TEXAS CoCoRaHS OBSERVER

Summer 2021

Vol. 7 - 2

Welcome to The Texas CoCoRaHS Observer Newsletter

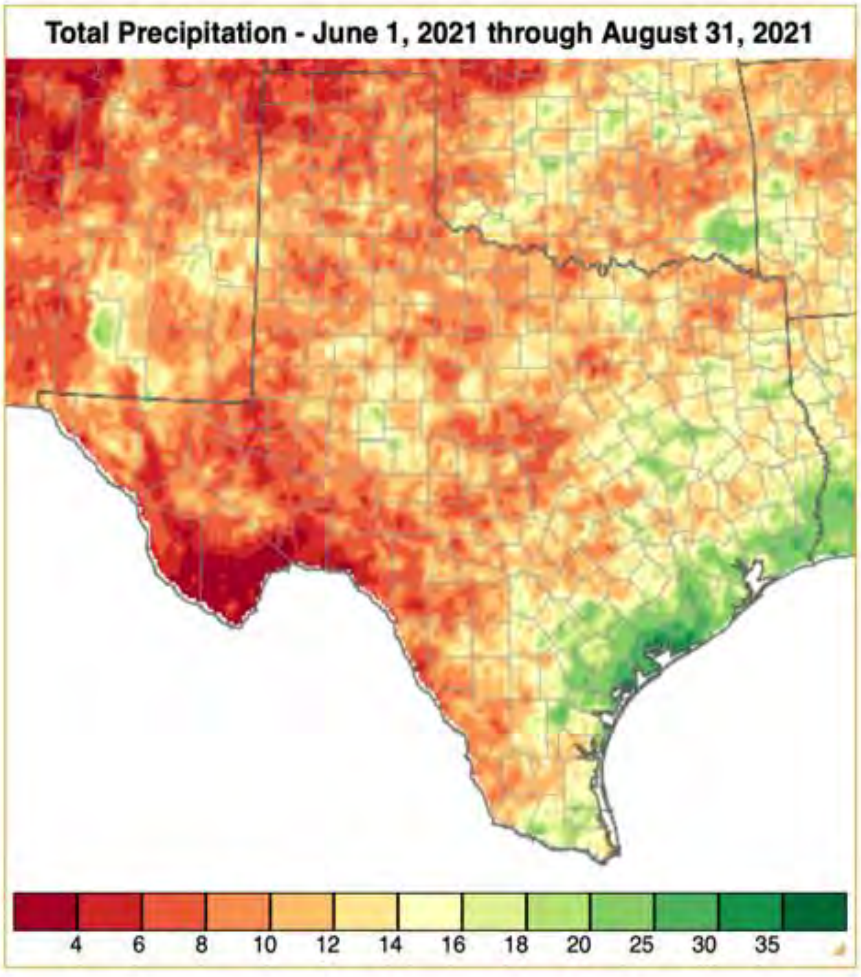
The purpose of this newsletter is to keep observers informed of the latest news, events, training, and happenings related to the CoCoRaHS program here in Texas, as well as news about the latest weather patterns affecting each region of Texas seasonally.

Inside this issue

Texas Weather Summary
Summer 2021

John Nielsen-Gammon, Texas State Climatologist

Figures from the PRISM group, Oregon State University, generated using SC-ACIS



Here's a typical summer precipitation pattern for you. Most years, most of the rain that falls during the summer comes from individual thunderstorms. A typical thunderstorm is surprisingly short-lived, going through its entire life cycle in only an hour or so. Because of this, most Texas thunderstorms affect only a fraction of a county.

Continued page 2>

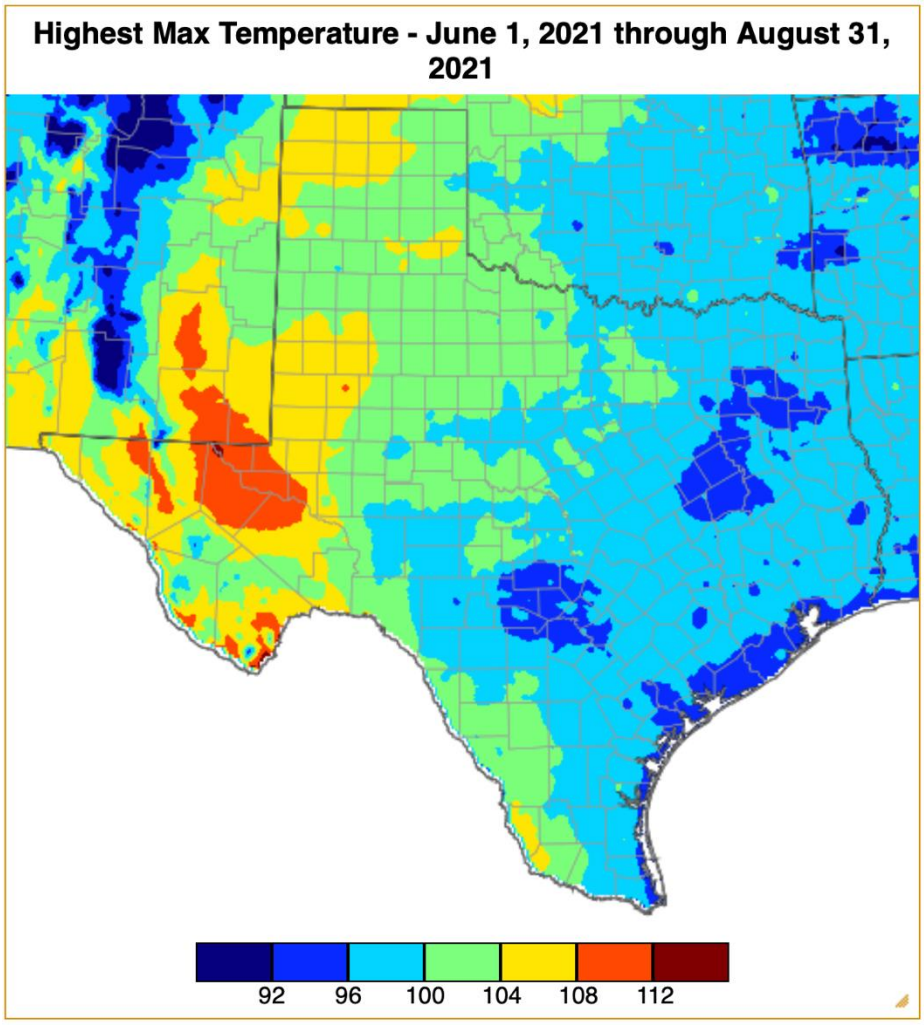
"Because Every Drop Counts, As Do All Zeros"

Texas Summer Summary (continued)

One consequence of this is the complex pattern of rainfall. Go ahead, try to find a county that has fewer than three different colors in it. I've only found one such county that's not one of the ten tiniest counties in Texas and that's not along the Gulf Coast where I got bored with all the contours and switched to a 5" interval.

How many CoCoRaHS stations does it take to measure rainfall? According to this map, you'd need at least six stations to have any hope of decently representing the rainfall pattern in just a single county. You observers who are the only observer in your county: I feel your pain. It's a great service to provide some reliable rainfall data, but it sure would be nice if y'all got some help from others in your area.

Another thing about that summer precipitation pattern: it's a lot of precipitation. Over five inches per month near San Angelo! Over ten inches per month near the Coastal Bend! All that rain, and temperatures are bound to be mild. For one thing, it must be cloudier than normal. More importantly, all that rain lets the ground steam rather than bake. Any sunlight that got used to evaporate water didn't get used to heat up the surface.



Only about half of the state, mostly the western half, had made it up to triple digits by the end of August. This millennium, only 2007, 2004, and arguably 2002 were similarly mild, and none were much cooler. Sure, the humidity was high (all that steam, etc.), but at least we saved a bit on air conditioning bills. Now, if only winter heating can be more *well-behaved* than last year...

West Texas/SE New Mexico Summary

A typical summer, characterized by little convective activity and below-normal rainfall.

By: James DeBerry, Meteorologist/Hydrology Program Manager, NWS Midland

June

June started typical for West Texas and Southeast New Mexico, but was abnormally cool and wet during the last week or so. A cold front moved into the area and stalled roughly along the I-20 corridor, as an upper trough moved into the region. This resulted in several days of widespread convection, starting out as severe weather, then turning into heavy showers as the air-mass turned tropical. Because of the tropical nature of the air-mass, radars overshot much of the low-level warm rain processes that accompany such air masses, and radar estimates were often too low as a result.

Severe storms began in earnest on June 26th, and flash-flooded parts of the Permian Basin during the evening. Roads quickly flooded in Midland County, as well as Lamesa in Dawson County.

By the morning of the 27th, flash flooding had become more widespread. Numerous high water rescues were reported in and around Big Spring in Howard County, as well as in Midland. Many of the few ponds in Midland overflowed their banks. Farther west, flash flooding was reported in Odessa in Ector County and Monahans in Ward County.

Rain and flooding continued into June 28th. Further flooding was reported in Midland, with runoff up to 6' deep in low-lying roadways. Flooding continued in Odessa and Lamesa, and developed into Fluvanna in Scurry County. Unfortunately, by mid-morning some residences in east Odessa started taking on water. Numerous roads were closed and/or washed out near Fluvanna and Lamesa. Farther east, flash flooding began in Scurry and Mitchell Counties. During the afternoon, storms began developing in the Pecos River valley, flooding oil lease roads in and around Orla in Reeves, Eddy and Culberson Counties. Flash flooding and road closures were then reported in and around Artesia, Lakewood, Loving, and Malaga, all in Eddy County.

Late in the evening, storms produced intense rainfall over the headwaters of Alamito Creek in Jeff Davis County. A flash flood later moved into Marfa in Presidio County, washing away a vehicle on Alamito Creek Crossing. The motorist driving the vehicle died. Local law enforcement said waters in the normally-dry wash rose to 12' in depth.

Overall, 21 water rescues were performed in Odessa, and 20 in Midland.

On the 29th, the focus shifted to Carlsbad in Eddy County, where numerous roads flooded and were barricaded. Dark Canyon flash flooded, emptying runoff into southwest Carlsbad. Avalon Reservoir, a small reservoir just to the north of Carlsbad, quickly filled and overtopped its (uncontrolled) dam with up to 7500 cfs at one point. Unfortunately, another fatality occurred when a motorist drove around a barricade and was swept away.

June 30th closed out the month when flash flooding closed McKittrick Canyon and Williams Ranch in Guadalupe Mountains National Park.

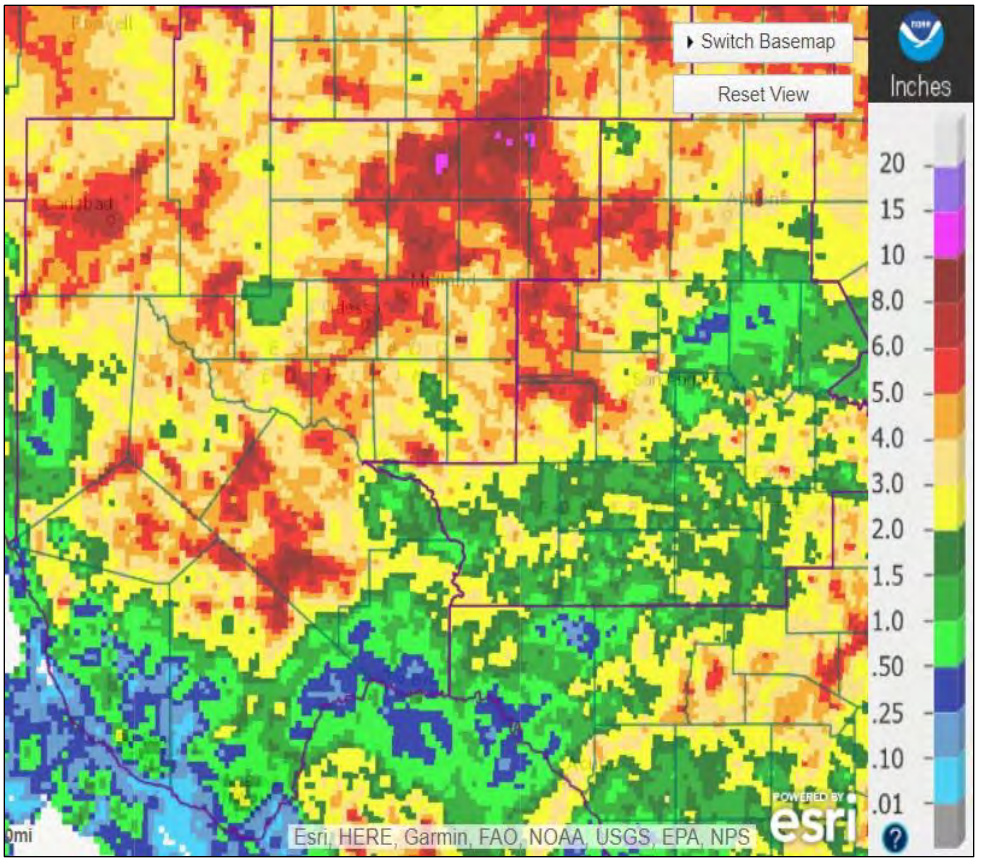


Figure 1: June Precipitation for West Texas

West Texas/SE New Mexico Summary (continued)

All of this rainfall ultimately led to elevated flows on tributaries and the mainstem rivers. The Rio Grande went into minor flood below Presidio, and flooding in Dark Canyon brought the Pecos into minor flood in Carslbad NM.

Monthly radar rainfall estimates ranged from no rainfall in the Presidio Valley to up to 15" in the upper Colorado River Valley. See figure 1. Highest observed rainfall was 8.95" at Lenorah in Martin County. Average rainfall was 3.64".

July

The synoptic pattern that brought all the rainfall to the last week of June diminished during the first week of July, but a few lingering events were noted.

On July 3rd, thunderstorms developed over the Permian Basin. Several roads were flooded in western Midland County. Farther east, flash flooding occurred in Colorado City in Mitchell County, where multiple low water rescues took place.

On the 5th, thunderstorms developed over Snyder in Scurry County, flooding many streets in downtown, and rendering them impassable.

These events also resulting in minor flooding of Deep Creek and the Colorado River.

Farther south, on July 12th, thunderstorms near the confluence of the Rio Conchos and Rio Grande brought the Rio Grande into minor flood stage at the Presidio International Bridge.

Monthly radar rainfall estimates ranged from nothing in central Presidio and Brewster Counties to up to 10" in the upper Colorado River Valley. Highest observed rainfall was 7.25" at Colorado City in Mitchell County. Average rainfall was 2.14".

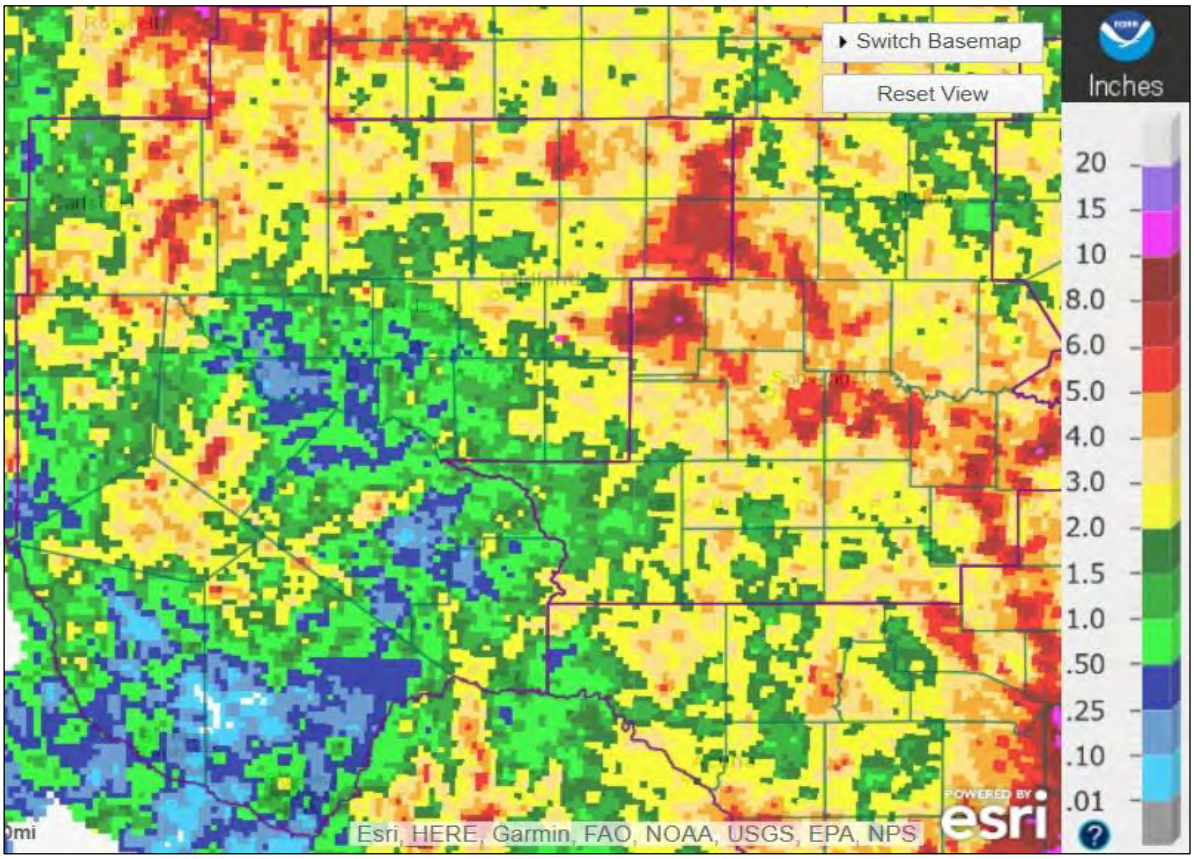


Figure 2: July Precipitation for West Texas

West Texas/SE New Mexico Summary (continued)

August

Few hydrologic events were reported during the month of August, as much heavy rainfall fell in rural, unpopulated areas. The only event of note occurred on August 20th, when flash flooding from thunderstorms covered a stretch of Highway 118 between Fort Davis and Alpine in Jeff Davis County. Even so, rainfall was decent for August.

Monthly radar precipitation estimates ranged from nothing near Lajitas in southwest Brewster County to up to 15" in Guadalupe Mountains National Park in northwest Culberson County. However, highest observed rainfall was 10.42" at Chisos Basin Brewster County. Average rainfall was 2.69".

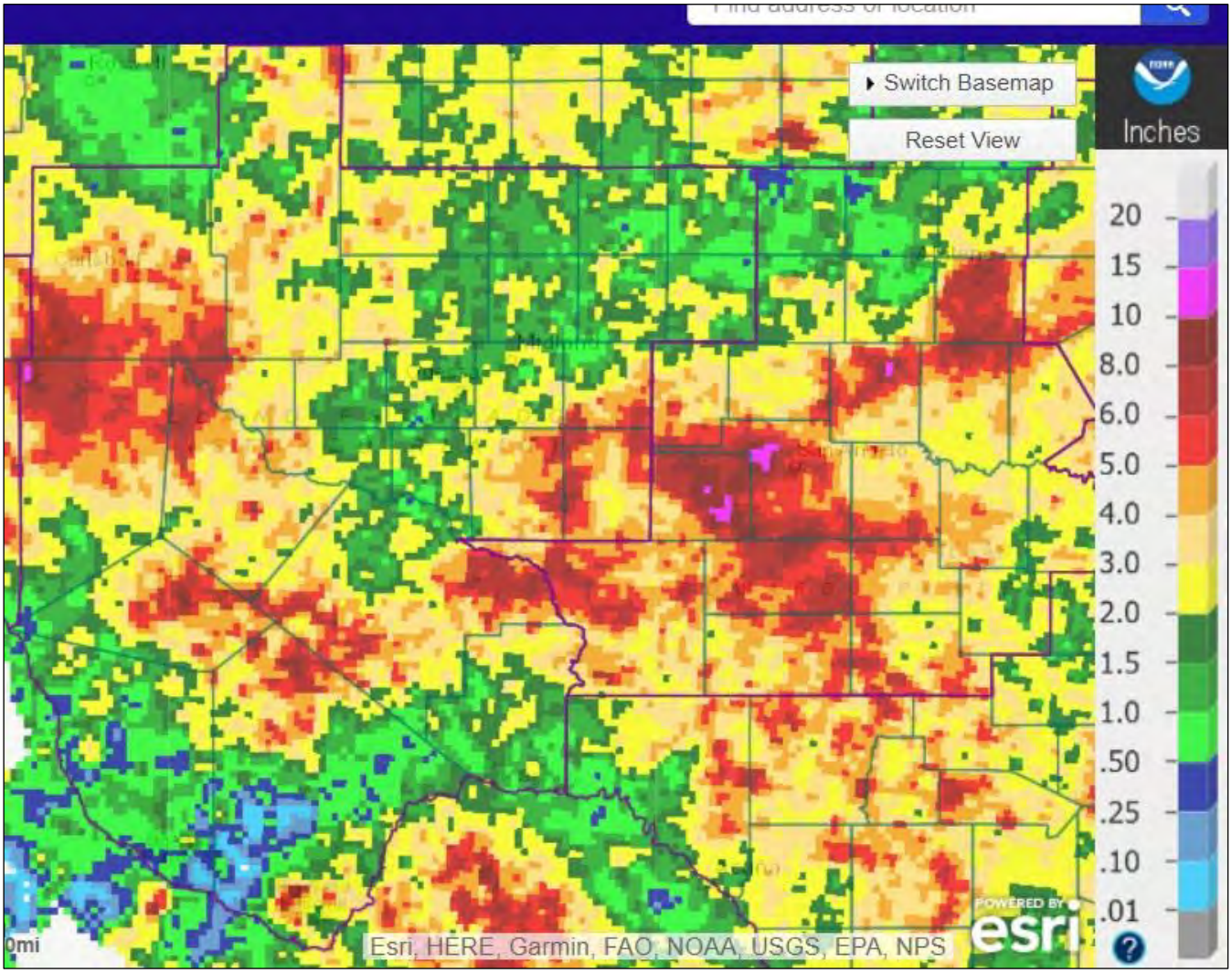


Figure 3: August Precipitation for West Texas

West Texas/SE New Mexico Summary (continued)

Overall, the summer 2021 was wet for West Texas and Southeast New Mexico.

Due to abundant summer rainfall, as of August 26th, in Southeast New Mexico, only far west Eddy County was in extreme drought. Most of West Texas and Southeast New Mexico was out of drought.

Area reservoirs are at 71.6% of conservation capacity as of September 1st.

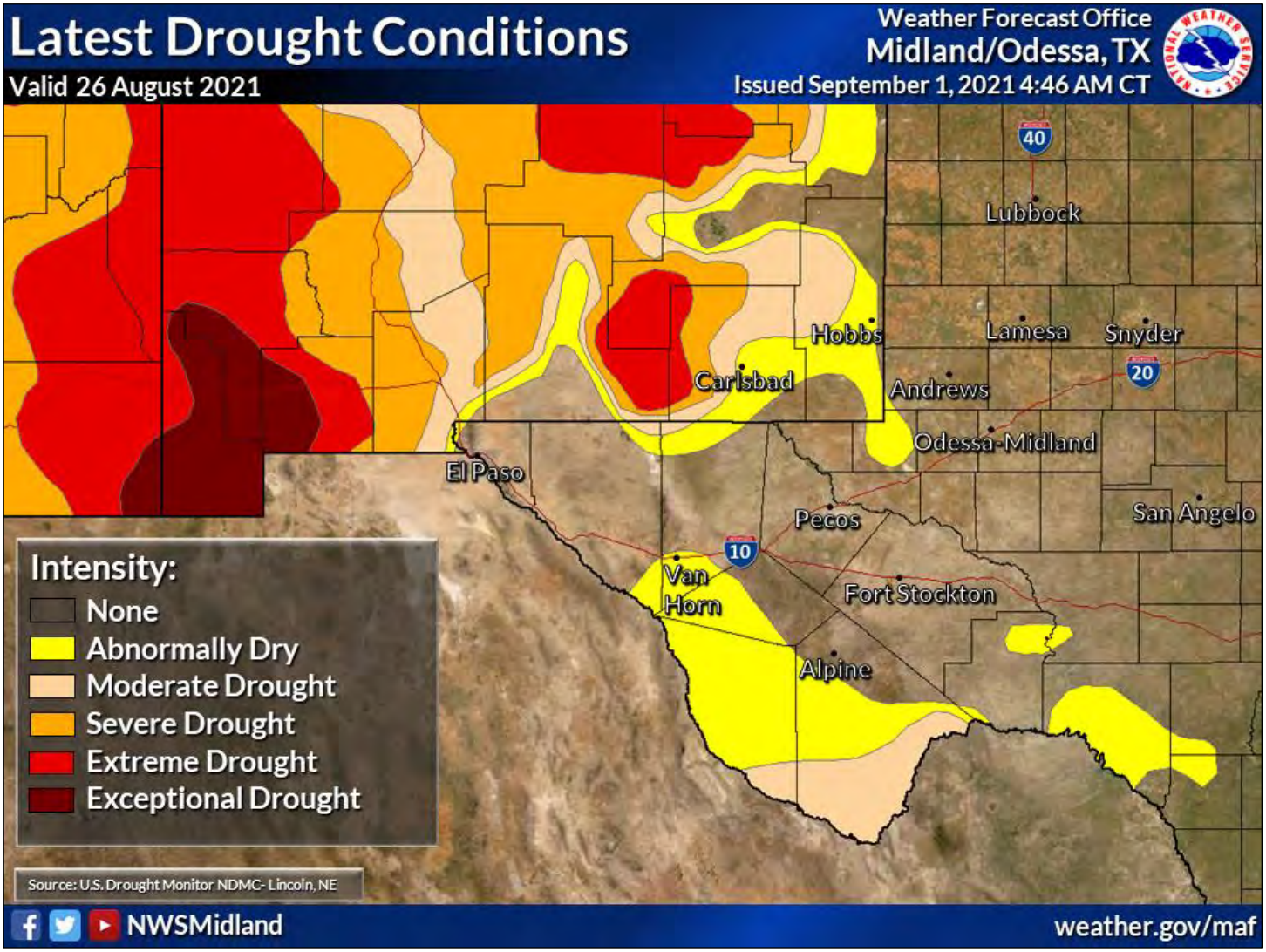


Figure 4: Drought Conditions across West Texas after the summer of 2021

Austin/San Antonio Regional Summary

Wetter and Cooler than Average, but Still Summerlike in South-Central Texas in 2021

By: Keith White, Meteorologist – NWS WFO Austin/San Antonio

Meteorological summer picked up where spring left off in south-central Texas: wet. Right away on the evening of June 2nd, a swath of heavy rain fell across northeastern portions of the area from Llano to Travis and Lee counties, prompting a Flash Flood Warning for portions of Burnet and Williamson counties where radar estimates exceeded 4". More widespread rainfall affected the region on the 3rd, with two large swaths of 1.5 to 3" from Fredericksburg to Bastrop as well as from southern Bexar to southern Lavaca counties with a few CoCoRaHS reports of more than 5" in this area. The only other Flash Flood Warning issued in June came two days later on the 5th as one lone strong thunderstorm dropped 1.5 to 3.5" from NW Bexar County up to near New Braunfels. In both this event and the event on the 2nd, timely reports from the CoCoRaHS Significant Weather Reporting form immediately came through in AWIPS (our internal computer systems) and helped verify and calibrate our radar estimated precipitation amounts, increasing confidence in warning decisions. One of these reports denoted an impressive 11-minute rainfall total of 0.70"!

The driest stretch of summer for our region followed from the 6th to the 13th, with no measurable rainfall anywhere in south-central Texas during the 5 days between the 9th and 13th. Some on and off wetter days followed through the end of the month. Much of our area finished June with below normal rainfall, although much of the Coastal Plains was wetter and a stripe from Del Rio to western Williamson County also finished with above normal rain, primarily as a result of an event on June 21st into the 22nd. In July, positive precipitation anomalies would expand across the majority of the region.

The most impactful single event through the summer occurred on the morning of July 6th, when a nearly stationary thunderstorm producing intense rainfall rates as high as 3" per hour stalled across northwest Bexar County. Much of this area had already received 1 to 2.5" in the day prior, and in total 14 CoCoRaHS observers in the county recorded 5" or greater amounts in the 48-hour period ending 7am on the 7th. Four observers reported amounts in excess of 8" in the vicinity of the Leon Creek watershed. Significant flash flooding resulted, with impacts to roads and structures (Figure 1 next page). Although the rain ended by mid to late morning, Leon Creek at I-35 South (several miles downstream from the precipitation maximum) quickly swelled to its 4th highest crest on record of 25.79 feet by about 4pm (Figure 2 next page). The flood wave worked into and down the San Antonio River over the following 24 to 48 hours, reaching Moderate Flood Stage at Elmendorf on the morning of the 7th. As it moved downstream the flood wave dampened significantly, although the San Antonio River at Floresville was at Minor Flood Stage until the evening of the 8th.

A coastal low stuck around south TX for a few more days, leading to additional heavy rainfall across the Coastal Plains. On the evening of the 8th as rain set up across the Coastal Plains once again, a band of 4+" fell over Karnes County with as much as 8+" estimated by radar along Highway 181 south of Kenedy. Off and on days with mostly hit or miss shower and thunderstorm activity continued, although we had another drier period during the last week or so of the month.

Austin/San Antonio Summary (continued)

Figure 1: Flooding observed on July 6th on US-90 at Leon Creek. Photo courtesy KSAT12 News.

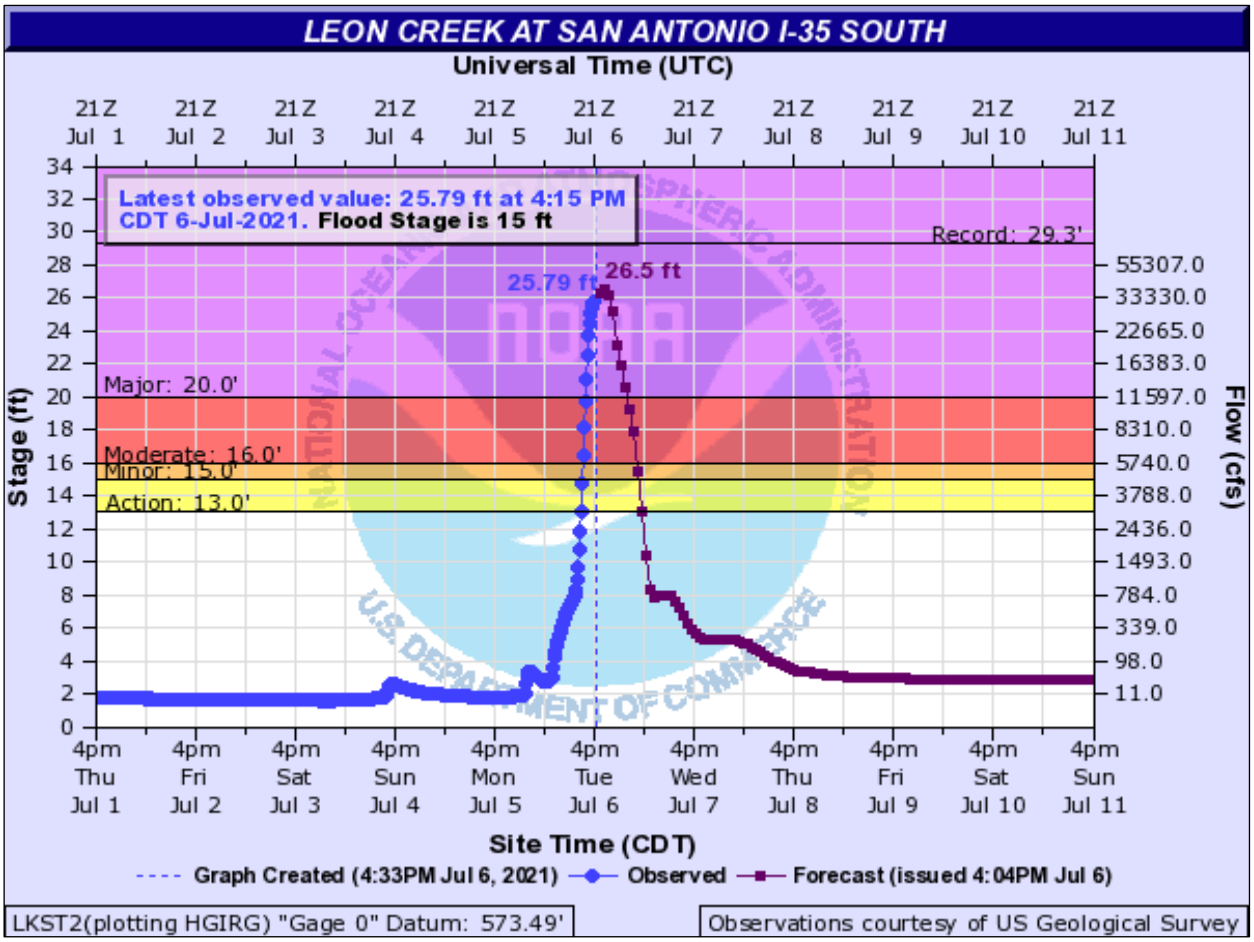


Figure 2: Hydrograph on Leon Creek at I-35 South, 4pm on 7/6/2021 as it crested well above Major Flood Stage.

Austin/San Antonio Summary (continued)

July is typically the driest month of the year for areas near and northeast of Austin. In most years subtropical ridging keeps east Texas hot and dry through the summer. This year, the summertime ridge and associated "heat dome" set up over drought-stricken portions of the western US after a wet 2nd half of spring locally. This allowed for a continuation of the wet, cool pattern. In terms of number of days with measurable rainfall, it was the 3rd most on record for Austin and tied for 4th at San Antonio in over 120 years of records. With more of the sun's energy going towards evaporation rather than heating, daytime highs across the area were below normal this summer while overnight lows were still near to above normal as a result of the higher humidity. For the first time since 2007, San Antonio recorded no 100 degree days, while Austin only had 5 (with a 6th on September 1st). As a result of the anomalous summertime pattern we even had a few very late season cold fronts reach the area, including on July 21st and even as late as August 1st.

That last front stuck around the region for several days, wavering from north to south but not fully exiting the region until the evening of the 5th. August started out very wet and cool as a result. A number of flash flooding reports were received on the morning 2nd across Bexar and Comal counties with rainfall totals of 4-6" across much of the area between Boerne and just west of Buda. As we rounded out the summer, three more notable but much localized rainfall events occurred directly over urban areas. One storm that sat right over Austin the afternoon of the 15th and dropped up to 5" of rain led to some flash flooding impacts as well as flooding at the Gregory Gym at the University of Texas. Another dropped a quick 1-2.5" right over Del Rio on the 17th that also led to some minor flood reports. And lastly, a very small area of 2" to nearly 5" of rain impacted a sliver of northern San Antonio near Hollywood Park on the 28th and inundated some roadways, with a well-placed CoCoRaHS observer reporting 4.27" in that event.

Through the summer, the majority of the region experienced above to well above normal rainfall. Total precipitation amounts ranged from just 2" or in a few spots across Val Verde and Maverick counties (as much as 2-4" below normal) to as much as 20" for portions of the Coastal Plains (8-12" above normal; Figure 3 below). The highest seasonal rainfall observation came from a CoCoRaHS observer south of Cuero with 19.72" of rain reported.

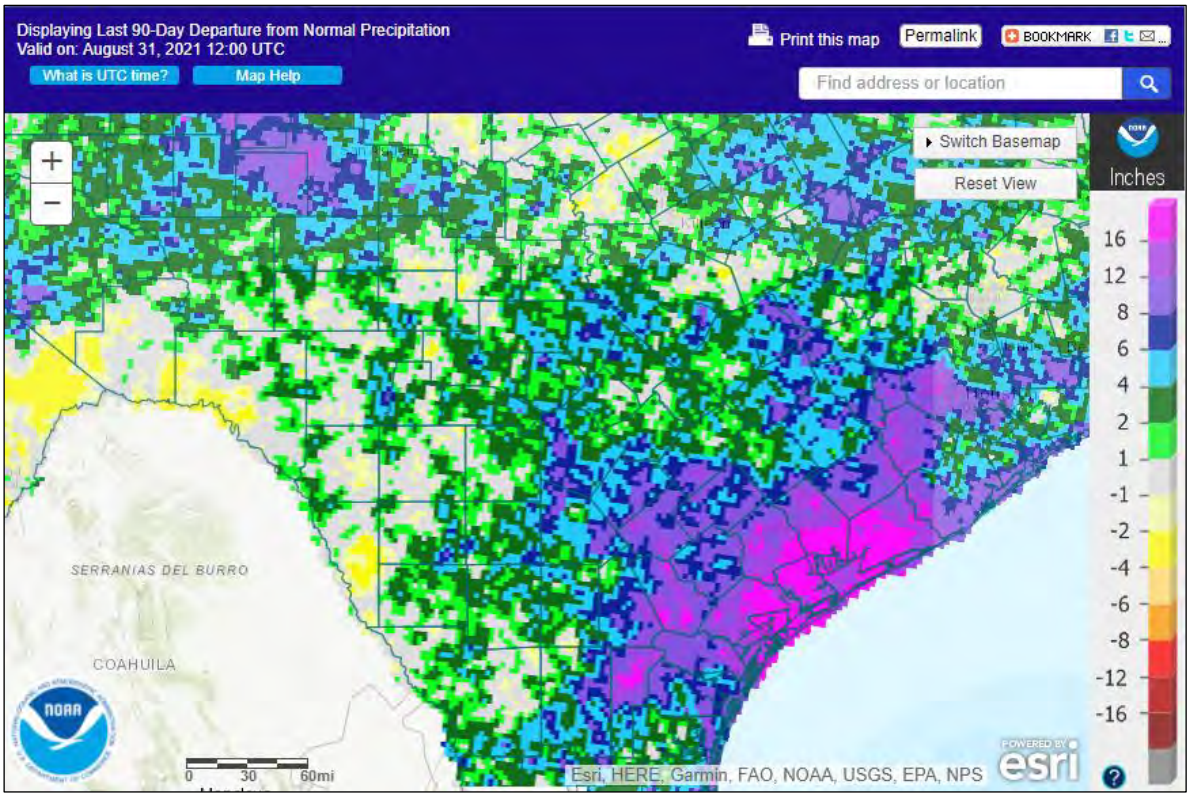


Figure 3: Estimated 90 day departure from normal precipitation ending August 31st

Far West Texas Regional Summary

Historic Monsoonal Rains Bring an End to the Drought

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

The 2021 summer season featured an active monsoon across much of the U.S. Southwest, resulting in the first above-normal rainfall summer since 2017 and the most active monsoon season since the 2006 El Paso floods. Widespread seasonal totals of **8-12"** were recorded across the far west Texas counties of El Paso and Hudspeth, with a few localized locations of nearly 15". Flooding became a concern for many areas due to excessive rainfall and saturated soils. Because of the cloudiness and moisture during much of the season, temperatures averaged slightly below normal. Most areas east of the Rio Grande valley totaled from **120 to 300%** of normal, while areas to the west totaled from 75 to 200 % of normal. In the El Paso metro area, though both sides prospered with rainfall during the month, west El Paso and the neighboring suburbs of southern Dona Ana County were the big winners—with 2 to 3 times the rainfall as the east side.

At the beginning of the summer season, severe to extreme drought conditions plagued much of the region due to the abnormally dry 2020 monsoon and complete lack of winter and spring time precipitation. Concerns regarding water supply and crop yields in the Rio Grande Valley were very high as irrigation restrictions were expected to cause major impacts to area farmers and ranchers. Thankfully, the monsoonal rains came in force by late June and continued throughout the season, **nearly eliminating drought conditions** across the Chihuahua Desert. The latest outlook from the U.S. Drought Monitor has no drought conditions at all across far west Texas, a major change from the Severe to Extreme outlooks at the start of June.

While most CoCoRaHS stations recorded measurable (> 0.01") precipitation during 25-30 days this season, the heaviest rains fell during three separate events spanning all three summertime months. The first occurred **June 27th and 28th** behind a frontal boundary that spilled abundant moisture into the region. Two-day rain totals ranged from 1.5-4" across El Paso County, causing several roadway closures due to flooding.

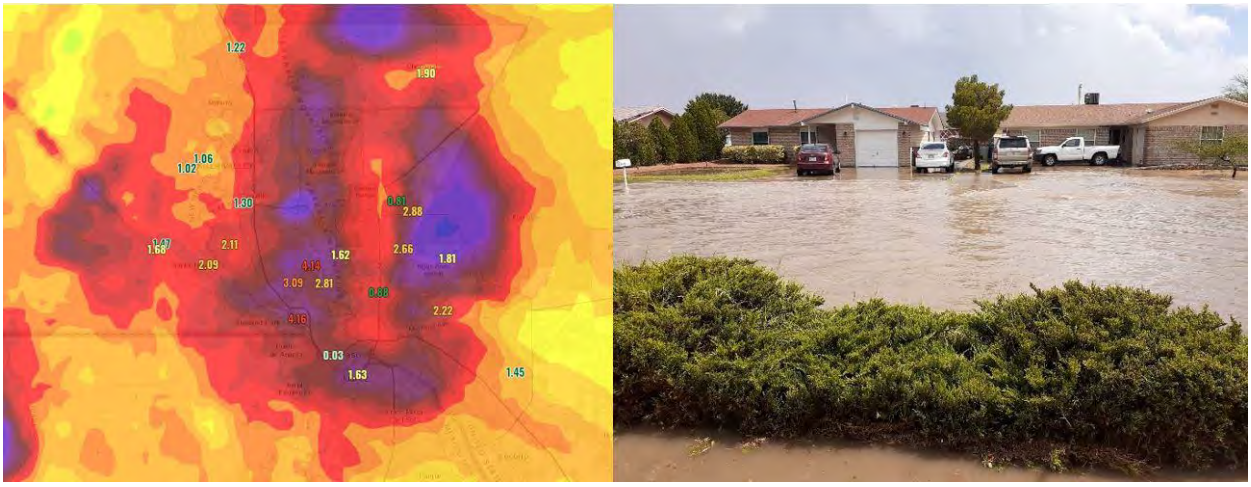


Figure 1: Storm Total Rainfall Estimates and Urban Street Flooding from the June 27-28 flooding event in El Paso, TX

The second major event occurred on **July 18th** as strong thunderstorms formed across El Paso County and caused significant flash flooding across portions of east El Paso. Localized areas surpassing 3.00" of rain fell in a span of an hour, and the city's mitigation infrastructure was not able to handle the nearly 200-year return interval rain intensities. Several vehicles were floated and damaged along the Interstate-10 frontage roads with water spilling onto the highway itself.

Far West Texas Regional Summary

Figure 2: Radar imagery and damage photos of the July 18th flash flood in El Paso, TX

Finally, yet another influx of deep atmospheric moisture flowed into the region the week of **August 12-16** with prolonged flooding impacts across much of far west Texas and southern New Mexico. Several CoCoRaHS stations recorded back-to-back 1"+ readings, something that is very rare here in the desert southwest. Storm totals ranged from 3-6" for much of far west Texas, with a few locations surpassing 7.00" of rainfall in just a few days. Flooding due to excessive rainfall was most widespread during this event, with numerous streets and roadways closed due to standing water, debris, and mudslides. Flooding was even more severe in the nearby town of La Union, NM with fears of earthen dam breaks and multiple structures inundated. Sadly, two fatalities were reported due to a home wall collapse in El Paso.

Figure 3: Arroyos running through the Rio Grande Valley, a common sight during the 2021 Monsoon Season. Photo Credit: Nathan Fish

There were several other days of notable rainfall throughout the summer months as rain showers and thunderstorms frequently produced heavy rains and kept CoCoRaHS observers busy checking gauges. The season ended with several local stations setting **new all-time records**, with many observers setting new annual rainfall total records with four months to go!

Far West Texas Regional Summary (continued)

El Paso Average Summer Rainfall (June-August):	3.98

(Data Source: El Paso International ASOS KELP, CoCoRaHS)

West El Paso	13.20	Northeast El Paso	14.80
	12.15		13.25
	12.05		13.19
	11.58		12.12
	9.69		11.66
	9.52		11.00
	8.48		10.61
	7.24		10.55
Central El Paso	11.06		10.04
	11.05		7.98
	10.71	East El Paso	11.64
	9.45		11.91
	9.33		11.90
Lower Valley	7.47		10.37
	2.40		9.26
Hudspeth County	10.87		8.89
	7.68		8.65
	4.45		8.31
	1.94		7.57

Figure 4: Summer 2021 (June-August) Precipitation Totals for El Paso CoCoRaHS Observers

The summer season featured 39 active observers in El Paso County, and 4 in Hudspeth County. This very active monsoon season garnered a total of 2,218 daily reports submitted, along with 29 multi-day reports. Several station records were set, including a record-high observation of 4.65" by an observer in northeast El Paso on August 13th. One Significant Weather Report was filed on June 27th to report minor flooding. No Condition Monitoring reports were submitted this season. Thanks again to all our local observers who participated in this incredible 2021 summer season!

Figure 5: Lush greenery covering the Franklin Mountains in El Paso, TX after a very wet monsoon season. Photo Credit: Ray Chiarello

Rio Grande Valley Summary

Wet Starts to June and July; Hot and Dry Conditions Return in August

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

For the fourth summer in a row, multi-day torrential rainfall events were sufficient to push seasonal rainfall above thirty-year averages for a good portion of the heavily populated Lower Rio Grande Valley, which extends from the McAllen metropolitan area east to Harlingen and Brownsville. The four-day period from July 6-9, 2021, joined July 25-27, 2020 (Hurricane Hanna), June 24, 2019 (mesoscale thunderstorm system), and June 18-22, 2018 (The Great Flood of June, 2018) in producing 1/50 ("50 year", or 2% probability) or lower events. The relative frequency of multi-million-dollar flood damage events has prompted communities across the LRGV to develop flood mitigation strategies through grant funds supplied by the Texas Water Development Board and other sources. One example from this past August was the formation of the Hidalgo County Municipal Drainage Committee, comprised of the cities that make up the McAllen metropolitan region (McAllen, Edinburg, Pharr, and Mission). The purpose of the Committee is to improve the ability to flow water through the County's highly interconnected drainage canals, ditches, pipes, and pumps. Similar discussions have occurred in Cameron and Willacy County in recent months.

The periodic heavy rainfall, which also impacted the first few days of June, provided sufficient and initially deep layer soil moisture to provide welcome assistance to summer crops, finishing off the last of drought and dryness across the region that had been sharply reduced in May. Unlike 2020, when late July's Hanna wiped out much of the Valley's cotton crop, the end of torrential rainfall in early July 2021, followed by seasonable temperatures and minimal rainfall, allowed a nearly full complement of a "normal" season's cotton output to close out summer.

For the predominance of Rio Grande Valley locations with sufficient records, summer 2021 ranked among the top fifteen wettest on record, with most locations falling within the top ten wettest. In general, 2008 – the year of a record wet July bookended by a wet start to the month and a wet finish from Hurricane Dolly, followed by periodic wet periods in August – was common year that remained number one.

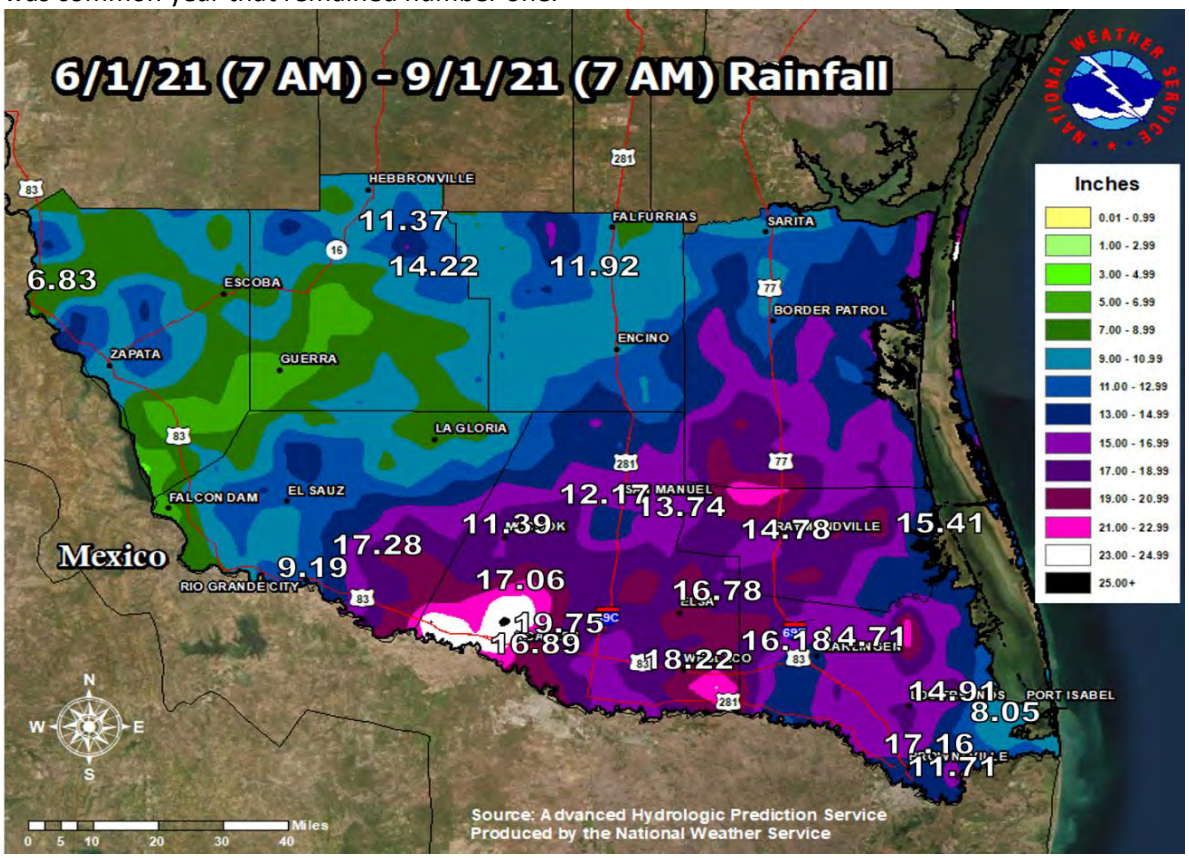


Figure 1. Summer 2021 (June-August) preliminary rainfall for the Rio Grande Valley/Deep South Texas ranch and brush country region. Annotations Include data from NWS, FAA, CoCoRaHS, and trusted mesonet locations.

Rio Grande Valley Summary (continued)

Image 1 & 2: Photos from July 9 from in/near Brownsville, following pockets of more than ten inches of rainfall in four days. Heaviest rain fell on July 9th in this area.

Although March was the driest month of the season, it was still fairly active. A series of troughs and frontal boundaries moved through the region during the month, bringing sufficient rain. Precipitation amounts varied across the region. CoCoRaHS sites across Deep East Texas and across the Tyler area only received 2" to 3", while sites in Cherokee, Rusk, and Harrison Counties saw totals in the 6" to 7" range. There was also a return in severe weather. Storms brought golf ball size hail on the 17th and 24th to areas of northeast Texas near the Interstate 30 corridor. On the 27th, a supercell produced 3 long track tornadoes that moved through Cherokee, Rusk, and Panola counties. Golf ball size hail was also observed with storm around the Carthage area in Panola County.

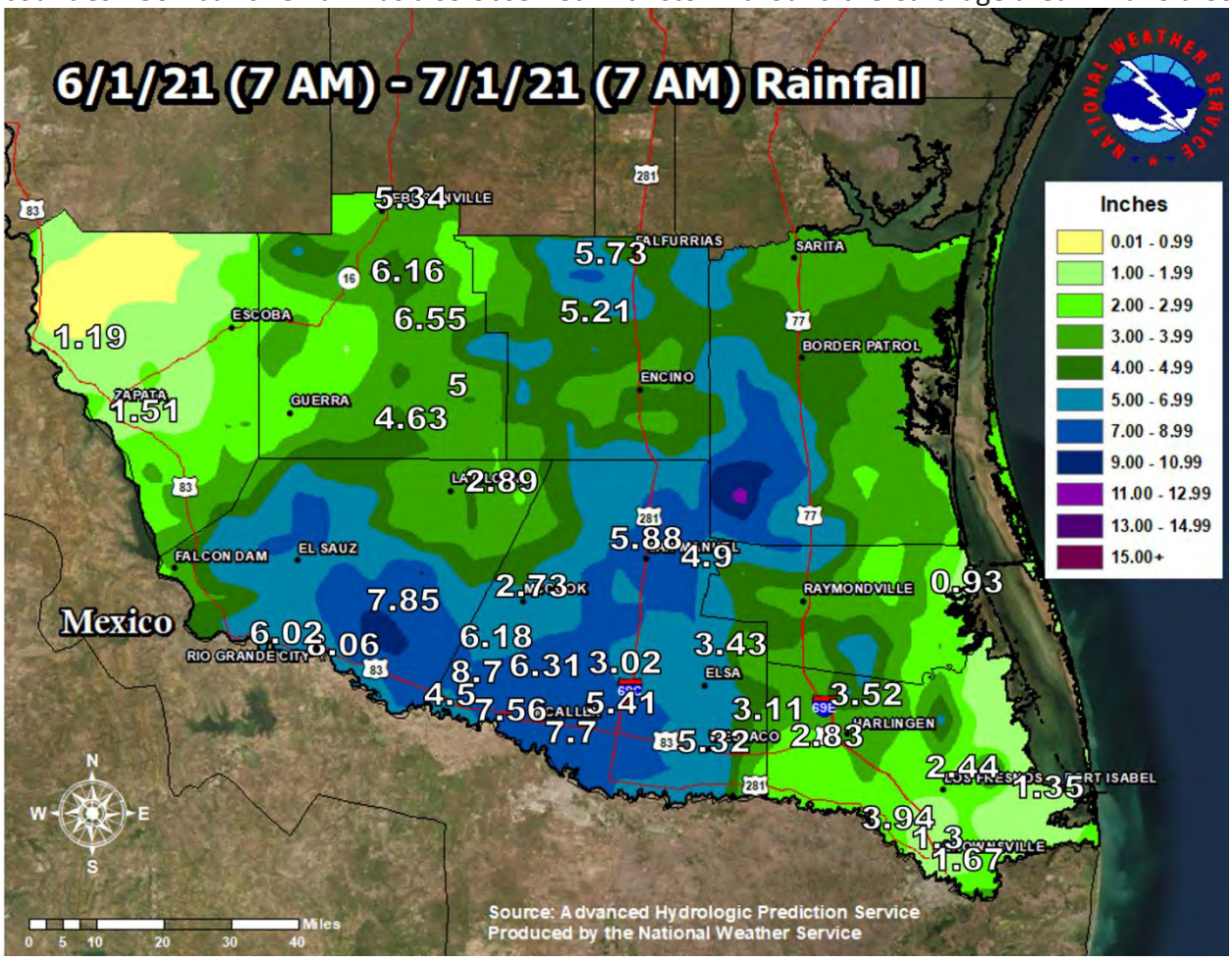


Figure 2. Preliminary June 2021 rainfall, with annotation for a mix of NWS, FAA, CoCoRaHS, and Mesonet observations.

Rio Grande Valley Summary (continued)

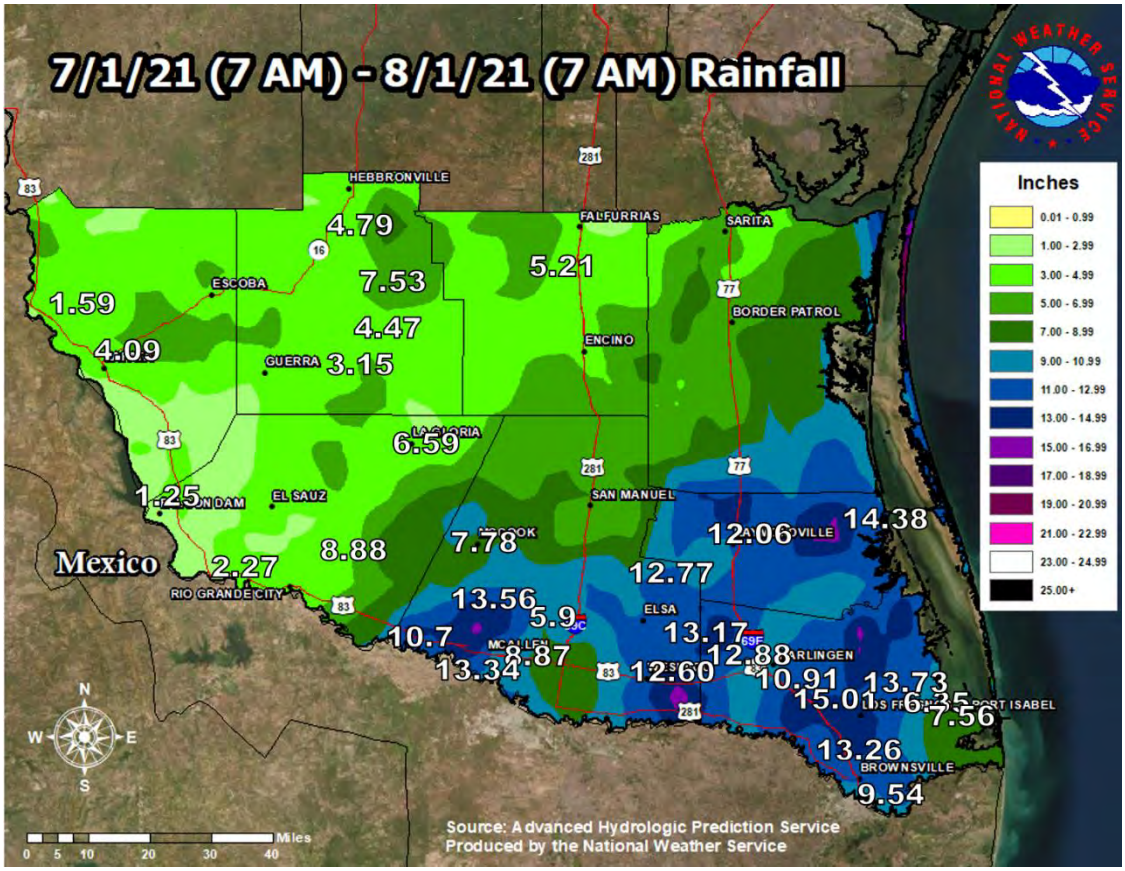


Figure 3. Same as Figure 2, except for July 2021.

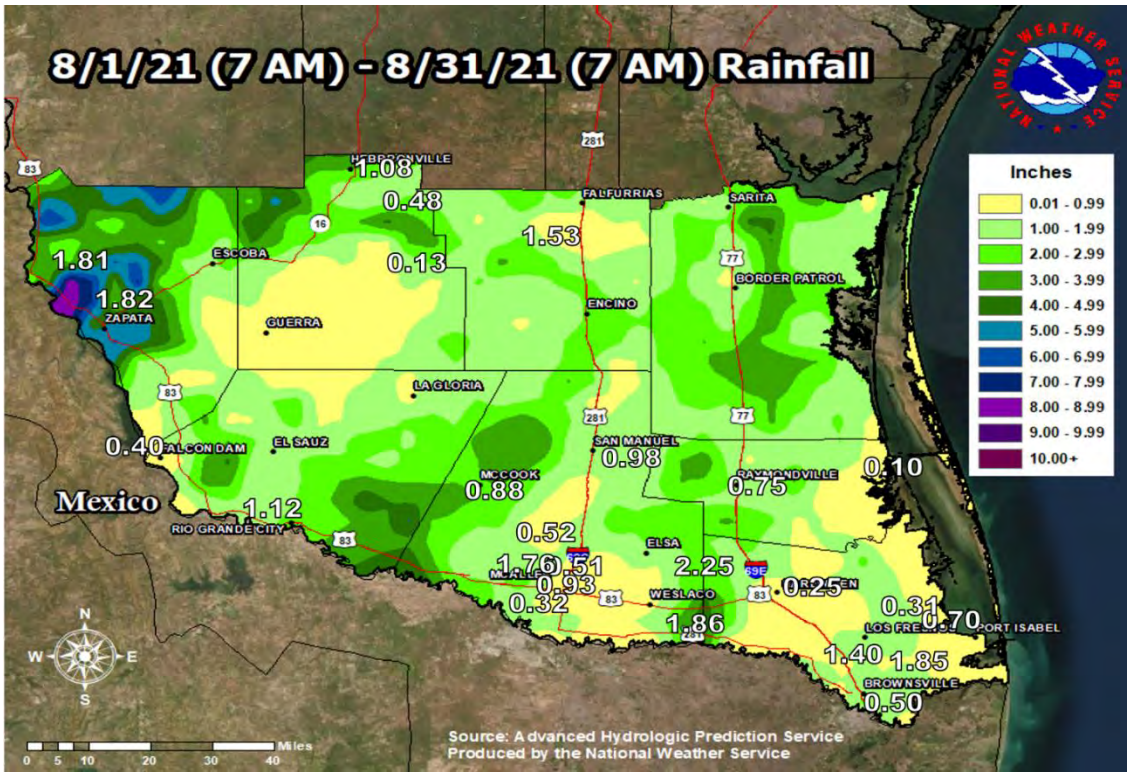


Figure 4. Same as Figs. 1-3, except for August 2021.

Rio Grande Valley Summary (continued)

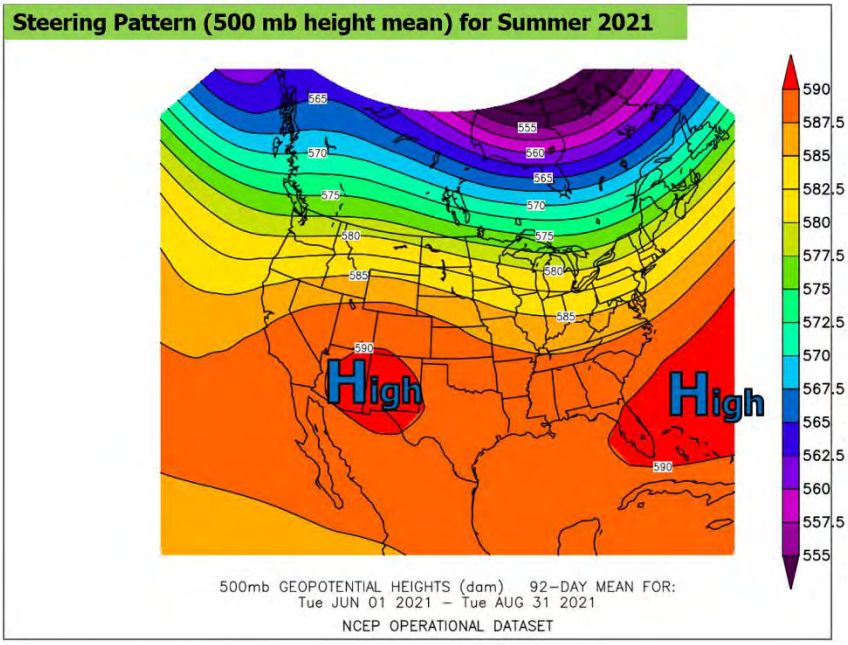


Figure 5. Average summer 2021 steering pattern (500 mb, 18,000 feet above ground level), across North America

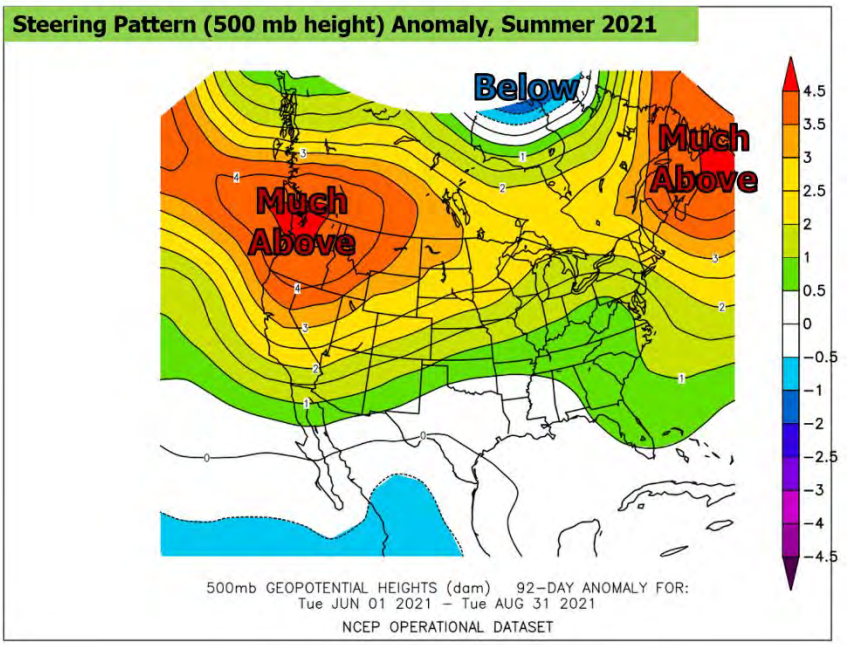


Figure 6. A record hot summer across the Pacific Northwest/Cascadia region of the U.S. and Canada.

That position allowed for two variables to influence temperatures: First, the series of weak easterly waves (Figure 7) that produced five consecutive soaking days in early July, which on their own reduced daytime temperatures for the next few weeks due to evapotranspiration; Second, a general weakness between the western ridge and the Bermuda ridge, which kept the atmosphere from heating up sufficiently to push temperatures toward or above the century mark. In fact, July's average temperatures for Harlingen and McAllen fell on the "cool" side of the ledger, with McAllen ranking 16th *lowest* (since 1941) and Harlingen 55th lowest (since 1911).

Rio Grande Valley Summary (continued)

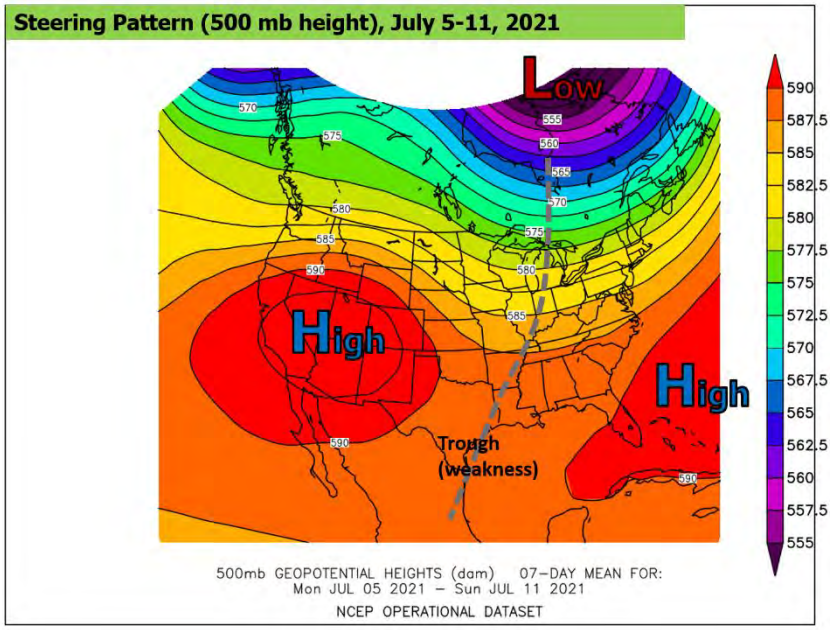


Figure 7. Mean steering pattern (500 mb, or approximately 18,000 feet above ground level) for July 5-11, 2021. As was common during parts of the summer, the 500 mb ridges shifted west, with the "La Canicula" ridge centered over the U.S. Four Corners region and the Bermuda ridge extending into the eastern Gulf. A broad trough of low pressure extended from Hudson Bay southward to Arkansas; easterly waves fed the southern extent of the trough along the Texas coast to produce copious rainfall from deep tropical moisture.

By August, a broad ridge stretched from the western Atlantic (west of Bermuda) through Texas (Figure 8), which allowed for gradual drying and ultimately hotter temperatures by afternoon and sultry values each morning. The broad ridge also helped steer Hurricane Grace well south of the Valley, into Veracruz (state) Mexico on August 21st. Temperature recovery from late July through the end of August ultimately moved summer into the top 25 percent warmest for Brownsville and Harlingen. McAllen, which received the highest local area rainfall totals in the Valley, finished in among the top half of *cooler* summers. In McAllen, the additional rainfall, combined with the less-hot atmosphere compared with most years of the recent decade, tilted the average below the median year (40th ranked).

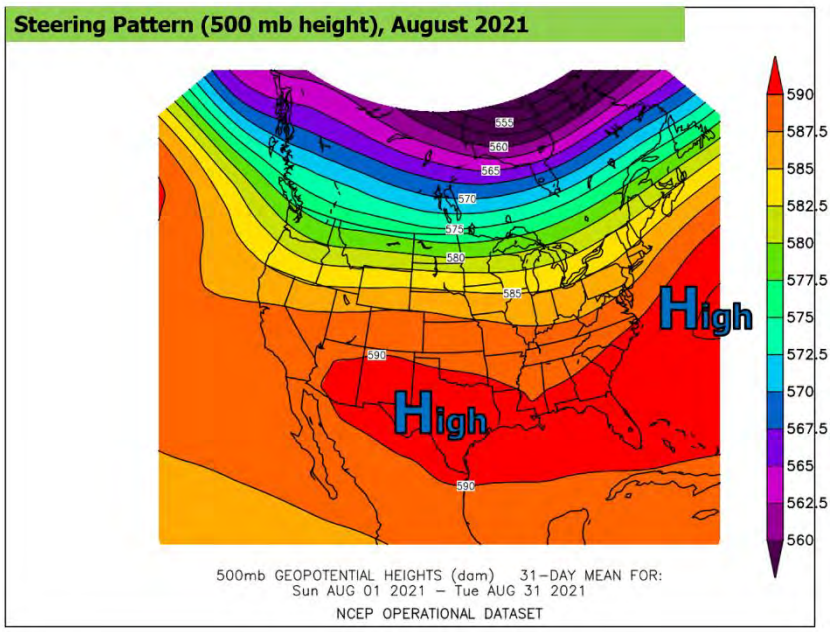


Figure 8. Mean steering pattern (500 mb heights, or around 18,000 feet above ground level) for August 2021. The high pressure ridge returned to Texas and extended through Florida out to Bermuda. The ridge both locked in drier and hotter weather for the Rio Grande Valley and helped steer Hurricane Grace into Veracruz in late August.

Rio Grande Valley Summary (continued)

Table 1: Rainfall, Rankings, and Comparisons for the Rio Grande Valley – Summer 2021

Location	2021 Rainfall	Rank	Departure from 1991-2020 Average	Record/Prior Record (year)
Brownsville (since 1878)	11.71	21	+4.71	21.25 (1880)
Harlingen (since 1911)	14.35	7	+7.47	21.37 (2008)
McAllen/Miller (since 1961)	16.89	2	+10	19.72 (1975)
McAllen/Coop (since 1941)	19.75	1	+13.63	---
McCook (since 1942)	11.89	7	+6.55	19.09 (2008)
Port Mansfield (since 1958)	15.41	2	+9.87	25.69 (2007)
Raymondville (since 1911*)	14.78	6*	+7.64	17.47 (2008)
Rio Grande City (since 1893*)	9.81	13*	+3.67	23.81 (2007)
Santa Rosa (since 1987)	18.53	3	+11.88	21.27 (2020)
Weslaco 2 E (since 1914*)	18.22	2	+11.32	19.24 (2008)

*Missing several to many years of summer records.

Table 2: 2021 Summer and June-August Average Temperatures and Rankings for the Rio Grande Valley

Location	Month/Season	2021 Observed	Rank	Prior Record (year)
Brownsville (since 1878)	Summer	85.3	23	87.9 (2019)
	June	84.1	38	87.3 (1998)
	July	84.5	57	87.5 (2018)
	August	87.1	5	89.3 (2019)
Harlingen (since 1911)	Summer	85.2	33	88.0 (2019)
	June	84.2	38	88.2 (1998)
	July	84.4	65	88.7 (2016)
	August	86.9	19	89.7 (2019)
McAllen (since 1941)	Summer	85.1	49	90.8 (2009)
	June	84	49	90.3 (1998)
	July	84.3	66	92.8 (2009)
	August	87.1	30	91.5 (2019)

Wichita Falls Regional Summary

Near Normal Summer Brings Nice Break from Extremes

By Charles Kuster

CIMMS/NSSL

After the extreme cold and snow during the winter and damaging storms this spring, this summer brought a good break from the active and sometimes extreme weather our region has experienced recently. Precipitation for the season was just slightly above normal (Fig. 1a) though we did see more days with rain than we typically do. This summer, we experienced 60 dry days (all CoCoRaHS stations reported less than 0.05") and 32 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. The greater prevalence of wet days probably helped us see slightly below average temperatures across much of the region with areas in Foard and Knox County seeing temperatures several degrees below normal (Fig. 1b). Thanks to the precipitation, we ended the season drought free in the region, according to the U.S. Drought Monitor (https://droughtmonitor.unl.edu/).

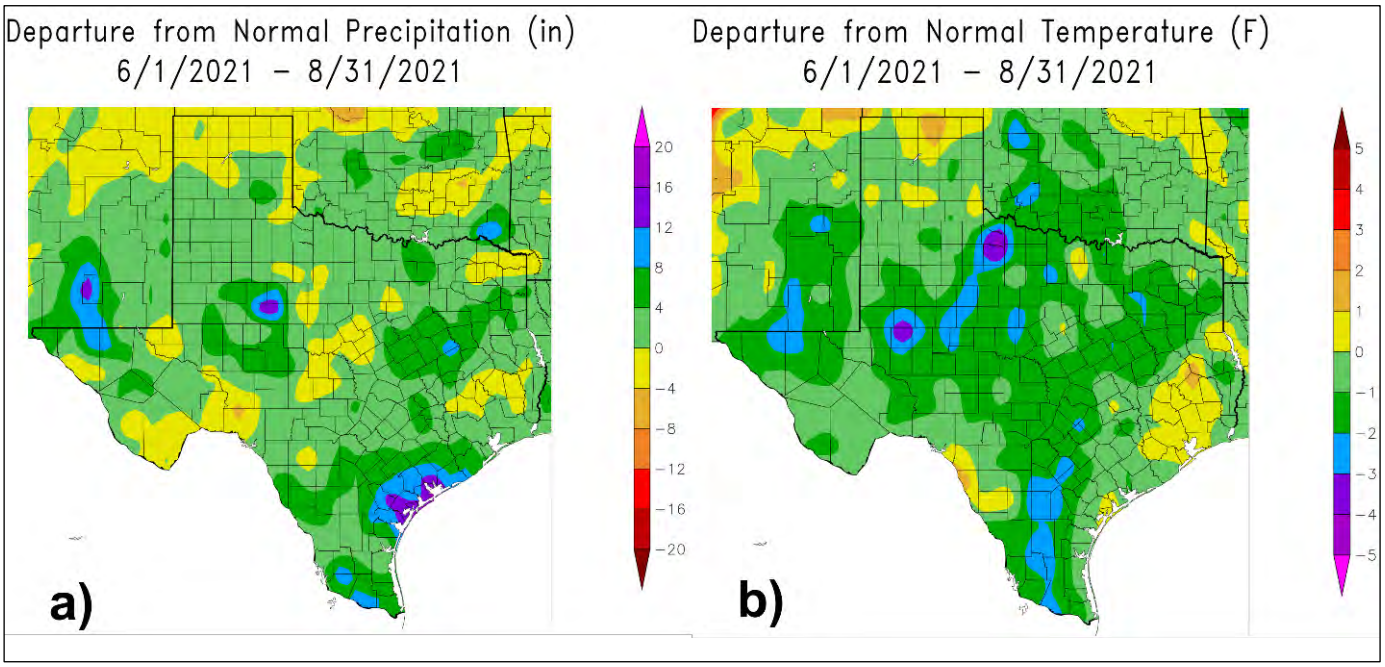


Figure 1. Departure from normal a) precipitation and b) temperature for the beginning of June through the end of August. Warm colors indicate below normal precipitation (a) and above normal temperatures (b), while cool colors indicate above normal precipitation (a) and below normal temperatures (b).

Likely the most notable precipitation event in our region occurred at the end of June. Heavy rain, with totals over 4" in some locations, fell on June 26th into the 27th, especially across Hardeman and Foard County (Fig. 2a). Many CoCoRaHS stations reported at least 2.5" of rain in the final 4 days of June with the highest amounts falling in Hardeman County and adjacent areas of southwest Oklahoma (Fig. 2b). During days with heavy precipitation such as this, submitting additional significant weather reports can be really helpful, especially to National Weather Service forecasters who are alerted when a CoCoRaHS observer submits a significant weather report.

Wichita Falls Regional Summary (continued)

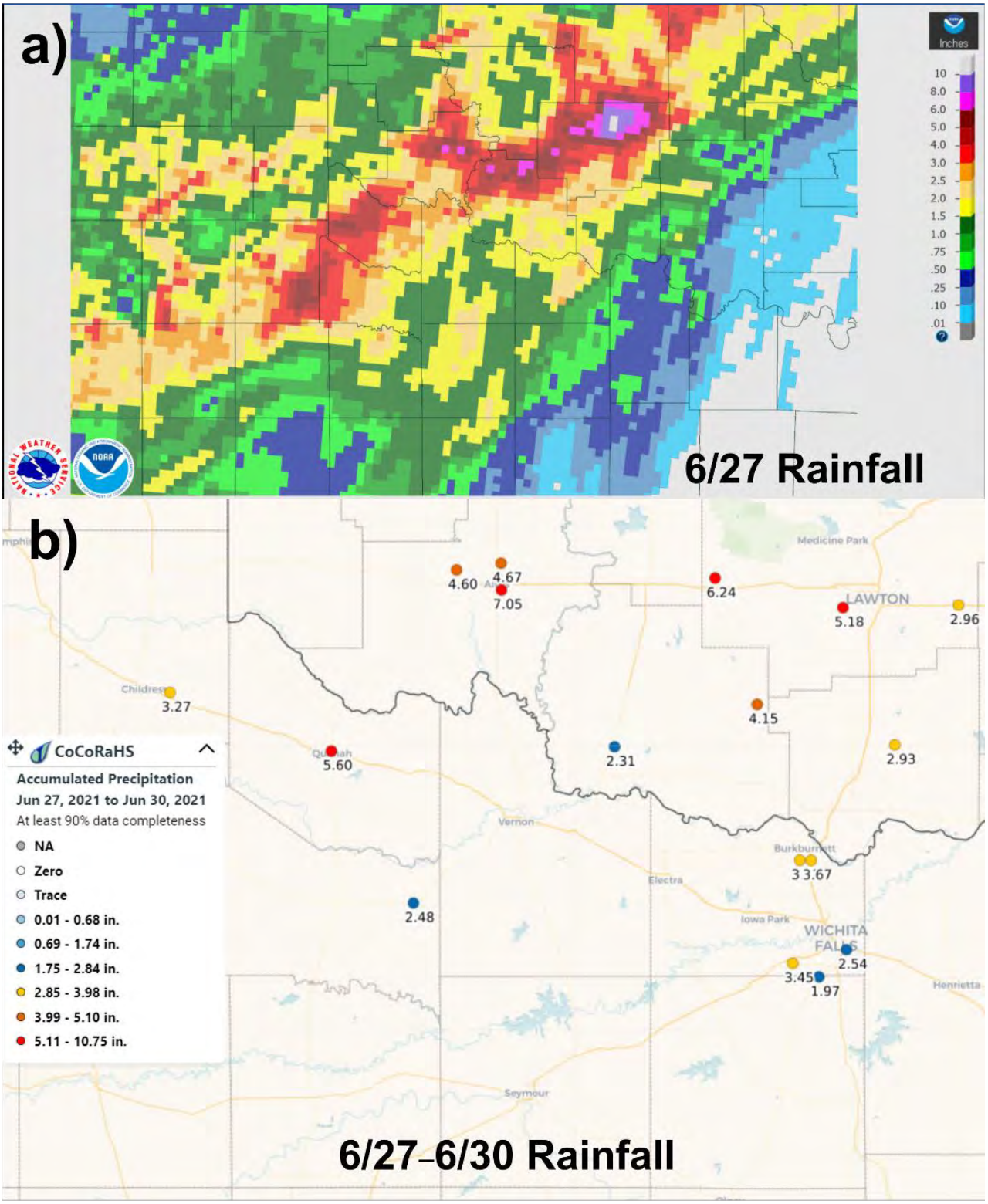


Figure 2. Estimated rainfall for the 24-hour period ending at 7am on 6/27 (a), and 4-day CoCoRaHS rainfall reports ending at 7am on 6/30 (b).

East Texas Regional Summary

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

An active weather pattern remained over the region as we moved into the meteorological summer. Near the beginning of June, an upper level low meandered across the region from the 5th through the 7th. With tons of low-level moisture in place, along with good instability during this time frame, some storms became severe and very efficient rainfall producers. Most of the East Texas CoCoRaHS sites received between 1" to 2" of rainfall during this time frame, with a couple sites in NE Harrison County reporting between 3" to 5". There were several reports of Flash Flooding in Panola County on the 6th and quarter size hail was reported in the city of Tyler. Also, tornadoes were reported on the 8th in the Reklaw community in Cherokee County and in the city of Tyler. Afterwards, mostly dry conditions moved into the region through the middle of the month, although an isolated thunderstorm ahead of a frontal boundary produced quarter size hail in Upshur County in the town of Gilmer after midnight on the 14th. Widespread rainfall returned across the region by the 21st as another cool front moved across the area. Also, additional widespread rainfall occurred between the 27th and 29th as deep S/SE flow from the Gulf resulted in sea breeze convection. Many locations south of the Interstate 20 corridor reported between 1" to 2" of rainfall. Overall, rainfall for the month generally ranged from 2" to 3" north of the Interstate corridor and 3" to 6" southward. Based on National Weather Service climatology, the average rainfall for East Texas is around 4".

Fig.1: Tyler, TX (Smith County) Hail on June 6, 2021
Photo Credit: KLTV Meteorologist – Mark Scirto

East Texas Regional Summary (continued)

Fig.2: Tornado in the city of Tyler, TX (Smith County) on June 8, 2021
Photo Credit: Robert Strong/Tyler Morning Telegraph

Sufficient rain continued into the month of July, resulting in above average rainfall for the month. A cool front moved into the region around the 1st and 2nd of the month, but most of the rainfall was generally along and north of the Interstate 20 corridor. Most of the rainfall totals were around 1" or less, with the exception of a couple locations in Wood County and another in NE Harrison, where totals were just over 2". Southerly flow kept an active sea breeze convection pattern, especially across Deep East Texas, bringing widespread afternoon thunderstorms through the first portion of the month. By the 10th and 11th, showers and thunderstorms developed along and ahead of another approaching cool front, bringing widespread rainfall to the region. Many sites saw over 2" of rain with this system, with a few places in Smith, Cherokee, and Rusk counties reporting between 3" to 5". A couple observers in southern Smith and extreme Northern Cherokee reported total rainfall amounts from near 5" to just over 6". By the 13th, deep southerly flow returned across the region, bringing back afternoon sea breeze convection. Most of this convection was confined to portions of Deep East Texas, with the largest reported amounts across Angelina County. Although the highest amount reported was near 1.5", the National Weather Service in Shreveport reported a daily record rainfall amount of 2.96" on the 13th at the Angelina County Airport in Lufkin. Southerly flow continued across the region, bringing greater coverage of afternoon convection, but there was a bit of break in precipitation after the 15th as high pressure settled across the area. However, widespread rainfall returned on the 19th, as a cool front moved through the region. Locally heavy rainfall accompanied this system, with many observers reporting 2" to 3" of rainfall. The highest amounts were recorded near the Interstate 20 corridor, with a few locations between Smith and Gregg counties reporting over 4" by the morning of the 20th. The National Weather Service in Shreveport reported record rainfall amounts at the airports in Tyler and Longview of 3.53" and 2.04" respectively, along with flash flooding in those counties. Four injuries occurred along Interstate 20 near Allen Branch Creek, as flash flooding and erosion along the creek caused a large pine tree to fall along the Interstate, resulting in a wreck involving several vehicles. Rainfall amounts tapered off for the remainder of the month, although general afternoon and sea breeze convection continued on and on. Overall, most of CoCoRaHS sites received double the amount of the normal July average of 2" to 3", including a near 11" total in extreme Northern Cherokee County and 8" to near 9" totals in a few locations in Smith and Gregg counties.

East Texas Regional Summary (continued)

Fig.3: Flash Flooding in Longview, TX (Gregg County) on July 19, 2021
Photo Credit: Michael Cavazos/Longview News-Journal

August was the driest month of the summer, but most of the East Texas CoCoRaHS sites still received above average rainfall, as several slow-moving frontal boundaries and upper level disturbances moved across the region. The highlight of the month occurred between the 17th and 19th, when several disturbances moved across the axis of an upper level trough oriented near the region, resulting in very heavy rainfall. Most of the heaviest rainfall occurred along and north of the Interstate 20 corridor, especially in the Tyler and Longview areas. The National Weather Service reported flooding on numerous roadways in the city of Tyler on 18th along with 4.75" of rainfall at Tyler Pounds Regional Airport. This matches up very well with the 5" to near 6" totals reported by CoCoRaHS sites nearby. Like the previous month, drier conditions moved into the region on the latter portions of the month, resulting in much lower rainfall totals.

In summary, despite the fact that summer is usually the driest of the four seasons, an active weather pattern culminated in near to above normal precipitation, along with periods of severe weather. As a result, drought free conditions remained over the region for the start of the Meteorological Fall as they did throughout the summer months.

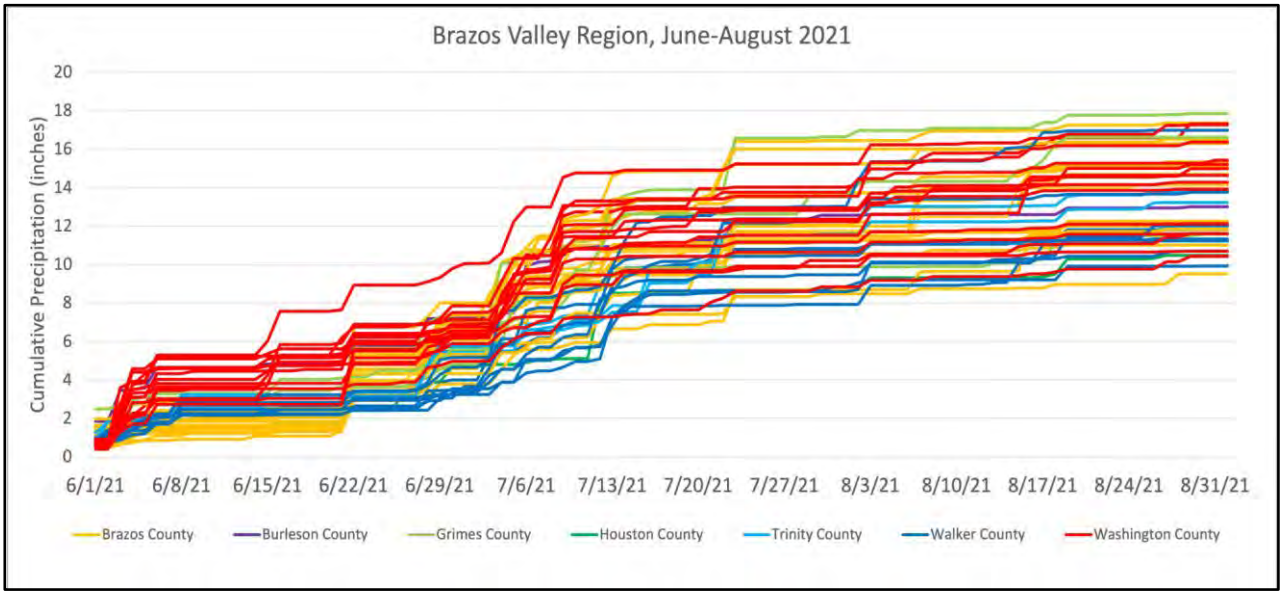
Fig.4: Flooding on Smith County Road 494 near the city of Tyler on August 18, 2021
Photo Credit: Tyler Morning Telegraph

Brazos Valley Regional Summary

Summer 2021 Precipitation Summary

Bryan-College Station/Brazos Valley Region, Texas

Hayden Dove and John Nielsen-Gammon, Texas A&M University, Office of the State Climatologist of Texas



Summary:

Following the incredibly wet end to the previous spring season, the Brazos Valley continued into summer with continued wet conditions. The first week of the summer season saw precipitation totals of 1”-5” across the region. Precipitation tapered off during the remainder of June, but the month of July brought buckets to the region. Although July is climatologically a dry month, rainfall totals around 7" were common”. Following July was a very dry August where most of the region only saw 1”-2”. While the regions farther east typically receive more rain, the counties of the west were able to pull their weight this season as Brazos, Grimes, and Washington Counties outperformed the likes of Houston and Trinity Counties in the rainfall department.

Observer Statistics:

It was great to see 51 observers making observations across this season. What makes it even better is that 36 of those observers were able to make observations every day or almost every day! Overall, there were 46 stations that were usable for cumulative precipitation data.

Season Statistics:

Wettest day: 5.4", June 22, Brazos County

Wettest seasonal total: 17.85”, Grimes County

Driest seasonal total: 9.51", Brazos County

Soggy Socks Award (longest spell of daily reports with measurable rain): Brazos County had thirteen consecutive days of rain from July 4th through July 16th.

Dusty Soles Award (longest spell of daily reports without measurable rain): Tie at 15 days: Walker County, June 7-21, and Burleson and Walker Counties, August 4-18.

Abilene/San Angelo Regional Summary

Summer was wet and mild overall, August was hotter

By: Joel Dunn, Observation Program Leader- San Angelo NWS WFO

Summer was wet and mild overall, though West Central Texas never fully escapes the heat. June started wet, July started wet, and August started hot as the upper level high pressure we normally see finally settled into the Continental Southwest.

June 2021

The month of June began wet and mild, with several round of showers and thunderstorms moving through West Central Texas. This pattern did not persist, but rather gave way to hot and dry weather as is often expected in June. Up until the middle of June, not a single 100°F day had been observed. Though not unheard of, it is also not common. Given how wet the year had been, some speculation was given to not reaching 100°F all this year, the last such occurrence being 2007. This was not to be, as several 100°F were observed mainly across the Concho Valley, though no more than is normally expected during the month of June. Abilene did not reach 100°F even once, likely due to the copious amount of rainfall received during the month of May. San Angelo, however, recorded five days reaching at least 100°F.

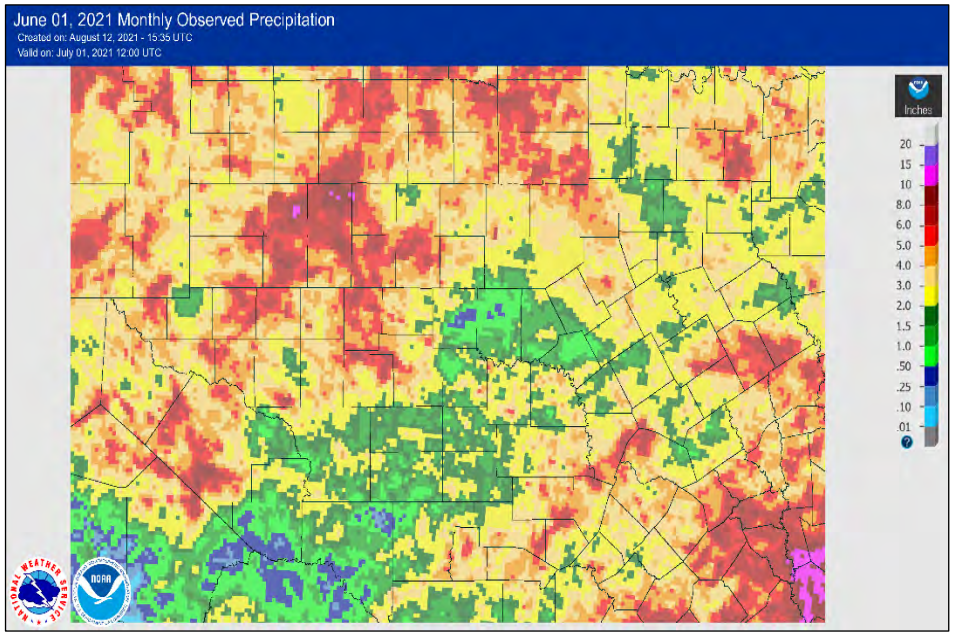


Image 1 – Observed Precipitation June 2021

The month ended as it began, wet and cool, with several more rounds of showers and thunderstorms passing across West Central Texas. As can be seen in the table to the right, despite the healthy rainfall received, several areas of the county warning area (CWA) still ended the month below normal, while others ended June with very good totals.

City	Observed Rainfall	Departure from Normal
Abilene	2.69"	-0.75"
Brownwood	1.93"	-2.01"
Haskell	3.95"	0.03"
Junction	1.22"	-1.61"
Mason	3.34"	-0.10"
Roscoe	6.72"	2.75"
San Angelo	4.88"	2.57"

Table 1 - Observer Rainfall vs. Departure from Normal June 2021

Abilene/San Angelo Regional Summary (continued)

July 2021

Similar to the month of June, the month of July began wet and mild, and remained that way through the middle of the month. This resulted in much of West Central Texas receiving above normal precipitation. As can be seen by the image below, the central portion of West Central Texas (shades of blue into purple) received 150%-600% of their normal rainfall.

As is common in this part of Texas, summer took hold in the form of high pressure over the continental southwest, effectively ending rain chances and setting up a warmer and drier pattern. Additional 100°F days were observed across the Concho Valley and Abilene recorded their first three 100°F days of the year.

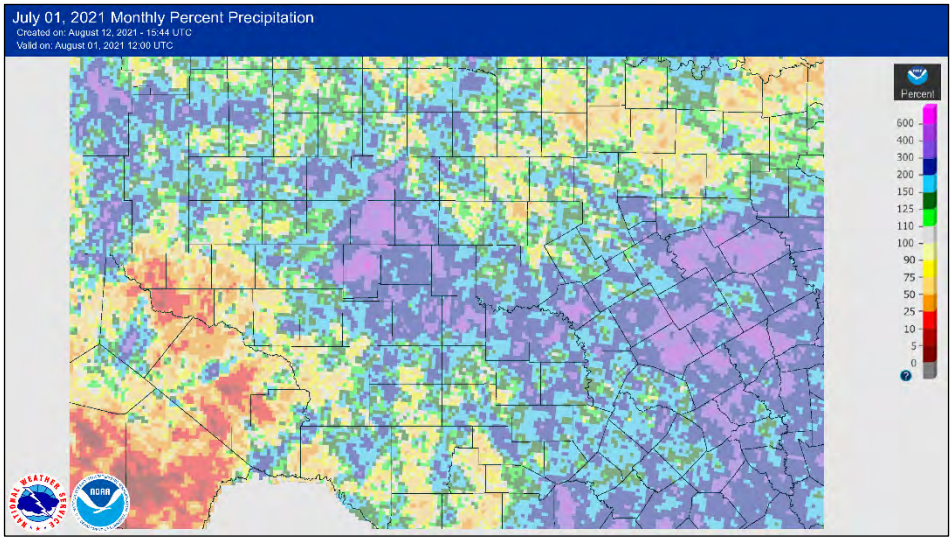


Image 2 - Percent of Normal July 2021

City	Observed Rainfall	Departure from Normal
Abilene	0.89“	-1.03“
Brownwood	2.26“	0.01“
Haskell	3.74“	1.56“
Junction	0.94“	-0.54“
Mason	1.57“	-0.78“
Roscoe	4.31“	2.58“
San Angelo	3.66“	2.56“

Table 2 - Observer Rainfall vs. Departure from Normal July 2021

Abilene/San Angelo Regional Summary (continued)

August 2021

The Month of August was marked by rainfall, high humidity and cooler than normal temperatures. Though cooler than normal temperatures were observed, the higher relative humidifies resulted in higher heat indices, and so it felt more like central Texas than West Central Texas. The image below right reflects the observed rainfall during the month of August and it can be seen that the Concho Valley, Northern Edward's Plateau and Northwest Hill Country saw the most rainfall. What's more, Tom Green and Irion County received the highest totals.

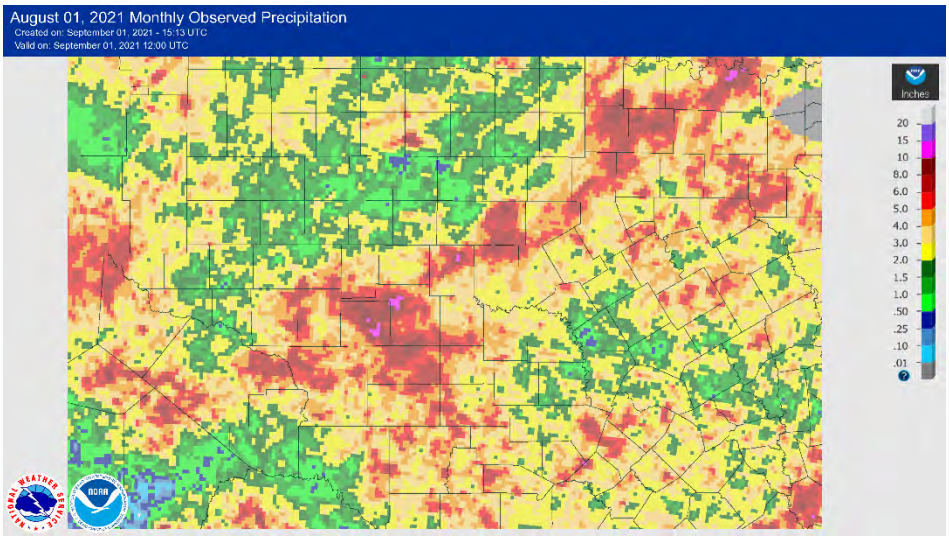


Image 3 - Observed Precipitation August 2021

On August 17th, a storm system began training over Tom Green and Irion County. Flash Flood Warnings were issued, along with Area Flood Warnings. Radar Storm Total estimated 10" northwest of San Angelo, with estimates of 7-8" near the town of Mertzon. As the ground was decently saturated before the event began, these storms created a fair amount of runoff resulted in the aforementioned Flash Flood Warnings. The area lakes began responding soon after. The resultant increase can be seen in the table below.

City	Observed Rainfall	Departure from Normal
Abilene	0.57"	-2.02"
Brownwood	1.69"	-0.81"
Haskell	1.21"	-1.30"
Junction	1.13"	-1.07"
Mason	0.90"	-1.00"
Roscoe	9.90"	7.67"
San Angelo	5.31"	3.05"

Table 3 - Observer Rainfall vs. Departure from Normal August 2021

Abilene/San Angelo Regional Summary (continued)

	Percent increase	Storage increase	Surface Area increase
O.C. Fisher	1.9%	2261 acre-ft	152 acres
Twin Buttes	6.4%	11643 acres-ft	562 acres

Table 4 - Lake Level Information

To put this number in perspective, the City of San Angelo's average annual water usage is 13,441 acre-ft. Thus, this event left the City of San Angelo with just over a year's worth of water or 4,530,638,308 gallons, and that is only what made it into the lakes.

Summer of 2021 across West Central Texas was notably cooler and wetter than many other years. Included below is a table of the summer (June, July, and August) average rainfall received this year for each county.

County	Average Rainfall
Brown	8.64
Callahan	12.32
Coke	9.09
Coleman	7.82
Concho	6.46
Crockett	3.96
Fisher	9.85
Haskell	8.17
Irion	11.85
Jones	9.01
Kimble	6.47
Mason	5.56
McCulloch	9.18
Menard	10.14
Nolan	15.72
Runnels	12.58
San Saba	8.22
Schleicher	7.34
Shackelford	8.72
Sterling	11.16
Sutton	7.72
Taylor	7.51
Throckmorton	10.09
Tom Green	13.89

Table 1 - Summer (3-month) Rainfall Totals

Corpus Christi Regional Summary

With the Exception for July, Seasonal Rainfall Pattern Returns

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

June ended up being rather seasonal with the majority of the rain occurring across the Coastal Plains, Coastal Bend and Victoria Crossroads. Observers across the most active areas reported accumulations between 4" to 9". The majority of the rain occurred during the first week June as an upper level disturbance moved across the area. Observers across the Brush Country and Victoria Crossroads reported accumulations between 2" to 5" while sites further west only reported less than an inch of rain. Through the rest of the month, the majority of the activity remained across the Victoria Crossroads except for the end of the month, where the Brush Country was the winner for precipitation. Towards the end of the month, a couple sites reported accumulations just north of 2.00" across the Brush Country.

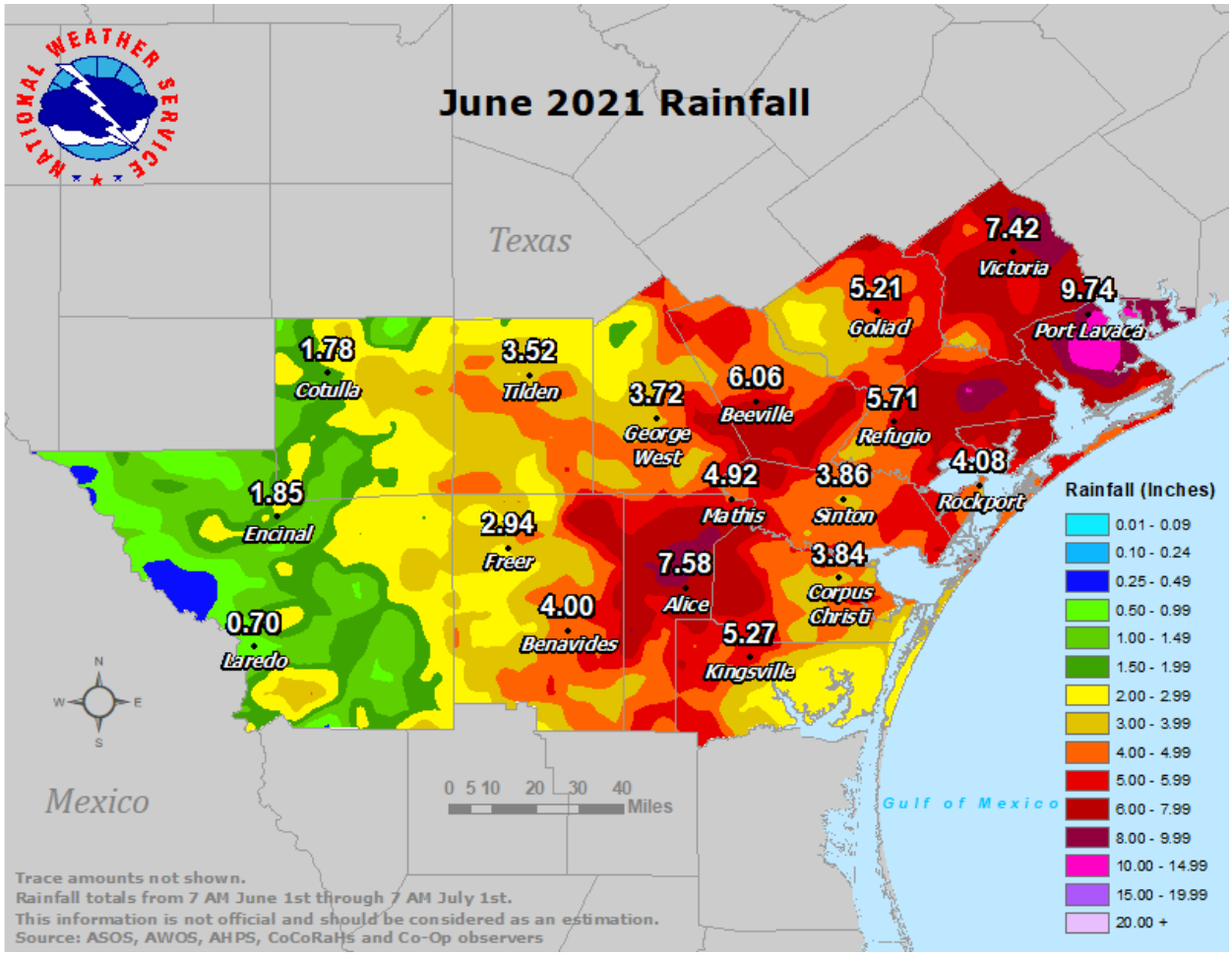


Figure 1: Total reported rainfall for the month of June

Corpus Christi Regional Summary (continued)

Flooding rains returned for the month of July, especially right after the 4th of July holiday. An upper level disturbance along with an abundance of moisture resulted in heavy downpours across South Texas. Some of these rains were so intense that it resulted in the issuance of flash flood warnings. Across the Rio Grande and the Brush Country, observers reported accumulations between 2" to 3". A little further east across the Coastal Plains, observers reported accumulations ranging between 4" to 8". The most significant rainfall occurred across the Coastal Bend and Victoria Crossroads where observers reported between 5" to 12" of rain for this event. After this event, the weather pattern quieted down with mostly dry conditions observed for the rest of the month allowing us to dry out. Other than a couple of days with scattered showers across the eastern portion of the area, everyone remained rather dry. For the month of July (as seen below), observers across the Coastal Bend reported accumulations north of 15" while observers across the Coastal Plains and Victoria Crossroads came in between 8" to 14". Across the western portion of the county warning area, accumulations ranged between 2" to 4" with only a couple of observers reporting over 5.00".

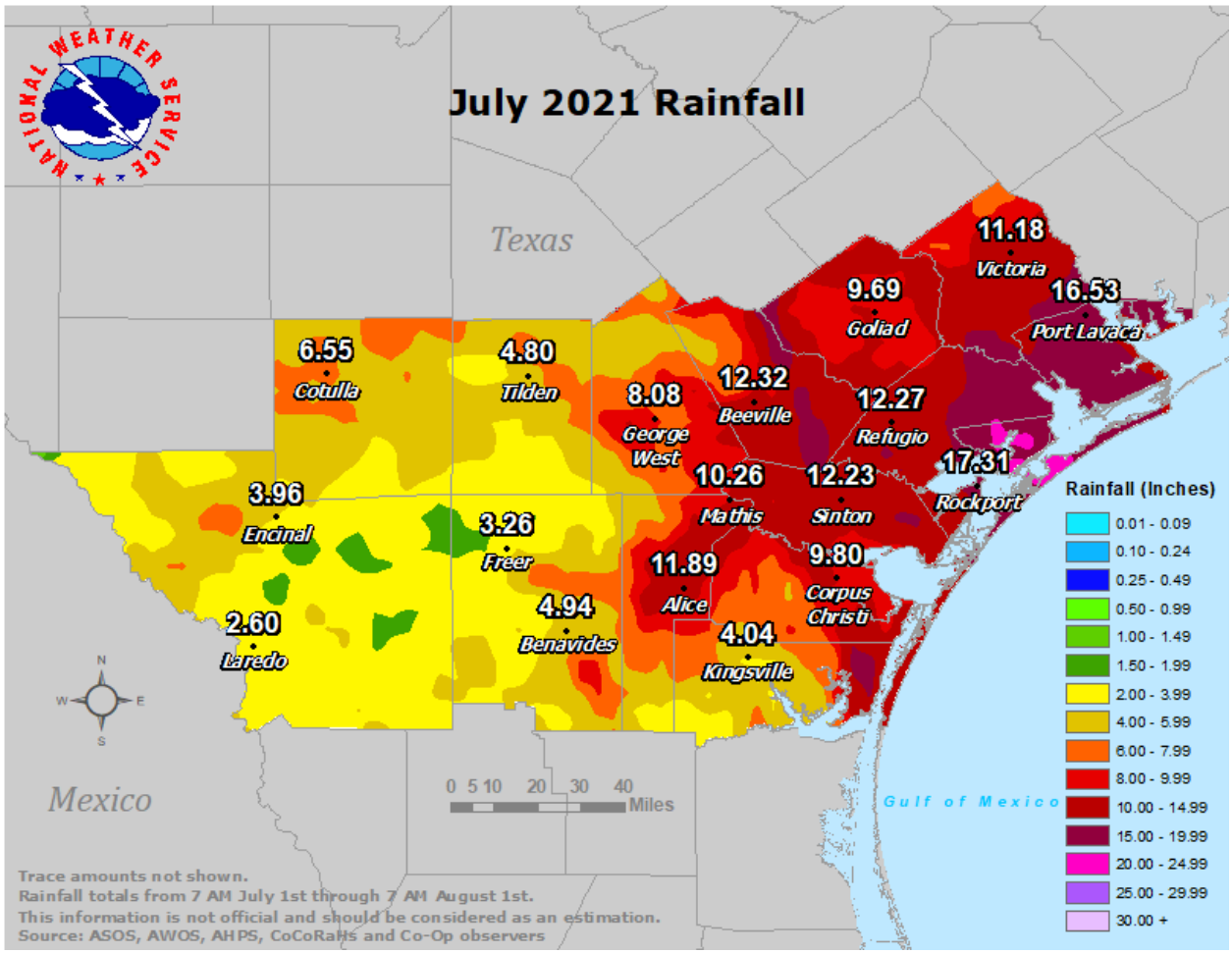


Figure 2: Total reported rainfall for the month of July

Corpus Christi Regional Summary (continued)

August featured another seasonal month in terms of rainfall, with only the Victoria Crossroads and Rio Grande with above normal rainfall by a couple of inches. Early in the month of August, an upper level disturbance moved across area resulting in moderate to heavy showers across the Rio Grande and Brush Country. Observers in and near Laredo reported accumulations ranging between 2" to 6" of rain with all other observers reporting less than 2.00". The remaining days within the month of August featured normal diurnal rain patterns with the sea breeze triggering showers and storms, some even reaching the Rio Grande area. When August was all said and done, rainfall accumulations was pretty well spread out with monthly accumulations ranging between 1" to 8".

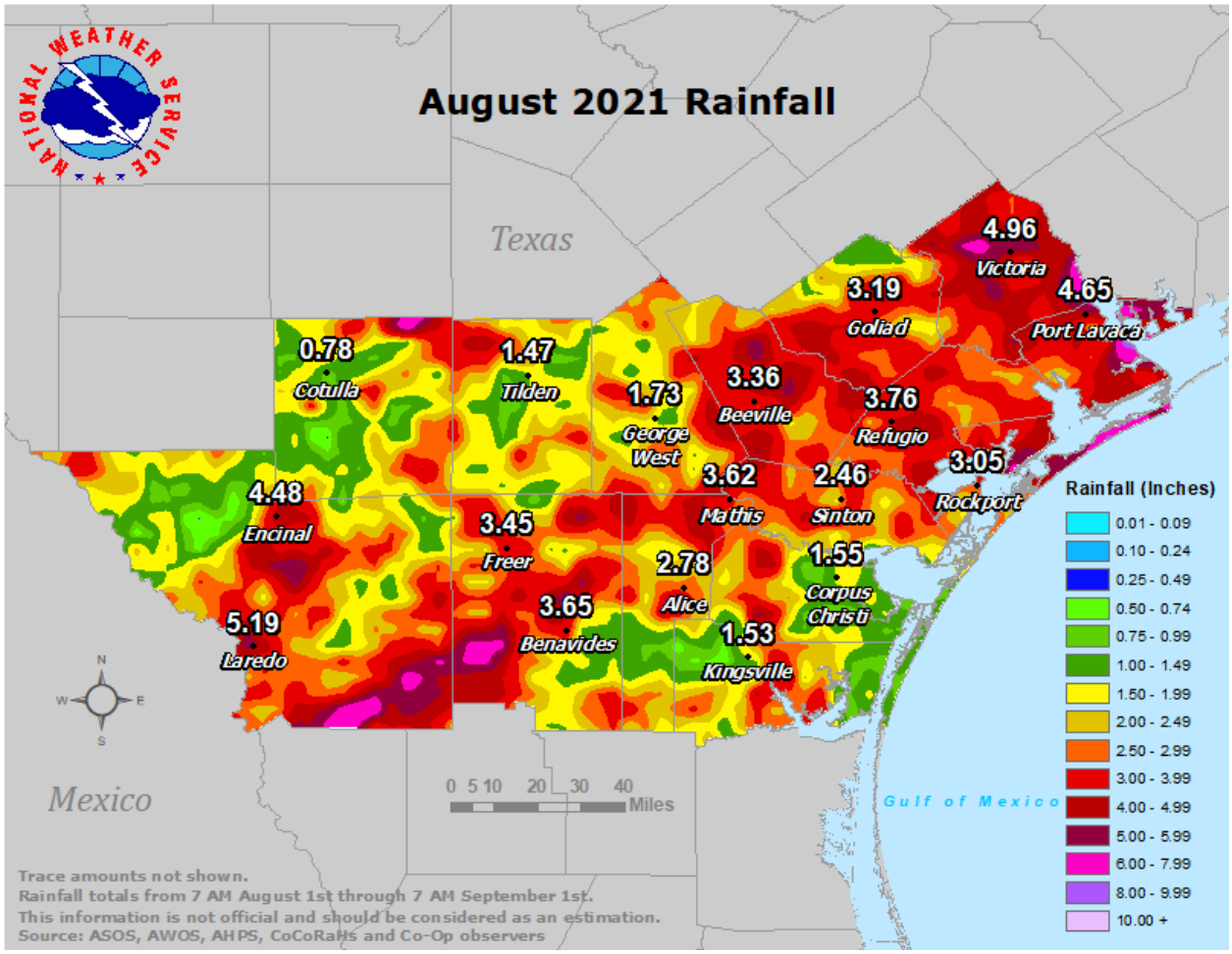


Figure 3: Total reported rainfall for the month of August

North Texas Regional Summary

Summer season starts below normal rainfall in June, ends above normal rainfall in July & August

By: Greg Story, NWS, Retired

Hello from North Texas! It certainly was an eventful summer weather-wise, especially in August with the well above normal rainfall in north Texas. And now with Texas being in the peak of the tropical storm season, your rainfall reports are as valuable as ever. I am thankful to each and every one of you for reporting your rainfall via CoCoRaHS! Your reports continue to be invaluable to the National Weather Service (and other entities) to determine both locations of flooding and drought.

Over the past several months, back in March 2021 it was a very dry month, with only the Texas panhandle region having above normal precipitation. The majority of the state had below normal precipitation. In April we began a wet cycle, one that continued through May. April saw above normal rainfall in most locations. Only the Rio Grande valley regions and the Texas panhandle saw below normal precipitation. In May it was very wet. Like April, most locations saw above normal rainfall, with only the Texas Big Bend region having below normal rainfall readings. In June it turned dry over most of the state. The Gulf coast, parts of far southern Texas, and west Texas saw above normal rainfall. But a lot of southwest, central and northeast Texas saw below normal precipitation. In July the wet cycle returned. Only north central, northeast and far southwest Texas had below normal rainfall. But much of central and south Texas had above normal rains. In August, rainfall was above normal across much of northern Texas, as well as the Concho valley. But, a good part of east Texas and the Texas panhandle had drier than normal conditions.

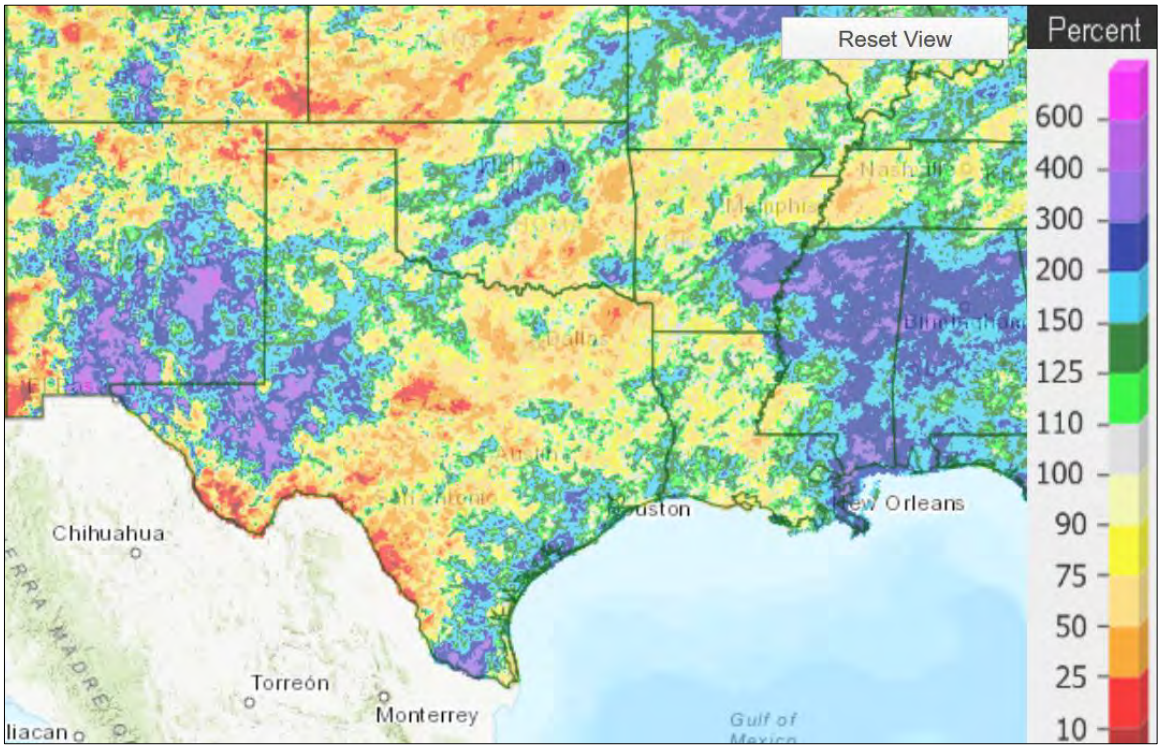


Figure 1: Percent of normal precipitation map for June 2021: The dark green, blue and purple colors indicate above normal precipitation; the beige, dark yellow and light green colors indicate near normal, while the orange and dark red colors indicate below normal precipitation.

June was dry over most of the state. The Gulf coast, parts of far southern Texas, and west Texas saw above normal rainfall. But a lot of southwest, central and northeast Texas saw below normal precipitation.

At DFW Airport in June 2021 they received 2.15". The normal amount of rain in June is 3.70" so they were -1.55" below normal for the month. However, at my CoCoRaHS station in north Fort Worth I received 4.87" (above the normal).

In Waco for June 2021, they received 2.79". The normal June rainfall for Waco is 3.35" so they were -0.56" below normal for the month.

For each month, I will highlight the more significant weather events. I know there is a lot of information given, and it is intended for you to pick your "favorite" storm to see what happened. Which days did you report your heaviest precipitation amounts? You can read about them here and compare what you observed against the maximum amounts. There were about six storm systems which affected our weather in June. Here are the highlights of the weather for the month.

North Texas Regional Summary (continued)

June 1 - 9:
Boy did June start off stormy and wet. The storm from May 31 carried into June. The rain moved off to the east and south on the 1st into east and far southern Texas, as well as into Louisiana. There was 2" to 3" over far southern Texas. Total rain from the 31st to June 1 was 5.11" in Eastland and 4" near Streetman and Highbank. More showers and thunderstorms formed over west Texas and moved east on the 2nd, as well as over central Texas near a stalled frontal boundary. They got 3.50" to 4.25" in the Houston area, and a little over 4" near Bertram. Then, a new closed low pressure system approached Texas from the west. The low moved very slowly and really didn't leave Texas until the 9th. Showers and thunderstorms moved along a stalled front on the 3rd. The rainfall amounts in north Texas were light. Widespread showers and thunderstorms occurred on the 4th. In north Texas the heaviest rain was from southwest Dallas to around De Soto where 1 to 1.25" fell. Very heavy rainfall occurred over the northeast east side of the DFW metroplex on the 5th. From 3.50" to over 6.00" fell from McKinney to Plano and Richardson, with the maximum amount being 6.35" in Plano, 6.16" in McKinney, and 4.87" about 3 miles west southwest of Richardson. Most of north Texas got light rain on the 6th, but the western parts of north Texas did pick up some fairly heavy rain from thunderstorms. The heaviest rainfall amounts were measured near Seymour, Graham and Throckmorton with 1.50" to 1.75". Widespread showers and thunderstorms again occurred on the 7th. The heaviest rain was south of Waco where the area from near Hewitt to near Lorena received 3.50" to over 4.50". The northeast part of the DFW metroplex also received another 2" to over 2.75". The showers and thunderstorms began shifting southward as the upper low began moving away on the 8th. The area from Waco to near Lorena picked up another 1.50" to 2.50". This slow moving low led to tremendous rainfall and flooding further north from eastern Oklahoma (near Okmulgee) through Arkansas to northern Mississippi. Residual showers and thunderstorms occurred over east Texas on the 9th. The amounts were light.

June 12 - 14:
An early morning MCS moved into north Texas from Oklahoma on the 12th. Rainfall amounts were 1" to 2" from McKinney to Prosper and Sherman. Other thundershowers formed along its outflow boundaries over east Texas later on the 12th. Additional rainfall amounts of around 0.50" were noted around Cumby and Lake Lavon. Thunderstorms moved south out of Oklahoma into the western parts of north Texas late on the 13th into the 14th. Rainfall amounts of a little over 1.50" were noted from Merkel to Hamlin and Sweetwater.

June 15:
A wave of low pressure brought over 2" of rain to southeast Texas from Pasadena and Webster to Richmond TX.

June 21 – 22:
A cold front passed through Texas. The heaviest rainfall was south of the north Texas region, with Del Rio receiving 4.26". Lingering rainfall of around 2.50" occurred around Corpus Christi and Kingsville into the 23rd.

June 23 - 24:
Aside from thunderstorms along the sea breeze front, the weather in Texas has been dry for a few days. Around 1" of rain occurred each day in isolated locations of southeast Texas.

June 26 - 30:
The weather was active at the end of the month. Isolated strong thunderstorms occurred on the 26th over southwest Texas which brought 5 - 6" of rain from Lamesa to Lenorah. Isolated thunderstorms developed due to a weak frontal boundary in the central Texas area on the 27th. Locally heavy rain fell under isolated locations, including over 4" near Mertzon and over 3.50" at Georgetown. More numerous thunderstorms occurred on the 28th primarily due to outflow boundaries from previous days' storms. The heaviest rain of around 4" occurred over west Texas around Lake Alan Henry. Scattered thunderstorms occurred for a fourth straight day on the 29th due to a moist atmosphere and no capping inversion. The heaviest rain was over southeast Texas where Kountze received 4.05". Locally heavy rain redeveloped over south Texas on the 30th where Beaumont received 3.50".

North Texas Regional Summary (continued)

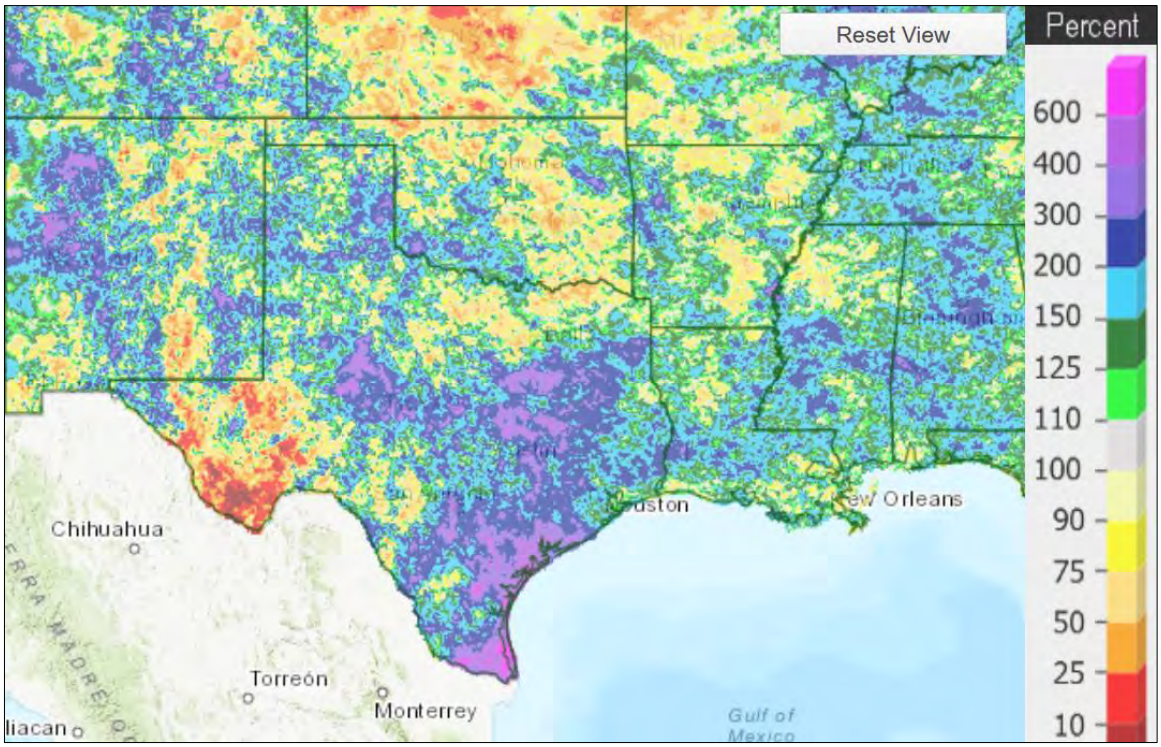


Figure 2: Percent of normal precipitation map for July 2021. **The dark green, blue and purple colors indicate above normal precipitation; the light yellow and light green colors indicate near normal, while the orange and dark red colors indicate below normal precipitation.**

In July the wet cycle from last spring returned. Only north central, extreme northeast and far southwest Texas had below normal rainfall. But much of central and south Texas had above normal rains.

At DFW Airport in July 2021 they received 1.50”. The normal amount of rain in July is 2.08” so they were -0.58” below normal for the month. However, at my CoCoRaHS station in north Fort Worth I received 2.71” (above the normal).

In Waco for July 2021, they received 4.46”. The normal July rainfall for Waco is 1.82” so they were +2.64” above normal for the month.

There were about five storm systems which affected our weather in July. Here are the highlights of the weather for the month.

July 1 - 4:
Showers and thunderstorms ahead of a cold front developed south out of Oklahoma on the evening of the 1st and produced locally heavy rain over north Texas. The heaviest rain fell northeast of North Richland Hills where 2.20" was measured. Scattered thundershowers again occurred with the cold front on the 2nd across primarily northern and central Texas. They got nearly 2.50" of rain northwest of Rowlett. Rainfall continued near the frontal boundary on the 3rd from the western parts of north Texas into central and southeast Texas. Nearly 5" fell near Aquilla and 3.75" at Granbury. Scattered showers and thunderstorms continued on the 4th near a stationary front which lingered across the region. Around 3.50" fell near Hearne and near Mason.

July 5 - 9:
More scattered thundershowers occurred for yet another day on the 5th close to where an upper atmospheric low pressure system formed. The heaviest rain was over south Texas where the west side of San Antonio received up to 9". Scattered thundershowers occurred for yet another day on the 6th over primarily south Texas due to a pesky upper air low pressure system. They got 8" at Port Mansfield, and there was 7" to 8" in the lower Rio Grande valley near Harlingen and Raymondville. Scattered thundershowers occurred again over primarily south Texas on the 7th due to the stalled upper low near Corpus Christi. Rockport and vicinity received 8" to 10.50". As the rain continued over south Texas on the 8th, the maximum rainfall was 7.31" at Kenedy and 6.82" near Edna. The upper low finally shifted westward and weakened on the 9th, and the rain began to decrease over south Texas. Remaining rainfall of 3.50" to 3.75" fell from Edna to Hallettsville.

North Texas Regional Summary (continued)

July 11 - 14:
A squall line moved into north Texas from Oklahoma early on the 11th ahead of a cold front, then moved south of DFW during the afternoon and evening. Early on the 11th the thunderstorms brought 2.31" near Powell and 2" at Bardwell. Further west, Knox City received nearly 3". Then there was 4.50" to 6" from near Neches TX to near Alto later on the 11th. As the front stalled across central Texas, more thunderstorms developed on the 12th. There was 4" of rain around San Saba, a little over 4" near Pecan Hill (Ellis County), and 4.37" near Easterly. The sea breeze front produced thundershowers across primarily southeast Texas on the 13th. They got nearly 3" in Lufkin. There was a near repeat of sea breeze activity on the 14th as there was on the 13th. The area southeast of Victoria in southeast Texas received 5". And an isolated thunderstorm over Dallas produced 2.79".

July 18 - 20:
Some thunderstorms moved out of Oklahoma into Texas early on the 18th, then redeveloped the afternoon of the 18th. The heaviest rain was over the western parts of north Texas where 1.29" fell near Truscott. A few thunderstorms developed along and near a weak cold front that moved through north and central Texas on the 19th. The heaviest rain was in the area around Tyler and Longview. New Summerfield 2 W received 3.77", Jacksonville got 3.30", and Gilmer picked up 3". Lingering thunderstorms occurred over south Texas on the 20th, with more scattered storms over southern and eastern Texas. Over 1" of rain fell over the lower Rio Grande valley.

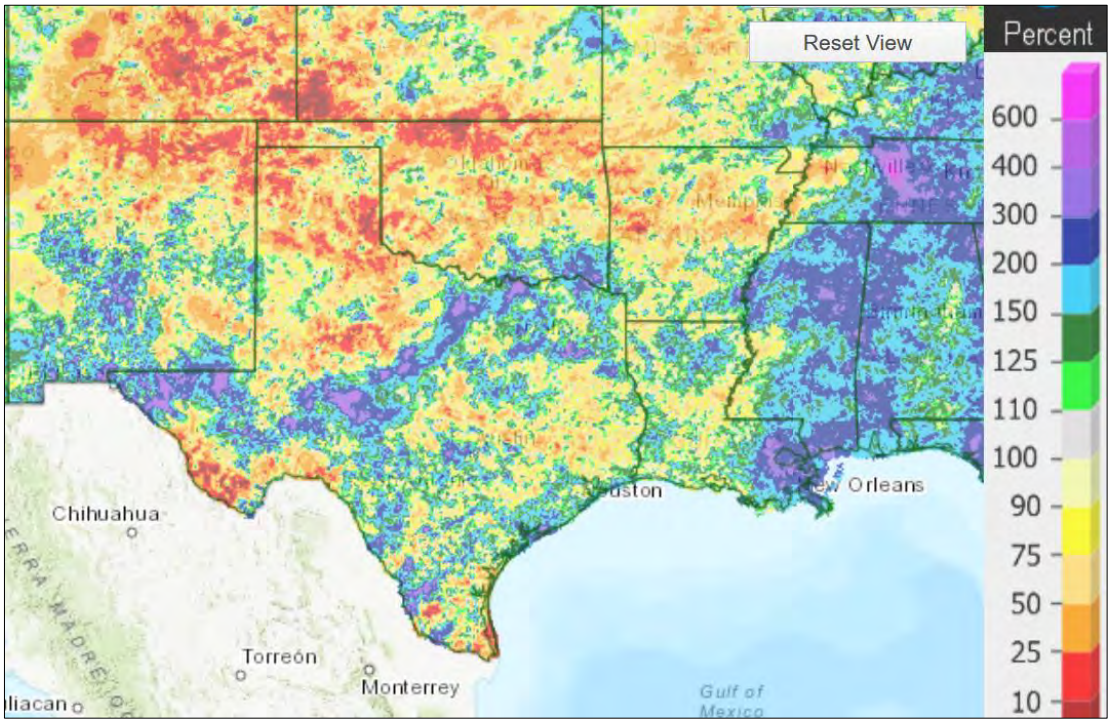


Figure 3: Percent of normal Precipitation map for August 2021. **The dark green, blue and purple colors indicate above normal precipitation; the light yellow and light green colors indicate near normal, while the orange and dark red colors indicate below normal precipitation.**

August saw rainfall that was above normal across much of northern Texas, as well as the Concho valley. But, a good part of east Texas and the Texas panhandle had drier than normal conditions.

At DFW Airport in August 2021 they received 4.82”. The normal amount of rainfall in August is 2.18” so they were +2.64” above normal for the month.

In Waco for August 2021, they received 7.30”. The normal amount for August is only 2.05” so Waco was +5.25” above normal for the month.

There were about four significant storm systems which affected our weather in August. Here are the highlights of the weather for the month.

North Texas Regional Summary (continued)

August 1 – 3:

A summertime cold front moved from north to south across Texas. The heaviest rainfall amounts were initially heaviest over west Texas around Turkey where about 2.50" fell late on the 31st into the 1st. Then very heavy rain fell over northern and central Texas late on the 1st. In north Texas over 5" of rain fell near Cedar Hill. But further south they received 5.75" to 6.35" in and near Seguin. Late on the 2nd another 4.30" to 5" fell in and near Johnson City. In north Texas, near Dawson around Navarro Mills Lake they got 2.00". By the 3rd the rain was confined near the front over south Texas where Wharton received nearly 3.50".

August 5:
A few thunderstorms developed on the 5th. Near Gordonville they received 0.86" and near Haslet they got 0.85".

August 12 - 15:
On the 12th El Paso received 2.50 to 3.42" due to the monsoon. A cold front approached Texas from the north on the 13th and continued moving south. Wichita Falls got around 1.80". Meanwhile, far west Texas had extreme monsoonal rainfall for the second straight day. They got just over 3" at Guadalupe Pass on the 13th. As the front moved through on the 14th there was locally heavy rain, including near Waxahachie (at Lake Waxahachie) with 3.69", near Mesquite where they received 3.37" and near Lindale with 3.33". The heaviest rain in north Texas on the 15th was at Crawford with 3.76" and near Meridian with 3.24". Meanwhile in Austin they got 4.50" to 5" which flooded the capitol.

August 16 – 19:
While tropical storm Fred moved into the Florida panhandle on the 16th, the showers and thunderstorms were less numerous over Texas. But there were some locally heavy downpours. Near Saginaw they got 1.62" while near McKinney they received 1.48". Meanwhile, further southwest, they got nearly 4" northwest of San Angelo. Rainfall became more widespread on the 17th due to a very moist air-mass and the old front which became a surface trough. They got 5" to 5.50" in the Tyler area. They received 4.50" near Bridgeport and a little over 4" near Sherman. Showers and thundershowers continued on the 18th, with locally heavy rain again in some spots. They got over 5" of rain near Glen Rose, 4" near Mineral Wells and Eastland, and almost 4" near Aubrey. Over the three day period the town of Truce in Jack County received 5.92". The rain began to move off to the east and decreased on the 19th, but before that the Sherman/Denison area got heavy rain of 2.50" or more. The maximum amount was Denison at the Red River Dam where 4.13" fell.

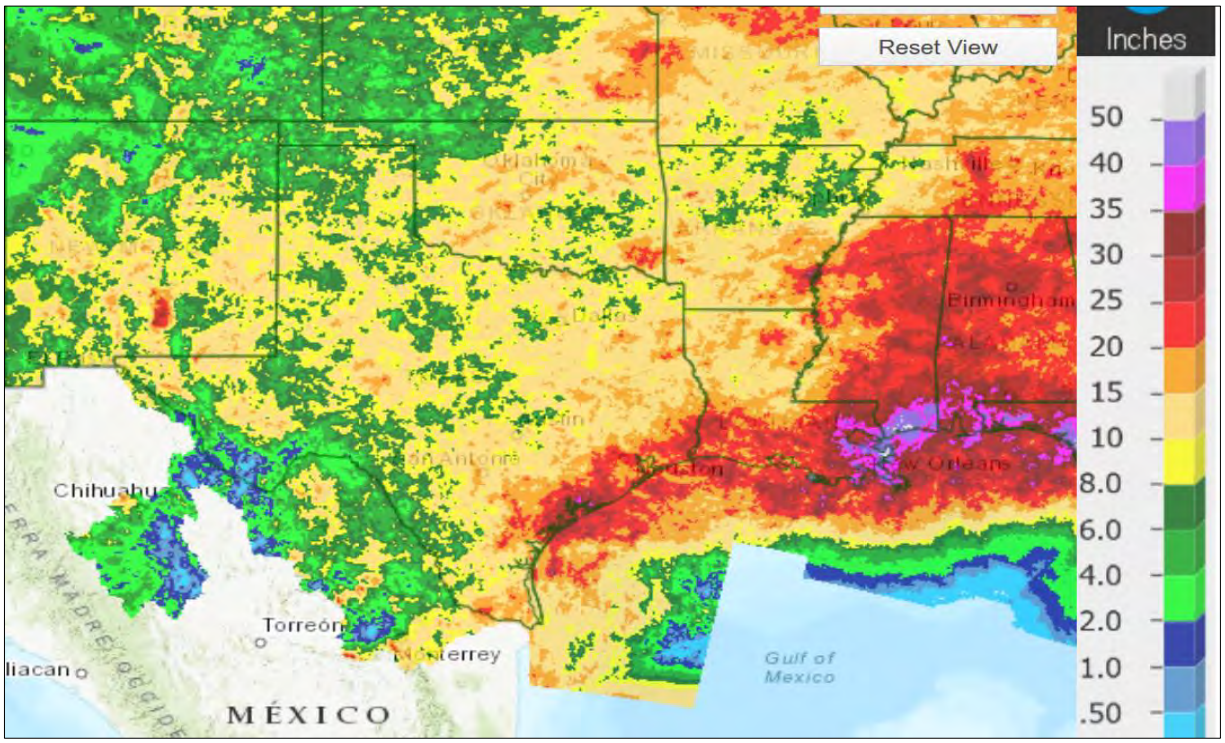


Figure 4: Summer season precipitation for 2021. **The brown, bright red, and purple colors indicate the largest precipitation totals, while the light green and blue colors show the lightest amounts.**

North Texas Regional Summary (continued)

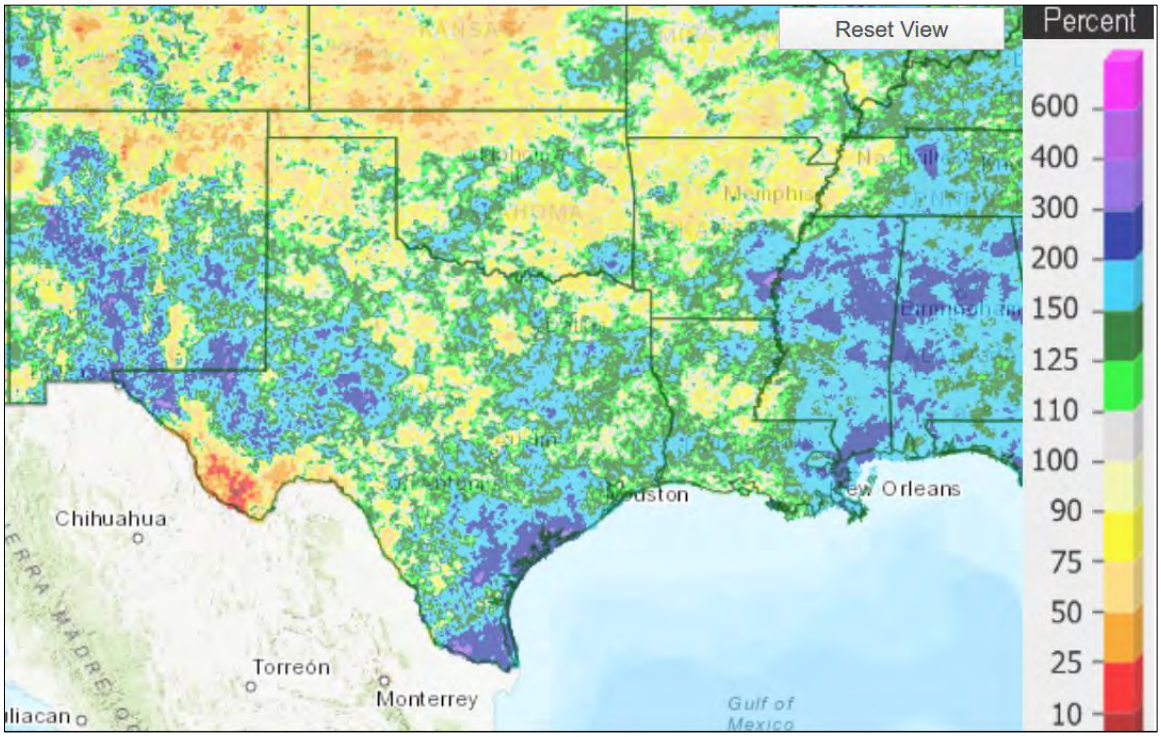


Figure 5: Percent of Normal Precipitation for summer 2021. The purple, dark blue and green colors indicate above normal precipitation. The brown, bright yellow and red colors indicate below normal amounts.

Note the areas of prolonged dryness are fairly limited. A few were noted over far southwest Texas and the northern Texas panhandle. But also of note was the isolated spots along the middle Texas Gulf coast into far southern Texas that received much above normal amounts (almost 300% of normal for summer). Overall, near to above normal precipitation occurred over Texas.

For the summer season (June through August 2021) DFW airport received 8.47". The normal amount of rainfall during the summer months is 7.96" so they were +0.51" for the season.

In Waco for the June, July and August period they received 14.55". The normal amount for the summer season in Waco is 7.22" so they were +7.33" this summer.

Through August 31 DFW airport has received 26.84" for 2021. The normal amount of precipitation is 24.55" so they are +2.29" above normal for the year through August.

In Waco through August 31, they received 26.90" for 2021. The normal amount of precipitation is 23.54" so they are +3.36" above normal for the year through August.

Thanks again to all of you for your weather observations! I say this often, but it is true. The amount of the rainfall which fell at your station is extremely important and valuable information to the National Weather Service, especially the West Gulf River Forecast Center. I know a lot of you, especially those of you who are new to CoCoRaHS, may wonder if anyone looks at your weather reports day in and day out. Rest assured, they are! Remember, on days you are not home or unable to report for any reason, you can make a multi-day accumulation report upon your return. This is important information as well.

Please 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.

I realize that this has been a difficult time for many of you due to COVID-19. Your faithfulness in submitting your rainfall readings to CoCoRaHS during this summer season have not gone unnoticed. Your dedication to observing helps the users of CoCoRaHS data a lot. If we can help you with your observations in any way, please let us know! Have a great autumn, stay well, and happy observing!

Greg Story

SE Texas Regional Summary

Abundant Rainfall and Mild Temperatures across SE Texas for 2021 summer

By: Ron Havran – CoCoRaHS SE Texas Regional Coordinator, HCFCD

June

The stormy pattern SE Texas had in May carried over into June with abundant rainfall. Temperatures averaged near normal throughout most of the region. Daytime highs were kept down from all the storms. Temperatures didn't reach 100° but heat index values were very high from the extremely high dew points across all of SE Texas.

Nearly all counties had rainfall that was above average. SE Texas had some very wet conditions to start the month with saturated conditions in many areas. Mostly sunny conditions were noted mid-month followed by more thunderstorm activity to the end of the month. Fort Bend and Orange counties had the highest average rainfall for CoCoRaHS observers. See chart 1 & 2. Polk and Montgomery counties had the lowest rainfall average from CoCoRaHS observers. The state of Texas had its 31st wettest June since 1895. Figure 1 shows many areas that received over 10.00" of rain for the month of June.

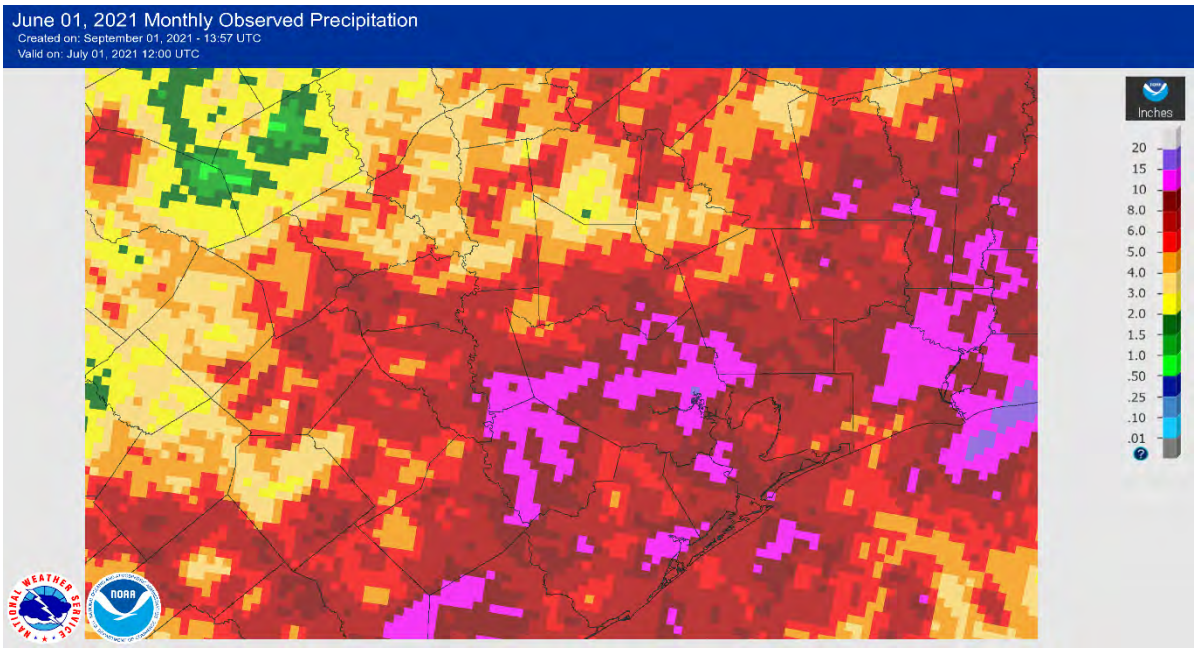


Figure 1: June 2021 Precipitation across SE Texas

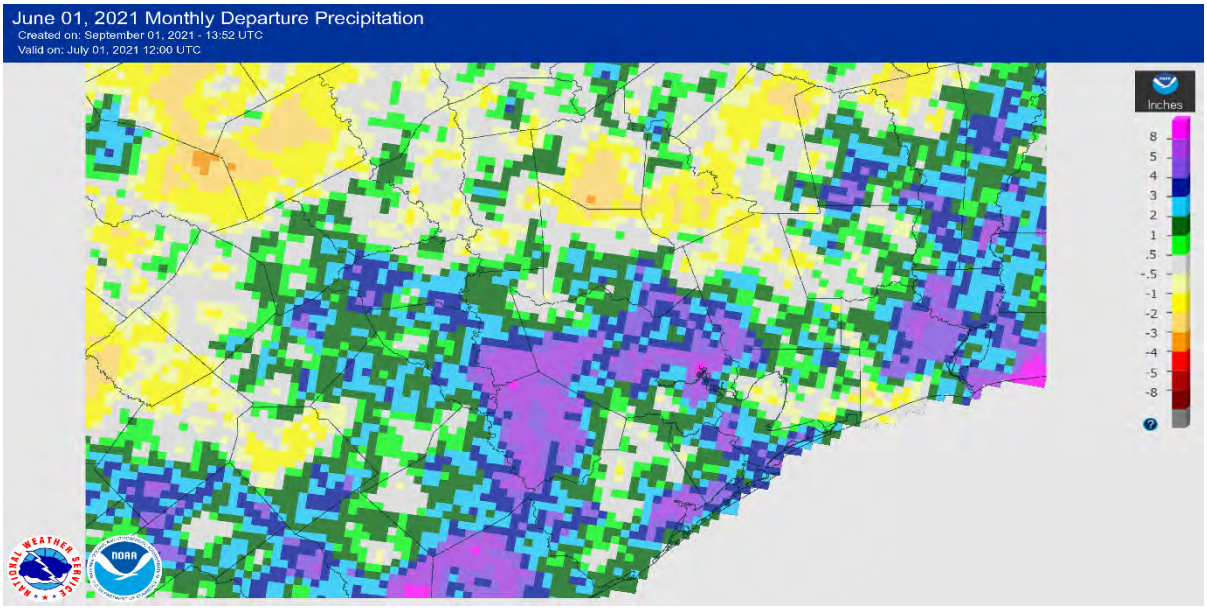


Figure 2: June 2021 Departure from Normal Precipitation across SE Texas

SE Texas Regional Summary (continued)

July

Texas had its 8th wettest July and 21st coolest July since 1895. Well above normal rainfall and very mild conditions occurred across SE Texas as well. The first 10 days of the month saw record rainfall in some areas. Jackson and Brazoria counties averaged over 10.00" for the month. Driest conditions were noted across Chambers, Polk, and San Jacinto counties with CoCoRaHS observers averaging around 4.00" of rainfall for the month for each county.

Jasper County in the Golden Triangle Section averaged 9.56"and Jefferson County averaged 8.74" from CoCoRaHS observers. Tyler County had the lowest CoCoRaHS observer county rainfall average with 5.95". See Chart 2.

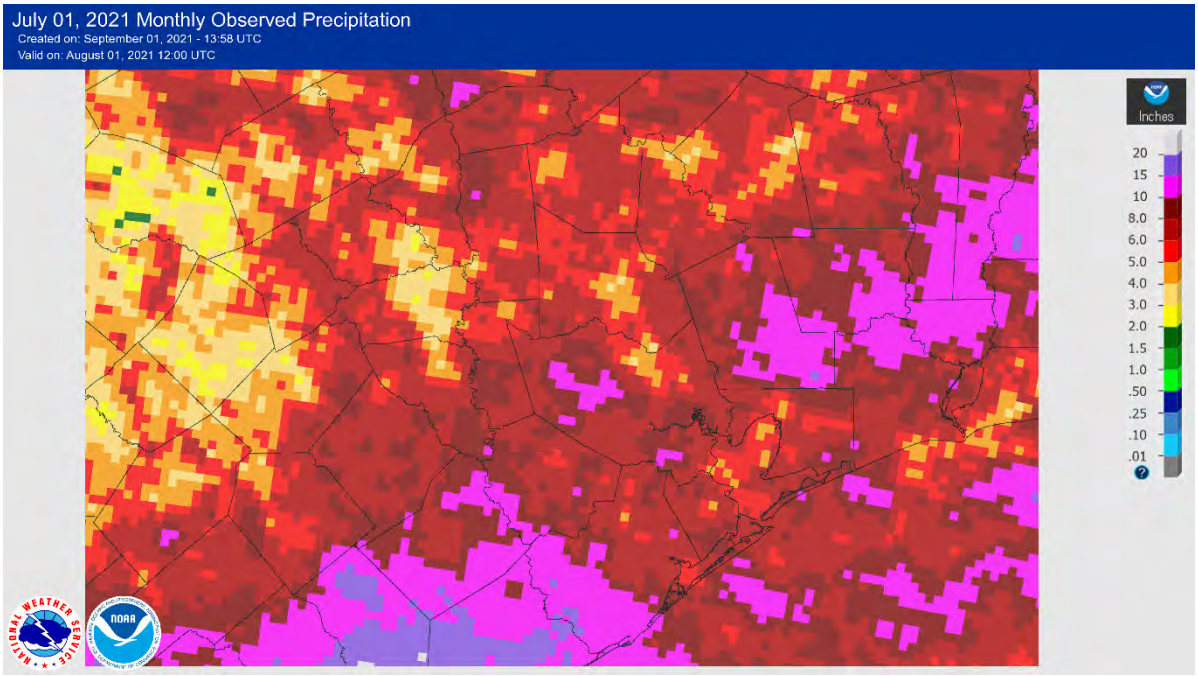


Figure 3: July 2021 Precipitation across SE Texas

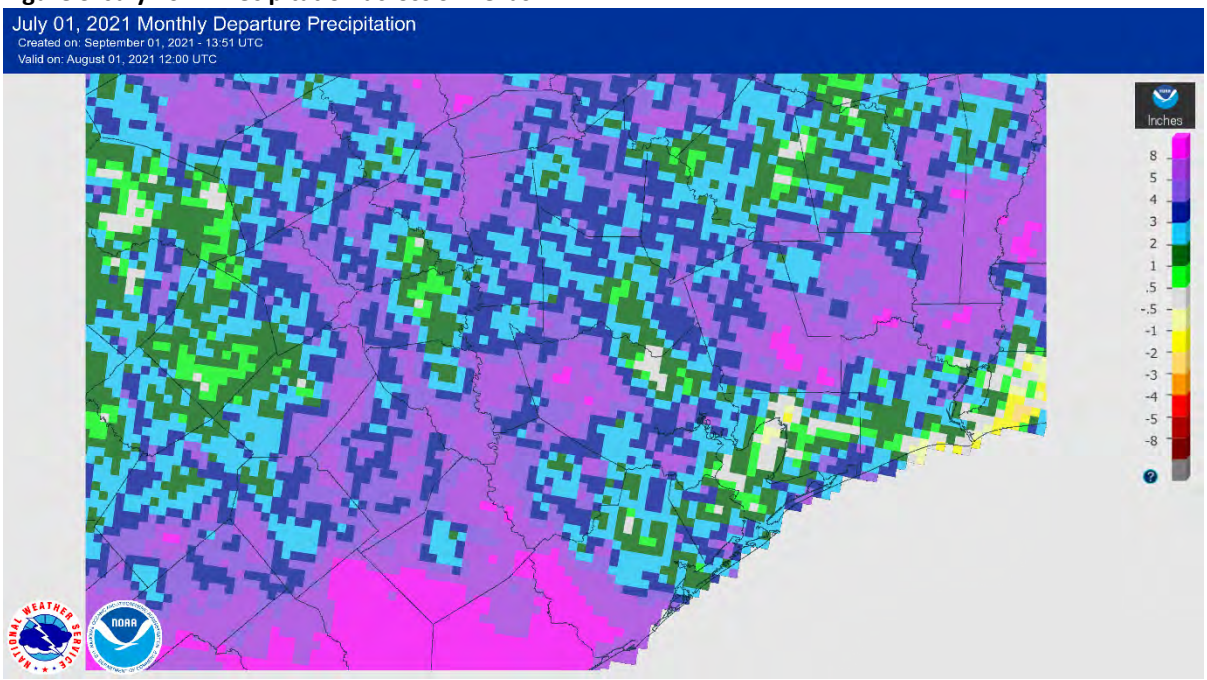


Figure 4: July 2021 Departure from Normal Precipitation across SE Texas

SE Texas Regional Summary (continued)

August

August was a much warmer and drier month than June and July had been this summer. Rainfall was mainly focused near the coastal counties with afternoon and evening storms associated with the sea breeze boundary. Coastal counties receiving rainfall from the sea breeze storms got a break from the higher temperatures while inland counties had hotter more sunny conditions and less rainfall for the month. Daytime of high temperatures of 100° didn't appear this summer season.

Hardin, Jackson, and Brazoria counties benefited the most from this pattern having the higher rainfall totals. Hardin County had the highest CoCoRaHS rainfall average. The drier counties inland still had a few spots receive isolated heavy rainfall from a few storms scattered about the region. In daily summertime patterns with isolated thunderstorms occurring often the importance of having a dense network of CoCoRaHS observers to measure the variability of precipitation is needed. Please mention CoCoRaHS to others so we can get more observers to help fill in the gaps between stations across SE Texas.

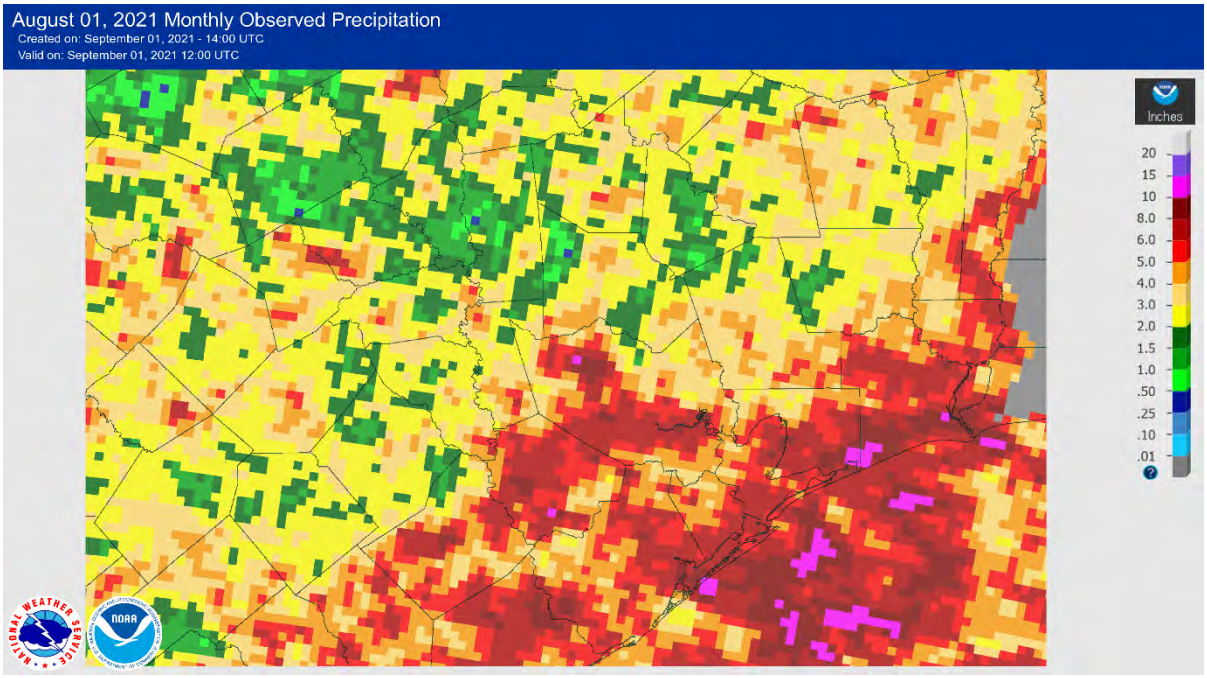


Figure 5: August 2021 Precipitation across SE Texas

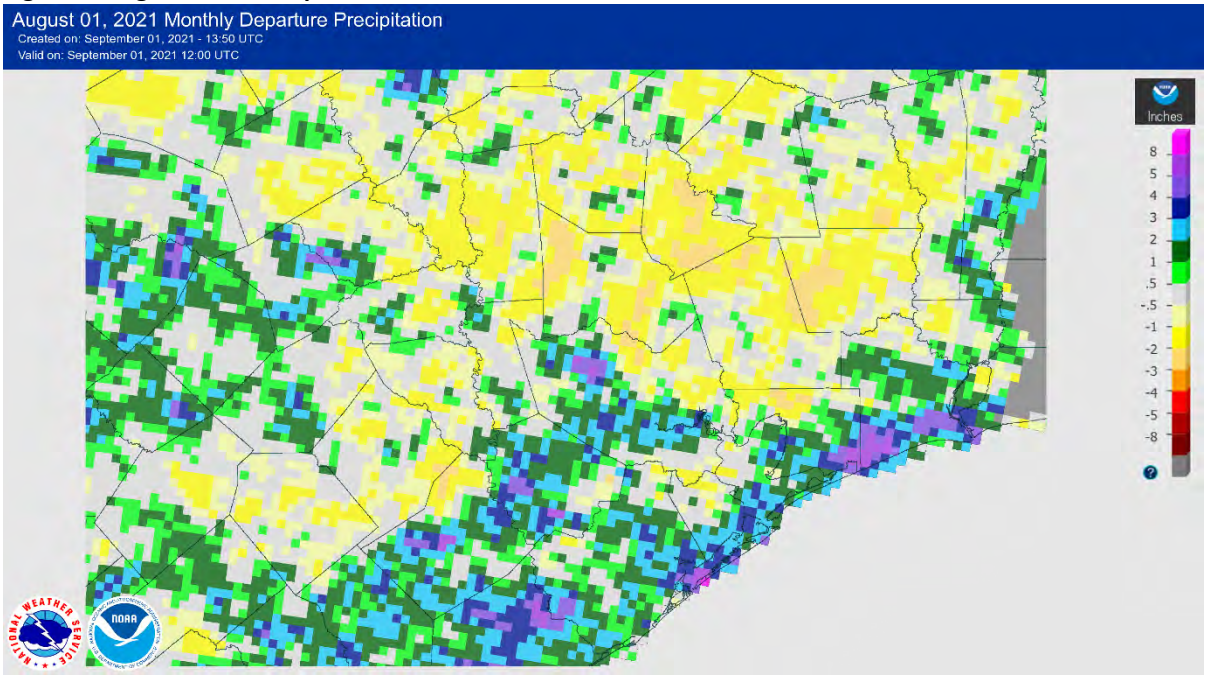


Figure 6: August 2021 Departure from Normal Precipitation across SE Texas

SE Texas Regional Summary (continued)

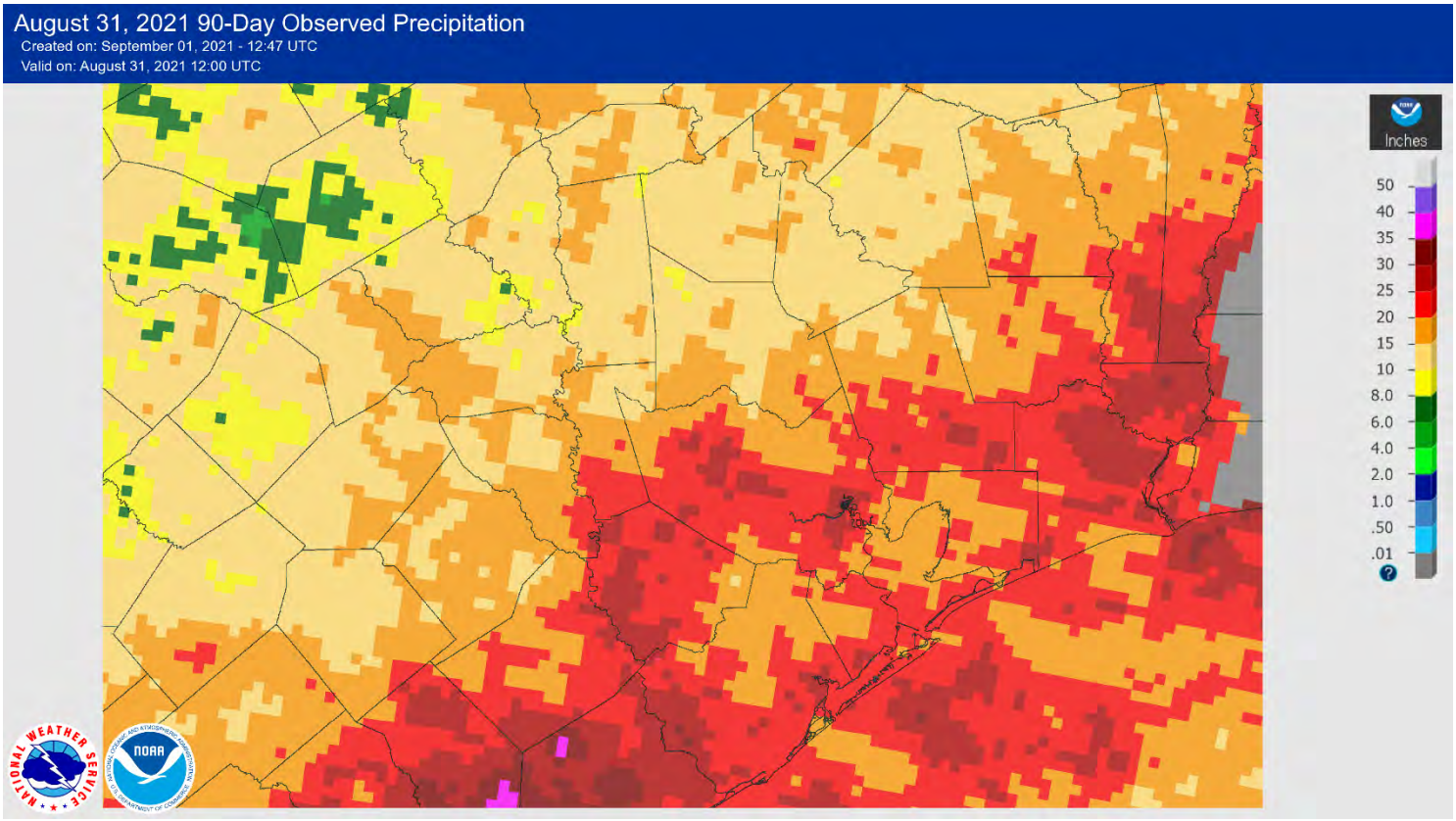


Figure 7: Summer Precipitation June – August for SE Texas

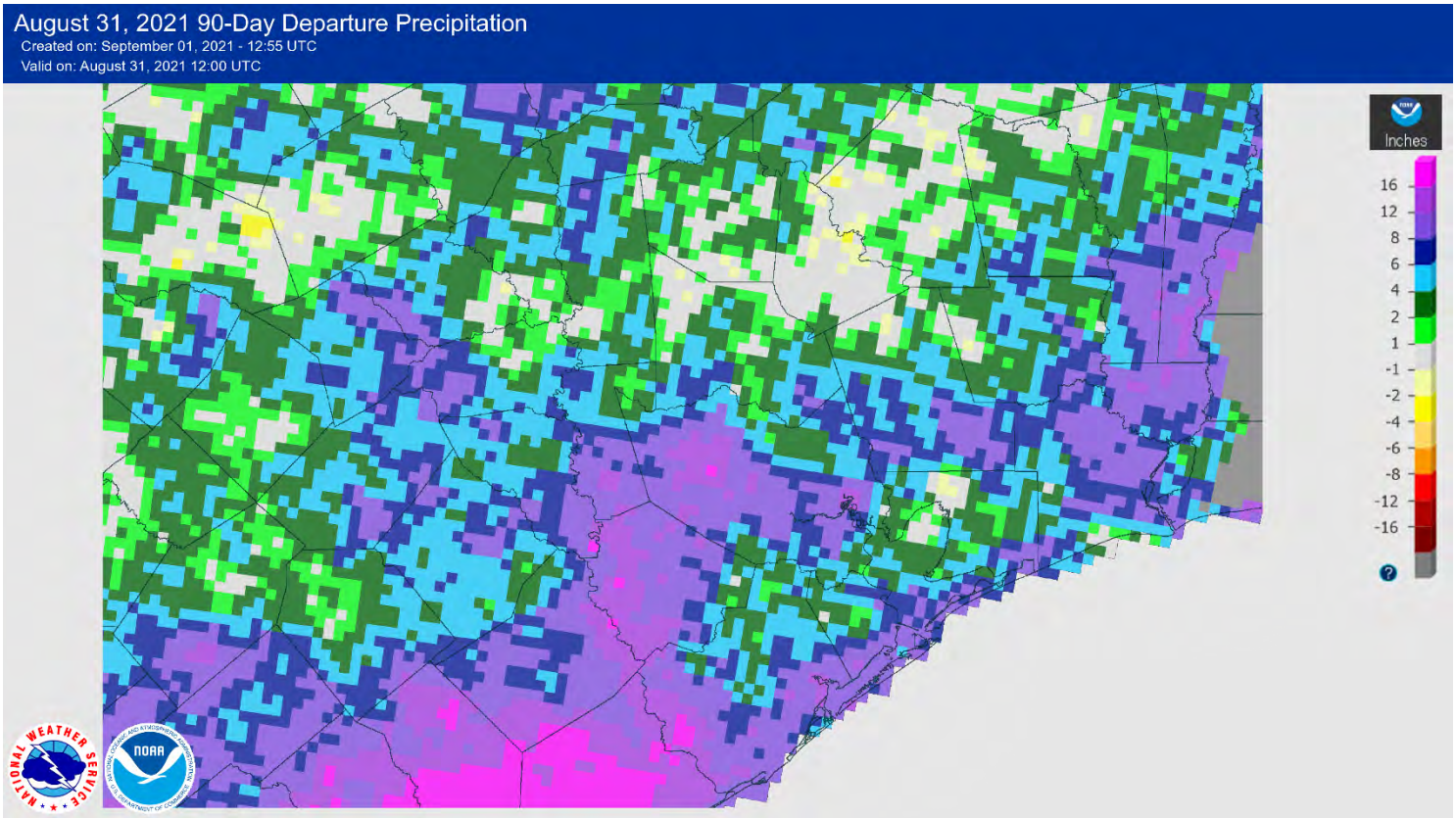


Figure 8: Summer Precipitation Departure from Normal for June – August for SE Texas

SE Texas Regional Summary (continued)

Summer 2021 CoCoRaHS SE Texas Stations Houston/Galveston Section Rainfall

Actual Station Measured County Rainfall Averages in inches per month

County	June	July	August	Summer Total
	AVG.	AVG.	AVG.	Jun.- Aug.
Austin	7.01	5.85	2.04	14.90
Brazoria	5.91	10.27	4.55	20.73
Chambers	7.02	3.82	2.57	13.41
Colorado	5.31	6.34	1.92	13.57
Fort Bend	9.36	5.86	4.70	19.92
Galveston	7.13	6.44	4.34	17.91
Harris	7.46	7.64	3.34	18.44
Jackson	5.36	14.63	4.96	24.95
Liberty	6.76	7.43	3.10	17.29
Montgomery	4.18	4.99	2.06	11.23
Polk	4.06	3.91	1.98	9.95
San Jacinto	4.53	4.04	2.02	10.59
Wharton	6.67	8.03	4.16	18.86
Region Totals	6.21	6.87	3.21	16.29

Highlights highest rain total for a county in a month

Highlights lowest rain total for a county in a month

Note: All data taken from the CoCoRaHS website in Total Precipitation Summary Report

Note: Only counties with 2 or more active observers reporting are displayed in this chart

Chart 1: Houston/Galveston Section CoCoRaHS Observer Rainfall for 2021 summer

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Summer 2021 CoCoRaHS SE Texas Stations Golden Triangle Section Rainfall

Actual Station Measured County Rainfall Averages in inches per month

County	June	July	August	Summer Total
	AVG.	AVG.	AVG.	Jun.- Aug.
Hardin	8.44	7.72	8.11	24.27
Jasper	9.18	9.56	1.78	20.52
Jefferson	9.26	8.74	4.44	22.44
Newton	No Data	No Data	No Data	No Data
Orange	9.33	8.17	4.35	21.85
Tyler	6.33	5.94	2.33	14.60
Region Totals	8.51	8.03	4.20	20.74

Highlights highest average rain total for a county in a month

Highlights lowest average rain total for a county in a month

Note: All data taken from the CoCoRaHS website in Total Precipitation Summary Report

Note: Only counties with 2 or more active observers reporting are displayed in this chart.

Chart 2: Golden Triangle Section CoCoRaHS Observer Rainfall for 2021 summer

SE Texas Regional Summary (continued)

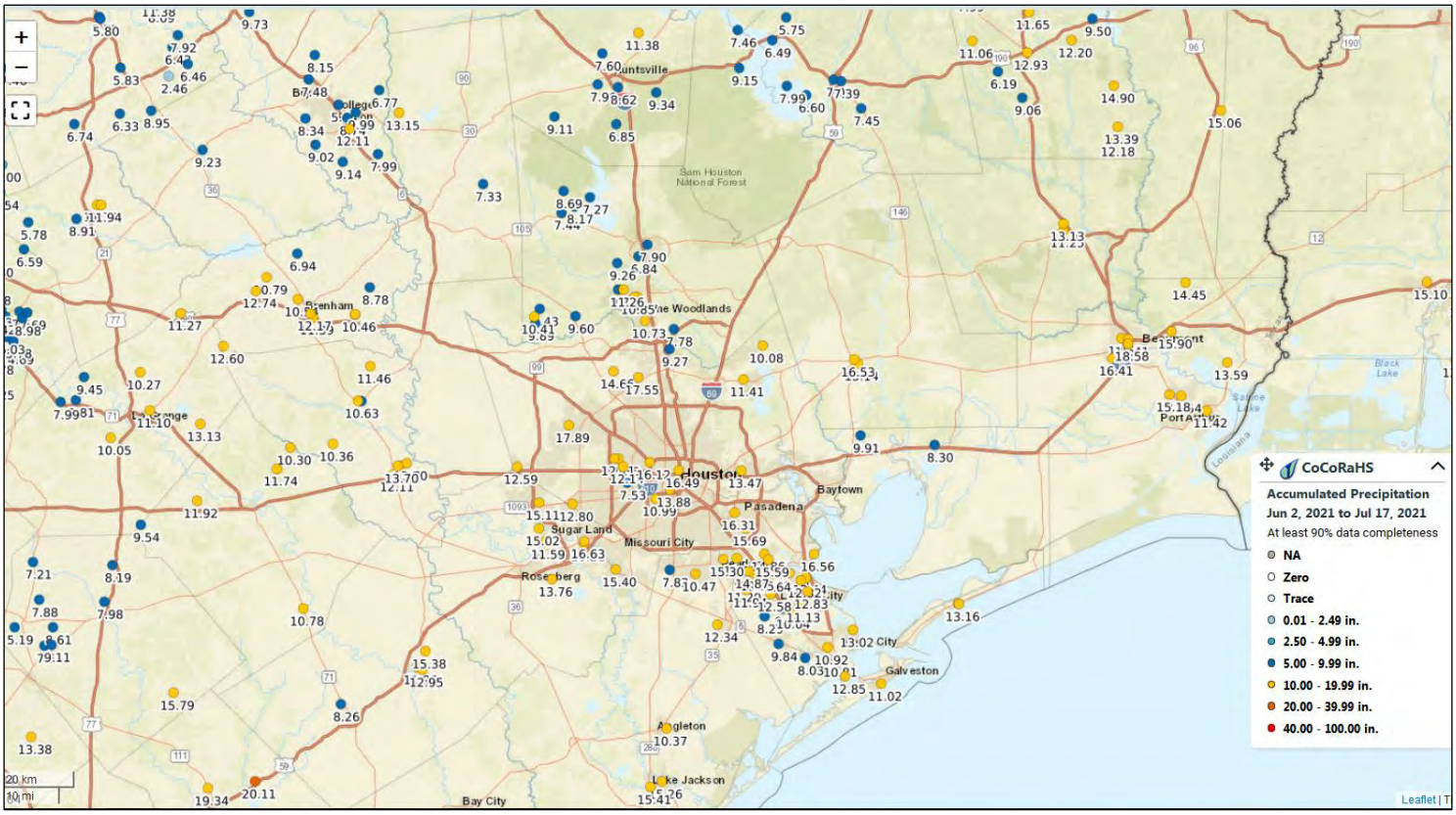

Figure 9: SE Texas CoCoRaHS observers reported rainfall from June 2, 2021 through July 17, 2021

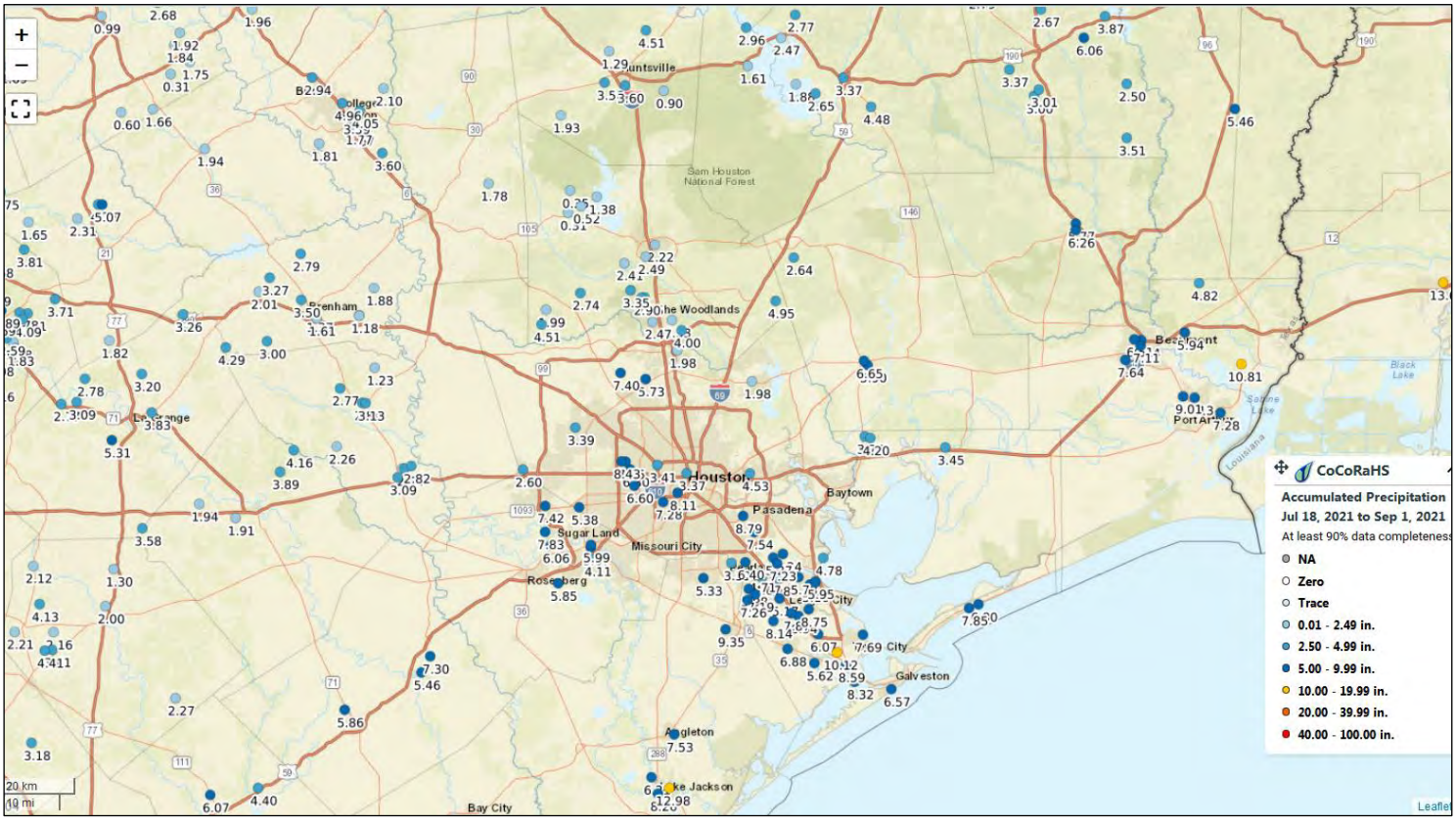

Figure 10: SE Texas CoCoRaHS observers reported rainfall from July 18, 2021 through September 1, 2021

Panhandle CoCoRaHS Observers Rainfall Maps

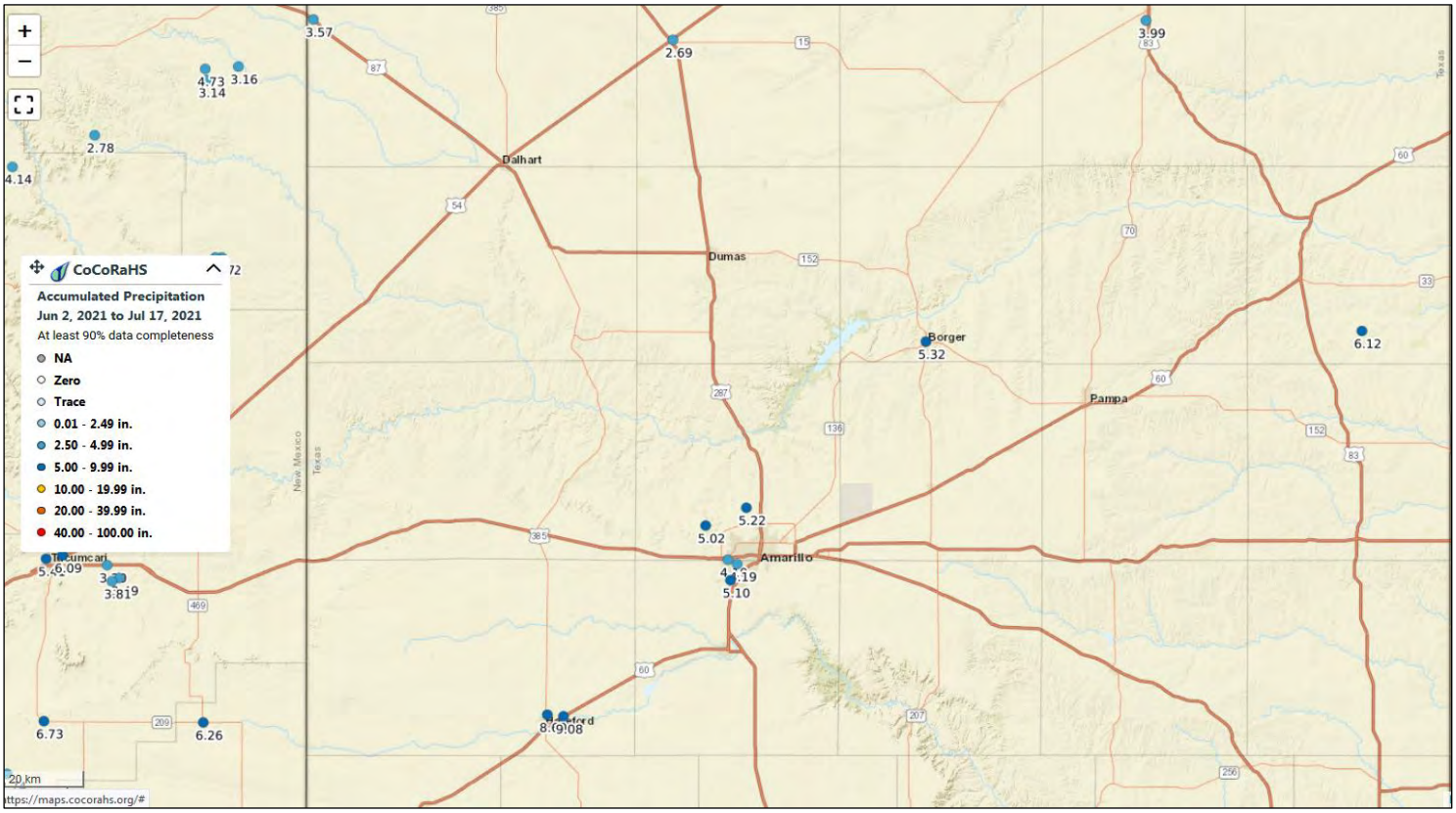

Figure 1: Panhandle CoCoRaHS observers reported rainfall from June 2, 2021 through July 17, 2021

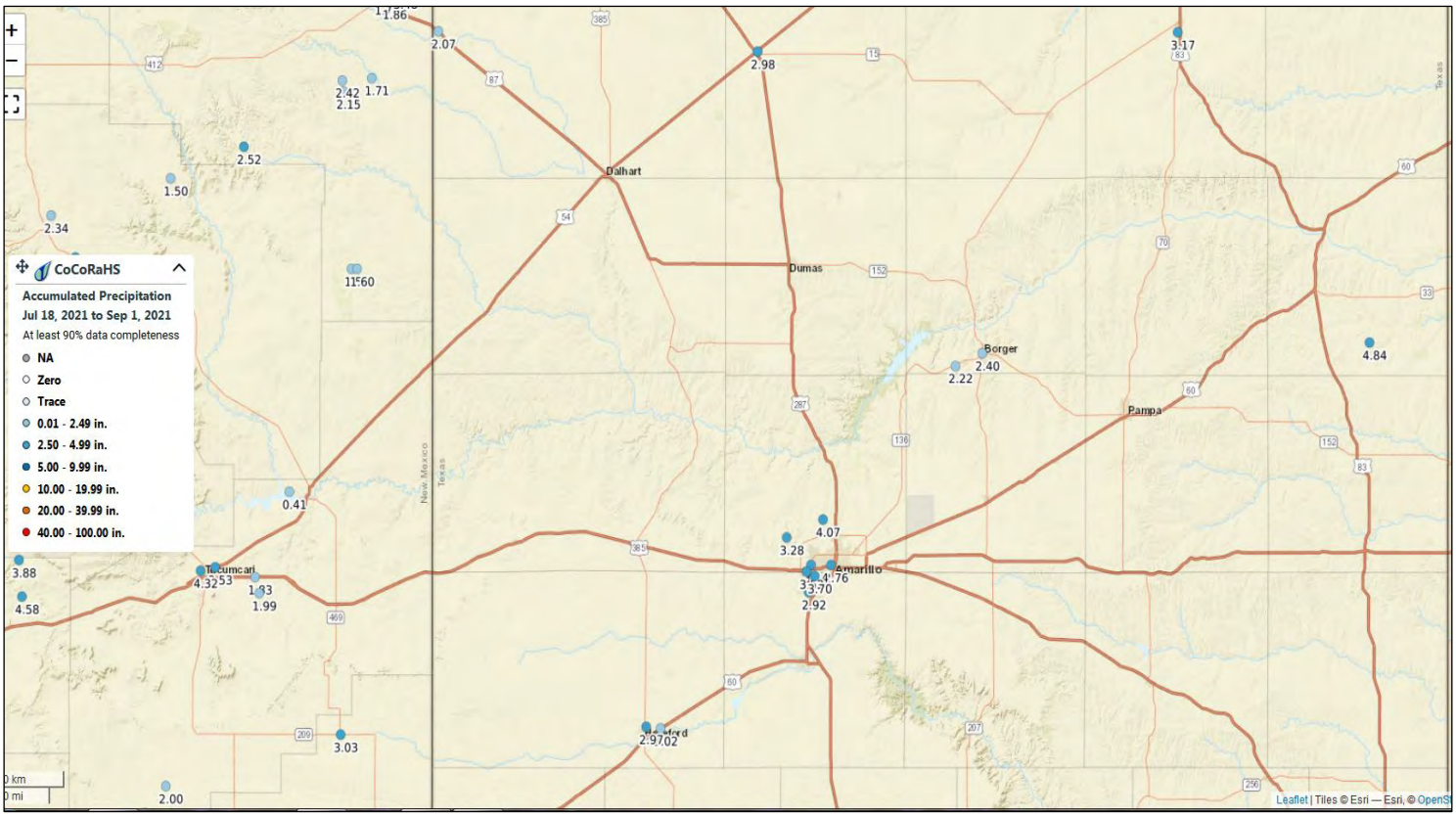

Figure 2: Panhandle CoCoRaHS observers reported rainfall from July 18, 2021 through September 1, 2021

Palo Duro Basin CoCoRaHS Observers Rainfall Maps

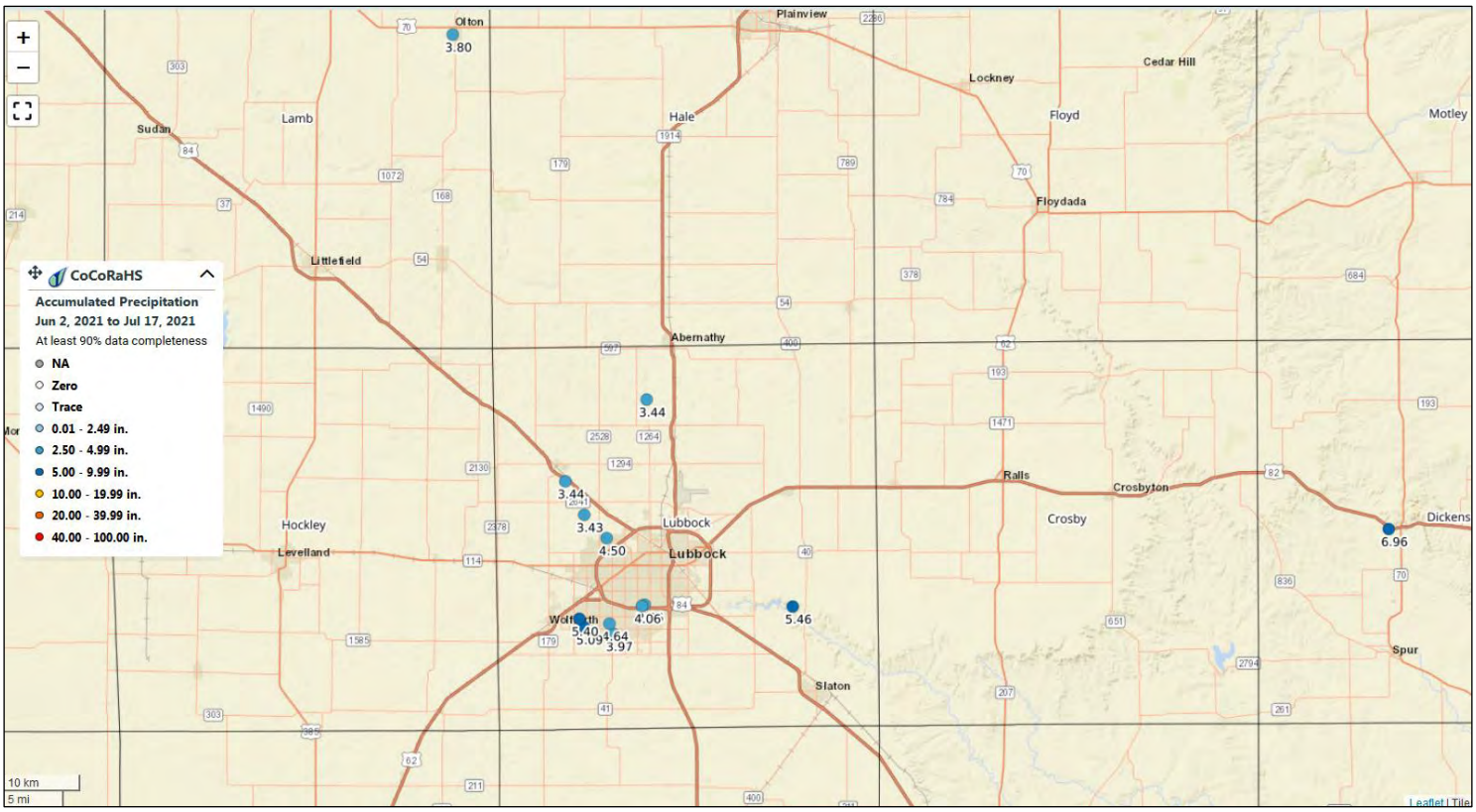

Figure 1: Southern Panhandle/Palo Duro Basin CoCoRaHS observers reported rainfall from June 2, 2021 through July 17, 2021

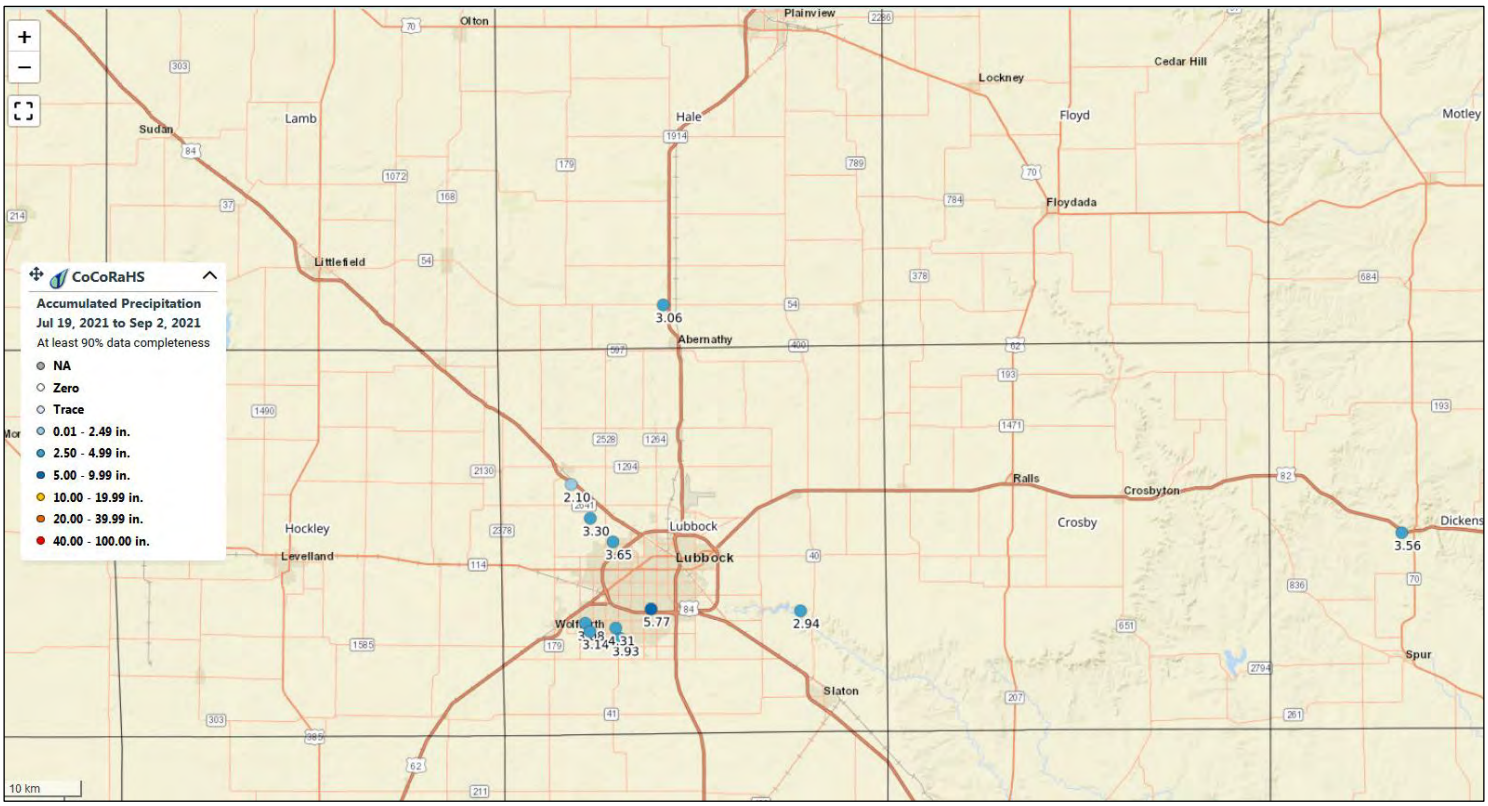

Figure 2: Southern Panhandle/Palo Duro Basin CoCoRaHS observers reported rainfall from July 18, 2021 through September 2, 2021

Texas Autumn 2021 Weather Outlook

By: Bob Rose, Meteorologist, Lower Colorado River Authority

Summer 2020 was a fairly mild summer by Texas standards, with the temperature averaging slightly below normal. In fact, it was Texas' mildest summer since 2007. While much of the western U.S. fried, temperatures across Texas remained pretty much in check. In addition to temperatures being somewhat tolerable, most areas also saw above normal rainfall. That's a combination we rarely see in the summer. But summer is now fading, and fall is on the horizon. Will the unusually mild and wet pattern persist for the next few months?

Texas's mild summer pattern came about as the heat dome, which normally sets up across Texas in the heart of summer, instead set up across the western and northwestern U.S. With the heat dome out to our west, it opened the door for several unusual summer cold fronts and wet weather systems. This pattern persisted from early June till about mid-August. But beginning in late August, the heat dome began moving back across Texas, heating up the temperature and turning off much of the rain. It was a good run, but the mild and wet summertime pattern appears to have faded in late August.

Heading into autumn, a warm, late-summer pattern persists across Texas. Forecasters are also monitoring developments in the tropical Pacific Ocean where sea surface temperatures between the west coast of South American and the International Date Line have steadily cooled since July. Climate Prediction Center (CPC) forecasters have strong confidence these waters will continue to slowly cool and reach the threshold for La Niña sometime in October. La Nina is forecast to develop and persist through the upcoming winter. La Niña is a significant driver for the weather across Texas in the fall and winter months as it tends to alter the normal position of the jet stream, often leading to milder than-normal and drier than-normal weather conditions.

In La Nina, sinking air across the eastern Pacific creates an area of high pressure in the upper atmosphere that builds north to Alaska and western Canada. The Jet stream coming east from Asia is forced to bend north around the ridge into Alaska and Canada instead of coming east into Texas. With the jet staying further to the north, it limits the number of storm systems that would otherwise track east across Texas through the fall and winter months. At the same time, it also limits the number of cold fronts and cold air outbreaks from spreading into Texas.

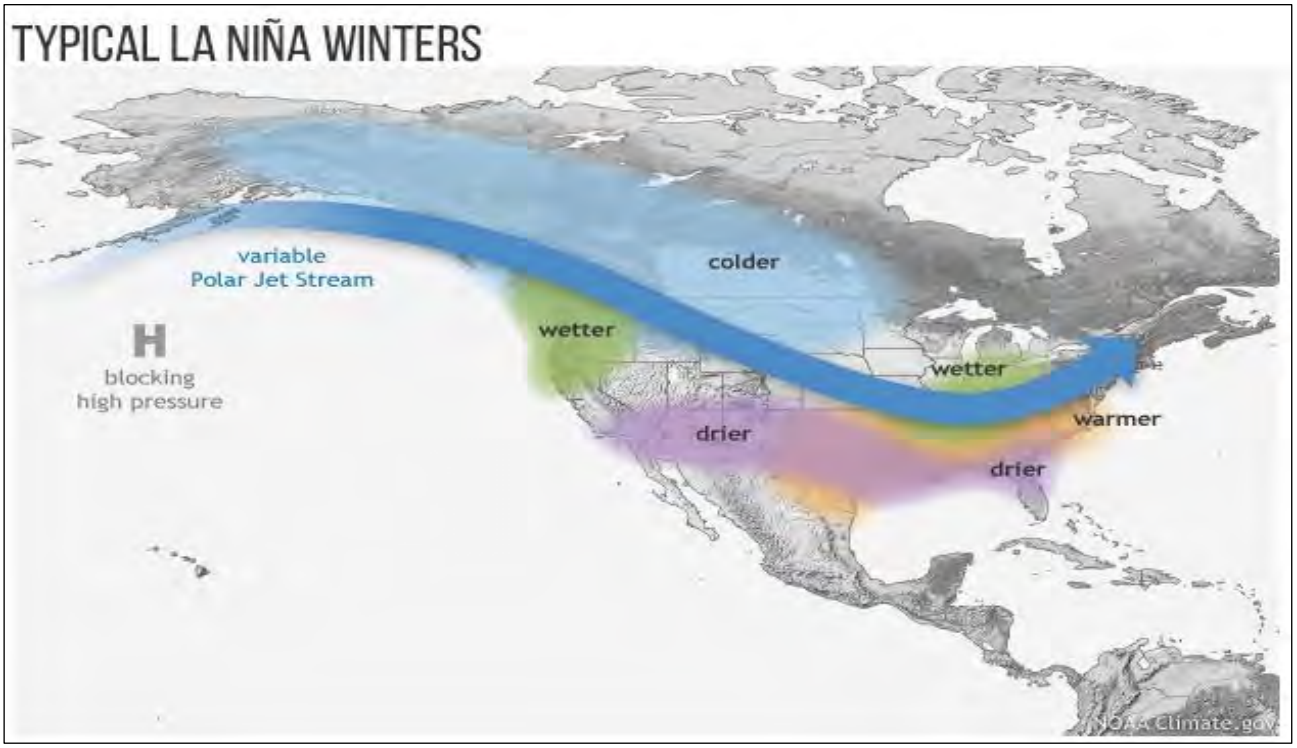

Figure 1: Upper level pattern during a typical La Nina winter across North America that may develop late this autumn season

Texas Autumn 2021 Weather Outlook (continued)

Based on the current late summer pattern and the expected signal from La Nina, CPC's autumn outlook calls for increased odds temperatures will average milder than-normal, and rainfall will average below-normal across all of Texas.

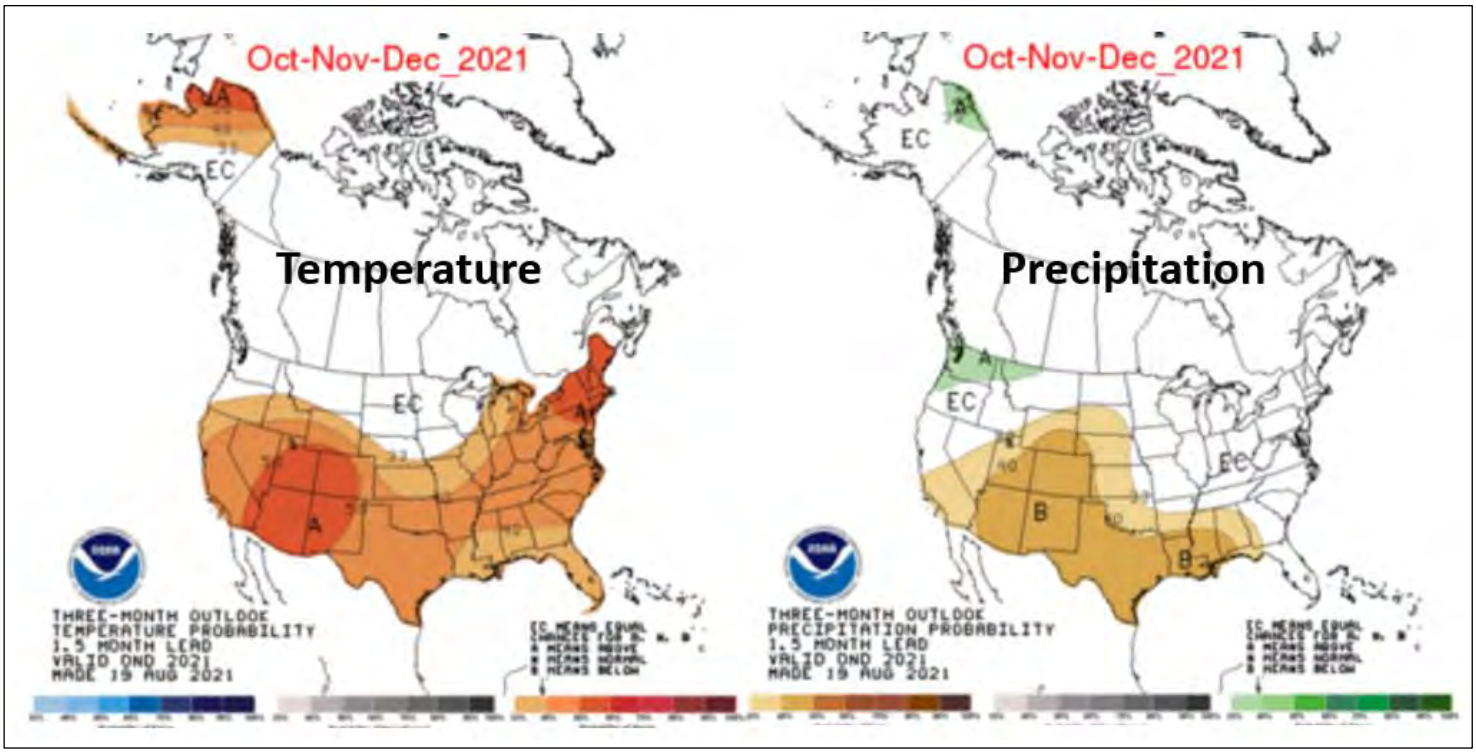

Figure 2: Forecast for temperatures and precipitation across North America this autumn

Fall's noticeably cooler temperatures may be slow to arrive as cold fronts have a hard time making it into Texas. While several cold fronts will eventually press into the state, the cool air isn't expected to remain in place for extended periods. Meanwhile, below-average rainfall over the course of autumn may lead to the development of drought conditions by the start of winter.

Do keep in mind that every La Niña event is different as other oscillations in the oceans and atmosphere can at times overwhelm the typical mild and dry La Niña response. Don't be too surprised to see some occasional cold shots and a couple of periods of significant rain.

Observer Tips, Information & Training Material

Recruiting – It's How We Grow

The last year was amazingly productive for CoCoRaHS. More folks stayed home, more people were looking for activities they could do as a family that would "make a difference". We recently conducted an analysis of CoCoRaHS new recruits. National Weather Service and other organizations (like Extension Master Gardeners, Master Naturalists, and some similar groups in Canada) account for close to 50% of our new sign ups. But a large and steadily growing recruiting category is YOU. The category we call "friends & family" now makes up nearly 25% of new recruits and they are being recruited by CoCoRaHS volunteers encouraging friends, family and co-workers to give it a try. Keep in mind we need close to 400 new recruits every year to continue to grow slowly, so as you get away from home and travel again please mention CoCoRaHS to someone that you think would enjoy being a part of our network. If we each recruit just one new volunteer per year, amazing things would happen.

New County Coordinators Needed – To Recruit New Observers

We cannot grow without recruiting new observers. County Coordinators help in bringing new observers onboard and getting the word out about our organization in counties across Texas. County Coordinators are needed in many counties across Texas. To find out if the county you live has an opening for a CoCoRaHS County Coordinator please visit the **Home Page** at https://www.cocorahs.org and go to **Resources** section and click on **Volunteer Coordinators.** Once here click on the link for the state of **Texas** then look for you region and your county listing to see if a county coordinator is listed for your county. If no county coordinator is listed then that county has an opening for a coordinator. Please send an e-mail to texas@cocorahs.org requesting information that you are interested in the requirements of becoming a CoCoRaHS County Coordinator.

Please Make Sure You Contact Information Is Up To Date – Communication between CoCoRaHS and You

Make sure all of your contact information is up to date and correct. If we don't have your correct information then we will not be able to contact if your account password is forgotten or lost. Home phones, cell phone numbers, and e-mails all change over time so please check to see if you information is current in the CoCoRaHS system. Sometimes a meteorologist my need to call you about a very important observation you made during a severe weather event for more information on conditions.

Change of address or moving??? – Critically important to know where your data is being measured at in Texas

Please contact Texas CoCoRaHS at texas@cocorahs.org if you plan to move to a new address or different location. In order for the mapping of your data to be displayed correctly on CoCoRaHS maps we must have your correct geographic location. If you move away to a new home your old station doesn't move with you and must be closed. A new station number and ID will need to be generated to accurately map your data into the system.

New Climate Normals Have Been Released – Some CoCoRaHS stations included with over 10 years of data

Every 10 years the National Centers for Environmental Information (NCEI) calculates new climate normals for the United States. The 1981-2010 normals have been used for the past 10 years. On May 4, the normals for the period 1991-2020 were released and will serve as the base period with which to compare our current weather until 2031.

For the first time ever, CoCoRaHS stations are included in the calculation of normals. The period of record (POR) is long enough for many CoCoRaHS stations so they can be included in the calculations. While no CoCoRaHS station has been operating for 30 years yet (the "Standard" normal), NCEI uses methods to calculate normals based on shorter periods of data. There are two classes of these normals, "Provisional" and "Pseudo-normal".

In Texas there was 45 stations with provisional data that now have official normals based exclusively on their CoCoRaHS observations. For more information about this story please read the **Spring Edition of the newsletter State Summary article** on the front page. Also read about this story on the CoCoRaHS Home Page under the **Resources Section** at **NCEI Normals**.

Scheduled CoCoRaHS Webinars

Upcoming WxTalk Webinars:

Webinar #79 - Thursday, November 11, 2021 -1PM EST

"Ice Accretion"
Jay Shafer
Northern Vermont University-Lyndon (formerly Lyndon State College)
Atmospheric Sciences
Lyndonville. VT

Texas CoCoRaHS Observer

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