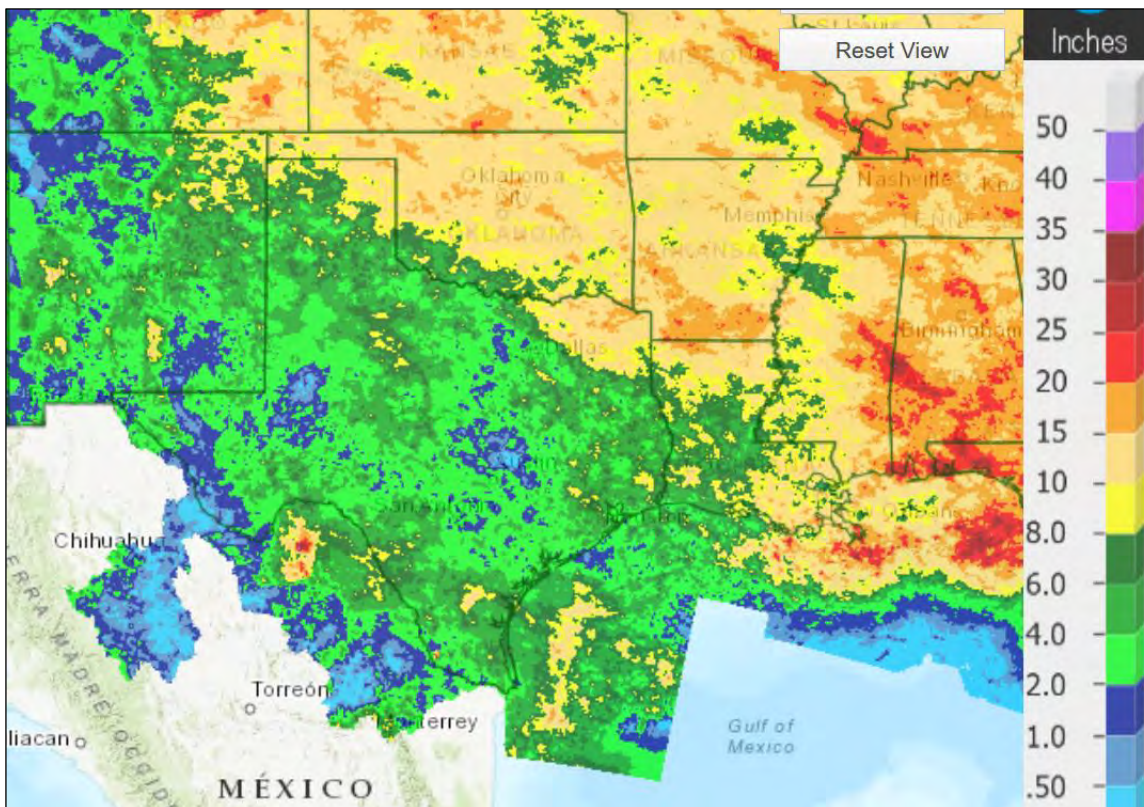


Figure 4: Summer season precipitation for 2023. The brown, orange and bright red colors indicate the largest precipitation totals, while the light green and blue colors show the lightest amounts.

North Texas Regional Summary (continued)

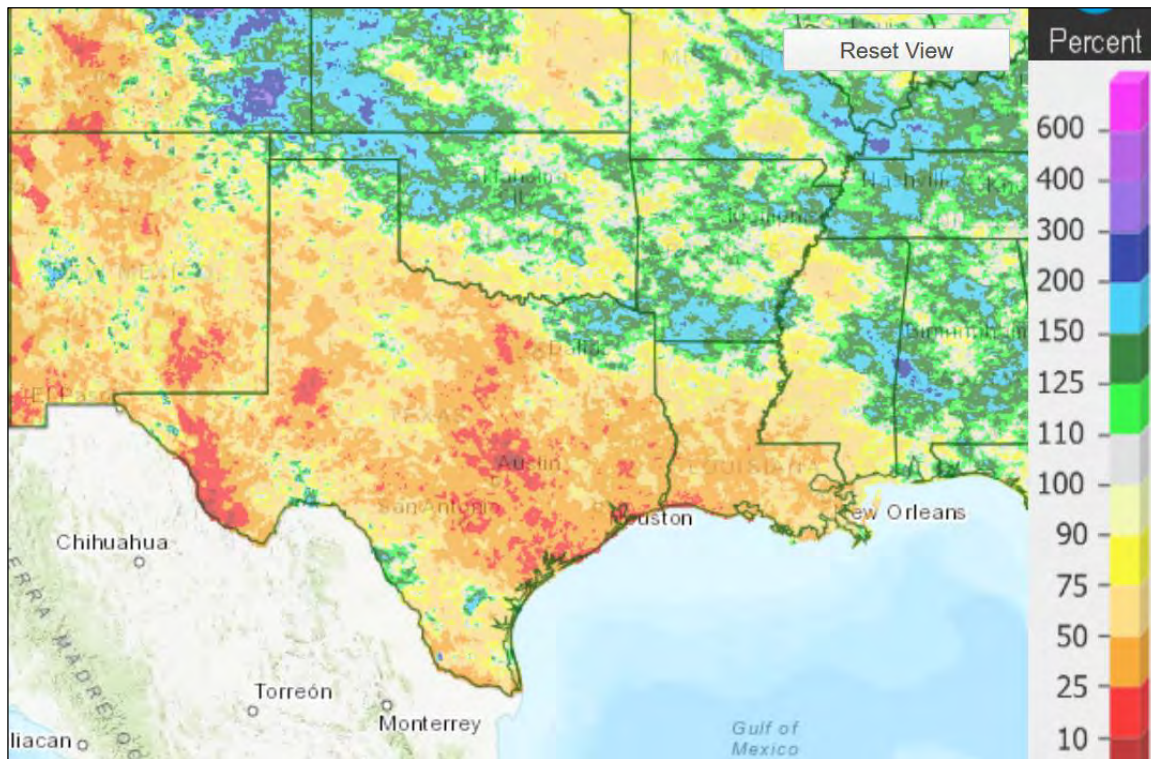


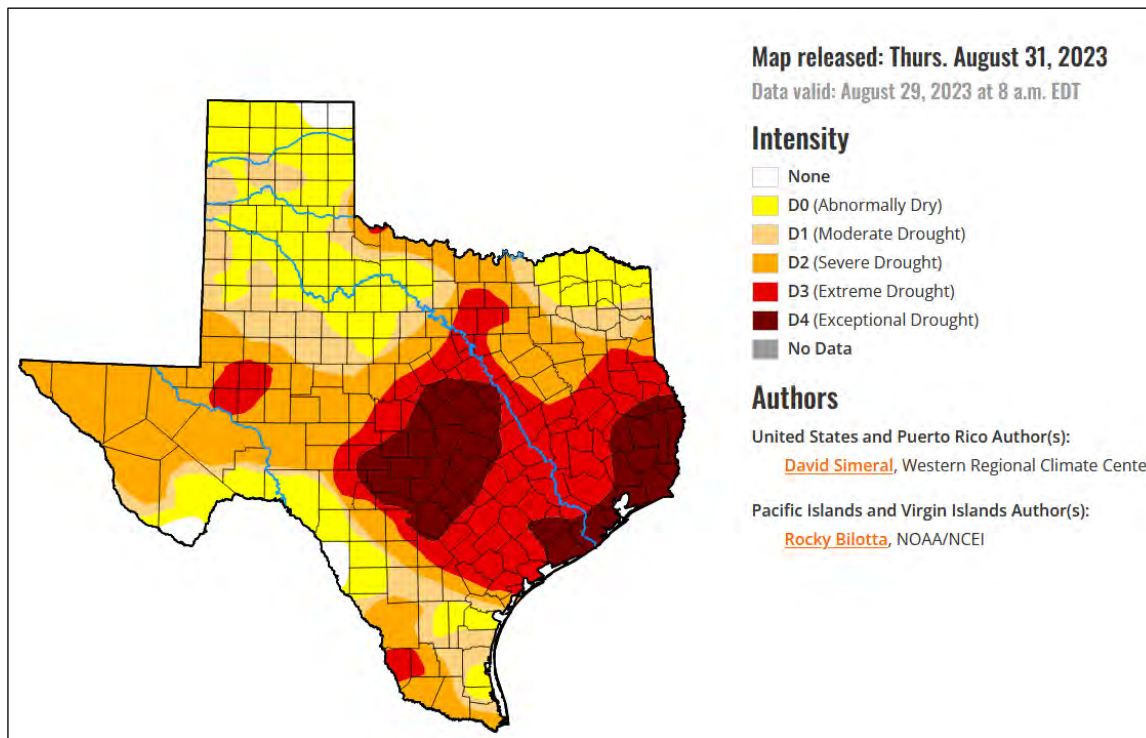
Figure 5: Percent of Normal Precipitation for summer 2023.

For the summer season DFW airport received 1.25". The normal amount of rainfall for June through August is 7.96" so this is -6.71" below normal for the season. As August concluded there were 46 consecutive days without measurable rain. This tied for the 9th longest streak of consecutive days without measurable rain. With 1.25" of rainfall during June-August, 2023 finished up as the 4th driest summer on record at DFW. In Waco for the summer season, only 0.74" fell. The normal amount of rainfall for the June through August time period is 7.22" so this is -6.48" below normal for the season.

The 2023 summer total (0.74") in Waco barely exceeded the summer total of 1980 (0.51"), making this the 2nd driest summer on record for Waco. Waco went 71 consecutive days without measurable rainfall at the Regional Airport (June 17 to August 26). This was the second longest streak of record. The longest streak without measurable rain was 82 days in 1924. This streak eclipsed a 43-day rainless streak in 2022 and was the longest stretch without measurable rainfall since a 61-day span in 2012. Waco also set an all-time record for the most consecutive days without any precipitation. Waco went 56 days from July 2 to August 26, 2023. The previous record of most consecutive days without any precipitation was 49 days in 2015.

Killeen had 71 consecutive days without measurable rainfall at Gray Army Airfield (GRK). This was a record for the longest time period without measurable rain. The previous record was 69 days which occurred from July 19 to September 25 in 2011. Weather records for GRK go back to 1950. This eclipsed a 43-day rainless streak in 2015. GRK finally ended its record streak on August 27, but unfortunately the storms were spotty and only 0.07" of rain was officially measured at the airfield. Summer 2023 was the driest on record at GRK with only 0.66" of rainfall, behind 2011 (0.94").

North Texas Regional Summary (continued)



Current Drought Monitor for Texas as of August 31. The results of the dry weather of the past few months show up well on this drought monitor, as well as those few locations that received higher rainfall amounts. Very few areas of Texas are free from drought, with most of the state is experiencing abnormally dry conditions or worse. Exceptional drought is occurring over Central Texas and over southeast parts of the state. Parts of northeast and northwest Texas continue to be abnormally dry or in moderate drought, while north central Texas, including DFW, is in severe to extreme drought.

I want to give a special hello to those who are new to CoCoRaHS. Welcome! If you have any difficulty with making your observations or have any questions, please feel free to contact me or your county coordinator. And in case you were wondering if anyone looks at your rainfall reports after you enter them, rest assured; someone is! As one example, each day CoCoRaHS data is carefully examined and incorporated by the National Weather Service at the West Gulf River Forecast Center for use in their soil moisture accounting flood forecasting models. So please continue to report, and consider inviting your neighbors, relatives and friends to join CoCoRaHS! The more rainfall observers we have, the better our chances are of determining the highest rainfall totals during rainfall events, and on the flip side, the exact location of drought when it doesn't rain. We appreciate it when you report zero rainfall daily on the dry days (which we had so many of this summer). Why? Because if you go a month or longer without measurable rainfall (as someone probably did this summer), that tells us a lot, too!

Thanks again for your dedication in making all your weather observations! And don't forget that on days you are not home or unable to report your 24-hour rainfall observation for any reason, you can make a multi-day accumulation report upon your return. That data is used, too. There is now a new link on the CoCoRaHS reporting page you can use for this purpose.

Welcome to autumn. Have a great fall season!

Greg Story

Southeast Texas Regional Summary

Extreme Heat & Drought Set Records

By: Ron Havran, Southeast Texas CoCoRaHS Regional Coordinator, HCFCD

The above normal rainfall pattern Southeast had in the spring of 2023 slowly faded away as the calendar changed over to June. An upper level high pressure ridge moved into Texas from its origin out in the eastern Pacific Ocean off the coast of Mexico in early June. Showers and thunderstorms decreased and temperatures started heating up. Temperatures climbed higher as the month with on day by day. The average temperature for the month was 2°F to 3.5°F above normal across the region at most climate data sites. High dew point reading made for very high heat index values in the day and temperatures stayed above 80°F at night.

Rainfall across all of Southeast Texas was below normal in most places except northwestern Harris and eastern Waller Counties. Orange County north of Beaumont had slightly higher rainfall totals than most areas. Several climate stations ended the month with well below normal rainfall. CoCoRaHS observer rainfall totals for the month finished with most stations recording below 2.00" of rainfall. There were a few CoCoRaHS observer stations that did get some higher rainfall totals from some of those isolated storms. The more CoCoRaHS observer stations that are out there in the region the better chance we have of knowing how much rain fell from some of those isolated heavy thunderstorms away from any kind of meteorological weather station and beyond Doppler radars complete scan. Help recruit a friend that has an interest in weather to join CoCoRaHS.

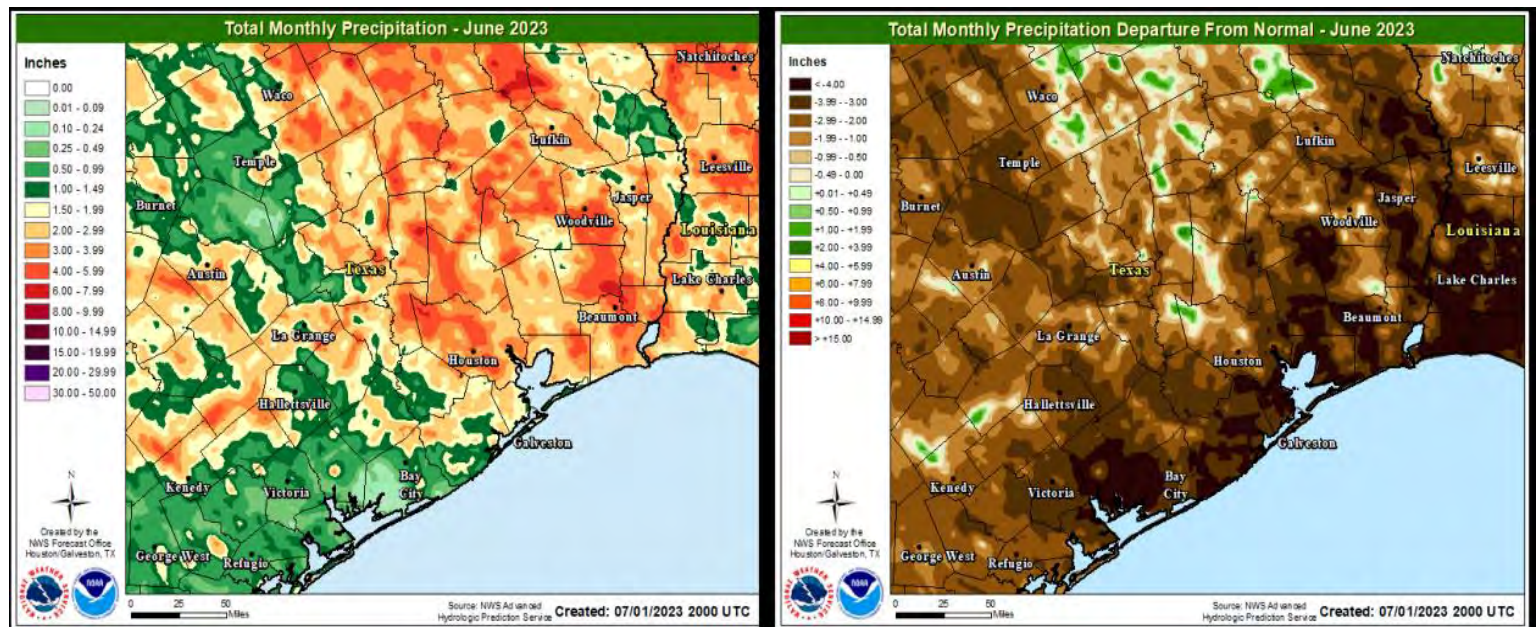


Figure 1: June monthly precipitation and departure from normal across Southeast Texas.

The heat reached excessive levels in July with just about all the days of the month well above 100°F across the region. Several climate data stations observed a record highest average temperature for July. Many other sites finished in the top 5 for hottest July on record. Just about all the days of the month had full sun the entire day which dried vegetation out fast. The combined extreme heat and lack of rainfall led to the expansion of drought across Southeast Texas. Moderate to Severe Drought conditions increased over the region rather quickly from the middle of June to the end of July. See figures 6 and 7.

Rainfall was well below normal region wide. The only areas with above normal precipitation was northwestern and west central Harris County. A significant amount of the rainfall that fell in northwestern Harris County was part of a storm complex that moved into the county on July 4 and caused high winds at Bush Intercontinental Airport of 98 mph. The rain came to stop after the 4th and the rest of the month had only a few isolated showers and storms. Thanks to all the observers for reporting the zeros and small sprinkle amounts of rainfall this month. Your data is just as valuable as any day with rainfall.

Southeast Texas Regional Summary (continued)

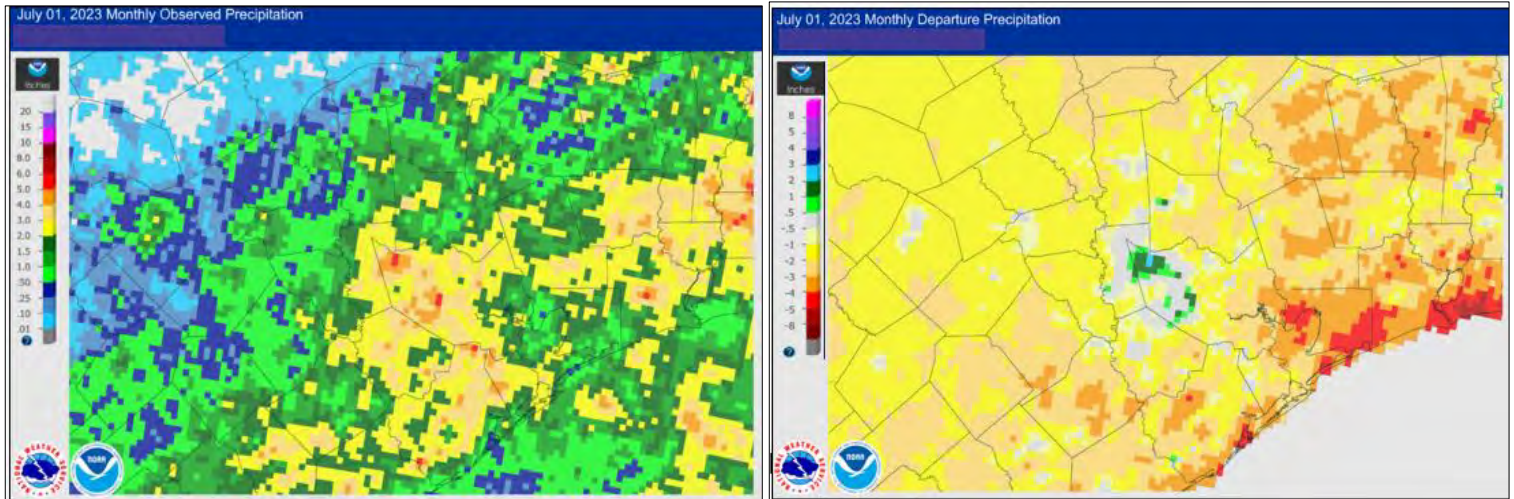


Figure 2: July monthly precipitation and departure from normal across Southeast Texas.

August broke just about every type of high temperature record possible in the region. Most sites experienced their hottest August on record and either set or tied all-time hottest temperatures on record. Average temperatures for the month were from 3°F to 8°F above normal. In addition to the extreme heat very little rainfall fell this month over the entire region. Most stations across the region either had record low rainfall amounts or very near to a record. To put this into prospective Galveston had its 6th driest August on record with only 0.27" and Houston had its second driest at 0.01". Galveston weather records go way back to April 1, 1871 and are some of the oldest weather records in this part of the country. Galveston was the first weather office west of the Mississippi River. The office was commissioned by the Signal Corps on April 1, 1871. Galveston also had its warmest August on record at 88.6. Houston had its record hottest August at 91.0°F. Houston records go back to 1888. A historical August.

Galveston's August Lists (1871-2022)			
Wettest	Driest	Warmest	Coollest
26.67 2017	0.00 1902	88.5 2011	80.2 1894
19.08 1915	0.02 1927	87.9 2020	80.7 1967
15.29 1953	0.10 2011	87.8 2019	80.7 1961
14.67 2002	0.18 1990	87.3 2010	81.2 1904
14.46 1888	0.26 1999	86.8 2022	81.3 1915
13.38 1981	0.35 1896	86.6 2021	81.4 1882
13.18 1945	0.38 1951	86.6 2012	81.4 1879
11.18 1983	0.41 1952	86.6 2005	81.5 1889
10.59 2001	0.49 1924	86.5 2009	81.6 1966
10.25 1973	0.52 2010	86.1 2015	81.9 1893

Figure 3: All time weather records for Galveston in August

Houston's August Lists (1888-2022)			
Wettest	Driest	Warmest	Coollest
39.11 2017	Trace 1927	90.4 2011	78.7 1894
15.43 1915	0.09 2011	87.7 2010	79.5 1973
11.26 1920	0.31 1990	87.6 2019	79.5 1891
11.13 1945	0.37 1902	87.5 1962	80.1 1992
10.74 1900	0.50 1999	87.0 1951	80.3 1972
10.58 1996	0.52 1939	86.8 1999	80.4 1971
10.41 2016	0.58 1905	86.8 1902	80.5 1893
9.42 1983	0.64 1924	86.6 2020	81.0 1892
9.24 1914	0.74 1952	86.6 1980	81.1 1975
8.58 2022	0.78 1909	86.5 1993	81.3 1904

Figure 4: All time weather records for Houston in August

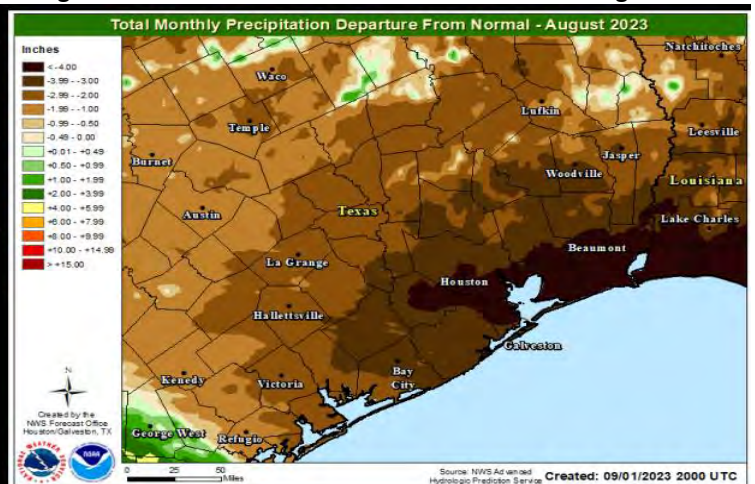
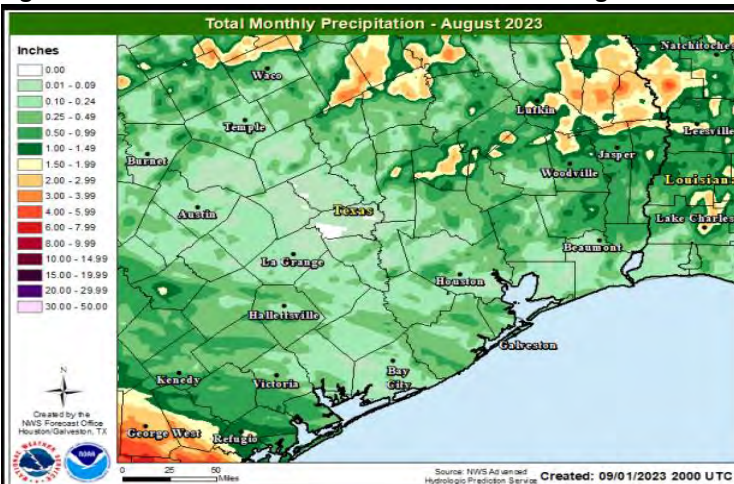




Figure 5: August monthly precipitation and departure from normal across Southeast Texas

Southeast Texas Regional Summary (continued)



Summer 2023 CoCoRaHS SE Texas Houston/Galveston Section Rainfall				
CoCoRaHS Station measured county rainfall averages in inches per month				
County	June	July	August	Summer Total
	AVG.	AVG.	AVG.	Jun - Aug.
Austin	1.69	0.84	0.13	2.66
Brazoria	1.24	2.34	0.36	3.94
Chambers	2.62	1.59	0.51	4.72
Colorado	1.71	0.67	0.12	2.50
Fort Bend	1.89	2.51	0.10	4.50
Galveston	1.91	2.05	0.40	4.36
Harris	2.81	2.45	0.14	5.40
Jackson	0.53	2.81	0.10	3.44
Liberty	1.79	1.69	0.63	4.11
Matagorda	0.44	1.99	0.11	2.54
Montgomery	3.05	1.03	0.35	4.43
Polk	2.09	0.53	0.46	3.08
San Jacinto	1.72	0.56	0.12	2.40
Wharton	1.17	0.99	0.15	2.31
Region Totals	1.76	1.58	0.26	3.60

 Color indicates highest avg. rainfall total for a county in a month
 Color indicates lowest avg. rainfall total for a county in a month

Note: Counties without a significant # of observers reporting are not listed on the chart.

Table 1: Southeast Texas rainfall for the Houston/Galveston Section

Summer 2023 CoCoRaHS SE Texas Golden Triangle Section Rainfall				
CoCoRaHS Station measured county rainfall averages in inches per month				
County	June	July	August	Summer Total
	AVG.	AVG.	AVG.	Jun. - Aug.
Hardin	3.68	2.57	2.55	8.80
Jasper	1.33	1.20	0.47	3.00
Jefferson	3.90	2.37	0.04	6.31
Newton	NA	NA	NA	NA
Orange	4.27	2.71	0.55	7.53
Tyler	2.50	1.34	0.62	4.46
Region Totals	3.14	2.04	0.85	6.02

 Color indicates highest avg. rainfall total for a county in a month
 Color indicates lowest avg. rainfall total for a county in a month

Note: Counties without a significant # of observers reporting are not listed on the chart.

Table 2: Southeast Texas rainfall for the Golden Triangle Section

Southeast Texas Regional Summary (continued)

Houston/Galveston Temperature & Rainfall Data for 2023 Summer Season

June Climate							
Site Location (record start)	Hi	Lo	Mean	Departure	Rain	Normal	Departure
Bush Airport (1888)	95.0	75.1	85.1	2.1	3.24	6.00	-2.76
Hobby Airport (1930)	95.2	76.6	85.9	3.0	3.62	6.09	-2.47
Galveston (1871)	88.9	78.1	83.5	-0.3	1.78	4.23	-2.45
Sugar Land (2000)	95.2	75.0	85.1	1.9	1.69	4.22	-2.53
July Climate							
Site Location (record start)	Hi	Lo	Mean	Departure	Rain	Normal	Departure
Bush Airport (1888)	97.7	77.8	87.8	2.7	2.98	3.77	-0.79
Hobby Airport (1930)	97.5	79.0	88.3	3.5	2.75	4.59	-1.84
Galveston (1871)	91.7	81.2	86.5	1.0	1.99	3.41	-1.42
Sugar Land (2000)	98.6	77.2	87.9	2.5	3.76	4.16	-0.40
August Climate							
Site Location (record start)	Hi	Lo	Mean	Departure	Rain	Normal	Departure
Bush Airport (1888)	102.7	79.4	91.0	5.8	0.01	4.84	-4.83
Hobby Airport (1930)	101.8	80.6	91.2	6.1	Trace	5.44	-5.44
Galveston (1871)	94.7	82.6	88.6	2.7	0.27	4.71	-4.44
Sugar Land (2000)	102.9	77.8	90.3	5.3	0.09	5.27	-5.18

Table 3: Southeast Texas monthly climate data for the Houston/Galveston Section

Golden Triangle Temperature & Rainfall Data for 2023 Summer Season

June Climate							
Site Location	Hi	Lo	Mean	Departure	Rain	Normal	Departure
Port Arthur Airport	92.5	73.4	83.0	0.9	3.22	6.70	-3.48
Beaumont Research Center	92.0	74.6	83.3	2.0	2.37	7.57	-5.20
Orange 9N	90.7	72.9	81.8	2.5	2.42	6.84	-4.42
July Climate							
Site Location	Hi	Lo	Mean	Departure	Rain	Normal	Departure
Port Arthur Airport	98.3	76.1	87.2	3.6	2.03	6.85	-4.82
Beaumont Research Center	96.4	76.5	86.4	3.2	3.00	5.39	-2.39
Orange 9N	94.0	74.8	84.4	3.1	2.82	5.82	-3.00
August Climate							
Site Location	Hi	Lo	Mean	Departure	Rain	Normal	Departure
Port Arthur Airport	101.4	77.1	89.2	5.4	0.36	6.89	-6.53
Beaumont Research Center	101.0	76.6	88.8	5.6	0.27	6.43	-6.16
Orange 9N	98.9	74.9	86.9	5.6	0.41	6.71	-6.30

Table 4: Southeast Texas monthly climate data for the Golden Triangle Section

Southeast Texas Regional Summary (continued)

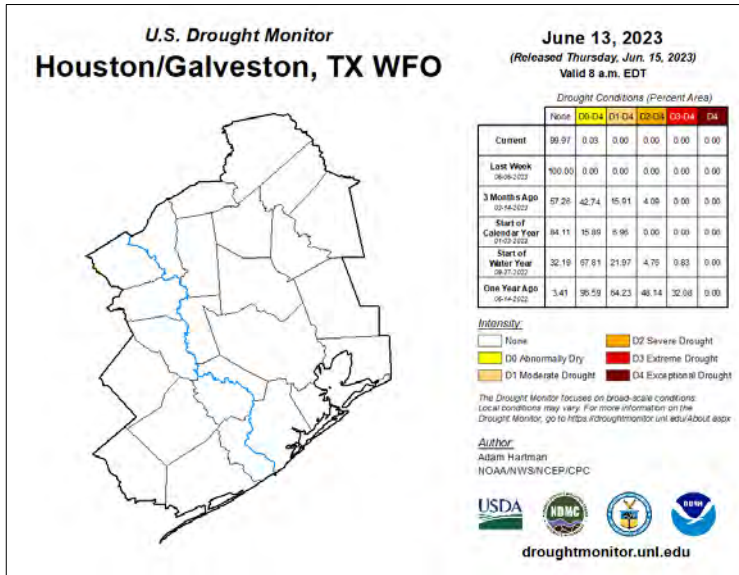
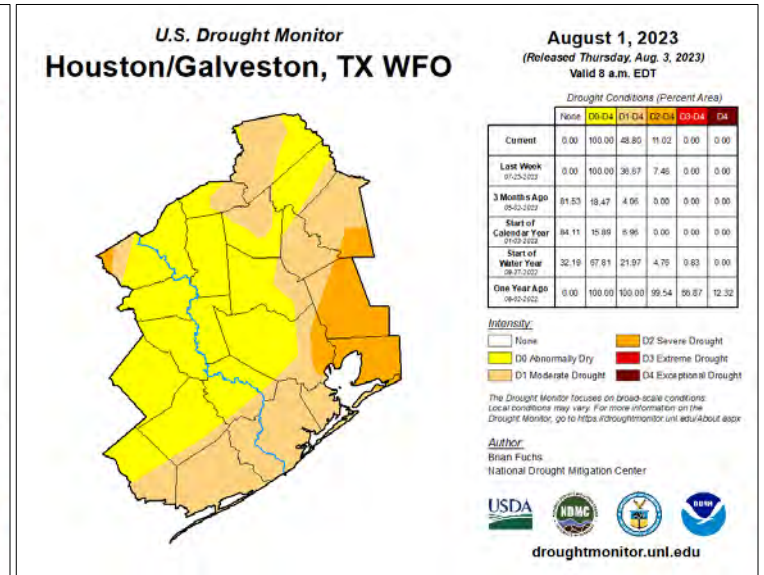
Figure 6: SE Texas had zero drought on June 13th, 2023

Figure 7: SE Texas drought developed rapidly by August 1, 2023

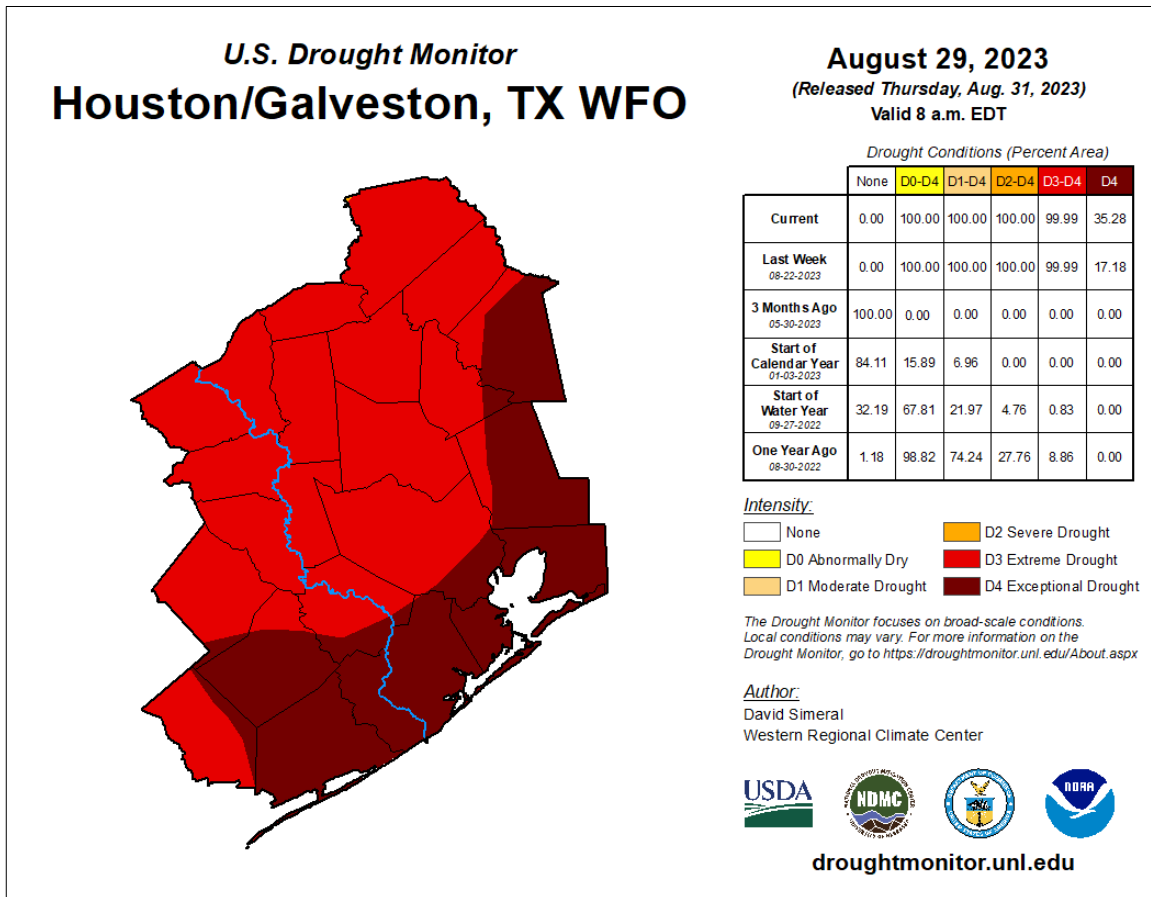


Figure 8: At the end of August SE Texas was in Extreme to Exceptional Drought

Texas had its 2nd hottest summer on record and 7th driest summer on record since 1895. We are looking to autumn, so it must be time for Bob's seasonal outlook. Please see his outlook on the next page.

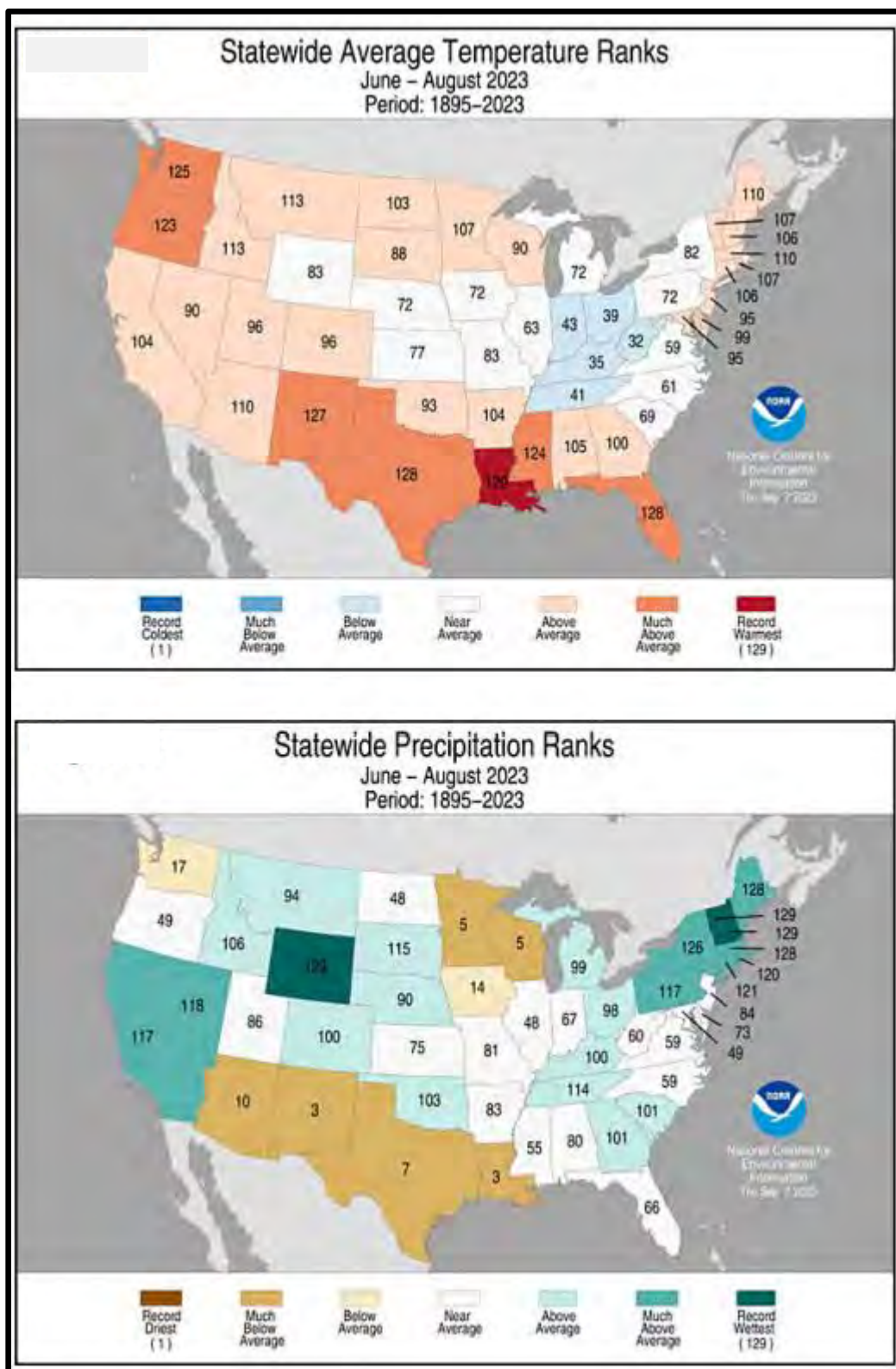


Figure 9: State rankings across the lower 48 for temperature and precipitation this summer.

Texas Autumn Outlook for 2023

Drought Improvement & Pleasant Temperatures by November

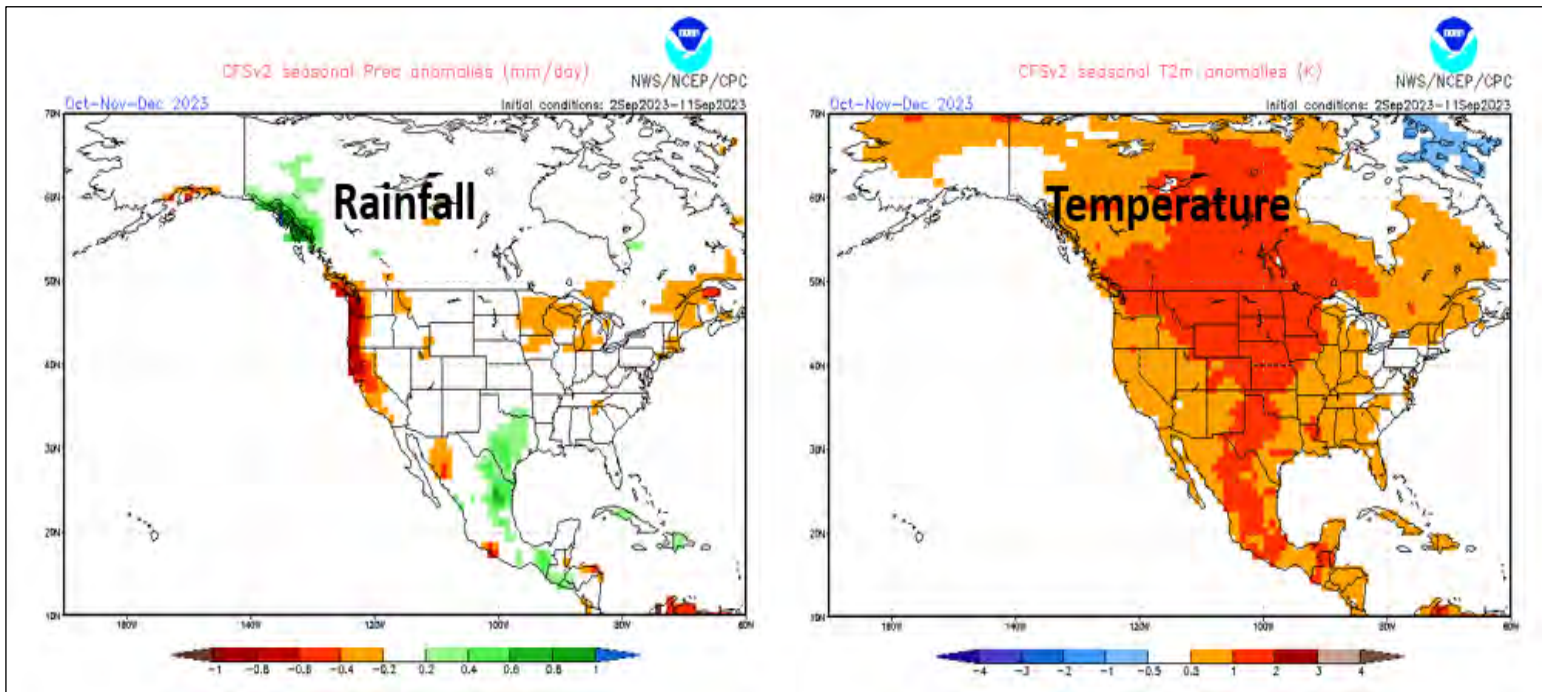
By: Bob Rose, Meteorologist, Lower Colorado River Authority

It's been a brutally hot and dry summer across Texas. Day after day of blazing sunshine, record-breaking triple digit heat and very little rainfall made this summer in some ways even worse than summer 2011. Serious drought definitely made its presence felt due to the lack of rain. But thankfully, summer is finally beginning to fade, and fall is on the horizon. To many folks, fall is the best season of the year in Texas. The triple digit temperatures go away, temperatures turn cooler, and rainfall increases. Hopes are high widespread rain will return this fall and winter. And after the kind of summer we've just been through, wetter and cooler weather sounds really nice.

As the heat dome of summer fades, the biggest influence on Texas weather this fall is expected to come from the Pacific, where a moderate to strong El Niño is in place. Opposite from its sister La Niña, El Niño tends to bring Texas conditions that are wetter and somewhat cooler than normal in the fall and winter months. El Niño refers to the development of unusually warm sea surface temperatures across the eastern and central tropical Pacific, between the west coast of South America and the International Date Line. These unusually warm waters help create more thunderstorms, rising air, and general low pressure across the eastern and central tropical Pacific. The circulation around the broad area of low pressure helps direct the southern branch of the jet stream across the southern U.S. Frequent storm systems traveling along the jet will move across Texas, bringing periods of rain showers and thunderstorms. Some of the rain can even be heavy at times. In addition, El Niño often causes fall and winter temperatures to average near-normal to slightly below-normal due to frequent, rainy days and air spreading in from the Pacific.

This fall, El Niño is expected to be a big influence on Texas weather. However, its wetter and slightly cooler influence is not expected to happen right away. October is setting up to be the transition period between the unusually warm and dry pattern of summer and El Niño's wetter and slightly cooler than-normal weather influence. Storm systems and rain are forecast to increase during October, becoming more widespread during November and December. The temperature looks to stay warmer than-normal during October, but trend more towards normal in November and December.

Averaging the months of October, November, and December together, NOAA's Climate Forecast System Model (CFSv2) Center is predicting rainfall will average near-normal to above normal, while temperatures will average between 0.5 and 1 degree above normal.

Texas Autumn Outlook for 2023 (continued)

***NOAA's Climate Forecast System (CFSv2) Model rainfall and temperature outlook
for October-November-December***

Again, autumn's cooler, pleasant temperatures may be a little slow to arrive this year as summer tries to hang on a little longer than normal. But eventually, the cold fronts will begin moving into the state, bringing cooler and more pleasant readings. Very serious drought conditions are forecast to continue into October, but drought improvement is expected November into December and through the upcoming winter as widespread rains increase thanks to El Niño.

With Texas seeing drier than-normal falls and winters for the past 3 years, this year's trend toward wetter weather will be very welcome indeed!

Wichita Falls Regional Summary

A Tale of Two Summers

By: Charles Kuster

NSSL

This summer in the Wichita Falls region generally took on two different faces, with the first half being wetter with somewhat above normal temperatures and the second half being much drier and hotter. Six out of the first ten days and nine out of the first twenty days of the season were wet (at least one CoCoRaHS station reported 0.05" or more). By July 20, our area had experienced 21 wet days. Then the faucet turned off and the heat cranked up. After July 20, our area only experienced six wet days and high temperatures for the month of August were ten degrees above normal (Fig. 1). In June and July, high temperatures were still above normal but only by about 3–4 degrees F.

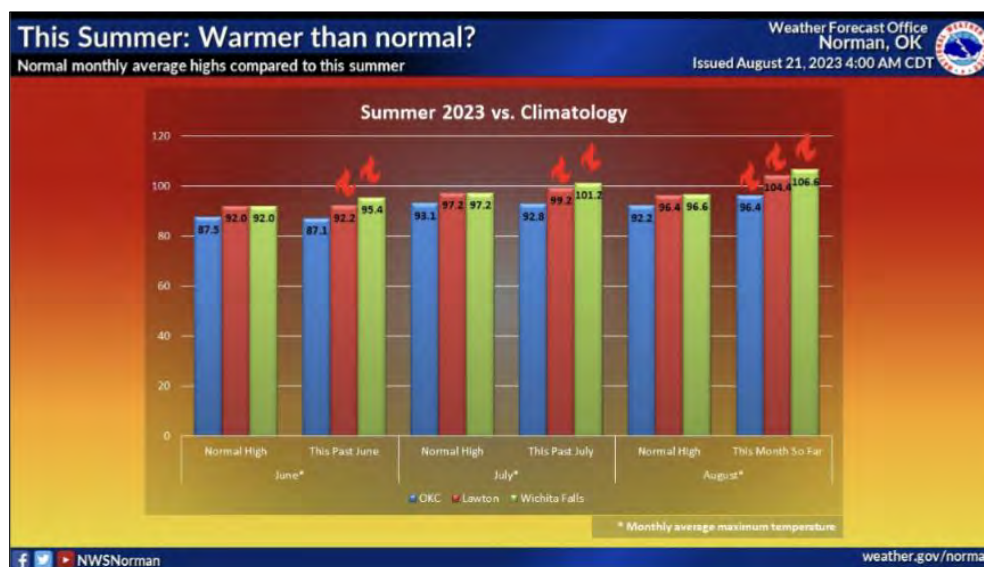


Figure 1. Monthly average maximum temperatures in 2023 (right bars) compared to normal monthly average maximum temperatures (left bars) for June (left), July (middle) and August (right). Oklahoma City is shown by the blue bars, Lawton is shown by the red bars, and Wichita Falls is shown by the green bars. Graphic created by the National Weather Service Forecast Office in Norman, OK (<https://www.weather.gov/oun/>).

It total, our area experienced 66 dry days (all CoCoRaHS stations reported less than 0.05") and 26 wet days (at least one CoCoRaHS station reported 0.05" or more). For comparison, the region experienced 70 dry days and 22 wet days last summer. Overall, temperatures were above average and precipitation was below average for the season (Fig. 2). This combination resulted in an increase in the area affected by drought conditions according to the U.S. Drought Monitor (available at <https://droughtmonitor.unl.edu/>).

Wichita Falls Regional Summary (continued)

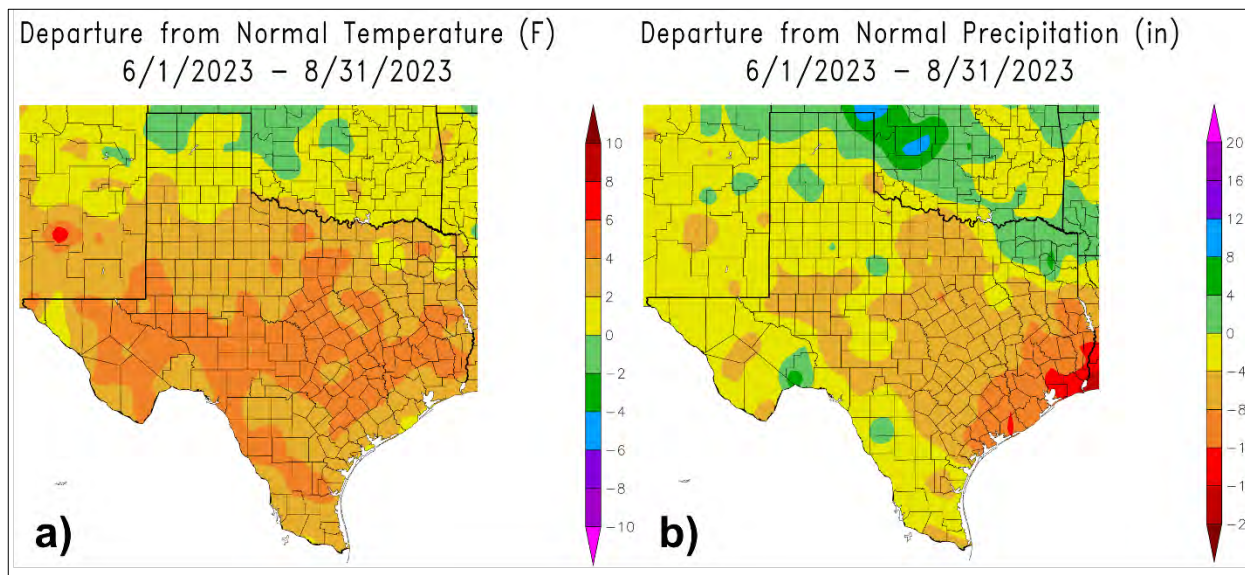


Figure 2. Departure from normal a) temperature and b) precipitation for the beginning of June through the end of August. Warm colors indicate below normal precipitation (b) and above normal temperatures (a), while cool colors indicate above normal precipitation (b) and below normal temperatures (a).

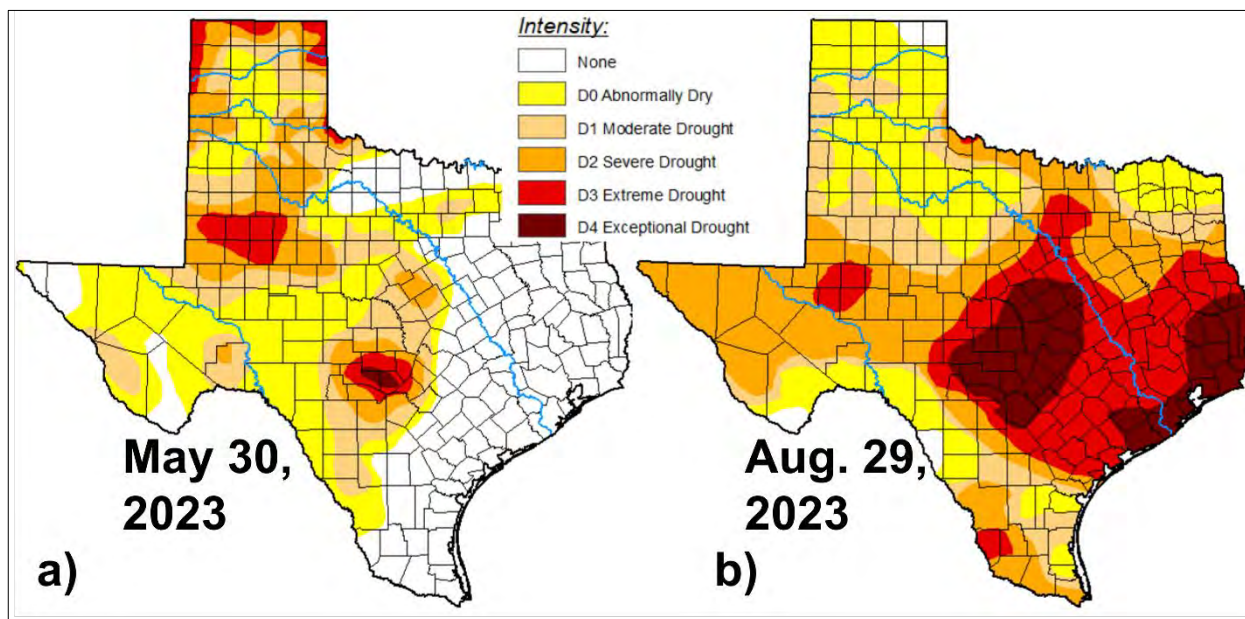


Figure 3. Changes in drought conditions over the summer according to the U.S. Drought Monitor (available at <https://droughtmonitor.unl.edu/>) for Texas on a) May 30, 2023 and b) August 29, 2023.

Amarillo & Lubbock Regional Summer Total Rainfall Maps

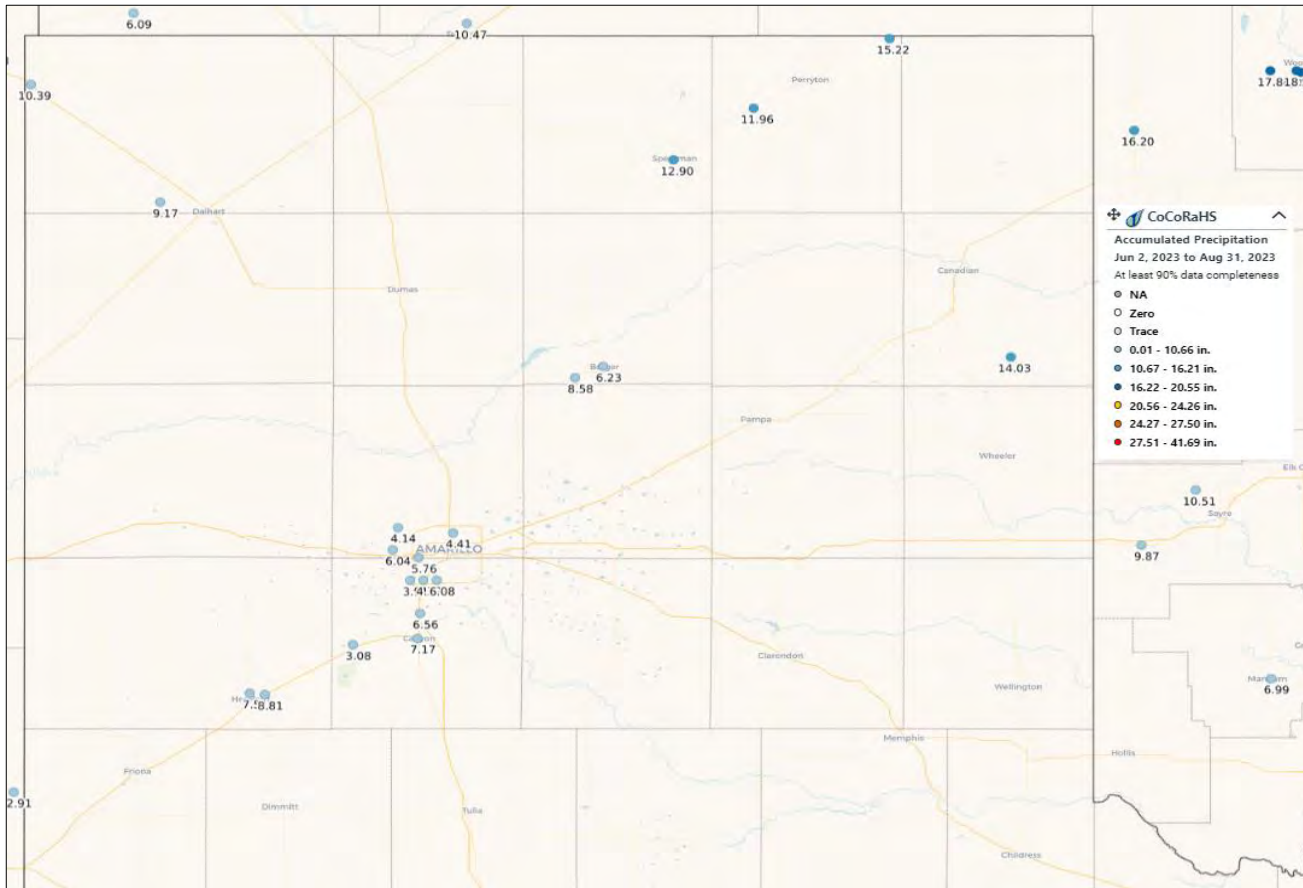


Figure 1: Amarillo 90 day seasonal rainfall maps for the summer months.

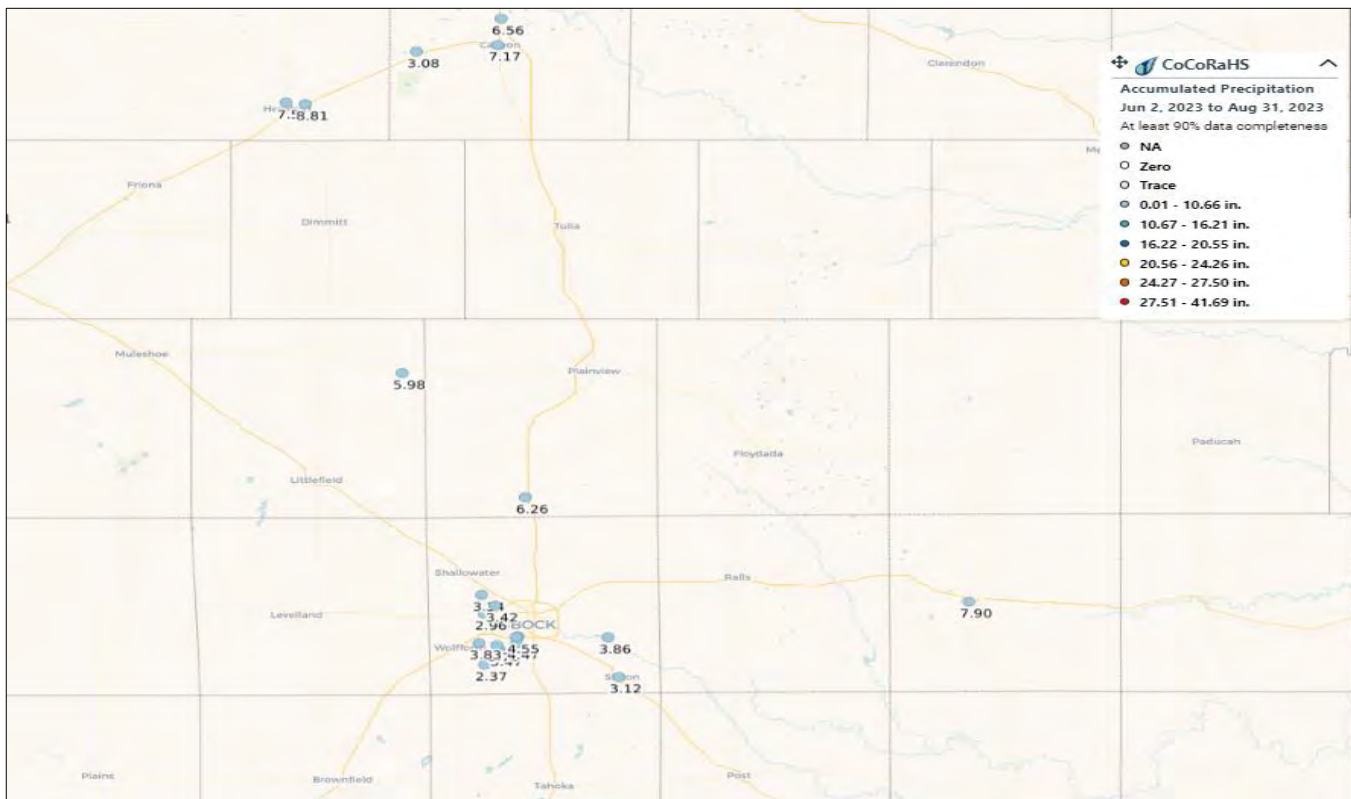


Figure 2: Lubbock Regional 90 day seasonal rainfall maps for the summer months.

Scheduled CoCoRaHS Webinars & Information

Webinar #87 - Thursday, October 5, 2023 - 1:00 PM Eastern

Atmospheric Rivers (2023 Update)

[Registration](#)

Marty Ralph

Director, Center for Western Weather and Water Extremes
UCSD/Scripps Institution of Oceanography
La Jolla, California



[\(Biography\)](#)

Atmospheric Rivers (AR) are relatively narrow regions in the atmosphere that are responsible for most of the horizontal transport of water vapor outside of the tropics. While ARs come in many shapes and sizes, those that contain the largest amounts of water vapor, the strongest winds, and stall over watersheds vulnerable to flooding, can create extreme rainfall and floods. However, not all ARs cause damage – most are weak, and simply provide beneficial rain or snow that is crucial to water supply. In fact, they can also be drought busters.

This presentation will provide a brief history of the emergence of understanding of atmospheric rivers as a phenomenon, and as a key factor in precipitation in many regions. An emphasis will be placed on lessons learned from studies in the Western US, with highlights from the emerging exploration of ARs as important elsewhere. Efforts to better monitor and predict ARs will also be summarized.

Webinar #88 - Thursday, December 2023




Bring it on.....an avalanche of snow musings

David Robinson

Rutgers Univ.
New Brunswick, NJ



"Many people love snow. Others hate it. David Robinson (Rutgers University) has been fascinated with snow his entire life and will share some of his knowledge and experiences with the CoCoRaHS community. Topics that will be covered include 1) snowfall patterns across the US, 2) snow cover over the Northern Hemisphere, 3) major snowstorms 5) the density of fresh snow and how/why it varies so much, and 6) trends in snowfall over the past century. Finally, he will address why CoCoRaHS snowfall observations are so useful and important."

	<p>Texas CoCoRaHS Observer</p> <p>The official newsletter of Texas CoCoRaHS</p>
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Questions, Comments, and Suggestions about this newsletter are welcomed at the above email addresses.